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# PJ.10-W2 PROSA

## SEPARATION MANAGEMENT AND CONTROLLER TOOLS

This initial validation report is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874464 under European Union's Horizon 2020 research and innovation programme.



### Abstract

The objective of the SESAR Solution PJ.10-W2- 93 is to explore different operational use cases of delegation of provision of ATM Services amongst ATSUs based on traffic / organisation needs (either static on fix-time transfer schedule (Day/Night) or dynamic e.g., when the traffic density is below/over certain level) or on contingency needs. Most of the validation exercises are based on Virtual Centre architectures. A second objective of the SESAR Solution PJ.10-W2- 93 is to validate three different architectures of a Virtual Centre: The Y architecture based on one ADSP and the U and D architectures based on two different ADSPs.

This validation Report describes the **outcomes from the five exercises** under Solution PJ.10-W2- 93:

- EXE-10.93-V3-VALP-002 ENAIRE exercise
- EXE-10.93-V3-VALP-003 SKYGUIDE exercise
- EXE-10.93-V3-VALP-004 ENAV exercise
- EXE-10.93-V3-VALP-005 COOPANS exercise
- EXE-10.93-V3-VALP-006 PANSA exercise

## Table of Contents

Abstract .....	4
<b>1 Executive summary .....</b>	<b><u>1918</u></b>
<b>2 Introduction .....</b>	<b><u>2019</u></b>
2.1 Purpose of the document.....	<b><u>2019</u></b>
2.2 Intended readership .....	<b><u>2019</u></b>
2.3 Background .....	<b><u>2019</u></b>
2.4 Structure of the document.....	<b><u>2120</u></b>
2.5 Glossary of terms.....	<b><u>2221</u></b>
2.6 Acronyms and Terminology .....	<b><u>2423</u></b>
<b>3 Context of the Validation .....</b>	<b><u>2928</u></b>
3.1 SESAR Solution PJ.10-W2-93: a summary.....	<b><u>2928</u></b>
3.2 Summary of the Validation Plan .....	<b><u>3635</u></b>
3.2.1 Validation Plan Purpose .....	<b><u>3635</u></b>
3.2.2 Summary of Validation Objectives and success criteria.....	<b><u>39383837</u></b>
3.2.2.1 PJ.10-W2-93 Validation Objectives .....	<b><u>39383837</u></b>
3.2.2.2 PJ.10-W2-93a Technical Validation Objectives .....	<b><u>79787877</u></b>
3.2.2.3 PJ.10-W2-93b Technical Validation Objectives .....	<b><u>87868685</u></b>
3.2.2.4 PJ.10-W2-93c Technical Validation Objectives.....	<b><u>94939392</u></b>
3.2.3 Validation Assumptions.....	<b><u>10110010099</u></b>
3.2.4 Validation Exercises List .....	<b><u>102101101400</u></b>
3.3 Deviations .....	<b><u>110109109408</u></b>
3.3.1 Deviations with respect to the S3JU Project Handbook.....	<b><u>110109109408</u></b>
3.3.2 Deviations with respect to the Validation Plan .....	<b><u>110109109408</u></b>
<b>4 SESAR Solution PJ.10-W2-93 Validation Results .....</b>	<b><u>112111111440</u></b>
4.1 Summary of SESAR Solution PJ.10-W2-93 Validation Results.....	<b><u>112111111440</u></b>
4.2 Detailed analysis of SESAR Solution Validation Results per Validation objective	
<b><u>133132132434</u></b>	
4.2.1 OBJ-PJ.10-W2-93-V3-VALP-001 Results .....	<b><u>133132132434</u></b>
4.2.2 OBJ-PJ.10-W2-93-V3-VALP-003 Results .....	<b><u>133132132434</u></b>
4.2.3 OBJ-PJ.10-W2-93-V3-VALP-004 Results .....	<b><u>134133133432</u></b>
4.2.4 OBJ-PJ.10-W2-93-V3-VALP-005 Results .....	<b><u>134133133432</u></b>
4.2.5 OBJ-PJ.10-W2-93-V3-VALP-006 Results .....	<b><u>134133133432</u></b>
4.2.6 OBJ-PJ.10-W2-93-V3-VALP-007 Results .....	<b><u>135134134433</u></b>
4.2.7 OBJ-PJ.10-W2-93-V3-VALP-008 Results .....	<b><u>135134134433</u></b>
4.2.8 OBJ-PJ.10-W2-93-V3-VALP-009 Results .....	<b><u>135134134433</u></b>
4.2.9 OBJ-PJ.10-W2-93-V3-VALP-010 Results .....	<b><u>136135135434</u></b>
4.2.10 OBJ-PJ.10-W2-93-V3-VALP-011 Results .....	<b><u>136135135434</u></b>
4.2.11 OBJ-PJ.10-W2-93-V3-VALP-012 Results .....	<b><u>137136136435</u></b>
4.2.12 OBJ-PJ.10-W2-93-V3-VALP-013 Results .....	<b><u>137136136435</u></b>
4.2.13 OBJ-PJ.10-W2-93-V3-VALP-014 Results .....	<b><u>138137137436</u></b>
4.2.14 OBJ-PJ.10-W2-93-V3-VALP-015 Results .....	<b><u>139138138437</u></b>
4.2.15 OBJ-PJ.10-W2-93-V3-VALP-016 Results .....	<b><u>139138138437</u></b>

4.2.16	OBJ-PJ.10-W2-93-V3-VALP-017 Results .....	<a href="#">140139139138</a>
4.2.17	OBJ-PJ.10-W2-93-V3-VALP-018 Results .....	<a href="#">140139139138</a>
4.2.18	OBJ-PJ.10-W2-93-V3-VALP-019 Results .....	<a href="#">140139139138</a>
4.2.19	OBJ-PJ.10-W2-93-V3-VALP-020 Results .....	<a href="#">141140140139</a>
4.2.20	OBJ-PJ.10-W2-93-V3-VALP-021 Results .....	<a href="#">141140140139</a>
<b>4.3</b>	<b>Summary of SESAR Solution PJ.10-W2-93a Technical Validation Results.....</b>	<b><a href="#">142141141140</a></b>
<b>4.4</b>	<b>Detailed analysis of SESAR Solution PJ.10-W2-93a Validation Results per Validation objective .....</b>	<b><a href="#">143142142141</a></b>
4.4.1	OBJ-PJ.10-W2-93a-V3-VALP-001 Results .....	<a href="#">144143143142</a>
4.4.2	OBJ-PJ.10-W2-93a-V3-VALP-002 Results .....	<a href="#">144143143142</a>
4.4.3	OBJ-PJ.10-W2-93a-V3-VALP-003 Results .....	<a href="#">144143143142</a>
4.4.4	OBJ-PJ.10-W2-93a-V3-VALP-004 Results .....	<a href="#">144143143142</a>
4.4.5	OBJ-PJ.10-W2-93a-V3-VALP-005 Results .....	<a href="#">144143143142</a>
<b>4.5</b>	<b>Summary of SESAR Solution PJ.10-W2-93b Technical Validation Results.....</b>	<b><a href="#">145144144143</a></b>
<b>4.6</b>	<b>Detailed analysis of SESAR Solution PJ.10-W2-93b Validation Results per Validation objective .....</b>	<b><a href="#">146145145144</a></b>
4.6.1	OBJ-PJ.10-W2-93b-V3-VALP-001 Results .....	<a href="#">146145145144</a>
4.6.2	OBJ-PJ.10-W2-93b-V3-VALP-002 Results .....	<a href="#">147146146145</a>
4.6.3	OBJ-PJ.10-W2-93b-V3-VALP-003 Results .....	<a href="#">147146146145</a>
4.6.4	OBJ-PJ.10-W2-93b-V3-VALP-004 Results .....	<a href="#">147146146145</a>
4.6.5	OBJ-PJ.10-W2-93b-V3-VALP-005 Results .....	<a href="#">147146146145</a>
<b>4.7</b>	<b>Summary of SESAR Solution PJ.10-W2-93c Technical Validation Results .....</b>	<b><a href="#">147146146145</a></b>
<b>4.8</b>	<b>Detailed analysis of SESAR Solution PJ.10-W2-93c Validation Results per Validation objective .....</b>	<b><a href="#">149148148147</a></b>
4.8.1	OBJ-PJ.10-W2-93c-V3-VALP-001 Results.....	<a href="#">149148148147</a>
4.8.2	OBJ-PJ.10-W2-93c-V3-VALP-002 Results.....	<a href="#">150149149148</a>
4.8.3	OBJ-PJ.10-W2-93c-V3-VALP-003 Results.....	<a href="#">150149149148</a>
4.8.4	OBJ-PJ.10-W2-93c-V3-VALP-004 Results.....	<a href="#">150149149148</a>
4.8.5	OBJ-PJ.10-W2-93c-V3-VALP-005 Results.....	<a href="#">150149149148</a>
<b>4.9</b>	<b>Confidence in Validation Results .....</b>	<b><a href="#">150149149148</a></b>
4.9.1	Limitations of Validation Results.....	<a href="#">150149149148</a>
4.9.1.1	Quality of Validation Results .....	<a href="#">151150150149</a>
4.9.1.2	Significance of Validation Results.....	<a href="#">152151151150</a>
<b>5</b>	<b>Conclusions and recommendations.....</b>	<b><a href="#">153152152151</a></b>
<b>5.1</b>	<b>Conclusions .....</b>	<b><a href="#">153152152151</a></b>
5.1.1	Conclusions on SESAR Solution maturity .....	<a href="#">153152152151</a>
5.1.2	Conclusions on concept clarification.....	<a href="#">153152152151</a>
5.1.3	Conclusions on technical feasibility .....	<a href="#">155154154153</a>
5.1.4	Conclusions on performance assessments .....	<a href="#">156155155154</a>
<b>5.2</b>	<b>Recommendations.....</b>	<b><a href="#">157156156155</a></b>
5.2.1	Recommendations for next phase .....	<a href="#">157156156155</a>
5.2.2	Recommendations for updating ATM Master Plan Level 2.....	<a href="#">158157157156</a>
5.2.3	Recommendations on regulation and standardisation initiatives .....	<a href="#">158157157156</a>
<b>6</b>	<b>References .....</b>	<b><a href="#">160159159158</a></b>
<b>6.1</b>	<b>Applicable Documents .....</b>	<b><a href="#">160159159158</a></b>

6.2	Reference Documents.....	<a href="#">160159159158</a>
<b>Appendix A Validation Exercise #02 Report .....</b> <a href="#">162161161160</a>		
A.1	Summary of the Validation Exercise #02 Plan .....	<a href="#">162161161160</a>
A.1.1	Validation Exercise description, scope.....	<a href="#">162161161160</a>
A.1.2	Summary of Validation Exercise #02 Validation Objectives and success criteria .....	<a href="#">162161161160</a>
A.1.3	Summary of Validation Exercise #02 Validation scenarios.....	<a href="#">162161161160</a>
	Reference Scenario(s).....	<a href="#">163162162161</a>
	Solution Scenario(s).....	<a href="#">164163163162</a>
A.1.4	Summary of Validation Exercise #02 Validation Assumptions .....	<a href="#">165164164163</a>
A.2	Deviation from the planned activities.....	<a href="#">165164164163</a>
A.3	Validation Exercise #02 Results .....	<a href="#">166165165164</a>
A.3.1	Summary of Validation Exercise #02 Results .....	<a href="#">166165165164</a>
A.3.2	Analysis of Exercise 2 Results per Validation objective.....	<a href="#">193192192191</a>
1.	EX2-OBJ-PJ.10-W2-93-V3-VALP-001 Results .....	<a href="#">193192192191</a>
2.	EX2-OBJ-PJ.10-W2-93-V3-VALP-002 Results .....	<a href="#">194193193192</a>
3.	EX2-OBJ-PJ.10-W2-93-V3-VALP-003 Results .....	<a href="#">195194194193</a>
4.	EX2-OBJ-PJ.10-W2-93-V3-VALP-004 Results .....	<a href="#">196195195194</a>
5.	EX2-OBJ-PJ.10-W2-93-V3-VALP-005 Results .....	<a href="#">198197197196</a>
6.	EX2-OBJ-PJ.10-W2-93-V3-VALP-006 Results .....	<a href="#">200199199198</a>
7.	EX2-OBJ-PJ.10-W2-93-V3-VALP-007 Results .....	<a href="#">201200200199</a>
8.	EX2-OBJ-PJ.10-W2-93-V3-VALP-008 Results .....	<a href="#">204203203202</a>
9.	EX2-OBJ-PJ.10-W2-93-V3-VALP-009 Results .....	<a href="#">207206206205</a>
10.	EX2-OBJ-PJ.10-W2-93-V3-VALP-010 Results .....	<a href="#">210209209208</a>
11.	EX2-OBJ-PJ.10-W2-93-V3-VALP-011 Results .....	<a href="#">211210210209</a>
12.	EX2-OBJ-PJ.10-W2-93-V3-VALP-012 Results .....	<a href="#">211210210209</a>
13.	EX2-OBJ-PJ.10-W2-93-V3-VALP-013 Results .....	<a href="#">212211211210</a>
A.3.3	Unexpected Behaviours/Results .....	<a href="#">213212212211</a>
A.3.4	Confidence in Results of Validation Exercise 2.....	<a href="#">213212212211</a>
1.	Level of significance/limitations of Validation Exercise Results.....	<a href="#">213212212211</a>
2.	Quality of Validation Exercises Results .....	<a href="#">214213213212</a>
3.	Significance of Validation Exercises Results .....	<a href="#">215214214213</a>
A.3.5	Conclusions Exercise 2 .....	<a href="#">215214214213</a>
1.	Conclusions on concept clarification.....	<a href="#">215214214213</a>
2.	Conclusions on technical feasibility .....	<a href="#">217216216215</a>
3.	Conclusions on performance assessments .....	<a href="#">218216216215</a>
A.3.6	Recommendations .....	<a href="#">218217217216</a>
<b>Appendix B Validation Exercise #03 Report .....</b> <a href="#">220219219218</a>		
B.1	Summary of the Validation Exercise #03 Plan .....	<a href="#">220219219218</a>
B.1.1	Validation Exercise description, scope.....	<a href="#">220219219218</a>
B.1.2	Summary of Validation Exercise #03 Validation Objectives and success criteria .....	<a href="#">221220220219</a>
B.1.3	Summary of Validation Exercise #03 Validation scenarios.....	<a href="#">222221221220</a>
	Validation Scenario(s).....	<a href="#">222221221220</a>
	Reference Scenario(s).....	<a href="#">226225225224</a>
	Solution Scenario(s).....	<a href="#">226225225224</a>
B.1.4	Summary of Validation Exercise #03 Validation Assumptions .....	<a href="#">226225225224</a>
B.2	Deviation from the planned activities.....	<a href="#">227226226225</a>
B.3	Validation Exercise #03 Results .....	<a href="#">227226226225</a>
B.3.1	Summary of Validation Exercise #03 Results for the PJ.10-W2-93 Main Operational Solution	<a href="#">227226226225</a>

B.3.2	Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93 Main Operational Solution .....	<a href="#">245244244243</a>
1.	EX3-OBJ-PJ.10-W2-93-V3-VALP-001 Results .....	<a href="#">245244244243</a>
1.	EX3-OBJ-PJ.10-W2-93-V3-VALP-002 Results .....	<a href="#">253252252251</a>
2.	EX3-OBJ-PJ.10-W2-93-V3-VALP-003 Results .....	<a href="#">261260260259</a>
3.	EX3-OBJ-PJ.10-W2-93-V3-VALP-004 Results .....	<a href="#">269268268267</a>
4.	EX3-OBJ-PJ.10-W2-93-V3-VALP-005 Results .....	<a href="#">278277277276</a>
5.	EX3-OBJ-PJ.10-W2-93-V3-VALP-006 Results .....	<a href="#">286285285284</a>
6.	EX3-OBJ-PJ.10-W2-93-V3-VALP-007 Results .....	<a href="#">293292292291</a>
7.	EX3-OBJ-PJ.10-W2-93-V3-VALP-008 Results .....	<a href="#">299298298297</a>
8.	EX3-OBJ-PJ.10-W2-93-V3-VALP-009 Results .....	<a href="#">303302302301</a>
9.	EX3-OBJ-PJ.10-W2-93-V3-VALP-010 Results .....	<a href="#">305304304303</a>
10.	EX3-OBJ-PJ.10-W2-93-V3-VALP-011 Results .....	<a href="#">305304304303</a>
11.	EX3-OBJ-PJ.10-W2-93-V3-VALP-012 Results .....	<a href="#">306305305304</a>
12.	EX3-OBJ-PJ.10-W2-93-V3-VALP-013 Results .....	<a href="#">307306306305</a>
B.3.3	Summary of Validation Exercise #03 Results for the PJ.10-W2-93a Technological Solution <a href="#">309308308307</a>	
B.3.4	Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93a Technological Solution .....	<a href="#">313312312311</a>
B.3.5	Summary of Validation Exercise #03 Results for the PJ.10-W2-93b Technological Solution <a href="#">317316316315</a>	
B.3.6	Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93b Technological Solution .....	<a href="#">321320320319</a>
B.3.7	Summary of Validation Exercise #03 Results for the PJ.10-W2-93c Technological Solution <a href="#">322321321320</a>	
B.3.8	Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93c Technological Solution <a href="#">326325325324</a>	
B.3.9	Unexpected Behaviours/Results .....	<a href="#">328327327326</a>
B.3.10	Confidence in Results of Validation Exercise 3 .....	<a href="#">328327327326</a>
1.	Level of significance/limitations of Validation Exercise Results .....	<a href="#">328327327326</a>
2.	Quality of Validation Exercises Results .....	<a href="#">329328328327</a>
3.	Significance of Validation Exercises Results .....	<a href="#">330329329328</a>
B.3.11	Conclusions Exercise 3 .....	<a href="#">331330330329</a>
1.	Conclusions on concept clarification .....	<a href="#">331330330329</a>
2.	Conclusions on technical feasibility .....	<a href="#">332331331330</a>
3.	Conclusions on performance assessments .....	<a href="#">333332332331</a>
B.3.12	Recommendations Exercise 3 .....	<a href="#">333332332331</a>
<b>Appendix C</b>	<b>Validation Exercise #04 Report .....</b>	<b><a href="#">336335335334</a></b>
<b>C.1</b>	<b>Summary of the Validation Exercise #04 Plan .....</b>	<b><a href="#">336335335334</a></b>
C.1.1	Validation Exercise description, scope .....	<a href="#">336335335334</a>
C.1.2	Summary of Validation Exercise #04 Validation Objectives and success criteria .....	<a href="#">339338338337</a>
C.1.3	Summary of Validation Exercise #04 Validation scenarios .....	<a href="#">339338338337</a>
1.	Reference Scenario(s) .....	<a href="#">344343343342</a>
2.	Solution Scenario(s) .....	<a href="#">344343343342</a>
C.1.4	Summary of Validation Exercise #04 Validation Assumptions .....	<a href="#">346345345344</a>
<b>C.2</b>	<b>Deviation from the planned activities .....</b>	<b><a href="#">347346346345</a></b>
<b>C.3</b>	<b>Validation Exercise #04 Results .....</b>	<b><a href="#">350349349348</a></b>
C.3.1	Summary of Validation Exercise #03 Results .....	<a href="#">350349349348</a>
C.3.2	Analysis of Exercise 4 Results per Validation objective .....	<a href="#">393392392391</a>
1.	EX4-OBJ-PJ.10-W2-93-V3-VALP-001 Results .....	<a href="#">393392392391</a>



2.	EX4-OBJ-PJ.10-W2-93-V3-VALP-002 - EX4-OBJ-PJ.10-W2-93-V3-VALP-003 and EX4-OBJ-PJ.10-W2-93-V3-VALP-004 Results .....	<a href="#">395394394393</a>
3.	EX4-OBJ-PJ.10-W2-93-V3-VALP-005 Results .....	<a href="#">399398398397</a>
4.	EX4-OBJ-PJ.10-W2-93-V3-VALP-006 – EX4-OBJ-PJ.10-W2-93-V3-VALP-007 and EX4-OBJ-PJ.10-W2-93-V3-VALP-008 Results .....	<a href="#">401400400399</a>
5.	EX4-OBJ-PJ.10-W2-93-V3-VALP-009 Results .....	<a href="#">411410410409</a>
6.	EX4-OBJ-PJ.10-W2-93-V3-VALP-010 Results .....	<a href="#">415414414413</a>
7.	EX4-OBJ-PJ.10-W2-93-V3-VALP-011 Results .....	<a href="#">422421421420</a>
8.	EX4-OBJ-PJ.10-W2-93-V3-VALP-012 Results .....	<a href="#">427426426425</a>
9.	EX4-OBJ-PJ.10-W2-93-V3-VALP-013 Results .....	<a href="#">430429429428</a>
10.	EX4-OBJ-PJ.10-W2-93-V3-VALP-014 Results .....	<a href="#">432431431430</a>
11.	EX4-PJ.10-W2-93-V3-VALP-015 Results .....	<a href="#">433432432431</a>
12.	EX4-OBJ-PJ.10-W2-93-V3-VALP-016 Results .....	<a href="#">434433433432</a>
13.	EX4-OBJ-PJ.10-W2-93-V3-VALP-017 Results .....	<a href="#">439438438437</a>
14.	EX4-OBJ-PJ.10-W2-93-V3-VALP-018 Results .....	<a href="#">440439439438</a>
15.	EX4-OBJ-PJ.10-W2-93-V3-VALP-019 Results .....	<a href="#">441440440439</a>
16.	EX4-OBJ-PJ.10-W2-93-V3-VALP-020 Results .....	<a href="#">441440440439</a>
C.3.3	Summary of Validation Exercise #04 Results for the PJ.10-W2-93a Technological Solution <a href="#">443442442441</a>	
C.3.4	Analysis of Exercise 4 Results per Validation objective for the PJ.10-W2-93a Technological Solution .....	<a href="#">445444444443</a>
1.	EX4-OBJ-PJ.10-W2-93a-V3-VALP-001 Results .....	<a href="#">445444444443</a>
2.	EX4-OBJ-PJ.10-W2-93a-V3-VALP-002 Results .....	<a href="#">446445445444</a>
3.	EX4-OBJ-PJ.10-W2-93a-V3-VALP-003 Results .....	<a href="#">446445445444</a>
4.	EX4-OBJ-PJ.10-W2-93a-V3-VALP-004 Results .....	<a href="#">447446446445</a>
5.	EX4-OBJ-PJ.10-W2-93a-V3-VALP-005 Results .....	<a href="#">448447447446</a>
C.3.5	Unexpected Behaviours/Results .....	<a href="#">448447447446</a>
C.3.6	Confidence in Results of Validation Exercise 4.....	<a href="#">448447447446</a>
1.	Level of significance/limitations of Validation Exercise Results.....	<a href="#">448447447446</a>
2.	Quality of Validation Exercises Results .....	<a href="#">449448448447</a>
3.	Significance of Validation Exercises Results .....	<a href="#">449448448447</a>
C.3.7	Conclusions .....	<a href="#">449448448447</a>
1.	Conclusions on concept clarification.....	<a href="#">449448448447</a>
2.	Conclusions on technical feasibility .....	<a href="#">449448448447</a>
3.	Conclusions on performance assessments .....	<a href="#">450449449448</a>
C.3.8	Recommendations .....	<a href="#">455454545453</a>
<b>Appendix D Validation Exercise #05 Report .....</b>		<b><a href="#">458457457456</a></b>
<b>D.1</b>	<b>Summary of the Validation Exercise #05 Plan .....</b>	<b><a href="#">458457457456</a></b>
D.1.1	Validation Exercise description, scope.....	<a href="#">458457457456</a>
D.1.2	Summary of Validation Exercise #05 Validation Objectives and success criteria .....	<a href="#">464463463462</a>
D.1.3	Summary of Validation Exercise #05 Validation scenarios.....	<a href="#">464463463462</a>
D.1.4	Summary of Validation Exercise #05 Validation Assumptions .....	<a href="#">464463463462</a>
<b>D.2</b>	<b>Deviation from the planned activities.....</b>	<b><a href="#">465464464463</a></b>
<b>D.3</b>	<b>Validation Exercise EXE#5 Results .....</b>	<b><a href="#">466465465464</a></b>
D.3.1	Summary of Validation Exercise #05 Results .....	<a href="#">466465465464</a>
D.3.2	Analysis of Exercise #05 Results per Validation objective.....	<a href="#">475474474473</a>
1.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-001 Results .....	<a href="#">475474474473</a>
2.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-004 Results .....	<a href="#">477476476475</a>
3.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-009 Results .....	<a href="#">480479479478</a>
4.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-012 Results .....	<a href="#">483482482481</a>
5.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-014 Results .....	<a href="#">489488488487</a>

6.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-016 Results .....	<a href="#">491490490489</a>
7.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-019 Results .....	<a href="#">493492492491</a>
8.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-022 Results .....	<a href="#">494493493492</a>
9.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-024 Results .....	<a href="#">495494494493</a>
10.	EXE5-OBJ-PJ.10-W2-93-V3-VALP-025 Results .....	<a href="#">495494494493</a>
D.3.3	Unexpected Behaviours/Results .....	<a href="#">495494494493</a>
D.3.4	Confidence in Results of Validation Exercise EXE-05 .....	<a href="#">496495495494</a>
1.	Level of significance/limitations of Validation Exercise Results .....	<a href="#">496495495494</a>
2.	Quality of Validation Exercises Results .....	<a href="#">497496496495</a>
3.	Significance of Validation Exercises Results .....	<a href="#">497496496495</a>
D.3.5	Conclusions .....	<a href="#">498497497496</a>
1.	Conclusions on concept clarification.....	<a href="#">498497497496</a>
2.	Conclusions on technical feasibility .....	<a href="#">498497497496</a>
3.	Conclusions on performance assessments .....	<a href="#">499498498497</a>
D.3.6	Recommendations .....	<a href="#">499498498497</a>
<b>Appendix E Validation Exercise #06 Report .....</b>		<b><a href="#">502501501500</a></b>
<b>E.1</b>	<b>Summary of the Validation Exercise #06 Plan .....</b>	<b><a href="#">502501501500</a></b>
E.1.1	Validation Exercise description, scope.....	<a href="#">502501501500</a>
E.1.2	Summary of Validation Exercise #06 Validation Objectives and success criteria .....	<a href="#">503502502501</a>
E.1.3	Summary of Validation Exercise #06 Validation scenarios.....	<a href="#">503502502501</a>
	Validation scenarios .....	<a href="#">503502502501</a>
	Reference Scenario(s).....	<a href="#">504503503502</a>
E.1.4	Summary of Validation Exercise #06 Validation Assumptions .....	<a href="#">505504504503</a>
<b>E.2</b>	<b>Deviation from the planned activities.....</b>	<b><a href="#">505504504503</a></b>
<b>E.3</b>	<b>Validation Exercise #06 Results .....</b>	<b><a href="#">505504504503</a></b>
E.3.1	Summary of Validation Exercise #06 Results .....	<a href="#">505504504503</a>
E.3.2	Analysis of Exercise 6 Results per Validation objective.....	<a href="#">517516516515</a>
1.	EX006-OBJ-PJ.10-W2-93-V3-VALP-001 Results – To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.....	<a href="#">517516516515</a>
a.	CRT-10.02a-V2-VALP-001-001 .....	<a href="#">517516516515</a>
b.	CRT-10.02a-V2-VALP-001-002 .....	<a href="#">518517517516</a>
c.	CRT-10.02a-V2-VALP-001-005 .....	<a href="#">518517517516</a>
2.	EX006-OBJ-PJ.10-W2-93-V3-VALP-002 Results – To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night" use case. <a href="#">520519519518</a>	
a.	CRT-10.02a-V2-VALP-002-001 .....	<a href="#">521520520519</a>
b.	CRT-10.02a-V2-VALP-002-002 .....	<a href="#">522521521520</a>
c.	CRT-10.02a-V2-VALP-002-003 .....	<a href="#">524523523522</a>
d.	CRT-10.02a-V2-VALP-002-004 .....	<a href="#">525524524523</a>
3.	EX006-OBJ-PJ.10-W2-93-V3-VALP-004 Results – To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-Demand" use case. ....	<a href="#">525524524523</a>
a.	CRT-10.02a-V2-VALP-004-001 .....	<a href="#">525524524523</a>
b.	CRT-10.02a-V2-VALP-004-002 .....	<a href="#">526525525524</a>
c.	CRT-10.02a-V2-VALP-004-003 .....	<a href="#">527526526525</a>
d.	CRT-10.02a-V2-VALP-004-004 .....	<a href="#">528527527526</a>
4.	EX006-OBJ-PJ.10-W2-93-V3-VALP-007 Results – To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Night" use case. ....	<a href="#">528527527526</a>
a.	CRT-10.02a-V2-VALP-007-001 .....	<a href="#">529528528527</a>
b.	CRT-10.02a-V2-VALP-007-002 .....	<a href="#">531530530529</a>
c.	CRT-10.02a-V2-VALP-007-003 .....	<a href="#">532531531530</a>

d.	CRT-10.02a-V2-VALP-007-004.....	<a href="#">533532532531</a>
e.	CRT-10.02a-V2-VALP-007-005.....	<a href="#">536535535534</a>
f.	CRT-10.02a-V2-VALP-007-006.....	<a href="#">537536536535</a>
g.	CRT-10.02a-V2-VALP-007-007.....	<a href="#">537536536535</a>
h.	CRT-10.02a-V2-VALP-007-008.....	<a href="#">538537537536</a>
5.	EX006-OBJ-PJ.10-W2-93-V3-VALP-009 Results – To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand" use case. <a href="#">538537537536</a>	
a.	CRT-10.02a-V2-VALP-009-001.....	<a href="#">538537537536</a>
b.	CRT-10.02a-V2-VALP-009-002.....	<a href="#">540539539538</a>
c.	CRT-10.02a-V2-VALP-009-003.....	<a href="#">541540540539</a>
d.	CRT-10.02a-V2-VALP-009-004.....	<a href="#">542541541540</a>
e.	CRT-10.02a-V2-VALP-009-005.....	<a href="#">544543543542</a>
f.	CRT-10.02a-V2-VALP-009-006.....	<a href="#">545544544543</a>
g.	CRT-10.02a-V2-VALP-009-007.....	<a href="#">545544544543</a>
h.	CRT-10.02a-V2-VALP-009-008.....	<a href="#">545544544543</a>
6.	EX006-OBJ-PJ.10-W2-93-V3-VALP-012 Results – To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions.....	<a href="#">546545545544</a>
a.	CRT-10.02a-V2-VALP-012-001.....	<a href="#">546545545544</a>
b.	CRT-10.02a-V2-VALP-012-002.....	<a href="#">547546546545</a>
c.	CRT-10.02a-V2-VALP-012-003.....	<a href="#">548547547546</a>
d.	CRT-10.02a-V2-VALP-012-004.....	<a href="#">549548548547</a>
e.	CRT-10.02a-V2-VALP-012-005.....	<a href="#">550549549548</a>
f.	CRT-10.02a-V2-VALP-012-006.....	<a href="#">552551551550</a>
7.	EX006-OBJ-PJ.10-W2-93-V3-VALP-014 Results – To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions.....	<a href="#">552551551550</a>
a.	CRT-10.02a-V2-VALP-014-001.....	<a href="#">552551551550</a>
b.	CRT-10.02a-V2-VALP-014-002.....	<a href="#">554553553552</a>
8.	EX006-OBJ-PJ.10-W2-93-V3-VALP-018 Results – Performance - PRD.....	<a href="#">555554554553</a>
a.	CRT-10.02a-V2-VALP-018-001.....	<a href="#">555554554553</a>
9.	EX006-OBJ-PJ.10-W2-93-V3-VALP-019 Results – Performance - CEF.....	<a href="#">556555555554</a>
a.	CRT-10.02a-V2-VALP-019-001.....	<a href="#">556555555554</a>
E.3.3	Unexpected Behaviours/Results.....	<a href="#">557556556555</a>
E.3.4	Confidence in Results of Validation Exercise 6.....	<a href="#">558557557556</a>
1.	Level of significance/limitations of Validation Exercise Results.....	<a href="#">558557557556</a>
2.	Quality of Validation Exercises Results.....	<a href="#">558557557556</a>
3.	Significance of Validation Exercises Results.....	<a href="#">559558558557</a>
E.3.5	Conclusions.....	<a href="#">559558558557</a>
E.3.6	Recommendations.....	<a href="#">560559559558</a>

**List of Tables**

Table 1: PJ.10-W2-93 Validation Exercise List at V3.....	<a href="#">1918</a>
Table 2: Glossary of terms.....	<a href="#">2423</a>
Table 3: Acronyms and terminology.....	<a href="#">2827</a>
Table 4: SESAR Solution(s) under Validation.....	<a href="#">3231</a>
Table 5. SESAR Solution PJ.10-W2-93 Enablers.....	<a href="#">36353534</a>
Table 6 PJ.10-W2-93 Validation Approach for V2 EXE-PJ.10-W2-93-V2-VALR-001.....	<a href="#">38373736</a>

Table 7 PJ.10-W2-93 Validation environment for V3 exercises .....	<a href="#">39383837</a>
Table 8: Validation Assumptions overview .....	<a href="#">102101101400</a>
Table 9: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-002 .....	<a href="#">104103103402</a>
Table 10: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-003 .....	<a href="#">106105105404</a>
Table 11: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-004 .....	<a href="#">108107107406</a>
Table 12: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-005 .....	<a href="#">109108108407</a>
Table 13: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-006 .....	<a href="#">110109109408</a>
Table 14: Summary of Validation Exercises Results .....	<a href="#">132131131430</a>
Table 15: EXE-PJ.10-W2-93-V3-VALP-002 Validation Assumptions overview .....	<a href="#">165164164463</a>
Table 16: Validation Results for Exercise EXE-PJ.10-W2-93-V3-VALP-002 .....	<a href="#">192191191490</a>
Table 17. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-010. CAP2 .....	<a href="#">210209209208</a>
Table 18. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-010. CAP1 .....	<a href="#">211210210209</a>
Table 19. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-011. FEFF1 .....	<a href="#">211210210209</a>
Table 20. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-012. PRD2 .....	<a href="#">212211211240</a>
Table 21. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-013. CEF2 .....	<a href="#">213212212241</a>
Table 22. EXE-PJ.10-W2-93-V3-VALP-003 Summary of Scenarios use cases .....	<a href="#">222221221220</a>
Table 23. EXE-PJ.10-W2-93-V3-VALP-003 Validations Scenarios .....	<a href="#">225224224223</a>
Table 24. Validation Exercise Assumptions EXE-PJ.10-W2-93-V3-VALP-003 .....	<a href="#">227226226225</a>
Table 25: Validation Results for EXE-PJ.10-W2-93-V3-VALP-003 .....	<a href="#">244243243242</a>
Table 26: Validation Results for EXE-PJ.10-W2-93a-V3-VALP-003 .....	<a href="#">312311311340</a>
Table 27: Validation Results for EXE-PJ.10-W2-93b-V3-VALP-003 .....	<a href="#">320319319348</a>
Table 28: Validation Results for EXE-PJ.10-W2-93c-V3-VALP-003 .....	<a href="#">325324324323</a>
Table 29. EXE-PJ.10-W2-93-V3-VALP-004 Validation Scenario .....	<a href="#">344343343342</a>
Table 30: Validation Assumptions overview .....	<a href="#">347346346345</a>
Table 31: Validation Results for Exercise 04 .....	<a href="#">392391391390</a>

Table 32. Safety Data on Under separations and Tactical Conflicts.....	<a href="#">430429429428</a>
Table 33. Validation Results for EXE-PJ.10-W2-93a-V3-VALP-004 .....	<a href="#">445444444443</a>
Table 34: Validation Assumptions overview .....	<a href="#">465464464463</a>
Table 35: Validation Results for Exercise EXE5.....	<a href="#">474473473472</a>
Table 36 - En-route Airspace Capacity Increase – ISA.....	<a href="#">493492492491</a>
Table 37: Validation Assumptions overview .....	<a href="#">505504504503</a>
Table 38: Validation Results for Exercise 6 .....	<a href="#">516515515514</a>

## List of Figures

Figure 1. EXE-PJ.10-W2-93-V3-VALP-002. Scenarios Madrid ACC (LECMCTAS) and Sevilla ACC (LECS)	<a href="#">163162162161</a>
Figure 2. EXE-PJ.10-W2-93-V3-VALP-002. Scenarios LECB (LECBCTAE) and LECP (Palma TACC)	<a href="#">163162162161</a>
Figure 3. EXE-PJ.10-W2-93-V3-VALP-002 executed scenarios	<a href="#">166165165164</a>
Figure 4. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-001. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)	<a href="#">193192192191</a>
Figure 5. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-002. Operational feasibility (Night use case)	<a href="#">194193193192</a>
Figure 6. EXE-PJ.10-W2-93-V3-VALP-003 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-003. Operational feasibility (Fixed time use case)	<a href="#">195194194193</a>
Figure 7. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-004. Operational feasibility (On-demand / cross-border use case)	<a href="#">197196196195</a>
Figure 8. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-004. Operational feasibility (On-demand / ATFM use case)	<a href="#">198197197196</a>
Figure 9. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-005. Operational acceptance (Night use case)	<a href="#">199198198197</a>
Figure 10. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-006. Operational acceptance (Fixed time use case)	<a href="#">200199199198</a>
Figure 11. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-007. Operational acceptance (On-demand / cross-border use case)	<a href="#">202201201200</a>
Figure 12. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-007. Operational acceptance (On-demand / ATFM use case)	<a href="#">203202202201</a>

Figure 13. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Potential for human error. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)	<a href="#">205204204203</a>
Figure 14. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Communication load. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)	<a href="#">206205205204</a>
Figure 15. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Human performance and system support. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)	<a href="#">207206206205</a>
Figure 16. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-014. Safety (Night time use case)	<a href="#">208207207206</a>
Figure 17. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (Fixed time use case)	<a href="#">208207207206</a>
Figure 18. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (On-demand/Cross-border use case)	<a href="#">209208208207</a>
Figure 19. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (On-demand/ATFM)	<a href="#">209208208207</a>
Figure 20. EXE-PJ.10-W2-93-V3-VALP-003 Geographical scope	<a href="#">220219219218</a>
Figure 21. VC environment EXE-PJ.10-W2-93-V3-VALP-004	<a href="#">337336336335</a>
Figure 22. Rome ACC and Brindisi ACC Scenario A	<a href="#">340339339338</a>
Figure 23. Rome ACC and Brindisi ACC Scenario B	<a href="#">340339339338</a>
Figure 24. Rome ACC and Brindisi ACC Scenario B	<a href="#">341340340339</a>
Figure 25. Rome ACC and Brindisi ACC Scenario C	<a href="#">341340340339</a>
Figure 26. EXE#04 Agenda	<a href="#">345344344343</a>
Figure 27. Operational Feasibility of the Delegation Procedure: Scenario A	<a href="#">393392392391</a>
Figure 28. Operational Feasibility of the Delegation Procedure: Scenario B	<a href="#">394393393392</a>
Figure 29. Operational Feasibility of the Delegation Procedure: Contingency Scenario	<a href="#">394393393392</a>
Figure 30. Operational Feasibility Night vs Fixed Time vs On Demand Scenarios	<a href="#">395394394393</a>
Figure 31. Delegation Procedure Clearly Defined and Documented - Night vs Fixed Time vs On Demand Scenarios	<a href="#">396395395394</a>
Figure 32. Roles and Responsibilities - Night vs Fixed Time vs On Demand Scenarios	<a href="#">397396396395</a>
Figure 33. Quality of Services During and After the delegation process	<a href="#">398397397396</a>
Figure 34. Quality of Services - ATSEP point of view	<a href="#">398397397396</a>

Figure 35. Operational Feasibility - Civil Military Scenario	<a href="#">400399399398</a>
Figure 36. Roles and Responsibilities - Civil Military Scenario	<a href="#">401400400399</a>
Figure 37. Operational Acceptability Night vs Fixed Time vs On Demand Scenarios	<a href="#">402401401400</a>
Figure 38. Level of Workload - Night Delegation Scenario	<a href="#">403402402401</a>
Figure 39. Level of Workload - Fixed Time	<a href="#">403402402401</a>
Figure 40. Level of Workload - On Demand Scenarios	<a href="#">404403403402</a>
Figure 41. Supervisors Workload	<a href="#">404403403402</a>
Figure 42. FMP Workload	<a href="#">405404404403</a>
Figure 44. CWP HMI	<a href="#">406405405404</a>
Figure 44. Level of Situational Awareness - Night Scenario	<a href="#">407406406405</a>
Figure 45. Level of Situational Awareness - Fixed Time Scenario	<a href="#">407406406405</a>
Figure 46. Level of Situational Awareness - On Demand Scenario	<a href="#">408407407406</a>
Figure 47. Level of Situational Awareness Supervisors	<a href="#">408407407406</a>
Figure 48. Level of Situational Awareness FMP	<a href="#">409408408407</a>
Figure 49. Level of Trust in the system	<a href="#">410409409408</a>
Figure 50. Level of Trust in the system - Supervisors	<a href="#">410409409408</a>
Figure 51. Level of system support - Supervisors	<a href="#">411410410409</a>
Figure 52 - Operational Acceptability - Civil Military Scenario	<a href="#">412411411410</a>
Figure 53. Level of Workload - Civil Military Scenario	<a href="#">412411411410</a>
Figure 54. Level of Situational Awareness - Civil Military Scenario	<a href="#">413412412411</a>
Figure 55. Supervisors' Level of Workload - Civil Military Scenario	<a href="#">413412412411</a>
Figure 56. Supervisors' Level of Situational Awareness - Civil Military Scenario	<a href="#">414413413412</a>
Figure 57. Level of Trust in the system - Civil Military Scenario	<a href="#">415414414413</a>
Figure 58. Supervisors' Level of Trust in the system - Civil Military Scenario	<a href="#">415414414413</a>
Figure 59. Bedford Scale	<a href="#">416415415414</a>
Figure 60. Bedford Scale ratings - Night Scenario	<a href="#">416415415414</a>
Figure 61. Bedford Scale ratings - Fixed Time Scenario	<a href="#">417416416415</a>
Figure 62. Bedford Scale ratings - On Demand Scenario	<a href="#">417416416415</a>

Figure 63. SASHA ratings - Night Scenario	<a href="#">418417417416</a>
Figure 64. SASHA ratings - Fixed Time Scenario	<a href="#">419418418417</a>
Figure 65. SASHA ratings - On Demand Scenario	<a href="#">420419419418</a>
Figure 66. Potential for Human Error - Night vs Fixed Time vs On Demand Scenarios	<a href="#">421420420419</a>
Figure 67. Communication Load - Night vs Fixed Time vs On Demand Scenarios	<a href="#">421420420419</a>
Figure 68. Bedford Scale ratings - Contingency Scenario	<a href="#">423422422421</a>
Figure 69. SASHA ratings - Contingency Scenario	<a href="#">424423423422</a>
Figure 70. Potential for Human Error - Contingency Scenarios	<a href="#">425424424423</a>
Figure 71. Communication Load - Contingency Scenarios	<a href="#">426425425424</a>
Figure 72. Roles and Responsibilities - Contingency Scenarios	<a href="#">426425425424</a>
Figure 73. Level of Safety - Night Scenario	<a href="#">427426426425</a>
Figure 74. Level of Safety – Fixed Time Scenario	<a href="#">428427427426</a>
Figure 75. Level of Safety – On Demand Scenario	<a href="#">428427427426</a>
Figure 76. Separation Provision - Night Scenario	<a href="#">429428428427</a>
Figure 77. Separation Provision - Fixed Time Scenario	<a href="#">429428428427</a>
Figure 78. Separation Provision - On Demand Scenario	<a href="#">430429429428</a>
Figure 79. Level of Safety - Contingency Scenario	<a href="#">431430430429</a>
Figure 80. Separation Provision - Contingency Scenario	<a href="#">431430430429</a>
Figure 81. ADSP ATSEP Ability to perform tasks	<a href="#">432431431430</a>
Figure 82. VCS ATSEP Ability to change of configuration	<a href="#">433432432431</a>
Figure 83. Roles and Responsibilities – Contingency Scenario	<a href="#">434433433432</a>
Figure 84. Operational Acceptability – Contingency Scenario	<a href="#">435434434433</a>
Figure 85. Level of Workload - Contingency Scenario	<a href="#">435434434433</a>
Figure 86. Level of Situational Awareness - Contingency Scenario	<a href="#">436435435434</a>
Figure 87. China Lakes Questionnaire	<a href="#">437436436435</a>
Figure 88. Supervisors China Lakes Ratings - Contingency Scenario	<a href="#">437436436435</a>
Figure 89. Supervisors Level of Workload - Contingency Scenario	<a href="#">438437437436</a>
Figure 90. Level of Trust in the system - Contingency Scenario	<a href="#">438437437436</a>



Figure 91. Supervisors Level of Trust in the system - Contingency Scenario	<a href="#">439438438437</a>
Figure 92. Overall Workload	<a href="#">450449449448</a>
Figure 93. Average Situational Awareness	<a href="#">451450450449</a>
Figure 94. Operational Safety	<a href="#">452451451450</a>
Figure 95. SHAPE Teamwork ratings	<a href="#">453452452451</a>
Figure 96. Phraseology results	<a href="#">454453453452</a>
Figure 97. Overall Procedure Acceptability	<a href="#">455454454453</a>
Figure 98 – EXE Validation Platform overview	<a href="#">459458458457</a>
Figure 99 - EXE Validation environment - geographical area	<a href="#">460459459458</a>
Figure 100 EXE5 OPS feasibility per SOL run	<a href="#">476474474473</a>
Figure 101 - EXE5 Operational Feasibility	<a href="#">476475475474</a>
Figure 102 - EXE5 Feasibility of handover dialogue	<a href="#">478477477476</a>
Figure 103 - EXE5 Acceptability on roles and responsibilities	<a href="#">479478478477</a>
Figure 104 - EXE5 Acceptability of roles and responsibilities (Overall)	<a href="#">479478478477</a>
Figure 105 - EXE5 Quality of service provision	<a href="#">480479479478</a>
Figure 106 - EXE5, Workload, SA, Trust and System Support (ATCO)	<a href="#">482481481480</a>
Figure 107 - EXE5, Workload, SA, Trust and System Support (SUP)	<a href="#">482481481480</a>
Figure 108 - EXE5 Bedford result	<a href="#">483482482481</a>
Figure 109 - EXE5 Situational Awareness during delegation process	<a href="#">485484484483</a>
Figure 110 - EXE5 Roles and Responsibilities acceptance	<a href="#">487486486485</a>
Figure 111 - EXE5 Communication load acceptance	<a href="#">488487487486</a>
Figure 112 - EXE5 ATCO Support Tools	<a href="#">489488488487</a>
Figure 113 EXE5 OPS Safety	<a href="#">490489489488</a>
Figure 114 EXE5 Separation Management	<a href="#">491490490489</a>
Figure 115 - EXE5 Preservation of safety when workload increase	<a href="#">492491491490</a>
Figure 116 – Cost Efficiency Increase	<a href="#">494493493492</a>
Figure 117 Validation Scenarios EXE-PJ.10-W2-93-V3-VALP-006	<a href="#">503502502501</a>



# 1 Executive summary

This document describes the Validation Report (VALR) for the:

- **V3 maturity** level of Solution PJ.10-W2-93 “Delegation of ATM services provision amongst ATSUs”.
- **TRL6 maturity** level of Solution PJ.10-W2-93a, which is the Technological solution based on the “Y” architecture
- **TRL4 maturity** level of Solution PJ.10-W2-93b, which is the Technological solution based on the “D” architecture
- **TRL4 maturity** level of Solution PJ.10-W2-93c, which is the Technological solution based on the “U” architecture

The Final PJ.10-W2-93 VALR at maturity V3 is based on the final outcomes from five different exercises. The validation runs for all exercises took place during the Q2 to Q4 2022 period, at different places in Europe, see below:

Exercise	Lead	Partners	Execution Month	Location(s)
EXE-10.93-V3-VALP-002	ENAIRES	INDRA	04.2022	Madrid (ENAIRES/CRIDA)
EXE-10.93-V3-VALP-003	SKYGUIDE	Skysoft-ATM, DSNA, DFS, NATS, INDRA, FREQUENTIS	10.2022	Geneva, Toulouse, Madrid, Vienna, Langen, Southampton
EXE-10.93-V3-VALP-004	ENAV	SITTI, LEONARDO,	11.2022	Roma
EXE-10.93-V3-VALP-005	COOPANS	THALES, NAVIAIR	10.2022	Paris, Copenhagen, Malmoe
EXE-10.93-V3-VALP-006	PANSA	ON, INDRA	09.2022	Warsaw, Vilnius

Note: Notice that EXE-10.93-V3-VALP-001 led by DFS was the sole validation exercise at V2 and thus is described in a separate document PJ.10-W2-93 VALR at V2, see document ref [25]

Table **1111114**: PJ.10-W2-93 Validation Exercise List at V3

## 2 Introduction

### 2.1 Purpose of the document

This document provides the Final Validation Report for Solution PJ.10-W2-93 “Delegation of ATM services provision among ATSUs” at maturity level V3 and for the three related technological solutions: PJ.10-W2-93a (based on Y architecture), PJ.10-W2-93b (based on D architecture) and PJ.10-W2-93c (based on U architecture). It describes the results from the five validation exercises under Solution PJ.10-W2-93.

### 2.2 Intended readership

The intended readership of this document is presented below:

- SESAR Joint Undertaking (SJU), as SESAR 2020 Programme Manager.
- SESAR 2020 PJ.10-W2-93 involved actors.
- SESAR 2020 PJ.32-W3-VC involved actors.
- SESAR 2020 PJ.10-W2-73– Increased Flexibility in ATCO Validations, with regards to ATCO licensing and competences related aspects.
- SESAR 2020 PJ.10-W2-44– Dynamic Airspace Configuration, with regards to the cross-border airspace configuration concept.
- SESAR 2020 PJ.32-W3– Virtual Centre, as main contributor to the development of the Virtual Centre validation platforms.
- SESAR 2020 PJ.19-W2 – Content Integration, Performance Management and Business Case Development, as responsible for SESAR 2020 Program Operational Performance Management.
- SESAR 2020 PJ.20-W2– Master Planning, for all the matters related to the contribution to the ATM Master Plan.
- SESAR 2020 PJ. 33 FALCO

### 2.3 Background

The V3 maturity phase of SESAR Solution PJ.10-W2-93 is built as a follow-up of the work carried out within SESAR 2020 Wave 2 PJ.10-W2-93 at V2 level, and continues the research initiated in SESAR 2020 Wave 1 by PJ.15-09 and PJ.16-03 in the operational and technical aspects, respectively, for the delegation of ATM services provision concept.

On the operational side, PJ.15-09 “Delegation of airspace and contingency” explored an initial set of potential use cases for the delegation of ATM services provision among ATSUS in case of nominal and abnormal conditions (i.e., contingency). This solution was launched after the TRL-2 maturity gate of “Enabling rationalisation of infrastructure using virtual centre-based technology” to cover the operational gap.

Considering the initial set of use cases developed within PJ.15-09, PJ.10-W2-93 validated at V2 level the operational concept, operational requirements and operational procedures defined for the delegation of ATM services provision among ATSUs at night and during abnormal conditions (i.e., ATSU contingency).

On the technological side, the virtual centre technology supporting the delegation of ATM services provision was originally explored in SESAR 1 – B04.04, which focused on the demonstration of the technical feasibility.

In SESAR 2020 Wave 1, PJ.16-03 “Enabling rationalisation of infrastructure using virtual centre based technology” continued the work performed in SESAR 1 and matured up to TRL-6 some of the services used in support of Virtual Centre. In particular, the objective of PJ.16-03 was to model and then validate services between the two new entities: ADSP and Virtual Centre ATSU. Based on the selection of services identified from the current system exchanges and based also on partially modelled services developed by SESAR1 - B04.04, the TRL4 activities modelled an expanded set of services. These services were technically validated at TRL6 with platforms from different providers.

In SESAR 2020 Wave 2, PJ.10-W2-93 further explored the use of both existing (PJ.16-03) and new services at V2 level, involving different ATSUs and ADSPs from different vendors. The following recommendations were derived from the validation activities conducted at this maturity phase:

- The set of tools provided to the ATCOs was limited in the V2 exercise and did not include conflict management aids. To improve the realism of the validation environment, conflict detection and resolution tools should be included in the V3 activities.
- In terms of validation scenarios, the number of traffic samples should be increased (one traffic sample per run) to avoid repetitiveness. These traffic samples should also consider the load balancing between the sectors included in the validation.
- Due to a technical limitation of the voice communication system setup at V2 level, the radiofrequency (ATC – pilot) and telephone (ATC – ATC) channels were integrated into a single output. It is recommended to have these channels in separate outputs, as in operational environments.
- Further work is required on the definition of operational procedures to support multiple ADSPs, to determine the right time for handover, and to improve the quality and safety of the handover process.
- Training on the specific procedures and airspace of the delegated sectors, as well as licensing and skills issues should be further investigated.

To be adhered to the handover procedure, identical ATC systems are recommended on both the delegating and receiving ATSUs

## 2.4 Structure of the document

The structure of this document is based on the SESAR2020 Wave 2 templates for the Validation Report (VALR). It is organized as follows:

- **Section 1** is the executive summary and contains the key information of the Validation Report.
- **Section 2** Introduction (this chapter).
- **Section 3** Context of the Validation. Provides the general background from the Validation Plan and describes the context of the Validation for V3.
- **Section 4** Validation Results. Provides the validation results, mainly from the sole validation exercise 2 from ENAIRE, at maturity V3.

- **Section 5** Conclusions & recommendations (if any) for the remaining validation exercises.
- **Section 6** is the reference list, containing all the references used through the document.
- **Appendix A** Validation exercise 2 (EXE-10.93-V3-VALP-002 from ENAIRE) Report.
- **Appendix B** Validation exercise 3 (EXE-10.93-V3-VALP-003 from SKYGUIDE) Report.
- **Appendix C** Validation exercise 4 (EXE-10.93-V3-VALP-004 from ENAV) Report.
- **Appendix D** Validation exercise 5 (EXE-10.93-V3-VALP-005 from COOPANS) Report.
- **Appendix E** Validation exercise 6 (EXE-10.93-V3-VALP-006 from PANSA) Report.

## 2.5 Glossary of terms

Term	Definition	Source of the definition
<b>AIR-REPORT</b>	A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.	ICAO Annex 3
ADSP	The ADSP is providing all the data necessary for an ATSU. An ATSU may use of multiple ADSP, e.g., one for ADSP data and one for Voice services. An ADSP may also provide to several ATSUs.	PJ.10-W2-93
Alliance Model	ANSPs could form alliances by creating a dedicated jointly owned entity responsible for producing and providing the needed air traffic data for their airspace (e.g. COOPANS/iTEC like model);	Airspace Architecture Study (SJU, 2019)
Area of Interest	The airspace encompassing the AoR and a defined buffer zone within which airspace status and flight information are of operational interest to the system operators.	ATM Lexicon
Area of Responsibility	An airspace of defined dimensions within which an ATC unit provides air traffic services.	ATM Lexicon
Collaborative Decision Making	A process focused on how to decide on a course of action articulated between two or more community members.	SESAR Concept of Operations Step 2 Edition 2014 (Ed. 01.01.00)
Delegating ATSU	A delegating ATSU is an ATSU that delegates parts of its airspace or even its entire airspace to the receiving ATSU.	PJ.10-W2-93
Delegation Procedure	The operational procedure describes the actors, their activities and their order of execution within the process of delegating the provision of ATM services amongst ATUs.	PJ.10-W2-93

Group of sectors	A set of sectors that belong together organisationally and in terms of licensing.	PJ.10-W2-93
Key Performance Indicator	<p>Current/past performance expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g., cost-per-flight-indicator = Sum(cost)/Sum(flights). Performance measurement is therefore done through the collection of data for the supporting metrics.”</p> <p>9.5.2013 EC Official Journal of Union definition: In the context EC Performance Implementing Regulation, Key Performance Indicator means specifically the performance indicators used for the purpose of performance target setting</p>	ICAO Doc 9883
Network Management Function	An integrated ATM activity with the aim of ensuring optimised Network Operations and ATM service provision meeting the Network performance targets.	ATM Lexicon
Rating	indicates the type of service which the licence holder is authorised to provide	Reg (EU) 2015-340
Receiving ATSU	A receiving ATSU is an ATSU that receives parts of the airspace or even the entire airspace from a delegating ATSU.	PJ.10-W2-93
Sector	Part of a control area and/or part of a flight information region or upper region	Reg (EU) 2015-340
Service	The contractual provision of something (a non-physical object), by one, for the use of one or more others. Services involve interactions between providers and consumers, which may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures	EATMA Guidance Material

Virtual Centre	A virtual centre is a single Air Traffic Service Unit (ATSU) or a grouping of collaborative ATSUs using data services provided by ATM Data Service Provider (ADSP). The concept provides, at least, geographical decoupling between ADSP(s) and ATSU(s), through service interfaces defined in Service Level Agreements. One ATSU may use data services from multiple ADSPs, just as an ADSP may serve multiple ATSUs.	PJ.16-03 solution
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Table 222222: Glossary of terms

## 2.6 Acronyms and Terminology

Term	Definition
A/G	Air-Ground
AAS	Airspace Architecture Study
ACC	Area Control Centre
ADSP	ATM Data Services Provider
AMQP	Advanced Message Queue Protocol
AN	Availability Note
ANS	Air Navigation Service
ANSP	Air National Service Provider
AoR	Area of Responsibility
APP	Approach Control Office
ASTERIX	All-purpose Structured EUROCONTROL Surveillance Information Exchange
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATG	Air Traffic Generator
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSEP	Air Traffic Safety Electronics Personnel
ATSP	Air Traffic Services Provider
ATSU	Air Traffic Services Unit
BIM	Benefit and Impact Mechanisms
CARS	Controller Acceptance Rating Scale



<b>CAP</b>	Capacity
<b>CBA</b>	Cost Benefit Analysis
<b>CCS</b>	Coflight Cloud Service - ADSP from DSNA/ENAV
<b>CD&amp;R</b>	Conflict Detection and Resolution
<b>CEF</b>	Cost-Efficiency
<b>COOPANS</b>	Alliance of ANSPs from six European countries: Austria, Croatia, Denmark, Ireland, Portugal and Sweden
<b>CORRD</b>	Correlation Distribution
<b>CORRM</b>	Correlation Management
<b>CR</b>	Change Request
<b>CTM</b>	Coordination and Transfer Management
<b>CWP</b>	Controller Working Position
<b>D</b>	Virtual Centre Architecture "D"
<b>DAC</b>	Dynamic Airspace Configuration
<b>E-OCVM</b>	European Operational Concept Validation Methodology
<b>EATMA</b>	European ATM Architecture
<b>EC</b>	European Commission
<b>ED</b>	EUROCAE Document
<b>ER/APP</b>	En-Route/APProach
<b>EU</b>	European Union
<b>EXE</b>	Exercise
<b>F2F</b>	F2F meeting in opposite to a visio-conference meeting
<b>FDD</b>	Flight Data Distribution
<b>FDM</b>	Flight Data Management
<b>FDO</b>	Flight Data Operator
<b>FEEF</b>	Fuel Efficiency
<b>FMTP</b>	Flight Message Transfer Protocol
<b>G/G</b>	Ground-Ground
<b>HMI</b>	Human Machine Interface
<b>HP</b>	Human Performance
<b>HPAP</b>	Human Performance Assessment Plan
<b>IBP</b>	Industrial Business Platform
<b>ICAO</b>	International Civil Aviation Organisation

<b>INTEROP</b>	Interoperability Requirements
<b>IOP</b>	Inter-Operability (Flight Object)
<b>IP</b>	Internetwork Protocol
<b>iRIFs</b>	Frequentis Radio Interfaces
<b>IRS</b>	Interface Requirements Specification
<b>iSIM</b>	Indra Simulator
<b>iTEC</b>	interoperability Through European Collaboration
<b>KPA</b>	Key Performance Area
<b>KPI</b>	Key Performance Indicator
<b>LAN</b>	Local Area Network
<b>MONA</b>	MONitoring Aid (tool)
<b>MTCD</b>	Middle Term Conflict Detection
<b>N/A</b>	Not Applicable
<b>NSA</b>	National Supervisory Authority
<b>OCD</b>	Operational Configuration Data
<b>OCM</b>	Operational Configuration Management
<b>OI</b>	Operational Improvement
<b>OLDI</b>	On-Line Data Interchange
<b>OPCONFD</b>	Operational Configuration Distribution
<b>OPCONFM</b>	Operational Configuration Management
<b>OPSUP</b>	Operational Supervision
<b>Operational Mode</b>	CWP configured in the Operational Mode, means operationally used to provide ATS
<b>OSED</b>	Operational Service and Environment Definition
<b>PRD</b>	Predictability
<b>Preview Mode</b>	CWP configured in the Preview Mode at the receiving ATSU and used for the need of transfer of traffic from delegating to receiving ATSUs, before the switch to the operational mode
<b>PUN</b>	Punctuality
<b>RE</b>	ATCO Radar Executive
<b>RP</b>	ATCO Radar Planner
<b>R&amp;D</b>	Research & Development
<b>RTS</b>	Real Time Simulation
<b>SAR</b>	Safety Assessment Report

<b>SARS-CoV</b>	Severe Acute Respiratory Syndrome CoronaVirus
<b>SHAPE</b>	Solutions for Human Automation Partnerships in European ATM
<b>SASHA</b>	Situation Awareness for SHAPE
<b>SATI</b>	SHAPE Automation Trust Index
<b>SVC</b>	Service
<b>SDM</b>	Service Delivery Management
<b>SeAP</b>	Security Assessment Plan
<b>SecRAM</b>	Security Risk Assessment Methodology
<b>SES</b>	Single European Sky
<b>SESAR</b>	Single European Sky ATM Research Programme
<b>SH</b>	SystemHouse
<b>SJU</b>	SESAR Joint Undertaking
<b>SPOC</b>	Single Point of Contact
<b>SPR</b>	Safety and Performance Requirements
<b>SPVR</b>	Operational Supervisor
<b>SUP</b>	Operational Supervisor
<b>SUS</b>	System Usability Scale
<b>SVC</b>	Service
<b>SWIM</b>	System-Wide Information Management
<b>TDM</b>	Time Division Multiplexer
<b>TEFF</b>	Time Efficiency
<b>TCT</b>	Tactical Controller Tool
<b>TMA</b>	Terminal Manoeuvring Area / Terminal Control Area (ICAO)
<b>TRL</b>	Technical Readiness Level
<b>TS</b>	Technical Specification
<b>TWR</b>	Tower Control Unit
<b>U</b>	Virtual Centre Architecture "U"
<b>UAC</b>	Upper Area Control
<b>UC</b>	Use Case
<b>V&amp;V</b>	Verification & Validation
<b>VALP</b>	Validation Plan
<b>VALR</b>	Validation Report
<b>VALS</b>	Validation Strategy

VC	Virtual Centre
VCCI	Virtual Centre Communication Infrastructure
VCD	Voice Communication Information Distribution
VCM	Voice Communication Management
VCS	Voice Communication System
VoIP	Voice Over IP
VPN	Virtual Private Network
VT	Validation Target
WAN	Wide Area Network
WP	Work Package
WS	Workshop
XML	eXtensible Markup Language
XSD	XML Schema Definition
Y	Virtual Centre Architecture "Y"

Table ~~333333~~: Acronyms and terminology

## 3 Context of the Validation

### 3.1 SESAR Solution PJ.10-W2-93: a summary

SESAR Solution **PJ.10-W2-93** aimed at exploring operational concepts of the delegation of ATM services provision amongst ATSUs. Delegations can be done either in nominal operating conditions, to improve the overall efficiency of the ATM system or in abnormal conditions (i.e., contingency situations), in order to improve the resilience of the network and to minimise the impact of a system failure.

The delegation of ATM services provision concept applies when one ATSU delegates a portion of its airspace, or the entire airspace, to another ATSU based on a particular condition. The Solution investigated Use Cases for the Delegation of ATM services in conjunction with the Virtual Centre Technology, where the ATM Data Service Provider is geographically decoupled from the ATSU providing ATS to a region of airspace.

Based on the new operational opportunities offered by the Virtual Centre technology, a preliminary set of use cases have been selected, with the aim to further investigate and develop dynamic airspace configurations and advanced ATFCM capabilities. These allow a completely new architecture to provide Air Traffic Services. These use cases consider the operational procedures and resource management processes required to support static and dynamic delegation of ATS and are identified before defining the operational requirements for different ATSU and ADSP configurations.

This agility leads to new opportunities to provide Air Traffic Services, both from a technical and operational perspective, increasing the flexibility in the use of resources, which in turn will improve the overall European network performance.

In addition, the work carried out within PJ.10-W2-93 solution is well-aligned with the standardization activities performed by EUROCAE WG-122. The alignment is performed in both directions: on the one hand, the working group is taking the results of the solution and previous background as input, while on the other hand the solution is considering WG-122 outputs to complement both the operational and technical threads.

From the technological point of view, we have shown that the delegation of ATM services provision, that is, the operational concept developed by PJ.10-W2-93 might be achieved with different system architectures (this is where there was a cooperation with the other project PJ32-W3 Virtual Centre). Therefore, three different technological solutions have been defined in support of the ATM solution (PJ.10-W2-93). These solutions are:

- **PJ.10-W2-93a** – Delegation of ATM services provision with a “Y” architecture: This solution focuses on the “Y” architecture relying on a delegation between 2 ATSUs sharing the same ADSP.
- **PJ.10-W2-93b** – Delegation of ATM services provision with a “D” architecture: This solution focuses on the “D” architecture relying on a delegation between 2 ATSUs, each one with its own ADSP, and using Virtual Centre (service) interoperability for remotely connecting CWP’s of the receiving ATSU to the ADSP of the delegating ATSU, without affecting the respective ATSU AoRs.
- **PJ.10-W2-93c** – Delegation of ATM services provision with a “U” architecture: This solution focuses on the “U” architecture relying on a delegation between 2 ATSUs, each one with its

own system, and using exchange capabilities between the 2 systems for transferring relevant data to the ATSU receiving the delegation. Each system may be a legacy one or be provided by an ADSP (i.e., VC “I” architecture). In this architecture, the respective AoRs are reshaped according to the expected delegation.

More details about the description of each architecture (Y, U, D) in EATMA is provided in the technical document PJ.10-W2-93 TS-IRS, which is based on DS23 at the EATMA level.

The following table depicts the link between the OIs and enablers linked to PJ.10-W2-93, and also the link between the POIs and enablers linked to technological solutions defined in support of SDM-0217.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI/POI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
PJ.10-W2-93 - Delegation of ATM services provision among ATSUs	The objective of this key R&D activity is to explore the different possible delegation of airspace amongst ATSUs based on traffic/organisational needs (either static on fix-time transfer schedule (Day/Night) or dynamic (e.g., when the traffic density is below/over certain level) or on contingency situations.	M	The validation activities described in this Validation Plan will contribute to both the operational and technical thread of the solution, validating the operational procedures and technical services (in a Virtual Centre environment) associated to the delegation of ATM services provision.	SDM-0217	REG-0546 CR 07428 (PRO-267) CR 07429 (HUM-067) CR 07430 (HUM-068) CR 07431 (HUM-069) CR 07432 (HUM-070)
PJ.10-W2-93a – Y- Architecture supporting delegation of ATM services provision amongst ATSUs	The objective of this solution is the development of the “Y” architecture, in support of the operational concept developed by PJ.10-W2-93	C	The validation activities described in this Validation Plan will contribute to the technical thread of PJ.10-W2-93, validating the technical services (in a Virtual Centre environment) associated to the	POI-0075-SDM	SVC-008 SVC-009 SVC-010 SVC-013 SVC-014 SVC-015 SVC-016 SVC-017 SVC-018 SVC-019 SVC-020 SVC-021 SVC-049

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI/POI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
			delegation of ATM services provision.		SVC-022 SVC-050 SVC-023 SVC-024 SVC-025 SVC-026 SVC-027 SVC-028 SVC-029 SVC-031 SVC-032 SVC-033 SVC-034 ER APP 184 ER APP 185 ER APP 186 ER APP 193 ER APP 194 ER APP 195 ER APP 216 ER APP 218 ER APP 209 <b>STD-097</b>
PJ.10-W2-93b – D-Architecture supporting delegation of ATM services provision amongst ATSUs	The objective of this solution is the development of the “D” architecture, in support of the operational concept developed by PJ.10-W2-93	C		POI-0076-SDM	SVC-008 SVC-009 SVC-010 SVC-013 SVC-014 SVC-015 SVC-016 SVC-017 SVC-018 SVC-019 SVC-020 SVC-021 SVC-049 SVC-022 SVC-050 SVC-023 SVC-024 SVC-025 SVC-026 SVC-027

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the Solution short description	to SESAR short description	OI/POI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
						SVC-028 SVC-029 SVC-031 SVC-032 SVC-033 SVC-034 ER APP 184 ER APP 185 ER APP 186 ER APP 193 ER APP 194 ER APP 215 ER APP 217 <b>STD-097</b>
PJ.10-W2-93c – U-Architecture supporting delegation of ATM services provision amongst ATSUs	The objective of this solution is the development of the “U” architecture, in support of the operational concept developed by PJ.10-W2-93	C			POI-0077-SDM	ER APP 193 ER APP 194 ER APP 196 ER APP 197

Table 444444: SESAR Solution(s) under Validation

Below, the description of the SDM-0217 enablers with their coverage under Solution PJ.10-W2-93.

Enabler ID	Enabler Title	OI Step/Enabler Coverage
REG-0546	Regulatory provisions for delegation of ATM services provision among ATSUs	n/a <sup>1</sup>
CR 07428 (PRO-XXX)	Procedure for Delegation of ATM Services provision between ATSUs	Fully

<sup>1</sup> The Solution didn't work on the area of regulation. This Enabler is created to indicate that for a deployment of the concept regulatory efforts are necessary. Thus, it is declared as n/a here.



CR 07429 (HUM-XXX)	Updated role/responsibilities for ATCOs in context of the delegation of ATS between ATSUs	Fully
CR 07430 (HUM-XXX)	Updated role/responsibilities for ACC/Approach/TMA Supervisor in context of the delegation of ATS between ATSUs	Partial
CR 07431 (HUM-XXX)	Updated role/responsibilities for ATSEPs in context of the delegation of ATS between ATSUs	Partial
CR 07432 (HUM-XXX)	Updated role/responsibilities for Technical Supervisor in context of the delegation of ATS between ATSUs	Partial

Below, the description of the different enablers considered is presented, as well as the initial and target maturity level.

Enabler Ref	Description	Initial Maturity Level	Target Maturity Level	Architecture		
				Y	D	U
SVC-008	Provision and Consumption of FlightDataDistribution Service in the context of Virtual Centres.	TRL6	TRL6	Optional	Optional	N/A
SVC-009	Provision and Consumption of FlightDataManagement Service in the context of Virtual Centres	TRL6	TRL6	Optional	Optional	N/A
SVC-010	Provision and Consumption of CoordinationAndTransferManagement Service in the context of Virtual Centres	TRL6	TRL6	Optional	Optional	N/A
SVC-013	Provision and Consumption of Airspace Status Distribution Service	TRL6	TRL6	Optional	Optional	N/A
SVC-014	Provision and Consumption of Arrival Sequence Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-015	Provision and Consumption of Arrival Sequence Management Service	TRL4	TRL4	Optional	Optional	N/A
SVC-016	Provision and Consumption of Correlation Distribution Service	TRL6	TRL6	Optional	Optional	N/A
SVC-017	Provision and Consumption of Correlation Management Service	TRL6	TRL6	Optional	Optional	N/A
SVC-018	Provision and Consumption of Medium Term Conflict Detection Distribution Service	TRL4	TRL4	Optional	Optional	N/A

Enabler Ref	Description	Initial Maturity Level	Target Maturity Level	Architecture		
				Y	D	U
SVC-019	Provision and Consumption of Medium Term Conflict Management Service	TRL4	TRL4	Optional	Optional	N/A
SVC-020	Provision and Consumption of Monitoring Aids Distribution Service	TRL4	TRL6	Optional	Optional	N/A
SVC-021	Provision and Consumption of Operational Configuration Distribution Service	TRL4	TRL6	Optional	Optional	N/A
SVC-049	Operational Configuration Distribution of Working Position Preview Mode, and Neighbouring ATSU Sector configuration for ATM Service Delegation	NEW	TRL6	Optional	Optional	N/A
SVC-022	Provision and Consumption of Operational Configuration Management Service	TRL4	TRL6	Optional	Optional	N/A
SVC-050	Operational Configuration Management of Working Position Preview Mode, and Neighbouring ATSU Sectors for ATM Service Delegation	NEW	TRL6	Optional	Optional	N/A
SVC-023	Provision and Consumption of Safety Net (SNET) Alert Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-024	Provision and Consumption of SSR Code Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-025	Provision and Consumption of SSR Code Management Service	TRL4	TRL4	Optional	Optional	N/A
SVC-026	Provision and Consumption of Support Functions Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-027	Provision and Consumption of Support Functions Management Service	TRL4	TRL4	Optional	Optional	N/A
SVC-028	Provision and Consumption of Surveillance Data Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-029	Provision and Consumption of Technical Supervision Distribution Service	TRL4	TRL6	Optional	Optional	N/A

Enabler Ref	Description	Initial Maturity Level	Target Maturity Level	Architecture		
				Y	D	U
SVC-031	Provision and Consumption of Time-based Separation Distribution Service	TRL4	TRL4	Optional	Optional	N/A
SVC-032	Provision and Consumption of Time-based Separation Management Service	TRL4	TRL4	Optional	Optional	N/A
SVC-033	Provision and Consumption of Voice Comm Information Distribution Service	TRL6	TRL6	Optional	Optional	N/A
SVC-034	Provision and Consumption of Voice Comm Management Service	TRL6	TRL6	Optional	Optional	N/A
ER APP ATC 184	ATM Data Service Provider for ATC services in a Virtual Centre context	TRL6	TRL6	Required	Required	N/A
ER APP ATC 185	ATM Data Service Provider for Voice services in a Virtual Centre context	TRL6	TRL6	Required	Required	N/A
ER APP ATC 186	Virtual Centre ATSU	TRL6	TRL6	Required	Required	N/A
ER ATC APP 193	Management in the VC ATSU of a CWP preview mode during delegation of ATS Provision between ATUs	NEW	TRL6	Required	Required	Optional
ER ATC APP 194	Management in the ADSP of a CWP preview mode during delegation of ATS Provision between ATUs	NEW	TRL6	Required	Required	Optional
ER ATC APP 195	Management in the VC ATSU of Delegation of ATS Provision between ATUs with Static AoRs for Y-Architecture	NEW	TRL6	Required	N/A	N/A
ER ATC APP 196	Management in the VC ATSU of Delegation of ATS provision between ATUs with Dynamic AoRs for U-Architecture	NEW	TRL4	N/A	N/A	Required
ER ATC APP 197	Management in the ADSP of Delegation of ATS provision between ATUs with Dynamic AoRs for U-Architecture	NEW	TRL4	N/A	N/A	Required
ER APP ATC 215	Management in the VC ATSU of Delegation of ATS Provision between	NEW	TRL4	N/A	Required	N/A

Enabler Ref	Description	Initial Maturity Level	Target Maturity Level	Architecture		
				Y	D	U
	ATUs with Static AoRs in a D-Architecture					
ER APP ATC 216	Management in the ADSP of Delegation of ATS provision between ATUs with Static AoRs in a Y-Architecture	NEW	TRL6	Required	N/A	N/A
ER APP ATC 217	Management in the ADSP of Delegation of ATS provision between ATUs with Static AoRs in a D-Architecture	NEW	TRL4	N/A	Required	N/A
ER APP ATC 218	Management in the VC ATSU of Delegation of ATS provision between ATUs with Dynamic AoRs in a Y-Architecture	NEW	TRL6	Optional	N/A	N/A
ER APP ATC 209	Management in the ADSP of Delegation of ATS provision between ATUs with Dynamic AoRs in a Y-Architecture	NEW	TRL6	Optional	N/A	N/A
STD-097	<b>EUROCAE ER for Taxonomy of Services between ATSU &amp; ADSP(s), and between ADSP &amp; ADSP</b>	NEW	TRL6	Optional	Optional	N/A

Table ~~555555~~. SESAR Solution PJ.10-W2-93 Enablers

## 3.2 Summary of the Validation Plan

### 3.2.1 Validation Plan Purpose

The present validation report aims to demonstrate the V3 maturity of Solution PJ.10-W2-93, the TRL6 maturity of the technological Solution PJ.10-W2-93a (Y architecture), the TRL4 maturity of the technological Solution PJ.10-W2-93b (D architecture) and the TRL4 maturity of the technological Solution PJ.10-W2-93c (U architecture).

For Solution PJ.10-W2-93, The purpose at V3 is to:

- Validate the Normal Delegation and Contingency procedures as described in the PJ.10-W2-93 SPR-INTEROP/OSED V2 ([13])
- Demonstrate the feasibility of these procedures in an operational environment and through various operational use cases: Night Delegation, Contingency, with Civil-Military cooperation or with ATFCM load balancing measures

The following table provides an overview of the validation exercises at V3:

EXE ID	Addressed R&D need	Addressed solution validation targets	Related (previous) activities, dependencies, relationships
EXE-PJ.10-W2-93-V3-VALR-002 (ENAIRE)	To validate the operational feasibility and acceptability and evaluate impact of ATS delegation in En-Route environment, through three use cases: ATS delegation by night, at fixed time and on-demand	CAP1, CAP2, CEF2, FEEF1, PRD1, SAF, HP	Previous activities: <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 1 PJ15.09 and SESAR 2020 Wave 1 PJ16.03</li> <li>• SESAR 2020 Wave 2 PJ.10-W2-93-V2</li> </ul>
EXE-PJ.10-W2-93-V3-VALR-003 (Skyguide)	To validate the operational feasibility and acceptability and evaluate impact of ATS delegation in En-Route environment, through two main use cases: ATS delegation by night and in Contingency	CEF2, SAF, HP	Previous activities: <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 1 PJ15.09 and SESAR 2020 Wave 1 PJ16.03</li> <li>• SESAR 2020 Wave 2 PJ.10-W2-93-V2</li> </ul> Dependencies: <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 3 PJ32 W3</li> </ul>
EXE-PJ.10-W2-93-V3-VALR-004 (ENAV)	To validate the operational feasibility and acceptability and evaluate impact of ATS delegation in En-Route environment, through three main use cases: ATS delegation involving Civil-Military cooperation, on-demand and in Contingency	CAP1, FEEF1, PRD1, SAF, HP	Previous activities: <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 1 PJ15.09 and SESAR 2020 Wave 1 PJ16.03</li> <li>• SESAR 2020 Wave 2 PJ.10-W2-93-V2</li> </ul> Dependencies: <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 3 PJ32</li> </ul>

EXE-PJ.10-W2-93-V3-VALR-005 (COOPANS)	To validate the operational feasibility and acceptability and evaluate impact of ATS delegation in En-Route environment, through two main use cases: ATS delegation on-demand and in Contingency	CAP2, CEF2, SAF, HP	<p>Previous activities:</p> <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 1 PJ15.09 and SESAR 2020 Wave 1 PJ16.03</li> <li>• SESAR 2020 Wave 2 PJ.10-W2-93-V2</li> </ul> <p>Dependencies: SESAR 2020 Wave 3 PJ32</p>
EXE-PJ.10-W2-93-V3-VALR-006 (PANSAS)	To validate the operational feasibility and acceptability and evaluate impact of ATS delegation in En-Route environment, through two main use cases: ATS delegation by night and on-demand	SAF, HP	<p>Previous activities:</p> <ul style="list-style-type: none"> <li>• SESAR 2020 Wave 1 PJ15.09 and SESAR 2020 Wave 1 PJ16.03</li> <li>• SESAR 2020 Wave 2 PJ.10-W2-93-V2</li> </ul> <p>Dependencies: SESAR 2020 Wave 3 PJ32</p>

Table 6666666 PJ.10-W2-93 Validation Approach for V2 EXE-PJ.10-W2-93-V2-VALR-001

The following table identifies the partners, operational environment and technological environment of the validation activities captured in this validation report:

Exercise identifier	Partners involved	Operational environment	Technology environment
EXE-PJ.10-W2-93-V3-VALR-002 (ENAIRES)	ENAIRES (lead)	<p>The airspace of the exercise covers the following units:</p> <ul style="list-style-type: none"> <li>- LECM (Madrid ACC)</li> <li>- LECS (Sevilla ACC)</li> <li>- LECB (Barcelona ACC)</li> <li>- LECP (Palma TACC)</li> </ul>	Single ADSP (Y architecture) with local CWPs
EXE-PJ.10-W2-93-V3-VALR-003 (Skyguide)	Skyguide (lead), Skysoft-ATM, DFS, DSNA, INDRA, FREQUENTIS, NATS	The airspace of the exercise covers the Upper Sectors of southern part of Germany (Karlsruhe UAC) and Switzerland.	Virtual Centre distributed environment with two involved ATC ADSPs: CCS from DSNA and iTEC from INDRA; CWPs from different vendors Skyguide, INDRA and DFS SH; and two Voice ADSPs from FREQUENTIS and INDRA, all platforms connected through a central AMQP broker provided by FREQUENTIS Architectures: Y, U and D
EXE-PJ.10-W2-93-V3-	ENAV (lead)	The airspace of the exercise covers the Upper Sectors LIRR (Rome ACC) and LIBB (Brindisi ACC).	Virtual Centre distributed environment with CCS ATC ADSP from ENAV and DSNA; CWPs from LEONARDO; Voice ADSPs from

VALR-004 (ENAV)			SITTI. All platforms connected through a central AMQP broker provided ENAV and DSNA. Architecture: Y
EXE-PJ.10-W2-93-V3-VALR-005 (COOPANS)	NAVIAIRE (lead), THALES	The airspace of the exercise covers the Upper Sectors belonging to Copenhagen and to Malmoe ACCs	Distributed platform with a THALES TopSky ADSP, situated at Rungis (FR) while the CWP's are based in Copenhagen (DAN) & Malmoe (SWE) Architecture: Y
EXE-PJ.10-W2-93-V3-VALR-006 (PANSA)	PANSA (lead), ON, INDRA	The airspace of the exercise covers the Upper Sectors belonging to Warsaw and to Vilnius ACCs	Distributed platform with two iTEC ADSPs providing services to two ATSU's: Warsaw (PL) and Vilnius (LIT) Architectures: Y, D

Table ~~777777~~ PJ.10-W2-93 Validation environment for V3 exercises

### 3.2.2 Summary of Validation Objectives and success criteria

This section details all the objectives for the Solution PJ.10-W2-93 at V3, of the Solution PJ.10-W2-93a at TRL6, of the Solution PJ.10-W2-93b at TRL4 and of the Solution PJ.10-W2-93c at TRL4, and their related success criterion.

#### 3.2.2.1 PJ.10-W2-93 Validation Objectives

[OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-001
Objective	To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions
Title	Delegation conditions feasibility
Category	<Operational feasibility>
Key environment conditions	Nominal conditions, abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

[OBJ Trace]

Relationship	Linked Element Type	Identifier

<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0001
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-001-001	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.
CRT-PJ.10-W2-93-V3-VALP-001-002	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.
CRT-PJ.10-W2-93-V3-VALP-001-003	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the contingency use case according to ATCO's expert judgment.
CRT-PJ.10-W2-93-V3-VALP-001-004	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the contingency use case according to ATCO's expert judgment.
CRT-PJ.10-W2-93-V3-VALP-001-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-001-006	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the contingency use case.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-002
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night" use case
Title	Operational feasibility of the delegation procedure (Night use case)



Category	<Operational Feasibility>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-002-001	The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined, and documented.
CRT-PJ.10-W2-93-V3-VALP-002-002	The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
CRT-PJ.10-W2-93-V3-VALP-002-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.
CRT-PJ.10-W2-93-V3-VALP-002-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-003
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision at fixed time” use case
Title	Operational feasibility of the delegation procedure (Fixed time use case)
Category	<Operational Feasibility>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA

V Phase	V3
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## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-003-001	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is clearly defined and documented.
CRT-PJ.10-W2-93-V3-VALP-003-002	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
CRT-PJ.10-W2-93-V3-VALP-003-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.
CRT-PJ.10-W2-93-V3-VALP-003-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-004
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-Demand" use case
Title	Operational feasibility of the delegation procedure (On-Demand use case)
Category	<Operational feasibility>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-004-001	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.
CRT-PJ.10-W2-93-V3-VALP-004-002	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
CRT-PJ.10-W2-93-V3-VALP-004-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.
CRT-PJ.10-W2-93-V3-VALP-004-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.

Identifier	OBJ-PJ.10-W2-93-V3-VALP-005
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision between Civil and Military ATSUs” use case
Title	Operational feasibility of the delegation procedure (Civil-Military use case)
Category	<Operational feasibility>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-005-001	The delegation procedure for the Civil-Military Use Case, including the handover dialogue, is clearly defined and documented.
CRT-PJ.10-W2-93-V3-VALP-005-002	The delegation procedure for the Civil-Military Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
CRT-PJ.10-W2-93-V3-VALP-005-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Civil-Military Use Case, including the handover dialogue.
CRT-PJ.10-W2-93-V3-VALP-005-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Civil-Military Use Case, including the handover dialogue.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-006
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision in case of contingency” use case
Title	Operational feasibility of the delegation procedure (Contingency use case)
Category	<Operational feasibility>
Key environment conditions	Abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-006-001	The delegation procedure for the Contingency Use Case, including the handover dialogue, is clearly defined and documented.
CRT-PJ.10-W2-93-V3-VALP-006-002	The delegation procedure for the Contingency Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
CRT-PJ.10-W2-93-V3-VALP-006-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Contingency Use Case, including the handover dialogue.
CRT-PJ.10-W2-93-V3-VALP-006-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Contingency Use Case, including the handover dialogue.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-007
Objective	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Night" use case
Title	Operational acceptance of the delegation procedure (Night use case)
Category	<Acceptability>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-007-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.



CRT-PJ.10-W2-93-V3-VALP-007-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.
CRT-PJ.10-W2-93-V3-VALP-007-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-008
Objective	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Fixed Time" use case
Title	Operational acceptance of the delegation procedure (Fixed Time use case)
Category	<Acceptability>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-008-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.
CRT-PJ.10-W2-93-V3-VALP-008-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-009
Objective	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand" use case
Title	Operational acceptance of the delegation procedure (On-Demand use case)
Category	<Acceptability>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier

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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-009-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.
CRT-PJ.10-W2-93-V3-VALP-009-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.

CRT-PJ.10-W2-93-V3-VALP-009-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.
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## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-010
Objective	To demonstrate the operational acceptance of the delegation procedure for the ""Delegation of ATM services provision between Civil and Military ATSUs"" use case
Title	Operational acceptance of the delegation procedure (Civil-Military use case)
Category	<Acceptability>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
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CRT-PJ.10-W2-93-V3-VALP-010-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Civil-Military Use Case.
CRT-PJ.10-W2-93-V3-VALP-010-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Civil-Military Use Case.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-011
Objective	To demonstrate the operational acceptance of the delegation procedure for the ""Delegation of ATM services provision in case of contingency"" use case
Title	Operational acceptance of the delegation procedure (Contingency use case)
Category	<Acceptability>
Key environment conditions	Abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93

<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0059
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<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-011-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.

CRT-PJ.10-W2-93-V3-VALP-011-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.
CRT-PJ.10-W2-93-V3-VALP-011-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-012
Objective	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions
Title	Human Performance assessment in nominal conditions
Category	<Human Performance>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-HPF.0001
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	HP

## [OBJ Suc]

Identifier	Success Criterion
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CRT-PJ.10-W2-93-V3-VALP-012-001	Impact remains acceptable according to ATCO expert judgment in terms of workload are before, during and after the delegation procedure of ATM services provision in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-012-002	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-012-003	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-012-004	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-012-005	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-012-006	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-013
Objective	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in abnormal conditions
Title	Human Performance assessment in abnormal conditions
Category	<Human Performance>
Key environment conditions	Abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-HPF.0001
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity

<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	HP

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-013-001	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-013-002	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-013-003	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-013-004	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-013-005	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-013-006	ATCO support tools provided before, during and after the delegation of ATM services provision in abnormal conditions do not impair ATCO human performance.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-014
Objective	To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions
Title	Safety assessment in nominal conditions
Category	<Safety>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-SAF.0001
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<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-SAF.0003
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<COVERS>	<Validation Target>	SAF

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-014-001	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in nominal conditions.
CRT-PJ.10-W2-93-V3-VALP-014-002	Impact remains acceptable according to ATCO expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.

## [OBJ]



Identifier	OBJ-PJ.10-W2-93-V3-VALP-015
Objective	To assess the impact in terms of Safety of the ATM services provision delegation concept in abnormal conditions
Title	Safety assessment in abnormal conditions
Category	<Safety>
Key environment conditions	Abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	SAF

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-015-001	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in abnormal conditions.
CRT-PJ.10-W2-93-V3-VALP-015-002	Impact remains acceptable according to ATCO's expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in abnormal conditions are identified.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-016
Objective	To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept
Title	Performance Assessment: Airspace Capacity
Category	<Performance>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	CAP2
<COVERS>	<Validation Target>	CAP1

## [OBJ Suc]

Identifier	Success Criterion

CRT-PJ.10-W2-93-V3-VALP-016-001	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.
CRT-PJ.10-W2-93-V3-VALP-016-002	A positive increase on TMA Capacity without degrading the current level of safety is demonstrated.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-017
Objective	To assess the performance benefits in terms of Fuel Efficiency of the delegation of ATM services provision among ATSUs concept
Title	Performance Assessment: Fuel Efficiency
Category	<Performance>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	FEFF1

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-017-001	A reduction in the average fuel burn per aircraft is demonstrated

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-018
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Objective	To assess the performance benefits in terms of Predictability of the delegation of ATM services provision among ATSU's concept
Title	Performance Assessment: Predictability
Category	<Performance>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	PRD1

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-018-001	A reduction in the variance of the difference between the planned flight duration and actual flight duration is demonstrated.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-019
Objective	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSU's concept
Title	Performance Assessment: Cost-Efficiency
Category	<Performance>
Key environment conditions	Nominal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	CEF2

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-019-001	A positive increase on ATCO productivity is demonstrated.
CRT-PJ.10-W2-93-V3-VALP-019-002.	A reduction on the average technology cost per aircraft is demonstrated.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-020
Objective	To assess the performance benefits in terms of Resilience of the delegation of ATM services provision among ATSUs concept
Title	Performance Assessment: Resilience
Category	<Performance>
Key environment conditions	Abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity

<COVERS>	<Sub-Operating Environment>	En-Route Very High Complexity
<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-020-001	The loss of airspace capacity generated by the contingency situation is reduced.
CRT-PJ.10-W2-93-V3-VALP-020-002	The airspace time to recover from non-nominal to nominal conditions is reduced.
CRT-PJ.10-W2-93-V3-VALP-020-003	The minutes of delay generated by the contingency situation is reduced.
CRT-PJ.10-W2-93-V3-VALP-020-004	The number of cancellations generated by the contingency situation is reduced.

## [OBJ]

Identifier	OBJ-PJ.10-W2-93-V3-VALP-021
Objective	To validate the ATSEP operational requirements based on expert judgment
Title	ATSEP operational requirements
Category	<Operational feasibility>
Key environment conditions	Nominal conditions, abnormal conditions, low to high density, medium to very high complexity, En-Route, TMA
V Phase	V3

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93
<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0044
<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0045
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<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0047

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<COVERS>	<ATMS Requirement>	REQ-PJ.10-W2.93-SPRINTEROP-0058
<COVERS>	<Sub-Operating Environment>	En-Route Medium Complexity
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<COVERS>	<Sub-Operating Environment>	TMA Very High Complexity
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93-V3-VALP-021-001	Impact remains acceptable from the ATSEP's expert group perspective for the different operational requirements related to the ATSEP role.
CRT-PJ.10-W2-93-V3-VALP-021-002	The requirements related to the ATSEP role are reformulated according to the feedback received from the ATSEP expert group.

### 3.2.2.2 PJ.10-W2-93a Technical Validation Objectives

Following are the objectives of the technological solution PJ.10-W2-93a based on the Y architecture (i.e. several ATSUs connected to one ADSP). The traceability to the TS/IRS requirements is provided per each defined Objective.

[OBJ]

Identifier	OBJ-PJ.10-W2-93a-V3-VALP-001
Objective	To assess the maturity of the Virtual Centre architecture and services
Title	Maturity Assessment
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL6

[OBJ Trace]

Relationship	Linked Element Type	Identifier

<COVERS>	<SESAR Solution>	PJ.10-W2-93a
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<COVERS>	<Validation Target>	
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<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
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OBJ-PJ.10-W2-93a-V3-VALP-01-001	a "VC maturity assessment report" is provided
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## [OBJ]

Identifier	OBJ-PJ.10-W2-93a-V3-VALP-02
Objective	To produce and complement/provide the technical validation platform
Title	Validation Platform
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL6

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93a
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<COVERS>	<Validation Target>	
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<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93a-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture
CRT-PJ.10-W2-93a-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services
CRT-PJ.10-W2-93a-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP

## [OBJ]

Identifier	OBJ-PJ.10-W2-93a-V3-VALP-03
Objective	To increase the number of defined as well as implemented Virtual Centre services
Title	Virtual Centre Services
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL6

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93a
<COVERS>	<Sub-Operating Environment>	
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<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93a-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)
CRT-PJ.10-W2-93a-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated
CRT-PJ.10-W2-93a-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated

## [OBJ]

Identifier	OBJ-PJ.10-W2-93a-V3-VALP-04
Objective	To demonstrate the Virtual Centre architecture interoperability and flexibility
Title	Interoperability
Category	<Interoperability>
Key environment conditions	Nominal and Abnormal
V Phase	TRL6

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93a
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<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93a-V3-VALP-04-001	Services from one ADSP have been provided to CWPs from different vendors/ANSPs
CRT-PJ.10-W2-93a-V3-VALP-04-002	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G

## [OBJ]

Identifier	OBJ-PJ.10-W2-93a-V3-VALP-05
Objective	To complement the performance assessment of the Virtual Centre architecture and services
Title	Virtual Centre services performance
Category	<Technical Performance>
Key environment conditions	Nominal and Abnormal
V Phase	TRL6

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93a
<COVERS>	<ATMS Requirement>	
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93a-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold
CRT-PJ.10-W2-93a-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform
CRT-PJ.10-W2-93a-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated
CRT-PJ.10-W2-93a-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations

CRT-PJ.10-W2-93a-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations
CRT-PJ.10-W2-93a-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations

### 3.2.2.3 PJ.10-W2-93b Technical Validation Objectives

Following are the objectives of the technological solution PJ.10-W2-93b based on the D architecture. The traceability to the TS/IRS requirements is provided per each defined Objective.

[OBJ]

Identifier	OBJ-PJ.10-W2-93b-V3-VALP-01
Objective	To assess the maturity of the Virtual Centre architecture and services
Title	Maturity Assessment
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93b
<COVERS>	<Sub-Operating Environment>	
<COVERS>	<Validation Target>	
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0008
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
OBJ-PJ.10-W2-93b-V3-VALP-01-001	a "VC maturity assessment report" is provided

## [OBJ]

Identifier	OBJ-PJ.10-W2-93b-V3-VALP-02
Objective	To produce and complement/provide the technical validation platform
Title	Validation Platform
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93b
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<COVERS>	<Validation Target>	
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<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93b-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the D architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture
CRT-PJ.10-W2-93b-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services
CRT-PJ.10-W2-93b-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP

## [OBJ]

Identifier	OBJ-PJ.10-W2-93b-V3-VALP-03

Objective	To increase the number of defined as well as implemented Virtual Centre services
Title	Virtual Centre Services
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93b
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<COVERS>	<Validation Target>	
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<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
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CRT-PJ.10-W2-93b-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)
CRT-PJ.10-W2-93b-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated
CRT-PJ.10-W2-93b-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated

## [OBJ]

Identifier	OBJ-PJ.10-W2-93b-V3-VALP-04
Objective	To demonstrate the Virtual Centre architecture interoperability and flexibility
Title	Interoperability
Category	<Interoperability>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93b
<COVERS>	<Sub-Operating Environment>	
<COVERS>	<Validation Target>	
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<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93b-V3-VALP-04-001	Services from one ADSP have been provided to CWPs from different vendors/ANSPs
CRT-PJ.10-W2-93b-V3-VALP-04-002	CWPs of a vendor/ATSU have consumed the same services from ADSPs of different vendors
CRT-PJ.10-W2-93b-V3-VALP-04-003	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G

## [OBJ]

Identifier	OBJ-PJ.10-W2-93b-V3-VALP-05
Objective	To complement the performance assessment of the Virtual Centre architecture and services
Title	Virtual Centre services performance
Category	<Technical Performance>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier

<COVERS>	<SESAR Solution>	PJ.10-W2-93b
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93b-V3-VALP-05-001	Response time from the ADSP(s) to CWP's requests remains within a defined threshold
CRT-PJ.10-W2-93b-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform
CRT-PJ.10-W2-93b-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated
CRT-PJ.10-W2-93b-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations
CRT-PJ.10-W2-93b-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations
CRT-PJ.10-W2-93b-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations

### 3.2.2.4 PJ.10-W2-93c Technical Validation Objectives

Following are the objectives of the technological solution PJ.10-W2-93c based on the U architecture. The traceability to the TS/IRS requirements is provided per each defined Objective.

[OBJ]

Identifier	OBJ-PJ.10-W2-93c-V3-VALP-01
Objective	To assess the maturity of the Virtual Centre architecture and services
Title	Maturity Assessment
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

[OBJ Trace]

Relationship	Linked Element Type	Identifier
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0037

<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0038
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0008
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
OBJ-PJ.10-W2-93c-V3-VALP-01-001	a "VC maturity assessment report" is provided

## [OBJ]

Identifier	OBJ-PJ.10-W2-93c-V3-VALP-02
Objective	To produce and complement/provide the technical validation platform
Title	Validation Platform
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93c
<COVERS>	<Sub-Operating Environment>	
<COVERS>	<Validation Target>	
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0001
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0002
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0003
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0004
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0005
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0006
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0007
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0008
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0011
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0012
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0013



<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0014
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0015
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0006
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0002
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0003
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0004
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0005
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0001
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0002
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0003
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0004
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0005
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0006
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0008
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93c-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture
CRT-PJ.10-W2-93c-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services

CRT-PJ.10-W2-93c-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP
---------------------------------	-----------------------------------------------------------------------------------------

## [OBJ]

Identifier	OBJ-PJ.10-W2-93c-V3-VALP-03
Objective	To increase the number of defined as well as implemented Virtual Centre services
Title	Virtual Centre Services
Category	<Technical feasibility>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93c
<COVERS>	<Sub-Operating Environment>	
<COVERS>	<Validation Target>	
<COVERS>	<ATMS Requirement>	REQ-16-03-TS-TECSUPD.0001
<COVERS>	<ATMS Requirement>	REQ-16-03-TS-TECSUPD.0002
<COVERS>	<ATMS Requirement>	REQ-16-03-TS-TECSUPD.0003
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0007
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0008
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0035
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0036
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0037
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0038
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
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CRT-PJ.10-W2-93c-V3-VALP-03-001	Specific inter-ADSP services have been defined to manage airspace delegation in “U” architecture
---------------------------------	--------------------------------------------------------------------------------------------------

## [OBJ]

Identifier	OBJ-PJ.10-W2-93c-V3-VALP-04
Objective	To demonstrate the Virtual Centre architecture interoperability and flexibility
Title	Interoperability
Category	<Interoperability>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93c
<COVERS>	<Sub-Operating Environment>	
<COVERS>	<Validation Target>	
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0001
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0002
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0003
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0004
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0008
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0009
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0011
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DDA.0012
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSD.0001
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DPM.0002
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0002
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0003
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0004
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-DSM.0006
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<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0036
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0037
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPM.0038
<COVERS>	<ATMS Requirement>	REQ-10-W2.93-TS-OPD.0008
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93c-V3-VALP-04-001	Specific to U: the ADSPs have successfully shared data between them to allow for delegation
CRT-PJ.10-W2-93c-V3-VALP-04-002	Specific to U: the ADSP has been able to increase or reduce its AoR
CRT-PJ.10-W2-93c-V3-VALP-04-003	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G

## [OBJ]

Identifier	OBJ-PJ.10-W2-93c-V3-VALP-05
Objective	To complement the performance assessment of the Virtual Centre architecture and services
Title	Virtual Centre services performance

Category	<Technical Performance>
Key environment conditions	Nominal and Abnormal
V Phase	TRL4

## [OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.10-W2-93c
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A

## [OBJ Suc]

Identifier	Success Criterion
CRT-PJ.10-W2-93c-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold
CRT-PJ.10-W2-93c-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform
CRT-PJ.10-W2-93c-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated
CRT-PJ.10-W2-93c-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations
CRT-PJ.10-W2-93c-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations
CRT-PJ.10-W2-93c-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations
CRT-PJ.10-W2-93c-V3-VALP-05-007	Specific to U: % of Coordinated flights between ADSPs against total number of flights is in a acceptable rate for the operations
CRT-PJ.10-W2-93c-V3-VALP-05-008	Specific to U: % of manually coordinated flights between ATSUs against total number of flights is in a acceptable rate for the operations

### 3.2.3 Validation Assumptions

The below assumptions were defined in the document PJ.10-W2-93 Initial VALR for V3.

Identifier	Title	Description	Justification	Impact on Assessment
ASS-PJ.10-W2-93-V3-001	Traffic characteristics	It is assumed that the results obtained for medium, high, and very high complexity environments is also applicable to low complexity environments.	It has been agreed by the operational experts involved in the concept validation that the results obtained for medium, high and very high complexity environments should be extrapolated to low complexity environments (concept limitations are only applicable for medium, high and very high complexity).	Low
ASS-PJ.10-W2-93-V3-002	Regulatory	It is assumed that the receiving ATCO is endorsed for the delegated sector.	The exercises are conducted considering the current ATCO licensing framework. Training has been planned to avoid the lack of ATCO sector-based knowledge.	Medium
ASS-PJ.10-W2-93-V3-003	Ground tools/technology	It is assumed that ATCO and SUP support tools are available to compensate the lack of ATCO sector-based knowledge during implementation.	The ATCO and SUP support tools available for the validation activities cover only limited functionalities (e.g., CD&R, conformance monitoring).	Medium

Table ~~888888~~: Validation Assumptions overview

### 3.2.4 Validation Exercises List

This section provides a high-level description of the validation activities at V3 phase for Solution PJ.10-W2-93 and its related Technological solutions.

[EXE]Identifier	EXE-PJ.10-W2-93-V3-VALP-002
Title	Delegation of ATM services provision among ATSUs - ENAIRE
Description	<p>Real Time Simulation on the delegation of ATM services provision among ATSUs.</p> <p>The objective is to validate the operational aspects of the delegation of ATM services provision in nominal conditions.</p> <p>A Safety and Human Performance analysis will be conducted as well as part of the activities.</p>

Expected Achievements	Improved Cost-Efficiency and improved Capacity
V Phase	<V3>
Use Cases	Delegation of ATM services provision at night Delegation of ATM services provision at fixed time Delegation of ATM services provision on-demand
Validation Technique	<Real Time Simulation>
KPA/TA Addressed	<Capacity> <Human Performance> <Environment><Operational efficiency><Safety><Cost-Efficiency><Resilience>
Start Date	14/02/2022
End Date	25/02/2022
Validation Coordinator	ENAIRE
Validation Platform	ENAIRE IBP
Validation Location	Madrid
Status	Done
Dependencies	PJ.32-02 ENAIRE Exercise

## [EXE Trace]

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93
<Sub-Operating Environment>	En-Route Medium Complexity
<Sub-Operating Environment>	TMA Very High Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-007
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-008
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-009
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-012
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<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-018
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-019

Table **999999**: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-002

[EXE]Identifier	EXE-PJ.10-W2-93-V3-VALP-003
Title	Delegation of ATM services provision among ATSU's - skyguide
Description	<p>Real Time Simulation on the delegation of ATM services provision among ATSU's.</p> <p>The objective is to validate the operational and technical aspects (including the validation of new services) of the delegation of ATM services provision.in nominal and abnormal conditions.</p> <p>A Safety and Human Performance analysis will be conducted as well as part of the activities.</p>
Expected Achievements	Improved Cost-Efficiency and improved Resilience
V Phase	<V3>
Use Cases	<p>Delegation of ATM services provision at night</p> <p>Delegation of ATM services provision in case of contingency</p>
Validation Technique	<Real Time Simulation>
KPA/TA Addressed	<Cost-Efficiency><Safety><Capacity><Resilience><Human Performance>
Start Date	05/10/2022
End Date	20/10/2022
Validation Coordinator	Skyguide
Validation Platform	ATG, VCS, CCS and iTEC. CWP in multiple ATSU's (Geneva, Zürich, Langen, Southampton, Madrid). Y, D and U architectures covered.
Validation Location	<p>Geneva</p> <p>Toulouse</p> <p>Frankfurt</p> <p>Madrid</p> <p>Vienna</p> <p>Southampton</p>



Status	Done
Dependencies	PJ.32 W3 Virtual Centre

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93
<Sub-Operating Environment>	En-Route Very High Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-006
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-007
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-011
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-012
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<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-015
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-016
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-019
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<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-021

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93a
<Sub-Operating Environment>	En-Route Very High Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-aV3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-006

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93b
<Sub-Operating Environment>	En-Route Very High Complexity

<Validation Objective>	OBJ-PJ.10-W2-93b-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93b-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93b-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93b-V3-VALP-006

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93c
<Sub-Operating Environment>	En-Route very High Complexity
<Validation Objective>	OBJ-PJ.10-W2-93c-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93c-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93c-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93c-V3-VALP-006

Table [10101010101010](#): Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-003

[EXE]Identifier	EXE-PJ.10-W2-93-V3-VALP-004
Title	Delegation of ATM services provision among ATSUs - ENAV
Description	<p>Real Time Simulation on the delegation of ATM services provision among ATSUs.</p> <p>The objective is to validate the operational and technical aspects of the delegation of ATM services provision in nominal and abnormal conditions.</p> <p>A Safety and Human Performance analysis will be conducted as well as part of the activities.</p>
Expected Achievements	Improved Cost-Efficiency and improved Resilience
V Phase	<V3>
Use Cases	<p>Delegation of ATM services provision at night</p> <p>Delegation of ATM services provision at fixed time</p> <p>Delegation of ATM services provision on-demand</p> <p>Delegation of ATM services provision in case of contingency</p> <p>Delegation of ATM services provision between Civil and Military ATSUs</p>
Validation Technique	<Real Time Simulation>

KPA/TA Addressed	<Cost-Efficiency><Capacity><Resilience><Human Performance> <Safety><Environment><Operational Efficiency>
Start Date	25/10/22
End Date	11/11/22
Validation Coordinator	ENAV
Validation Platform	Rome IBP. Y architecture.
Validation Location	Rome
Status	Done
Dependencies	PJ.32-02 ENAV exercise

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93
<SESAR Solution>	PJ.10-W2-93a
<Sub-Operating Environment>	En-Route Medium Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-005
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-007
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<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-005

Table ~~11111111111144~~: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-004

[EXE]Identifier	EXE-PJ.10-W2-93-V3-VALP-005
Title	Delegation of ATM services provision among ATSUs - COOPANS
Description	<p>Real Time Simulation on the delegation of ATM services provision among ATSUs.</p> <p>The objective is to validate the operational and technical aspects of the delegation of ATM services provision in nominal and abnormal conditions.</p> <p>A Human Performance analysis will be conducted as well as part of the activities.</p>
Expected Achievements	Improved Resilience
V Phase	<V3>
Use Cases	<p>Delegation of ATM services provision in case of contingency</p> <p>Delegation of ATM services provision on-demand</p>
Validation Technique	<Real Time Simulation>
KPA/TA Addressed	<Resilience><Human Performance><Safety>
Start Date	24/10/22
End Date	28/10/22
Validation Coordinator	COOPANS
Validation Platform	TopSky ATC. Y architecture
Validation Location	Copenhagen & Malmoe
Status	Done
Dependencies	PJ.32 W3 Virtual Centre

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93
<SESAR Solution>	PJ.10-W2-93a

<Sub-Operating Environment>	En-Route Medium Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-009
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-012
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-014
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-016
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-019
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-002

Table ~~12121212121212~~: Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-005

[EXE]Identifier	EXE-PJ.10-W2-93-V3-VALP-006
Title	Delegation of ATM services provision among ATSUs - PANSA
Description	<p>Real Time Simulation on the delegation of ATM services provision among ATSUs.</p> <p>The objective is to validate the operational aspects of the delegation of ATM services provision in nominal and abnormal conditions.</p> <p>A Human Performance analysis will be conducted as well as part of the activities.</p>
Expected Achievements	Improved Cost-Efficiency
V Phase	<V3>
Use Cases	<p>Delegation of ATM services provision at night</p> <p>Delegation of ATM services provision on-demand</p> <p>Delegation of ATM services provision in case of contingency</p>
Validation Technique	<Real Time Simulation>
KPA/TA Addressed	<Cost-Efficiency>
Start Date	04/04/22
End Date	08/04/22
Validation Coordinator	PANSA
Validation Platform	iTEC. D architecture

Validation Location	Warsaw and Vilnius
Status	Done
Dependencies	N/A

Linked Element Type	Identifier
<SESAR Solution>	PJ.10-W2-93
<Sub-Operating Environment>	En-Route Medium Complexity
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-007
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-009
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-012
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-014
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-018
<Validation Objective>	OBJ-PJ.10-W2-93-V3-VALP-019
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-001
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-002
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-003
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-004
<Validation Objective>	OBJ-PJ.10-W2-93a-V3-VALP-005

Table [13131313131343](#): Validation Exercise layout EXE-PJ.10-W2-93-V3-VALP-006

### 3.3 Deviations

#### 3.3.1 Deviations with respect to the S3JU Project Handbook

There is no deviation from the S3JU Project Handbook.

#### 3.3.2 Deviations with respect to the Validation Plan

All the runs of Solution PJ.10-W2-93 were executed successfully according to their original Objectives and Scope, defined in the Validation Plan document PJ.10-W2-93 Final VALP for V3.

However, in term of Objective Assessment, there is a deviation from the PJ.10-W2-93 Final VALP V3, regarding the OBJ-PJ.10-W2-93-V3-VALP-021 " Validate the ATSEP operational requirements based on expert judgment".



It was expected for this objective to be assessed by Real ATSEPs, according to their Expert judgment, while no real ATSEP took part of the simulations. This role was played under EXE3 by the technical managers of the distributed VC validation platform (i.e., Skysoft-ATM, DSNA, INDRA, FREQUENTIS, etc.).

## 4 SESAR Solution PJ.10-W2-93 Validation Results

### 4.1 Summary of SESAR Solution PJ.10-W2-93 Validation Results

Summarised SESAR Solution Validation results are provided in the table below.

Results obtained are assessed against the success criteria to make an overall assessment if the PJ.10-W2-93 Validation Objective Analysis Status is OK, partially OK (POK), Not OK (NOK) or Not Applicable (N/A).

Please see EXE reports for more detailed results on each objective. The view in the below table is on a consolidated level for the overall solution. For justification of consolidated results, please see section 4.2.

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Success ID	Solution Criterion	SESAR Solution Success Criterion	SESAR Solution Validation Results	SESAR Solution Validation Objective Status
OBJ-PJ.10-W2-93-V3-VALP-001	<b>Delegation conditions feasibility</b> To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic	CRT-PJ.10-W2-93-V3-VALP-001		Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-002		Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very		



environment conditions		high complexity is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.
	CRT-PJ.10-W2-93-V3-VALP-003	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the contingency use case according to ATCO's expert judgment.
	CRT-PJ.10-W2-93-V3-VALP-004	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the contingency use case according to ATCO's expert judgment.
	CRT-PJ.10-W2-93-V3-VALP-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.
	CRT-PJ.10-W2-93-V3-VALP-006	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the contingency use case.



OBJ-PJ.10-W2-93-V3-VALP-002	<b>Operational feasibility of the delegation procedure (Night use case)</b>  To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision at Night” use case	CRT-PJ.10-W2-93-V3-VALP-007	The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined, and documented.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-008	The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.		
		CRT-PJ.10-W2-93-V3-VALP-009	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.		
		CRT-PJ.10-W2-93-V3-VALP-010	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.		
OBJ-PJ.10-W2-93-V3-VALP-003	<b>Operational feasibility of the delegation procedure</b>	CRT-PJ.10-W2-93-V3-VALP-011	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is clearly defined and documented.	Details of the results are under Section Ref 4.2	OK

	<b>(Fixed time use case)</b> To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at fixed time" use case	CRT-PJ.10-W2-93-V3-VALP-012	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.		
		CRT-PJ.10-W2-93-V3-VALP-013	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.		
		CRT-PJ.10-W2-93-V3-VALP-014	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.		
OBJ-PJ.10-W2-93-V3-VALP-004	<b>Operational feasibility of the delegation procedure (On-Demand use case)</b> To demonstrate the operational	CRT-PJ.10-W2-93-V3-VALP-015	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-016	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different		

	feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-Demand" use case		actors involved in the delegation process.		
		CRT-PJ.10-W2-93-V3-VALP-017	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.		
		CRT-PJ.10-W2-93-V3-VALP-018	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.		
OBJ-PJ.10-W2-93-V3-VALP-005	<b>Operational feasibility of the delegation procedure (Civil-Military use case)</b>  To demonstrate the operational feasibility of the ATM services	CRT-PJ.10-W2-93-V3-VALP-019	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-020	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.		

	provision delegation procedure for the “Delegation of ATM services provision between Civil and Military ATSUs” use case	CRT-PJ.10-W2-93-V3-VALP-021	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.		
		CRT-PJ.10-W2-93-V3-VALP-022	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.		
OBJ-PJ.10-W2-93-V3-VALP-006	<b>Operational feasibility of the delegation procedure (Contingency use case)</b>	CRT-PJ.10-W2-93-V3-VALP-023	The delegation procedure for the Contingency Use Case, including the handover dialogue, is clearly defined and documented.	Details of the results are under Section Ref 4.2	OK
	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation	CRT-PJ.10-W2-93-V3-VALP-024	The delegation procedure for the Contingency Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.		
		CRT-PJ.10-W2-93-V3-VALP-025	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the		

	of ATM services provision in case of contingency" use case		delegation procedure for the Contingency Use Case, including the handover dialogue.		
		CRT-PJ.10-W2-93-V3-VALP-025	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Contingency Use Case, including the handover dialogue.		
OBJ-PJ.10-W2-93-V3-VALP-007	<b>Operational acceptance of the delegation procedure (Night use case)</b>  To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Night" use case	CRT-PJ.10-W2-93-V3-VALP-026	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-027	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-028	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-029	The level of system support is judged as sufficient by the ATCO during the		

			delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-030	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-031	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-032	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-033	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.		
OBJ-PJ.10-W2-93-V3-VALP-008	<b>Operational acceptance of the delegation procedure</b>	CRT-PJ.10-W2-93-V3-VALP-034	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.	Details of the results are under Section Ref 4.2	OK

<p><b>(Fixed Time use case)</b></p> <p>To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision at Fixed Time” use case</p>	CRT-PJ.10-W2-93-V3-VALP-035	The level of ATCO situation awareness remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Fixed Time Use Case.
	CRT-PJ.10-W2-93-V3-VALP-036	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.
	CRT-PJ.10-W2-93-V3-VALP-037	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.
	CRT-PJ.10-W2-93-V3-VALP-038	The level of SUP workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Fixed Time Use Case.
	CRT-PJ.10-W2-93-V3-VALP-039	The level of SUP situation awareness remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Fixed Time Use Case.
	CRT-PJ.10-W2-93-V3-VALP-040	The level of trust in the system is judged as sufficient by the SUP during





			the delegation procedure for the Fixed Time Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-041	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.		
OBJ-PJ.10-W2-93-V3-VALP-009	<b>Operational acceptance of the delegation procedure (On Demand use case)</b>  To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On Demand" use case	CRT-PJ.10-W2-93-V3-VALP-042	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On Demand Use Case, except in EXE2 which was played in high traffic conditions and EXE6 which was played with technical and resource limitations	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-043	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On Demand Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-044	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On Demand Use Case, except in EXE2 which was played in high traffic conditions and EXE6 which was		

			played with technical and resource limitations.		
		CRT-PJ.10-W2-93-V3-VALP-045	The level of system support is judged as not sufficient by the ATCO during the delegation procedure for the On Demand Use Case. Result obtained from 2 out of 4 Validation Exercises but mainly due to their specific conditions (high traffic load and limitations in the validation platform)		
		CRT-PJ.10-W2-93-V3-VALP-046	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On Demand Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-047	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On Demand Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-048	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On Demand Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-049	The level of system support is judged as sufficient by the SUP during the		

			delegation procedure for the On Demand Use Case.		
OBJ-PJ.10-W2-93-V3-VALP-010	<p><b>Operational acceptance of the delegation procedure (Civil &amp; Military use case)</b></p> <p>To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision Civil &amp; Military” use case</p>	CRT-PJ.10-W2-93-V3-VALP-050	The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Civil & military Use Case.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-051	The level of ATCO situation awareness remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Civil & military Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-052	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Civil & military Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-053	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Civil & military Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-054	The level of SUP workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Civil & military Use Case.		

		CRT-PJ.10-W2-93-V3-VALP-055	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil & military Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-056	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Civil & military Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-057	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Civil & military Use Case.		
OBJ-PJ.10-W2-93-V3-VALP-011	<b>Operational acceptance of the delegation procedure (Contingency use case)</b>  To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services	CRT-PJ.10-W2-93-V3-VALP-058	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-059	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		
		CRT-PJ.10-W2-93-V3-VALP-060	The level of trust in the system is judged as sufficient by the ATCO		

provision in case of contingency		during the delegation procedure for the Contingency Use Case.		
	CRT-PJ.10-W2-93-V3-VALP-061	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.		
	CRT-PJ.10-W2-93-V3-VALP-062	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		
	CRT-PJ.10-W2-93-V3-VALP-063	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		
	CRT-PJ.10-W2-93-V3-VALP-064	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.		
	CRT-PJ.10-W2-93-V3-VALP-065	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.		
<b>Human Performance assessment in</b>	CRT-PJ.10-W2-93-V3-VALP-066	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the	Details of the results are under Section Ref 4.2	OK

OBJ-PJ.10-W2-93-V3-VALP-012	<b>nominal conditions</b>		delegation procedure of ATM services provision in nominal conditions.
	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions	CRT-PJ.10-W2-93-V3-VALP-067	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.
		CRT-PJ.10-W2-93-V3-VALP-068	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in nominal conditions.
		CRT-PJ.10-W2-93-V3-VALP-069	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.
		CRT-PJ.10-W2-93-V3-VALP-070	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the

			delegation procedure in nominal conditions.		
		CRT-PJ.10-W2-93-V3-VALP-071	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.		
OBJ-PJ.10-W2-93-V3-VALP-013	<b>Human Performance assessment in abnormal conditions</b>  To assess the impact in terms of Human Performance of the ATM services provision delegation concept in abnormal conditions	CRT-PJ.10-W2-93-V3-VALP-072	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in abnormal conditions.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-073	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in abnormal conditions.		
		CRT-PJ.10-W2-93-V3-VALP-074	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in abnormal conditions.		
		CRT-PJ.10-W2-93-V3-VALP-075	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles		

			and responsibilities before, during and after the delegation procedure of ATM services provision in abnormal conditions.		
		CRT-PJ.10-W2-93-V3-VALP-076	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in abnormal conditions.		
		CRT-PJ.10-W2-93-V3-VALP-077	ATCO support tools provided before, during and after the delegation of ATM services provision in abnormal conditions do not impair ATCO human performance.		
OBJ-PJ.10-W2-93-V3-VALP-014	<b>Safety assessment in nominal conditions</b>  To assess the impact in terms of Safety of the ATM services provision delegation concept in	CRT-PJ.10-W2-93-V3-VALP-078	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in nominal conditions.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-079	Impact remains acceptable according to ATCO expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.		



	nominal conditions				
EX3-OBJ-PJ.10-W2-93-V3-VALP-015	<b>Safety assessment in abnormal conditions</b> To assess the impact in terms of Safety of the ATM services provision delegation concept in abnormal conditions	CRT-PJ.10-W2-93-V3-VALP-080	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in abnormal conditions.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-081	Impact remains acceptable according to ATCO's expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in abnormal conditions are identified.		
EX3-OBJ-PJ.10-W2-93-V3-VALP-016	<b>Performance Assessment: Airspace Capacity</b> To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services	CRT-PJ.10-W2-93-V3-VALP-082	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.	Details of the results are under Section Ref 4.2	OK
		CRT-PJ.10-W2-93-V3-VALP-083	A positive increase on TMA Capacity without degrading the current level of safety is demonstrated.		

	provision among ATSU's concept				
OBJ-PJ.10-W2-93-V3-VALP-017	<p><b>Performance Assessment: Fuel Efficiency</b></p> <p>To assess the performance benefits in terms of Fuel Efficiency of the delegation of ATM services provision among ATSU's concept</p>	CRT-PJ.10-W2-93-V3-VALP-084	A reduction in the average fuel burn per aircraft is demonstrated	Details of the results are under Section Ref 4.2	OK
OBJ-PJ.10-W2-93-V3-VALP-018	<p><b>Performance Assessment: Predictability</b></p> <p>To assess the performance benefits in terms of Predictability of the delegation of ATM services provision among ATSU's concept</p>	CRT-PJ.10-W2-93-V3-VALP-085	A reduction in the variance of the difference between the planned flight duration and actual flight duration is demonstrated.	Details of the results are under Section Ref 4.2	OK

EX3-OBJ-PJ.10-W2-93-V3-VALP-019	<b>Performance Assessment: Cost-Efficiency</b>	CRT-PJ.10-W2-93-V3-VALP-086	A positive increase on ATCO productivity is demonstrated.	Details of the results are under Section Ref 4.2	OK
	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept	CRT-PJ.10-W2-93-V3-VALP-087	A reduction on the average technology cost per aircraft is demonstrated.		
EX3-OBJ-PJ.10-W2-93-V3-VALP-020	<b>Performance Assessment: Resilience</b>	CRT-PJ.10-W2-93-V3-VALP-088	The loss of airspace capacity generated by the contingency situation is reduced.	Details of the results are under Section Ref 4.2	OK
	To assess the performance benefits in terms of Resilience of the delegation of ATM services provision among ATSUs concept	CRT-PJ.10-W2-93-V3-VALP-089	The airspace time to recover from non-nominal to nominal conditions is reduced.		
		CRT-PJ.10-W2-93-V3-VALP-090	The minutes of delay generated by the contingency situation is reduced.		
		CRT-PJ.10-W2-93-V3-VALP-091	The number of cancellations generated by the contingency situation is reduced.		
		CRT-PJ.10-W2-93-V3-VALP-092	Impact remains acceptable from the ATSEP's expert group perspective for the different operational	Details of the results are under Section Ref 4.2	OK

EX3-OBJ- PJ.10-W2-93- V3-VALP-021	<b>ATSEP operational requirements</b>		requirements related to the ATSEP role.	-	
	To validate the ATSEP operational requirements based on expert judgment	CRT-PJ.10-W2-93-V3-VALP-093	The requirements related to the ATSEP role are reformulated according to the feedback received from the ATSEP expert group.		

Table [14141414141414](#): Summary of Validation Exercises Results

## 4.2 Detailed analysis of SESAR Solution Validation Results per Validation objective

Note: The achievement of the objective with respect to the success criteria is assessed by means of ad-hoc questionnaires (PRQ and PSQ), debriefing sessions and over the shoulder observation.

For further details regarding the results of the simulations, please refer to the Appendixes of each exercise.

### 4.2.1 OBJ-PJ.10-W2-93-V3-VALP-001 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-001 is covered by five exercises (EXE2, EXE3, EXE4, EXE5, EXE6). The objective is related to the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.

Mostly positive feedback is collected by the exercises covering this objective. All the simulations agreed regarding the feasibility of delegation of ATS in environments from low to high density in nominal and contingency (where tested) conditions. Some remarks are to be researched in the On Demand or Civil-Military scenarios, where some controllers at ENAIRE or at ENAV reported that the high level of traffic complexity and traffic demand did not allow the compliance of the ATC procedures in place due to their complexity and, therefore, leading to a higher number of conflicts, non-optimal trajectories, and lower levels of situational awareness.

Furthermore, some potential limitations for the applicability of the delegation of ATM services provision were documented (e.g., the managed traffic densities are from Low to Medium, especially in the use cases with AoR extension).

The validation objective OBJ-PJ.10-W2-93-V3-VALP-002 is covered by four exercises (EXE2, EXE3, EXE4, EXE6). The objective is related to the operational feasibility of the delegation of ATM services provision for the “Delegation of ATM services provision at Night” use case.

To complement the results obtained for OBJ-PJ.10-W2-93-V3-VALP-001, the four exercises provided positive feedback for the specific case of night delegation. Overall, the delegation procedure was quite feasible and well documented. Controllers were able to efficiently manage the traffic in their own sector, especially in low traffic situations. No impact on roles and responsibilities was recorded during and after the delegation process. In addition, with reference to the quality of ATM services provision, controllers reported it to be acceptable throughout the simulations’ runs.

### 4.2.2 OBJ-PJ.10-W2-93-V3-VALP-003 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-003 is covered by two exercises (EXE2 and EXE4). The objective is related to the operational feasibility of the delegation of ATM services provision for the “Delegation of ATM services provision at fixed time” use case.

In case of Fixed Time Use Case, the delegation procedure was reviewed as operationally feasible by the controllers. During the runs, there were no problems detected with its operation and was easily performed. In case of higher traffic, in EXE4 controllers suggested to improve and better define the

procedure in order to be perfectible workable by them also in this case. In fact, higher traffic and the already mentioned technical limitation in the preview mode did not allow them to be totally ahead of the traffic. The importance of the checklist has been highlighted considering an improved coordination and have a common understanding between the delegating and receiving ATCO during the exchange traffic situation phase of the delegation procedure. No impact recorded on roles and responsibilities during and after the delegation process. Quality of ATM services provision was neutrally impacted during the delegation process.

#### 4.2.3 OBJ-PJ.10-W2-93-V3-VALP-004 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-004 is covered by four exercises (EXE2, EXE4, EXE5, EXE6). The objective is related to the operational feasibility of the delegation of ATM services provision for the “Delegation of ATM services provision On-Demand” use case.

In case of On-Demand use case, overall controllers were able to efficiently manage the traffic in their own sector, except for EXE2 where some negative feedbacks were gathered because of high traffic demand and complexity. The delegation procedure was deemed operationally feasible but, in some cases, more challenging to be operated in some specific context. In fact, in addition to the already reported EXE2 results, in both EXE4 and EXE5, the hand over dialogue was clear, but it would be eased with some system support (e.g., track highlight on unconcerned flights, preview mode). In EXE6, ATCOs agreed that the situation was still manageable and feasible.

In general, roles and responsibilities were not impacted by delegation process and the quality of ATM services provision remained at an acceptable level.

#### 4.2.4 OBJ-PJ.10-W2-93-V3-VALP-005 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-005 is covered by the sole EXE 4. The objective is related to the operational feasibility of the delegation of ATM services provision for the “Delegation of ATM services provision between Civil and Military ATSUs” use case.

The scenario involved the activation of a TSA (Temporary Segregated Area) and it was based on the possibility that LIBB (Brindisi ACC) has to delegate its Airspace to LIRR (Roma ACC) while a military activity managed by military controllers is planned during the Delegation time period. Controllers reported that the delegation procedure was efficiently executed without adversely affecting controllers’ operations. Consequently, the delegation procedure was considered quite feasible by all involved actors.

#### 4.2.5 OBJ-PJ.10-W2-93-V3-VALP-006 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-006 is covered by two exercises (EXE3 and EXE4). The objective is related to the operational feasibility of the delegation of ATM services provision for the “Delegation of ATM services provision in case of contingency” use case.

Overall, no negative feedback has been gathered for the contingency use case. The delegation procedure in case of contingency was suitable and operationally feasible. The roles and responsibilities were clear to all operational and technical staff. Regarding the quality of ATC services, in EXE3 ATCOs expressed some concerns that could be improved by an adequate training on the delegated sectors environment (LoA, airspace design, routes, Waypoints, Entry/Exit points, etc). This feedback from EXE3

was also due to the lack of controller support tools (Safety Nets, CD&R) which are all available today in the OPS rooms and which are key to provide a good quality of the ATC service.

#### 4.2.6 OBJ-PJ.10-W2-93-V3-VALP-007 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-007 is covered by four exercises (EXE2, EXE3, EXE4, EXE6). The objective is related to the operational acceptance of the delegation of ATM services provision for the “Delegation of ATM services provision at Night” use case.

In general, the delegation procedure was judged operationally acceptable to the ATCOs and supervisors for the Night use cases. The workload and mental effort faced by the ATCOs and SUP was well acceptable. Both the controllers and supervisors felt comfortable during the simulation runs and they felt able to plan and organize their work according to the preferences. Situational awareness was at an acceptable level although the level of ATCO support tools (Safety Nets or CD&R) could be improved in a final implementation project (see recommendations). The supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process.

#### 4.2.7 OBJ-PJ.10-W2-93-V3-VALP-008 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-008 is covered by two exercises (EXE2, EXE4). The objective is related to the operational acceptance of the delegation of ATM services provision for the “Delegation of ATM services provision at Fixed Time” use case.

Mostly positive feedback is collected by the exercises covering this objective. All the simulations agree regarding the acceptability of delegation procedure performed at a Fixed time. Regarding the workload and situational awareness level of both controllers and Supervisor, results are positive and comparable to the ones obtained in the Night Use Case scenario. Some issues related to the system might be highlighted as source of a slight decrease in the situational awareness, but the amount of traffic managed allowed controllers to maintain acceptable safety levels. These technical issues (e.g., a basic implementation of preview mode in EXE4) affected the results in the controllers level of trust in the system. Hence, the level of Acceptability was good. In EXE4, controllers recommended further refinements (see recommendation section) in the system, especially in the preview phase, to easily and safely perform their tasks speeding up and smoothing traffic flows.

#### 4.2.8 OBJ-PJ.10-W2-93-V3-VALP-009 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-009 is covered by four exercises (EXE2, EXE4, EXE5, EXE6). The objective is related to the operational acceptance of the delegation of ATM services provision for the “Delegation of ATM services provision On-Demand” use case.

The level of acceptability of the delegation of ATM services provision On-Demand was good. As for the other scenarios, workload and situational awareness levels remained in satisfactory levels, but in some cases the lack of some supporting tools might have been a limitation. In the EXE2, the level of workload did not remain under acceptable levels during the delegation procedure due to the high traffic load and the high traffic complexity for these scenarios. Even if the sectors that were delegated were not always the ones with hotspots and considering that the moment of delegation was chosen by the air traffic controllers and supervisors at their convenience, the traffic load did not allow to carry out the procedure with an acceptable level of workload and in safe conditions. After the delegation procedure is completed, the level of workload decreased and remained acceptable, but negative feedback was

received with regards to the efficiency of managing these levels of traffic in the receiving ATSU compared to the delegating one.

Generally, the workload experienced by the supervisors was good as well as the situational awareness. Supervisors also had a good level of trust and confidence in the system as to allow them to properly handle the delegation process.

From controllers' point of view, also in this scenario, their trust in the system was affected by some issues and/or tool lacking (e.g. CD&R) and the system needs some refinements in order to better support controllers in the execution of the task and allow a smoother delegation process.

#### 4.2.9 OBJ-PJ.10-W2-93-V3-VALP-010 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-010 is covered by EXE4. The objective is related to the operational acceptance of the delegation of ATM services provision for the “Delegation of ATM services provision between Civil and Military ATSUs” use case.

Operational Acceptability was assessed in terms of workload and situational awareness experienced, also considering the impact of system support and level of trust in the system reported by controllers.

The Delegation of ATM services provision when a military activity is in place has been considered as acceptable from controllers' point of view. The results testify that the workload perceived by both controllers and supervisor during the execution of civil/military scenario was well acceptable and satisfactory. Also, the good results obtained for the situational awareness reinforced the idea that no deterioration in performance was recorded.

Overall, during the execution of the scenario, no problems or difficulties have been encountered. However, from system point of view, the results obtained, both for the ATCOs and for the SUP, are in line with those obtained for the other scenarios with the same perplexities on the technical aspects of the validation expressed in the previous scenarios.

For further details regarding the results of the EXE4, please refer to the Appendix C of this document.

#### 4.2.10 OBJ-PJ.10-W2-93-V3-VALP-011 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-011 is covered by two exercises (EXE3 and EXE4). The objective is related to the operational acceptance of the delegation of ATM services provision for the “Delegation of ATM services provision in case of contingency” use case.

Overall, the delegation procedure in case of contingency was operationally acceptable, of course there are different aspects in the contingency situations to be taken into account as well as controllers would have felt more confident in case of total availability of supporting tools (e.g. CD&R tools).

In both exercises, the level of Workload for Contingency Use Case remains at a low level during all phases of the delegation, which corresponds to a satisfactory level of workload. The level of workload might increase during the delegation but remaining at an acceptable level and decreasing after the delegation is completed. The same results were recorded for the Situational Awareness, found acceptable by most of the controllers during the exercises. No clear differences have been highlighted with the other scenarios executed. Also in this case, some recommendations have been made especially from system point of view. As example, the level of trust and confidence on the system could be improved by adding some controller support tools. From SUP point of view, the delegation process



in case of contingency did not bring to a significative increase of workload or decrease of SA levels. In EXE 4, the delegating supervisor at LIBB never loss his/her awareness when the contingency occurred being able to coordinate the delegation with LIRR in a smooth and safe way. Also, their trust in the system was always maintained at high level, all the coordination actions to safely perform the delegation in case of failure were timely performed as they felt supported by the system.

#### 4.2.11OBJ-PJ.10-W2-93-V3-VALP-012 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-012 is covered by five exercises (EXE2, EXE3, EXE4, EXE5, EXE6). The objective is related to the human performance aspects of the delegation of ATM services provision in nominal conditions.

Overall workload experienced was satisfactory in all the simulations. The Bedford scale assessment confirmed that the results are quite positive regarding the workload level in nominal conditions for the ATCOs except for the On Demand scenarios in EXE2 where the level of workload increased because of high level of traffic demand and complexity. SASHA assessment conducted in all the simulations showed positive results regarding the overall situational awareness of the actors involved in the simulations. Sometimes, during the delegation process, lower rating of situational awareness and a slight increase of the workload were registered with an improvement after the delegation process. In fact, controllers were able to perform their tasks but some of the tools they were used to in daily operations were missing, and they would have helped reduce workload during delegation process. Also, delegation process had no negative impact on likely and frequency of human errors, that are more dependent on the traffic load. Also, regarding roles and responsibilities, no impact was reported on the delegation process.

Finally, overall controllers did not experience difficulties in terms of communication, that was deemed satisfactory.

#### 4.2.12OBJ-PJ.10-W2-93-V3-VALP-013 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-013 is covered by two exercises (EXE3, EXE4). The objective is related to the human performance aspects of the delegation of ATM services provision in abnormal conditions.

The analysis of workload results collected through different means indicates that the level of workload and estimated performance (e.g., attention, skill, effort, frustration, stress) were equivalent in both exercises in case of contingency. The overall level of workload experienced in all the simulations during contingencies is satisfactory. Sometimes there were quite a few issues with the technical aspect of the validation (in EXE 4 the ones reported several times and related to preview mode), leading to a slight increase in the workload perceived by the ATCOs but nevertheless it has remained in a region of tolerability. The global level of situation awareness was rated as good in abnormal conditions. The total availability of all supporting tools would have contributed to the maintenance of a clearer mental picture of the traffic, especially during the delegation. Regarding the potential to mislead controllers during the delegation procedure in case of contingency, no risk of misleading was reported. Also, the communication load remains controlled to acceptable levels during a contingency event and no risk of overloading the controllers from a communications point of view was reported.

Finally, as for the nominal situation, no impact on the distribution of roles and responsibilities for the contingency delegation procedures was identified.

#### 4.2.13OBJ-PJ.10-W2-93-V3-VALP-014 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-014 is covered by five exercises (EXE2, EXE3, EXE4, EXE5, EXE6). The objective is related to the safety aspects of the delegation of ATM services provision in nominal conditions. This data was used to report on potential safety concerns linked to the delegation of ATM services provision. In addition, potential losses of separation were analysed to provide a quantitative and deeper safety assessment.

Overall, although the global level of safety was felt as quite good, the controllers expressed some safety concerns. However, these concerns were more linked to specific situations in which controllers experienced difficulties and technical issues related to the validation rather than attributable to the delegation process itself. Even if in some cases safety level was sometimes impacted, no real losses of separations were detected.

In EXE2, there were discrepancies concerning the safety perception depending on the use case. Whilst for the night and fix time use case the both the level of safety and the management and provision of aircraft separation remains at an acceptable level, in the on-demand use case (ATFM and cross-border), a potential negative impact in terms of safety was registered.

In EXE3, the execution of the delegation procedure was found to support a safe delegation process (especially for the Y or D architectures UC#). According to ATCOs feedback, they were generally able to manage traffic in a safe way, although some potential safety related issues were detected mainly due to the lack of several supporting & conflict detection tools that are commonplace for ATS provision, and the level of sector knowledge for the receiving ATCOs. Use cases with Dynamic AoR (delegated sector collapsed with receiving sector) could lead to potential selective attention from the receiving ATCOs due to gained processing fluency: receiving ATCOs inadvertently directing more of their attention to their usual sector rather than the entire AoR/ collapsed sectors. While the delegation procedure was found to support a safe delegation process, the interoperability limitations, particularly associated with the U architecture, were found to lack the required maturity: clearances entered by the delegating ATSU were not visible on the receiving ATSU's CWP. The receiving ATCO team had to remember all these clearances (verbally coordinated during the exchange of traffic situation), and re-enter them for each flight after they were in operational mode. In general, the exchange of traffic situation phase needs to be complemented by adequate supporting tools in order to minimize, to the furthest extent practicable, the probability of information (or flights) being omitted/ misheard/ misinterpreted.

In EXE4, taking into account the traffic samples, ATCOs considered the concept quite safe and they were quite able to safely manage situations. Otherwise, due to some preview phase issues (i.e. not clear understanding on the switch to the operational mode and specific indications on the traffic to be gained and on the one to be delegated), controllers reported that it was sometimes difficult to maintain full control of the traffic situation during the delegation process. It was highlighted that controllers were not familiar with the system used. Also, during the first days of simulation, controllers felt that the time for decision, negotiation and acceptance of delegation process was too long, this aspect was then improved during the simulation week where the learning effect allowed a better coordination among parties. Hence the system issues during the delegation process and also the long duration of the delegation process in the first days of the simulation week contributed sometimes to not maintain a full mental picture of the traffic situation.

In EXE5, safety was not impaired even though ATCOs stated they missed some tools and warnings from their "normal" operational system. There was a varying delay in system inputs/outputs due to limited

communication bandwidth with the ADSP which contributed to higher workload but was not considered to affect safety.

In EXE6, Controllers agreed that the level of safety remained acceptable with the introduction of the new operating method particularly in terms of coordination between executive and planner ATCOs. Also, they were able to ensure the management and provision of aircraft separation thanks to a good situational awareness and efficient coordination between planner and executive ATCOs.

Finally, the consensus was that the working method used during the delegation process would not adversely impact on safety in nominal conditions. Generally, the objective is met because these results are strictly related to the scenarios and traffic conditions experienced during the exercises and to the low level of controller support tools that are key to provide a Safe ATC service.

#### 4.2.14OBJ-PJ.10-W2-93-V3-VALP-015 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-015 is covered by two exercises (EXE3, EXE4). The objective is related to the safety aspects of the delegation of ATM services provision in abnormal conditions. This data was used to report on potential safety concerns linked to the delegation of ATM services provision. In addition, potential losses of separation were analysed to provide a quantitative and deeper safety assessment.

Mostly positive feedback is provided by the controllers regarding the safety levels during contingency. Overall, the level of safety was maintained at acceptable levels. Controllers were quite able to manage traffic in a safe way during all the phases of the delegation process also in case of contingency events.

Although the occurrence of a failure might prevent the controller to have access to all functionalities required to safely manage traffic, the possibility to delegate ATC to another fully operating unit can be considered as a mitigation to improve the situation. Nevertheless, also during the execution of contingency scenario, most of the controllers' concerns were not related to the procedure itself but to simulation setup issues. The importance of the checklist and training was also highlighted.

Finally, the level of conflicts was manageable by ATCO due to traffic conditions from Low to Medium. Hence, no under separation and/or conflicts have been recorded.

#### 4.2.15OBJ-PJ.10-W2-93-V3-VALP-016 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-016 is covered by three exercises (EXE2, EXE4, EXE5). The objective is related to the Airspace Capacity aspects of the delegation of ATM services provision.

According to the SESAR Performance Framework, the Capacity KPA was evaluated at local level for En-Route airspace and TMA airspace as the increase in En-Route throughput (CAP2) and TMA throughput (CAP1), respectively, in challenging airspace, per unit time.

The analysis carried out showed positive results in both En-Route and TMA capacity without eroding safety levels.

Also, a positive increase on En-Route Capacity without degrading the current level of safety was demonstrated because of distribution of workload, e.g., when an additional ATCO team (RE+RP) was managing the delegated Sector. Table below shows **the En-Route & TMA Capacity** (CAP1 and CAP2) increase figures, obtained from exercises EXE2, EXE4 and EXE5

	CAP1 (TMA)	CAP2 (En- route)
EXE2	+20%	+12 %
EXE4	-	+4 %
EXE5	-	+8 %-

#### 4.2.16OBJ-PJ.10-W2-93-V3-VALP-017 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-017 is covered by EXE2 and EXE4. The objective is related to the Fuel Efficiency aspects of the delegation of ATM services provision.

According to the SESAR Performance Framework, the Fuel Efficiency (FEFF1) indicator has been calculated as the total amount of fuel burnt divided by the number of flight movements.

Table below shows **the Fuel Efficiency KPI (FEFF1)** figures, obtained from exercises EXE2 and EXE4.

	FEFF1
EXE2	-9.6 %
EXE4	-20 %

#### 4.2.17OBJ-PJ.10-W2-93-V3-VALP-018 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-018 is covered by two exercises (EXE2, EXE4). The objective is related to the Predictability aspects of the delegation of ATM services provision.

According to the SESAR Performance Framework, PRD2 KPI is computed as the variance of difference between actual and planned flight durations.

Table below shows **the Predictability KPI (PRD2)** figures, obtained from exercises EXE2 and EXE4.

	PRD2
EXE2	+6.5 %
EXE4	+0.5 %

#### 4.2.18OBJ-PJ.10-W2-93-V3-VALP-019 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-019 is covered by three exercises (EXE2, EXE3, EXE5). The objective is related to the Cost Efficiency aspects of the delegation of ATM services provision.

According to the SESAR Performance Framework, the Cost Efficiency KPI (CEF2) is computed as the number of flights handled divided by the number of ATCO-hours on duty.

Table below shows **the ATCO Productivity KPI (CEF2)** figures, obtained from exercises EXE2 and EXE4.

	CEF2
EXE2	+24.70 %
EXE3	+40%

EXE5	+6 %
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The **Technology Cost KPI (CEF3)** was assessed by the sole EXE4 based on a methodology detailed in **Annex C.3.216**. ENAV have shown a reduction of the Technology Costs compared to the basic "Do nothing" scenario, i.e., the today legacy infrastructure.

	CEF3
EXE4	-5 % *

*\*The Cost reduction is calculated in the period 2024-2043 and is valid only for the ENAV infrastructure (source ENAV, LEONARDO, 2023)*

#### 4.2.19OBJ-PJ.10-W2-93-V3-VALP-020 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-020 is covered by the sole EXE3. The objective is related to the Resilience aspects of the delegation of ATM services provision.

From EXE3, it has been highlighted that the reduced loss of airspace capacity generated by the contingency situation, is proportional to the number of additional controlled flights/hour at the supporting ATSU. Also, the time to perform a full delegation is between 1 to 3 minutes (see below Table) while the time to recover from an ATSU failure is much more than that (count 2 hours in average). The time to recover from non-nominal to nominal situations is then significantly reduced with the delegation procedure.

Global Time of the Delegation Process (EXE3)	
UC# with Static AoR (using Spare CWPs at the receiving ATSU)	UC# with Dynamic AoR (Receiving ATSU CWP already controlling a local Sector)
60 sec	1 min
2 min	-
2 min	3 min

#### 4.2.20OBJ-PJ.10-W2-93-V3-VALP-021 Results

The validation objective OBJ-PJ.10-W2-93-V3-VALP-021 is covered by EXE3 and EXE4. The objective is related to the validation of ATSEP operational requirements.

The results gathered for EXE3 showed that the ATSEP at the ATSU, thanks to provided supervision tools, was able to monitor both the status of all local CWPs and all the services provided by a remote ATC ADSP. The ATSEP, being at the ATSU or at the ADSP locations, had full monitoring & control of their systems. The voice ADSP as well as the Network connections via the broker are also fully monitored locally at the broker site and remotely at the ATSU and ADSP sites.

Similar monitoring tools are put in place under EXE4 for the ATSEPs to make sure that all interfaces and systems are in full operation and all required services and data are provided to the ATSUs while ensuring the quality, accuracy, availability, and integrity of the data.

### 4.3 Summary of SESAR Solution PJ.10-W2-93a Technical Validation Results

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Solution Success Criterion	Solution	Success	SESAR Solution Validation Results	SESAR Solution Validation Objective Status
OBJ-PJ.10-W2-93a-V3-VALP-001	Maturity Assessment	CRT-PJ.10-W2-93a-V3-VALP-01-001	a "VC maturity assessment report" is provided			N/A - No longer Valid Objective from the SJU feedback	N/A
OBJ-PJ.10-W2-93a-V3-VALP-002	Validation Platform	CRT-PJ.10-W2-93a-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture			Details of the results are under Section Ref 4.4	OK
		CRT-PJ.10-W2-93a-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services			Details of the results are under Section Ref 4.4	OK
		CRT-PJ.10-W2-93a-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP			Details of the results are under Section Ref 4.4	OK
OBJ-PJ.10-W2-93a-V3-VALP-003	Virtual Centre Services	CRT-PJ.10-W2-93a-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)			Details of the results are under Section Ref 4.4	OK
		CRT-PJ.10-W2-93a-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated			Details of the results are under Section Ref 4.4	OK

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Criterion	Solution	Success	SESAR Validation Results	Solution Results	SESAR Solution Validation Objective Status
		CRT-PJ.10-W2-93a-V3-VALP-03-003	Additional operations services- implemented	- or updated within existing have been		Details of the results are under Section Ref 4.4		OK
OBJ-PJ.10-W2-93a-V3-VALP-04	Interoperability	CRT-PJ.10-W2-93a-V3-VALP-04-001	Services from one ADSP have been provided to CWP	from different vendors/ANSPs		Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-04-002	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G			Details of the results are under Section Ref 4.4		OK
OBJ-PJ.10-W2-93a-V3-VALP-05	Virtual Centre services performance	CRT-PJ.10-W2-93a-V3-VALP-05-001	Response time from the ADSP(s) to CWP	requests remains within a defined threshold		Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform			Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated			Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations			Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations			Details of the results are under Section Ref 4.4		OK
		CRT-PJ.10-W2-93a-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations			Details of the results are under Section Ref 4.4		OK

#### 4.4 Detailed analysis of SESAR Solution PJ.10-W2-93a Validation Results per Validation objective

#### 4.4.1 OBJ-PJ.10-W2-93a-V3-VALP-001 Results

N/A – Objective no longer valid as per SJU feedback.

#### 4.4.2 OBJ-PJ.10-W2-93a-V3-VALP-002 Results

The technical objective OBJ-PJ.10-W2-93a-V3-VALP-002 is covered by EXE3, EXE#04 and EXE5. The objective is related to the status and the maturity of the VC Validation Platform based on the Y architecture and on the Technical Supervision service put in place to monitor ATC ADSP and Voice ADSP.

This OBJ is directed against the platform development to support the operational procedures. Even if some limitations were available in the platform, it was considered mature enough to support the operational validation and ready for use to play the identified operational scenarios. The main limitation identified in the virtual centre architecture that was found under the EXE#05 validation was the speed in transfer of data. A VPN connection via public internet was used, and delays in data transmission was observed during all runs.

The Status of both voice ADSPs and ATC ADSP were monitored via local supervision tools (EXE#03). The broker and related Network components were monitored via supervision tools that measure their performances real-time.

#### 4.4.3 OBJ-PJ.10-W2-93a-V3-VALP-003 Results

The technical objective OBJ-PJ.10-W2-93a-V3-VALP-003 is covered by three exercises (EXE#03, EXE#04 and EXE#05). The OBJ is related to VC Validation Platform services (implemented, additional or not validated yet) to test their ability to provide support in all steps of the delegation procedure.

Overall, the Y-architecture based platform was judged mature enough to provide the requested services to the operators. The used ADSP (CCS & iTEC) in EXE#03 have both shown their maturity to deliver required services to different ATSUs to support delegation steps (switch from operational to preview and then operational modes for the CWPs of the receiving ATSU).

#### 4.4.4 OBJ-PJ.10-W2-93a-V3-VALP-004 Results

The technical objective OBJ-PJ.10-W2-93a-V3-VALP-004 is covered by EXE#03 and EXE#04 and is related to Interoperability of services with a special focus on the ability of ATC ADSP to provide its support to different users (ANSPs) and of Voice ADSP to enable A/G and G/G communication.

Mostly positive feedback was collected by the exercise; the iTEC ADSP provided its services to both CWPs at DFS and at NATS. The DFS CWP was able to consume services from both different ADSPs switching instantaneously from one to the other ADSP.

Positive feedback was received from all involved actors (Pseudo-pilots, ATCOs and SVPRs) about the performance of the G/G and A/G communications.

#### 4.4.5 OBJ-PJ.10-W2-93a-V3-VALP-005 Results

The technical objective OBJ-PJ.10-W2-93a-V3-VALP-005 is covered by EXE#03 and EXE#04. This OBJ is aimed at testing the performance of the VC Validation Platform services from a technical point of view.



The responses given by the systems/services were all within the expected thresholds and the performances were judged acceptable by the ATCOs involved for the operational use for the UC# based on Y architecture.

#### 4.5 Summary of SESAR Solution PJ.10-W2-93b Technical Validation Results

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Solution Success Criterion	Solution Success	SESAR Solution Validation Results	SESAR Solution Validation Objective Status
OBJ-PJ.10-W2-93b-V3-VALP-01	Maturity Assessment	CRT-PJ.10-W2-93b-V3-VALP-01-001	a "VC maturity assessment report" is provided		N/A - No longer Valid Objective from the SJU feedback	N/A
OBJ-PJ.10-W2-93b-V3-VALP-02	Validation Platform	CRT-PJ.10-W2-93b-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the D architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture		Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services		Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP		Details of the results are under Section Ref 4.6	OK
OBJ-PJ.10-W2-93b-V3-VALP-03	Virtual Centre Services	CRT-PJ.10-W2-93b-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)		Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated		Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated		Details of the results are under Section Ref 4.6	OK

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Solution Success Criterion	Solution	Success	SESAR Solution Validation Results	SESAR Solution Validation Objective Status
OBJ-PJ.10-W2-93b-V3-VALP-04	Interoperability	CRT-PJ.10-W2-93b-V3-VALP-04-001	Services from one ADSP have been provided to CWPs from different vendors/ANSPs			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-04-002	CWPs of a vendor/ATSU have consumed the same services from ADSPs of different vendors			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-04-003	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G			Details of the results are under Section Ref 4.6	OK
OBJ-PJ.10-W2-93b-V3-VALP-05	Virtual Centre services performance	CRT-PJ.10-W2-93b-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations			Details of the results are under Section Ref 4.6	OK
		CRT-PJ.10-W2-93b-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations			Details of the results are under Section Ref 4.6	OK

## 4.6 Detailed analysis of SESAR Solution PJ.10-W2-93b Validation Results per Validation objective

### 4.6.1 OBJ-PJ.10-W2-93b-V3-VALP-001 Results

N/A - No longer Valid Objective from the SJU feedback.

#### **4.6.2 OBJ-PJ.10-W2-93b-V3-VALP-002 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-002 is covered by EXE#03 and EXE#06. The objective is related to the status and the maturity of the VC Validation Platform based on the D architecture and on the Technical Supervision service put in place to monitor ATC ADSP and Voice ADSP.

The results from the sole UC# played with the D architecture are the same as the UC# based on the Y architecture, thus all the results are applicable for the D architecture Use Cases.

#### **4.6.3 OBJ-PJ.10-W2-93b-V3-VALP-003 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-003 is covered by EXE#03, EXE#06. The OBJ is related to VC Validation Platform services (implemented, additional or not validated yet) to test their ability to provide support in all steps of the delegation procedure.

The results from the sole UC# played with the D architecture are the same as the UC# based on the Y architecture, thus all the results are applicable for the D architecture Use Cases.

#### **4.6.4 OBJ-PJ.10-W2-93b-V3-VALP-004 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-004 is covered by EXE#03, EXE#06 and is related to Interoperability of services with a special focus on the ability of ATC ADSP to provide its support to different users (ANSPs) and of Voice ADSP to enable A/G and G/G communication.

The results from the sole UC# played with the D architecture are the same as the UC# based on the Y architecture, thus all the results are applicable for the D architecture Use Cases.

#### **4.6.5 OBJ-PJ.10-W2-93b-V3-VALP-005 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-005 is covered by EXE#03, EXE#06. This OBJ is aimed at testing the performance of the VC Validation Platform services from a technical point of view.

The results from the sole UC# played with the D architecture are the same as the UC# based on the Y architecture, thus all the results are applicable for the D architecture Use Cases.

### **4.7 Summary of SESAR Solution PJ.10-W2-93c Technical Validation Results**

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Criterion	Solution	Success	SESAR Validation Results	Solution Validation Results	SESAR Solution Validation Objective Status
OBJ-PJ.10-W2-93c-V3-VALP-01	Maturity Assessment	CRT-PJ.10-W2-93c-V3-VALP-01-001	a "VC maturity assessment report" is provided			N/A - No longer Valid Objective from the SJU feedback		N/A
OBJ-PJ.10-W2-93c-V3-VALP-02	Validation Platform	CRT-PJ.10-W2-93c-V3-VALP-02-001	a Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture			Details of the results are under Section Ref 4.8		OK
		CRT-PJ.10-W2-93c-V3-VALP-02-002	a Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services			Details of the results are under Section Ref 4.8		OK
		CRT-PJ.10-W2-93c-V3-VALP-02-003	a Technical Supervision service is put in place to monitor the status of the Voice ADSP			Details of the results are under Section Ref 4.8		OK
OBJ-PJ.10-W2-93c-V3-VALP-03	Virtual Centre Services	CRT-PJ.10-W2-93c-V3-VALP-03-001	Specific inter-ADSP services have been defined to manage airspace delegation in "U" architecture			Details of the results are under Section Ref 4.8		POK
OBJ-PJ.10-W2-93c-V3-VALP-04	Interoperability	CRT-PJ.10-W2-93c-V3-VALP-04-001	Specific to U: the ADSPs have successfully shared data between them to allow for delegation			Details of the results are under Section Ref 4.8		POK
		CRT-PJ.10-W2-93c-V3-VALP-04-002	Specific to U: the ADSP has been able to increase or reduce its AoR			Details of the results are under Section Ref 4.8		OK
		CRT-PJ.10-W2-93c-V3-VALP-04-003	The Voice ADSPs (when many) are able to exchange voice communications A/G and G/G			Details of the results are under Section Ref 4.8		OK
OBJ-PJ.10-W2-93c-V3-VALP-05	Virtual Centre services performance	CRT-PJ.10-W2-93c-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold			Details of the results are under Section Ref 4.8		OK

SESAR Solution Validation Objective ID	SESAR Solution Validation Objective Title	SESAR Solution Success Criterion ID	SESAR Solution Success Criterion	Solution Success	SESAR Solution Validation Results	SESAR Solution Validation Objective Status
		CRT-PJ.10-W2-93c-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform		Details of the results are under Section Ref 4.8	OK
		CRT-PJ.10-W2-93c-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated		Details of the results are under Section Ref 4.8	OK
		CRT-PJ.10-W2-93c-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations		Details of the results are under Section Ref 4.8	OK
		CRT-PJ.10-W2-93c-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations		Details of the results are under Section Ref 4.8	OK
		CRT-PJ.10-W2-93c-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations		Details of the results are under Section Ref 4.8	POK
		CRT-PJ.10-W2-93c-V3-VALP-05-007	Specific to U: % of Coordinated flights between ADSPs against total number of flights is in a acceptable rate for the operations		Details of the results are under Section Ref 4.8	POK
		CRT-PJ.10-W2-93c-V3-VALP-05-008	Specific to U: % of manually coordinated flights between ATSU's against total number of flights is in a acceptable rate for the operations		Details of the results are under Section Ref 4.8	POK

## 4.8 Detailed analysis of SESAR Solution PJ.10-W2-93c Validation Results per Validation objective

### 4.8.1 OBJ-PJ.10-W2-93c-V3-VALP-001 Results

N/A - No longer Valid Objective from the SJU feedback.

#### **4.8.2 OBJ-PJ.10-W2-93c-V3-VALP-002 Results**

The technical objective OBJ-PJ.10-W2-93c-V3-VALP-002 is covered by EXE#03. The objective is related to the status and the maturity of the VC Validation Platform based on the U architecture and on the Technical Supervision service put in place to monitor ATC ADSP and Voice ADSP.

The results from the sole UC# played with the U architecture are the same as the UC# based on the Y and D architectures, thus all the results are applicable for the U architecture Use Cases.

#### **4.8.3 OBJ-PJ.10-W2-93c-V3-VALP-003 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-003 is covered by EXE#03. The OBJ is related to specific inter-ADSP services defined to manage airspace delegation in “U” architecture.

The objective was partially covered by the definition of ad-hoc services addressed for better management of U architecture in EXE3.

#### **4.8.4 OBJ-PJ.10-W2-93c-V3-VALP-004 Results**

The technical objective OBJ-PJ.10-W2-93c-V3-VALP-004 is covered by EXE#03 and is related to Interoperability of services. This objective is focussed on some ADSP(s) functionalities specific to U-architecture about sharing data.

Following the results obtained in EXE3 validation, the ADSPs have successfully shared data between them to allow for delegation also being able to increase or reduce their AoRs.

Positive feedback is received from all involved actors (Pseudo-pilots, ATCOs and SVPRs) also about the performance of the G/G and A/G communications.

#### **4.8.5 OBJ-PJ.10-W2-93c-V3-VALP-005 Results**

The technical objective OBJ-PJ.10-W2-93b-V3-VALP-005 is covered by EXE3. This OBJ is aimed at testing the performance of the VC Validation Platform services from a technical point of view. However, some specific performances have been added to the U architecture.

### **4.9 Confidence in Validation Results**

#### **4.9.1 Limitations of Validation Results**

The limitations of the validation results are summarised below:

- In general, although experienced in some exercises, the delegation of ATM services would not be feasible in High to very High traffic densities but was demonstrated as feasible in Low to Medium traffic densities
- The acceptance of the solution was somehow altered by the lack of controller support tools (such as Safety Nets, MTCDS) while this should not be considered as an element of the delegation procedure
- Preview functionality: The related support tools of the Preview functionality or the Preview function itself were not sufficiently developed in all the validation exercises. The outcomes for this key function for the delegation of ATM services, is limited to some exercises.
- ATSEP role: This role was not properly played as being part of the RTS. It was only played by "non trained ATSEPs" which are represented by the Technical Leaders of the validation platforms
- Procedures:
  - SUP role was played (in some exercises, i.e., EXE3) by a Planner ATCO with a SUP qualification in the OPS room, mainly due to the lack of ATCO resources. This did not have an impact on the delegation process itself, mainly due to the low workload (in link with the low/medium traffic conditions)
- ATCO Training: Although, the training of ATCO on the system, the procedures and the delegated airspace environment was the subject during several Dry run sessions, it was reported in the end by all ATCOs, that this was not sufficient to perform their job at the delegated airspace.
- Technical limitations:
  - As reported, the Preview mode was well implemented in all the ATC and Voice ADSPs, as well as in the CWPs under EXE3. However, the lack of interoperability between ADSPs (CCS and iTEC) was the cause of the low maturity of the U architecture platform.
  - In most of the VC validation platforms, some Network issues have led to interrupt, restart or postpone the runs
  - In some exercises (EXE5 or EXE6), a latency in the communication between the CWPs and the ADSPs was reported, without altering the simulations
- Performance assessment:
  - Among the six Performance Targets (KPIs) apportioned to the SESAR PJ.10-W2-93 solution, some of them are assessed by only one or two exercises (e.g., CAP1 assessed by EXE2 only; CEF3 assessed by EXE4 only).

#### 4.9.1.1 Quality of Validation Results

The quality of the validation results is considered as high based on the following aspects:

- Operational

The air traffic controllers involved in the exercise are highly experienced active controllers in the airspace under analysis from both En-Route and TMA. Quality and non-biased feedback was gathered by means of questionnaires and debriefings and issued from different ATCO communities (seven ANSPs -Skyguide-DFS-NATS-ENAV-ENAIRe-NAVIAIR-ON have contributed to the results). The SUP role was played by qualified supervisors from the OPS rooms.

- Training

Although judged not sufficient by ATCOs (lack of knowledge of some LoAs or of the delegated airspace design), all participating ATCOs and pseudo-pilots were trained on the procedures, on the CWP and on the delegated airspace environment, during the dry runs.

- Analysis

The results obtained through the questionnaires and de-briefing sessions have been thoroughly analysed by human factors experts with operational background, allowing the extraction of relevant conclusions and recommendations.

- Technical

The validation platforms, although sometimes complex such as distributed VC platforms, were well prepared and showed a certain stability during the final runs. And this is particularly true for the VC platforms based on the Y or D architectures while for the specific U architecture, the technical platform was not mature enough for the delegation of ATM services.

The VCS from FREQUENTIS and INDRA were highly mature and have largely contributed to the validation of the delegation of ATM services on a VC platform with multiple ADSPs and ATSUs

- Simulation

The realism of the simulation was judged as very high from the air traffic controllers' point of view, in terms of traffic load, environment, flight plans, traffic complexity, etc. The higher the realism of the simulation, the higher the fidelity and representativeness of the results is.

The participants were skilled and experienced, and very interested in participating to the validations. The high-level of motivation/involvement during the RTS directly contributed to the quality of the validation results

#### 4.9.1.2 Significance of Validation Results

The level of significance of the validation results is summarised below:

- Procedures:
  - The procedures for the execution of each run, were very well documented for all actors involved by the simulations (ATCO, SUP, ATSEPs) and this was key to synchronise the tasks performed locally at the involved ADSP or ATSU locations
  - Sometime the procedures are complemented by additional "Check Lists", which were judged very useful to follow the status and configuration of the technical platform
  - The actors of the delegation procedures described in the PJ10.W2 Sol 93 ATM Solution OSED V3(ATCO, SUP, ATSEPs), were all played, and the participating pseudo-pilots were trained to the SESAR Voice and ATM simulation CWPs
- The validations were performed for all the exercises by the mean of Real Time Simulation with recorded "Real traffic data". Highly experienced ATCOs from different ANSPs (Skyguide, DFS, NATS, ENAV, ENAIRE, NAVIAIR and ON) with some of them being Operational SUP in the OPS rooms, have participated to the simulations
- Technical:
  - Use of Complex Virtual Centre Validation Platforms involving several ATC or voice ADSPs and several ATSUs
  - The ATCOs (in most of the EXE) were familiar with the HMI of the CWPs, as it is close to what they use in the OPS rooms
  - The tuning and testing conducted prior to the RTS (e.g., EXE3, EXE4 and EXE5) and the multiple Dry runs performed with ATCOs have considerably contributed to the stability of the technical platform(s)



## 5 Conclusions and recommendations

### 5.1 Conclusions

#### 5.1.1 Conclusions on SESAR Solution maturity

The solution PJ10W2.93 was focused on the delegation of ATM service provision between ATSUs and its operational concept PJ10.W2 Sol 93 ATM Solution OSED V3 suggested to validate the concept in difference traffic and airspace environments, through operational use cases detailed under §5.1.2.

Among the 21 Objectives allocated to this solution and besides the foreseen reserves from ATCOs and SUPs regarding the HP and Safety performances which cannot be compared to the level of the OPS rooms, the grand majority of the Objectives were successful, see summary Table under §4.1.

Furthermore, the efforts in the technical and human resources were huge and the used validations platforms were all different and based on different technologies while they all reached almost the same results in the end.

Concerning the Operational/Safety requirements detailed in the PJ10.W2 Sol 93 ATM Solution OSED V3 or the Technical requirements detailed in the TS/IRS, a big majority of them were implemented in one or another validation exercise. The whole solution is demonstrated to be mature at V3 as a traceability could be established from the Operational or Technical requirements to the implemented functions and services at different levels (CWPs, ATC and voice ADSP).

Finally, the acceptance from the involved ATCO communities of the delegation procedures, is another argument of the maturity of the solution PJ10W2.93.

Concerning the technological solution PJ10.93a, all the services to be improved from TRL4 to TRL6 were all updated and validated and the new services (mainly in link with the delegation process) were also implemented and validated at TRL6. And based on its objectives which were all reached, the technical solution PJ10W2.93a (Y architecture) has demonstrated its maturity at TRL6.

Also based on their objectives, the two other solutions PJ10W2.93 b (D architecture) and PJ10W2.93c (U architecture) have proven their maturity at TRL4.

#### 5.1.2 Conclusions on concept clarification

##### Delegation Procedure

The procedure of delegation of ATM services has been proven to be acceptable, from the feedback received by the overall participating ATCOs, belonging to different ANSPs. The delegation procedure is deemed clearly defined and documented for all actors involved in the delegation (ATCOs, SUPs and ATSEPs) and correctly followed during the simulation runs.

The validations exercises covered all the operational delegation uses cases in normal or abnormal conditions and the delegation with Static (usage of a spare CWP at the receiving ATSU) vs Dynamic AoR (the receiving CWP is initially controlling a Sector of the receiving ATSU).

The ATSEP role was played during the validations although by non "trained ATSEPs" as in the real life.

Concerning the handover dialog (during the Preview Mode), the concept recommends having it done between the Planner ATCOs while it was shown that this was also possible between Executive ATCOs in low traffic conditions.

The configuration of the Rx mode during the Preview Mode was not mandatory in certain conditions, e.g., the receiving CWP is Idle or the receiving is a Planner ATCO

### Operational Feasibility

The concept has been demonstrated as operationally feasible in almost all use cases described in the OSED:

- Night use case
- Fixed time use case
- Contingency use case
- Civil-Military use case
- Cross-border use case

For the On-demand (with ATFCM), the operational feasibility results are not as positive as in the above use cases.

In addition, potential limitations regarding the concept applicability have been identified, resulting the following environment conditions as potential barriers:

- High and very high complexity scenarios, impacted by both the air traffic complexity and the structural airspace complexity.
- Low airspace sectors, with terminal areas and or airport interfaces.
- Non-nominal conditions in high traffic demand and high complexity scenarios.
- High or very High traffic conditions in combination with Dynamic AoR delegation use cases
- The training of ATCO on the systems and on the airspace environment (e.g., LoAs), although addressed during the dry runs and during the first days of the final runs, is further required to improve the operational feasibility & acceptance of the concept

### Operational Acceptance

Operational acceptance of the concept has been assessed from different points of view: workload, situation awareness, level of trust in the system, and system support.

Like the results obtained in term of operational feasibility, the concept has been validated as operationally acceptable in all use cases, except for the On-Demand use case. However, some potential limitations in term of operational acceptance have been identified:

- Additional information accessible directly on the CWP, e.g., for the delegated area. would increase the Situation Awareness
- The Situation Awareness was more impacted in the use cases with Dynamic AoR due to the "sudden" increase of the controlled airspace while keeping control of the current one. Additional controller support tools might be helpful in such situation, e.g., Scanning Tools or MTCDs

- Additional functionalities may be added for the "Preview" function such as: pointing/highlighting traffic from delegating to receiving CWPs,

### General conclusions

- In term of application of the delegation procedures, we noticed the central roles played by the ATCOs and the SUPs. However, the validation of the ATSEP role, although well described in the procedures, was limited due to the lack of "really licensed ATSEPs" in our simulations.
- Training of ATCO on the newly controlled area is key to improve operational acceptance of the delegation procedures.
- Safety and Situation Awareness could be improved by additional controller support tools such as Safety Nets, MTCO or Smart traffic views during the Preview mode.
- In contingency situations, an ATSU can more easily support the "failing" ATSU when a spare CWP and a dedicated ATCO team are used, i.e., using the so-called "Static delegation" rather than a delegation with an AoR extension
- The standardization of services between the supporting ADSPs and the ATSUs is a key enabler for the delegation of ATS between ATSUs belonging to different ANSPs
- Potential barriers – With regards to the potential barriers that can prevent the concept for being partially or fully deployed, these have been preliminary identified. In particular, the main reasons that can be considered as an impediment are the regulatory aspects, the societal aspects and the technology aspects.

### 5.1.3 Conclusions on technical feasibility

- **VC architectures Y/U/D & Maturity**
  - The use cases based on the Y or D architectures have provided a much better operational acceptance than the uses cases with the U architecture. And this is mainly due to the lack of maturity of the U architecture platform: the low level of interoperability put in place under EXE3 between two different ADSPs CCS and iTEC, did not bring the expected level of Safety and Situation Awareness at the CWP of the receiving ATSU (e.g., flights that need to be correlated manually, OLDI messages which were not forwarded from the delegating to the receiving ADSP). Those issues were not found under the Y or D architectures, as they are based mainly on a central source of data that allowed a full synchronisation between the delegating and receiving ATSUs.
  - Although some new services were developed and validated at TRL6, some other existing since PJ16.03 were improved from TRL4 to TRL6 (mainly under the Y architecture)
  - The U architecture requires further development to improve interoperability between the ADSPs and might be between ATSUs as well.
- **Preview mode**

- The preview mode is the main "technical enabler" of the overall delegation of ATS between ATSU. While it was not properly implemented in some exercises, it was successfully implemented in some others, and this was done both at the CWPs and ADSPs levels.
- In details, this function could be improved at the CWP level, but this cannot come without a close cooperation between the delegating and receiving CWPs. Mainly in the case they are connected to a same ADSP (Y).

- **Supervision & Monitoring**

Monitoring tools were developed for each involved Voice/ATC ADSPs or involved ATSU. If the supervision and monitoring of the systems is mainly performed by the various ATSEPs, this was done in close collaboration with the local SUPs and the decisions taken during the delegation process (e.g., switch of CWP modes) are performed together.

- **ATSEP roles**

The ATSEP role was validated but with "non experienced ATSEPs". The ATSEPs in our simulations were in charge of the configuration & stability of the validation platform and provided all the Technical support to ATCOs, Pseudo-Pilots and SUPs during the delegation process.

#### 5.1.4 Conclusions on performance assessments

The V3 validation exercises have proved that the delegation of ATM services concept with respect to the different experienced scenarios and traffic condition is mature. In general, the quality of the achieved results is expected to be high. The results base on questionnaires made with a proven method and include standardized questions and scales. Debriefings complemented the assessment through questionnaires, enabling the participants to state their opinions and thoughts freely.

**Safety** was addressed and confirmed to be maintained during validation of both nominal and abnormal situations. It was not negatively impacted according to the validation results. Due to the amount of traffic experienced, controllers were able to easily perform their task and safely manage the traffic. No safety related events or under-separations occurred.

**Human Performance** received mostly positive feedback from controllers in all exercises. The delegation process did not negatively affect controllers during operations in both nominal and contingency conditions. Overall, both situational awareness and workload level in tested scenarios was considered tolerable or acceptable. No specific risk of increase of human error with relation to the delegation process was observed or reported with during the exercises. Operating methods and procedures were found acceptable, in both nominal and abnormal cases.

A performance assessment was done for a set of KPIs and summarised in below Table. The **ATCO Productivity KPI (CEF2)** was particularly increased (>25%) by the delegation process while the **Airspace Capacity KPIs (CAP1 for TMA and CAP2 for en-route)** are also increased with more than 10%. The **Fuel Efficiency KPI (FEEF1)** observes a reduction (>10%). And based on the assessment of the sole EXE4, the **Technology Costs (CEF3)** have been assessed and compared between a "Do Nothing" scenario (the today legacy infrastructure) and the VC infrastructure at ENAV, the conclusion was a cost reduction of about 5% is foreseen at the end of transition period (by 2043).

		EXE2	EXE3	EXE4	EXE5	EXE6
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CAP1	TMA Capacity	+12%	-	-	-	-
CAP2	En-Route Capacity	+20%	-	+4%	+8%	-
CEF2	ATCO Productivity	+24.7%	+40%	-	+6%	-
CEF3	Technology Costs	-	-	-5%	-	-
FEEF1	Fuel Efficiency	-9.6%	-	-20%	-	-
PRD2	Predictability	+6.5%	-	+0.5%	-	-

**Resilience** aspects demonstrated that the loss of airspace capacity generated by the contingency situation is reduced. Also, the time to recover from non-nominal to nominal situations is significantly reduced with the delegation procedure. In case of contingency, thanks to the delegation, it is possible to reduce the number of cancellation or the possibility of delays occurrence.

Also, for each of the KPI, proper assessments have been performed and recorded in specific PJ10.W2 Sol 93 ATM Solution OSED V3 Annex:

- a Safety Assessment has been performed and described in the PJ10.W2 Sol 93 ATM Solution OSED V3 Part II SAR;
- a Human Performance Assessment has been performed and described in the PJ10.W2 Sol 93 ATM Solution OSED V3 Part IV HPAR;
- a Performance Assessment covering Capacity, Fuel Efficiency, Cost Efficiency, Predictability, Resilience has been performed and described in the PJ10.W2 Sol 93 ATM Solution OSED V3 Part V PAR. Also, aspect related to cost efficiency can be found in the V3 CBA.

## 5.2 Recommendations

### 5.2.1 Recommendations for next phase

- **Delegation Procedure & Concept**

Due to limited ATCO resources, in some exercises, the SUP role was played by a Planner ATCO. It is recommended to perform a validation of the concept with specific SUP roles, at different ATSUs while providing them with the necessary support tools (Supervision, Monitoring, VCS, ..).

About the delegation environment, It is recommended that the environment of the delegating ATSU has the same level of complexity or, if possible, lower compared to the receiving ATSU (i.e., compatible sub-OEs).

When the delegation takes place at the receiving ATSU, although addressed in the PJ10.W2 Sol 93 ATM Solution OSED V3, a concept of "Unit Call" for the specific delegated flights, is missing. We recommend this "Unit Call" concept to be further developed under a SESAR3 project or Solution.

- **Preview Mode**

Develop further support tools for ATCOs and SUPs to improve Situation Awareness during the Preview Mode. As examples: pointing traffic from the delegating to the receiving during the exchange of traffic situation (i.e., during the preview mode).

Develop additional supervision/monitoring tools to improve situation awareness of the SUPs and ATSEPs at the delegating and receiving ATSUs.

For the specific U architecture: improve in general the interoperability between the ADSPs, in order to improve situation awareness about delegated traffic (e.g., full correlation of FPLs and all clearance data input at the delegating shall be available at the receiving, etc)

- **VC architectures & maturity**

We have used VC architectures to validate the delegation concept between ATSUs. In addition, all the services used belong to standards previously developed in SESAR Wave 1 (PJ16.03). These development from previous research activities allowed us to successfully validate the delegation concept in use cases based on the U or D architectures. The U architecture, due to the lack of interoperability between the ADSPs, was not enough mature and failed to validate the delegation concept. The first recommendation, if this U architecture is deemed useful in future implementations of European Virtual Centres, is to spend bigger efforts to develop standards / protocols for the interoperability between European ADSPs and we know this will be difficult to achieve without the involvement of suppliers within the European ATM Market.

Despite the improved maturity of some services from TRL4 to TRL6, there are a lot of others which are kept at TRL4. Future efforts should be concentrated on developing new services ADSP-ATSU and ADSP-ADSP, while increasing the maturity of the current VC services.

## 5.2.2 Recommendations for updating ATM Master Plan Level 2

There is no recommendation regarding the update of the ATM Master Plan Level 2.

## 5.2.3 Recommendations on regulation and standardisation initiatives

- **Regulation**

The National Supervisory Authorities (NSAs) of both the delegating and receiving ATSUs must work closely for following development (and the list is not exhaustive):

- Review of ATCO and ATSEP licensing schemes by providing them with new Certification means
- Review of eventual SLAs- Service Level Agreements put in place between the involved ATSUs
- Supervision of the implemented changes at each ATSU for the need for example of Cross-border delegation and this shall include those related to IOP- Interoperability

- **Standardisation**

The solution PJ10.93 is a follow up of the SESAR Wave 1 PJ16.03 which has brought a first list of services between ADSPs and ATSU. The maturity of the services varies from TRL4 to TRL6 and our solution has increased the maturity of some services from TRL4 to TRL6 while new services (mainly those supporting the delegation process) have been created and validated at TRL6.

Furthermore, none of the listed services was standardized yet. As the European standardization body in ATM domain is EUROCAE, our recommendation to EUROCAE is to rapidly start the work of standardization of the VC services, especially those subject to validation under Solution 93. In a first step, one can focus on the most mature services, e.g., at TRL6. This recommendation is already a reality as we are aware that EUROCAE has already started the standardisation task in parallel with the SESAR research & development projects.

## 6 References

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### 6.1 Applicable Documents

#### Content Integration

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- [1] SESAR ATM Lexicon

#### Content Development

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- [2] PJ.19 CI D2.5 SESAR Concept of Operations (CONOPS 2019), May 2019

#### System and Service Development

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- [3] B.04.03 D102 SESAR Working Method on Services

- [4] B.04.05 Common Service Foundation Method

#### Performance Management

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- [5] PJ.19.04 D4.7 Performance Framework 2019, November 2019

- [6] PJ.19-W2 D4.0.1 Validation Targets – SESAR 2020 Wave 2 & Wave 3, May 2021

#### System Engineering

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- [7] PJ.22 Updated V&VP, V&VI and Demonstration Platform Development Methodology (final release), June 2019

- [8] Requirements and Validation Guidelines. Edition 00.02.02, May 2021

#### Safety

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- [9] PJ.19 CI D4.0.060 SESAR Safety Reference Material, Edition 00.04.01, December 2018

- [10] PJ.19 CI D4.0.050 Guidance to Apply SESAR Safety Reference Material, Edition 00.03.01, December 2018

#### Human Performance

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- [11] PJ.19 CI D4.0.070 SESAR Human Performance Assessment Process V1 to V3 – including VLD, Edition 00.03.01, January 2020

#### Security

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- [12] Security Risk Assessment Methodology for SESAR 2020 (SecRAM 2.0), September 2017

### 6.2 Reference Documents

- [13] SESAR Solution PJ\_10-W2- Solution 93 SPR-INTEROP\_OSED - Part I (latest version)



- [14] ED-78A Guidelines for approval of the provision and use of Air Traffic Services supported by data communications.<sup>2</sup>
- [15] D3.2.150 - PJ.10-W2-93-V3 Final VALR
- [16] SESAR2020 PJ.10-W2-93 V3 SPR-INTEROP/OSED Part II – Safety Assessment Report
- [17] SESAR2020 D3.2.150 - PJ.10-W2-93-V3 Final VALR Part III – Security Assessment Plan
- [18] SESAR2020 PJ.10-W2-93 V3 SPR-INTEROP/OSED Part IV – Human Performance Assessment Report
- [19] SESAR2020 PJ.10-W2-93 V3 SPR-INTEROP/OSED Part V – Performance Assessment Report
- [20] PJ.10-W2-93 Initial VALR for V3
- [21] EUROCONTROL Common Format Letter of Agreement Between Air Traffic Services Units
- [22] Annex 11 ICAO Air Traffic Services Air Traffic Control Service - Flight Information Service
- [23] SESAR Solution PJ.15-09 SPR-INTEROP/OSED for V1
- [24] PJ19-W2 CI D4.1 PJ19-W2: Validation Targets – Wave 2, Edition 00.01.00, June 2020
- [25] PJ.10-W2-93-V2 Final VALR

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<sup>2</sup> The EUROCAE ED-78A has been used as an initial guidance material. ED-78A is useful, but is not an applicable document, because it mostly addresses the V4-V5 phases, whilst the SESAR R&D programme is focussed on development (V1-V2-V3, and because of its partial compliance with safety regulatory requirements).

## Appendix A Validation Exercise #02 Report

### A.1 Summary of the Validation Exercise #02 Plan

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I.

#### A.1.1 Validation Exercise description, scope

The primary objective of EXE-PJ.10-W2-93-V3-VALP-002 is to validate the operational thread of the delegation of ATM services provision among ATSUs in nominal conditions. This validation activity aims at demonstrating the operational feasibility, operational acceptance, and performance benefits of the PJ.10-W2-93 concept for the following use cases:

- Delegation of ATM services provision at night
- Delegation of ATM services provision at fixed time
- Delegation of ATM services provision on-demand

To achieve the abovementioned objective, a set of validation scenarios have been selected covering the Spanish airspace of the following ACCs and TACCs:

- LECM (Madrid ACC)
- LECS (Sevilla ACC)
- LECB (Barcelona ACC)
- LECP (Palma TACC)

The scenarios will cover potential delegations of the air traffic services between Madrid ACC and Sevilla ACC, and between Barcelona ACC and Palma TACC.

The exercise was conducted in Q1 2022 by means of a Human-In-The-Loop (HITL) Real Time Simulation, involving ten air traffic controllers from the four ATSUs corresponding to the validation scenarios selected (LECM-LECS and LECB-LECP).

This validation activity will contribute to the maturity of the concept by:

- Assessing the concept acceptability and feasibility for different traffic complexity and traffic density environments, with more than ten air traffic controllers involved in the process.
- Contributing to the performance assessment and validation of the concept benefit and impact mechanisms.
- Increasing the number of use cases subject to validation, compared to the exercise conducted at V2 (focused only on the night and contingency use case).

#### A.1.2 Summary of Validation Exercise #02 Validation Objectives and success criteria

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I.

#### A.1.3 Summary of Validation Exercise #02 Validation scenarios

For the selection of the scenarios, historical data from 2018 and 2019 for the Spanish airspace have been analysed, aiming at identifying the most interesting time periods and airspace for the validation of the delegation of ATM services provision use cases covered by the exercise.

As a result, a set of potential scenarios were defined and then validated by operational staff from ENAIRE. The selected scenarios are:

- Delegation between Madrid ACC (LECM) and Sevilla ACC (LECS), covering En-Route airspace.
- Delegation between Barcelona ACC (LECB) and Palma TACC (LECP), covering En-Route and Terminal Airspace, respectively.

Figure 111111 shows Madrid ACC (in particular, LECMCTAS) and Sevilla ACC (LECS) airspace; and Figure 222222 shows Barcelona ACC (in particular, LECBCTAE) and Palma TACC (LECP).

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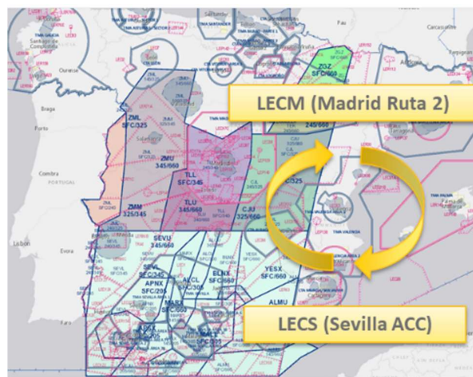


Figure 111111. EXE-PJ.10-W2-93-V3-VALP-002. Scenarios Madrid ACC (LECMCTAS) and Sevilla ACC (LECS)

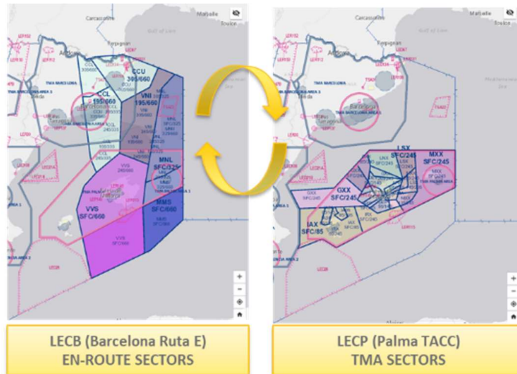


Figure 222222. EXE-PJ.10-W2-93-V3-VALP-002. Scenarios LECB (LECBCTAE) and LECP (Palma TACC)

**Reference Scenario(s)**

The Reference Scenario is as per current operating method in the Spanish airspace, that is, with no possibility to consider the delegation of ATM services provision.

The main characteristics of the Reference Scenario to be considered for each one of the use cases addressed by the validation activity is described below:

- Delegation of ATM services provision at Night
  - No delegation
  - Consolidation of sectors at night within the same ATSU
  - No cross-border sectorisation
- Delegation of ATM services provision at Fixed Time
  - No delegation
  - No cross-border sectorisation
- Delegation of ATM services provision on-demand
  - No delegation
  - No cross-border sectorisation
  - ATFCM measures: ATFM regulations, ATFM scenarios, capacity measures, tactical STAM

The traffic sample corresponds to traffic from 2019 (pre-SARs-CoV-2).

### Solution Scenario(s)

The Solution Scenario is as described in PJ.10-W2-93 V3 OSED, that is, with the possibility to consider the delegation of ATM services provision.

The main characteristics of the Solution Scenario to be considered for each one of the use cases addressed by the validation activity is described below:

- Delegation of ATM services provision at Night
  - Delegation between ATSUs of the same ANSP
  - Consolidation of sectors at night within the same ATSU
  - No cross-border sectorisation
- Delegation of ATM services provision at Fixed Time
  - Delegation between ATSUs of the same ANSP
  - No cross-border sectorisation
- Delegation of ATM services provision on-demand
  - Delegation between ATSUs of the same ANSP
  - Cross-border sectorisation available when delegating and receiving ATSUs are adjacent.
  - ATFCM measures: ATFM regulations, ATFM scenarios, capacity measures, tactical STAM

The traffic sample corresponds to traffic from 2019 (pre-SARs-CoV-2).

It should be noted that, for the “Delegation of ATM services provision on-demand” use case, the scenarios were divided into “cross-border” and “ATFM”. The former makes reference to scenarios with high traffic demand but without ATFM issues where the delegation carried out for the integration of cross-border sectors. The latter refers to the delegation of ATM services provision in situations where there are ATFM issues in the delegating ATSUs with no possibility to further split the sectors with the identified hotspot because of a lack of resources. In this case, and in order to avoid the implementation

of ATFM regulations, one or more sectors are delegated to the receiving ATSU to increase the number of available air traffic controllers in the delegating ATSU.

#### A.1.4 Summary of Validation Exercise #02 Validation Assumptions

Identifier	Title	Description	Justification	Impact on Assessment
EX2-ASS-PJ10-W2-93-V3-VALP-001	Virtual Centre environment	The exercise will be carried out using ENAIRE's legacy system, that will be used to emulate the virtual centre concept ("Y" architecture).	Since the exercise is focused on the validation of the operational thread of PJ.10-W2-93 (SDM-0217), no technical developments will be tested. The current ENAIRE's legacy system allows the delegation of the provision of air traffic services with minor changes in the environment data.	Low
EX2-ASS-PJ10-W2-93-V3-VALP-002	On-demand scenarios (NMf)	The process carried out for the on-demand scenarios by the NMf will be performed as part of the exercise preparatory activities.	NM and INAP roles are out of the scope of PJ.10-W2-93. The coordination procedure for the on-demand scenarios is being developed within PJ.32-W3.	Low

Table [15151515151545](#): EXE-PJ.10-W2-93-V3-VALP-002 Validation Assumptions overview

#### A.2 Deviation from the planned activities

Some changes were applied to the planned scenarios, being the final selection the ones that are reported below.

	ATSU 1 (LECM/LECP)					ATSU 2 (LECS/LECB)				
	Before	After	Before	After		Before	After	Before	After	
	ATCO1		ATCO2		ATCO3	ATCO4		ATCO5		ATCO6
NIGHT1_MADSEV SOLUTION	LECMR1J	LECMR1J	LECMR2J	Idle	-	LECSAPT	LECSALL	LECSRTA	LECMR2I	-
FIX1_MADSEV SOLUTION	LECMRTL	LECMTLI	LECMTLU	LECSMA4	Feeder	LECSSEV	LECSSEV	LECSMA4	Idle	Feeder
ATFM1_MADSEV SOLUTION	LECMTLI	LECMTLI	LECMCJI	LECMCJI	Feeder	LECSSEV	LECMTLU	LECSMA4	LECSSM2	Feeder
CROSS2_MADSEV SOLUTION	LECMCIU	MCIU+LECSN	LECMCJL	LECMCJL	Feeder	LECSNO1	LECSSUR	LECSMA4	LECSMA4	Feeder
ATFM1_MADSEV REFERENCE	LECMTLI	-	LECMCJI	-	Feeder	LECSSEV	-	LECSMA4	-	Feeder
CROSS2_MADSEV SOLUTION	LECMCIU	-	LECMCJL	-	Feeder	LECSNO1	-	LECSMA4	-	Feeder
ATFM3_MADSEV SOLUTION	LECMTLI	LECMTLU	LECMCIU	LECMCIU	Feeder	LECSMA4	LECMTLI	LECSSEV	LECSSM2	Feeder
FIX2_MADSEV SOLUTION	LECMCJL	LECSNO1	LECMCIU	LECMCJI	Feeder	LECSNO1	Idle	LECSMA4	LECSMA4	Feeder
ATFM3_MADSEV REFERENCE	LECMTLI	-	LECMCIU	-	Feeder	LECSMA4	-	LECSSEV	-	Feeder
NIGHT3_BCNPAL SOLUTION	LECPAPR	Idle	LECPRIUT	Idle	-	LECBCVN	LECBKKE	LECBMVS	LECPALP	Feeder
FIX5_BCNPAL SOLUTION	LECPMXX	Idle	LECPF2X	LECPF2X	Feeder	LECBBAS	LECPMXX	LECBMNI	BMNI+LECB	Feeder
CROSS1_BCNPAL SOLUTION	LECPMXX	Idle	LECPF2X	LECPF2X	Feeder	LECBBAS	LECBBAS	LECBMNI	BMNI+LECPN	Feeder
ATFM5_BCNPAL SOLUTION	LECPMXX	LECPGOM	LECPGOX	LECBMNU	Feeder	LECBMMI	LECBMLS	LECBVVS	LECBVVS	Feeder
CROSS1_BCNPAL REFERENCE	LECPMXX	-	LECPF2X	-	Feeder	LECBMNI	-	LECBBAS	-	Feeder
ATFM5_BCNPAL REFERENCE	LECPMXX	-	LECPGOX	-	Feeder	LECBMMI	-	LECBVVS	-	Feeder
CROSS3_BCNPAL SOLUTION	LECPMXX	Idle	LECPF2X	LECPF2X	Feeder	LECBMVS	BMVS+LECPN	LECBVNI	LECBVNI	Feeder
FIX6_BCNPAL SOLUTION	LECPMXX	Idle	LECPF2X	LECPF2X	Feeder	LECBVNI	LECBCVN	LECBCC	LECPMXX	Feeder
CROSS3_BCNPAL REFERENCE	LECPMXX	-	LECPF2X	-	Feeder	LECBMVS	-	LECBVNI	-	Feeder
ATFM7_BCNPAL SOLUTION	LECPGOX	LECPIAW	LECPIXX	LECPIRW	Feeder	LECBLGU	LECBLLI	LECBGL	LECPGOX	Feeder
FIX7_BCNPAL SOLUTION	LECPMXX	Idle	LECPF2X	LECPF2X	Feeder	LECBMMI	LECBMVS	LECBVVS	LECPMXX	Feeder
ATFM7_BCNPAL REFERENCE	LECPGOX	-	LECPIXX	-	Feeder	LECBLGU	-	LECBGL	-	Feeder

Figure 333333. EXE-PJ.10-W2-93-V3-VALP-002 executed scenarios

### A.3 Validation Exercise #02 Results

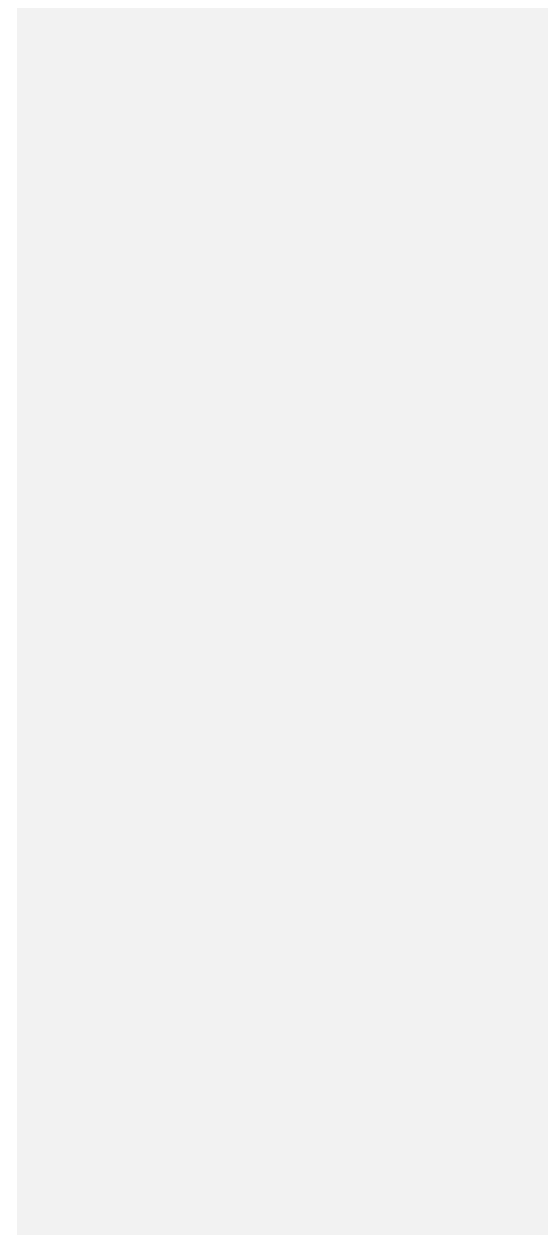
#### A.3.1 Summary of Validation Exercise #02 Results

The following table shows the summary of results compared to the success criteria identified within the Validation Plan per exercise validation objective as well as the global validation objective status (OK, partially OK or NOK) according to the following criterion:

- **OK:** Validation objective achieves the expectations (exercise results achieve success criteria);
- **NOK:** Validation objective does not achieve the expectations (exercise results do not achieve success criteria);
- **POK (Partially OK):** Validation objective achieves the expectations to a certain extent.

Validation Exercise #01 Validation Objective ID	Validation Exercise #01 Validation Objective Title	Validation Exercise #01 Success Criterion ID	Validation Exercise #01 Success Criterion	Sub-operating environment	Exercise #01 Validation Results	Validation Exercise #01 Validation Objective Status
EX2-OBJ-PJ.10-W2-93-V3-VALP-001	<p><b>Delegation conditions feasibility</b></p> <p>To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions</p>	EX2-CRT-PJ.10-W2-93-V3-VALP-001	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.	ER Medium Complexity TMA Very High Complexity	<p>Negative feedback has been received for high demand and high complexity scenarios for the on-demand use case.</p> <p>Limitations identified.</p>	POK
		EX2-CRT-PJ.10-W2-93-V3-VALP-002	Positive feedback concerning the operational feasibility of			

			<p>the delegation of ATM services provision in environments from low to very high complexity is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.</p>			
		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-003</p>	<p>Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the contingency use case according to</p>			





			ATCO's expert judgment.		
		EX2-CRT-PJ.10-W2-93-V3-VALP-004	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the contingency use case according to ATCO's expert judgment.		
		EX2-CRT-PJ.10-W2-93-V3-VALP-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented		



			for the different use cases in nominal conditions.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-006	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the contingency use case.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-002	<b>Operational feasibility of the delegation procedure (Night use case)</b>  To demonstrate the operational	EX2-CRT-PJ.10-W2-93-V3-VALP-007	The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined, and documented.	ER Medium Complexity TMA Very High Complexity	No negative feedback has been gathered for the night use case.	<b>OK</b>

feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night" use case	EX2-CRT-PJ.10-W2-93-V3-VALP-008	The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
	EX2-CRT-PJ.10-W2-93-V3-VALP-009	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.



		EX2-CRT-PJ.10-W2-93-V3-VALP-010	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-003	<b>Operational feasibility of the delegation procedure (Fixed time use case)</b>  To demonstrate the operational feasibility of the ATM services provision delegation procedure for	EX2-CRT-PJ.10-W2-93-V3-VALP-011	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium Complexity  TMA Very High Complexity	No negative feedback has been received for the fixed time use case	<b>OK</b>
		EX2-CRT-PJ.10-W2-93-V3-VALP-012	The delegation procedure for the Fixed Time Use Case, including the			

the “Delegation of ATM services provision at fixed time” use case		handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
	EX2-CRT-PJ.10-W2-93-V3-VALP-013	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.
	EX2-CRT-PJ.10-W2-93-V3-VALP-014	Impact remains acceptable according to ATCO expert



			judgment with regards to the quality of the ATM services provision for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-004	<b>Operational feasibility of the delegation procedure (On-Demand use case)</b>  To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-	EX2-CRT-PJ.10-W2-93-V3-VALP-015	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium Complexity	Negative feedback has been gathered for high demand/complexity scenarios. In particular, the on-demand cross-border can be considered as POK, and the on-demand ATFM as NOK:.	POK
		EX2-CRT-PJ.10-W2-93-V3-VALP-016	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as	TMA Very High Complexity		



Demand" use case		operationally feasible by the different actors involved in the delegation process.			
	EX2-CRT-PJ.10-W2-93-V3-VALP-017	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.			
	EX2-CRT-PJ.10-W2-93-V3-VALP-018	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the			



			ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-005	<p><b>Operational acceptance of the delegation procedure (Night use case)</b></p> <p>To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision at Night” use case</p>	EX2-CRT-PJ.10-W2-93-V3-VALP-019	The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Night Use Case.	<p>ER Medium Complexity</p> <p>TMA Very High Complexity</p>	No negative feedback has been received for the night use case.	OK
		EX2-CRT-PJ.10-W2-93-V3-VALP-020	The level of ATCO situation awareness remains within acceptable levels according to ATCO’s expert			



			judgment during the delegation procedure for the Night Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-021	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-022	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.			



		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-023</p>	<p>The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.</p>			
		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-024</p>	<p>The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.</p>			

		EX2-CRT-PJ.10-W2-93-V3-VALP-025	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-026	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-006	<p><b>Operational acceptance of the delegation procedure (Fixed Time use case)</b></p> <p>To demonstrate the operational acceptance of</p>	EX2-CRT-PJ.10-W2-93-V3-VALP-027	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for	<p>ER Medium Complexity</p> <p>TMA Very High Complexity</p>	No negative feedback has been received for the fix time use case.	<b>OK</b>

the delegation procedure for the “Delegation of ATM services provision at Fixed Time” use case		the Fixed Time Use Case.
	EX2-CRT-PJ.10-W2-93-V3-VALP-028	The level of ATCO situation awareness remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Fixed Time Use Case.
	EX2-CRT-PJ.10-W2-93-V3-VALP-029	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.

	EX2-CRT-PJ.10-W2-93-V3-VALP-030	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.		
	EX2-CRT-PJ.10-W2-93-V3-VALP-031	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.		
	EX2-CRT-PJ.10-W2-93-V3-VALP-032	The level of SUP situation awareness remains within acceptable levels according to		





			ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.		
		EX2-CRT-PJ.10-W2-93-V3-VALP-033	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.		
		EX2-CRT-PJ.10-W2-93-V3-VALP-034	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.		

EX2-OBJ-PJ.10-W2-93-V3-VALP-007	<p><b>Operational acceptance of the delegation procedure (On-Demand use case)</b></p> <p>To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision On-Demand” use case</p>	EX2-CRT-PJ.10-W2-93-V3-VALP-035	The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the On-Demand Use Case.	<p>ER Medium Complexity</p> <p>TMA Very High Complexity</p>	<p>Negative feedback has been gathered for high demand/complexity scenarios. In particular, the on-demand cross-border can be considered as POK, and the on-demand ATFM as NOK.</p>	<p><b>POK</b></p>
		EX2-CRT-PJ.10-W2-93-V3-VALP-036	The level of ATCO situation awareness remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the On-Demand Use Case.			



		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-037</p>	<p>The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.</p>			
		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-038</p>	<p>The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.</p>			
		<p>EX2-CRT-PJ.10-W2-93-V3-VALP-039</p>	<p>The level of SUP workload remains within acceptable levels according to ATCO's expert</p>			



			judgment during the delegation procedure for the On-Demand Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-040	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-041	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for			

			the On-Demand Use Case.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-042	The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-008	<b>Human Performance assessment in nominal conditions</b>  To assess the impact in terms of Human Performance of the ATM services provision delegation concept in	EX2-CRT-PJ.10-W2-93-V3-VALP-043	Impact remains acceptable according to ATCO expert judgment in terms of workload are before, during and after the delegation procedure of ATM services provision in nominal conditions.	ER Medium Complexity  TMA Very High Complexity	OK for night time and fixed time use case. Negative feedback in terms of workload and situational awareness has been received for the on-demand use case.	<b>POK</b>



nominal conditions	EX2-CRT-PJ.10-W2-93-V3-VALP-044	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.			
	EX2-CRT-PJ.10-W2-93-V3-VALP-045	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in			

			nominal conditions.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-046	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-047	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation			



			procedure of ATM services provision the delegation procedure in nominal conditions.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-048	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-009	<p><b>Safety assessment in nominal conditions</b></p> <p>To assess the impact in terms of Safety of the ATM services provision delegation</p>	EX2-CRT-PJ.10-W2-93-V3-VALP-049	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of	<p>ER Medium Complexity</p> <p>TMA Very High Complexity</p>	Negative feedback has been gathered for the on-demand use case.	<b>POK</b>



	concept in nominal conditions		ATM services provision in nominal conditions.			
		EX2-CRT-PJ.10-W2-93-V3-VALP-050	Impact remains acceptable according to ATCO expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-010	<b>Performance Assessment: Airspace Capacity</b>	EX2-CRT-PJ.10-W2-93-V3-VALP-051	A positive increase on En-Route Capacity without degrading the current level of	ER Medium Complexity TMA Very High Complexity	Positive benefit	OK

	To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept	EX2-CRT-PJ.10-W2-93-V3-VALP-052	safety is demonstrated. A positive increase on TMA Capacity without degrading the current level of safety is demonstrated.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-011	<b>Performance Assessment: Fuel Efficiency</b> To assess the performance benefits in terms of Fuel Efficiency of the delegation of ATM services provision among ATSUs concept	EX2-CRT-PJ.10-W2-93-V3-VALP-053	A reduction in the average fuel burn per aircraft is demonstrated	ER Medium Complexity TMA Very High Complexity	Positive benefit	OK
EX2-OBJ-PJ.10-W2-93-V3-VALP-012	<b>Performance Assessment: Predictability</b>	EX2-CRT-PJ.10-W2-93-V3-VALP-054	A reduction in the variance of the difference between the planned flight	ER Medium Complexity TMA Very High Complexity	Positive benefit	OK

	To assess the performance benefits in terms of Predictability of the delegation of ATM services provision among ATSUs concept		duration and actual flight duration is demonstrated.			
EX2-OBJ-PJ.10-W2-93-V3-VALP-013	<b>Performance Assessment: Cost-Efficiency</b> To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept	EX2-CRT-PJ.10-W2-93-V3-VALP-055	A positive increase on ATCO productivity is demonstrated.	ER Medium Complexity	Positive benefit	OK
		EX2-CRT-PJ.10-W2-93-V3-VALP-056	A reduction on the average technology cost per aircraft is demonstrated.	TMA Very High Complexity		

Table 16161616161616: Validation Results for Exercise EXE-PJ.10-W2-93-V3-VALP-002



### A.3.2 Analysis of Exercise 2 Results per Validation objective

#### 1. EX2-OBJ-PJ.10-W2-93-V3-VALP-001 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-001:** To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.

As indicated in §A.2, the scenarios covered by the exercise included different levels of traffic density and traffic complexity, tested in the different use cases addressed by this validation activity. The results obtained with regards to the question: “The feasibility of the concept is operationally acceptable” are shown below for the different use cases.

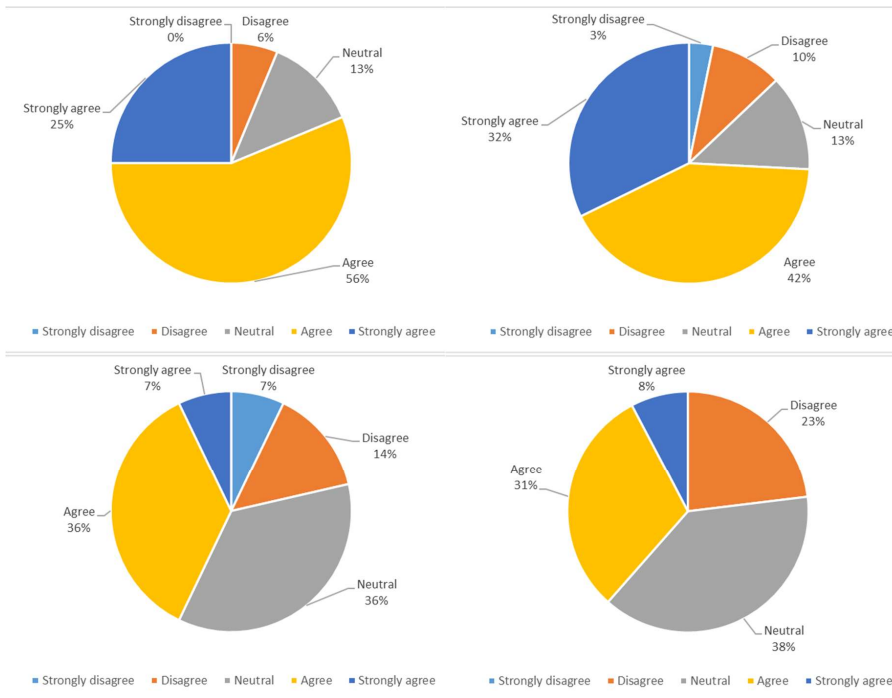


Figure 444444. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-001. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)

As it can be observed, overall, the results indicate a positive response concerning the feasibility of the concept except for the on-demand use case, where higher levels of traffic demand and traffic complexity were tested. In these cases, the “Neutral” and “Disagree/Strongly disagree” answers represent between the 57% and 61% for the on-demand (cross-border) and on-demand (ATFM) scenarios. In these cases, the ATCOs reported that the high level of traffic complexity and traffic demand did not allow the compliance of the ATC procedures in place due to their complexity and, therefore, leading to a higher number of conflicts, non-optimal trajectories, and lower levels of situational awareness.

## 2. EX2-OBJ-PJ.10-W2-93-V3-VALP-002 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-002:** To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision at Night” use case.

The operational feasibility has been assessed through the following questions, for which the results are reported below:

- The delegation procedure is clearly defined.
- TheThe delegation procedure is operationally feasible.
- TheThe roles and responsibilities during the delegation process are clearly defined.
- The quality of the ATC service provision is not impacted during the delegation process.
- The quality of the ATC service provision is not impacted after the delegation process.



Figure 555555. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-002. Operational feasibility (Night use case)

In general terms, no negative feedback has been gathered with regards to the operational feasibility of the concept for the night use case. The delegation procedure, as defined in the OSED [13], was validated and considered operationally feasible without reservations. This fact is mainly supported by the low level of traffic demand and traffic complexity.

### 3. EX2-OBJ-PJ.10-W2-93-V3-VALP-003 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-003:** To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision at fixed time” use case.

As indicated in the night time use case, the results for the different questions under analysis are shown in the figure below. It can be observed, that, overall, no negative feedback has been expressed by the air traffic controllers involved in the validation of the concept with regards to the operational feasibility of the delegation procedure for the fixed time use case. However, it can be also seen that, compared to the night use case, the number of neutral answers for the different questions increases. As reported by the operational staff involved in the HITL simulation, as the traffic demand and traffic complexity increases, the feasibility of the concept decreases.



Figure 6666666. EXE-PJ.10-W2-93-V3-VALP-003 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-003. Operational feasibility (Fixed time use case)

#### 4. EX2-OBJ-PJ.10-W2-93-V3-VALP-004 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-004:** To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision On-Demand” use case.

Figure 777777Figure 7777Figure 77Figure-7 and Figure 888888Figure 8888Figure 88Figure-8 illustrate the operational feasibility results obtained for the On-demand use case, both for the ATFM and cross-border cases, respectively.

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In these cases, the number of negative answers received concerning the operational feasibility of the concept and the impact on the quality of the ATC service provided during and after the delegation, i.e., strongly disagree and disagree options, significantly increases.

For the on-demand cross-border use case, even though the level of agreement (46%) with regards to the operational feasibility is higher than the level of disagreement (31%), there is a 23% of neutral answers that indicates that there is no clear opinion on this topic. On the contrary, there is a clear negative impact identified (47%) concerning the quality of the ATC service provided after the delegation. The main reasons behind this negative feedback are the high levels of traffic complexity and traffic demand, the lack of proficiency in the delegated sectors due to the airspace complexity and the ATC procedures variability when controlling sectors with lower airspace or terminal areas interfaces (Palma TACC). In some cases, the airspace volume resulting from the cross-border sectors integration was considered not appropriate from the point of view of induced conflicts and points of attention dispersion.

In the on-demand ATFM use case, the level of disagreement in terms of operational feasibility is even higher (71%). Also, the quality of the ATC service provided has been demonstrated as negatively impacted (58%). The causes for this negative feedback are exactly the same as the ones provided for the cross-border runs. For the ATFM case, even if the delegated sectors were not the ones with demand and capacity issues, the traffic load and traffic complexity of these scenarios were too high, as reported by the air traffic controllers.

In these cases, the following changes to the delegation procedure were considered as convenient in order to ease the delegation process and mitigate additional negative impacts in terms of human performance:

- The delegation procedure has been performed by the planner controllers without intervention of the executive controllers, as opposed to the night and fix time use case, where the procedure was carried out by the executive controllers themselves, both in the delegating and receiving ATSUs.
- The configuration of the Rx mode on the receiving ATSU by the executive and planner controller during the preview mode was not applied by any of the air traffic controllers due to the high levels of traffic when the receiving team was not idle.

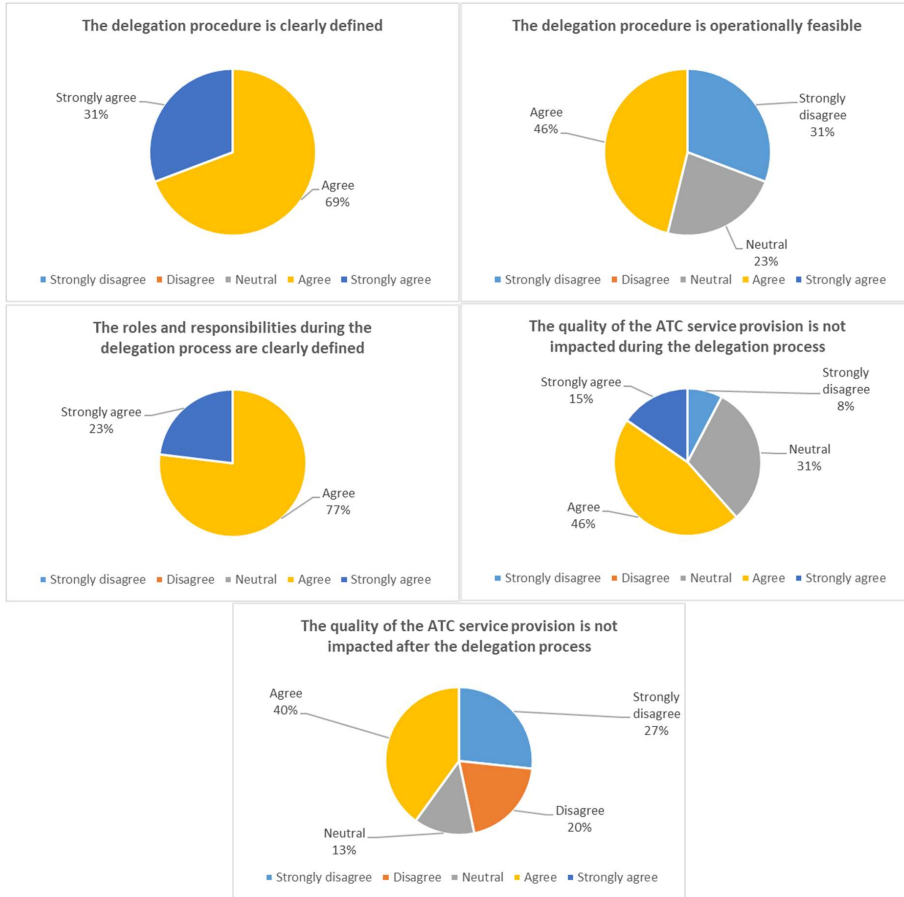


Figure 777777. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-004. Operational feasibility (On-demand / cross-border use case)

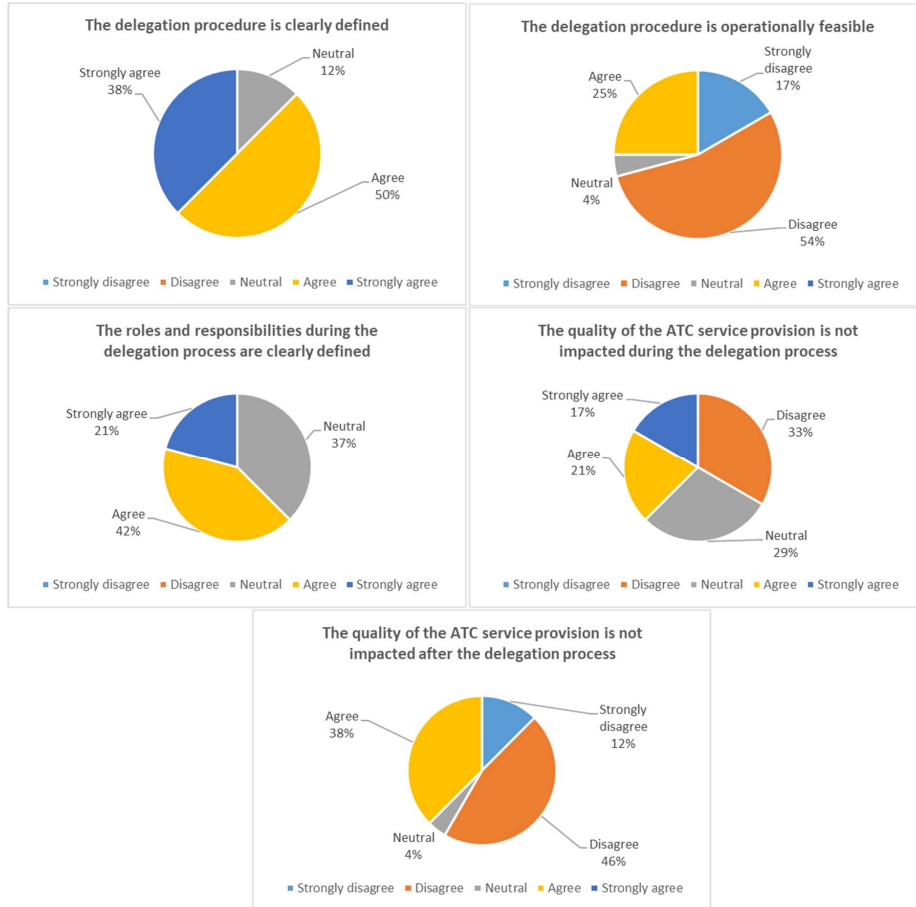


Figure 8888888. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-004. Operational feasibility (On-demand / ATFM use case)

### 5. EX2-OBJ-PJ.10-W2-93-V3-VALP-005 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-005:** To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision at Night” use case.

The operational acceptance of the concept has been assessed through the following questions, for which the results are reported below:

- The level of workload remains within acceptable levels during the delegation procedure.
- The level of workload The level of workload remains within acceptable levels after the delegation procedure is completed.

- The level of situation awareness remains within acceptable levels during the delegation procedure.
- The level of situation awareness remains within acceptable levels after the delegation procedure is completed.
- The level of trust in the system is judged as sufficient.
- The level of system support (TTM/iCMON/preview) is judged as sufficient.

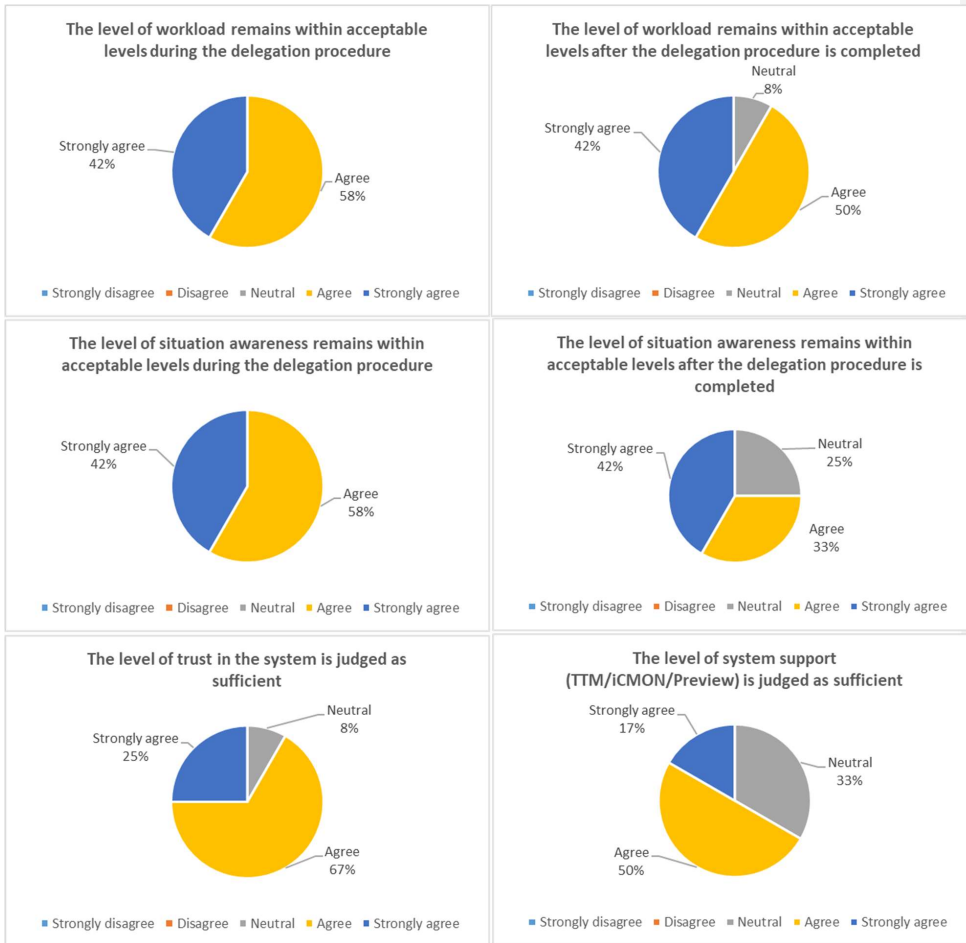


Figure 999999. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-005. Operational acceptance (Night use case)

As it can be observed, no negative impacts have been identified in terms of operational acceptance for the night use case. Even neutral opinions were reported in some cases, the level of agreement represents more than the 50% of the answers gathered.

### 6. EX2-OBJ-PJ.10-W2-93-V3-VALP-006 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-006:** To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision at Fixed Time” use case

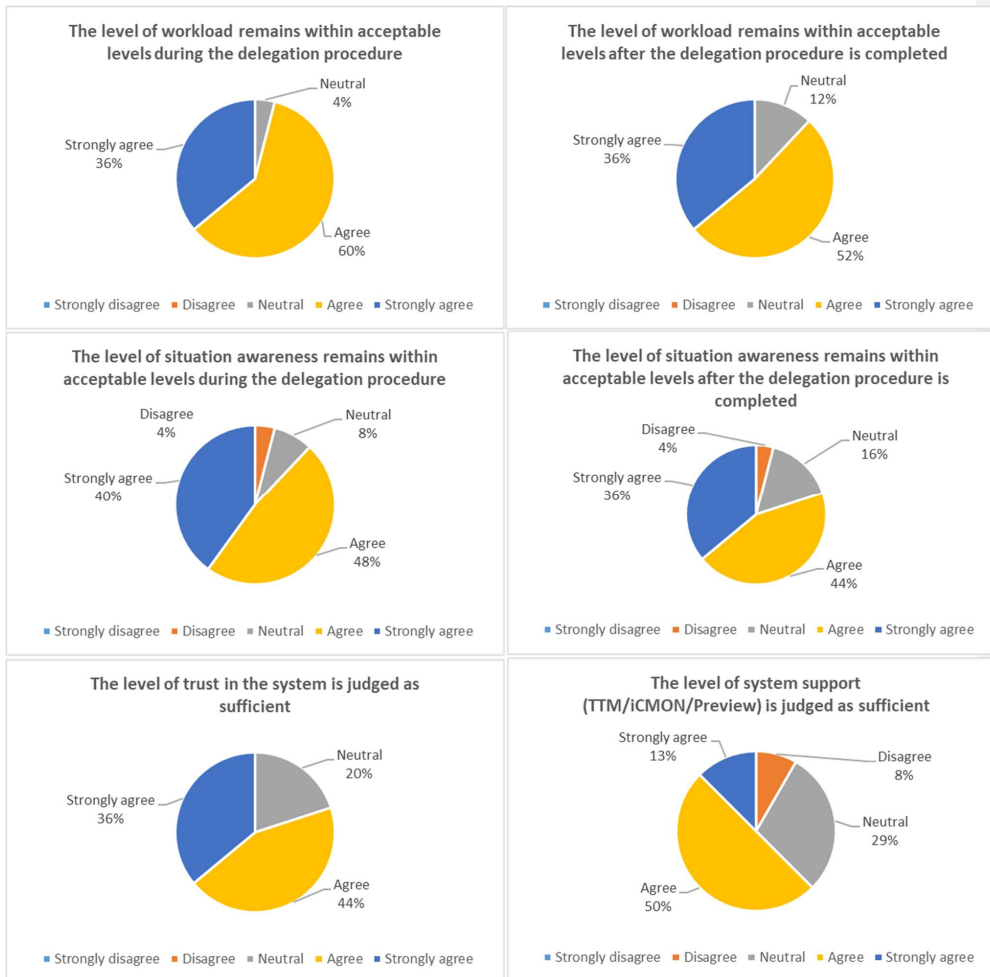


Figure 10101010101010. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-006. Operational acceptance (Fixed time use case)

In relation to the fix time use case, the operational acceptance of the concept has also been demonstrated.

However, some negative aspects were identified in some runs and scenarios that are worth highlighting:



- To keep the situation awareness, it is crucial for the receiving ATCO to be trained not only in the delegated sector but also in the adjacent ones. Knowing the ATC procedures of the adjacent sectors, including the coordination procedures and conditions was considered as a prerequisite for delegating sectors of the lower airspace of sectors with terminal areas interfaces.
- Some issues related to the Conflict Detection and Resolution tool (TTM) implemented in the system were reported but are not related to the concept under validation. Even though Conflict Detection and Resolution tools were not considered as a mandatory prerequisite for the implementation of the concept, its availability and good functioning was considered as positive and appreciated.

### 7. EX2-OBJ-PJ.10-W2-93-V3-VALP-007 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-007:** To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand" use case.

Figure 111111111111Figure 1111111111Figure 1111Figure 11 and Figure 121212121212Figure 1212121212Figure 1212Figure 12 illustrate the operational acceptance results for the on-demand use case, both for the cross-border and ATFM scenarios, respectively.

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For the cross-border scenarios:

- The level of workload remains under acceptable levels for air traffic controllers. However, some level of disagreement has been identified with regards to the workload associated to the configuration of the Rx mode during the preview mode by the executive controller of the receiving ATSU.

No issues reported by the supervisors on this matter

- The situation awareness remains under acceptable levels. Nevertheless, there is a significant number of answers that reported a negative impact in terms of situation awareness as previously indicated, derived from the dimension of the airspace volume resulting from the integration of cross-border sectors and the dispersion of attentional points.
- The level of trust in the system has been judged as sufficient.
- In general terms, the level of system support has been judged as sufficient. However, some issues were reported in relation to the Conflict Detection and Resolution tool that are out of the scope of the validation.

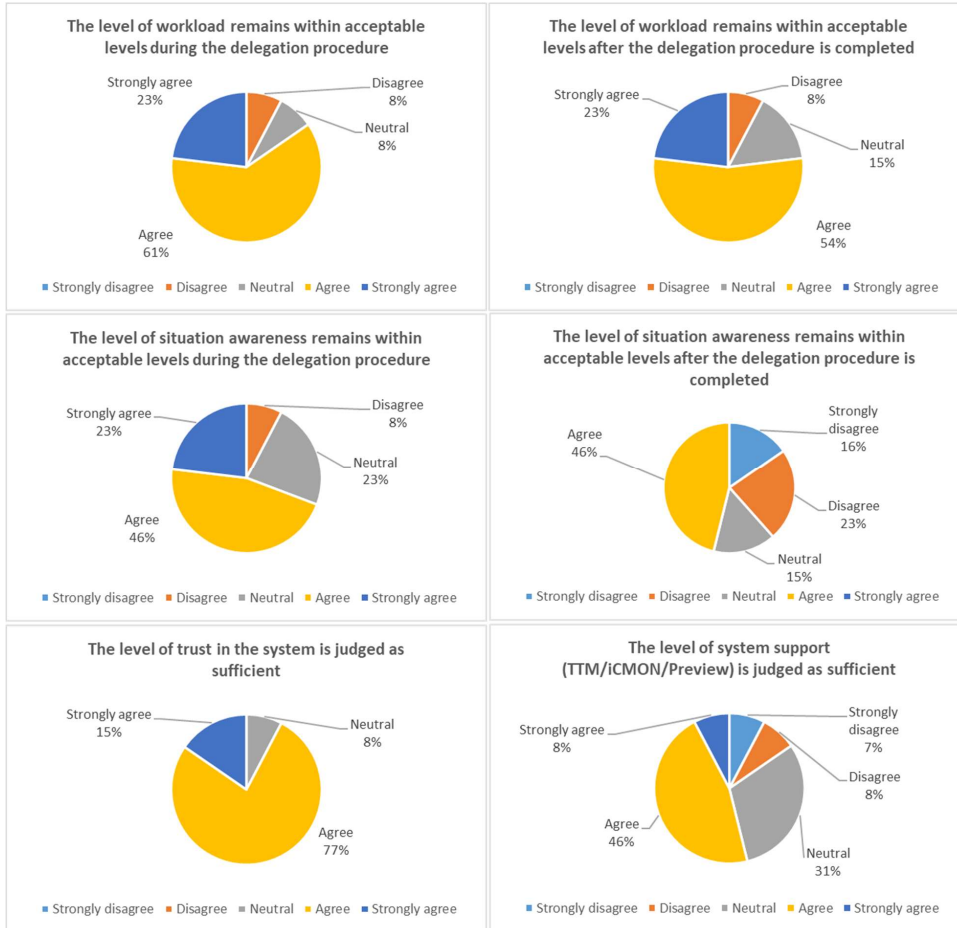


Figure 1111111111114. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-007. Operational acceptance (On-demand / cross-border use case)

Regarding the ATFM scenarios:

- The level of workload does not remain under acceptable levels for air traffic controllers during the delegation procedure due to the high level of traffic demand and traffic complexity for these scenarios. Even if the sectors that were delegated were not always the ones with hotspots and considering that the moment of delegation was chosen by the air traffic controllers and supervisors at their convenience, the traffic load did not allow to carry out the procedure with an acceptable level of workload and in safe conditions. After the delegation procedure is completed, the level of workload decreases and remains acceptable, but negative feedback was received with regards to the efficiency of managing these levels of traffic in the receiving ATSU compared to the delegating one.

No issues reported by the supervisors on this matter.

- As far as the situation awareness concerns, even if the overall results indicate an acceptable level, negative feedback has been gathered on this regard due to the significant number of exchanges during the delegation phase to capture all the relevant information about all the traffics.
- The level of trust in the system has been judged as sufficient.
- The negative feedback received with regards to the level of system support is, again, derived from the malfunctioning of the Conflict Detection and Resolution aid.

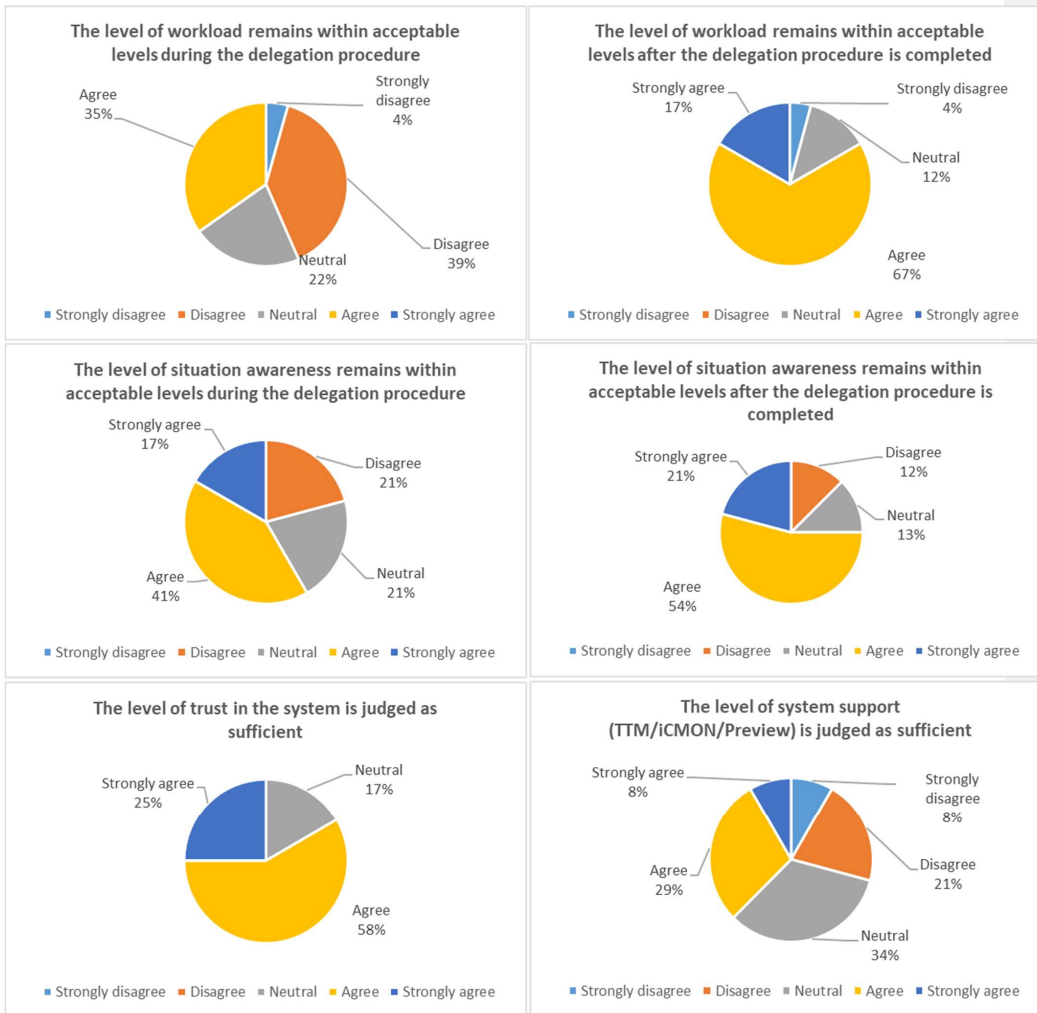


Figure 1212121212121212. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-007. Operational acceptance (On-demand / ATFM use case)

## 8. EX2-OBJ-PJ.10-W2-93-V3-VALP-008 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-012:** To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions.

Although the assessment of Human Performance is also implicit in the analysis of the previous validation objectives related to the operational acceptance, some additional HP aspects have been more specifically addressed by analysing the following factors at use case level:

- Workload (Bedford Scale)

Use Case	Before delegation	During delegation	After delegation
Night	1.2	1.3	1.6
Fix time	2.4	2.5	2.7
On-demand cross-border	3.1	4.1	3.7
On-demand ATFM	4.3	6.1	5.5

As previously mentioned, the level of workload remains under acceptable levels in general terms except for the on-demand use cases, where the workload moves between 4 to 6 in the Bedford scale, meaning that, in the worst case (6), there is little spare capacity and the level of effort allows little attention to additional tasks.

- Situational Awareness (SASHA)

Use Case	During delegation	After delegation
Night	5.4	5.2
Fix time	5.1	5.3
On-demand cross-border	4.4	3.5
On-demand ATFM	4.5	4.4

The situation awareness remains at acceptable level for all the use cases, although as it is depicted from the table presented before, this factor is negatively impacted for the on-demand use case, especially in the case of cross-border after delegation.

- Trust in automation (SATI)

Use Case	During delegation	After delegation
Night	5.8	5.8
Fix time	5.5	5.4
On-demand cross-border	5.0	4.9
On-demand ATFM	4.6	5.1

It can be concluded that no major issues have been identified with regards to the trust in automation implied by the concept under validation, remaining this factor under acceptable levels during and after the delegation according to the SATI scale.

- Potential for human error

In summary, the potential for human error remains under acceptable levels. Only for the on-demand use case some negative feedback was gathered based on the reasons already presented in the analysis of the previous objectives. The high level of traffic demand and traffic complexity led to unsafe situations and high levels of workload.

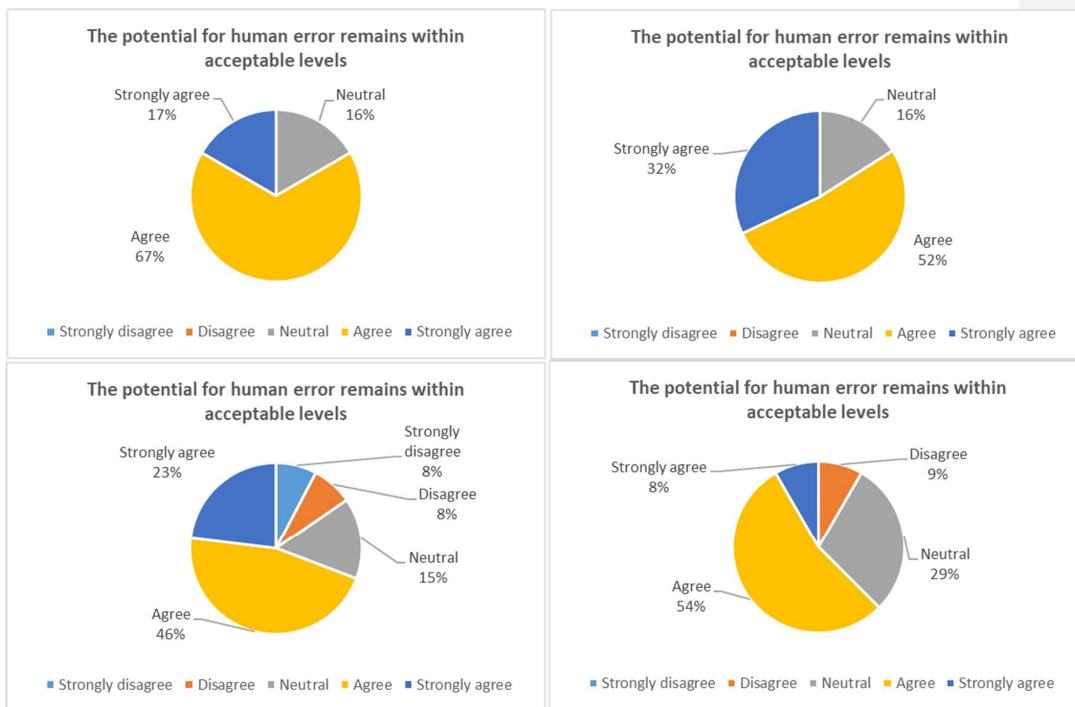


Figure 1313131313131313. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Potential for human error. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)

- Communication load

The communication load, as previously reported, has been considered as satisfactory except for the on-demand use case, where the number of exchanges between controllers significantly increased the radiofrequency and phone line occupation rate, as well as the overall workload, making it not acceptable for the ATFM scenarios.

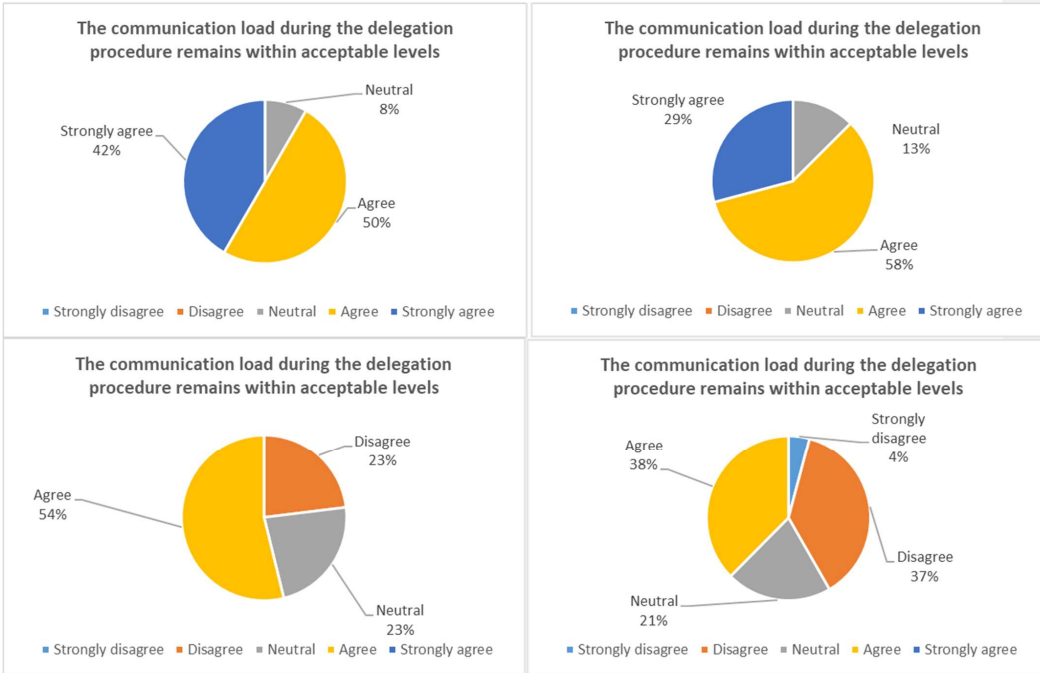


Figure 14141414141414. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Communication load. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)

- Human performance and system support

The level of system support and related human performance has been judged as acceptable. As it was already mentioned, the only issue arises from the the undesired behaviour of the Conflict Detection and Resolution tool integrated into the CWP. The number of false alarms increased the air traffic controller workload and negatively impacted the situation awareness.

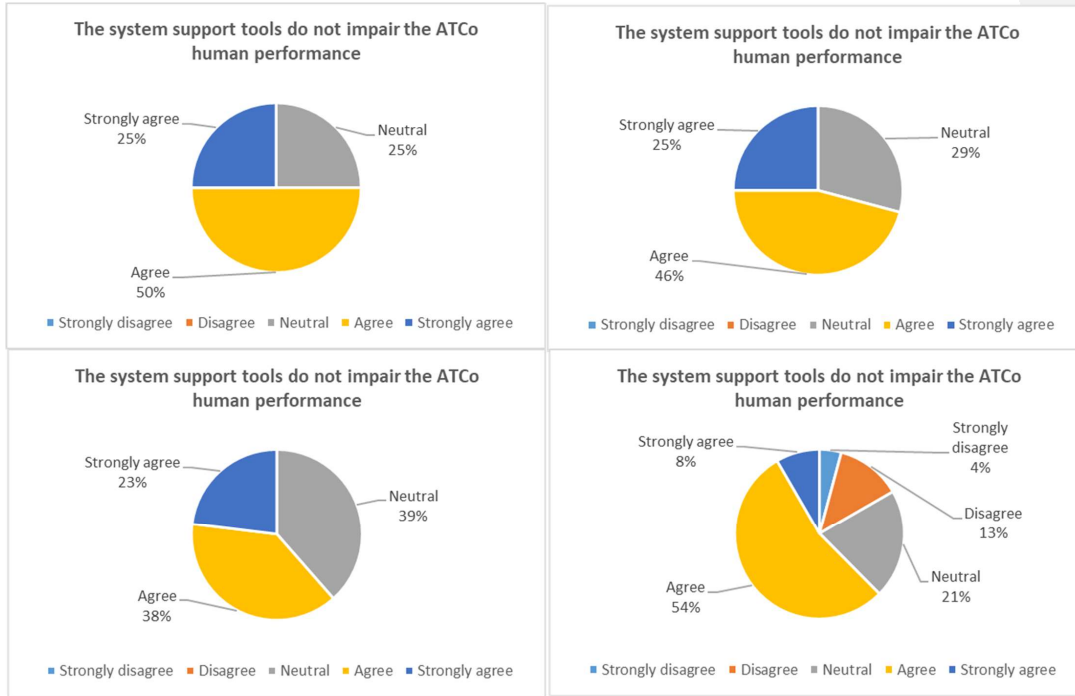


Figure 15151515151515. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-008. Human Performance. Human performance and system support. Top left: night, top right: fix, bottom left: on-demand (cross-border), bottom right (on-demand ATFM)

### 9. EX2-OBJ-PJ.10-W2-93-V3-VALP-009 Results

EX2-OBJ-PJ.10-W2-93-V3-VALP-009: To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions

The safety impact has been qualitatively assessed by the air traffic controllers and supervisors involved in the validation activity by means of the following questions:

- The level of safety remains at an acceptable level during the delegation procedure
- The level of safety remains at an acceptable level after the delegation procedure is completed
- The management and provision of aircraft separation during the delegation procedure is acceptable
- The management and provision of aircraft separation after the delegation procedure is completed is acceptable

The level of agreement / disagreement is presented below for the different use cases.

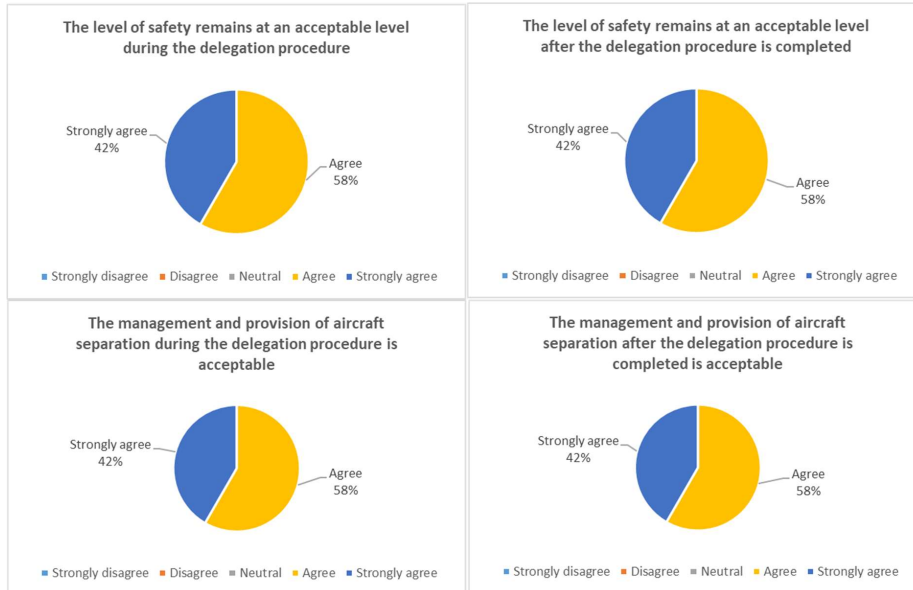


Figure 16161616161616. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-014. Safety (Night time use case)

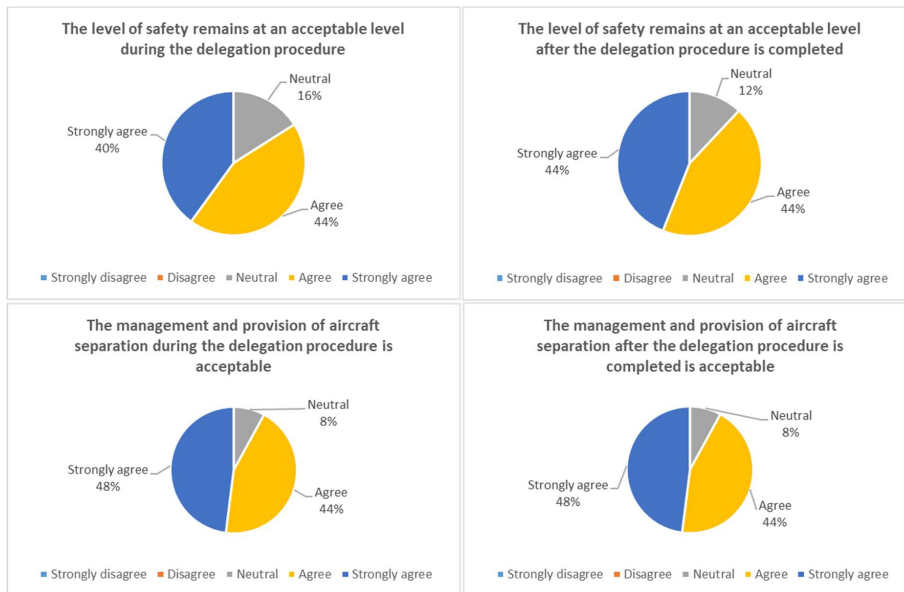


Figure 17171717171717. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (Fixed time use case)



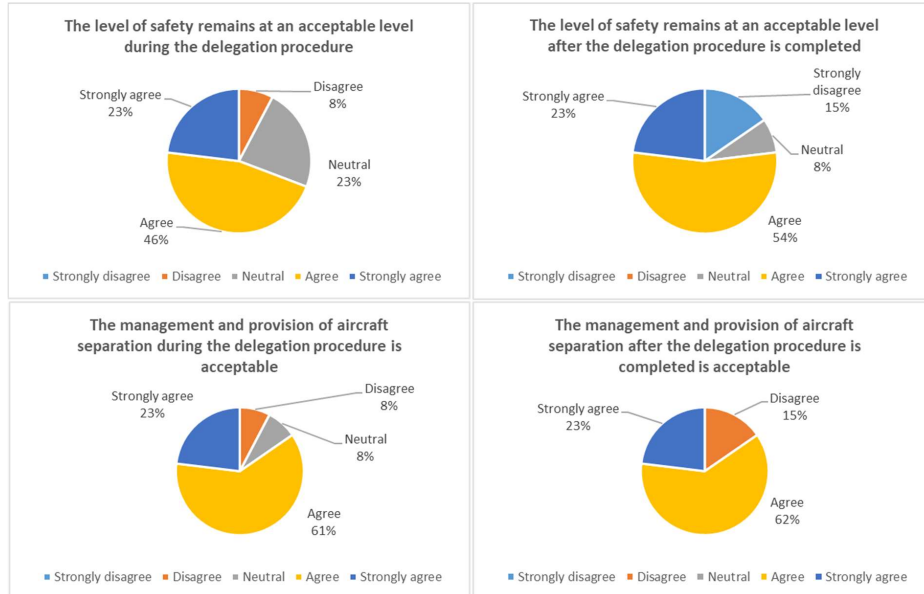


Figure 18181818181818. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (On-demand/Cross-border use case)

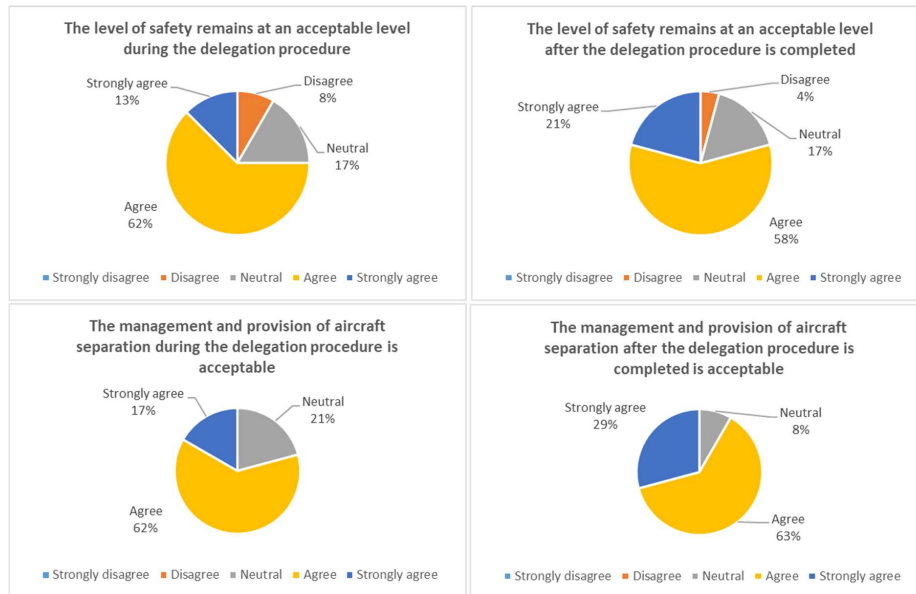


Figure 19191919191919. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-009. Safety (On-demand/ATFM)

As it can be observed, there are discrepancies concerning the safety perception depending on the use case. Whilst for the night and fix time use case the both the level of safety and the management and provision of aircraft separation remains at an acceptable level, in the on-demand use case (ATFM and cross-border), between the 4% and 15% of the feedback gathered during the HITL simulation leads to a potential negative impact in terms of safety. This negative feedback was expressed based on the following reasons:

- The scenarios run under this use cases were high and very high complexity scenarios, with high levels of traffic demand. Under these circumstances, the lack of proficiency in managing traffic of the delegated sectors in the receiving ATSU without being fully trained led to this unsafe perception reported by the air traffic controllers.
- In the specific case of the cross-border use case, the integration of sectors in some of the runs led to a significantly bigger piece of airspace with multiple and disperse points of attention, adding even higher levels of complexity to the delegation per se.

### 10. EX2-OBJ-PJ.10-W2-93-V3-VALP-010 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-010:** To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept

Following the reference of the SESAR Performance Framework, the Capacity KPA is evaluated at local level for En-Route airspace (LECM, LECS, LECB) and TMA airspace (LECP) as the increase in En-Route throughput (CAP2) and TMA throughput (CAP1), respectively, in challenging airspace, per unit time.

The following aspects should be noted when considering the results presented:

- The scenarios considered are limited to the runs addressing the On-Demand (ATFM) use case. This is the only scenario where the number of movements can be increased, since according to the Benefit Impact Mechanism defined for PJ.10-W2-93 V3 solution, the delegation of the provision of ATM services can avoid DCB measures such as ATFM regulations, flight level-capping or horizontal re-routings and, therefore, increase the number of flights per unit time. In the rest of cases (night, fix-time and on-demand cross-border), the number of flights in the reference and solution scenarios remains identical.
- In the case of LECP – LECB scenarios, where the delegation occurs between En-Route airspace and TMA airspace units, the capacity benefit is allocated only to the unit for which the sector is delegated (ATFM regulation not applicable), in order to avoid potential double counting.

The following table shows the results obtained for each scenario relevant for the CAP2 (En-Route Capacity) indicator computation.

Scenario	CAP2 Benefit (Reference vs. Solution scenario)
ATFM1_MADSEV	+ 9.5 %
ATFM3_MADSEV	+ 25.9 %
ATFM5_BCNPAL	+ 23.0 %

Table ~~17171717171747~~. EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-010. CAP2



As indicated for the FEFF1 KPI, the benefit in the Predictability KPA is only considered for the on-demand use case, where the avoidance of ATFM measures and inter-sector coordination could lead to better levels of predictability.

Following the SESAR Performance Framework, PRD2 KPI is computed as the variance of difference between actual and planned flight durations. The following aspects should be highlighted with regards to how the indicator has been calculated:

- Since not all the flights were not controlled from block-to-block due to the scope of the simulation, the comparison of flight duration is made only taking into consideration the sectors of analysis.
- The actual flight duration is calculated based on the cancelled flight plan, assuming that it should be almost identical to the flight radar tracks.
- The planned flight duration is calculated based on the initial flight plan.

The following table summarises the results obtained for the predictability KPI.

Use Case	Duration difference variance (min <sup>2</sup> ) (Reference vs. Solution scenario)	PRD2 Benefit (Reference vs. Solution scenario)
On-demand ATFM	0.011 (6.3 seconds)	+ 9.8 % (negative impact)
On-demand cross-border	0.107 (19.6 seconds)	- 22.8 % (positive impact)

Table ~~20202020202020~~ EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-012. PRD2

As it can be observed, on average, **the Predictability KPI (PRD2) improves a 6.5%**, being the cross-border use case the one contributing the most to this improvement.

### 13. EX2-OBJ-PJ.10-W2-93-V3-VALP-013 Results

**EX2-OBJ-PJ.10-W2-93-V3-VALP-013:** To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSU's concept

According to the SESAR Performance Framework, the Cost Efficiency KPI (CEF2) is computed as the number of flights handled divided by the number of ATCO-hours on duty.

The following table summarises the results obtained at local level for each one of the scenarios run in the simulation, when applicable.

Scenario	CEF2 Benefit (Reference vs. Solution scenario)
NIGHT1_MADSEV	+ 25 %
FIX1_MADSEV	+ 25 %
ATFM1_MADSEV	+ 9.5 %
CROSS2_MADSEV	+ 25 %
ATFM3_MADSEV	+ 25.9 %
FIX2_MADSEV	+ 25 %
NIGHT3_BCNPAL	+ 50 %

Scenario	CEF2 Benefit (Reference vs. Solution scenario)
FIX5_BCNPAL	+ 25 %
CROSS1_BCNPAL	+ 25 %
ATFM5_BCNPAL	+ 23 %
CROSS3_BCNPAL	+ 25 %
FIX6_BCNPAL	+ 25 %
ATFM7_BCNPAL	+ 12.3 %
FIX7_BCNPAL	+ 25 %

**Table 212121212121214.** EXE-PJ.10-W2-93-V3-VALP-002 Validation Objective EX2-OBJ-PJ.10.W2-93-V3-VALP-013. CEF2

Bearing in mind the previous results, the Cost-Efficiency KPI is improved as follows for the different use cases:

- Night: + 37.5 %
- Fix Time: + 25 %.
- On-demand (ATFM): + 17.7 %.
- On-demand (Cross-border): + 25 %.

Therefore, it can be concluded that, on average, **the Cost-Efficiency KPI (CEF2) is improved a 24.7 %.**

### A.3.3 Unexpected Behaviours/Results

No unexpected behaviours nor results have been identified.

### A.3.4 Confidence in Results of Validation Exercise 2

#### 1. Level of significance/limitations of Validation Exercise Results

The selected validation environment is representative of high / very high traffic density and high / very high complexity environments for En-Route and TMA, including four different air traffic service units of the Spanish airspace. Therefore, the results could be easily extrapolated to the rest of sub-operating environments with the same characteristics within the ECAC area.

The scenarios selected in terms of traffic samples also contribute to the representativeness of the validation results, by considering real traffic data. The realism of the traffic scenarios was judged, on average, as 4.7 over 5 by the air traffic controllers involved in the validation activities.

The ten air traffic controllers that have participated in the exercise are active controllers, coming from the four different ATSUs involved in the validation activity. All of them were highly experienced staff, with more than ten years (on average) of operational background in the simulated airspace.

Nevertheless, some limitations have been identified with regards the validation activity. The impact of these limitations on the validation results is considered as low for the reasons below:

- Conflict Detection and Resolution Tool

As indicated in the analysis of results per validation objective, the CD&R tool integrated into the platform did not work as expected, producing several false alarms and missing conflicts. Therefore, and in order to avoid potential human performance issues, the tool was deactivated during the first week of the validation, being present only for three days out of fourteen.

In any case, and as it has already been reported, the lack of CD&R tools did not impact the results of the exercise. Due to the operating method in place for the Spanish air traffic controllers, the existence of the LAD tool - that allows them to measure distances between flights and to display the minimum separation that will be achieved and when - together with the STCA, were considered as enough. A proper CD&R tool is considered as appreciated for the implementation of the concept under validation, but not mandatory.

- Preview Mode

The preview – mode functionality was not integrated into the controller working position, but in a parallel and auxiliary screen. Even though all the preview – mode requirements were considered as satisfied, the non-integration led to some HP issues reported during the debriefings mainly related to the lack of integrated interfaces and divided points of attention.

Nonetheless, the impact on the validation results is considered as low.

- ATC procedures

As part of the simulation set up, for some of the scenarios the ATC procedures in place were simplified (e.g., coordination flight levels for group of airports, unification of coordination flight levels regardless the entry/exit waypoints, etc.) in order to facilitate the validation.

This is considered to have a medium impact on the validation results obtained for high traffic load scenarios (mainly, on-demand use case). The simplification allowed the concept to be more easily tested, but air traffic controllers expressed the need to keep the real operational ATC procedures if capacity thresholds were intended to be kept. The simplification of procedures facilitates the operational acceptance, but this acceptance is not real as it can not be achieved without reducing capacity.

- ATSEP role

Due to the validation set up and exercise scope, no ATSEP role was simulated. All the configuration of the platform derived from the concept implementation (sectorisation after delegation, etc.), was performed by the operational supervisors.

No impact has been considered on the validation results.

- Non-nominal conditions

It was not within the exercise scope the assessment of non-nominal conditions. This do not impact the exercise results, but might have an impact at solution level.

## 2. Quality of Validation Exercises Results

The quality of the validation results is considered as high based on the following aspects:

- Operational quality

The air traffic controllers involved in the exercise are highly experienced active controllers in the airspace under analysis from both En-Route and TMA. Quality and non-biased feedback was gathered by means of questionnaires and debriefings.

- Simulation quality

The realism of the simulation was judged as very high from the air traffic controllers' point of view, in terms of traffic load, environment, flight plans, traffic complexity, etc. The higher the realism of the simulation, the higher the fidelity and representativeness of the results is.

- Analysis quality

The results obtained through the questionnaires and de-briefing sessions have been thoroughly analysed by human factors experts with operational background, allowing the extraction of relevant conclusions and recommendations.

### 3. Significance of Validation Exercises Results

As in small scale Human-In-The-Loop simulations, the statistical significance of the validation exercise results is limited due to the small number of runs that can be executed (in this case, 15 different scenarios were conducted). Therefore, no meaningful statistical analysis could be performed.

However, and with regards to the number of participants, the involvement of 10 air traffic controllers is considered as representative enough for the purpose of the validation.

Operational significance, measured in terms of environment realisms (airspace, complexity, traffic, etc.) has been also judged as high by the air traffic controllers involved, as described in §A.3.4.1.

## A.3.5 Conclusions Exercise 2

### 1. Conclusions on concept clarification

Bearing in mind the results obtained and shown in the previous sections, the following conclusions can be derived:

#### Delegation Procedure

In general terms, the delegation procedure under validation has been proven to be acceptable. Nonetheless, the following aspects have been identified as potential improvements:

- If the level of traffic load is low (e.g., nighttime use case, fix time use case), the delegation procedure has been proposed to be directly performed between the delegating and receiving executive controllers, regardless the receiving executive controller initial status (idle or working). This proposal is based on the efficiency and accuracy of the executive controllers' information exchange.
- If the level of traffic load is high (e.g., on-demand use case), the delegation procedure has been proposed to be performed between the delegating and receiving planner controller if the receiving executive is working, and between the delegating planning controller and the receiving executive controller if the receiving executive controller is idle.
- Concerning the configuration of the Rx mode by the receiving controllers during the preview-mode phase:
  - If the receiving executive controller is idle, the configuration of the Rx mode has been considered as positive, but not essential.

- If the receiving executive controller is working, the configuration of the Rx mode has been considered prejudicial in terms of workload, and therefore, should not be part of the procedure.
- The configuration of the Rx mode by the planner controller has been considered as not essential nor needed.
- After the delegation is completed, the delegating executive controller should not disconnect the Rx mode for the delegated sector until the receiving executive controller verbally confirms that everything is handled.

### Operational Feasibility

The concept has been demonstrated as operationally feasible for the following use cases:

- Night use case
- Fixed time use case

For the on-demand use case (cross-border and ATFM), the operational feasibility results are not as positive as in the previous cases. While for the cross-border scenario the results indicate a mix between positive, neutral and negative answers, without a clear conclusion, the ATFM scenario has been demonstrated as non-feasible due to the high traffic load and high complexity. In both cases the quality of the ATC service has been proven as highly negatively impacted.

In addition, potential limitations regarding the concept applicability have been identified, resulting the following environment conditions as potential barriers:

- High and very high complexity scenarios, impacted by both the air traffic complexity and the structural airspace complexity.
- Low airspace sectors, with terminal areas and or airport interfaces.
- Sectors with military areas or VFR flights.
- Non-nominal conditions in high traffic demand and high complexity scenarios.

### Operational Acceptance

Operational acceptance of the concept has been assessed from different points of view workload, situation awareness, level of trust in the system, and system support.

Like the results obtained in term of operational feasibility, the concept has been validated as operationally acceptable for the:

- Night use case
- Fixed time use case
- On-demand use case, cross-border scenario

The on-demand use case has resulted as non-operationally acceptable for the ATFM scenario in terms of workload and situation awareness as well.

### General conclusions

- Simplification of ATC procedures – In order to ease the delegation process and test more scenarios and environment conditions, the ATC procedures defined for each one of the delegated sectors under analyses were simplified (e.g., simplification of TFLs, grouping of coordination flight level conditions with TMAs and airports or exit waypoints, etc.). Even



though this simplification could be considered a priori as positive, the overall agreement among the participants is that, if procedures are simplified, the level of traffic (i.e., the capacity thresholds defined) should be reduced as the reason for the ATC procedures to be that complex is the management of high levels of traffic demand without out safety issues.

- Geographical continuity of delegated sectors – When the receiving air traffic controller is not idle before the delegation starts, the need to receive or not adjacent sectors to the one under his/her responsibility was analysed. It was demonstrated that, even if in terms of situational awareness, the delegation improves, it is not a mandatory prerequisite to conduct a delegation. This conclusion does not apply to the cross-border scenario, where all the cases tested considered the integration of an adjacent sector.
- Delegation of ATC supervision – It was clearly concluded that the ATC supervision has to be delegated together with the ATC service, i.e., the supervisor of the receiving ATSU should take care of the supervision activities for the delegated sector. It has been also highlighted that the supervisor shall be able to replace any of the air traffic controller on the shift in case of need, including the position of the receiving controller. Therefore, the supervisor needs to have the same licensing, endorsement, and training as the receiving controller.
- Training and licensing – Training needs were identified during the debriefing sessions. It was concluded that the level of training applied in the delegating ATSU, in terms of both content and hours, should be equally applied for the receiving ATSU. This training includes not only the sector per se, but also the collateral ones.

In relation to the licensing and endorsement aspects of the concept, according to the feedback received, the receiving controller should have the same licensing and endorsement as the delegating controller. Negative feedback was received with regards to the potential definition of partial endorsements (e.g., maximum number of flights that can be managed), since there are conditions and situations (e.g., storms, runway closures impacting terminal areas, etc.) that might be missed and that can compromise safety levels.

- Potential barriers – With regards to the potential barriers that can prevent the concept for being partially or fully deployed, these have been preliminary identified. In particular, the main reasons that can be considered as an impediment are: the regulatory aspects, the societal aspects and the technology aspects.

## 2. Conclusions on technical feasibility

In terms of technical feasibility, the following conclusions have been derived:

- **Preview mode**

Even though the preview mode tested during the exercise was deployed in a parallel screen, the technical needs on this topic could be equally identified. It was concluded that the preview mode should allow the receiving controller to see exactly the same information as the one presented to the delegating controller (i.e., a replicated view). The preview mode shall be integrated into the controller working position, and the receiving controller shall be able to interact with the preview mode functionality as per his/her screen (i.e., filters, configuration of visuals, etc.).

- **Conflict Detection and Resolution support tools**

The existence of Conflict Detection and Resolution tools, if proper implementations are done, has been considered as positive. However, if the system already allows to measure distance between flights and to identify potential losses of minima separation, the supporting aid can be considered as a desire rather than a pre-requisite.

### 3. Conclusions on performance assessments

In terms of performance, the following conclusions are presented for the different KPAs at local level.

- **Airspace Capacity** – A positive benefit has been achieved for both En-Route Capacity – CAP2 (+19.5%) and TMA Capacity – CAP1 (+12.3%).
- **Fuel Efficiency** – A positive benefit has been achieved for Fuel Efficiency – FEFF1 (+9.6%).
- **Predictability** – A positive benefit has been achieved for Predictability – PRD2 (+6.5%).
- **Cost-Efficiency** – A positive benefit has been achieved for Cost-Efficiency – CEF2 (+24.7%).
- **Human Performance** – Human Performance levels have been demonstrated as acceptable for the night use case and fixed time use case. For the on-demand use case (cross-border and ATFM), negative impacts have been identified.
- **Safety** – Safety levels have been demonstrated as acceptable for the night use case and fixed time use case. For the on-demand use case (cross-border and ATFM), negative impacts have been identified.

For the specific details on the applicable sub-operating environment, use cases and computation details for the abovementioned KPIs can be found on the corresponding analysis of the associated validation objective in §A.3.2.

#### A.3.6 Recommendations

Considering the results obtained, the recommendations below have been extracted.

- Delegation environment

It is recommended that the environment of the delegating ATSU has the same level of complexity or, if possible, lower compared to the receiving ATSU (i.e., compatible sub-OEs).

Upper En-Route sectors with a high percentage of overflights are more feasible in terms of delegation compared to sectors from the lower airspace with terminal interfaces. It is recommended that, prior to the implementation of the delegation concept, an airspace study should be conducted in order to identify the most optimal sectors to be delegated in case of need and to identify potential airspace changes (e.g., change of transition flight levels between sectors).

- Delegation conditions

Even though the delegation concept has been tested with receiving controllers already working in a sector, it is recommended that the executive controller of the receiving ATSU could be idle before the delegation starts for the sake of human performance and safety levels.

In the case of nighttime delegations, it is recommended that the delegating ATSU remains operative (i.e., not completely closed), with at least one air traffic controller or operational supervisor ready to answer any potential doubt or issue that might arise in the receiving ATSU.

- On-demand / cross-border use case

For cross-border scenarios, it is recommended to analyse in detail well in advance the sectors that can be integrated based on the common flows, resulting airspace from the integration and conflict points. Resulting airspaces with different points of attention and disperse flows are not recommended from a human factors point of view.

- On-demand / ATFM use case

It is recommended that, in case of ATFM-based delegations, the sectors that are delegated are the ones with the lowest traffic load in the delegating ATSU. Overloaded sectors or regulated sectors are not recommended as potential candidates for delegation.

## Appendix B Validation Exercise #03 Report

### B.1 Summary of the Validation Exercise #03 Plan

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I under description of EXE-PJ.10-W2-93-V3-VALP-003.

#### B.1.1 Validation Exercise description, scope

EXE-PJ.10-W2-93-V3-VALP-003 exercise aimed to achieve a double objective:

- Validate the concept of delegation of ATM services provision among ATSUs in nominal and abnormal conditions, contributing to the maturity V3 of the Solution PJ.10-W2-93.
- Validate the three architectural options (Y, U and D) of Virtual Centre based platforms, as well as the increase of Maturity of the Virtual Centres and related services, while involving multiple ATSUs connected to one or several ADSPs. This part is being supported by another project SESAR W3 PJ32-VC W3.

EXE-PJ.10-W2-93-V3-VALP-003 exercise selected two delegation scenarios from the PJ.10-W2-93 V3 SPR-INTEROP\_OSED, which were played in a VC platform of different architectures Y/U/D:

- Delegation of ATM services provision at night.
- Delegation of ATM services provision in contingency (case of ATSU failure).

The delegation was performed from one of the sectors (or group of sectors) belonging to German or Switzerland Upper airspaces, see Figure below:

- LSAG (Geneva Upper)
- LSAZ (Zürich Upper)
- EDUU (Karlsruhe ACC)



Figure 2020202020202020. EXE-PJ.10-W2-93-V3-VALP-003 Geographical scope

The delegation scenarios involved four different ATSUs belonging to three different ANSPs (Skyguide, DFS and NATS), which are:

- Geneva (Skyguide, Switzerland),
- Zürich (Skyguide, Switzerland).
- Karlsruhe (DFS, Germany),
- Southampton (NATS, UK)

The delegation of ATS is performed at the borders marked with circled numbers ① to ④.

EXE-PJ.10-W2-93-V3-VALP-003 exercise contributed to the maturity of the "ATM service provision" delegation concept through use cases involving:

- Delegation by night and in ATSU contingency
- Cross-border delegation between ATSUs belonging to a same ANSP or to different ANSPs
- Different traffic complexity and traffic density environments
- Individual delegation of Sectors (or group of Sectors) or the overall controlled airspace by an ATSU
- ATCOs from different ANSPs (Skyguide, DFS and NATS) and having different licensing schemes
- CWP from different vendors (Skyguide, INDRA and DFS)
- Multiple ATC ADSPs: the French CCS /Coflight Cloud Service) from DSNA and the Spanish iTEC (Interoperability Through European Collaboration) from INDRA
- Multiple voice ADSP: the Austrian VCS from FREQUENTIS (provided to Skyguide and DFS ATSUs) and the Spanish VCS from INDRA (provided to NATS ATSU)

Furthermore, EXE-PJ.10-W2-93-V3-VALP-003 exercise contributed to increase the maturity of the Virtual Centre architecture and concept, by:

- Playing different delegation use cases on each of the proposed VC architecture options:
  - Y: Two ATSUs connected to one central ADSP, being it CCS or iTEC
  - U: Two ATSUs connected to different ADSP: CCS and iTEC
  - D: with a particularity of a CWP (from DFS) able to connect to one of the available ADSPs (CCS or iTEC)
- Developing Supervision & Monitoring tools for each of the ATC or Voice ADSPs involved in the delegation, as well as of the centralized broker and related Network components
- Increasing maturity of existing services and their operations from the former Wave 1 PJ16.03

## B.1.2 Summary of Validation Exercise #03 Validation Objectives and success criteria

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I under description of exercise EXE-PJ.10-W2-93-V3-VALP-003.

### B.1.3 Summary of Validation Exercise #03 Validation scenarios

#### Validation Scenario(s)

EXE-PJ.10-W2-93-V3-VALP-003 focused on validation scenarios based on following use cases:

- Delegation with "Static AoR" vs "Dynamic AoR"
- Normal delegation "by night" vs Abnormal delegation, i.e., in Contingency
- Delegation on a VC platform of different architecture options Y, U and D
- Delegation considering different roles of the supporting ADSPs: CCS and iTEC

EXE-PJ.10-W2-93-V3-VALP-003 proposed ten (10) different UC# using different traffic samples, taken from EUROCONTROL NEST data of AIRAC May 2017, see Table below

UC# Ref	Airspace	ADSP	Cross-border	Normal/Abnormal	AoR
UC#1	LSAG-LSAZ	CCS	No	Contingency	Dynamic
UC#2	LSAG-LSAZ	CCS	No	Contingency	Static
UC#3	LSAG-LSAZ	CCS	No	By Night	Dynamic
UC#15	EDDU	iTEC	No	Contingency	Static
UC#16	EDDU-ALP	iTEC	No	By Night	Static

Y

UC# Ref	Airspace	Delegation	Cross-border	Normal/Abnormal	AoR
UC#10	LSAZ-EDDU (SLN/TGO)	DFS to Skyguide	Yes	Contingency	Dynamic
UC#11	LSAZ-EDDU (SLN/TGO)	DFS to Skyguide	Yes	Contingency	Static
UC#13	LSAZ-EDDU (SLN/TGO)	Skyguide to NATS	Yes	Contingency	Static
UC#14	LSAZ-EDDU (ALP)	Skyguide to NATS	Yes	By Night	Dynamic

U

UC# Ref	Airspace	Delegation	Cross-border	Normal/Abnormal	AoR
UC#12	LSAZ	Skyguide to DFS	Yes	Contingency	Static

D

Table ~~222222222222~~. EXE-PJ.10-W2-93-V3-VALP-003 Summary of Scenarios use cases

Following Table details the 10 validation scenarios, among those:

- 5 UC# were played on the Y architecture (3 on CCS and 2 on iTEC)
- 4 UC# were played on the U architecture (2 with CCS receiving the delegation and 2 with iTEC receiving the delegation)
- One UC# was played on the D architecture: only CWP DFS can receive the delegation in such configuration

UC#	Description	Initial configuration	Delegation scenarios
UC#1 Y archi	<p>Contingency scenario simulating a failure at LSAZ ATSU, to be supported by LSAG ATSU:</p> <p><u>Delegation in 2 steps:</u></p> <ul style="list-style-type: none"> <li>- LSAZ sector M67 delegated to LSAG sector L67 by AoR extension</li> <li>- LSAZ sector M45 delegated to LSAG L45 sector by AoR extension</li> </ul>		
UC#2 Y archi	<p>Contingency scenario simulating a failure at LSAZ ATSU, to be supported by LSAG ATSU:</p> <p><u>Delegation:</u></p> <ul style="list-style-type: none"> <li>- LSAZ sector M45 delegated to LSAG on a Spare position with a new ATCO team</li> </ul>		
UC#3 Y archi	<p>Delegation scenario by night with a closure of LSAZ ATSU, after delegation to LSAG ATSU:</p> <p><u>Delegation:</u></p> <ul style="list-style-type: none"> <li>- All LSAZ delegated to LSAG by AoR extension</li> </ul>		
UC#10 U archi	<p>Cross-border (Skyguide-DFS) delegation scenario by night:</p> <p><u>Delegation:</u></p> <p>The EDUU (Karlsruhe) Sector STG1 (SLN1+TGO1) is delegated to LSAZ on an existing position controlling M24 Sector (i.e., with AoR extension)</p>		

UC#	Description	Initial configuration	Delegation scenarios
UC#11 U archi	<p>Contingency &amp; Cross-border (Skyguide-DFS) delegation scenario simulating a failure at EDUU ATSU:</p> <p><u>Delegation:</u> The EDUU (Karlsruhe) Sector STG1 (SLN1+TGO1) is delegated to LSAZ on a spare position with a new ATCO team.</p>		
UC#12 D archi	<p>Contingency &amp; Cross-border (Skyguide-DFS) delegation scenario:</p> <p><u>Delegation:</u> The LSAZ M24 Sector is delegated to EDUU on a spare position with a new ATCO team.</p>		
UC#13 U archi	<p>Contingency &amp; Cross-border delegation scenario, involving 3 different ATSUs (Skyguide, DFS &amp; NATS) and simulating a failure at LSAZ ATSU which is supported by a NATS ATSU.</p> <p><u>Delegation:</u> From LSAZ ATSU to a NATS ATSU.</p>		



UC#	Description	Initial configuration	Delegation scenarios
UC#14 U archi	<p>Cross-border delegation scenario by night, involving 3 different ATSUs (Skyguide, DFS &amp; NATS). NATS ATSU, originally controlling ALP Sector, extends its AoR to take control of LSAZ by night:</p> <p>Delegation: From LSAZ ATSU to a NATS ATSU.</p>		
UC#15 Y archi	<p>A simple Contingency delegation scenario simulating a failure at EDUU ATSU.</p> <p>Delegation: from EDUU ATSU to a NATS ATSU.</p>		
UC#16 Y archi	<p>A simple delegation scenario by night, with an AoR extension.</p> <p>Delegation: From EDUU ATSU to a NATS ATSU</p>		

Table 23232323232323. EXE-PJ.10-W2-93-V3-VALP-003 Validations Scenarios

In term of resources, additional to the technical staff in charge of each technical platform, at different sites (Geneva, Toulouse, Langen, Vienna, Madrid and Southampton), there are a bench of other operational staff participated to the validation runs:

- 3 ATCOS from Skyguide LSAG and one has a SUP license thus playing a SUP role
- 3 ATCOS from Skyguide LSAZ and one has a SUP license thus playing a SUP role
- 2 ATCOS from DFS, one playing a SUP role
- 2 ATCO from NATS, one playing a SUP role

### Reference Scenario(s)

The Reference Scenario is as per current operating method in the Swiss airspace, that is, with no possibility to consider the delegation of ATM services provision between ATSUs internally or externally.

The characteristics of the Reference Scenario are based on the conditions of the delegation (i.e. by night or in contingency):

- Delegation of ATM services provision by Night
  - No delegation between ATSUs of a same ANSP
  - No delegation between ATSUs of different ANSPs
  - Consolidation of sectors at night within the same ATSU
- Delegation of ATM services provision in Contingency (i.e. ATSU failure)
  - Empty the Sky procedure applied right after the failure with a consequence to close the airspace of the failing ATSU
  - No delegation between ATSUs internally or externally

### Solution Scenario(s)

The Solution Scenario is as described in PJ.10-W2-93 V3 SPR-INTEROP\_OSED, that is, with the possibility to consider the delegation of ATM services provision.

The main characteristics of the Solution Scenario to be considered for each one of the use cases addressed by the validation activity is described below:

- Delegation of ATM services provision by Night
  - Possibility of delegation between ATSUs of the same ANSP
  - Possibility of delegation between ATSUs of different ANSPs
  - Consolidation of sectors at night within the same ATSU
- Delegation of ATM services provision in Contingency (i.e., ATSU failure)
  - Apply the procedure described in the PJ.10-W2-93 V3 SPR-INTEROP\_OSED
  - Possibility of delegation between ATSUs of the same ANSP
  - Possibility of delegation between ATSUs of different ANSPs

## B.1.4 Summary of Validation Exercise #03 Validation Assumptions

The assumptions defined in the PJ.10-W2-93 Final VALP are no longer valid in this VALR, however the below assumptions are applicable to EXE-PJ.10-W2-93-V3-VALP-003.

Identifier	Title	Description	Justification	Impact on Assessment
EX3-ASS-PJ10-W2-93-V3-VALP-001	Regulatory	The ATCO licensing on the new delegated airspace is a pre-requisite for the execution of the delegation procedures in a Safe way.	In our EXE, same ATCO teams at Skyguide, DFS and NATS have participated to several dry runs which served as a training & familiarization before the final runs.	Medium

EX3-ASS- PJ10-W2- 93-V3- VALP-002	Traffic densities	In the specific delegation with an AoR extension (where an ATCO team, originally controlling a local airspace get control of a new Cross-border/extended airspace), the ATCO team at the receiving ATSU shall not be overload by the traffic volume.	Such scenarios were played during the dry runs and all ATCOs from the 3 ANSPs requested to reduce the traffic volumes until being Low to Medium densities	High
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Table **24242424242424**. Validation Exercise Assumptions EXE-PJ.10-W2-93-V3-VALP-003

## B.2 Deviation from the planned activities

There is no deviation from the planned validation activities: the use cases and the configuration of the final validation platform were all as planned.

## B.3 Validation Exercise #03 Results

### B.3.1 Summary of Validation Exercise #03 Results for the PJ.10-W2-93 Main Operational Solution

Following are the results from EXE-PJ.10-W2-93-V3-VALP-003 exercise for the PJ.10-W2-93 main Operational Solution.

Validation Exercise #03 Objective ID	Validation Exercise #03 Objective Title	Validation Exercise #03 Success Criterion ID	Validation Exercise #03 Success Criterion	Sub-operating environment	Exercise #03 Results	Validation Exercise #03 Objective Status
EX3-OBJ-PJ.10-W2-93-V3-VALP-001	<b>Delegation conditions feasibility</b>  To demonstrate the operational feasibility of the delegation of ATM services for different traffic environment conditions	EX3-CRT-PJ.10-W2-93-V3-VALP-001	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.	ER Very High Complexity	In term of feasibility of the delegation of ATM services, we received positive feedback from all our ATCOs Skyguide, DFS and NATS and also from the ATCOs playing the SUP role.	OK
		EX3-CRT-PJ.10-W2-93-V3-VALP-002	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.		The complexity of the airspace environment on which the delegation was performed is classified Very High, which by assumption covers also all the other complexities.	
		EX3-CRT-PJ.10-W2-93-V3-VALP-003	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is		Furthermore, the limitations were documented (e.g., the managed traffic densities are from Low to Medium, especially in the use cases with AoR extension)	

			gathered for the contingency use case according to ATCO's expert judgment.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-004	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the contingency use case according to ATCO's expert judgment.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-006	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the contingency use case.			
EX3-OBJ-PJ.10-W2-93-V3-VALP-002	<b>Operational feasibility of the delegation procedure</b>	EX3-CRT-PJ.10-W2-93-V3-VALP-007	The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined, and documented.	ER Very High Complexity	No negative feedback has been gathered for the Night use case.  The Delegation Procedures were well documented and	OK

	<p><b>(Night use case)</b></p> <p>To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision at Night” use case</p>	<p>EX3-CRT-PJ.10-W2-93-V3-VALP-008</p>	<p>The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.</p>		<p>applied, the handover dialog was similar to one used today in the OPS rooms (thus there is no need to define a specific handover dialog).</p> <p>The roles and responsibilities were clear to all operational and technical staff.</p> <p>No deviations were reported from the application of each role.</p>	
		<p>EX3-CRT-PJ.10-W2-93-V3-VALP-009</p>	<p>Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.</p>			
		<p>EX3-CRT-PJ.10-W2-93-V3-VALP-010</p>	<p>Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.</p>			
<p>EX3-OBJ-PJ.10-W2-93-V3-VALP-003</p>	<p><b>Operational feasibility of the delegation procedure</b></p>	<p>EX3-CRT-PJ.10-W2-93-V3-VALP-011</p>	<p>The delegation procedure for the Contingency Use Case, including the handover dialogue, is clearly defined and documented.</p>	<p>ER Very High Complexity</p>	<p>No negative feedback has been gathered for the contingency use case.</p> <p>The Delegation Procedures were well documented and</p>	<p>OK</p>

	<p><b>(Contingency use case)</b></p> <p>To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision in case of contingency” use case</p>	<p>EX3-CRT-PJ.10-W2-93-V3-VALP-012</p>	<p>The delegation procedure for the Contingency Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.</p>		<p>applied, the handover dialog was similar to one used today in the OPS rooms (thus there is no need to define a specific handover dialog).</p> <p>The roles and responsibilities were clear to all operational and technical staff.</p> <p>No deviations were reported from the application of each role.</p>	
		<p>EX3-CRT-PJ.10-W2-93-V3-VALP-013</p>	<p>Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Contingency Use Case, including the handover dialogue.</p>			
		<p>EX3-CRT-PJ.10-W2-93-V3-VALP-014</p>	<p>Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Contingency Use Case, including the handover dialogue.</p>			
<p>EX3-OBJ-PJ.10-W2-93-V3-VALP-004</p>	<p><b>Operational acceptance of the delegation procedure</b></p>	<p>EX3-CRT-PJ.10-W2-93-V3-VALP-015</p>	<p>The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the</p>	<p>ER Very High Complexity</p>	<p>The delegation procedure was judged operationally acceptable to the ATCOs and</p>	<p>OK</p>

<p><b>(Night use case)</b></p> <p>To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Night" use case</p>		delegation procedure for the Night Use Case.		other SUP roles, for the Night use cases.
	EX3-CRT-PJ.10-W2-93-V3-VALP-016	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.		The enabler of this success was the fully detailed and documented procedure document that covered all the operational and technical roles (ATCOs, SUP, ATSEPs).
	EX3-CRT-PJ.10-W2-93-V3-VALP-017	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.		It was reported that the "Level of system support for the SUP" could be improved with further tools to improve his situation awareness about the other ATSU(s).
	EX3-CRT-PJ.10-W2-93-V3-VALP-018	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.		
	EX3-CRT-PJ.10-W2-93-V3-VALP-019	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.		





		EX3-CRT-PJ.10-W2-93-V3-VALP-020	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-021	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-022	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.			
EX3-OBJ-PJ.10-W2-93-V3-VALP-005	<p><b>Operational acceptance of the delegation procedure (Contingency use case)</b></p> <p>To demonstrate the operational acceptance of the delegation</p>	EX3-CRT-PJ.10-W2-93-V3-VALP-023	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.	ER Very High Complexity	<p>The delegation procedure was judged operationally acceptable to the ATCOs and other SUP roles, for the Contingency use cases.</p> <p>The enabler of this success was the fully detailed and documented procedure document that covered all</p>	OK
		EX3-CRT-PJ.10-W2-93-V3-VALP-024	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation			

procedure for the "Delegation of ATM services provision in case of contingency		procedure for the Contingency Use Case.	the operational and technical roles (ATCOs, SUP, ATSEPs).  It was reported that the "Level of system support for the SUP" could be improved with further tools to improve his situation awareness about the other ATSU(s).
	EX3-CRT-PJ.10-W2-93-V3-VALP-025	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.	
	EX3-CRT-PJ.10-W2-93-V3-VALP-026	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.	
	EX3-CRT-PJ.10-W2-93-V3-VALP-027	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.	
	EX3-CRT-PJ.10-W2-93-V3-VALP-028	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.	

		EX3-CRT-PJ.10-W2-93-V3-VALP-029	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-030	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.			
EX3-OBJ-PJ.10-W2-93-V3-VALP-006	<b>Human Performance assessment in nominal conditions</b>  To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions	EX3-CRT-PJ.10-W2-93-V3-VALP-031	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in nominal conditions.	ER Very High Complexity	The workload was assessed and deemed acceptable by ATCOs in all phases of the delegation. The communication load as well.  The Situation Awareness remains at an acceptable level in each phase of the delegation but was slightly decreased after the delegation is completed.  The impact on roles & responsibilities was minor.  The overall usability is deemed acceptable by users	OK
		EX3-CRT-PJ.10-W2-93-V3-VALP-032	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-033	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during			

			and after the delegation procedure of ATM services provision in nominal conditions.		and appears to not impair Human Performance.
		EX3-CRT-PJ.10-W2-93-V3-VALP-034	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.		However, the lack of expertise on the sector taken over and the lack of supporting tools <u>impacted</u> their perception of ability to maintain safe operations.
		EX3-CRT-PJ.10-W2-93-V3-VALP-035	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in nominal conditions.		
		EX3-CRT-PJ.10-W2-93-V3-VALP-036	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.		



EX3-OBJ- PJ.10-W2-93- V3-VALP-007	<b>Human Performance assessment in abnormal conditions</b>  To assess the impact in terms of Human Performance of the ATM services provision delegation concept in abnormal conditions	EX3-CRT- PJ.10-W2-93- V3-VALP-037	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in abnormal conditions.	ER Very High Complexity	The workload was assessed and deemed acceptable by ATCOs in all phases of the delegation. The communication load as well.  The Situation Awareness remains at an acceptable level in each phase of the delegation but was slightly decreased after the delegation is completed.  The impact on roles & responsibilities was minor.  The overall usability is deemed acceptable by users and appears to not impair Human Performance.  However, the lack of expertise on the sector taken over and the lack of supporting tools <u>impacted</u> their perception of ability to maintain safe operations.	OK
		EX3-CRT- PJ.10-W2-93- V3-VALP-038	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in abnormal conditions.			
		EX3-CRT- PJ.10-W2-93- V3-VALP-039	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in abnormal conditions.			
		EX3-CRT- PJ.10-W2-93- V3-VALP-040	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services			

			provision in abnormal conditions.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-041	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in abnormal conditions.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-042	ATCO support tools provided before, during and after the delegation of ATM services provision in abnormal conditions do not impair ATCO human performance.			
EX3-OBJ-PJ.10-W2-93-V3-VALP-008	<p><b>Safety assessment in nominal conditions</b></p> <p>To assess the impact in terms of Safety of the ATM services provision delegation concept in</p>	EX3-CRT-PJ.10-W2-93-V3-VALP-043	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in nominal conditions.	ER Very High Complexity	In general, the level of safety was maintained acceptable throughout the runs. The procedure itself was considered somewhat safe. Overall, although the level of safety was evaluated relatively good, the controllers expressed some safety concerns. These concerns were mainly linked to specific situations in	OK
		EX3-CRT-PJ.10-W2-93-V3-VALP-044	Impact remains acceptable according to ATCO expert judgment in terms of the management and provision of			

	nominal conditions		aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.	<p>which controllers experienced difficulties with the use of the system and ability to maintain situational awareness, rather than attributable to a specific working technique, traffic load or whether the traffic was delegated or not. It was also noted that the ability to maintain safety relied mostly on their experience, not because the system provided support in this respect. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.</p> <p>Some controllers provided below average scores mainly due to the lack of supporting tools and the lower technical maturity of the U architecture. It was explicitly indicated that in the current state (lack of maturity and interoperability shortcomings) it renders any solution based on the U</p>	
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					architecture not acceptable from a safety point of view.	
EX3-OBJ- PJ.10-W2-93- V3-VALP-009	<p><b>Safety assessment in abnormal conditions</b></p> <p>To assess the impact in terms of Safety of the ATM services provision delegation concept abnormal conditions in</p>	EX3-CRT- PJ.10-W2-93- V3-VALP-045	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in abnormal conditions.	ER Very High Complexity	<p>In general, the level of safety was maintained acceptable throughout the runs. The procedure itself was considered somewhat safe. Overall, although the level of safety was evaluated relatively good, the controllers expressed some safety concerns. These concerns were mainly linked to specific situations in which controllers experienced difficulties with the use of the system and ability to maintain situational awareness, rather than attributable to a specific working technique, traffic load or whether the traffic was delegated or not. It was also noted that the ability to maintain safety relied mostly on their experience, not because the system provided support in this respect. The technical solution, in the version used during the exercise did not</p>	OK
		EX3-CRT- PJ.10-W2-93- V3-VALP-046	Impact remains acceptable according to ATCO's expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in abnormal conditions are identified.			



					<p>fully provide the expected ATCO support in carrying out their tasks.</p> <p>Some controllers provided below average scores mainly due to the lack of supporting tools and the lower technical maturity of the U architecture. It was explicitly indicated that in the current state (lack of maturity and interoperability shortcomings) it renders any solution based on the U architecture not acceptable from a safety point of view.</p>	
EX3-OBJ-PJ.10-W2-93-V3-VALP-010	<p><b>Performance Assessment: Airspace Capacity</b></p> <p>To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services</p>	EX3-CRT-PJ.10-W2-93-V3-VALP-047	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.	ER Very High Complexity	<p>- En-Route Capacity increase: Not assessed</p> <p>- TMA Capacity increase is NOT applicable</p>	N/A
		EX3-CRT-PJ.10-W2-93-V3-VALP-048	A positive increase on TMA Capacity without degrading the current level of safety is demonstrated.			



	provision among ATSUs concept					
EX3-OBJ-PJ.10-W2-93-V3-VALP-011	<b>Performance Assessment: Cost-Efficiency</b>	EX3-CRT-PJ.10-W2-93-V3-VALP-049	A positive increase on ATCO productivity is demonstrated.	ER Very High Complexity	About up to 50% increase of ATCO productivity is shown, mainly for UCs with AoR extension.  Technology Costs not assessed, please report to the CBA.	OK
	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept	EX3-CRT-PJ.10-W2-93-V3-VALP-050	A reduction on the average technology cost per aircraft is demonstrated.			
EX3-OBJ-PJ.10-W2-93-V3-VALP-012	<b>Performance Assessment: Resilience</b>	EX3-CRT-PJ.10-W2-93-V3-VALP-051	The loss of airspace capacity generated by the contingency situation is reduced.	ER Very High Complexity	Cancellations & delays were not assessed.  The Loss of airspace capacity has been reduced by 65% in average.  For the night Use case, the time to recover from non-nominal to nominal has been	OK
	To assess the performance benefits in terms of Resilience of the delegation of	EX3-CRT-PJ.10-W2-93-V3-VALP-052	The airspace time to recover from non-nominal to nominal conditions is reduced.			
		EX3-CRT-PJ.10-W2-93-V3-VALP-053	The minutes of delay generated by the contingency situation is reduced.			

	ATM services provision among ATSUs concept	EX3-CRT-PJ.10-W2-93-V3-VALP-054	The number of cancellations generated by the contingency situation is reduced.		drastically reduced (divided by +/- 10).	
EX3-OBJ-PJ.10-W2-93-V3-VALP-013	<p><b>ATSEP operational requirements</b></p> <p>To validate the ATSEP operational requirements based on expert judgment</p>	EX3-CRT-PJ.10-W2-93-V3-VALP-055	Impact remains acceptable from the ATSEP's expert group perspective for the different operational requirements related to the ATSEP role.	ER Very High Complexity	<p>The ATSEP at the ATSU, thanks to provided supervision tools, is able to monitor the status of all local CWPs, as well as of all the services provided by a remote ATC ADSP.</p> <p>The ATSEP being at the ATSU or at the ADSP locations have full monitoring &amp; control of their systems.</p> <p>Finally, no specific requirement was reformulated for the ATSEP role.</p> <p>Are missing:</p> <ul style="list-style-type: none"> <li>- Possibility to monitor status of an ADSP from another ADSP (for the U)</li> <li>- Possibility of an ADSP to monitor status of the CWPs at the connecting ATSUs which could be easily</li> </ul>	OK
		EX3-CRT-PJ.10-W2-93-V3-VALP-056	The requirements related to the ATSEP role are reformulated according to the feedback received from the ATSEP expert group.			



					implemented in an extra-time.	
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Table 25252525252525: Validation Results for EXE-PJ.10-W2-93-V3-VALP-003



## B.3.2 Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93 Main Operational Solution

Following are the results from PJ.10-W2-93-V3-VALP-003 per Validation Objective and their related Success Criteria.

**Important Note:** Only the outcomes from the Use Cases based on the Y or D architectures are taken into account due to the higher maturity of the U/D architectures compared to the U architecture.

### 1. EX3-OBJ-PJ.10-W2-93-V3-VALP-001 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001:** To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-001 per Success Criteria:

Success criteria	Summary of Results	Suc. Crit. Status
EX3-CRT-PJ.10-W2-93-V3-VALP-001-001	Delegation of ATM services provision in nominal conditions was feasible in Low to Medium traffic densities as the workload of all involved ATCOs was manageable in all phases of the delegation. Moreover, the operational feasibility was found satisfactory by controllers. However, the ability to maintain safe operations was deemed as not entirely acceptable.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-001-002	Delegation of ATM services provision in nominal conditions was feasible in Low to Very High complexity environment	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-001-003	Delegation of ATM services provision in contingency use case was feasible in Low to Medium traffic densities as the workload of all involved ATCOs was manageable in all phases of the delegation.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-001-004	Delegation of ATM services provision in contingency use case was feasible in Low to Very High complexity environment	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-001-005	Following limitations for the applicability of the delegation of ATM services provision in <u>normal conditions</u> are identified: <ul style="list-style-type: none"> <li>The lack of adequate training had a negative impact on the feasibility of the delegation of ATM services provision in normal conditions. ATCOs express the need to have training to maintain the currency on the respective sectors to improve the feasibility/acceptability of the concept.</li> <li>The lack of supporting tools and safety nets commonly used in OPS room had a negative impact on the delegation. The</li> </ul>	OK

	<p>version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.</p> <ul style="list-style-type: none"> <li>• Controllers experienced difficulties in maintaining a clear traffic picture and managing traffic especially during the delegation process. This was strictly related to the preview phase issues (i.e., ATCOs would have needed an improved preview mode with a cleared understanding on the switch to the operational mode and specific indications on the traffic to be gained and on the one to be delegated).</li> <li>• The level of traffic should remain acceptable, (i.e., from low to medium) for the applicability of the delegation of ATMS service provision, in particular in dynamic AoR conditions.</li> <li>• The procedure is not feasible in the use cases involving different ADSPs at the delegating and the receiving ATSUs due to the lack of maturity of the VC U architecture platform, i.e., lack of synchronization between the ADSPs</li> <li>• Configuration Management of the various ADSPs and of the CWPS at the ATSUs requires ATSEP personal, well trained on their dedicated systems and a close coordination during all phases of the delegation. Therefore, the procedure would not be feasible without trained ATSEPs at the ADSP(s) and ATSU(s) levels.</li> </ul>
<p>EX3-CRT-PJ.10-W2-93-V3-VALP-001-006</p>	<p>Following limitations for the applicability of the delegation of ATM services provision in contingency use case are identified:</p> <ul style="list-style-type: none"> <li>• Above limitations also apply in the contingency UC#</li> <li>• Although the scenario is based on a failure of the delegating ATSU, the CWPs at that ATSU did not went really into a failure mode, the reason why the Normal "Empty the Sky" procedure (that shall be applied before initiating the delegation procedure) was not simulated. Such a simulation requires much more preparation and training for ATCOs of both ATSUs</li> </ul>

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-001:** Result = OK

**Method:**

To assess the operational Delegation of ATM services feasibility of the delegation of ATM services provision in environments from low to high density two main aspects have been considered including the level of workload and the acceptability/feasibility of the concept in nominal conditions. It has also have been investigated the ability for ATCOs to maintain safe operations as an indirect indicator.

The workload was assessed after each nominal condition’s run and at the end of the week for nominal conditions.

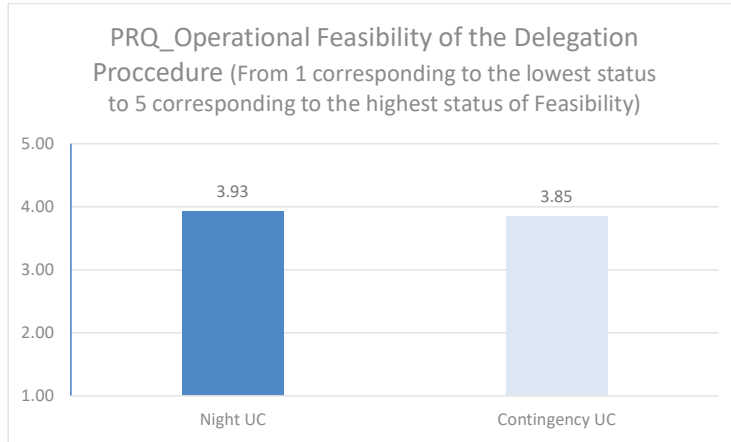
The acceptability/feasibility was assessed after each nominal condition’s run and at the end of the week for nominal conditions.

The ability to maintain safe operations was assessed after each nominal condition’s run.

Note: It has to be considered that the level of traffic was assessed Low to Medium by the ATCOs.

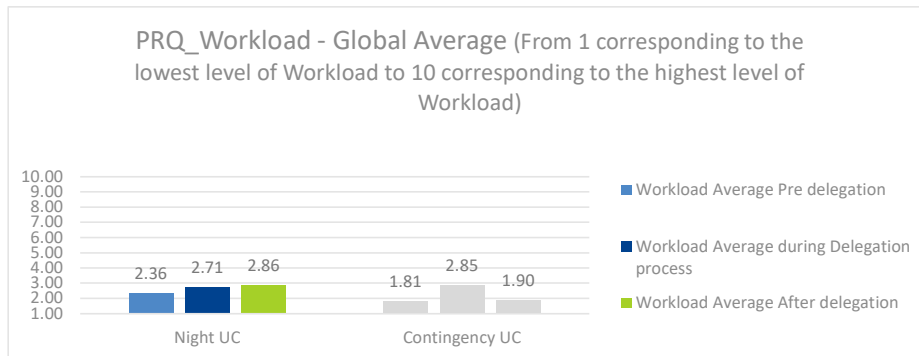
**Results:**

Feasibility & Acceptability:

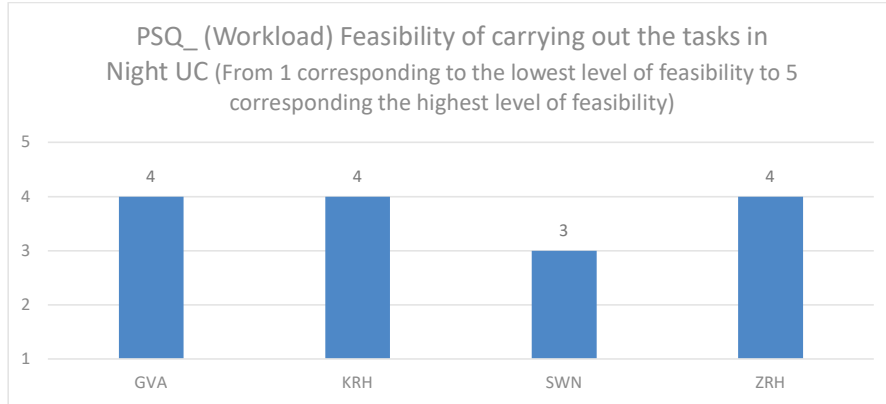


The first graph presents the results from the Post Run Questionnaire in nominal conditions (i.e., Night Use Cases). The average score in nominal condition is 3,93 corresponding to an acceptable level of Feasibility from ATCOs’ perspectives.

Workload:



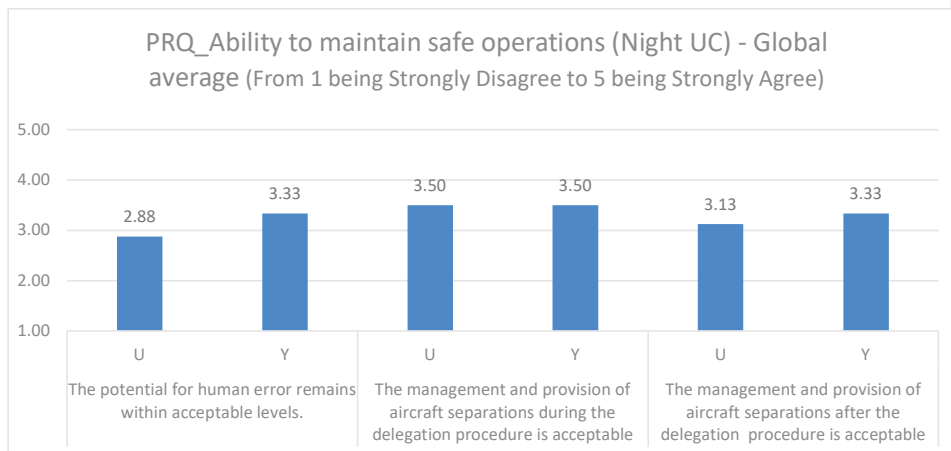
The first graph presents the results from the Post Run Questionnaire in nominal conditions (i.e., Night Use Cases). The average score in nominal condition is 2,36 before the delegation, 2,71 during the delegation process and 2,86 after the delegation. Results show that the workload tend to increase during and after the process of delegation, but the rates remain at a low level of Workload.



This graph presents the results from the Post Simulation Questionnaire. ATCOs were asked to answer the following question, based on a scale ranged from 1, meaning *Strongly Disagree*, to 5 meaning *Strongly Agree*: Do you consider that all the tasks you had to carry out were feasible?

Results show a satisfactory level of feasibility with rates of 4 (i.e., corresponding to the value *Agree*) for almost all the ATSUs, except for the SWN ATSU, giving the neutral rate 3.

Ability to maintain safe operations:



The ability to maintain safe operations was assessed through three aspects:

- The potential for human error remains within acceptable levels
- The management and provision of aircraft separations during the delegation procedure is acceptable
- The management and provision of aircraft separations after the delegation procedure is acceptable



- For the first aspect, results show that the U architecture has the lower score, with an average rate of 2,88 corresponding to the value *Disagree* to almost the value *Neutral*. The Y architecture obtained a higher average score with an average rate of 3,33 which is slightly higher than the *Neutral* corresponding value. The lower results of the U architecture could be explained by the fact that it was the least mature architecture and ATCOs experienced technical issues during the U architectures runs.
- The management and provision of aircraft separations during the delegation procedure tend to be acceptable for both architectures, with average scores of 3,5 which is higher than the *Neutral* corresponding value.
- The management and provision of aircraft separations after the delegation procedure was assessed and obtained rates slightly above 3 for both U and Y architectures, with Y obtaining the highest score being 3,33. There is no clear evidence of acceptability for this aspect.

Debriefing & comments:

- Controllers expressed concerns on the ability to maintain safe operations and noted that adequate training on the delegated airspace would improve the feasibility of the delegation process. Requirements to maintain currency on the sectors taken over should be part of the future solutions.
- Overall, ATCOs reported that the delegation concept is feasible but needs to be improved in terms of integration of supporting tools and safety nets that are currently used in OPS room. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.

**Conclusion:**

Delegation of ATM services provision in nominal conditions was feasible in Low to Medium traffic densities as the workload of all involved ATCOs was manageable in all phases of the delegation. Moreover, the operational feasibility was found satisfactory by controllers. The ability to maintain safe operations was deemed not entirely acceptable, due to the U architecture. ATCOs noted that an adequate training on the delegated sectors would have a positive impact on the feasibility of the concept, including the ability to maintain safe operations.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-002:** Result = OK

**Method:**

To assess the feasibility of delegation of ATM services provision in nominal conditions for Low to Very High complexity environment, the workload and acceptability/feasibility have been considered. It has also been investigated the ability for ATCOs to maintain safe operations as an indirect indicator.

The workload was assessed after each nominal condition's run and at the end of the week for nominal conditions.

The acceptability/feasibility was assessed after each nominal condition's run and at the end of the week for nominal conditions.

The ability to maintain safe operations was assessed after each nominal condition's run.

**Results:**

The level of workload was deemed low and manageable during all phases of the delegation (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-001).

The acceptability/feasibility was deemed satisfactory by the controllers (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-001).

The ability to maintain safe operations was rated neutral by controllers for the Y architecture Use Cases but not entirely acceptable for the U architecture Use Cases. ATCOs noted that an adequate training on the delegated sectors would have a positive impact on the feasibility of the concept, including the ability to maintain safe operations. (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-001).

**Conclusion:**  
 Delegation of ATM services provision in nominal conditions was feasible in Low to Very High Complexity environment.  
 This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-003:** Result = OK

**Method:**

To assess the operational Delegation of ATM services feasibility of the delegation of ATM services provision in environments from low to high density the level of workload and the acceptability/feasibility of the concept in contingency Use Cases were considered. It has also have been investigated the ability for ATCOs to maintain safe operations as an indirect indicator.

The workload was assessed after each nominal condition’s run and at the end of the week for nominal conditions.

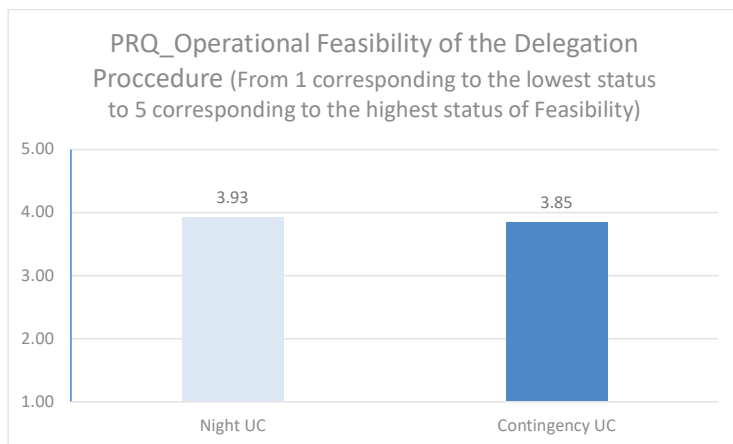
The acceptability/feasibility was assessed after each nominal condition’s run and at the end of the week for nominal conditions.

The ability to maintain safe operations was assessed after each nominal condition’s run.

**Note:** It has to be considered that the level of traffic was assessed Low to Medium by the ATCOs.

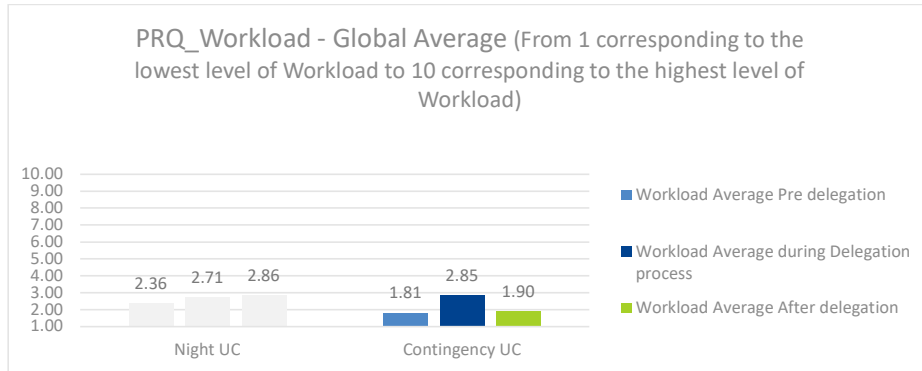
**Results:**

**Feasibility & Acceptability:**

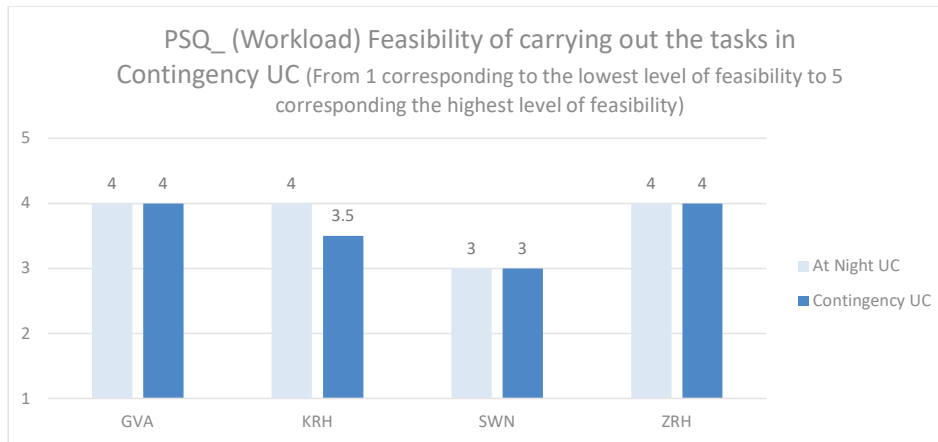


The first graph presents the results from the Post Run Questionnaire for contingency Use Cases. The average score is 3,85 corresponding to an acceptable level of Feasibility from ATCOs' perspectives.

**Workload:**



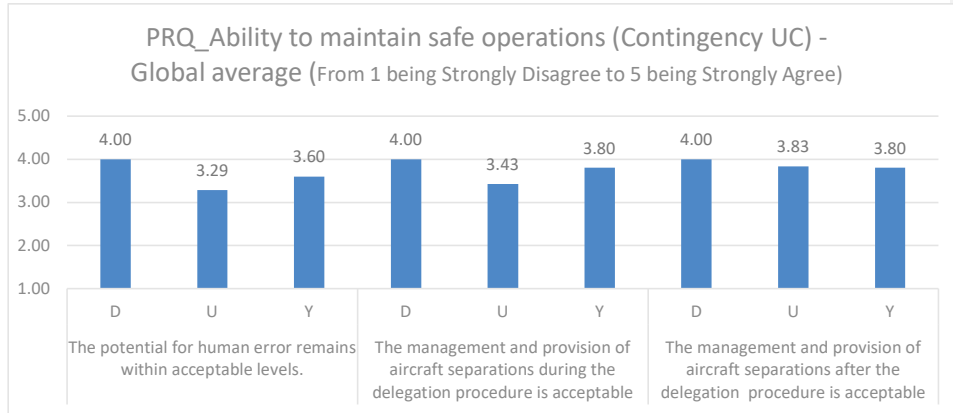
This first graph presents the results from the Post Run Questionnaire in nominal conditions (i.e., Contingency Use Cases). The average score in Contingency UC is 1,81 before the delegation, 2,85 during the delegation process and 1,90 after the delegation. Results show that the workload tend to increase during and after the process of delegation, but the rates remain at a low level of Workload.



This second graph presents the results from the Post Simulation Questionnaire. ATCOs were asked to answer the following question, based on a scale ranged from 1, meaning *Strongly Disagree*, to 5 meaning *Strongly Agree*: Do you consider that all the tasks you had to carry out were feasible?

Results show a satisfactory level of feasibility with rates of 4 (i.e., corresponding to the value *Agree*) for almost all the ATCUs, except for the SWN ATCU, giving the neutral rate 3.

Ability to maintain safe operations:



The ability to maintain safe operations was assessed through three aspects:

- The potential for human error remains within acceptable levels
- The management and provision of aircraft separations during the delegation procedure is acceptable
- The management and provision of aircraft separations after the delegation procedure is acceptable

The potential for human error remains within acceptable levels according to the results. The average scores ranged from 3,29 for the U architecture (corresponding to an average rate slightly higher the neutral value of the scale) to 4 for the architecture D, corresponding to the qualitative value *Agree*. The Y architecture obtained an average score of 3,60 which is higher than the neutral corresponding value.

The management and provision of aircraft separations during the delegation procedure tend to be acceptable for the architectures D and Y, with average scores from 3,8 which is higher than the *Neutral* corresponding value to the average score 4, indicating that controllers were agreeing with the statement. The scores are slightly lower for the U architecture.

The management and provision of aircraft separations after the delegation procedure obtained rates ranged from 3,8 to 4, indicating that it was acceptable.

Debriefing & comments:

Controllers noted that an adequate training to maintain the currency on the respective sectors would have a positive impact on the feasibility/acceptability of the concept.

Moreover, ATCOs reported that the delegation concept is feasible but needs to be improved in terms of integration of supporting tools and safety nets that are currently used in OPS room. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.

**Conclusion:**

The controllers expressed positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to medium density for the contingency use case.

However, controllers noted that an adequate training to maintain the currency on the respective sectors should be part of the future solution.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-004:** Result = OK

Delegation of ATM services provision in contingency use case was feasible in Low to Very High complexity environment

**Method:**

To assess the feasibility of delegation of ATM services provision in contingency use case for Low to Very High complexity environment, the workload and acceptability/feasibility have been considered. It has also have been investigated the ability for ATCOs to maintain safe operations as an indirect indicator.

The workload was assessed after each nominal condition's run and at the end of the week for nominal conditions.

The acceptability/feasibility was assessed after each nominal condition's run and at the end of the week for nominal conditions.

The ability to maintain safe operations was assessed after each nominal condition's run.

**Results:**

The level of workload was deemed low and manageable during all phases of the delegation (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-003).

The acceptability/feasibility was deemed satisfactory by the controllers (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-003).

The ability to maintain safe operations was rated neutral by controllers for the Y architecture Use Cases but not entirely acceptable for the U architecture Use Cases. Controllers noted that an adequate training to maintain the currency on the respective sectors should be part of the future solution. (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-001-003).

**Conclusion:**

Delegation of ATM services provision in nominal conditions was feasible in Low to Very High Complexity environment.  
Success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-005:** Result = OK

Results are reported in the Summary Table.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-001-006:** Result = OK

Results are reported in the Summary Table.

## 1. EX3-OBJ-PJ.10-W2-93-V3-VALP-002 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-002:** To demonstrate the Operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night".

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-002 per Success Criteria:

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-002-001	<p>A delegation procedure was detailed for each of the 10 played use cases (4 of them are night use cases), this included:</p> <ul style="list-style-type: none"> <li>- The operations to be performed by ATCOs on the ATC and Voice CWPs</li> <li>- The system configuration steps to be executed by each involved ATSEP of the distributed validation platform</li> <li>- The dialog and agreement to be established between ATCOs of delegating and receiving ATSUs</li> </ul>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-002-002	The delegation procedure for the night use case was judged feasible by all involved ATCOs from Skyguide, DFS and NATS	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-002-003	<p>The role of each actor was well understood and was correctly played during the delegation process for the night use case:</p> <ul style="list-style-type: none"> <li>- The Executive ATCO was only managing the frequency and the separations</li> <li>- The Planner ATCO had a double role to support the Executive and to play the SUP role</li> <li>- The SUPs at the delegating and receiving ATSUs had the responsibility to apply the delegation procedure and to coordinate via the phone</li> <li>- The SUPs rely to their local ATSEPs for any questions regarding the system configuration, supervision and monitoring of local CWPs or remote ADSPs</li> </ul>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-002-004	The quality of ATC service provision during and after delegation procedure was neutrally impacted during UC in Dynamic AoR conditions, whereas it was impacted during Static AoR conditions according to the results.	OK	

#### **Method at Validation Objective level:**

To assess the operational feasibility of the delegation procedure for Night use cases, the following indicators were investigated through the Post Run Questionnaire (PRQ) which was filled after each run and the Post Simulation Questionnaire (PSQ) which was filled at the end of the simulation:

##### Post Run Questionnaire:

- The clarity of the delegation definition
- The operational feasibility of delegation
- The clear definition of roles and responsibilities during the delegation process
- The impact on the quality of the ATC service provision during the delegation process
- The impact on the quality of the ATC service provision after the delegation process
- Open comment and debriefing sessions

##### Post Simulation Questionnaire:

- ATS delegation procedures in delegation of ATM services provision are clearly defined and documented
- ATS delegation procedures in Delegation of ATM services provision are acceptable
- The tasks linked to ATS delegation procedure can be done in timely manner
- How would you rate the level of difficulty linked to the tasks of ATS delegation procedure
- SHAPE Teamwork Questionnaire (STQ):
  - a. It was clear to me which tasks were my responsibility
  - b. It was clear to me which tasks were carried out by the other team members
  - c. It was clear to me which tasks I shared with the other team members

**EX3-OBJ-PJ.10-W2-93-V3-VALP-002-001:** Result = OK

#### **Method:**

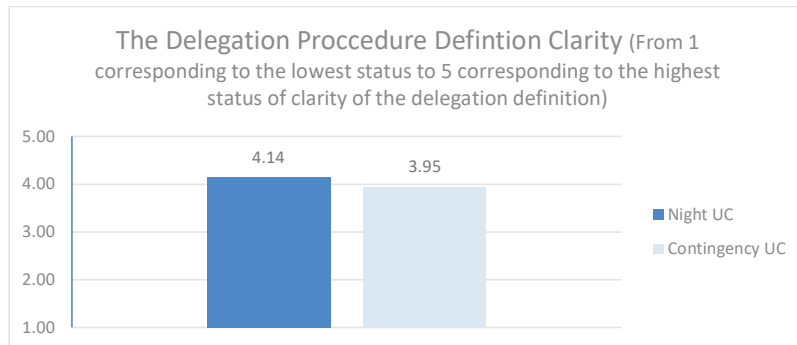
##### Post Run Questionnaire:

To assess if the delegation procedure for the Night use case is clearly defined and documented, including the handover dialogue, the controllers were asked to rate their level of agreement with the following statements after each run, based on a scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*:

- The delegation procedure is clearly defined

#### **Results:**

Results show that the delegation procedure is considered by the controllers to be acceptable as the average score for Night UC is 4,14 corresponding to the qualitative value *Agree*.



#### Debriefings:

The dialogue during the handover was also deemed clear and intuitive by controllers. However, a common display tool during the checking of the flights between the delegating sector and the receiving sector could facilitate the coordination between the controllers.

#### Method:

##### Post Simulation Questionnaire:

The controllers were asked at the end of the simulation to rate their level of agreement with the following statement based on a 5-point scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*.

- ATS delegation procedures in delegation of ATM services provision are clearly defined and documented
- ATS delegation procedures in Delegation of ATM services provision are acceptable

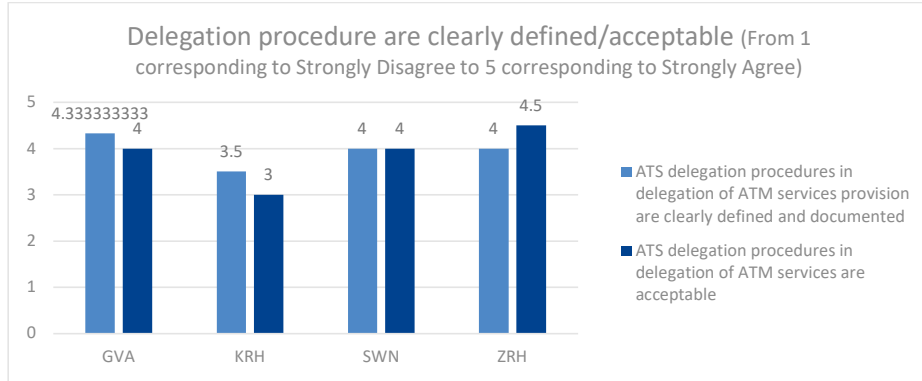
The results are not specific to Night UC as they are including Contingency UC, therefore the results are considered as indirect indicators to assess this criterion.

#### Results:

The ATS delegation procedures in delegation of ATM services provision is deemed clearly defined and documented by controllers, with average scores from 4 to 4,5 corresponding to the qualitative value *Agree*, except for the Karlsruhe controllers who gave the rate 3,5 which is slightly above the corresponding value *Neutral*.

The ATS delegation procedures in Delegation of ATM services provision were deemed also acceptable by almost all ATSUs, except for Karlsruhe ATCOs





**Conclusion:**

The delegation procedure was deemed acceptable, clearly defined and well documented.  
 This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-002-002:** Result = OK

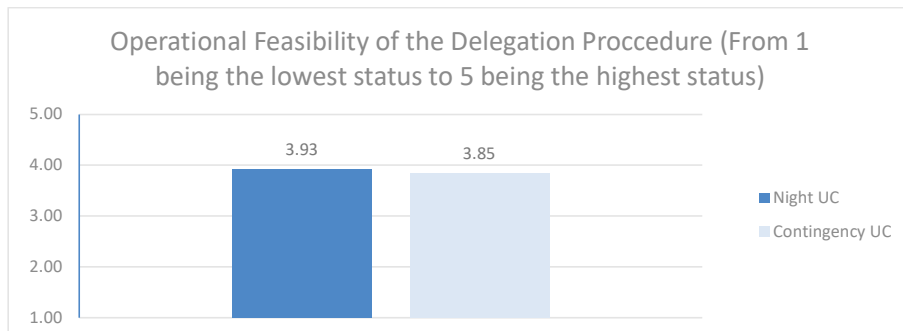
**Method:**

Post Run Questionnaire:

To assess if the delegation procedure for the Night use case is feasible including the handover dialogue, the controllers were asked to rate their level of agreement with the following statements after each run, based on a scale ranged from 1 meaning Strongly Disagree to 5 meaning Strongly Agree:

- The delegation procedure is operationally feasible

**Results:**



The graph displays the level of operational feasibility of the delegation procedure according to ATCOs. The average score is 3,93 for Night UC which correspond to an acceptable level of operational feasibility.

Post Simulation Questionnaire:

**Method:**

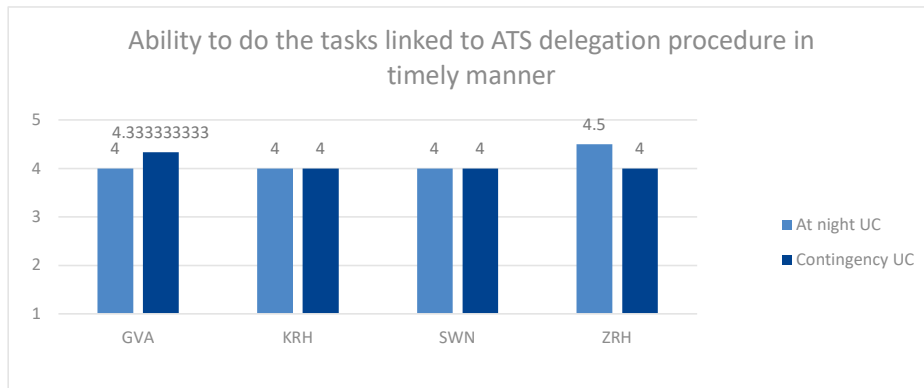
The controllers were asked at the end of the simulation to rate their level of agreement with the following statement based on a 5-point scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*.

- The tasks linked to ATS delegation procedure can be done in timely manner

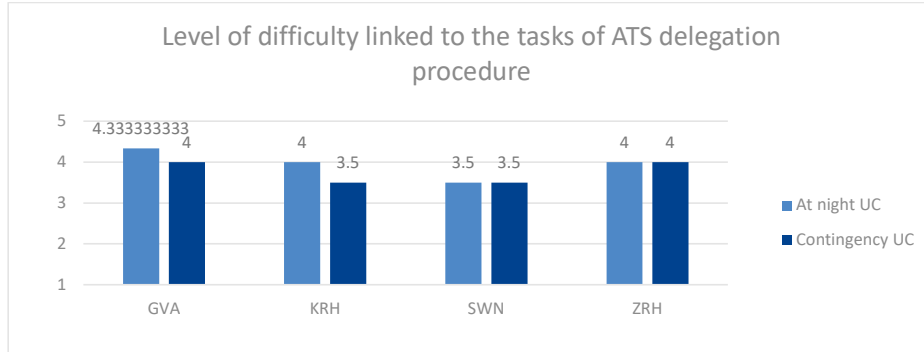
They were also asked to rate the level of difficulty linked to the delegation at Night UC based on a 5-point scale ranged from 1 meaning *Impossible* to 5 meaning *Extremely easy*:

- How would you rate the level of difficulty linked to the tasks of ATS delegation procedure?

**Results:**



The first graph displays the ability for controllers to do the tasks linked to ATS delegation procedure in timely manner. The scores ranged from 4 to 4,5 which indicate that ATCOs were able to manage the tasks in timely manner.



The second graph displays the level of difficulty linked to the tasks of ATS delegation procedure according to the controllers. Results ranged from 3,5 to 4.3 for Night UC? corresponding to acceptable level of difficulty.

**Conclusion:**

The operational feasibility is deemed acceptable by the controllers as well as the level of difficulty and the ability to do the tasks linked to delegation in timely manner for At Night UC.

This success criteria is Ok.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-002-003:** Result = OK

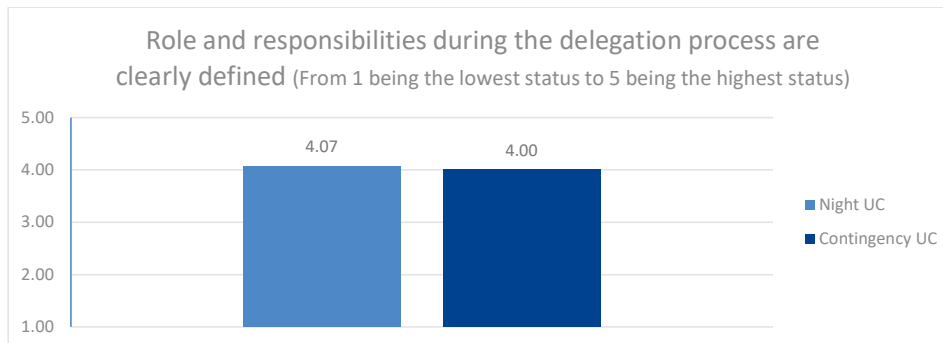
Post Run Questionnaire:

**Method:**

The impact concerning the distribution of roles and responsibilities for the delegation procedure and for Night UC was assessed after each run by asking the controllers to rate their level of agreement with the following statement, based on a scale ranged from 1 corresponding to the qualitative value *Strongly Disagree* to 5 corresponding to the qualitative value *Agree*:

- The roles and responsibilities during the delegation process are clearly defined

**Results:**



The distribution of roles and responsibilities are deemed clearly defined by controllers for Night UC, with an average score of 4,07 corresponding to the value *Agree*.

Post Simulation Questionnaire:

**Method:**

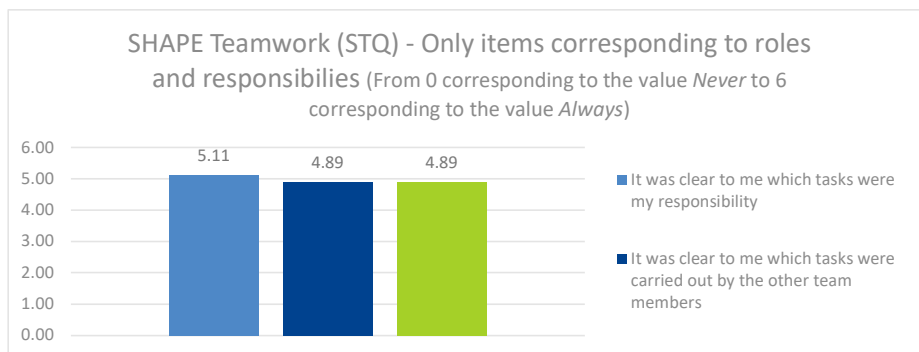
To assess the impact regarding the distribution of roles and responsibilities for the delegation procedure for the Night UC, the questionnaire SHAPE Teamwork (STQ) was filled by the controllers at the end of the simulation.

The following items were extracted to assess this success criteria:

- It was clear to me which tasks were my responsibility
- It was clear to me which tasks were carried out by the other team members
- It was clear to me which tasks I shared with the other team members

*Note: The results are not specific to Night UC as they are including Contingency UC, therefore the results are considered as indirect indicators to assess this criterion.*

**Results:**



Results show acceptable level for each aspect, with average scores ranged from 4,89 to 5,11 indicating that there is no negative impact on the role and responsibilities for the delegation procedure at Night UC.

**Conclusion:**

There is no negative impact on the role and responsibilities for the delegation procedure at Night UC. This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-002-004:** Result = OK

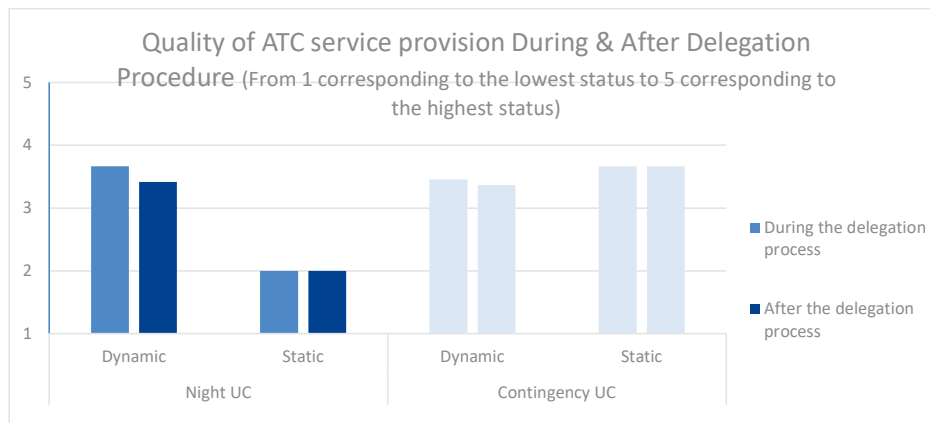
### Post Run Questionnaire:

#### Method:

The impact regarding the quality of the ATM services provision for the delegation procedure for the Night UC has been assessed after each run by asking the controllers to rate their level of agreement with the following statement, based on a scale ranged from 1 corresponding to the qualitative value *Strongly Disagree* to 5 corresponding to the qualitative value *Agree*:

- The quality of the ATC service provision is not impacted during the delegation process
- The quality of the ATC service provision is not impacted after the delegation process

#### Results:



The impact on quality of ATC service provision was rated as *neutral* by controllers for Dynamic AoR conditions and at Night Use Cases. However, results show that for the Static AoR UC the quality of the ATC service provision was impacted. ATCOs expressed that the technical issues occurred and negatively impacted the quality of ATC service provision. Results show no clear differences between during and after the delegation is completed regarding the impact on the quality of ATC service provision.

#### Debriefing & comments:

Controllers expressed concerns in terms of quality of ATC service provision and noted that an adequate training would help them in providing an acceptable level of ATC service provision.

#### Conclusion:

The quality of ATC service provision during and after delegation procedure was neutrally impacted during UC in Dynamic AoR conditions, whereas it was impacted during Static AoR conditions according to the results. ATCOs noted that an adequate training would help them in providing an acceptable level of ATC service provision.

This success criteria is OK.

## 2. EX3-OBJ-PJ.10-W2-93-V3-VALP-003 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-003:** operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision in case of contingency”.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-003 per Success Criteria:

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-003-001	<p>A delegation procedure was detailed for each of the 10 played use cases (6 of them are contingency use cases), this included:</p> <ul style="list-style-type: none"> <li>- The operations to be performed by ATCOs on the ATC and Voice CWPs</li> <li>- The system configuration steps to be executed by each involved ATSEP of the distributed validation platform</li> <li>- The dialog and agreement to be established between ATCOs of delegating and receiving ATSUs</li> </ul>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-003-002	<p>The delegation procedure for the contingency use case was judged feasible by all involved ATCOs from Skyguide, DFS and NATS</p>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-003-003	<p>The roles of each actor was well understood and was correctly played during the delegation process for the contingency use case:</p> <ul style="list-style-type: none"> <li>- The Executive ATCO was only managing the frequency</li> <li>- The Planner ATCO had a double role to support the Executive and to play the SUP role</li> <li>- The SUPs at the delegating and receiving ATSUs had the responsibility to apply the delegation procedure and to coordinate via the phone</li> <li>- The SUPs rely to their local ATSEPs for any questions regarding the system configuration, supervision and monitoring of local CWPs or remote ADSPs</li> </ul>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-003-004	<p>The quality of ATC service provision during and after delegation procedure was neutrally impacted according to the results</p>	OK	

#### **Method Validation Objective level:**

To assess the operational feasibility of the delegation procedure for Contingency use cases, the following indicators were investigated through the Post Run Questionnaire (PRQ) which was filled after each run and the Post Simulation Questionnaire (PSQ) which was filled at the end of the simulation:

#### **Post Run Questionnaire:**

- The clarity of the delegation definition
- The operational feasibility of delegation
- The clear definition of roles and responsibilities during the delegation process
- The impact on the quality of the ATC service provision during the delegation process
- The impact on the quality of the ATC service provision after the delegation process
- Open comment and debriefing sessions

#### **Post Simulation Questionnaire:**

- ATS delegation procedures in delegation of ATM services provision are clearly defined and documented
- ATS delegation procedures in Delegation of ATM services provision are acceptable
- The tasks linked to ATS delegation procedure can be done in timely manner
- How would you rate the level of difficulty linked to the tasks of ATS delegation procedure
- SHAPE Teamwork Questionnaire (STQ) :
  - a. It was clear to me which tasks were my responsibility
  - b. It was clear to me which tasks were carried out by the other team members
  - c. It was clear to me which tasks I shared with the other team members

**EX3-OBJ-PJ.10-W2-93-V3-VALP-003-001:** Result = OK

#### **Post Run Questionnaire:**

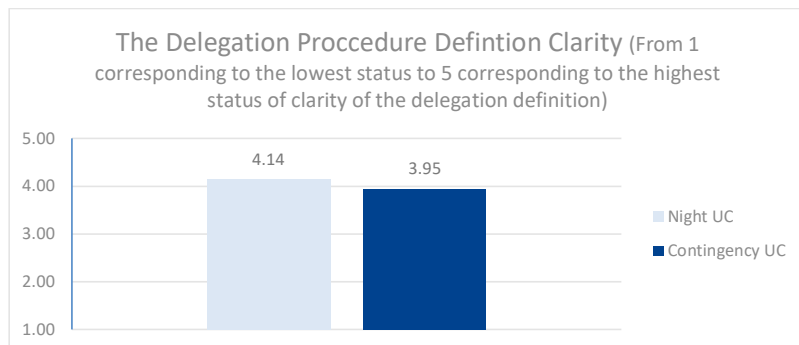
#### **Method:**

To assess if the delegation procedure for the Contingency use case is clearly defined and documented, including the handover dialogue, the controllers were asked to rate their level of agreement with the following statement after each run, based on a scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*:

- The delegation procedure is clearly defined

#### **Results:**

Results show that the delegation procedure is considered by the controllers to be acceptable on average as the mean value for Night UC is 3,95, corresponding almost to the qualitative value *Agree*.



#### Debriefing:

The dialogue during the handover was also deemed clear and intuitive by controllers. However, a common display tool during the preview mode for the coordination of the flights between the delegating sector and the receiving sector could facilitate the coordination between the controllers and the overall process of delegation of ATM service provision.

#### Post Simulation Questionnaire:

##### Method:

As for EX3-CRT-PJ.10-W2-93-V3-VALP-002-001, the controllers were asked at the end of the simulation to rate their level of agreement with the following statement based on a 5-point scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*.

- ATS delegation procedures in delegation of ATM services provision are clearly defined and documented
- ATS delegation procedures in Delegation of ATM services provision are acceptable

*Note: The results are not specific to Night UC as they are including Contingency UC, therefore the results are considered as indirect indicators to assess this criterion.*

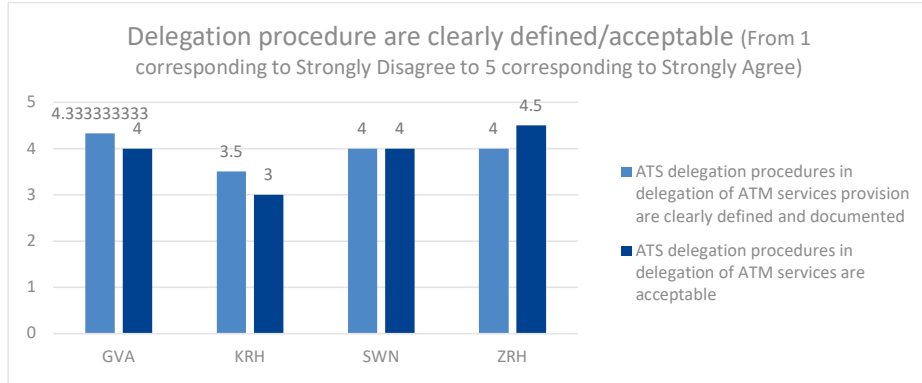
##### Results:

The ATS delegation procedures in delegation of ATM services provision is deemed clearly defined and documented by controllers, with average scores from 4 to 4,5 corresponding to the qualitative value *Agree*, except for the ATSU Karlsruhe which gave the rate 3,5 slightly above the corresponding value *Neutral*.

The ATS delegation procedures in Delegation of ATM services provision were deemed also acceptable by almost all ATSUs, except for Karlsruhe ATCOs.

Controllers expressed that the lack of common support tools, particularly during the preview mode and the coordination phase (i.e., Handover tool to check each flight during the coordination) between the respective ATSUs, negatively impacted the acceptability of the process of delegation.





**Conclusion:**

The delegation procedure was deemed acceptable and clearly defined and well documented. However, the lack of a common display on the traffic situation during the preview mode and the coordination phase (i.e., Handover tool to check each flight during the coordination) between the respective ATSUs, negatively impacted the acceptability of the process of delegation.

This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-003-002:** Result = OK

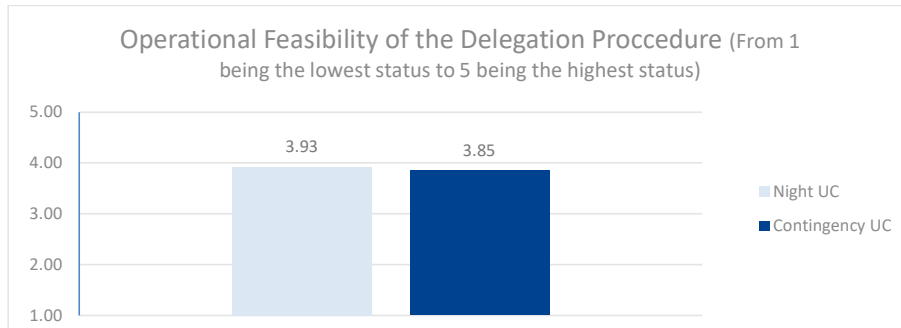
Post Run Questionnaire:

**Method:**

To assess the feasibility of the delegation procedure during Contingency Use Cases including the handover dialogue, the controllers were asked to rate their level of agreement with the following statements after each run, based on a scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*:

- The delegation procedure is operationally feasible

**Results:**



The graph displays the level of operational feasibility of the delegation procedure according to ATCOs. The average score is 3,85 for Contingency UC which correspond to an acceptable level of operational feasibility.

Post Simulation Questionnaire:

**Method:**

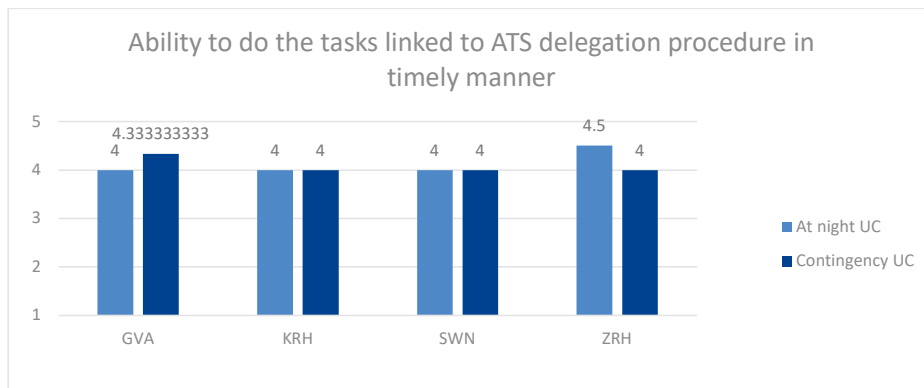
The controllers were asked at the end of the simulation to rate their level of agreement with the following statement based on a 5-point scale ranged from 1 meaning *Strongly Disagree* to 5 meaning *Strongly Agree*.

- The tasks linked to ATS delegation procedure can be done in timely manner

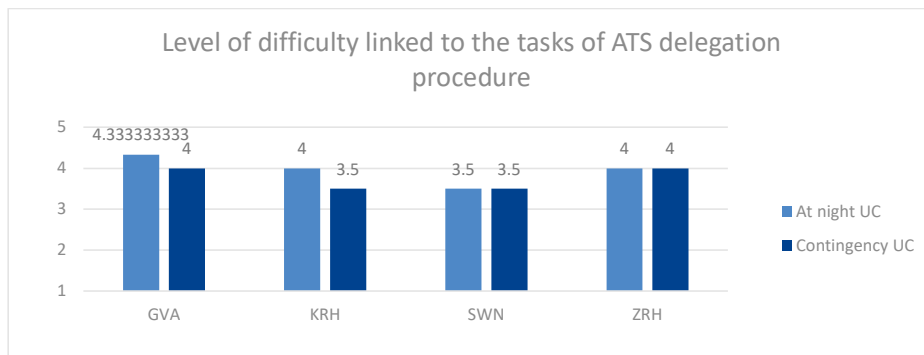
They were also asked to rate the level of difficulty linked to the delegation at Night UC based on a 5-point scale ranged from 1 meaning Impossible to 5 meaning Extremely easy:

- How would you rate the level of difficulty linked to the tasks of ATS delegation procedure?

**Results:**



The first graph displays the ability for controllers to do the tasks linked to ATS delegation procedure in timely manner. The scores ranged from 4 to 4,3 for Contingency UC, which indicate that ATCOs were able to manage the tasks in timely manner.



The second graph displays the level of difficulty linked to the tasks of ATS delegation procedure according to the controllers. Results ranged from 3,5 to 4 for Contingency UC, corresponding to acceptable level of difficulty.

**Conclusion:**

The operational feasibility is deemed acceptable by the controllers as well as the level of difficulty and the ability to do the tasks linked to delegation in timely manner for Contingency UC.

This success criteria is Ok.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-003-003: Result = OK**

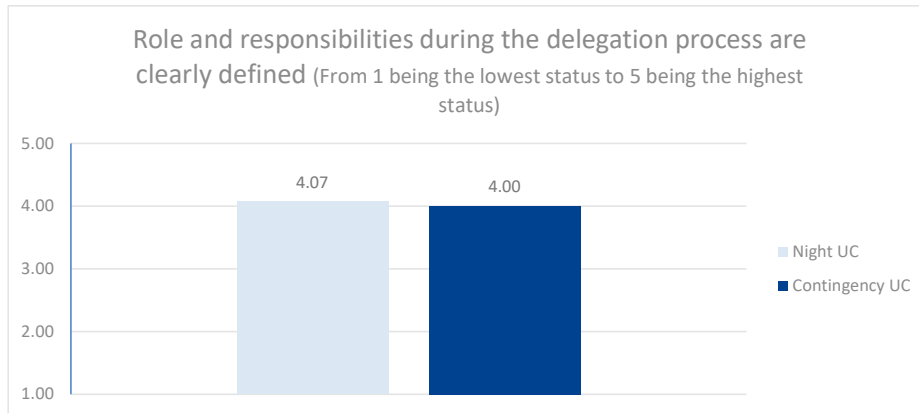
Post Run Questionnaire:

**Method:**

The impact regarding the distribution of roles and responsibilities for the delegation procedure for the Contingency UC was assessed after each run by asking the controllers to rate their level of agreement with the following statement, based on a scale ranged from 1 corresponding to the qualitative value *Strongly Disagree* to 5 corresponding to the qualitative value *Agree*:

- The roles and responsibilities during the delegation process are clearly defined

**Results:**



The distribution of roles and responsibilities are deemed clearly defined by controllers for Night UC, with an average score of 4,0 corresponding to the value *Agree*.

Post Simulation Questionnaire:

**Method:**

As described in the criteria EX3-CRT-PJ.10-W2-93-V3-VALP-003-003, the impact regarding the distribution of roles and responsibilities for the delegation procedure for the Contingency UC was

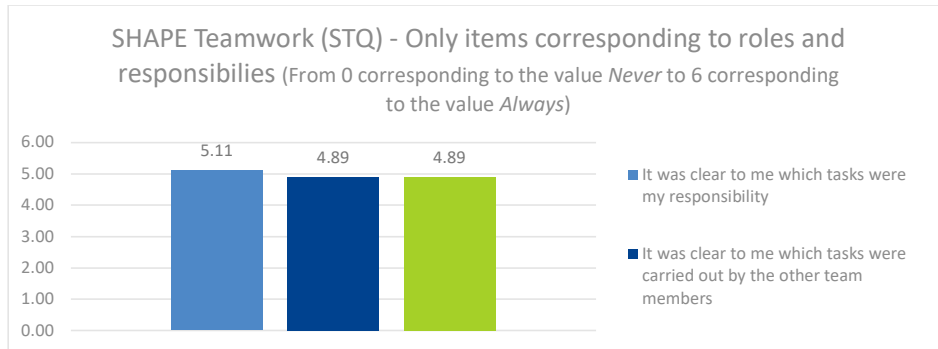
assessed also through the questionnaire SHAPE Teamwork (STQ) was filled by the controllers at the end of the simulation.

The following items were extracted to assess this success criteria:

- It was clear to me which tasks were my responsibility
- It was clear to me which tasks were carried out by the other team members
- It was clear to me which tasks I shared with the other team members

*Note: The results are not specific to Night UC as they are including Contingency UC, therefore the results are considered as indirect indicators to assess this criterion.*

**Results:**



Results show acceptable level for each aspect, with average scores ranged from 4,89 to 5,11 indicating that there is no negative impact on the role and responsibilities for the delegation procedure at Night UC.

Conclusion:  
 There is no negative impact on the role and responsibilities for the delegation procedure for Contingency UC.  
 This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-003-004:** Result = OK

Post Run Questionnaire:

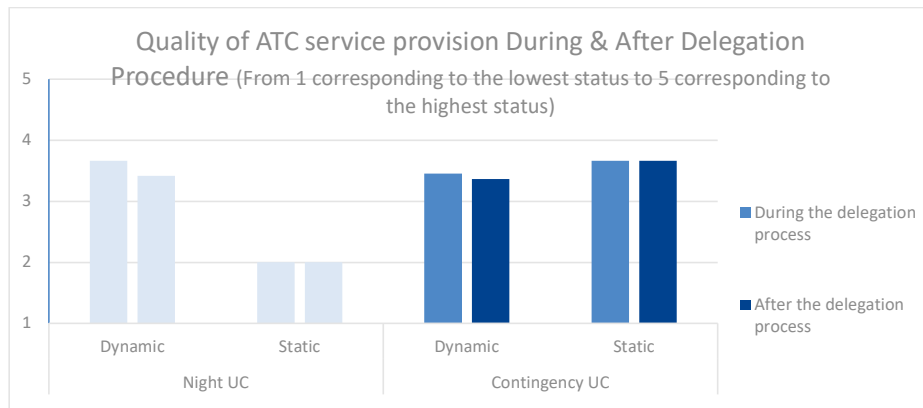
**Method:**

The impact regarding the quality of the ATM services provision for the delegation procedure for the Contingency UC has been assessed after each run by asking the controllers to rate their level of agreement with the following statement, based on a scale ranged from 1 corresponding to the qualitative value *Strongly Disagree* to 5 corresponding to the qualitative value *Agree*:

- The quality of the ATC service provision is not impacted during the delegation process

- The quality of the ATC service provision is not impacted after the delegation process

**Results:**



For Contingency UC, the results show that the controllers considered the impact on quality of ATC service provision as neutral. There is no clear differences between AoR conditions although controllers tend to be more agreeing with the statement “The quality of the ATC service provision is not impacted during & after the delegation procedure” in Static AoR conditions. Results show no clear differences between the results in function of the delegation’s phases (i.e., During and After the delegation process) regarding the impact on the quality of ATC service provision.

Debriefing & comments:

Controllers expressed concerns in terms of quality of ATC service provision after delegation procedure highlighting that the lack of information and expertise on the sector taken over negatively impacted their ability to maintain an efficient and good quality of ATC service provision. They noted that an adequate training to maintain the currency on the delegated sectors is needed to improve the quality of ATC service. The tools could also compensate the lack of expertise on the sectors by displaying additional information (e.g., routes, exit/entry points). Moreover, the lack of supporting tools and safety nets during the exercise negatively impacted their perceived quality of service.

Conclusion:  
 The quality of ATC service provision during and after delegation procedure was neutrally impacted according to the results.  
 This success criteria is OK.

**3. EX3-OBJ-PJ.10-W2-93-V3-VALP-004 Results**

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004:** Operational acceptance of the delegation procedure for the “Delegation of ATM services provision at Night”.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-004 per Success Criteria:

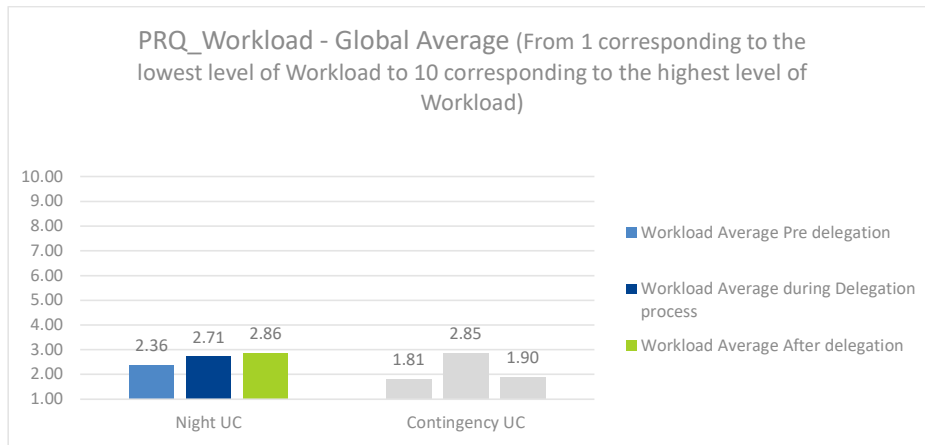
Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-004-001	The level of Workload for Night Use Case remains at a low level during all phases of the delegation, which corresponds to a satisfactory level of workload. The level of workload appeared to be increasing during the delegation and after the delegation is completed, but it remains at an acceptable level. The communication load was deemed satisfactory.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-002	The level of Situational awareness varied throughout the phases of the delegation process but was assessed acceptable by controllers. On average, the SA decreased a little during the process of delegation and after the delegation was completed but remained at an acceptable level.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-003	The level of trust and confidence was moderate as some technical issues occurred and the lack of certain tools controllers are used to work with were missing in the simulation and negatively impacted their confidence. There are no clear differences between the level of trust during Night UC compared to Contingency UC.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-004	When looking only to the delegation procedure, although improvements are always possible, we conclude that the Level of system support was satisfactory for all actors of the delegation: <ul style="list-style-type: none"> <li>- <b>ATCOs:</b> The CWPs provided a radar picture of both the delegated and currently controlled airspaces &amp; traffic. The preview functionality (although basic) was also implemented to support the delegation procedure. The level of maturity of these tools is good at least for the Y/D use cases.</li> <li>- <b>OPS/TECH SUPs:</b> Supervision &amp; Monitoring of the Voice &amp; ATC ADSPs, including details on the Status of the provided services, was ensured thanks to dedicated Supervision/Monitoring tools deployed at various places of the distributed VC validation platform.</li> </ul>	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-005	Level of SUP workload This role was played by the ATCO planners of both delegating and receiving ATSU, the reason why we assess a partial OK for this SC.  The level of workload remains low and at an acceptable level for Supervisors.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-006	The SA was deemed acceptable by Supervisors ATCOs in all phases of delegation. During the delegation the SA is slightly decreased and further decrease after the delegation is completed.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-004-007	The trust and confidence in the system was deemed acceptable and satisfactory by the Supervisors	OK	

EX3-CRT-PJ.10-W2-93-V3-VALP-004-008	Same result as under EX3-CRT-PJ.10-W2-93-V3-VALP-004-004.	OK
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**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-001:** Result = OK

**Post Run Questionnaire:**

Workload per delegation process phases



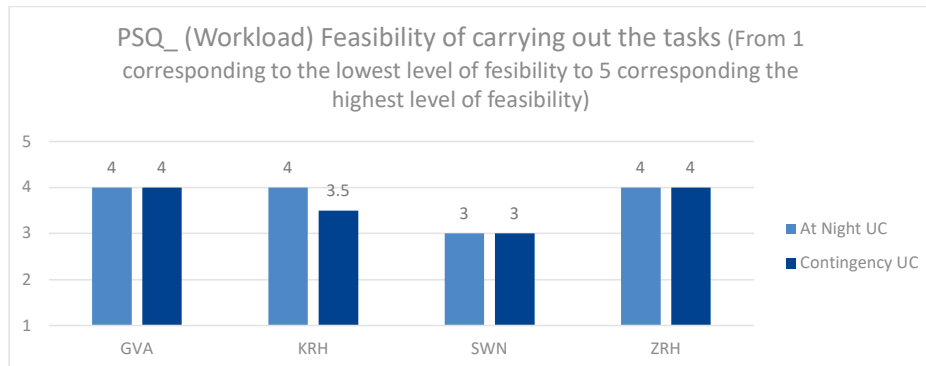
The first graph presents the results from the Post Run Questionnaire in both nominal and abnormal conditions. In this section only the Night UC (i.e., Nominal Conditions) is detailed.

The average score in nominal condition is 2,36 before the delegation, 2,71 during the delegation process and 2,86 out of 10 after the delegation. Results show that the workload tend to increase during and after the process of delegation, but the rates remain low indicating a low level of Workload.

Communication Load

The communication load during the delegation procedure was also assessed after each run and obtained the average score of 4 out 5, corresponding to a satisfactory level.

**Post Simulation Questionnaire:**



This graph presents the results from the Post Simulation Questionnaire. ATCOs were asked to answer the following question, based on a scale ranged from 1, meaning *Strongly Disagree*, to 5 meaning *Strongly Agree*: Do you consider that all the tasks you had to carry out were feasible?

In nominal conditions, results show a satisfactory level of feasibility with rates of 4 (i.e., corresponding to the value *Agree*) for almost all the ATSU, except for the SWN ATSU, giving the neutral rate 3.

**Conclusion:**

The level of Workload for Night Use Case remains at a low level during all phases of the delegation, which corresponds to a satisfactory level of workload. The level of workload appeared to be increasing during the delegation and after the delegation is completed, but it remains at an acceptable level.

The communication load was deemed satisfactory.

There is no clear differences between Contingency and Night Use Cases in terms of task performing feasibility.

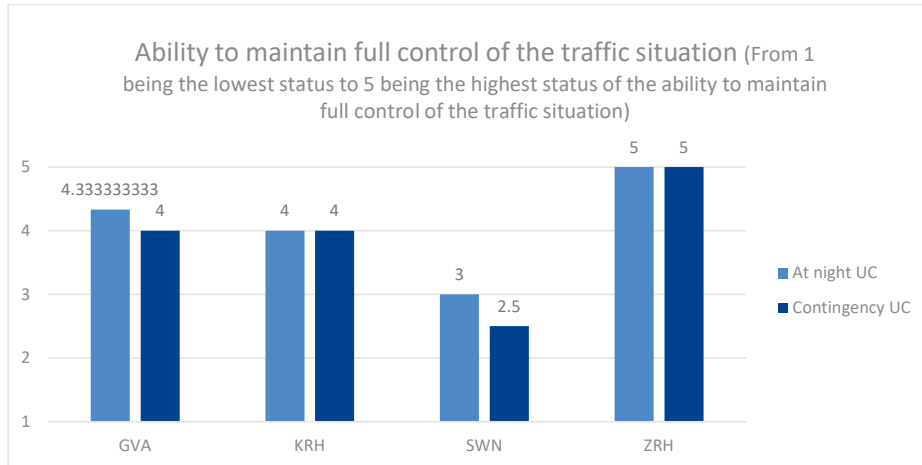
The criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-002:** Result = OK

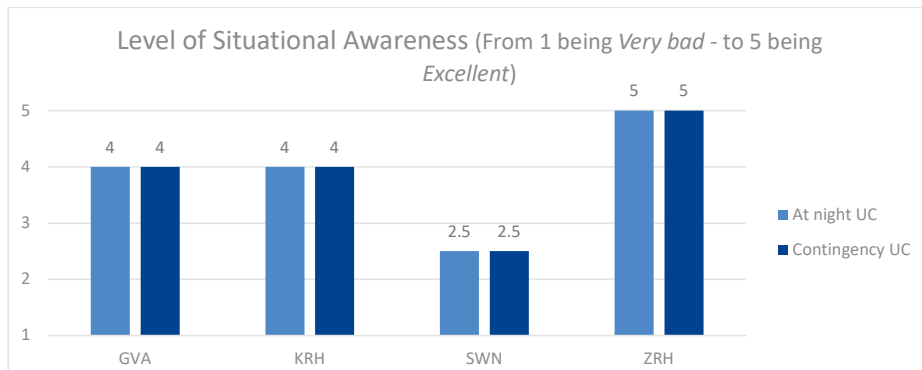
To assess this success criteria, the level of Situational Awareness and the ability to maintain full control of the traffic situation were assessed in the Post Simulation Questionnaire and by asking the controllers to give a rate based on a scale ranged from 1 corresponding to the lowest status to 5 corresponding to the highest status of the aspects assessed. The debriefings and comments have also been used to assess this success criteria.

**Post Simulation Questionnaire:**





Results show that the ability to maintain full control of the traffic situation is deemed satisfactory by most of the ATSUs, with average scores ranged from 4 to 5 out of 5, except for the SWN controllers, giving the rate of 3, corresponding to a neutral value.



The results of the overall level of Situational Awareness, confirm the trend described above, as SA is deemed acceptable by most of the ATSUs but the SWN ATSU, giving the rate of 2,5 corresponding to a negative value.

**Debriefing & comments:**

- Controllers highlighted the fact that the different HMI representation between centres involved, added complexity in building a common situational awareness.
- Moreover, they expressed that the lack of information on the delegated area had a negative impact on the Situational Awareness (e.g., Letter of Agreement, exit conditions, routes, waypoints).
- In addition, observations and debriefings highlighted the fact that Dynamic Area of Responsibility's Use Cases negatively impacted the Situational Awareness compared to the Static Area of

Responsibility's Use Cases because it changed the scanning/monitoring routine of the ATCOs. Indeed, controllers had suddenly to control a larger area including their own sector, without knowing the flows and the typical conflicts situations of the new sector taken over. The controllers may spend more time in analyzing the sector taken over at the expense of their own, which may result in reducing their global Situational Awareness.

- Observations and debriefings highlighted the fact that the receiving sector had to set up their HMI to adapt their screen to the sector taken over, including the level of zoom. Some ATCOs expressed difficulties in finding the right level of zoom to (e.g., level of zoom) and in finding their settings from one session to another. That could have negatively impacted the Situational Awareness.
- Controllers reported that during the preview mode and the coordination of flights between the delegating and receiving sector, they had difficulties in identifying the flights highlighted by the delegating sector. The delegating planner points out his flights one by one to help the receiving planner to quickly build up a situational awareness on the flights. However, the receiving planner was not able to see the flights highlighted one by one by the delegating planner as all the flights were displayed in yellow, from the receiving sector HMI. They needed time to identify the flight callsign introduced by the delegating planner.

**Conclusion:**

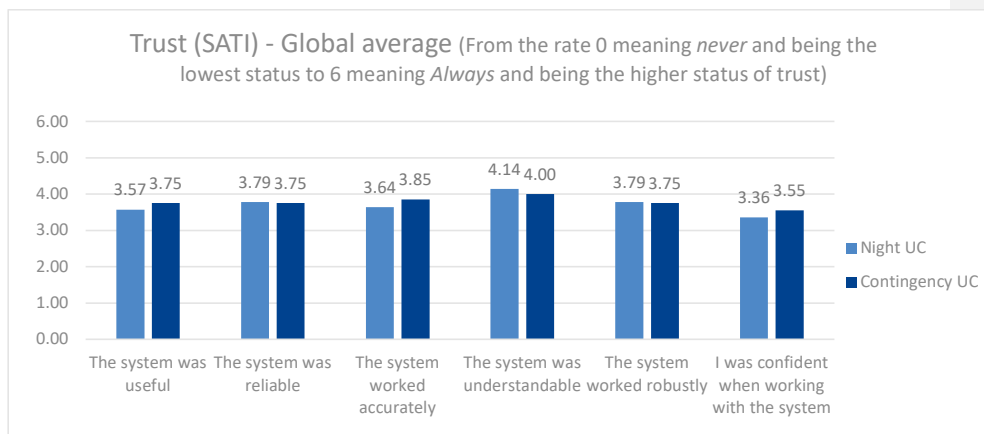
In summary, the SA was found acceptable by most of the controllers during the simulation but not acceptable by one ATSU. Controllers expressed concerns in terms of ability to perform an efficient and safe work. Some recommendations have been made.

This criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-003:** Result = OK

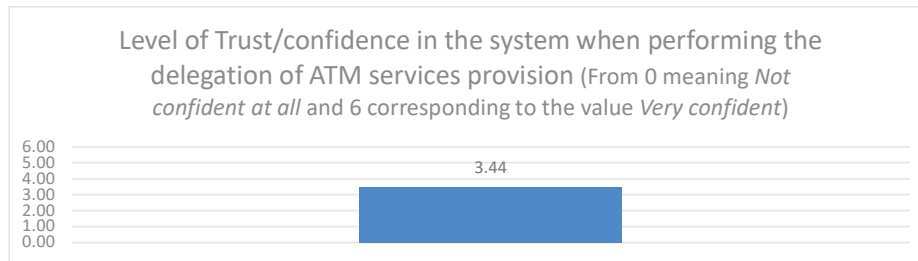
To assess this success criteria in Night UC, the level of trust / confidence was assessed after each run by the standardized questionnaire SATI. Moreover, the level of confidence in the system when performing the delegation of ATM service provision was assessed at the end of the simulation.

**Post Run Questionnaire:**



The average scores ranged from 3,36 which is corresponding to a neutral value to 4,14 corresponding to a positive value. Some technical issues with the system have been reported by controllers and could explain the results. Moreover, some controllers expressed that the lack of certain tools was negatively impacting the level of trust.

#### **Post Simulation Questionnaire:**



The level of trust obtained the average score of 3,44 out of 6, corresponding to the value *Neutral*. Controllers reported that the system was not stable enough and some technical issues have negatively impacted their level of confidence.

#### **Conclusion:**

The level of trust and confidence was deemed satisfactory despite some technical issues occurred and the lack of certain tools controllers are used to work with were missing in the simulation. There are no clear differences between the level of trust during Night UC compared to Contingency UC.

This success criteria is OK.

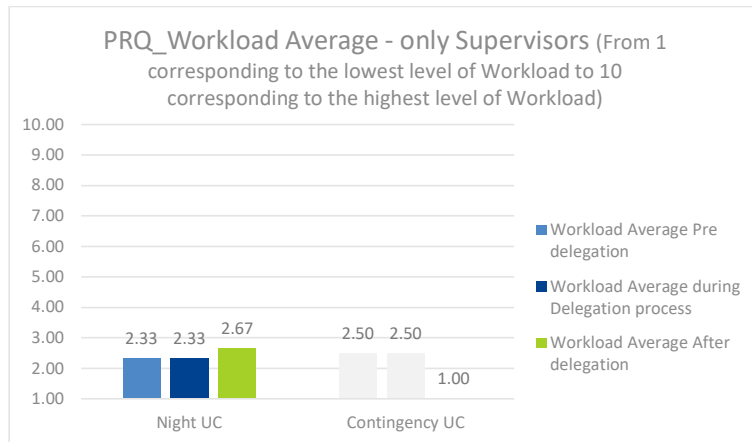
**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-004:** Result = OK

C.f. above Summary Table.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-005:** Result = OK

In order to assess the level of workload of the Supervisors in Night UC, the workload was assessed after each run for the 3 phases of delegation: Before, during and after delegation. The Supervisor role in the simulation was played by a planner, due to the lack of human resources.

#### **Post Run Questionnaire:**



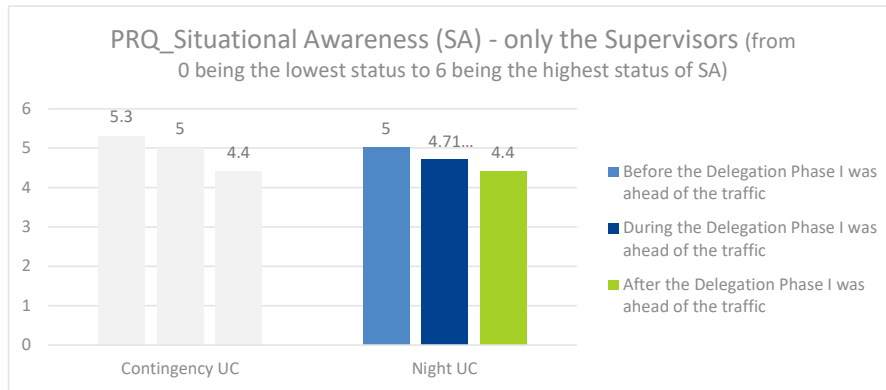
The level of workload results ranged from 2,33 to 2,67 corresponding to the value *Low* in each case. The workload tends to increase after the delegation is completed. That could be explained by the fact that the traffic capacity is increasing and supervisor who has to play his planner role in addition have to coordinate with his EC and manage the additional traffic.

Conclusion:  
 The level of traffic remains low and at an acceptable level for Supervisors.  
 This criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-006:** Result = OK

The Situation Awareness results of the Supervisors are detailed in this section regarding the Night UC. The SA was assessed after each run for the 3 phases of delegation: before, during and after the delegation is completed.

### Post Run Questionnaire:



Results show that SA was deemed acceptable with rate ranged from 4,4 to 5 out of 6. The SA tend to slightly decrease during the delegation procedure compared to before the delegation and then further decrease after the delegation is completed. The SA remain acceptable regardless the phase of delegation.

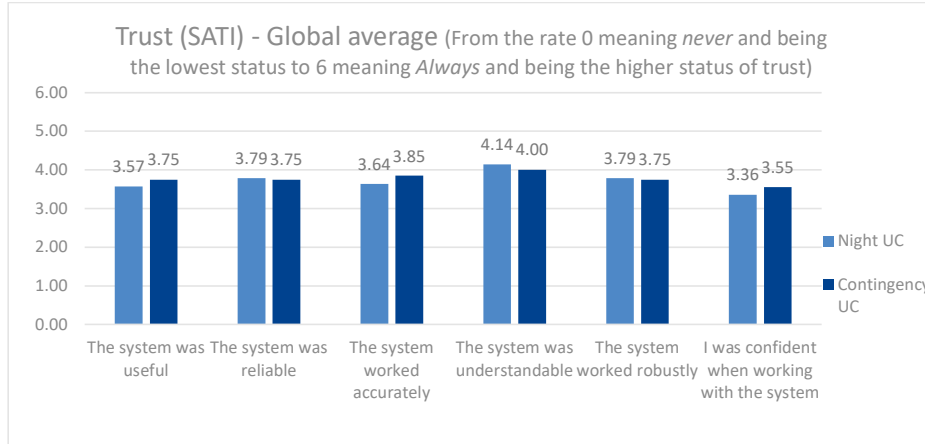
#### Conclusion:

The SA was deemed acceptable by Supervisors ATCOs in all phases of delegation. During the delegation the SA is slightly decreased and further decrease after the delegation is completed.

This criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-004-007:** Result = OK

The level of trust was assessed after each run based on the rates from the SATI standardized questionnaire. Only the Supervisors roles results are detailed in this section.



Results show acceptable level of trust with rates ranged from 4,67 to 5 out of 6. And knowing that SUP role was also playing a role of RP ATCO, this result may be considered as a global operational trust on the system.

**Conclusion:**

The trust and confidence in the system was deemed acceptable and satisfactory by the Supervisors.

This success criteria is OK

**4. EX3-OBJ-PJ.10-W2-93-V3-VALP-005 Results**

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005:** operational acceptance of the delegation procedure for the “Delegation of ATM services provision in case of contingency”.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-005 per Success Criteria:

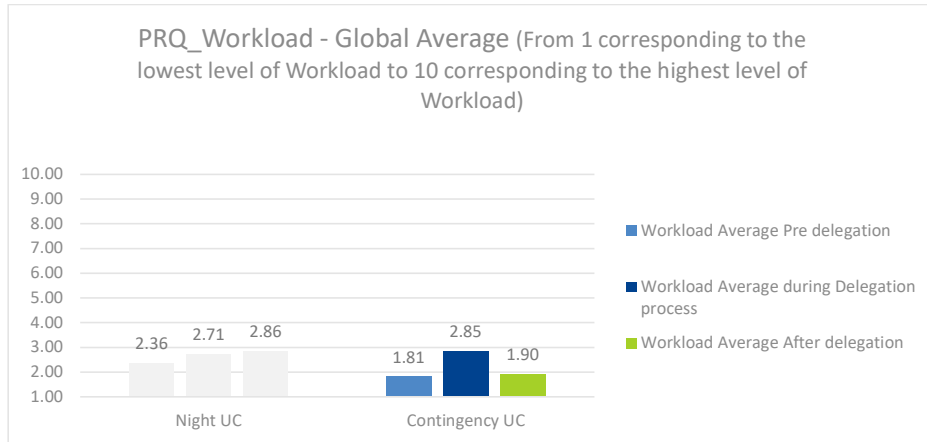
Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-005-001	In summary, the level of Workload for Contingency Use Cases remains at a low level during all phases of the delegation, which corresponds to a satisfactory level of workload. The level of workload appeared to be increasing during the delegation, but it remains at an acceptable level and decreasing after the delegation is completed. The communication load was deemed satisfactory.	OK	

EX3-CRT-PJ.10-W2-93-V3-VALP-005-002	In summary, for Contingency UC, the SA was found acceptable by most of the controllers during the simulation but not acceptable by one ATSU. Controllers expressed concerns in terms of ability to perform an efficient and safe work. There are no clear differences between Night UC and Contingency UC. Some recommendations have been made.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-003	The level of trust and confidence was not deemed satisfactory as some technical issues occurred and the lack of certain tools controllers are used to work with were missing in the simulation. There are no clear differences between the level of trust during Night UC compared to Contingency UC	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-004	When looking only to the delegation procedure, although improvements are always possible, we conclude that the Level of system support was satisfactory for all actors of the delegation: <ul style="list-style-type: none"> <li>- <b>ATCOs:</b> The CWPs provided a radar picture of both the delegated and currently controlled airspaces &amp; traffic. The preview functionality (although basic) was also implemented to support the delegation procedure. The level of maturity of these tools is good at least for the Y/D use cases.</li> <li>- <b>OPS/TECH SUPs:</b> Supervision &amp; Monitoring of the Voice &amp; ATC ADSPs, including details on the Status of the provided services, was ensured thanks to dedicated Supervision/Monitoring tools deployed at various places of the distributed VC validation platform</li> </ul>	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-005	Although this role was played by the ATCO planners of both delegating and receiving ATSUs, the level of workload remains low and at an acceptable level for the Supervisors. This is mainly due to the Low to Medium traffic conditions that did not require big support from the Planner to the Executive ATCOs of both ATSUs.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-006	The Situation Awareness (SA) was deemed acceptable by Supervisors ATCOs, in all phases of delegation. During the delegation the SA is slightly decreased and further decreased after the delegation is completed.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-007	The trust and confidence in the System was deemed acceptable and satisfactory by the Supervisors.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-005-008	Same result as in EX3-CRT-PJ.10-W2-93-V3-VALP-005-004	OK

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-001:** Result = OK

**Post Run Questionnaire:**

Workload per conditions



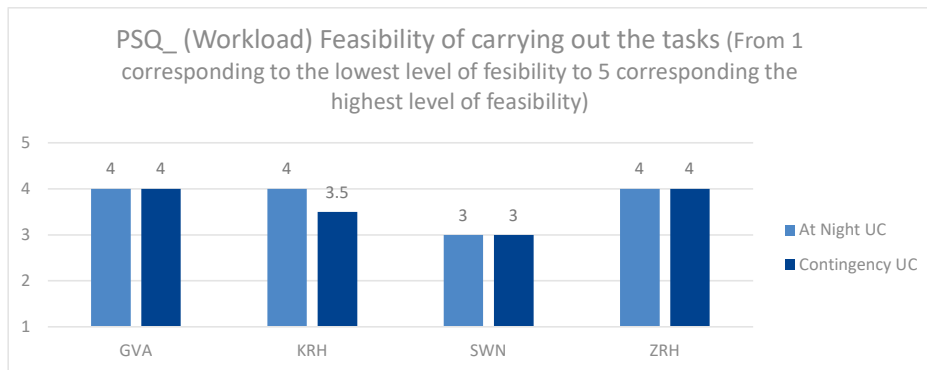
The first graph presents the results from the Post Run Questionnaire in both nominal and abnormal conditions. The Contingency Use Cases are detailed in this section.

In abnormal conditions (i.e., Contingency UC), the average score is of 1,81 before the delegation, 2,85 during the delegation and 1,90 out of 10 after delegation. The workload is very low before the delegation, increase during the delegation procedure and decrease to a very low level after the delegation procedure is completed.

Communication Load

The communication load during the delegation procedure was also assessed after each run and obtained the average score of 4 out 5, corresponding to a satisfactory level.

Post Simulation Questionnaire:



This graph presents the results from the Post Simulation Questionnaire. ATCOs were asked to answer the following question, based on a scale ranged from 1, meaning *Strongly Disagree*, to 5 meaning *Strongly Agree*: Do you consider that all the tasks you had to carry out were feasible?



In abnormal conditions, results also show a satisfactory level of feasibility of carrying out the tasks with average scores from 3 (i.e., meaning *Neutral*) to 4 (i.e., meaning *Agree*).

**Conclusion:**

In summary, the level of Workload for Contingency Use Cases remains at a low level during all phases of the delegation, which corresponds to a satisfactory level of workload. The level of workload appeared to be increasing during the delegation, but it remains at an acceptable level and decreasing after the delegation is completed.

The communication load was deemed satisfactory.

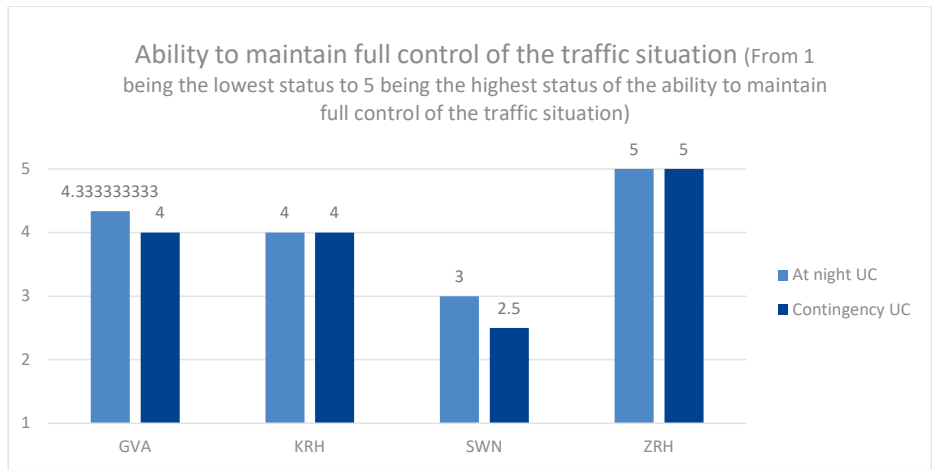
There is no clear differences between Contingency and Night Use Cases in terms of task performing feasibility.

The criteria is OK.

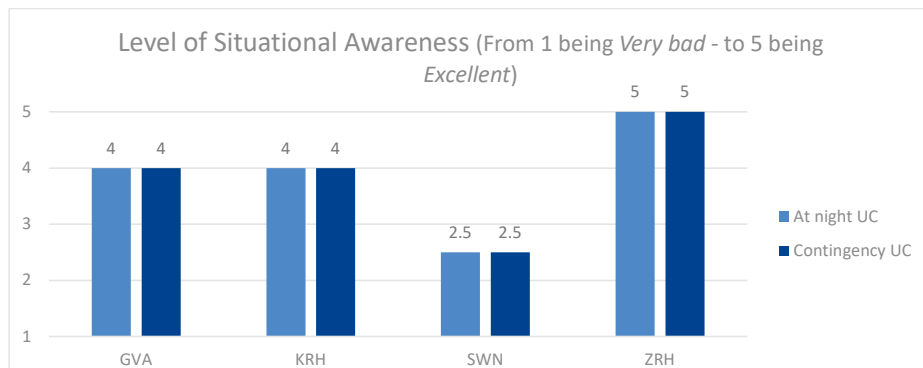
**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-002: Result = OK**

To assess this success criteria, the level of Situational Awareness and the ability to maintain full control of the traffic situation were assessed in the Post Simulation Questionnaire and by asking the controllers to give a rate based on a scale ranged from 1 corresponding to the lowest status to 5 corresponding to the highest status of the aspects assessed for Contingency Use Cases. The debriefings and comments have also been used to assess this success criteria.

**Post Simulation Questionnaire:**



The ability to maintain full control of the traffic situation is deemed satisfactory by almost all ATSUs, with average scores ranged from 4 to 5 out of 5, except for the SWN controllers, giving the rate of 2,5 corresponding to a negative value.



The results of the overall level of Situational Awareness, confirm the trend described above, as SA is deemed acceptable by most of the ATSU's but the SWN ATSU, giving the rate of 2,5 corresponding to a negative value.

**Debriefing & comments: (Same as EX3-CRT-PJ.10-W2-93-V3-VALP-004-002)**

- Controllers highlighted the fact that the different HMI representation between centres involved, added complexity in building a common situational awareness.
- Moreover, they expressed that the lack of information on the delegated area had a negative impact on the Situational Awareness (e.g., Letter of Agreement, exit conditions, routes, waypoints).
- In addition, observations and debriefings highlighted the fact that Dynamic Area of Responsibility's Use Cases negatively impacted the Situational Awareness compared to the Static Area of Responsibility's Use Cases because it changed the scanning/monitoring routine of the ATCOs. Indeed, controllers had suddenly to control a larger area including their own sector, without knowing the flows and the typical conflicts situations of the new sector taken over. The controllers may spend more time in analysing the sector taken over at the expense of their own, which may result in reducing their global Situational Awareness.
- Observations and debriefings highlighted the fact that the receiving sector had to set up their HMI to adapt their screen to the sector taken over, including the level of zoom. Some ATCOs expressed difficulties in finding the right level of zoom to (e.g., level of zoom) and in finding their settings from one session to another. That could have negatively impacted the Situational Awareness.
- Controllers reported that during the preview mode and the coordination of flights between the delegating and receiving sector, they had difficulties in identifying the flights highlighted by the delegating sector. The delegating planner points out his flights one by one to help the receiving planner to quickly build up a situational awareness on the flights. However, the receiving planner was not able to see the flights highlighted one by one by the delegating planner as all the flights were displayed in yellow, from the receiving sector HMI. They needed time to identify the flight callsign introduced by the delegating planner.

**Conclusion:**

In summary, for Contingency UC, the SA was found acceptable by most of the controllers during the simulation but not acceptable by one ATSU. Controllers expressed concerns in terms of ability to

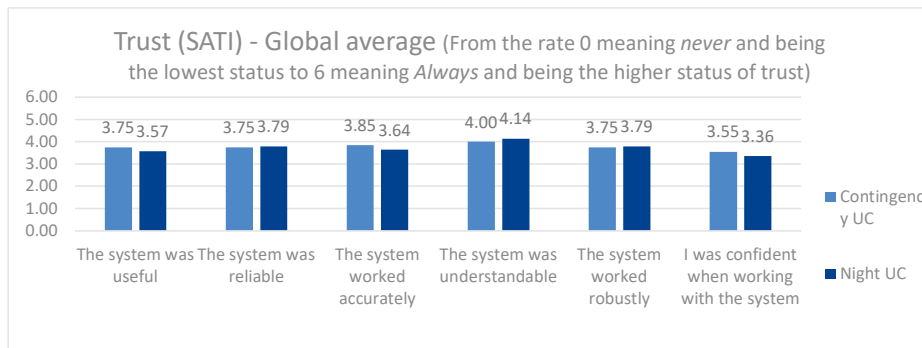
perform an efficient and safe work. There are no clear differences between Night UC and Contingency UC. Some recommendations have been made.

This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-003:** Result = OK

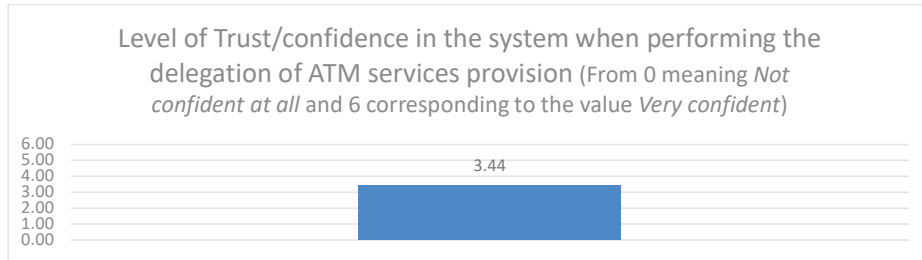
To assess this success criteria in Contingency UC, the level of trust / confidence was assessed after each run by the standardized questionnaire SATI. Moreover, the level of confidence in the system when performing the delegation of ATM service provision was assessed at the end of the simulation.

**Post Run Questionnaire:**



The average scores ranged from 3,55 which is corresponding to a neutral value to 4 corresponding to a positive value. Some technical issues with the system have been reported by controllers and could explain the results. Moreover, some controllers expressed that the lack of certain tools was negatively impacting the level of trust.

**Post Simulation Questionnaire:**



The level of trust obtained the average score of 3,44 out of 6, corresponding to the value *Neutral*. Controllers reported that the system was not stable enough and some technical issues have negatively impacted their level of confidence.

**Conclusion:**

The level of trust and confidence was deemed satisfactory despite some technical issues occurred and the lack of certain tools controllers are used to work with were missing in the simulation. There are no clear differences between the level of trust during Night UC compared to Contingency UC.

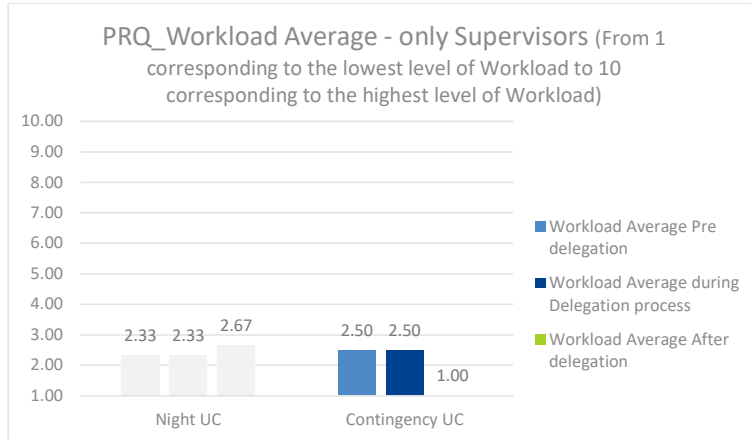
This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-004:** Result = OK

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-005-005	The level of workload remains low and at an acceptable level for Supervisors.	OK	

To assess the level of workload of the Supervisors in Contingency UC, the workload was assessed after each run for the 3 phases of delegation: Before, during and after delegation. The Supervisor role in the simulation was played by a planner, due to the lack of human resources.

**Post Run Questionnaire:**



The level of workload results ranged from 1 to 2,5 corresponding to the value *Insignificant to Low*. The workload decrease after the delegation is completed. That could be explained by the fact that after the coordination with the EC done, the workload is decreasing.

**Conclusion:**

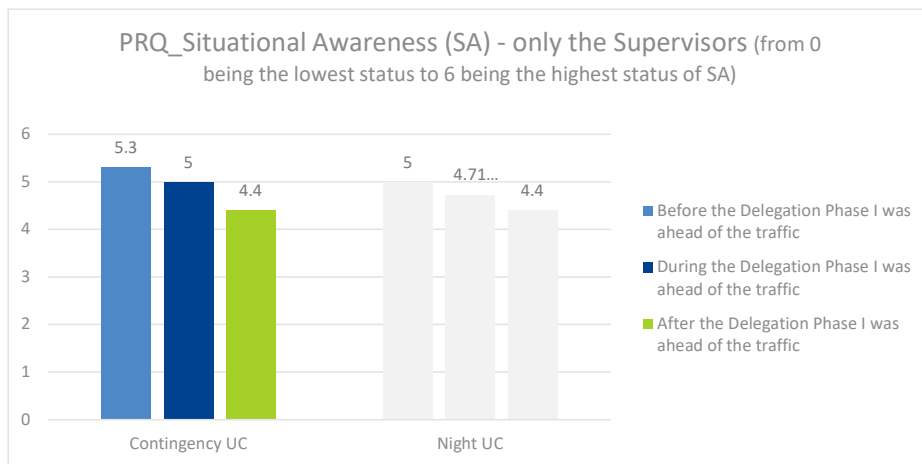
The level of workload remains low and at an acceptable level for Supervisors.

This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-006:** Result = OK

The Situation Awareness results of the Supervisors are detailed in this section regarding the Contingency UC. The SA was assessed after each run for the 3 phases of delegation: before, during and after the delegation is completed.

**Post Run Questionnaire:**



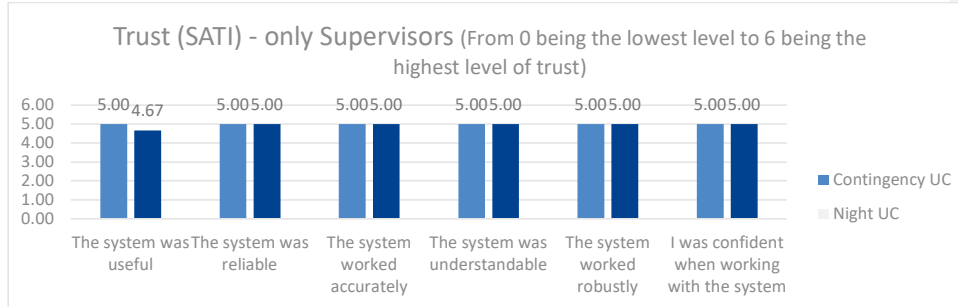
Results show that SA was deemed acceptable with rate ranged from 4,4 to 5,3 out of 6. The SA tend to slightly decrease during the delegation procedure compared to before the delegation and then further decrease after the delegation is completed. The SA remain acceptable regardless the phase of delegation.

**Conclusion:**

The SA was deemed acceptable by Supervisors ATCOs in all phases of delegation. During the delegation the SA is slightly decreased and further decrease after the delegation is completed.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-007:** Result = OK

The level of trust was assessed after each run based on the rates from the SATI standardized questionnaire. Only the Supervisors roles results are detailed in this section.



Results show a good level of trust with average rates of 5 out of 6 for each aspect of the trust and confidence in the system’s aspect.

**Conclusion:**  
 The trust and confidence in the system was deemed acceptable and satisfactory by the Supervisors.  
 This Success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-005-008:** Result = OK

### 5. EX3-OBJ-PJ.10-W2-93-V3-VALP-006 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-006:** Assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-006 per Success Criteria:

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-006-001	The level of workload was deemed low and manageable during all phases of the delegation (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-004-001)	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-006-002	The Situation Awareness remains at an acceptable level in each phase of the delegation but tend to be impacted negatively after the delegation is completed	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-006-003	The ability to maintain safe operations is rated neutrally by controllers who expressed some concerns.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-006-004	Impact remains acceptable in terms of distribution of roles and responsibilities before, during and after the delegation procedure	OK	

EX3-CRT-PJ.10-W2-93-V3-VALP-006-005	The communication load during the delegation procedure remains at an acceptable level. Also, it is assumed that it was such before and after the delegation.	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-006-006	This success criterion is not about the level of functionalities and controller support tools available at each CWP (SG, DFS or NATS). For the delegation, ATCO, SUPs and also Pseudo-Pilots were very well supported by an harmonized Voice CWP from FREQUENTIS (used at both SG and DFS) offering possibilities to choose a right configuration (PAGE) before, during and after the delegation (and this per played UC#). The Radar CWP also supported the ATCOs at the delegating and the receiving ATSUs by implementing the Preview traffic functionality at all involved CWPs (SG, DFS and NATS).	OK

**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-001:** Result = OK

Post Run Questionnaire :

**Method:**

The impact in terms of workload was assessed before during and after the delegation procedure of ATM services in nominal conditions, through the Post Run Questionnaire (See EX3-CRT-PJ.10-W2-93-V3-VALP-004-001).

**Conclusion:**

The workload was assessed and deemed acceptable by ATCOs in all phases of the delegation (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-004-001).

This success criteria is OK

**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-002:** Result = OK

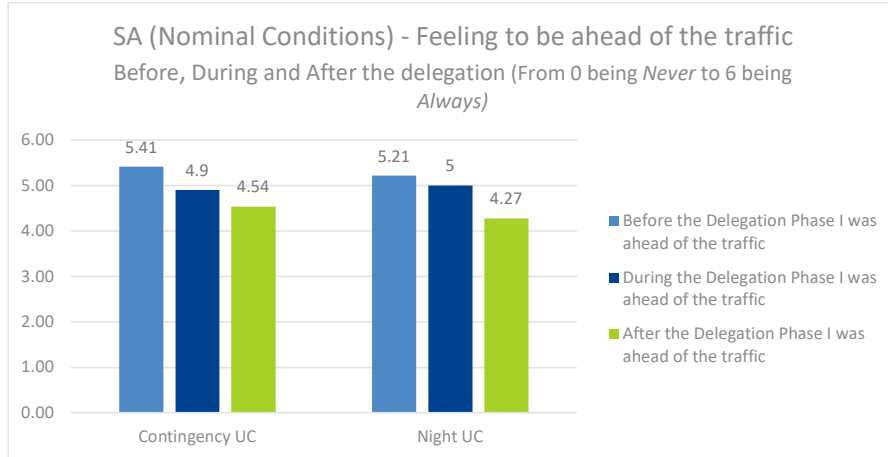
Post Run Questionnaire :

**Method:**

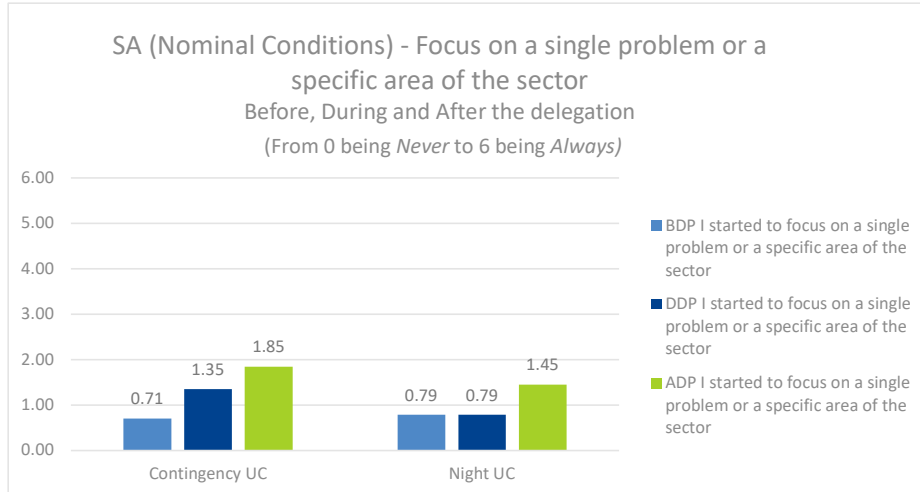
The impact in terms of Situational Awareness was assessed before, during and after the delegation procedure of ATMS services in nominal conditions, through the Post Run Questionnaire. The controllers had to give a rate to the following items based on a 7-point scale ranged from 0 corresponding to the value *Never* to 6 corresponding to the value *Always* and for the three phases of delegation procedure (i.e. Before, During and After):

- I was ahead of the traffic
- I started to focus on a single problem or a specific area of the sector

**Results:**



The first graph displays the feeling to be ahead of the traffic from the perspective of the controllers. Results show that in nominal conditions (i.e., Night UC) the feeling to be ahead of the traffic tend to decrease through the phases but remains in each phase at an acceptable level. The average scores range from 4,27 after the delegation phase to 5,21 corresponding to phase before starting the delegation process.



The second graph shows the results regarding the Focusing on a single problem or a specific area of the sector item. If controllers tend to focus on one problem or area of their sector, this may indicate a deterioration in their situational awareness. Results presented in the graph above for Night UC indicate that the tendency to focus is increasing through the phases of delegation being at its maximum level after the delegation procedure is completed. That indicate that the delegation procedure has a negative impact on the Situational Awareness of the controllers by reducing it. However, the scores



remain low with average scores range from 0,79 corresponding to the value *Never* before and during the delegation process to 1,45 corresponding to the value *Almost Never* after the delegation is completed.

#### Comments & debriefings:

- Controllers highlighted the fact that the different HMI representation between centres involved, added complexity in building a common situational awareness.
- Moreover, they expressed that the lack of information on the delegated area had a negative impact on the Situational Awareness (e.g., Letter of Agreement, exit conditions, routes, waypoints).
- In addition, observations and debriefings highlighted the fact that Dynamic Area of Responsibility's Use Cases negatively impacted the Situational Awareness compared to the Static Area of Responsibility's Use Cases because it changed the scanning/monitoring routine of the ATCOs. Indeed, controllers had suddenly to control a larger area including their own sector, without knowing the flows and the typical conflicts situations of the new sector taken over. The controllers may spend more time in analysing the sector taken over at the expense of their own, which may result in reducing their global Situational Awareness.
- Observations and debriefings highlighted the fact that the receiving sector had to set up their HMI to adapt their screen to the sector taken over, including the level of zoom. Some ATCOs expressed difficulties in finding the right level of zoom to (e.g., level of zoom) and in finding their settings from one session to another. That could have negatively impacted the Situational Awareness.
- Controllers reported that during the preview mode and the coordination of flights between the delegating and receiving sector, they had difficulties in identifying the flights highlighted by the delegating sector. The delegating planner points out his flights one by one to help the receiving planner to quickly build up a situational awareness on the flights. However, the receiving planner was not able to see the flights highlighted one by one by the delegating planner as all the flights were displayed in yellow, from the receiving sector HMI. They needed time to identify the flight callsign introduced by the delegating planner.

#### Conclusion:

The SA remains at an acceptable level in each phase of the delegation but tend to be impacted negatively after the delegation is completed.

This success criteria is OK.

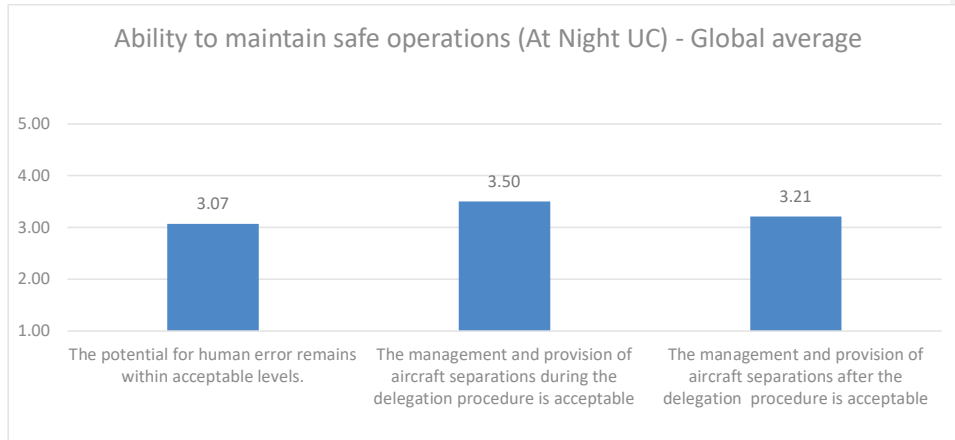
**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-003:** Result = POK

#### Method:

To assess the potential for error, the ability to maintain safe operations was investigated through different aspects. Controllers had to give a rate based on their level of agreement on the following items after each run (i.e., based on a scale ranged from 1 corresponding to the value *Strongly Disagree* to 5 corresponding to the value *Strongly Agree*):

- The potential for human error remains within acceptable levels
- The management and provision of aircraft separations during the delegation procedure is acceptable
- The management and provision of aircraft separations after the delegation procedure is acceptable

#### Results:



The results range from 3,07 to 3,50 corresponding to the value *Neutral*. Controllers expressed concerns about their ability to maintain safe operations.

**Debriefing & comments:**

Controllers expressed concerns on the ability to maintain safe operations particularly after the delegation was completed. They noted that adequate training on the delegated airspace would improve the feasibility of the delegation process. Requirements to maintain currency on the sectors taken over should be part of the future solutions.

Overall, ATCOs reported that the delegation concept is feasible but needs to be improved in terms of integration of supporting tools and safety nets that are currently used in OPS room. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.

**Conclusion:**

The ability to maintain safe operations is rated neutrally by controllers who expressed some concerns particularly after the delegation was completed. They noted that the lack of expertise on the sector taken over and the lack of supporting tools and safety nets negatively impacted their perception of ability to maintain safe operations. However, this feedback is not due to the delegation process. This success criteria is OK.

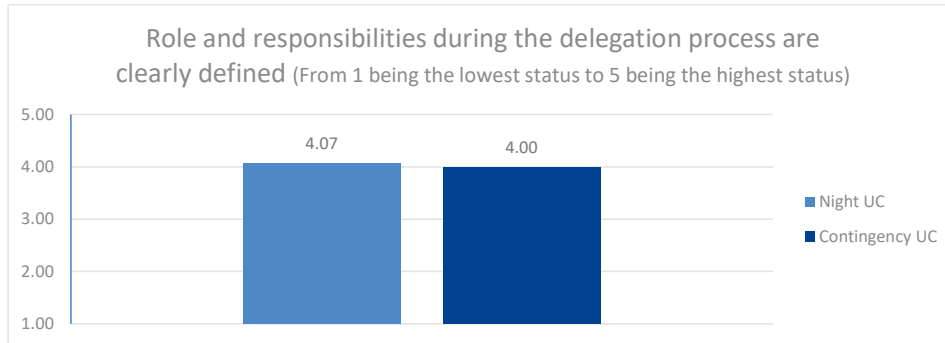
**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-004:** Result = OK

**Post Run Questionnaire:**

**Method:**

As described in EX3-CRT-PJ.10-W2-93-V3-VALP-002-003, the impact concerning the distribution of roles and responsibilities for the delegation procedure and for Night UC was assessed after each run. The impact on role and responsibilities was only assessed during the delegation process.

**Results:**



The distribution of roles and responsibilities are deemed clearly defined by controllers for Night UC, with an average score of 4,07 corresponding to the value *Agree*. The distribution of roles and responsibilities were deemed acceptable and clearly defined before, during and after the delegation was completed.

**Conclusion:**  
 The impact on role and responsibilities was assessed and deemed acceptable by the controllers.  
 This success criteria is OK.

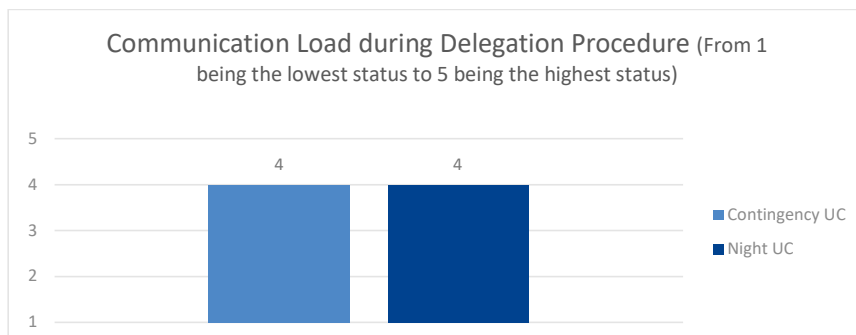
**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-005:** Result = OK

**Method :**

The communication load was assessed during the delegation procedure. By asking the controllers to give a rate on 5-point agreement-scale based on the following question (i.e., From 1 corresponding to *Strongly Disagree* to 5 corresponding to *Strongly Agree*):

- The communication load during the delegation procedure remains within acceptable levels

**Results:**



Results show an acceptable level of communication load during the delegation procedure, with an average score of 4 corresponding to the qualitative value *Agree*.

Controllers reported that the communication load was acceptable in each phase of delegation.

Conclusion: The communication load during the delegation procedure remains at an acceptable level during all phases of the delegation (i.e., Before, During and After).

This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-006-006:** Result = OK

The ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions were assessed in terms of impact on ATCO human performance.

To assess that success criteria, the following aspects have been assessed:

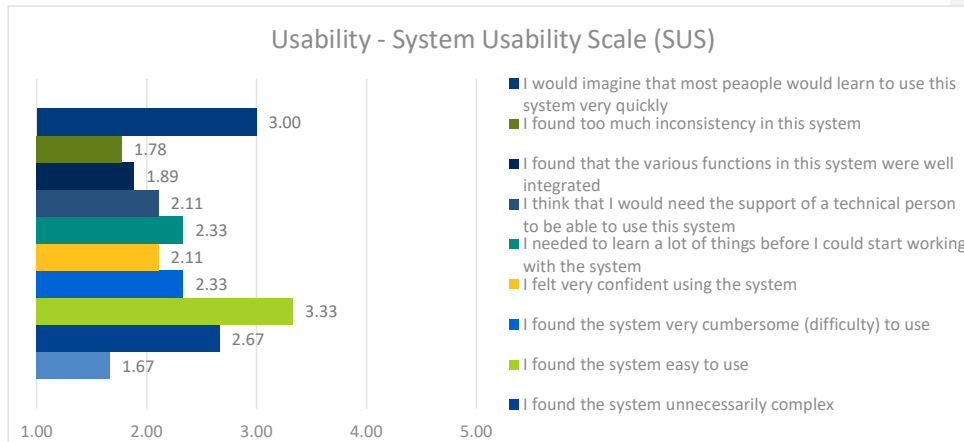
- The usability of the tools has been assessed at the end of the simulation, through the Post Simulation Questionnaire,
- The ability to maintain safe operations has also been assessed, through the Post Run Questionnaire.

*Usability*

Method:

Controllers had to give a rate based on 5-point agreement-scale, going from *Strongly Disagree* to *Strongly Agree* to assess the various aspects of Usability (c.f., see the graph in the result's section below).

Post Simulation Questionnaire:



**Results:**

The graph displays the usability assessment of the support tools used during the exercise and based on the SUS standardized questionnaire. The average score (i.e., obtained by calculation based on the SUS method) is of 58 which correspond to a correct level of usability according SUS method, indicating

that overall, the support tools provided before, during and after the delegation of ATM services provision in nominal conditions were deemed acceptable by controllers and tend to demonstrate that its no impairing Human performance.

**Conclusion:**

The overall usability is deemed acceptable by users and appears to not impair Human Performance.

This success criteria is OK.

## 6. EX3-OBJ-PJ.10-W2-93-V3-VALP-007 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-007:** Assess the impact in terms of Human Performance of the ATM services provision delegation concept in non-nominal conditions.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-007 per Success Criteria:

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-007-001	Impact remains acceptable in terms of workload before, during and after the delegation procedure	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-007-002	The Situation Awareness remains at an acceptable level in each phase of the delegation but tend to be impacted negatively after the delegation is completed	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-007-003	The ability to maintain safe operations is rated neutrally by controllers who expressed some concerns	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-007-004	Impact remains acceptable in terms of distribution of roles and responsibilities before, during and after the delegation procedure	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-007-005	The communication load during the delegation procedure remains at an acceptable level. Also, it is assumed that it was such before and after the delegation.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-007-006	This success criterion is not about the level of functionalities and controller support tools available at each CWP (SG, DFS or NATS). For the delegation, ATCO, SUPs and also Pseudo-Pilots were very well supported by an harmonized Voice CWP from FREQUENTIS (used at both SG and DFS) offering possibilities to choose a right configuration (PAGE) before, during and after the delegation (and this per played UC#). The Radar CWP also supported the ATCOs at the delegating and the receiving ATSUs by implementing the Preview traffic functionality at all involved CWPs (SG, DFS and NATS).	OK	

**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-001:** Result = OK

Post Run Questionnaire:

**Method:**

The impact in terms of workload was assessed before during and after the delegation procedure of ATM services in abnormal conditions, through the Post Run Questionnaire (See EX3-CRT-PJ.10-W2-93-V3-VALP-005-001).

**Results:**

In abnormal conditions (i.e., Contingency UC), the average score is of 1,81 before the delegation, 2,85 during the delegation and 1,90 out of 10 after delegation. The workload is low before the delegation, increase during the delegation procedure and decrease to a very low level after the delegation procedure is completed. (cf. EX3-CRT-PJ.10-W2-93-V3-VALP-005-001).

**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-002:** Result = OK

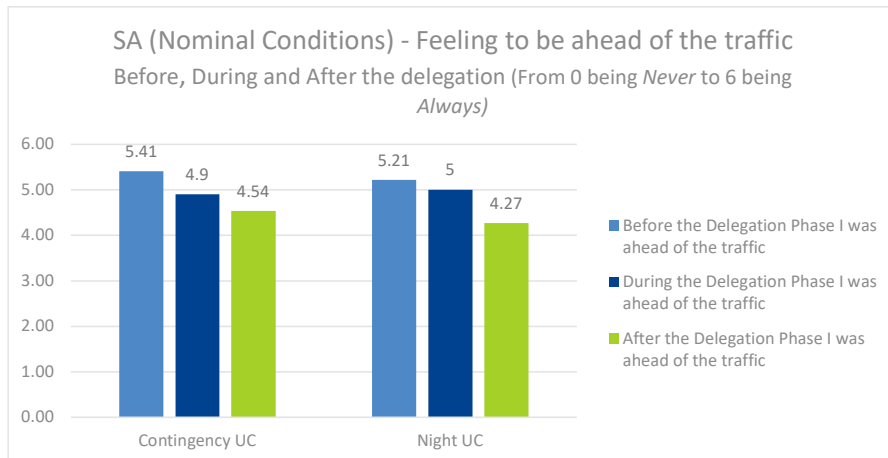
Post Run Questionnaire:

**Method:**

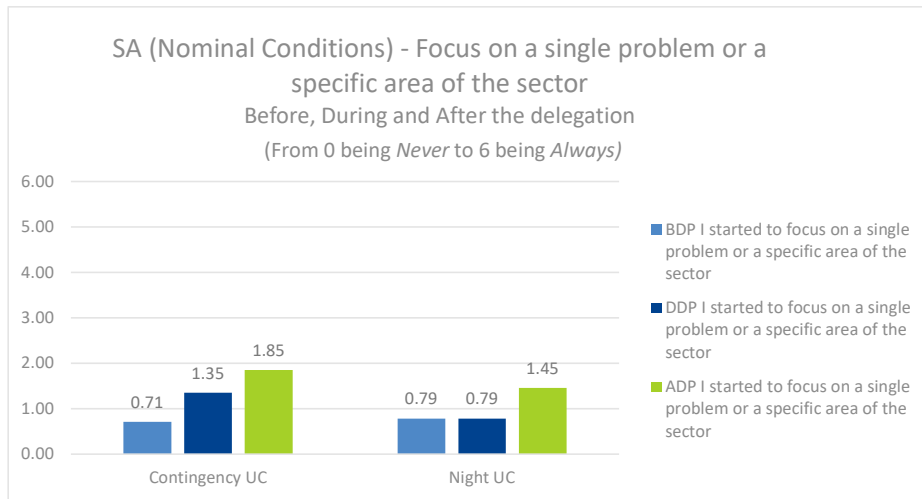
The impact in terms of Situational Awareness was assessed before, during and after the delegation procedure of ATMS services in abnormal conditions, through the Post Run Questionnaire. The controllers had to give a rate to the following items based on a 7-point scale ranged from 0 corresponding to the value *Never* to 6 corresponding to the value *Always* and for the three phases of delegation procedure (i.e. Before, During and After):

- I was ahead of the traffic
- I started to focus on a single problem or a specific area of the sector

**Results:**



The first graph displays the feeling to be ahead of the traffic from the perspective of the controllers. Results show that in abnormal conditions (i.e., Contingency UC) the feeling to be ahead of the traffic tend to decrease through the phases but remains in each phase at an acceptable level. The average scores range from 4,57 after the delegation phase to 5,41 corresponding to phase before starting the delegation process.



The second graph shows the results regarding the Focusing on a single problem or a specific area of the sector item. If controllers tend to focus on one problem or area of their sector, this may indicate a deterioration in their situational awareness. Results presented in the graph above for Contingency UC indicate that the tendency to focus is increasing through the phases of delegation being at its maximum level after the delegation procedure is completed. That indicate that the delegation procedure has a negative impact on the Situational Awareness of the controllers by reducing it. However, the scores remain low with average scores range from 0,71 corresponding to the value *Never* before and during the delegation process to 1,85 corresponding to the value *Almost Never* after the delegation is completed.

Comments & debriefings:

- Controllers highlighted the fact that the different HMI representation between centres involved, added complexity in building a common situational awareness.
- Moreover, they expressed that the lack of information on the delegated area had a negative impact on the Situational Awareness (e.g., Letter of Agreement, exit conditions, routes, waypoints).
- In addition, observations and debriefings highlighted the fact that Dynamic Area of Responsibility's Use Cases negatively impacted the Situational Awareness compared to the Static Area of Responsibility's Use Cases because it changed the scanning/monitoring routine of the ATCOs. Indeed, controllers had suddenly to control a larger area including their own sector, without knowing the flows and the typical conflicts situations of the new sector taken over. The controllers

may spend more time in analysing the sector taken over at the expense of their own, which may result in reducing their global Situational Awareness.

- Observations and debriefings highlighted the fact that the receiving sector had to set up their HMI to adapt their screen to the sector taken over, including the level of zoom. Some ATCOs expressed difficulties in finding the right level of zoom to (e.g., level of zoom) and in finding their settings from one session to another. That could have negatively impacted the Situational Awareness.
- Controllers reported that during the preview mode and the coordination of flights between the delegating and receiving sector, they had difficulties in identifying the flights highlighted by the delegating sector. The delegating planner points out his flights one by one to help the receiving planner to quickly build up a situational awareness on the flights. However, the receiving planner was not able to see the flights highlighted one by one by the delegating planner as all the flights were displayed in yellow, from the receiving sector HMI. They needed time to identify the flight callsign introduced by the delegating planner.

**Conclusion:**

The SA remains at an acceptable level in each phase of the delegation but tend to be impacted negatively after the delegation is completed.

This success criteria is OK.

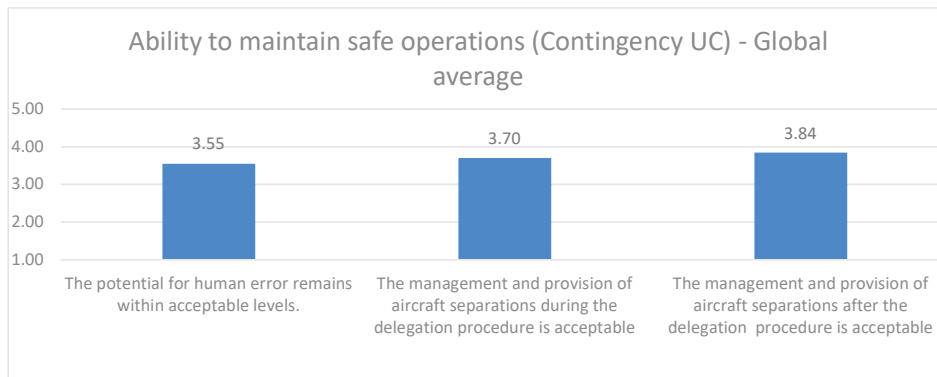
**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-003:** Result = OK

**Method:**

To assess the potential for error, the ability to maintain safe operations was investigated through different aspects. Controllers had to give a rate based on their level of agreement on the following items after each run (i.e., based on a scale ranged from 1 corresponding to the value *Strongly Disagree* to 5 corresponding to the value *Strongly Agree*):

- The potential for human error remains within acceptable levels
- The management and provision of aircraft separations during the delegation procedure is acceptable
- The management and provision of aircraft separations after the delegation procedure is acceptable

**Results:**





The results range from 3,55 to 3,84 corresponding to the value *Neutral*. Controllers expressed concerns about their ability to maintain safe operations.

Debriefing & comments:

Controllers expressed concerns on the ability to maintain safe operations particularly after the delegation was completed in Contingency UC. They noted that adequate training on the delegated airspace would improve the feasibility of the delegation process. Requirements to maintain currency on the sectors taken over should be part of the future solutions.

Overall, ATCOs reported that the delegation concept is feasible but needs to be improved in terms of integration of supporting tools and safety nets that are currently used in OPS room. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.

**Conclusion:**

The ability to maintain safe operations is rated between neutrally and positively by controllers for Contingency UC. They expressed some concerns particularly after the delegation was completed. They noted that the lack of expertise on the sector taken over and the lack of supporting tools and safety nets negatively impacted their perception of ability to maintain safe operations. However, this feedback is not due to the delegation process  
This success criteria is OK.

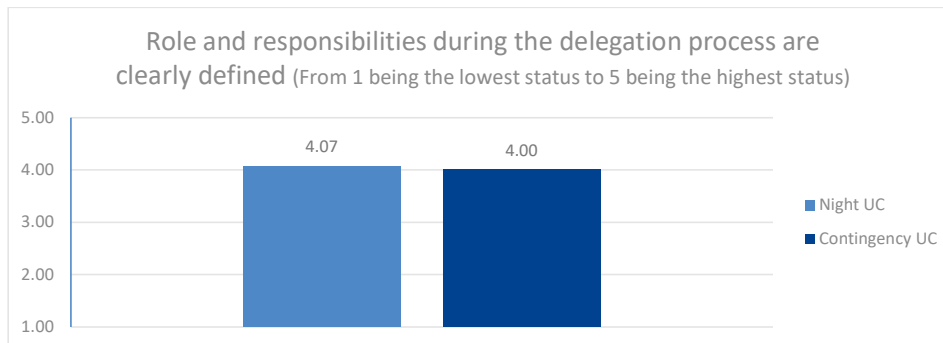
**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-004:** Result = OK

Post Run Questionnaire:

**Method:**

As described in EX3-CRT-PJ.10-W2-93-V3-VALP-003-003, the impact concerning the distribution of roles and responsibilities for the delegation procedure and for Contingency UC was assessed after each run. The impact on role and responsibilities was only assessed during the delegation process.

**Results:**



The distribution of roles and responsibilities are deemed clearly defined by controllers for Contingency UC, with an average score of 4,00 corresponding to the value *Agree*. The distribution of roles and responsibilities were deemed acceptable and clearly defined before, during and after the delegation was completed

**Conclusion:**

The impact on role and responsibilities was assessed and deemed acceptable by the controllers in Contingency UC.

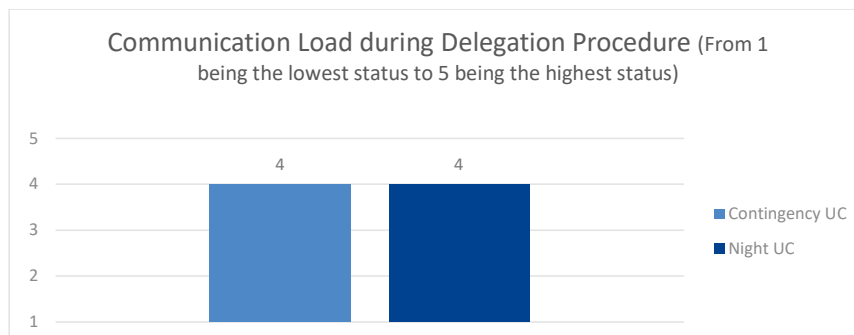
This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-005:** Result = OK

**Method :**

The communication load was assessed during the delegation procedure.

**Results:**



Results show an acceptable level of communication load during the delegation procedure. Controllers reported that the communication load was acceptable in each phase of delegation.

Conclusion: The communication load during the delegation procedure remains at an acceptable level during all phases of the delegation (i.e., Before, During and After) for Contingency UC.

This success criteria is OK.

**EX3-OBJ-PJ.10-W2-93-V3-VALP-007-006:** Result = POK

The ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions were assessed in terms of impact on ATCO human performance.

To assess that success criteria, the following aspects have been assessed:

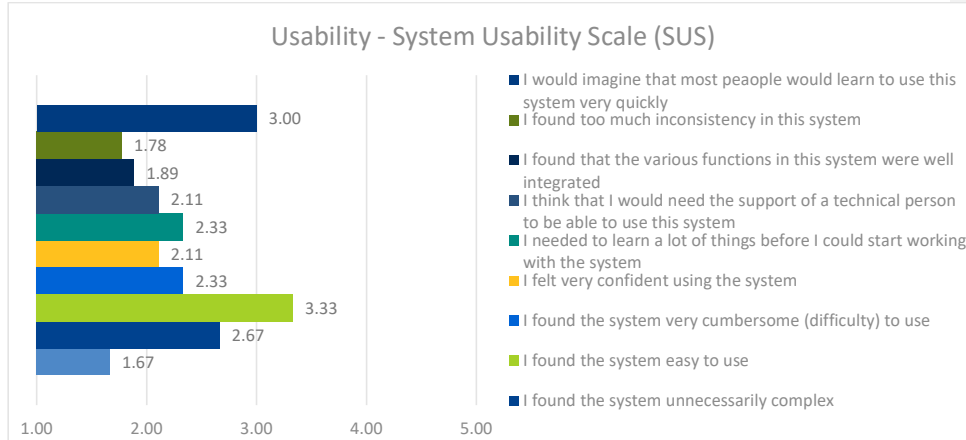
- The usability of the tools has been assessed at the end of the simulation, through the Post Simulation Questionnaire,
- The ability to maintain safe operations has also been assessed, through the Post Run Questionnaire.

*Usability*

Method:

Controllers had to give a rate based on 5-point agreement-scale, going from *Strongly Disagree* to *Strongly Agree* to assess the various aspects of Usability (c.f., see the graph in the result’s section below).

Post Simulation Questionnaire:



**Results:**

The graph displays the usability assessment of the support tools used during the exercise and based on the SUS standardized questionnaire. The average score (i.e., obtained by calculation based on the SUS method) is of 58 which correspond to a correct level of usability according SUS method, indicating that overall, the support tools provided before, during and after the delegation of ATM services provision in nominal conditions were deemed acceptable by controllers and tend to demonstrate that it is no impairing Human performance.

Conclusion:  
The overall usability is deemed acceptable by users and appears to not impair Human Performance. This success criteria is OK.

**7. EX3-OBJ-PJ.10-W2-93-V3-VALP-008 Results**

**EX3-OBJ-PJ.10-W2-93-V3-VALP-008:** Assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-008 per Success Criteria:

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-008-001	Considering only UC# based on the Y architecture, In general, the level of safety was maintained throughout the runs. The procedure itself was considered somewhat safe and this in all phases of the delegation.	OK	

EX3-CRT-PJ.10-W2-93-V3-VALP-008-002	Mainly because of the following concerns expressed by several ATCOs (from SG, DFS and NATS): <ul style="list-style-type: none"> <li>- Major support tools such as Safety Nets and MTCO that are used for the management and provision of aircraft separation, were not provided by the various CWPs/systems, or when they are, ATCO were not sufficiently trained to use them</li> <li>- Lack of training on the airspace environment and sometimes on the systems used</li> </ul> The impact was that the delegation procedures in such conditions would not be fully acceptable by ATCOs But assuming the training done and the controller tools available, the delegation procedure will be fully acceptable by ATCO. For this reason, we can consider the OK for this SC.	OK
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The aforementioned objective has been analysed providing evidence for the addressed success criteria. Results are supported by charts elaborated with data coming from Post Run and Post Simulation Questionnaires.

The following section summarises the ATCOs feedback from questionnaires and post run debriefings and reflect the current proposed solution. It does not represent a safety assessment as required by (EU) 2017/373 ATS.OR.205. Further development of the concept will require additional (safety) activities and other requirements may well be identified specific for a local implementation of the solution.

On an agreement scale from 1 (“strongly disagree”) to 5 (“strongly agree”), all ATCOs had to answer:

- If they were “able to manage critical situations and solve conflicts”,
- If they were "able to prevent critical situations and timely detect conflicts",
- To evaluate if "the introduced concepts (e.g., working methods, procedures) are acceptable from safety point of view",
- If "the management and provision of aircraft separations during the delegation procedure is acceptable",
- If "the management and provision of aircraft separations after the delegation procedure is acceptable".

The figures shows the average scores registered for each ATSU during all the Use Cases scenarios tested. In general, the level of safety was maintained throughout the runs. The procedure itself was considered somewhat safe.

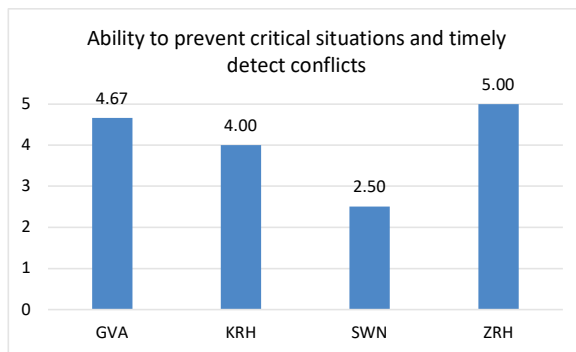
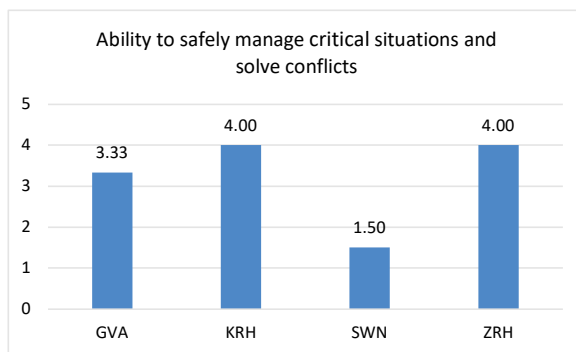
Overall, although the level of safety was evaluated relatively good, the controllers expressed some safety concerns. These concerns were mainly linked to specific situations in which controllers experienced difficulties with the use of the system and ability to maintain situational awareness, rather than attributable to a specific working technique, traffic load or whether the traffic was delegated or not. It was also noted that the ability to maintain safety relied mostly on their experience, not because the system provided support in this respect.

Nevertheless, during the debriefings controllers reported that the concept of the delegation is feasible but needs to be improved, particularly in terms of integration of supporting tools and safety nets that are already commonplace in every OPS room. The technical solution, in the version used during the exercise did not fully provide the expected ATCO support in carrying out their tasks.

**Results from Post Simulation Questionnaires<sup>3</sup>:**

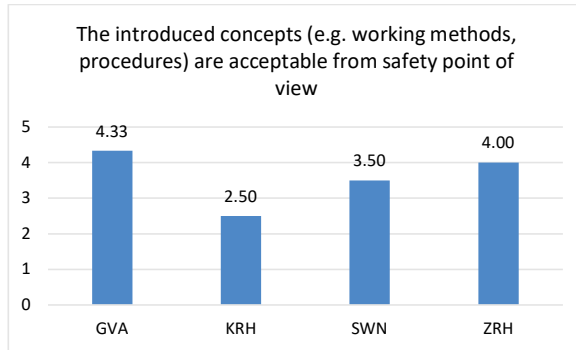
In general, ATCOs agreed they were able to safely manage critical situations and solve conflicts, as well as prevent critical situations and timely detect conflicts. Swanwick controllers provided below average scores mainly due to the lower technical maturity of the U architecture. It was explicitly indicated that in the current state (lack of maturity and interoperability shortcomings) it renders any solution based on the U architecture not acceptable from a safety point of view.

Karlsruhe controllers also provided below average scores for the safety acceptability of the solution citing the lack of supporting tools.



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<sup>3</sup> The Post Simulation Questionnaires were filled in at the end of the day, as such they do not distinguish between use cases with delegation in nominal or abnormal conditions.

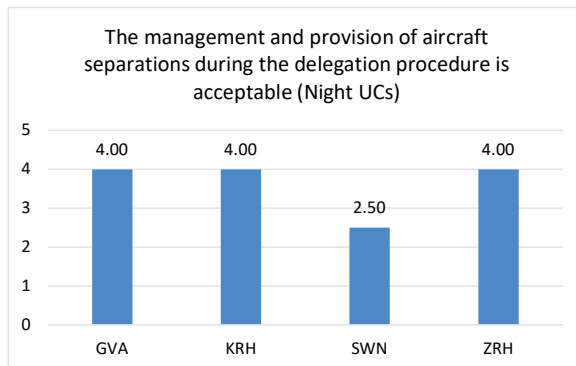


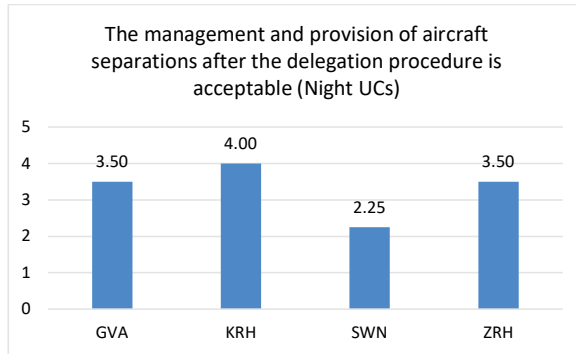
ATCOs noted that adequate training on the delegated airspace is paramount for the safety acceptability of the solution. Requirements for maintaining currency on the respective sectors also need to be part of any future solution.

**Results from Post Run Questionnaires:**

In post run questionnaires the ATCOs were asked if the management and provision of aircraft separation is acceptable answering to a 5-point agreement scale. The figures show, according to ATCOs feedback, that controllers were able to manage traffic in a quite safe way during all the phases of the delegation process. Although there was no occurrence of safety-related events, controllers sometimes experienced difficulties in maintaining a clear traffic picture and managing traffic especially during the delegation process. This was strictly related to the preview phase issues (i.e., ATCOs would have needed an improved preview mode with a clear understanding on the switch to the operational mode and specific indications on the traffic to be gained and on the one to be delegated).

Swanwick controllers provided below average scores mainly due to the lower technical maturity of the U architecture and the provided tools. They judged the technical setup not sufficiently mature to provide safe air traffic.





During the debriefings one additional safety requirement has been derived:

The delegating and receiving ATCOs shall be supported by appropriate automation and HMI functions to fully exchange relevant information and safely handover the responsibility.

This requirement is also contained in *SESAR Solution PJ10-W2-93 SPR-INTEROP/OSED for V3 - Part II - Safety Assessment Report* under SRD-027.

It has been strongly highlighted the importance of having a full set of supporting tools. ATSU's involved in the delegation should identify a minimum equipment/ tools list for safe delegation of airspace. The impact of the unavailability of any of the identified items should be included in the letter of agreement between the two ATSU's (e.g., unavailability of certain tools will not allow a delegation).

### 8. EX3-OBJ-PJ.10-W2-93-V3-VALP-009 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-009:** Assess the impact in terms of Safety of the ATM services provision delegation concept in abnormal conditions.

Below is the summary of the results for the Objective EX3-OBJ-PJ.10-W2-93-V3-VALP-009 per Success Criteria:

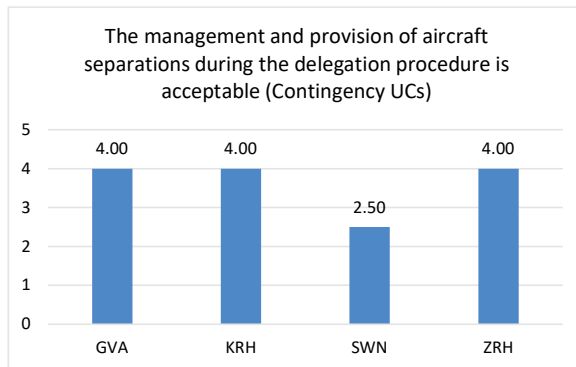
Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-009-001	Considering only UC# based on the Y or D architectures, In general, the level of safety was maintained throughout the runs. The procedure itself was considered somewhat safe and this in all phases of the delegation.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-009-002	Mainly because of the following concerns expressed by several ATCOs (from SG, DFS and NATS): <ul style="list-style-type: none"> <li>- Major support tools such as Safety Nets and MTCD that are used for the management and provision of aircraft separation, were not provided by the various CWP's/systems, or when they are, ATCO were not sufficiently trained to use them</li> <li>- Lack of training on the airspace environment and sometimes on the systems used</li> <li>- .</li> </ul>	OK	

The impact was that the delegation procedures in such conditions would not be fully acceptable by ATCOs. But assuming the training done and the controller tools available, the delegation procedure will be fully acceptable by ATCO. For this reason, we can consider the OK for this SC

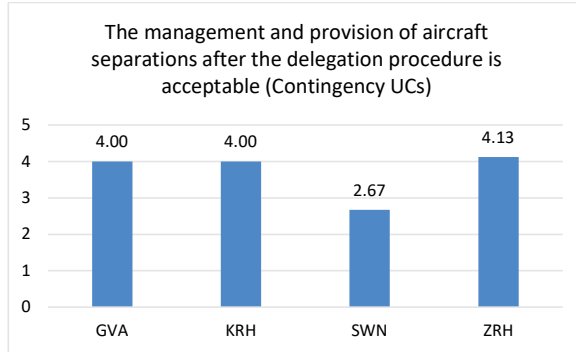
Results from Post Simulation Questionnaires are the same as those detailed above under *EX3-CRT-PJ.10-W2-93-V3-VALP-008 Safety assessment in nominal conditions*. This is due to the fact that the Post Simulation Questionnaires were filled in at the end of the day, as such they do not distinguish between use cases with delegation in nominal or abnormal conditions.

**Results from Post Run Questionnaires:**

In post run questionnaires the ATCOs were asked if the management and provision of aircraft separation is acceptable answering to a 5-point agreement scale. The figures show, according to ATCOs feedback, that controllers were able to manage traffic in a quite safe way during all the phases of the delegation process. Although there was no occurrence of safety-related events, controllers sometimes experienced difficulties in maintaining a clear traffic picture and managing traffic especially during the delegation process. This was strictly related to the preview phase issues (i.e., ATCOs would have needed an improved preview mode with a cleared understanding on the switch to the operational mode and specific indications on the traffic to be gained and on the one to be delegated).







Swanwick controllers provided below average scores mainly due to the lower technical maturity of the U architecture and the provided tools. They judged the technical setup not sufficiently mature to provide safe air traffic.

### 9. EX3-OBJ-PJ.10-W2-93-V3-VALP-010 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-010:** Assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSU's concept.

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-010-001	Increase of En-Route Capacity is not measured in EXE3.		
EX3-CRT-PJ.10-W2-93-V3-VALP-010-002	TMA is not in the scope of EXE3. Criteria is N/A.		N/A

### 10. EX3-OBJ-PJ.10-W2-93-V3-VALP-011 Results

**EX3-OBJ-PJ.10-W2-93-V3-VALP-011:** Assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSU's concept.

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-011-001	Based on scenarios UC# with a Dynamic AoR, the ATCO productivity could be increased up to 50% in Low to Medium traffic conditions.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-011-002	Technology Costs not assessed, report to CBA report		

**EX3-OBJ-PJ.10-W2-93-V3-VALP-011-001:** Result = OK

According to the SESAR Performance Framework, the Cost Efficiency KPI (CEF2) is computed as the number of flights handled divided by the number of ATCO-hours on duty.

The following table summarizes the results obtained for the Dynamic AoR UC#. Considered as the scenarios which bring a maximum ATCO productivity, compared the Static AoR UC#.

Scenario UC#	Archi	CEF2 Benefit (Reference vs. Solution scenario)
UC#1	Y	50%
UC#3	Y	50%
UC#10	U	38%
UC#14	U	46%

Notice that, the results for the ATCO productivity are sensibly high (40% to 50%), figures which are valid only in the Low to Medium traffic conditions. The same Performance Criteria measured by other excises show a much lower value (i.e., closer to 20% than 50%).

**EX3-OBJ-PJ.10-W2-93-V3-VALP-011-002:**

Technology Costs not assessed, please report to CBA report.

**11. EX3-OBJ-PJ.10-W2-93-V3-VALP-012 Results**

**EX3-OBJ-PJ.10-W2-93-V3-VALP-012:** Assess the performance benefits in terms of Resilience of the delegation of ATM services provision among ATSUs concept.

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93-V3-VALP-012-001	The reduced loss of airspace capacity generated by the contingency situation, is proportional to the number of additional controlled flights/hour at the supporting ATSU.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-012-002	From the simulations, the time to perform a full delegation is between 1 to 3 minutes while the time to recover from an ATSU failure is much more than that (count 2 hours in average). The time to recover from non-nominal to nominal situations is then significantly reduced with the delegation procedure.	OK	
EX3-CRT-PJ.10-W2-93-V3-VALP-012-003	Generated delays are not measured in EXE3. Criteria is N/A.	N/A	

EX3-CRT-PJ.10-W2-93-V3-VALP-012-004	Number of cancellations is not measured in EXE3. Criteria is N/A.	N/A
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**EX3-OBJ-PJ.10-W2-93-V3-VALP-012-001:** Result = OK

Based on the assumptions under EX3-OBJ-PJ.10-W2-93-V3-VALP-012-002, clearly:

- In case of delegation from a failing to a supporting ATSU, the reduced loss of airspace capacity is proportional to the number of additional controlled flights/hour at the supporting ATSU.
- Without the delegation, the capacity at the failing ATSU is reduced to ZERO at the end of the "Empty the Sky" procedure

**EX3-OBJ-PJ.10-W2-93-V3-VALP-012-002:** Result = OK

This criterion suggests comparing the time to recover from non-nominal (failure mode) to nominal (normal operation) in two situations:

- When performing a delegation of the whole airspace controlled by the failed ATSU to a supporting ATSU. And this including the "Empty the Sky" procedure mandatory upon the ATSU failure.
- Without performing a delegation of ATS but just initiating the "Empty the Sky" procedure

The comparison of the above times is done with the following assumptions:

- We consider a normal situation when the whole airspace is delegated from the failed to the supporting ATSUs
- We consider the time to "Empty the Sky" the same in the above cases
- We assume in average a recovery time from a major failure of an ATSU to normal operation, around 2 Hours

Furthermore, the below Table provides the measured times from our simulations, to perform a full delegation from a failing to supporting ATSUs:

Global Time of the Delegation Process		
Archi	UC# with Static AoR (using Spare CWP's at the receiving ATSU)	UC# with Dynamic AoR (Receiving ATSU CWP already controlling a local Sector)
Y	60 sec	1 min
D	2 min	-
U	2 min	3 min

The recovery time from non-nominal to nominal situations is reduced significantly and this criterion is OK.

**12. EX3-OBJ-PJ.10-W2-93-V3-VALP-013 Results**

**EX3-OBJ-PJ.10-W2-93-V3-VALP-013:** Validate the ATSEP operational requirements based on expert judgment

Success criteria	Summary of Results	Suc. Crit. Status
EX3-CRT-PJ.10-W2-93-V3-VALP-013-001	<p>An ATSEP role is defined at each ATSU and/or ADSP involved by the validation Use Case. The ATSEP role was played at the following locations:</p> <ul style="list-style-type: none"> <li>- Geneva: CWP Skyguide, CWP voice from Frequentis &amp; interfaces to CCS and iTEC ADSPs. The ATSEP was also responsible for the Simulation environment</li> <li>- Toulouse: CCS ADSP</li> <li>- Madrid: iTEC ADSP and NATS CWPs</li> <li>- Vienna: Voice ADSP and AMQP Broker</li> <li>- Langen: DFS CWPs</li> </ul> <p>In addition, the Geneva ATSEP had an additional role as a SPOC for all technical aspects and issues during the runs. Communication means (telephones or via Teams) were put in place between ATSEPs of different locations. Inside the ATSUs (delegating or receiving), a Verbal Communication between the local ATSEP and SUP is put in place.</p> <p>In the view of the OSED requirements, the ATSEPs have filled successfully following tasks:</p> <ul style="list-style-type: none"> <li>- Follow and execute the technical part of the delegation procedures</li> <li>- Manage local actions on their CWPs/ADSPs or delegate the tasks to other supportive ATSEPs (e.g., for Network monitoring &amp; management)</li> <li>- Ensure supervision &amp; monitoring of the systems being local or remote and report to the SUP about the status of the validation platform and of the shared services</li> </ul>	OK
EX3-CRT-PJ.10-W2-93-V3-VALP-013-002	<p>The ATSEP role was played by people who are not ATSEPs in the real life but rather experts and engineers, in charge of the validation platform preparation. After several months of cooperation, all experts are used to work together, and the simulations were performed in very good conditions.</p> <p>However, there were no specific requirements identified for the ATSEP role.</p>	OK

### B.3.3 Summary of Validation Exercise #03 Results for the PJ.10-W2-93a Technological Solution

Following are the results from EXE-PJ.10-W2-93-V3-VALP-003 exercise for the PJ.10-W2-93a Technological Solution.

Validation Exercise #03 Validation Objective ID	Validation Exercise #03 Validation Objective Title	Validation Exercise #03 Success Criterion ID	Validation Exercise #03 Success Criterion	Sub-operating environment	Exercise #03 Results	Validation Exercise #03 Validation Objective Status
EX3-OBJ-PJ.10-W2-93a-V3-VALP-001	<b>Maturity Assessment</b> To assess the maturity of the Virtual Centre architecture and services environment conditions	EX3-CRT-PJ.10-W2-93a-V3-VALP-01-001	A "VC maturity assessment report" is provided	ER Very High Complexity	N/A - No longer Valid Objective from the SJU feedback	N/A
EX3-OBJ-PJ.10-W2-93a-V3-VALP-002	<b>Validation Platform</b> To produce and complement/provide the technical validation platform	EX3-CRT-PJ.10-W2-93a-V3-VALP-02-001	A Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture	ER Very High Complexity	Status of both ATC & Voice ADSPs are monitored thanks to supervision tools put in place either locally at the ATSU level and/or at the location of the remote ADSP. The ADSP related services are also monitored from the remote ATSUSs.	OK
		EX3-CRT-PJ.10-W2-93a-V3-VALP-02-002	A Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services			

		EX3-CRT-PJ.10-W2-93a-V3-VALP-02-003	A Technical Supervision service is put in place to monitor the status of the Voice ADSP			
EX3-OBJ-PJ.10-W2-93a-V3-VALP-003	<b>Virtual Centre Services</b> To increase the number of defined as well as implemented Virtual Centre services	EX3-CRT-PJ.10-W2-93a-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)	ER Very High Complexity	The ADSPs were fully supervised from the ATSUs to follow all the phases of the delegation: from Operation to Preview and then to Operational at the receiving. The same applies at the delegating ATSU.  Some new services have been defined and validated and some existing ones have been validated at a higher maturity (TRL6)	OK
		EX3-CRT-PJ.10-W2-93a-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated			
		EX3-CRT-PJ.10-W2-93a-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated			
EX3-OBJ-PJ.10-W2-93a-V3-VALP-004	<b>Interoperability</b> To increase the number of defined as well as implemented Virtual Centre services	EX3-CRT-PJ.10-W2-93a-V3-VALP-04-001	Services from one ADSP have been provided to CWP's from different vendors/ANSPs	ER Very High Complexity	Standard services are used between CCS and iTEC ADSPs and the various CWP's	OK

		EX3-CRT-PJ.10-W2-93a-V3-VALP-04-002	CWPs of a vendor/ATSU have consumed the same services from ADSPs of different vendors			
		EX3-CRT-PJ.10-W2-93a-V3-VALP-04-003	Performance of the A/G and G/G communications between CWPs of a same or of different voice ADSP(s) are judged acceptable by End users (ATCOs, SUPs, ATSEPs)			
EX3-OBJ-PJ.10-W2-93a-V3-VALP-005	<b>Virtual Centre services performance</b> To complement the performance assessment of the Virtual Centre architecture and services	EX3-CRT-PJ.10-W2-93a-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold	ER Very High Complexity	The overall performance of the VC components (Network, CWPs, ADSPs voice and ATC) were measured and good figures were shown, see below under EX3-OBJ-PJ.10-W2-93a-V3-VALP-005.  The response time at the ATC or Voice CWPs are judged acceptable by the ATCOs and SUPs.	OK
		EX3-CRT-PJ.10-W2-93a-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform			
		EX3-CRT-PJ.10-W2-93a-V3-VALP-05-003	Removed as it is the same as EX3-CRT-PJ.10-W2-93a-V3-VALP-05-001			

	EX3-CRT-PJ.10-W2-93a-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations			
	EX3-CRT-PJ.10-W2-93a-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations			
	EX3-CRT-PJ.10-W2-93a-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations			

Table 26262626262626: Validation Results for EXE-PJ.10-W2-93a-V3-VALP-003



### B.3.4 Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93a Technological Solution

#### EX3-OBJ-PJ.10-W2-93a-V3-VALP-002 Validation Platform

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93a-V3-VALP-02-001	EX3-CRT-PJ.10-W2-93a-V3-VALP-02-001 is not considered as a SC by the SJU	N/A	
EX3-CRT-PJ.10-W2-93a-V3-VALP-02-002	<p>Status of CCS ADSP is monitored through 3 different supervision tools:</p> <ul style="list-style-type: none"> <li>- Locally at DSNA premises</li> <li>- Remote from Geneva via a DSNA Web application</li> <li>- Remote from Geneva via a supervision using the CCS TECHSUP service that provides detailed status of each service from CCS to the Geneva ATSU</li> </ul> <p>iTEC ADSP is also monitored via a local supervision tool</p> <p>All the OLDI lines with CCS &amp; iTEC are also monitored via the Skyguide supervision tool</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-02-003	<p>Status of FREQUENTIS and INDRA voice ADSPs are monitored via local supervision tools.</p> <p>The broker and related Network components are monitored via supervision tools that measure their performances real-time</p>	OK	

#### EX3-OBJ-PJ.10-W2-93a-V3-VALP-003 Virtual Centre Services

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93a-V3-VALP-03-001	<p>From the various CWP's (SG, DFS and NATS), and thanks to the data sent by the CCS/iTEC ADSPs regarding the current configuration of the CWP's at different ATSU's, it was possible to follow all the phases of delegation:</p> <ul style="list-style-type: none"> <li>- The Switch from Operation to Preview modes is clearly indicated as well as the switch from Preview to Operational modes at the receiving ATSU</li> </ul>	OK	

	<ul style="list-style-type: none"> <li>- The ATSEPs at both the delegating and receiving ATSUs, have a full control on the remote ADSPs and can continue or interrupt the delegation procedure at any time. From the various CWP (SG, DFS and NATS), and thanks to the data sent by the CCS/iTEC ADSPs regarding the current configuration of the CWPs at different ATSUs, it was possible to follow all the phases of delegation:</li> <li>- The Switch from Operation to Preview modes is clearly indicated as well as the switch from Preview to Operational modes at the receiving ATSU</li> <li>- The ATSEPs at both the delegating and receiving ATSUs, have a full control on the remote ADSPs and can continue or interrupt the delegation procedure at any time.</li> </ul>	
EX3-CRT-PJ.10-W2-93a-V3-VALP-03-002	<p>New developed and validated services at TRL6:</p> <ul style="list-style-type: none"> <li>- <b>SVC-049</b> and <b>SVC-050</b>: Operational Configuration Management/Distribution of Working Position Preview Mode (in all CWP (SG, DFS and NATS/iTEC): this allowed to configure properly both the supporting ADSPs and the ATSUs involved by the delegation.</li> </ul>	OK
EX3-CRT-PJ.10-W2-93a-V3-VALP-03-003	<p>The following existing services were further developed to reach a TRL6 maturity:</p> <ul style="list-style-type: none"> <li>- MONA: Monitoring Aids</li> <li>- OPSUP: Operational Configuration Management &amp; Distribution</li> <li>- TECHSUP: Technical Supervision Management &amp; Distribution</li> </ul>	OK

**EX3-OBJ-PJ.10-W2-93a-V3-VALP-004** Interoperability

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93a-V3-VALP-04-001	<p>The iTEC ADSP provided its services to both CWP (at DFS and at NATS).</p> <p>The CCS ADSP provided its services to both CWP (at SG and at DFS)</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-04-002	N/A in Y	N/A	
EX3-CRT-PJ.10-W2-93a-V3-VALP-04-003	Positive feedback is received from all involved actors (Pseudo-pilots, ATCOs and SVPRs) about the performance of the G/G and A/G communications.	OK	

**EX3-OBJ-PJ.10-W2-93a-V3-VALP-005** Virtual Centre services performance

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-001	<p>Response time for a full exchange CWP to/from ADSP is excellent with an average of 0.36 sec in the case of Skyguide CWP and CCS ADSP, see below:</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-002	<p>Except in cases of Network disruption (as we were using public Internet), there was no issue of Network capacity during the simulations</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-003	<p>Removed as it is the same as EX3-CRT-PJ.10-W2-93a-V3-VALP-05-001</p>	N/A	
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-004	<p>Although the time for a Switch to the Preview Mode was different from the architecture type, it was judged acceptable by all ATCOs involved in the delegation of ATS. See below Table.</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-005	<p>For the UC# based on the Y and D architecture, the time to switch to the operational mode was judged good and acceptable by all ATCOs involved in the delegation of ATS. For the UC# based on the U architecture, the time to switch to the operational mode was also acceptable while the switch itself was not acceptably Safe due to lack of synchronization between the involved ADSPs. See below Table.</p>	OK	
EX3-CRT-PJ.10-W2-93a-V3-VALP-05-006	<p>The Global time to perform the overall delegation process was judged acceptable by the involved ATCOs and SUPs, although different for various UC#, see Table below.</p>	OK	

The following Table shows the Switch performance from Operational to Preview modes and vice versa.

Archi	Receiving ATSU		Delegating
	Average Switch Time from Operational to Preview Modes	Average Switch Time from Preview Modes to Operational	Average Switch Time from Operational to Preview Modes
Y	10 sec	10 sec	10 sec
D	10 sec	10 sec	10 sec
U	10 sec	2 min	2 min

The following Table shows the Global time to perform a delegation under Low to Medium traffic conditions.

Archi	Global Time of the Delegation Process	
	UC# with Static AoR (using Spare CWP's at the receiving ATSU)	UC# with Dynamic AoR (Receiving ATSU CWP already controlling a local Sector)
Y	60 sec	2 min
D	2 min	-
U	3 min	5 min

### B.3.5 Summary of Validation Exercise #03 Results for the PJ.10-W2-93b Technological Solution

Following are the results from EXE-PJ.10-W2-93-V3-VALP-003 exercise for the PJ.10-W2-93b Technological Solution.

Validation Exercise #03 Validation Objective ID	Validation Exercise #03 Validation Objective Title	Validation Exercise #03 Success Criterion ID	Validation Exercise #03 Success Criterion	Sub-operating environment	Exercise #03 Results	Validation Exercise #03 Validation Objective Status
EX3-OBJ-PJ.10-W2-93b-V3-VALP-001	<b>Maturity Assessment</b> To assess the maturity of the Virtual Centre architecture and services environment conditions	EX3-CRT-PJ.10-W2-93b-V3-VALP-01-001	A "VC maturity assessment report" is provided	ER Very High Complexity	N/A - No longer Valid Objective from the SJU feedback	N/A
EX3-OBJ-PJ.10-W2-93b-V3-VALP-002	<b>Validation Platform</b> To produce and complement/provide the technical validation platform	EX3-CRT-PJ.10-W2-93b-V3-VALP-02-001	A Virtual Centre (VC) validation platform based on the D architecture is put in place and supports the validation of the delegation scenarios dedicated to the D architecture	ER Very High Complexity	Status of both ATC & Voice ADSPs are monitored thanks to supervision tools put in place either locally at the ATSU level and/or at the location of the remote ADSP. The ADSP related services are also monitored from the remote ATSUSs.	OK
		EX3-CRT-PJ.10-W2-	A Technical Supervision service is put in place to monitor the status of			

		93b-V3-VALP-02-002	the ATC ADSP and its services			
		EX3-CRT-PJ.10-W2-93b-V3-VALP-02-003	A Technical Supervision service is put in place to monitor the status of the Voice ADSP			
EX3-OBJ-PJ.10-W2-93b-V3-VALP-003	<b>Virtual Centre Services</b> To increase the number of defined as well as implemented Virtual Centre services	EX3-CRT-PJ.10-W2-93b-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)	ER Very High Complexity	The ADSPs were fully supervised from the ATSUs to follow all the phases of the delegation: from Operation to Preview and then to Operational at the receiving. The same applies at the delegating ATSU.	OK
		EX3-CRT-PJ.10-W2-93b-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated			
		EX3-CRT-PJ.10-W2-93b-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated			
EX3-OBJ-PJ.10-W2-	<b>Interoperability</b>	EX3-CRT-PJ.10-W2-	Services from one ADSP have been provided to		Standard services are used between CCS and	OK

93b-V3-VALP-004	To increase the number of defined as well as implemented Virtual Centre services	93b-V3-VALP-04-001	CWPs from different vendors/ANSPs	ER Very High Complexity	ITEC ADSPs and the various CWPs and the specific DFS CWP was able to connect to two different ADSPs: CCS and ITEC	
		EX3-CRT-PJ.10-W2-93b-V3-VALP-04-002	CWPs of a vendor/ATSU have consumed the same services from ADSPs of different vendors			
		EX3-CRT-PJ.10-W2-93b-V3-VALP-04-003	Performance of the A/G and G/G communications between CWPs of a same or of different voice ADSP(s) are judged acceptable by End users (ATCOs, SUPs, ATSEPs)			
EX3-OBJ-PJ.10-W2-93b-V3-VALP-005	<p><b>Virtual Centre services performance</b></p> <p>To complement the performance assessment of the Virtual Centre architecture and services</p>	EX3-CRT-PJ.10-W2-93b-V3-VALP-05-001	Response time from the ADSP(s) to CWPs requests remains within a defined threshold	ER Very High Complexity	<p>The overall performance of the VC components (Network, CWPs, ADSPs voice and ATC) were measured and good figures were shown, see below under EX3-OBJ-PJ.10-W2-93a-V3-VALP-005.</p> <p>The response time at the ATC or Voice CWPs are</p>	OK
		EX3-CRT-PJ.10-W2-93b-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support			

			data flows within the Validation Platform		judged acceptable by the ATCOs and SUPs.
		EX3-CRT-PJ.10-W2-93b-V3-VALP-05-003	Removed as it is the same as EX3-CRT-PJ.10-W2-93b-V3-VALP-05-001		
		EX3-CRT-PJ.10-W2-93b-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations		
		EX3-CRT-PJ.10-W2-93b-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations		
		EX3-CRT-PJ.10-W2-93b-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations		

Table ~~272727272727~~: Validation Results for EXE-PJ.10-W2-93b-V3-VALP-003



### **B.3.6 Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93b Technological Solution**

The results from the sole UC# played with the D architecture (UC#12) are the same as the UC# based on the Y architecture, thus all the results under §B.3.4 are applicable for the D architecture Use Cases.

### B.3.7 Summary of Validation Exercise #03 Results for the PJ.10-W2-93c Technological Solution

Following are the results from EXE-PJ.10-W2-93-V3-VALP-003 exercise for the PJ.10-W2-93c Technological Solution.

Validation Exercise #03 Validation Objective ID	Validation Exercise #03 Validation Objective Title	Validation Exercise #03 Success Criterion ID	Validation Exercise #03 Success Criterion	Sub-operating environment	Exercise #03 Validation Results	Validation Exercise #03 Validation Objective Status
EX3-OBJ-PJ.10-W2-93c-V3-VALP-001	<b>Maturity Assessment</b> To assess the maturity of the Virtual Centre architecture and services environment conditions	EX3-CRT-PJ.10-W2-93c-V3-VALP-01-001	A "VC maturity assessment report" is provided	ER Very High Complexity	N/A - No longer Valid Objective from the SJU feedback	N/A
EX3-OBJ-PJ.10-W2-93c-V3-VALP-002	<b>Validation Platform</b> To produce and complement/provide the technical validation platform	EX3-CRT-PJ.10-W2-93c-V3-VALP-02-001	A Virtual Centre (VC) validation platform based on the U architecture is put in place and supports the validation of the delegation scenarios dedicated to the U architecture	ER Very High Complexity	EX3-CRT-PJ.10-W2-93c-V3-VALP-02-001 is not considered as a SC by the SJU	POK
		EX3-CRT-PJ.10-W2-93c-	A Technical Supervision service is put in place to		Status of both ATC & Voice ADSPs are monitored thanks to supervision tools put in place either locally at the ATSU level	

		V3-VALP-02-002	monitor the status of the ATC ADSP and its services		and/or at the location of the remote ADSP	
		EX3-CRT-PJ.10-W2-93c-V3-VALP-02-003	A Technical Supervision service is put in place to monitor the status of the Voice ADSP			
EX3-OBJ-PJ.10-W2-93c-V3-VALP-003	<b>Virtual Centre Services</b>	EX3-CRT-PJ.10-W2-93c-V3-VALP-03-001	Specific inter-ADSP services have been defined to manage airspace delegation in "U" architecture	ER Very High Complexity	The synchronisation work between the CCS and iTEC ADSPs has well started but a lot of missing data have made this solution as not enough mature, see below analysis	POK
	To increase the number of defined as well as implemented Virtual Centre services					
EX3-OBJ-PJ.10-W2-93c-V3-VALP-004	<b>Interoperability</b>	EX3-CRT-PJ.10-W2-93c-V3-VALP-04-001	Specific to U: the ADSPs have successfully shared data between them to allow for delegation	ER Very High Complexity	While the voice ADSP was as much mature as for the Y/D architectures, the data sharing between the ADSPs was just not sufficient to guarantee a safe delegation procedure.  However, there was no issue to play UC# with Dynamic AoR	POK
	To increase the number of defined as well as implemented Virtual Centre services	EX3-CRT-PJ.10-W2-93c-V3-VALP-04-002	Specific to U: the ADSP has been able to increase or reduce its AoR			
		EX3-CRT-PJ.10-W2-93c-	The Voice ADSPs (when many) are able to			

		V3-VALP-04-003	exchange voice communications A/G and G/G		under the U architecture	
EX3-OBJ-PJ.10-W2-93c-V3-VALP-005	<b>Virtual Centre services performance</b> To complement the performance assessment of the Virtual Centre architecture and services	EX3-CRT-PJ.10-W2-93c-V3-VALP-05-001	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform	ER Very High Complexity	For this Objective, the results obtained from the U/D architectures are also valid for the U architecture for the first five SC which are all of them validated OK.  However, for the last two criteria (% of coordinated flights), the level of automation was not acceptable for the operations.	POK
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-002	Quality of Service (QoS) during the EXE runs has been evaluated			
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-003	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations			
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-004	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations			
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-005	The Global time to perform the overall delegation process is			

			acceptable for the operations			
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-006	Specific to U: % of Coordinated flights between ADSPs against total number of flights is in a acceptable rate for the operations			
		EX3-CRT-PJ.10-W2-93c-V3-VALP-05-007	Specific to U: % of manually coordinated flights between ATSUs against total number of flights is in a acceptable rate for the operations			

Table **28282828282828**: Validation Results for EXE-PJ.10-W2-93c-V3-VALP-003

### B.3.8 Analysis of Exercise 3 Results per Validation objective for the PJ.10-W2-93c Technological Solution

#### EX3-OBJ-PJ.10-W2-93c-V3-VALP-002 Validation Platform

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93c-V3-VALP-02-001	EX3-CRT-PJ.10-W2-93c-V3-VALP-02-001 is not considered as a SC by the SJU	N/A	
EX3-CRT-PJ.10-W2-93c-V3-VALP-02-002	<p>Status of CCS ADSP is monitored through 3 different supervision tools:</p> <ul style="list-style-type: none"> <li>- Locally at DSNA premises</li> <li>- Remote from Geneva via a DSNA Web application, see below Figures</li> <li>- Remote from Geneva via a supervision using the CCS TECHSUP service, see below Figures</li> </ul> <p>iTEC ADSP is also monitored via a local supervision tool</p> <p>All the OLDI lines with CCS &amp; iTEC are also monitored via the Skyguide supervision tool</p>	OK	
EX3-CRT-PJ.10-W2-93c-V3-VALP-02-003	<p>Status of FREQUENTIS and INDRA voice ADSPs are monitored via local supervision tools.</p> <p>The broker and related Network components are monitored via supervision tools that measure their performances real-time, see Figure below</p>	OK	

#### EX3-OBJ-PJ.10-W2-93c-V3-VALP-003 Virtual Centre Services

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93c-V3-VALP-03-001	<p>Although, synchronisation means of part of the OLDI messages were put in place between CCS and iTEC ADSPs, a lot of other data required a synchronisation for the need of the delegation.</p> <p>As example, activation of FPLs at the receiving ATSU was manually performed from a Super-User position to cope with the lack of synchronisation.</p> <p>Also, it was not possible to forward all cleared data at the delegating ATSU to the receiving during and after the delegation.</p>	POK	

#### **EX3-OBJ-PJ.10-W2-93c-V3-VALP-004** Interoperability

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93c-V3-VALP-04-001	The data shared between CCS & iTEC were limited to the OLDI messages: required for the activation of FPLs at the receiving CWP. And this was only done for the FPLs crossing the two ATSUs, the others had to be activated manually by the ATSEPs.	POK	
EX3-CRT-PJ.10-W2-93c-V3-VALP-04-002	Both CCS & iTEC were able to increase or reduce their AoR and the mechanism used is like the one used for the Y architecture: pre-configuration of both airspaces was required.	OK	
EX3-CRT-PJ.10-W2-93c-V3-VALP-04-003	The Voice ADSPs from FREQUENTIS & INDRA could exchange voice communications A/G and G/G.	OK	

#### **EX3-OBJ-PJ.10-W2-93c-V3-VALP-005** Virtual Centre services performance

Success criteria	Summary of Results	Suc. Status	Crit.
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-001	There were not Network capacity issues for UC# under the U architecture.	OK	
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-002	Response time for a full exchange CWP to/from ADSP is excellent with an average of 0.36 sec in the case of Skyguide CWP and CCS ADSP, see below:	OK	

all_operations		
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-003	Average time for a CWP switch to a Preview Mode is like the one measured under the Y/D architectures, see above.	OK
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-004	Average time for a CWP switch from a Preview to Operational Mode is like the one measured under the Y/D architectures, see above	OK
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-005	The Global time to perform the overall delegation process is acceptable for the operations	OK
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-006	About 60% of the delegated Flights were automatically coordinated between CCS and iTEC and this was judged not sufficient for the operations.	POK
EX3-CRT-PJ.10-W2-93c-V3-VALP-05-007	The remaining 40% of the delegated Flights were manually coordinated between CCS and iTEC and this was judged not sufficient for the operations	POK

### B.3.9 Unexpected Behaviours/Results

From the validation results obtained under the Y and D architecture UC#, we could surprisingly observe that the D UC# provided similar Technical and Operational results than the Y UC#. This suggests some similarities between these two architectures

However, during the simulations, there was no unexpected behaviour encountered neither technical, nor operational. And about the less mature technological solution under the U architecture, this was expected since the development of the technical requirements of the validation platforms.

### B.3.10 Confidence in Results of Validation Exercise 3

#### 1. Level of significance/limitations of Validation Exercise Results

The validation platform used was involving 3 different ATSUs with 3 different ATCOs communities (Skyguide, DFS and NATS) which is of a high significance for the validation of delegation of ATS cross



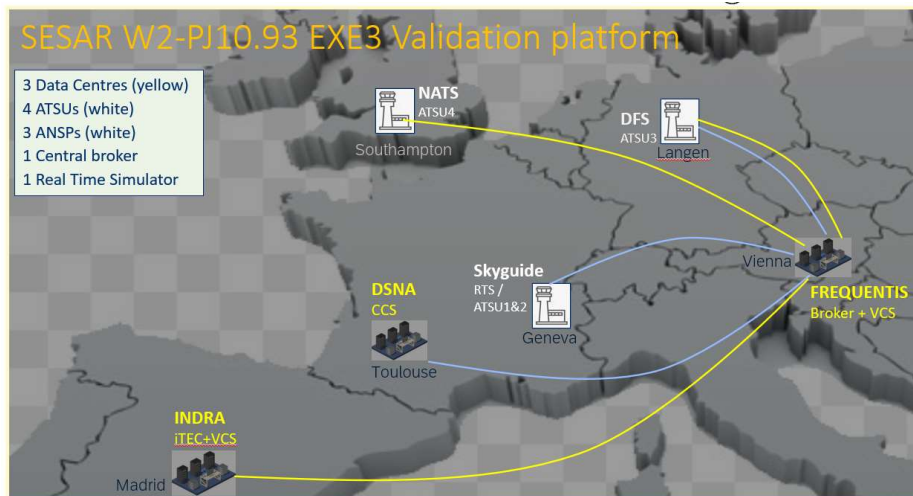
border ATSUs. It was also shown that the delegation of ATS was feasible and acceptable by all ATCOs in Low to Medium traffic conditions, based on HP and Safety considerations during the delegation process and after the delegation, especially for the UC# with extension of the AoR for which the increase of workload was systematically observed.

The following limitations were pointed by ATCOs during the exercise runs:

- Most of the objectives are HP and SAF oriented and since the debriefing sessions were made with the 2 to 3 ATCO communities (Skyguide, DFS and NATS) by the mean of Microsoft Teams while they did not know each other, the efficiency of these debriefing was NOT as efficient as in a F2F, thus we may have missed some interesting discussions between the ATCOs that should bring even more outcomes.
- Traffic scenarios: Most of the contingency use cases were performed on Sectors of the Upper airspace above FL-330, with many stable flights and very few conflictual situations. The reality would be a more complex traffic situation with several potential conflicts. However, the traffic was more realistic for the night delegation use cases.
- Although it was planned and because of the ATCO resource limitations, the SUP role was not played by a dedicated person, but it was allocated to the respective Planners (RP) at the delegating and receiving ATSUs.
- In term of familiarity of the involved ATCOs with their respective CWPs, while the Skyguide ATCO were using a similar CWP than the one in the OPS room, it was not the case for DFS or NATS ATCOs who were using a different HMI with slightly different controller tools. Therefore, the HP and SAF assessments would have a higher significance when based on feedback from Skyguide ATCOs than the feedback received from DFS or NATS ATCOs.
- In order to reach the right level of Safety or situation awareness, all ATCOs expressed the need of their usual controller support tools such as MTCD, Safety Nets or Monitoring Aids (MONA). These tools were missing in the Skyguide & DFS CWPs and although existing in the NATS CWP provided by Indra, it was one of the latest versions of iTEC, that ATCOs were not familiar with.
- Certain CWPs (mainly at NATS and sometimes at DFS as well) experienced some delay in the data transmission between ATSU to ADSP through the FREQUENTIS broker. The issue was well identified and should be solved by using other interface standards.
- Interoperability between CCS and iTEC was not enough mature to validate the VC "U" architecture and the workaround was to create a Super-User position from which an operator introduces all synchronisation data (manual correlation, clearances, etc) during and after the delegation.

## 2. Quality of Validation Exercises Results

The delegation of ATS performed on a Virtual Centre platform, spread over Europe (see Figure below), has bring a good quality of the validation results for the Y and D architecture UC# but a less good quality for the U architecture UC#:



- The used ADSP (CCS & iTEC) have both shown their maturity to deliver required services to different ATSUs, allowing them to achieve their missions of ATS provision and delegation of ATS between ATSUs
- The validation environment was based on a Real Time Simulation that involved 4 Pseudo-pilots and 10 different and well experienced ATCOs (two of them have an ACC SUP license) while all the ATCOs have filled the HP/SAF Questionnaires after each run
- The stability of the validation platform was demonstrated thanks to a long period of integration and testing between all partners of the exercise and also thanks to the multiple Dry runs performed before the final runs
- The participating ATCOs from Skyguide, DFS and NATS were trained on the delegated airspace environment, during the Dry runs (about 2 to 3 days each) and specific Radar Maps were distributed to all of them prior each run.
- All participating ATCOs were very experienced and have shown motivation to support such long-term projects. The discussions with the HP & SAF Experts were fruitful.
- The Pseudo-pilots got a short training prior each run to explain them the airspace environment, the manipulations to be done on the VCS when switching from one UC# to another
- The communication between the Skyguide Pseudo-pilots with the ATCOs from DFS and NATS was very good.

### 3. Significance of Validation Exercises Results

Based on the following considerations:

- Use of RTS together with a complex Virtual Centre.

- Having in the participants experienced ATCOs that are familiar with projects, experienced Pseudo-pilots and HP and SAF experts.
- The long preparation of the Validation platform with all partners during Months which has made it very stable in the End during the Final runs.

EXE3 has contributed to validate the concept of delegation of ATS between ATSUs (under Solution 93) and a good contributor to the innovation around Virtual Centre Research & Development.

The research on the three different VC architectures (Y, U, D) have shown different maturities in term of operational readiness for the delegation procedures between ATSUs, while opening the door to several improvements in each of the architectures.

## B.3.11 Conclusions Exercise 3

### 1. Conclusions on concept clarification

The following conclusions on the delegation concept are issued from our exercise:

- **Delegation Procedures**

The ATS delegation procedures is deemed clearly defined and documented for all actors involved in the delegation (ATCOs, SUPs and ATSEPs). Each of them can follow all the steps of the delegation and positive feedback was received from all the actors

Based on the taxonomy and characteristics of the delegation scenarios, this exercise contributed to validate delegation use cases based on following:

- Static vs Dynamic AoR: the second one was the most complex to manage at the ADSP and ATSU CWPs, as e.g., changing dynamically the AoR required to change dynamically the configuration of the ADSPs (OLDI lines) and the CWPs (Map display, FPL activation & display)
- Delegation in normal vs abnormal conditions
- Delegation based on different VC architecture options Y, U & D

- **Operational Feasibility**

The concept has been demonstrated as operationally feasible for the following use cases:

- Delegation by Night, and
- Delegation in ATSU Contingency

However, some limitations in the applicability of the delegation procedures are identified:

- The level of traffic should remain acceptable, (i.e., from low to medium) for the applicability of the delegation of ATM service provision
- The training of ATCO on the systems and on the airspace environment (including the LoAs), although addressed during the dry runs, is further required to improve the operational feasibility & acceptance of the concept

- Although some of them were available but not completely used, the ATCO support tools (Safety Nets, MTCD,) are also required to improve the operational feasibility & acceptance of the concept
- The delegation is feasible in use cases with the Y or D architecture options while the delegation under the U architecture is judged not feasible and/or acceptable due to Safety issues encountered (correlation issues and in general lack of synchronisation between the ADSPs)

- **Operational Acceptance**

In term of workload, the level remains in general Low for most of the use cases and the communication load was deemed satisfactory. In general, the delegation procedure (by night or in contingency) was acceptable with some limitations & improvements:

- Additional information accessible directly on the CWP, for the delegated area. would increase the Situation Awareness
- The Situation Awareness was more impacted in the use cases with Dynamic AoR due to the "sudden" increase of the controlled airspace while keeping control of the current one. Additional controller support tools might be helpful in such situation, e.g., Scanning Tools or MTCDs
- Additional functionalities may be added for the "Preview" function such as: pointing/highlighting traffic from delegating to receiving CWPs,

- **Conclusion on the concept**

- Very few differences in the results between Night and Contingency use cases and this is due to the VC architecture which is demonstrated as being the first enabler of the delegation of ATM service provision between ATSUs. In other terms, similar operational results are obtained for a same VC architecture.
- In term of application of the delegation procedures, we noticed the central roles played by the ATCO RE/RP and the SUPs. However, the validation of the ATSEP role, although well described in the procedures, was limited due to the lack of "really licensed ATSEPs" in our simulations.
- Training of ATCO on the newly controlled area is key to improve operational acceptance of the delegation procedures.
- Safety and Situation Awareness could be improved by additional controller support tools such as Safety Nets, MTCD or Smart traffic views during the Preview mode.

## 2. Conclusions on technical feasibility

For the technical feasibility, we have identified the following:

- **VC architectures Y/U/D & Maturity**

- The use cases based on the Y or D architectures have provided a much better operational acceptance than the uses cases with the U architecture
- Although some new services were developed and validated at TRL6, some other existing since PJ16.03 were improved from TRL4 to TRL6 (mainly under the Y architecture)

- The U architecture requires further development to improve interoperability between the ADSPs

- **Preview Mode**

The preview mode was successfully implemented in all the involved CWPs and ADSPs and operationally validated by the ATCOs and SUPs. We shall notice that this is the main enabler of the overall delegation of ATS between ATSUs.

In details, this function could be improved at the CWP level, but this cannot come without a close cooperation between the delegating and receiving CWPs. Mainly in the case they are connected to a same ADSP (Y).

- **Supervision & Monitoring**

The ADSP being ATC or Voice are all monitored, either locally, at the remote ATSUs or at both locations and this has increased the situation awareness of the technical platform, for the SUPs and the ATSEPs.

- **ATSEP roles**

The ATSEP role was validated but with "non experienced ATSEPs". The ATSEPs in our simulations oversaw the stability of the validation platform and provided all the technical support to ATCOs, Pseudo-Pilots and SUPs during the delegation process.

### 3. Conclusions on performance assessments

In terms of performance, the following conclusions are presented for the different KPAs at local level.

- **Cost-Efficiency** – A positive benefit has been achieved for Cost-Efficiency
  - ATCO Productivity (+40%).
- **Human Performance** – Human Performance levels have been demonstrated as acceptable for the night and contingency use cases.
- **Safety** – Safety levels have been demonstrated as acceptable for the night and contingency use cases.

#### B.3.12 Recommendations Exercise 3

The below recommendations are derived from the obtained results.

- **Delegation Procedure & Concept**

Due to limited ATCO resources, the SUP role was played by an ATCO RP. It is recommended to perform a validation of the concept with specific SUP roles, at different ATSUs while providing them with the necessary support tools (Supervision, Monitoring, VCS, ..).

- **Preview Mode**

Develop further support tools for ATCOs and SUPs to improve Situation Awareness during the Preview Mode.

- **VC architectures & maturity**

We have used VC architectures to validate the delegation concept between ATSUs. In addition, all the services used belong to standards previously developed in SESAR Wave 1 (PJ16.03). These development from previous research activities allowed us to successfully validate the delegation concept in use cases based on the U or D architectures. The U architecture, due to the lack of interoperability between the ADSPs, was not enough mature and failed to validate the delegation concept. The first recommendation, if this U architecture is deemed useful in future implementations of European Virtual Centres, is to spend bigger efforts to develop standards / protocols for the interoperability between European ADSPs and we know this will be difficult to achieve without the involvement of suppliers within the European ATM Market.

Despite the improved maturity of some services from TRL4 to TRL6, there are a lot of others which are kept at TRL4. Future efforts should be concentrated on developing new services ADSP-ATSU and ADSP-ADSP, while increasing the maturity of the current VC services.



## Appendix C Validation Exercise #04 Report

### C.1 Summary of the Validation Exercise #04 Plan

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I.

#### C.1.1 Validation Exercise description, scope

The objective of EXE-PJ.10-W2-93-V3-VALP-004 consisted in a Real Time Simulation that covered both the Operational and Technical Thread of the delegation of ATM services provision among ATSUs in nominal and non-nominal conditions in a Virtual Centre architecture. Therefore contingency aspects were also considered to be compliant with the "Y" Architectures defined as the Technical Validation objectives depending on the Quality of the services based on the Virtual Centre set-up.

In particular, this validation activity aimed at demonstrating the operational feasibility, operational acceptance, and performance benefits of the PJ.10-W2-93 concept for the following use cases using Virtual Centre Architecture infrastructures:

- Delegation of ATM services provision at night
- Delegation of ATM services provision at fixed time
- Delegation of ATM services provision on-demand
- Delegation of ATM services provision between Civil and Military ATSUs
- Delegation of ATM services provision in case of contingency

To achieve the abovementioned objective, a set of validation scenarios have been selected covering the Italian airspace of the following ACCs:

- LIRR (Rome ACC)
- LIBB (Brindisi ACC)

This Exercise was validated in a different Scenario and sectorization, using the "Y" Architecture in a Virtual Centre environment showed in the following picture:



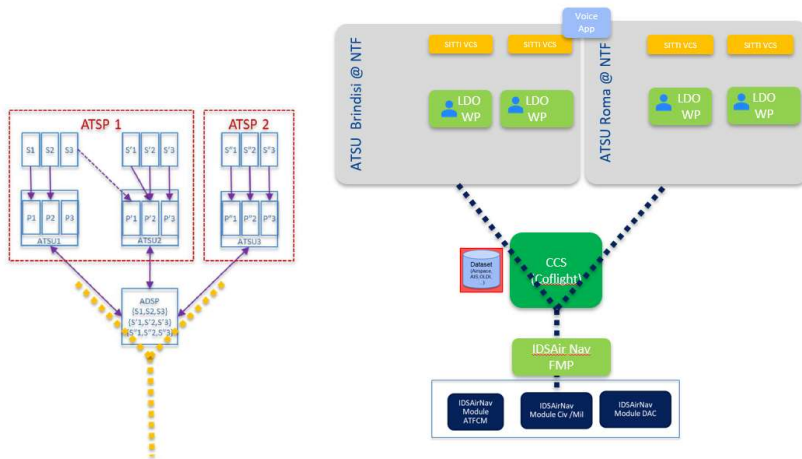


Figure 21212121212121. VC environment EXE-PJ.10-W2-93-V3-VALP-004

- This Architecture called “Y” Centralized Option has the possibilities to collapse several ATSU on one ADSP which manages the Airspace of these ATSUs. The “Y” architecture allows a complete flexibility among all connected ATSUs but cannot be re-configured to manage new ATSUs for delegation with dynamic AORs and it not required any standardization of the ADSP - ATSU interface.
- The EXE 4 is executed by ENAV National Test Facilities in Rome with LEONARDO, IDSAIRNAV and SITI1 for the setup of the industrial based platform integrating the CCS Coflight Cloud Services based prototype and validation platform that will be used in the context of Solution PJ.10-W2-93 for the conduct of the validation exercise EXE-PJ.10-W2-93-004.
- Network connectivity of the ATSUs with the Local Traffic Complexity Management (LTLMT) by IDSAIRNAV has been designed to manage air traffic complexity and capacity according specific ANSP’s business targets. The availability of continuously updated information such as weather actual/forecast and airspace constraints enables ANSPs to enhance their decision process leading to capacity optimization, reduction of environmental impacts, safety strengthen and therefore improve the quality of the navigation services provided to air operators.

The scenarios covered potential delegations of the air traffic services between Rome ACC and Brindisi ACC according to the different use cases in the following way:

- **Delegation of ATM services provision at night**

This Use Case is based on the “possibility that ATSU1 has to delegate a single ATC Sector or even all the Airspace of its responsibility to ATSU2”. This Use case used the Functionalities of OPSUP to request the delegation of ATS services. In these phases all the ATCOs will request all the information needed to set the CWP for the traffic situation exchange (Radar Maps, customization of the Sectorization and Airspace volumes) to manage the Traffic between the different CWP in the experiment.

- **Delegation of ATM services provision at fixed time**

The description of this use case is similar to the above use case “Delegation of ATM services provision at night” but different traffic complexity was tested in a High /High environment and different traffic load capabilities.

- **Delegation of ATM services provision on-demand**

This Use Case is based on the “possibility that ATSU1 has to delegate a single ATC Sector or even all the Airspace of its responsibility to ATSU2 and, with it, also the provision of ATFCM services for the Delegated Airspace”. Given the existing operational situation, ATSU1 did not delegate its entire Airspace to ATSU2. Specifically, for the ADSP services that provided each of the ATSUs object of the Delegation, in the circumstance of this Use Case, ATSU1 did not delegate the ATFCM Service in the Airspace under its responsibility; obviously in the case of Delegation of the Airspace, both partial and total, the ATFCM Service was delegated by ATSU1 only for the part of Airspace Delegated.

In relation to the portion delegated by ATSU1’s Airspace instead, or in the entire Airspace in the case of total Delegation, ATSU2 received ATS Services as defined in the Delegation Agreement, while also ensuring the continuity of the ATFCM Service associated with the Delegate Airspace.

In case of delegation of the airspace of ATSU 1 to ATSU 2, the ATFCM service was delegated; ATSU 2 had to handle the Flow Management activities also for the Airspace which it is delegated by ATSU 1.

The peculiarity of the ATFCM Service is in the real nature of the service; it is a connection, an extension, an interface with the Network Manager and the current service is offered by the FMP in the Control Room.

Thanks to the operational actions that are applied at local level in coordination or at centralized level by CHMI, the traffic flows management was homogeneous and coordinated at the ECAC level.

The delegation of the service did not presuppose a new, duplicate figure in the Operational Room of ATSU 2, but it was the operator himself who managed the traffic flows for the sectors that were delegated. And in the event of a contingency, the service can be quickly and easily managed by the Operational Room in Brussels without any penalty for the traffic that is currently inside the airspace of ATSU 2 or about to affect it.

- **Delegation of ATM services provision between Civil and Military ATSUs**

The use case is based on the “possibility that a Civil ATSU1 has to delegate one part or the entire its Airspace to ATSU2 with the particularity that it was conceived with the variable that a military activity is planned during the Delegation time period or is underway (hereafter declined in its nature) whose management is in charge of the military and why the Delegation of provision of ATS services from ATSU1 to ATSU2 was limited from the aforementioned activity of the Military ATSU. The Delegation, for this specific planned case, was analyzed normally as a Static Delegation but other situations could be planned and happen at a predefined time, regularly or whenever it is demanded by Civil ATSU, or in case of Contingency.

- **Delegation of ATM services provision in case of contingency**

This Use Case is based on the “possibility that ATSU1 has to delegate a single ATC Sector or even all the Airspace of its responsibility to ATSU2” due to the occurrence of a contingency in the ATSU 1.

The exercise was conducted in Q3 2022 in ENAV Ciampino Rome National Test Facilities using different Sectorization of LIRR (Rome ACC) and LIBB (Brindisi ACC), involving seven air traffic controllers plus two supervisors and ATSEP Technical Personnel from the ATSUs corresponding to the validation scenarios selected (LIRR and LIBB)

This validation activity contributed to the maturity of the concept by:

- Assessing the concept acceptability and feasibility for different traffic complexity and traffic density environments, with more than ten air traffic controllers involved in the process.
- Contributing to the performance assessment and validation of the concept benefit and impact mechanisms.
- Increasing the number of use cases subject to validation, compared to the exercise conducted at V3 (focused only on the night and contingency use case).
- Comparing the Reference scenario with No delegation compared with the Solution Scenario and Validating the concept of Delegation of ATS as described in the PJ10.W2 Sol 93 ATM Solution OSED V3

### C.1.2 Summary of Validation Exercise #04 Validation Objectives and success criteria

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I and section regarding deviation on the planned activities.

### C.1.3 Summary of Validation Exercise #04 Validation scenarios

For the selection of the scenarios, historical data from 2020 on 13th of January and February traffic period in LIRR and LIBB have been analysed, aiming at identifying the most interesting time periods and airspace for the validation of the delegation of ATM services provision use cases covered by the exercise. A specific Traffic punching has been performed in the Area of Interest in order to analyse the traffic sample to execute the Scenario in a M/M and H/H environment. The selected time chosen was 04.00 to 06.00 in the morning and 10.00 to 12.00 UTC time.

Therefore, before the execution of the EXE4 RTS specific study was performed with the aim to quantify, through qualitative evaluation and downstream of previous studies performed and validated with Model Based Simulation (MBS), the Maximum Theoretical Hourly Capacity of the new ATC Sector defined downstream of the optimization of the EnRoute ATC Sectorisation, pending and within the scope of the design of the operational scenarios for the design purposes of PJ10-W2.SOL 93.

The selected scenarios are:

- Delegation between Rome LIRR AND Brindisi LIBB Airspace covering En-Route airspace.

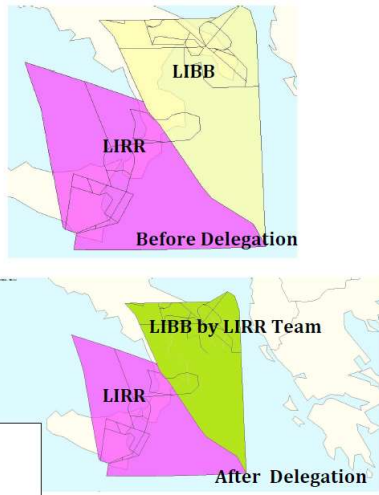


Figure 22222222222222. Rome ACC and Brindisi ACC Scenario A

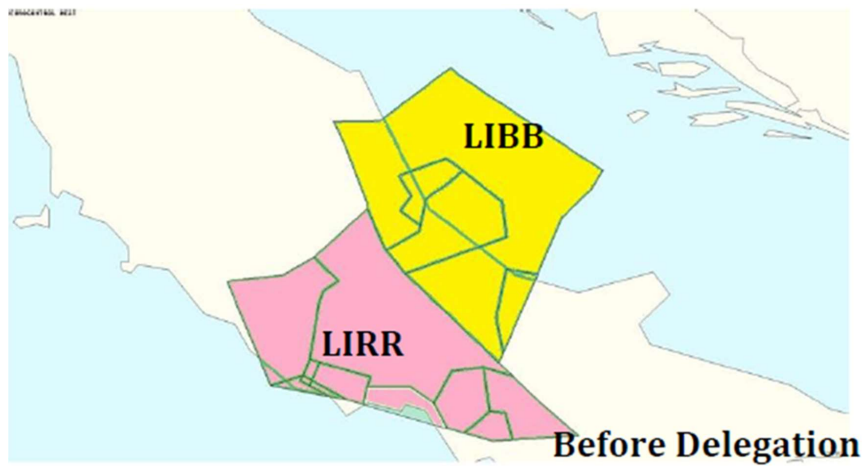


Figure 23232323232323. Rome ACC and Brindisi ACC Scenario B



Figure [24242424242424](#). Rome ACC and Brindisi ACC Scenario B

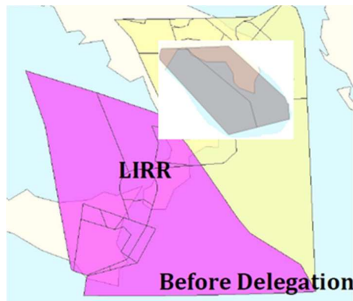


Figure [25252525252525](#). Rome ACC and Brindisi ACC Scenario C

The following table describes the scenario and sectors involved for each one of the scenarios selected.

	CWP1 (D07/D42)	CWP2 (D29/D52)	CWP3 (D3C/D29)	CWP4 (D20/D4D)	CWP5(D52/D36 )	CWP6 (D3F/D45)	Feeder + OPS UP	Note
FIR	LIBB	LIBB	LIRR	LIRR	LIRR	LIRR	LIRR + LIBB	

PJ10.W2 Sol 93 Sce A Reference Scenario	LIBBES47 (335-460) LIBBES4+E S5+ES6+ES 7 LITSA420A LITSA420B LITSA421A LITSA421B LITSA422A LITSA422B LITSA423A LITSA423B LITSA455A LITSA455B EXE  (120,58Mhz)	LIBBES47 (335-460) LIBBES4+E S5+ES6+ES 7 PLN  (120,58Mhz)	LIRR spare	LIRR spare	LIRRES47 (335-460) LIRRES4+LIRRES5+LIRRES6+LIRRES7  EXE (133,250)	LIRRES47 (335-460) LIRRES4+LIRRES5+LIRRES6+LIRRES7  PLN (133,250)	Feeder Ext Aol + OP /Tech h SUP LITS A42 0A LITS A42 0B LITS A42 1A LITS A42 1B LITS A42 2A LITS A42 2B LITS A42 3A LITS A42 3B LITS A45 5A LITS A45 5B  (XXX Mhz )	Note Scenario
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PJ10.W2 Sol 93 Sce A Solution Scenario	LIBB Delegated	LIBB Delegated	LIBBES47 (335-460) LIBBES4+E S5+ES6+ES 7 LITSA420A LITSA420B LITSA421A LITSA421B LITSA422A LITSA422B LITSA423A LITSA423B LITSA455A LITSA455B EXE  (120,58Mh z)	LIBBES47 (335-460) LIBBES4+E S5+ES6+ES 7 PLN  (120,58Mh z)	LIRRES47 (335- 460) LIRRES4+LIRRES 5+LIRRES6+LIR RES7  EXE (133,250)	LIRRES47 (335- 460) LIRRES4+LIRRES 5+LIRRES6+LIR RES7  PLN (133,250)	Feeder Ext Aol + OP /Tech h SUP LITS A42 OA LITS A42 OB LITS A42 1A LITS A42 1B LITS A42 2A LITS A42 2B LITS A42 3A LITS A42 3B LITS A45 5A LITS A45 5B  (XXX Mhz )	Note Scenar io. Funzio ne da attivar e dal Techni cal SUP per gli assorb imenti (EXE, PLN e ASSIST ANT) Le CWP di Roma vengot tate come Assista nt
PJ10.W2 Sol 93 Sce B Reference Scenario	LIBBND47 (335-460) LIBBND4+ ND5+ND6+ ND7  EXE  (129,22Mh z)	LIBBND47 (335-460) LIBBND4+ ND5+ND6+ ND7  PLN  (129,22Mh z)	LIRRUS47 (335-460) LIRRUS4+U S5+US6+U S7  EXE  (132,03Mh z)	LIRRUS47 (335-460) LIRRUS4+U S5+US6+U S7  PLN  (132,03Mh z)	LIRRUS3 (305- 335)  EXE  (134,200Mhz)	LIRRUS3 (305- 335)  PLN  (134,200Mhz)	Feeder Ext Aol + OP /Tech h SUP  (XXX Mhz )	Note Scenar io No Delega tion Foress en
PJ10.W2 Sol 93 Sce B Solution Scenario	LIBB Delegated	LIBB Delegated	LIRRUS47 (335-460) LIRRUS4+U S5+US6+U S7 + LIBBND47 (335-460)	LIRRUS47 (335-460) LIRRUS4+U S5+US6+U S7 + LIBBND47 (335-460)	LIRRUS3 (305- 335)  EXE  (134,200Mhz)	LIRRUS3 (305- 335)  PLN  (134,200Mhz)	Feeder Ext Aol + OP /Tech	Funci onaliti es of the Tech Supre and

			(335-460) LIBBND4+ ND5+ND6+ ND7  EXE  (132,03Mhz)	LIBBND4+ ND5+ND6+ ND7  PLN (132,03Mhz)			h SUP  (XXX Mhz )	OPSU must be Activa ted
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Table 29292929292929. EXE-PJ.10-W2-93-V3-VALP-004 Validation Scenario

### 1. Reference Scenario(s)

The main characteristics of the Reference Scenario considered for each one of the use cases addressed by the validation activity are described below:

- Delegation of ATM services provision at Night
  - No delegation
  - Consolidation of sectors at night within the same ATSU
- Delegation of ATM services provision at Fixed Time
  - No delegation
  - No cross-border sectorisation
- Delegation of ATM services provision on-demand
  - No delegation
  - No cross-border sectorisation
  - ATFCM measures: ATFM regulations, ATFM scenarios, capacity measures, tactical STAM

The traffic sample corresponds to traffic from 2020.

### 2. Solution Scenario(s)

The Solution Scenario is as described in PJ.10-W2-93 V3 OSED, that is, with the possibility to consider the delegation of ATM services provision.

The main characteristics of the Solution Scenario to be considered for each one of the use cases addressed by the validation activity are described below:

- Delegation of ATM services provision at Night
  - Delegation between ATSUs of the same ANSP
  - Consolidation of sectors at night within the same ATSU
  - No cross-border sectorisation
- Delegation of ATM services provision at Fixed Time
  - Delegation between ATSUs of the same ANSP
  - No cross-border sectorisation
- Delegation of ATM services provision on-demand
  - Delegation between ATSUs of the same ANSP



- Cross-border sectorisation available when delegating and receiving ATSUs are adjacent.
- ATFCM measures: ATFCM regulations, ATFCM scenarios, capacity measures, tactical STAM
- performed by FMP
- Delegation of ATM services provision Civil Military coordination
  - Delegation between ATSUs of the same ANSP while military areas are engaged in a civil airspace
  - No cross-border sectorisation
- Delegation of ATM services provision in case of contingency
  - Delegation between ATSUs of the same ANSP in case of VCS failure
  - No cross-border sectorisation

The traffic sample corresponds to traffic from 2020 (January AIRAC cycle) (pre-SARs-CoV-2).

In order to gather a good level of confidence in the results, all scenarios defined in the VALP were executed several times as shown in the following agenda (please note that the agenda comprises both PJ.10-W2-93 EXE4 and PJ.32 EXE1.5):

	TRAINING / EXE		EXECUTION EXE PJ10-W2-93						
	02/11/2022	03/11/2022	04/11/2022	07/11/2022	08/11/2022	09/11/2022	10/11/2022	11/11/2022	
09:00		Briefing	Briefing	Briefing	Briefing	Briefing	Briefing	Briefing	
09:15									
09:30	Introduction PJ.10-W2-93 + PJ.32-W3	PJ10.W2 Sol 93 SCEA REFERENCE - MEDIUM	PJ10.W2 Sol 93 SCEA - SOLUTION HIGH	PJ10.W2 Sol 93 SCEC	PJ10.W2 Sol 93 SCEB - REFERENCE MEDIUM	PJ32Reference LIAA - MEDIUM	PJ32Reference LIAA - MEDIUM to CNFAA	PJ32Reference LIAA - HIGH	O P E N D A Y
10:00									
10:15	PJ10.W2 Sol 93 SCEA SOL - MEDIUM								
10:30		PRQ + DEB	PRQ + DEB	PRQ + DEB	PRQ + DEB	PRQ + DEB	PRQ + DEB	PRQ + DEB	
10:45									
11:00	BREAK								
11:15									
11:30									
11:45				BREAK	BREAK				
12:00	PJ10.W2 Sol 93 SCEB SOL - MEDIUM	PJ10.W2 Sol 93 SCEA REFERENCE - HIGH	PJ10.W2 Sol 93 SCEN B REFERENCE HIGH			PJ32Reference LIAA - MEDIUM to CNF3C	PJ32Reference LIAA - HIGH to CNFAA	PJ32Reference LIAA - MEDIUM to CNFAA	
12:15									
12:30				PJ10.W2 Sol 93 SCEB - SOLUTION HIGH	PJ10.W2 Sol 93 SCEN A SOLUTION MEDIUM				
12:45		PRQ + DEB	PRQ + DEB			PRQ + DEB	PRQ + DEB		
13:00	LUNCH							PRQ + PSQ + DEB	
13:15				LUNCH	LUNCH				
13:30									
13:45	PJ10.W2 Sol 93 SCEC	LUNCH	LUNCH			LUNCH	LUNCH		
14:00									
14:15									
14:30	BREAK	PJ32Reference LIAA - HIGH	PJ10.W2 Sol 93 SCEN B SOLUTION MEDIUM			PJ32Reference LIAA - HIGH to CNF3C	PJ32Reference LIAA - MEDIUM to CNFAA CIV/MI	SPARE	
14:45									
15:00	PJ10.W2 Sol 93 REFERENCE SCEA - HIGH	BREAK							
15:15				PJ10.W2 Sol 93 SCEA SOLUTION - HIGH	PJ10.W2 Sol 93 SCEB SOLUTION HIGH				
15:30									
15:45	BREAK	PJ32Reference LIAA to CNF3C - MEDIUM	PRQ + DEB			PRQ + DEB	PRQ + DEB		
16:00									
16:15	PJ10.W2 Sol 93 SCEB REF - HIGH	BREAK		PRQ + DEB	PRQ + PSQ + DEB				
16:30									
16:45									
17:00		PJ32Reference LIAA - MEDIUM to CNFAA	SPARE			SPARE	SPARE		
17:15									
17:30				SPARE	SPARE				
17:45	SPARE								
18:00		SPARE							

Figure 262626262626. EXE#04 Agenda

From the agenda, the first two days were dedicated to the training. Training was based on a participatory approach by involving controllers early-on the platform so that HMI and basics interactions were assimilated. Controllers were trained by the Exercise Operational Leader so that complex and time-consuming issue could be handled before the exercise execution. Training session comprised an overview of SESAR PJ.10-W2-93 and PJ.32 concepts and of new function introduced to controllers on the platform.

In the remaining execution days, it can be seen the alternation of the various scenarios considering different traffic samples and consequent rotation of the ATCOs to obtain valid and substantial feedback for each position (EXE and PLN).

### C.1.4 Summary of Validation Exercise #04 Validation Assumptions

*This section shall provide an overview of the validation assumptions that are applicable to the validation exercise on top of those identified in section.3.2.3.*

*The Validation Assumptions should be recorded in a table of the following form.*

Identifier	Title	Description	Justification	Impact on Assessment
EX4-ASS-PJ10-W2-93-V3-VALP-001	Virtual Centre environment	The exercise has been carried out using ENAV CCS ADSP Virtual Centre, that was used to validate the virtual centre concept ("V" architecture).	Developments on the Technical Aspects on Virtual Centre	Medium
EX4-ASS-PJ10-W2-93-V3-VALP-002	Traffic characteristics	It is assumed that the results obtained for medium, high, complexity environments is also applicable to low complexity environments.	It has been agreed by the operational experts involved in the concept validation that the results obtained for medium, high complexity environments should be extrapolated to low complexity environments (concept limitations are considered to be only applicable for medium, high and very high complexity).	Low
EX4-ASS-PJ10-W2-	Regulatory	It is assumed that the	The exercises are conducted	Medium

93-V3-VALP-003		receiving ATCO are endorsed for the delegated sector.	considering the current ATCO licensing framework. Training was planned to avoid the lack of ATCO sector-based knowledge.	
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Table 30303030303030: Validation Assumptions overview

## C.2 Deviation from the planned activities

The exercise considered only traffic sample from low to high. In addition, with respect to the planned activities, the exercise also covered the validation objectives for the contingency use case and for performance as listed below:

Identifier	EX4-PJ.10-W2-93-V3-VALP-015
Objective	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the “Delegation of ATM services provision in case of contingency” use case

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-073	The delegation procedure for the Contingency Use Case, including the handover dialogue, is clearly defined, and documented.
EX4-CRT-PJ.10-W2-93-V3-VALP-074	The delegation procedure for the Contingency Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.
EX4-CRT-PJ.10-W2-93-V3-VALP-075	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Contingency Use Case, including the handover dialogue.
EX4-CRT-PJ.10-W2-93-V3-VALP-076	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Contingency Use Case, including the handover dialogue.

Identifier	EX4-PJ.10-W2-93-V3-VALP-016
Objective	To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision in case of contingency” use case

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-077	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-078	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-079	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-080	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-081	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-082	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-083	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.
EX4-CRT-PJ.10-W2-93-V3-VALP-084	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.

Identifier	EX4-PJ.10-W2-93-V3-VALP-0217
Objective	To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-085	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.

Identifier	EX4-PJ.10-W2-93-V3-VALP-018
Objective	To assess the performance benefits in terms of Fuel Efficiency of the delegation of ATM services provision among ATSUs concept

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-086	A reduction in the average fuel burn per aircraft is demonstrated

Identifier	EX4-PJ.10-W2-93-V3-VALP-019
Objective	To assess the performance benefits in terms of Predictability of the delegation of ATM services provision among ATSUs concept

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-087	A reduction in the variance of the difference between the planned flight duration and actual flight duration is demonstrated.

Identifier	EX4-PJ.10-W2-93-V3-VALP-020
Objective	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept

Identifier	Success Criterion
EX4-CRT-PJ.10-W2-93-V3-VALP-088	A positive increase on ATCO productivity is demonstrated.
EX4-CRT-PJ.10-W2-93-V3-VALP-089	A reduction on the average technology cost per aircraft is demonstrated.

## C.3 Validation Exercise #04 Results

### C.3.1 Summary of Validation Exercise #03 Results

Validation Exercise #04 Validation Objective ID	Validation #04 Objective Title	Exercise Validation	Validation Exercise #04 Success Criterion ID	Validation Exercise #04 Success Criterion	#04 Sub-operating environment	Exercise #04 Validation Results	Validation Exercise #04 Validation Objective Status
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<p>EX4-OBJ- PJ.10-W2-93- V3-VALP-001</p>	<p>To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions</p>	<p>EX4-CRT- PJ.10-W2- 93-V3- VALP-001</p>	<p>Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.</p>	<p>ER Medium to High Complexity</p>	<p>Controllers deemed the delegation procedure quite feasible in medium and high traffic conditions. Potential limitation impacting controllers answers are to be researched in the technical aspects of the validation to be improved (e.g. preview mode).</p>	<p>OK</p>
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		EX4-CRT-PJ.10-W2-93-V3-VALP-002	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.	ER Medium to High Complexity	The exercise did not cover very high complexity environment. Therefore, the results for this success criteria are comparable to the ones gathered for low to high environment.
		EX4-CRT-PJ.10-W2-93-V3-VALP-003	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to high density is gathered for the contingency use	ER Medium to High Complexity	The controllers "agreed" that the delegation procedure in case of contingency was suitable and operationally feasible, of course there are different aspects in the contingency situations to be taken into account as well as controllers would have felt more confident in case of total availability





			case according to ATCO's expert judgment.		of supporting tools (e.g. CD&R tools).
		EX4-CRT-PJ.10-W2-93-V3-VALP-004	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to very high complexity is gathered for the contingency use case according to ATCO's expert judgment.	ER Medium to High Complexity	The exercise did not cover very high complexity environment. Therefore, the results for this success criteria are comparable to the ones gathered for low to high environment.
		EX4-CRT-PJ.10-W2-93-V3-VALP-005	Potential limitations for the applicability of the delegation of ATM services	ER Medium to High Complexity	Controllers highlighted some potential limitation of the delegation of ATM

			provision are identified and documented for the different use cases in nominal conditions.		services provision during debriefing sessions.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-006	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the contingency use case.	ER Medium to High Complexity	See above	
EX4-OBJ-PJ.10-W2-93-V3-VALP-002	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM	EX4-CRT-PJ.10-W2-93-V3-VALP-007	The delegation procedure for the Night Use Case, including the handover	ER Medium to High Complexity	Overall, controllers deemed that procedures tested during the runs might be improved and better defined to be	OK

services provision at Night” use case		dialogue, is clearly defined, and documented.		perfectible workable by them. In general, all controllers felt that the delegation procedures needed some fine tuning.
	EX4-CRT-PJ.10-W2-93-V3-VALP-008	The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	ER Medium to High Complexity	Delegation Procedure was considered quite fine, acceptable, and feasible by all involved actors especially when the amount of traffic to be managed is low. According to the controllers’ feedback, gathered during the debriefing session, adequate training is needed. In addition, licensed and appropriately skilled ATCOs are needed in the receiving units.
	EX4-CRT-PJ.10-W2-93-V3-	Impact remains acceptable according to ATCO expert judgment with	ER Medium to High Complexity	In accordance with questionnaires ratings, ATCOs quite agree that the roles are clearly defined, and the



		VALP-009	regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.		responsibilities remained unchanged during the delegation process but all highlighted that a checklist is useful.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-010	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.	ER Medium to High Complexity	According to ATCOs feedback, the quality of service and the sector coordination were acceptable.	

EX4-OBJ- PJ.10-W2-93- V3-VALP-003	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at fixed time" use case	EX4-CRT- PJ.10-W2- 93-V3- VALP-011	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium to High Complexity	According to controllers feedback, delegation procedure in case of Fixed Time use case was properly defined. Although further refinements are needed.	OK
		EX4-CRT- PJ.10-W2- 93-V3- VALP-012	The delegation procedure for the Fixed Time Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	ER Medium to High Complexity	According to controllers feedback, delegation procedure in case of Fixed Time use case was operationally feasible.	

		EX4-CRT-PJ.10-W2-93-V3-VALP-013	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Fixed Time Use Case, including the handover dialogue.	ER Medium to High Complexity	Controllers deemed roles and responsibilities during the execution of delegation process.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-014	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Fixed Time Use Case, including the	ER Medium to High Complexity	QoS was acceptable during the delegation process.	

			handover dialogue.			
EX4-OBJ- PJ.10-W2-93- V3-VALP-004	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-Demand with ATFCM proposal" use case	EX4-CRT- PJ.10-W2- 93-V3- VALP-015	The delegation procedure for the On-Demand with ATFCM proposal Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium to High Complexity	According to controllers feedback, delegation procedure in case of delegation on demand use case was properly defined. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	OK
		EX4-CRT- PJ.10-W2- 93-V3- VALP-016	The delegation procedure for the On-Demand with ATFCM proposal Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	ER Medium to High Complexity	According to controllers feedback, delegation procedure in case of on demand use case was operationally feasible. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	

		EX4-CRT-PJ.10-W2-93-V3-VALP-017	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand with ATFCM proposal Use Case, including the handover dialogue.	ER Medium to High Complexity	Controllers deemed roles and responsibilities during the execution of delegation process. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-018	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand with ATFCM	ER Medium to High Complexity	QoS was acceptable during the delegation process. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	



			proposal Use Case, including the handover dialogue.			
EX4-OBJ-PJ.10-W2-93-V3-VALP-005	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision between Civil and Military ATSUs" use case	EX4-CRT-PJ.10-W2-93-V3-VALP-019	The Delegation procedure for the Civil-Military Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium to High Complexity	The delegation procedure in case of civil military scenario can be efficiently executed by ATCOs without adversely affecting controllers' operations.	OK
		EX4-CRT-PJ.10-W2-93-V3-VALP-020	The delegation procedure for the Civil-Military Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	ER Medium to High Complexity	Consequently, the delegation procedure was considered quite feasible by all involved actors. Also in this case, according to the controllers' feedback gathered during the debriefing session, adequate training is needed.	

		EX4-CRT-PJ.10-W2-93-V3-VALP-021	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Civil-Military Use Case, including the handover dialogue.	ER Medium to High Complexity	The results show that ATCOs roles were clear and quite exhaustive; operating methods were exhaustive and support human performance, and human actors were able to achieve their tasks in a timely and accurate way	
		EX4-CRT-PJ.10-W2-93-V3-VALP-022	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Civil-Military Use Case, including the	ER Medium to High Complexity	According to ATCOs feedback, the quality of service was acceptable.	

			handover dialogue.			
EX4-OBJ- PJ.10-W2-93- V3-VALP-006	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Night" use case	EX4-CRT- PJ.10-W2- 93-V3- VALP-023	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	The level of Workload remained within acceptable levels during the delegation procedures for the "Delegation of ATM services provision at Night" use case	OK
		EX4-CRT- PJ.10-W2- 93-V3- VALP-024	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	Controllers experienced satisfactory levels of situational awareness before and after delegation with a clear decrease of the situational awareness during the delegation process. This was attributable to the system and a basic implementation of the preview mode.	

		EX4-CRT-PJ.10-W2-93-V3-VALP-025	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	The level of trust in the system was not satisfactory. In fact, some problems raised during the validation related to the fact that the simulation environment was not the operational system the controllers are used to. ATCOs proposed a list of improvements for HMI and platform.
		EX4-CRT-PJ.10-W2-93-V3-VALP-026	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	According to controllers feedback, system needs some refinements (especially in the preview mode) in order to better support them in the execution of the task and allow a smoother delegation process.
		EX4-CRT-PJ.10-W2-93-V3-VALP-027	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during	ER Medium to High Complexity	The workload and mental effort faced by the ATCO SUP was much more than acceptable (values between Agree (4) and Strongly Agree

			the delegation procedure for the Night Use Case.		(5) during all runs performed.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-028	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	In all the encountered scenarios, both LIRR and LIBB supervisors always had a clear understanding of the situation, managing the delegation process in a safe way.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-029	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.	ER Medium to High Complexity	Supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process.	
		EX4-CRT-PJ.10-W2-	The level of system support is judged as sufficient by the	ER Medium to High Complexity		

		93-V3-VALP-030	SUP during the delegation procedure for the Night Use Case.			
EX4-OBJ-PJ.10-W2-93-V3-VALP-007	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision at Fixed Time" use case	EX4-CRT-PJ.10-W2-93-V3-VALP-031	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	The level of Workload remained within acceptable levels during the delegation procedures for the "Delegation of ATM services provision at Fixed Time" use case	OK
		EX4-CRT-PJ.10-W2-93-V3-VALP-032	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	Controllers Situational Awareness was considered at satisfactory levels	

		EX4-CRT-PJ.10-W2-93-V3-VALP-033	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	As for Night Delegation, the level of trust in the system was not satisfactory. In fact, some problems raised during the validation related to the fact that the simulation environment was not the operational system the controllers are used to. ATCOs proposed a list of improvements for HMI and platform.
		EX4-CRT-PJ.10-W2-93-V3-VALP-034	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	Also for the fixed time use case, system needs some refinements (especially in the preview mode) in order to better support controllers in the execution of the task and allow a smoother delegation process.
		EX4-CRT-PJ.10-W2-93-V3-VALP-035	The level of SUP workload remains within acceptable levels according to ATCO's expert	ER Medium to High Complexity	The workload experienced by the ATCO SUP was good (values between Agree (4) and Strongly Agree (5))



			judgment during the delegation procedure for the Fixed Time Use Case.		during fixed time use case runs.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-036	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	Both LIRR and LIBB supervisors always had a clear understanding of the situation, managing the delegation process in a safe way.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-037	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	Supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process.	



		EX4-CRT-PJ.10-W2-93-V3-VALP-038	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Fixed Time Use Case.	ER Medium to High Complexity	ATCO SUP indicated that coordination (via phone) for the delegation procedure worked well through the system support	
EX4-OBJ-PJ.10-W2-93-V3-VALP-008	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand with ATFCM proposal" use case	EX4-CRT-PJ.10-W2-93-V3-VALP-039	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand with ATFCM proposal Use Case.	ER Medium to High Complexity	The level of Workload remained within acceptable levels during the delegation procedures for the "Delegation of ATM services provision On-Demand with ATFCM proposal" use case. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	OK
		EX4-CRT-PJ.10-W2-93-V3-VALP-040	The level of ATCO situation awareness remains within acceptable levels	ER Medium to High Complexity	Controllers Situational Awareness was considered at satisfactory levels. Note that the results on	

			according to ATCO's expert judgment during the delegation procedure for the On-Demand with ATFCM proposal Use Case..		ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.
		EX4-CRT-PJ.10-W2-93-V3-VALP-041	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand with ATFCM proposal Use Case.	ER Medium to High Complexity	As for the other scenarios, the level of trust in the system was not satisfactory. In fact, some problems raised during the validation related to the fact that the simulation environment was not the operational system the controllers are used to. ATCOs proposed a list of improvements for HMI and platform. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.



		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-042</p>	<p>The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand with ATFCM proposal Use Case.</p>	<p>ER Medium to High Complexity</p>	<p>Also in this scenario, system needs some refinements (especially in the preview mode) to better support controllers in the execution of the task and allow a smoother delegation process. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.</p>	
		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-043</p>	<p>The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand with ATFCM proposal Use Case.</p>	<p>ER Medium to High Complexity</p>	<p>The workload experienced by the ATCO SUP was good (values between Agree (4) and Strongly Agree (5)). Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.</p>	

		EX4-CRT-PJ.10-W2-93-V3-VALP-044	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand with ATFCM proposal Use Case.	ER Medium to High Complexity	Both LIRR and LIBB supervisors always had a clear understanding of the situation, managing the delegation process in a safe way. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-045	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand with ATFCM proposal Use Case.	ER Medium to High Complexity	Supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	

		EX4-CRT-PJ.10-W2-93-V3-VALP-046	The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand with ATFCM proposal Use Case.	ER Medium to High Complexity	ATCO SUP indicated that coordination (via phone) for the delegation procedure worked well through the system support. Note that the results on ATFCM procedures are complemented by the ones coming from PJ32 exercise 1.5.	
EX4-OBJ-PJ.10-W2-93-V3-VALP-009	To demonstrate the operational acceptance of the delegation procedure for the ““Delegation of ATM services provision between Civil and Military ATSUs”” use case	EX4-CRT-PJ.10-W2-93-V3-VALP-047	The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	Although the presence of some technical issues related to the system and the need for an improved preview mode, the delegation process itself did not bring to a significant increase of workload or decrease of SA levels in a Civil Military Scenario.	OK
		EX4-CRT-PJ.10-W2-93-V3-VALP-048	The level of ATCO situation awareness remains within acceptable levels according to	ER Medium to High Complexity	See above	

			ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.			
		EX4-CRT-PJ.10-W2-93-V3-VALP-049	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	The results obtained, both for the ATCOs (PLN and EXE) and for the SUP, are in line with those obtained for the other scenarios. Controllers also reported during the debriefing that they might be better supported by the system considering further improvements especially in the preview phase.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-050	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	See above	

		EX4-CRT-PJ.10-W2-93-V3-VALP-051	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	The results obtained reinforced the idea that no deterioration in performance was recorded.
		EX4-CRT-PJ.10-W2-93-V3-VALP-052	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	Supervisors were able to perform his/her tasks, having a clear understanding of the situation.
		EX4-CRT-PJ.10-W2-93-V3-VALP-053	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for	ER Medium to High Complexity	Supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process when military activities are in

			the Civil-Military Use Case.		place during the delegation process.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-054	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Civil-Military Use Case.	ER Medium to High Complexity	ATCO SUP indicated that coordination (via phone) for the delegation procedure worked well through the system support.	
EX4-OBJ-PJ.10-W2-93-V3-VALP-010	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions	EX4-CRT-PJ.10-W2-93-V3-VALP-055	Impact remains acceptable according to ATCO expert judgment in terms of workload are before, during and after the delegation procedure of ATM services provision in nominal conditions.	ER Medium to High Complexity	ATCOs perceived a satisfactory workload. Only a few scores exceed this range but remaining in the tolerable region.	OK



		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-056</p>	<p>Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.</p>	<p>ER Medium to High Complexity</p>	<p>SASHA results affirmed that the level of situational awareness performed during the delegation in nominal condition was good.</p>	
		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-057</p>	<p>Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in</p>	<p>ER Medium to High Complexity</p>	<p>The results showed how this potential remains almost unchanged through the process despite the procedures (score between Neutral (3) and Strongly Agree (5)). In some cases, some technical issues have increased the possibility of controllers' errors.</p>	

			nominal conditions.		
		EX4-CRT-PJ.10-W2-93-V3-VALP-058	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.	ER Medium to High Complexity	Coordination between LIRR (receiving ATSU) and LIBB (delegating ATSU) was ensured by Supervisors relying on telephone communications. Among internal teams all the tasks and coordination were executed in efficient way.
		EX4-CRT-PJ.10-W2-93-V3-VALP-059	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of	ER Medium to High Complexity	The results show that the communication load remains almost unchanged through the delegation phase.

			ATM services provision the delegation procedure in nominal conditions.			
		EX4-CRT-PJ.10-W2-93-V3-VALP-060	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.	ER Medium to High Complexity	No specific support tools were provided to the ATCOs during the simulation (e.g. CD&R, SAFETY NET). No specific support tools were provided to the ATCOs during the simulation. However, during the debriefings controllers stated that they would have felt more confident in case of total availability of supporting tools. These tools might help them in building the picture and maintain situational awareness, as well as predict conflict.	
EX4-OBJ-PJ.10-W2-93-V3-VALP-011	To assess the impact in terms of Human Performance of the ATM services provision	EX4-CRT-PJ.10-W2-93-V3-VALP-061	Impact remains acceptable according to ATCO expert judgment in	ER Medium to High Complexity	The gathered data and feedback from the controllers confirmed that the level of Workload remained	OK

	delegation concept in abnormal conditions		terms of workload before, during and after the delegation procedure of ATM services provision in abnormal conditions.		within acceptable levels during the contingency procedures. Obviously, there were quite a few issues with the technical aspect of the validation
		EX4-CRT-PJ.10-W2-93-V3-VALP-062	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in abnormal conditions.	ER Medium to High Complexity	SASHA results affirmed that the level of situational awareness performed during the delegation was good despite the abnormal conditions encountered.

		EX4-CRT-PJ.10-W2-93-V3-VALP-063	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in abnormal conditions.	ER Medium to High Complexity	According to controllers feedback, delegation procedure did not increase potential for human error.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-064	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in	ER Medium to High Complexity	The results showed a score between Neutral (3) and Agree (4) on the agreement scale on the clarity of roles and responsibilities.	

			abnormal conditions.			
		EX4-CRT-PJ.10-W2-93-V3-VALP-065	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in abnormal conditions.	ER Medium to High Complexity		The communication load remains controlled to acceptable levels also during a contingency event.
		EX4-CRT-PJ.10-W2-93-V3-VALP-066	ATCO support tools provided before, during and after the delegation of ATM services provision in abnormal conditions do not impair ATCO	ER Medium to High Complexity		No specific support tools were provided to the ATCOs during the simulation (e.g. CD&R, SAFETY NET). No specific support tools were provided to the ATCOs during the simulation. However, during the debriefings controllers stated that they would

			human performance.		have felt more confident in case of total availability of supporting tools. These tools might help them in building the picture and maintain situational awareness, as well as predict conflict.	
EX4-OBJ-PJ.10-W2-93-V3-VALP-012	To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions	EX4-CRT-PJ.10-W2-93-V3-VALP-067	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in nominal conditions.	ER Medium to High Complexity	In general, the level of safety was maintained acceptable throughout the runs. The procedure itself was considered quite safe. Overall, although the global level of safety was felt quite good, the controllers expressed some safety concerns. However, these concerns were more linked to specific situations in which controllers experienced difficulties with the use of system rather than attributable to a specific working technique or	OK

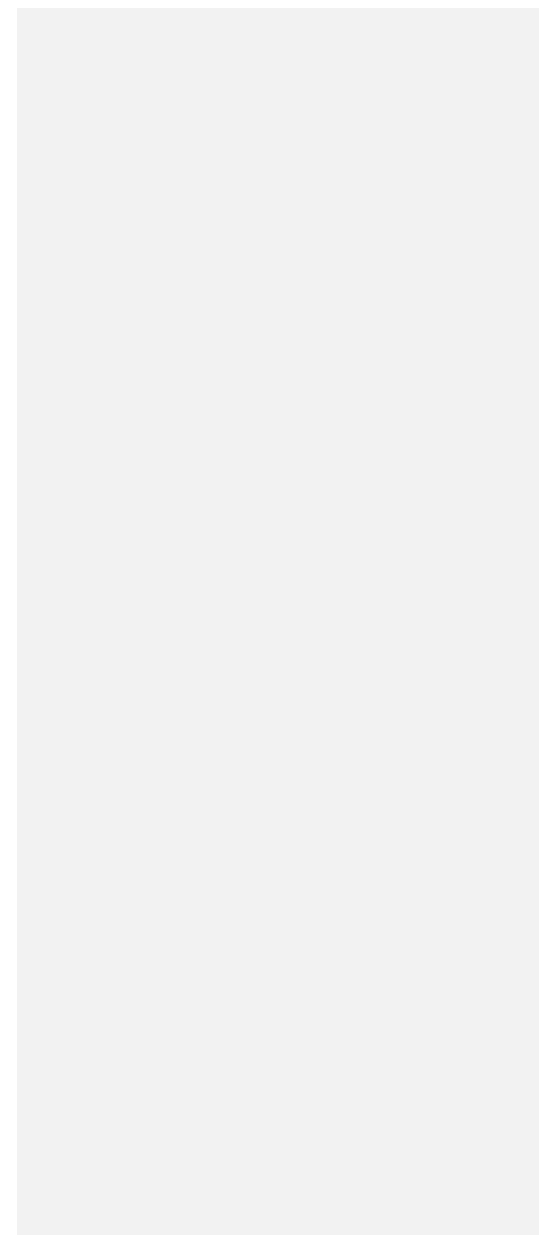
					whether the traffic was delegated or not	
		EX4-CRT-PJ.10-W2-93-V3-VALP-068	Impact remains acceptable according to ATCO expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.	ER Medium to High Complexity	According to ATCOs feedback, they were able to manage traffic in a quite safe way during all the phases of the delegation process ensuring a safe aircraft separation.	
EX4-OBJ-PJ.10-W2-93-V3-VALP-013	To assess the impact in terms of Safety of the ATM services provision delegation concept in abnormal conditions	EX4-CRT-PJ.10-W2-93-V3-VALP-069	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services	ER Medium to High Complexity	Overall, the level of safety was maintained at acceptable levels throughout the contingency run.	OK



			provision in abnormal conditions.			
		EX4-CRT-PJ.10-W2-93-V3-VALP-070	Impact remains acceptable according to ATCO's expert judgment in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in abnormal conditions are identified.	ER Medium to High Complexity	Controllers were able to manage traffic in a safe way during all the phases of the delegation process also in case of contingency events.	
EX4-OBJ-PJ.10-W2-93-V3-VALP014	To validate the ATSEP operational requirements based on expert judgment	EX4-CRT-PJ.10-W2-93-V3-VALP-071	Impact remains acceptable from the ATSEP's expert group perspective for the different operational requirements	ER Medium to High Complexity	ADSP ATSEP ensured that all interfaces and systems were in full operation and all required services and data were provided to the ATSU's, always	OK

			related to the ATSEP role.		ensuring the quality, accuracy, availability, and integrity of the data sensors. Regarding the VCS, he/she was able to tactically manage the technical aspects of the change of configuration during the delegation process.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-072	The requirements related to the ATSEP role are reformulated according to the feedback received from the ATSEP expert group.	ER Medium to High Complexity		
EX4-PJ.10-W2-93-V3-VALP-015	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision in case of contingency" use case	EX4-CRT-PJ.10-W2-93-V3-VALP-073	The delegation procedure for the Contingency Use Case, including the handover dialogue, is clearly defined and documented.	ER Medium to High Complexity	The procedure used during the contingency scenario was the same used during nominal scenarios. Overall, controllers deemed that procedures tested during the runs might be improved and better defined to be perfectible workable by them. In general, all controllers felt that the delegation procedures needed some fine tuning.	OK

		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-074</p>	<p>The delegation procedure for the Contingency Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.</p>		<p>The controllers “agreed” that the delegation procedure in case of contingency was suitable and operationally feasible, of course there are different aspects in the contingency situations to be taken into account as well as controllers would have felt more confident in case of total availability of supporting tools (e.g. CD&amp;R tools).</p>	
		<p>EX4-CRT-PJ.10-W2-93-V3-VALP-075</p>	<p>Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the Contingency Use Case, including the</p>		<p>ATCOs agree that the roles are well defined and the responsibilities remained unchanged during the delegation process but all highlighted that a checklist is useful, in case of contingency too.</p>	



			handover dialogue.			
		EX4-CRT-PJ.10-W2-93-V3-VALP-076	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the Contingency Use Case, including the handover dialogue.		According to ATCOs feedback, the quality of service and the sector coordination were acceptable.	
EX4-PJ.10-W2-93-V3-VALP-016	To demonstrate the operational acceptance of the delegation procedure for the “Delegation of ATM services provision in case of contingency” use case	EX4-CRT-PJ.10-W2-93-V3-VALP-077	The level of ATCO workload remains within acceptable levels according to ATCO’s expert judgment during the delegation procedure for the Contingency Use Case.	ER Medium to High Complexity	The level of Workload remained within acceptable levels during the delegation procedures in case of contingency.	OK

		EX4-CRT-PJ.10-W2-93-V3-VALP-078	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		Acceptable level of situational awareness was maintained by controllers during the execution of contingency run.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-079	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Contingency Use Case.		As for the other scenarios, the level of trust in the system was not satisfactory. In fact, some problems raised during the validation related to the fact that the simulation environment was not the operational system the controllers are used to. ATCOs proposed a list of improvements for HMI and platform.	
		EX4-CRT-PJ.10-W2-	The level of system support is judged as sufficient by the		Also in this scenario, system needs some refinements (especially in the preview mode) in	

		93-V3-VALP-080	ATCO during the delegation procedure for the Contingency Use Case.		order to better support controllers in the execution of the task and allow a smoother delegation process.
		EX4-CRT-PJ.10-W2-93-V3-VALP-081	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		The workload experienced by the ATCO SUP was good.
		EX4-CRT-PJ.10-W2-93-V3-VALP-082	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the Contingency Use Case.		Both LIRR and LIBB supervisors always had a clear understanding of the situation, managing the delegation process in a safe way during the contingency.

		EX4-CRT-PJ.10-W2-93-V3-VALP-083	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.		Supervisors had a good level of trust and confidence in the system as to allow them to properly handle the delegation process.	
		EX4-CRT-PJ.10-W2-93-V3-VALP-084	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Contingency Use Case.		ATCO SUP indicated that coordination (via phone) for the delegation procedure worked well through the system support.	
EX4-PJ.10-W2-93-V3-VALP-017	To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept	EX4-CRT-PJ.10-W2-93-V3-VALP-085	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.	ER Medium to High Complexity	A proper study has been conducted to evaluate the airspace capacity. Results shown an increase of 3.51% in CAP2.	OK





### C.3.2 Analysis of Exercise 4 Results per Validation objective

#### 1. EX4-OBJ-PJ.10-W2-93-V3-VALP-001 Results

##### Findings on Operational feasibility – Different Traffic Conditions

Feasibility addresses the “workability” of the assessed aspect (concept, procedures, methods, tools, etc.). Usability refers to the ease of use of a tool, of a working method, procedures, etc. (it is easy to do, to understand etc.).

The delegation procedure operational feasibility was investigated using controller feedback from questionnaires addressing the feasibility of the tasks in the different traffic conditions in nominal and contingency situations.

In order to assess the operational feasibility delegation procedures, an ad hoc post run question was submitted to controllers with 5 agreement response options ranging from *Strongly Disagree* (1) to *Strongly Agree* (5). The results related to all simulation runs were complemented according to controllers’ feedback gathered during debriefings.

In both Scenarios A and B controllers deemed the delegation procedure quite feasible in medium and high traffic conditions. The results in Scenario A are comparable to the ones gathered in Scenario B. Potential limitation impacting controllers answers are to be researched in the technical aspects of the validation to be improved (e.g. preview mode). Also one of the controller that gave a lower rating added “Two different time of evaluation for delegation phase caused a possible safety occurrence with 2 traffic overflying the same point on two different frequency. To consider in case of an emergency descent or in case of level burst”

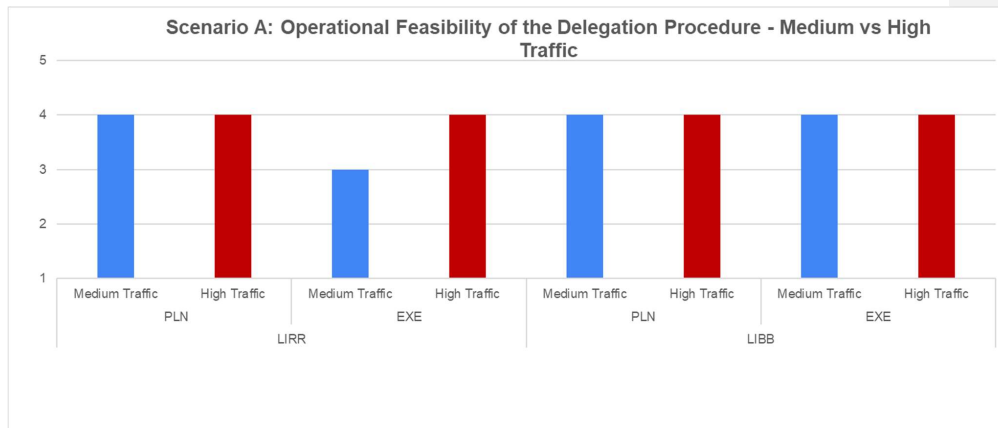


Figure ~~2727272727272727~~. Operational Feasibility of the Delegation Procedure: Scenario A

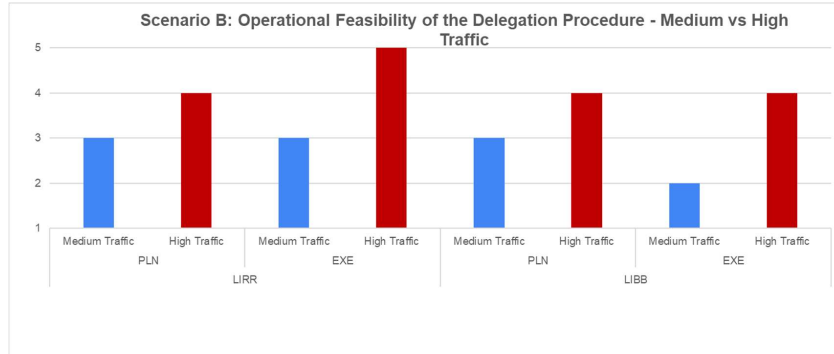


Figure 28282828282828. Operational Feasibility of the Delegation Procedure: Scenario B

The assessment of the operational feasibility during the contingency delegation is given on a five-point Likert scale ranging from 1 to 5, corresponding to answers from “Strongly Disagree” to “Strongly Agree”. As shown in the figure below, and confirmed in the debriefing, the controllers “agreed” that the contingency procedure was suitable and operationally feasible, of course there are different aspects in the contingency situations to be taken into account as well as controllers would have felt more confident in case of total availability of supporting tools (e.g. CD&R tools). Controllers also were not familiar with the operational system during the simulation. Furthermore, controllers highlighted that checklist, so mandatory steps to be followed shall be determined and they strongly requested to be trained on the procedures.

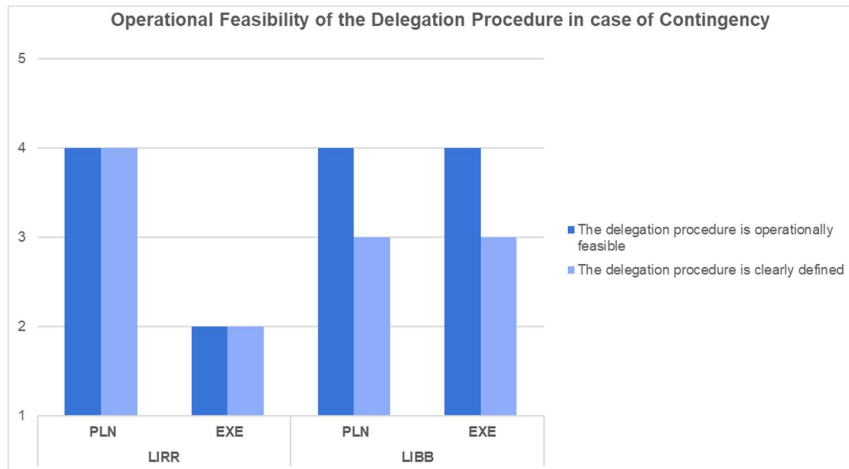


Figure 29292929292929. Operational Feasibility of the Delegation Procedure: Contingency Scenario

## 2. EX4-OBJ-PJ.10-W2-93-V3-VALP-002 - EX4-OBJ-PJ.10-W2-93-V3-VALP-003 and EX4-OBJ-PJ.10-W2-93-V3-VALP-004 Results

*Findings on Operational feasibility – Procedures clearly Defined and documented*

Results on operational feasibility of the delegation for the different tested use cases (i.e. Night, Fixed Time and On-Demand Use Cases) gathered through post run questionnaires are shown in the figure below. Controllers were asked to respond to the ad hoc question using a five-point agreement scale options ranging from *Strongly Disagree* (1) to *Strongly Agree* (5). The results related to all simulation runs were complemented according to controllers’ feedback. Delegation Procedure was considered quite fine, acceptable and feasible by all involved actors especially when the amount of traffic to be managed is low. According to the controllers’ feedback, gathered during the debriefing session, adequate training is needed. In addition, licensed and appropriately skilled ATCOs are needed in the receiving units.

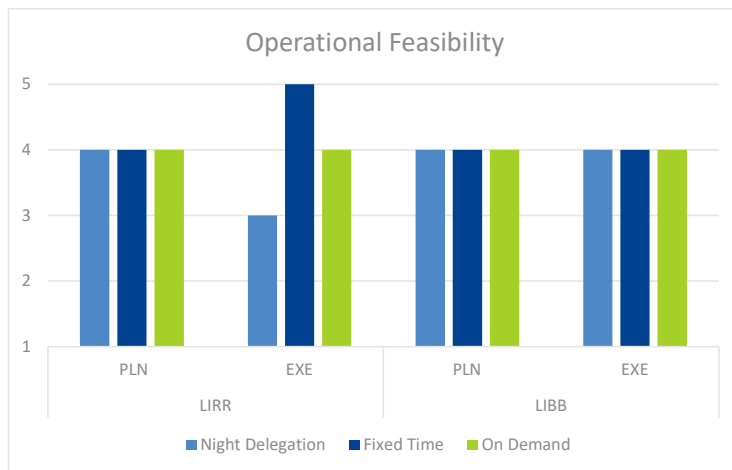


Figure ~~30303030303030~~. Operational Feasibility Night vs Fixed Time vs On Demand Scenarios

Also, overall controllers deemed that procedures tested during the runs might be improved and better defined in order to be perfectly workable by them. No particular differences were recorded with respect to the different simulated scenarios. In general, when questioned, all controllers felt that the delegation procedures needed some fine tuning.

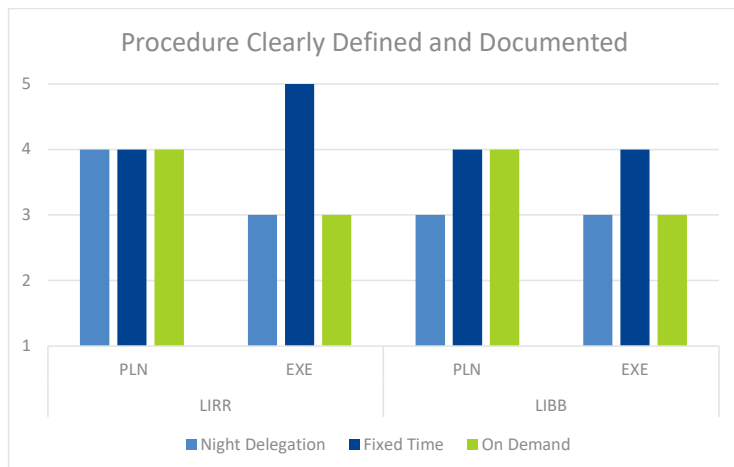


Figure 31313131313131. Delegation Procedure Clearly Defined and Documented - Night vs Fixed Time vs On Demand Scenarios

Also from FMP point of view the concept was considered feasible. During the exercise the FMP checked Demand/Capacity for each sector belonging to actual configuration, checked traffic details (e.g. crossing time of specific sectors, Entry count, Occupancy count etc.) and worked with the tool sector What-if analysis to apply different configurations, including the one which include the merged sector (LIRRUSN47) and then updating of opening scheme configuration.

*Findings on Roles and Responsibilities*

The impact of the conditions on the controllers’ roles and responsibilities was assessed using subjective feedback from the controllers and data recorded during the exercises. One of the main focuses was to determine whether the task distribution between the controllers was suitable and especially if there was an acceptable work balance after the delegation procedure.

According to questionnaire ratings and feedback, the building and maintaining of the separation was globally rated as quite manageable by the controllers. There was no (overall) clear impact of the working method observed in LIRR positions after taking in charge of LIBB traffic. Controllers stated that after the delegation, traffic was dealt with in an efficient way.

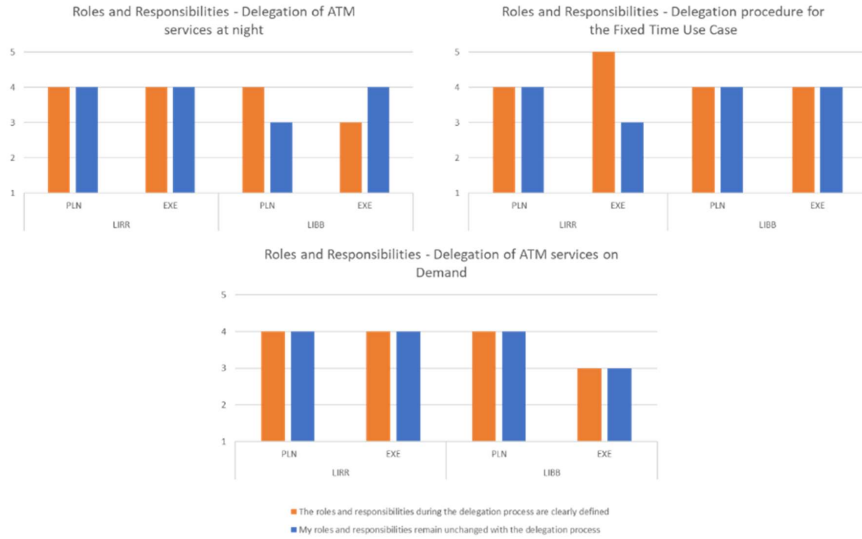


Figure 32323232323232. Roles and Responsibilities - Night vs Fixed Time vs On Demand Scenarios

Findings on Quality of Service

The Quality of Service was measured by means of post simulation questionnaire filled in just once by controllers and ATSEPs at very end of the simulation week. The graph reports on the horizontal axis each controllers chosen ID while on the vertical axis the agreement scale ranging from 1 for Strongly Disagree to 5 for Strongly Agree. According to ATCOs feedback, the quality of service and the sector coordination were acceptable but some refinements are needed.



Figure 33333333333333. Quality of Services During and After the delegation process

From ATSEP point of view, by the Technical supervision interfaces operated by the ATSEP staff was able to monitor and control the Virtual Centre services delegated in the Solution scenario and to be able to analyze the data before, during and after delegation process. Quality of service was not impacted during and after delegation process.

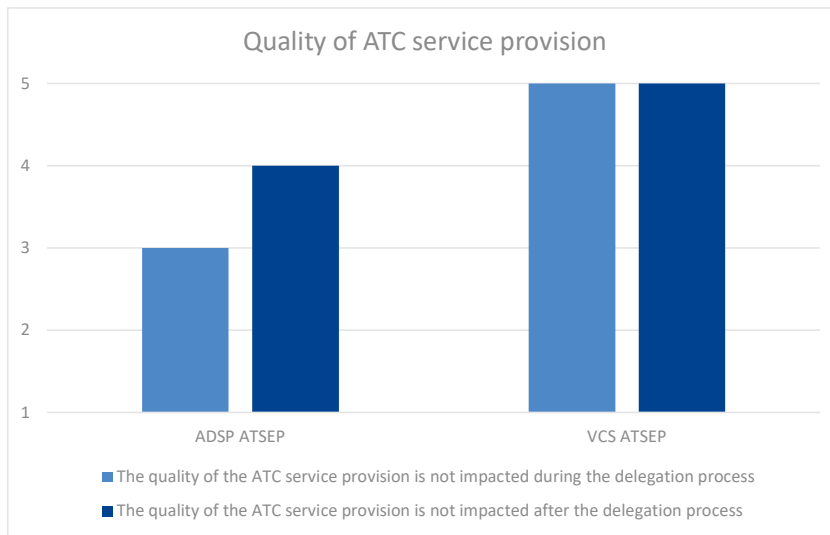


Figure 34343434343434. Quality of Services - ATSEP point of view

### 3. EX4-OBJ-PJ.10-W2-93-V3-VALP-005 Results

*Findings on Operational feasibility – Civil Military Delegation – clearly Defined and documented*

During the exercise, a civil military use case has been simulated. The scenario involved the activation of a TSA (Temporary Segregated Area). The scenario is based on the “possibility that LIBB has to delegate its Airspace to LIRR while a military activity managed by military controllers is planned during the Delegation time period.

During the run the following assumptions were considered:

The engagement of the areas takes place on the basis of a 'silent' procedure approved between the two units and detailed in the LoA, on the basis of which the military jets taking off from the specified aerodrome have a reserved level band (in any case to be confirmed) until entry into military zones (LITSA421A + LITSA422A). The scenario is composed of a mixed mode GAT and OAT scenario.

It is assumed that the Italian Air Force reserves ARES in the pre-tactical phase through the AUP.

The engagement of the areas shall take place at least for the time necessary to initiate and complete the delegation procedure between LIBB and LIRR.

The disengagement of the ARES zones also takes place on the basis of the same 'silent' procedure, which considers the route and levels to be reserved.

The VCS configurations foresee, among others, telephony availability with MIL entities in both the delegating and receiving sectors.

During the Pre-Delegation phase the LIBB SPV evaluated the compatibility of the military activity within the civil sector based on the relevant parameters (e.g. current/forecast traffic in relation to the MV, weather, traffic type, other military areas active/to be activated, etc.).

LIBB SPV did not detect critical issues, and alerts (also) the ATCO LIBB-XS47 team.

A phone test is coordinated and performed between EXE LIBB-XS47 and EXE MIL.

PLN MIL confirms the level of engagement of the mil areas with LIBB PLN of the relevant sector, and confirms the estimated take-off of flights mil.

LIBB SPV allow to activate the ARES graphics on the screen and informed the neighbouring units (including LIRR) of the engagement of the military areas for the re-routing of the traffic entering/leaving the FIR/UIR.

Within the exercise, during the planned delegation phase, the coordination between civil and military Supervisors was not analysed. The LIBB traffic was delegated to LIRR and the presence of the military traffic did not affect their job.

In fact, results on operational feasibility of the civil military delegation gathered through post run questionnaires are shown in the figure below. Controllers were asked to respond to the ad hoc question using a five-point agreement scale options ranging from *Strongly Disagree* (1) to *Strongly Agree* (5). The results related to all simulation runs were complemented according to controllers' feedback.

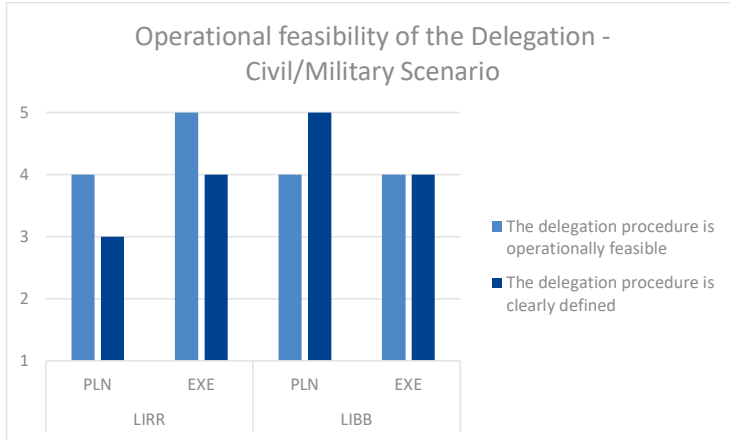


Figure 35353535353535. Operational Feasibility - Civil Military Scenario

With respect to the described procedure, as highlighted in the figure above, the delegation procedure in case of civil military scenario can be efficiently executed by ATCOs without adversely affecting controllers’ operations. Consequently, the delegation procedure was considered quite feasible by all involved actors. Also in this case, according to the controllers’ feedback gathered during the debriefing session, adequate training is needed. In addition, licensed and appropriately skilled ATCOs are needed in the receiving units

*Findings on Roles and Responsibilities – Civil Military Delegation*

During the exercise only civilian controllers were involved. All the tasks related to military controllers were simulated. However during the preparation of the scenario and debriefings, military operations experts were involved. As highlighted in the figure below, controllers were asked in a scale ranging from Strongly Disagree (1) to Strongly Agree (5) whether their roles and responsibilities were clearly defined when delegation procedures also involve military operations. The results show that their roles were clear and quite exhaustive; operating methods were exhaustive and support human performance, and human actors were able to achieve their tasks in a timely and accurate way. These positive feedback from controllers were complemented with proofs of feasibility based on acceptable level of workload and situational awareness assessments.



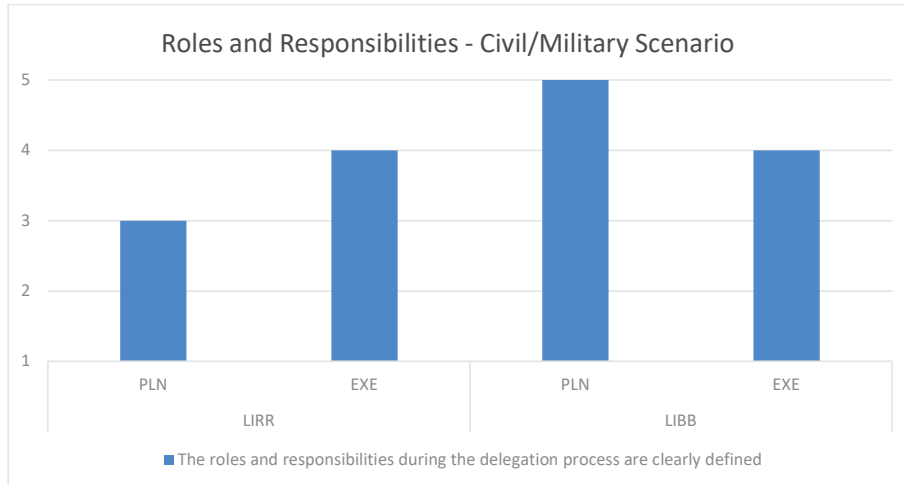


Figure 36363636363636. Roles and Responsibilities - Civil Military Scenario

*Findings on Quality of Service – Delegation of ATM services*

The Quality of Service was measured by means of post simulation questionnaire filled in just once by controllers at very end of the simulation week. According to ATCOs feedback, the quality of service and the sector coordination were acceptable but some refinements are needed.

**4. EX4-OBJ-PJ.10-W2-93-V3-VALP-006 – EX4-OBJ-PJ.10-W2-93-V3-VALP-007 and EX4-OBJ-PJ.10-W2-93-V3-VALP-008 Results**

*Findings on Operational Acceptability*

As shown in the figure below, controllers were asked on a scale from 1 “Strongly Disagree” to 5 “Strongly Agree” to rate if the concept under testing was operational acceptable. All the ATCOs have considered the procedure acceptable, rating an average score of four (Agree). This level of Acceptability has been confirmed by debriefing notes, but the ATCOs considered at this stage the used system not appropriate for harmonizing and smoothing the flow of traffic. Different recommendations have been gathered so as to compensate the current gaps and to achieve desired performances.



Figure 37373737373737. Operational Acceptability Night vs Fixed Time vs On Demand Scenarios

*Findings on Workload*

Workload (WL) can be defined as the effect of task load on the controller and the degree to which he accepts it. In contrast to task load which reflects objective task demands, workload is influenced by the controller’s internalised standards of performance, ability, and experience.

To assess the level of workload experienced by the controllers during the runs, ad hoc question was submitted to the ATCOs aimed at evaluating (in a scale ranging from Strongly Disagree (1) to Strongly Agree (5)) whether their level of attention and mental effort had remained at an acceptable level in all phases of the delegation process, i.e. before, during and after the delegation. The questions were submitted for all the tested use Cases (i.e. Fixed time, Night and On-demand). The figures below confirmed that the level of Workload remained within acceptable levels during the delegation procedures in all the tested Use Cases with small variations. The figures also show a comparison of the WL level faced during the various Use cases and the reference scenario (i.e. no delegation procedures implemented).

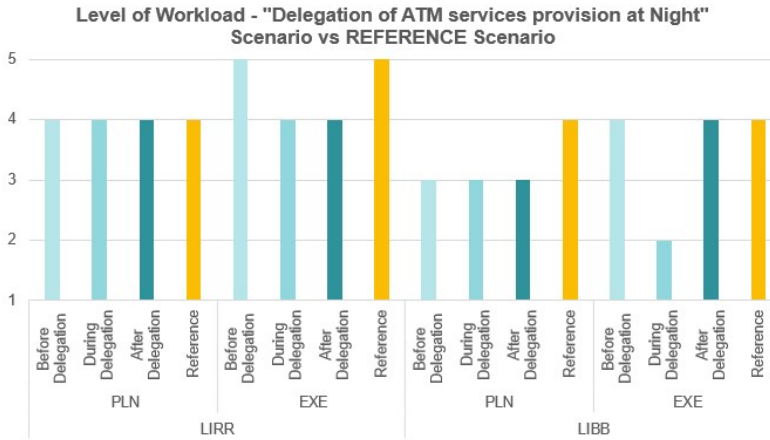


Figure ~~38383838383838~~. Level of Workload - Night Delegation Scenario

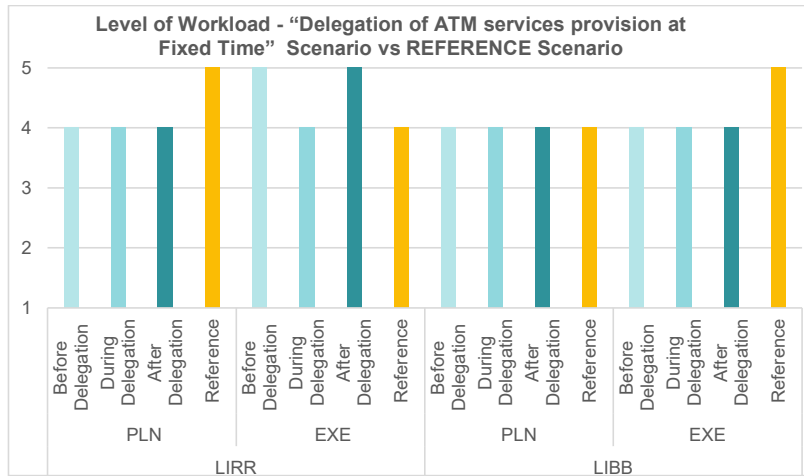


Figure ~~39393939393939~~. Level of Workload - Fixed Time

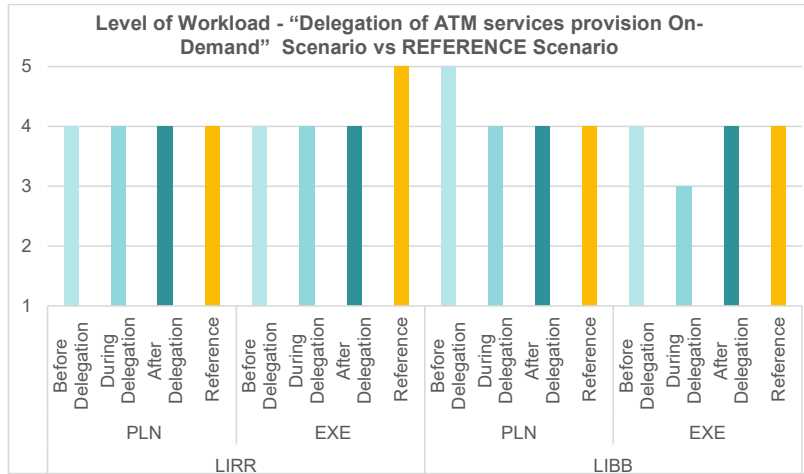


Figure 40404040404040. Level of Workload - On Demand Scenarios

The workload and mental effort faced by the ATCO SUP were also evaluated in a very similar way. At the end of each run, a customized questionnaire was submitted to the two SUP ATCOs (LIRR and LIBB) in such a way as to collect impressions and feedback also from their point of view. Regarding the level of workload, they were asked to answer the same questions submitted to EXE and PLN ATCOs, considering an agreement scale from Strongly Disagree (1) to Strongly Agree (5). The figure below clearly indicates how the level of workload was much more than acceptable (values between Agree (4) and Strongly Agree (5)) during all runs performed.

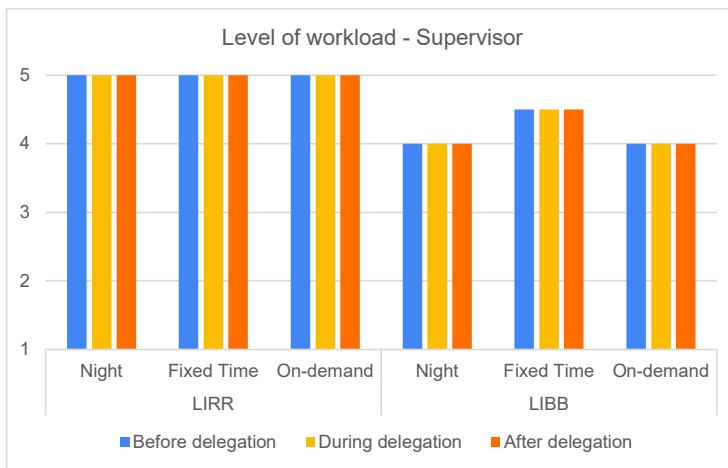


Figure 41414141414141. Supervisors Workload

In addition, during the exercise, the FMP position was assessed. The FMP used the LTLMT (Local Traffic Load Management Tool) tool that support operational personnel in identifying the best ACC room

configuration and to propose ATFCM measures to manage the Demand/Capacity imbalances in coordination with NM and with ATC. The level of workload of the FMP was always maintained at acceptable level, as shown in the figure below:

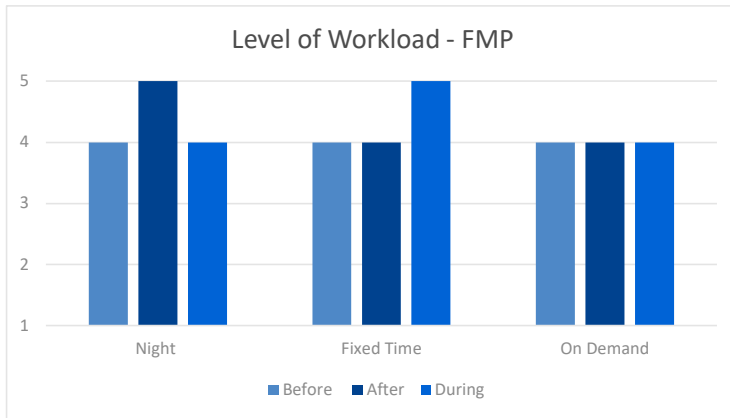


Figure 42424242424242. FMP Workload

Please note that the on demand scenario and the role of FMP has been better analysed and complemented in the PJ32 EXE1.5. The shape of the Target scenario sectorization has a better overview of the DCB due to the dimension and size of the sectors.

Finally stress and fatigue are linked to the perceived level of workload in that they reflect the ability of the controller to cope. The more easily the controller can handle the traffic, the less work-loaded s/he will feel, and the less stress and fatigue s/he will experience. The ability to cope is in turn strongly related to controller experience. Stress and fatigue aspects were considered during debriefing session. The results are in line with the different workload results presented above. There was a noteworthy overall quite low level of stress and fatigue recorded in all the positions and conditions. This result clearly denotes the high level of experience of the controllers, and their ability to work in the simulated operating environment and to cope with the different loaded traffic and new procedures without being overloaded.

The WL analysis is complemented with the results presented in OBJ-PJ.10-W2-93-V3-VALP-012 section.

*Findings on Situational Awareness*

Regarding the **Situational awareness (SA)**, it represents the perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future. During the exercise this indicator was assessed through ad hoc questions, SASHA questionnaire (results presented for OBJ-PJ.10-W2-93-V3-VALP-012) and debriefing. At the end of each run, the controllers evaluated whether their SA remained at acceptable levels during the various phases of the delegation process by selecting a score from an agreement scale from Strongly Disagree (1) to Strongly Agree (5). The following figures indicate the SA perceived by ATCO during the different Use Cases tested with a comparison with a Reference Scenario.

During the Reference Scenarios, controllers always perceived satisfactory and good levels of Situational Awareness. While for each of the tested use cases the results are very similar: overall

controllers experienced satisfactory levels of situational awareness before and after delegation with a clear decrease of the situational awareness during the delegation process. This was attributable to the system and a basic implementation of the preview mode. In fact, concerning all factors that contributed to the Situational Awareness and Workload assessment, the most important was the usability of the HMI. As shown in the figure below, traffic was displayed in “grey” colour and controllers had no clear automatic indication of the traffic that was “going to be gained” and the one that was “going to be lost” during the preview phase. This situation might be frustrating and cause of little bit higher workload and lower situational awareness.



Figure [434343434344](#). CWP HMI

The SA analysis is complemented with the results presented in OBJ-PJ.10-W2-93-V3-VALP-012 section.

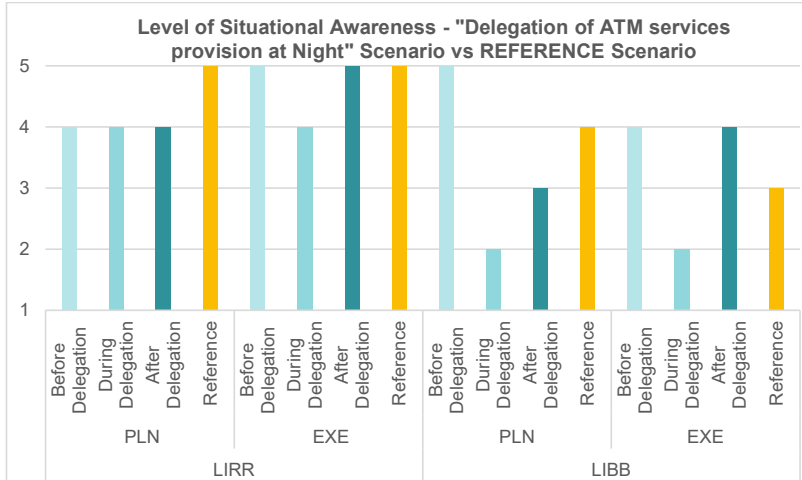


Figure 44444444444444. Level of Situational Awareness - Night Scenario

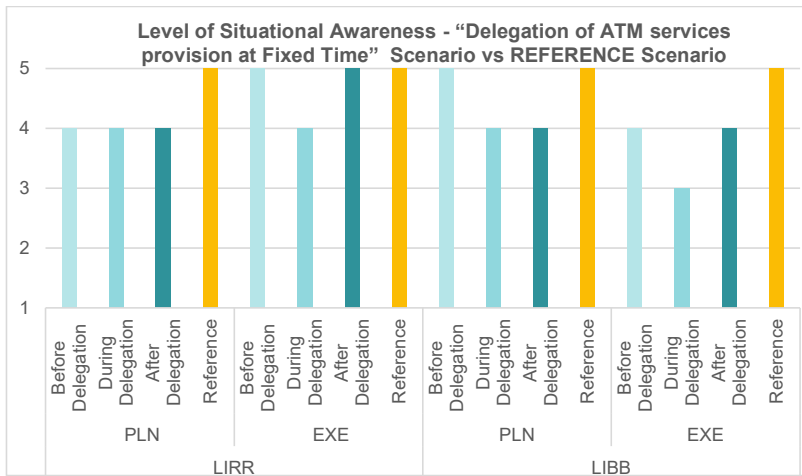


Figure 45454545454545. Level of Situational Awareness - Fixed Time Scenario

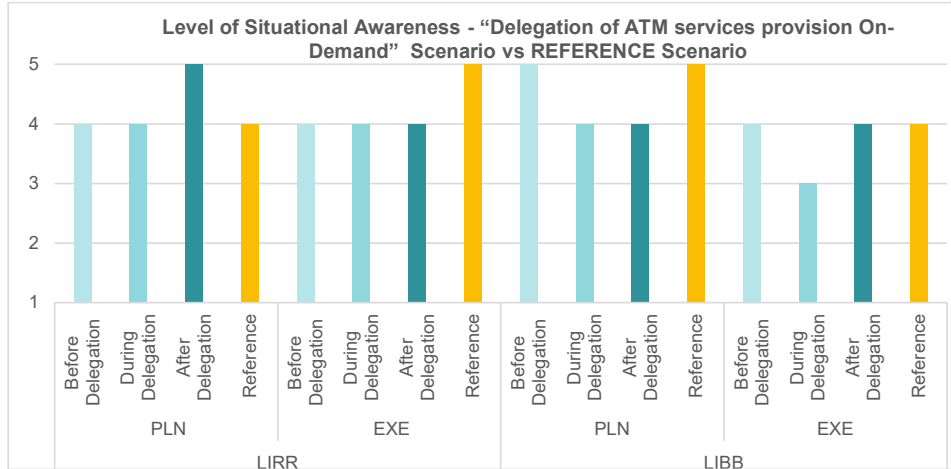


Figure 46464646464646. Level of Situational Awareness - On Demand Scenario

In the same way, the SA perceived by both supervisors of the two sectors and FMP was evaluated through customized post run questionnaires with results in line with the previous ones. In all the encountered scenarios, both LIRR and LIBB supervisors and FMP always had a clear understanding of the situation and supervisors managed the delegation process in a safe way.

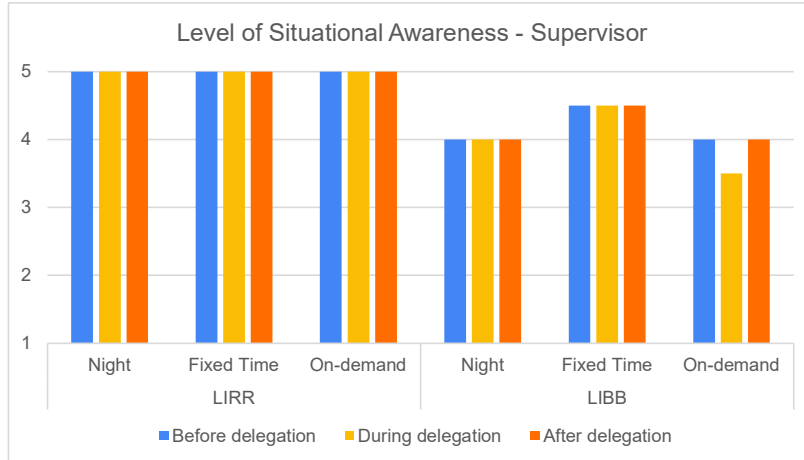


Figure 47474747474747. Level of Situational Awareness Supervisors



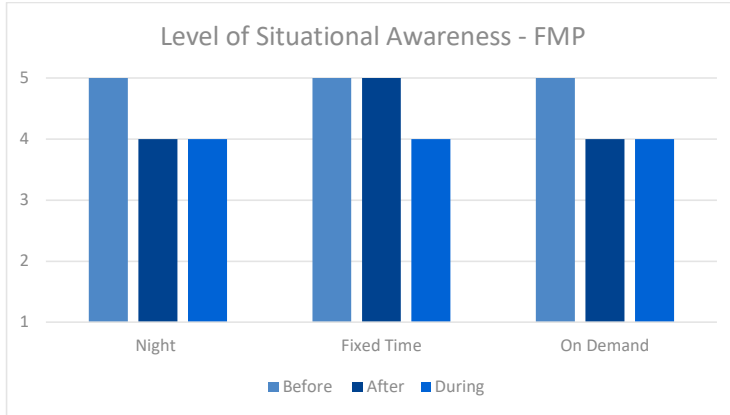


Figure 48484848484848. Level of Situational Awareness FMP

*Findings on the system*

Some feedback was also obtained regarding the system supporting the delegation process. These feedback were also obtained during the reference scenario in order to monitor the service in a stand alone way and to be comparable with the solution scenario aims at delegating the service itself. In particular, ad hoc questions were developed with the aim of understanding whether the system adequately supported the ATCOs in their work and whether the trust that the latter broke in the system was sufficient. The analysis was carried out for all the proposed scenarios giving acceptable results. Some problems raised during the validation related to the fact the simulation environment was not the operational system the controllers are used to. Further improvements were proposed by controllers, especially for the preview phase. In fact, during the EXE, the system HMI had some differences and sometimes controllers had to search for an information. There was no colour coding of the aircraft indicating the status (concerned, assumed, etc.) during the delegation phase. However, training and the execution of different runs throughout the simulation week allowed to familiarise, having a sort a learning effect during the simulation week.

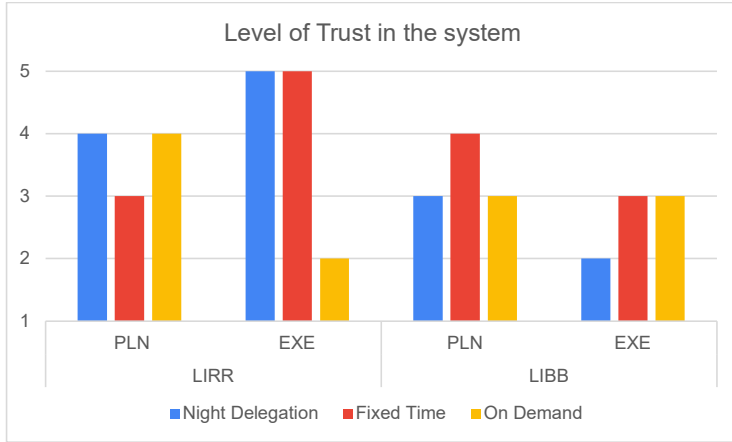


Figure 49494949494949. Level of Trust in the system

The same analysis was carried out for the supervisors: the following figures illustrate the results which are in line with the previous ones. Coordination between LIRR and LIBB Supervisors for the delegation procedure relied on telephone communications, handling co-ordination with adjacent centres was also reported to be very easy and straightforward and worked well.

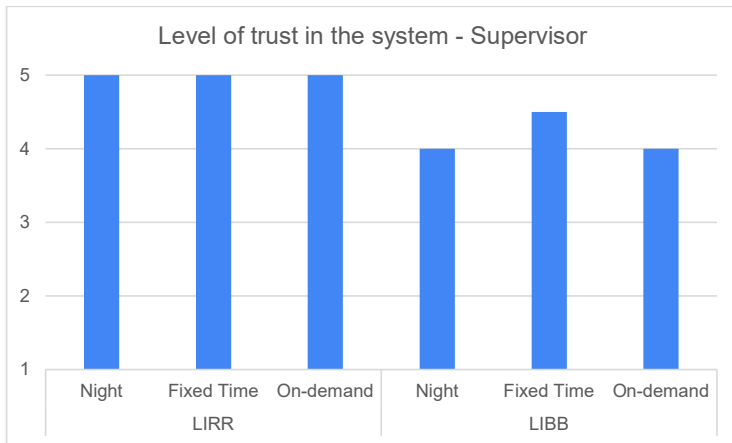


Figure 50505050505050. Level of Trust in the system - Supervisors



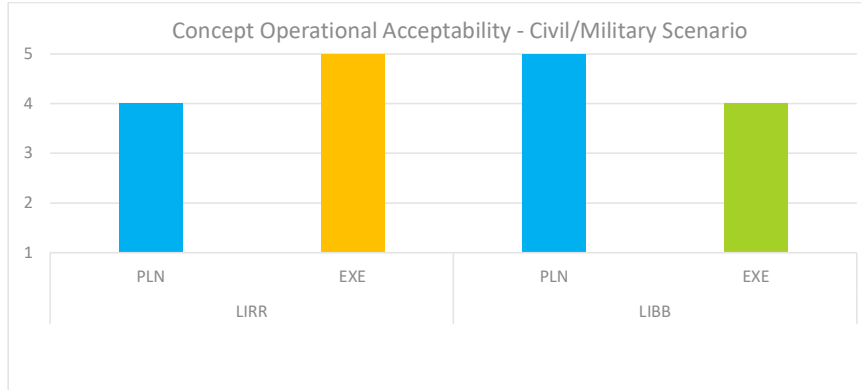


Figure 52525252525252 - Operational Acceptability - Civil Military Scenario

Although the presence of some technical issues related to the system and the need for an improved preview mode, the delegation process itself did not bring to a significant increase of workload or decrease of SA levels, as reported in the figures below.

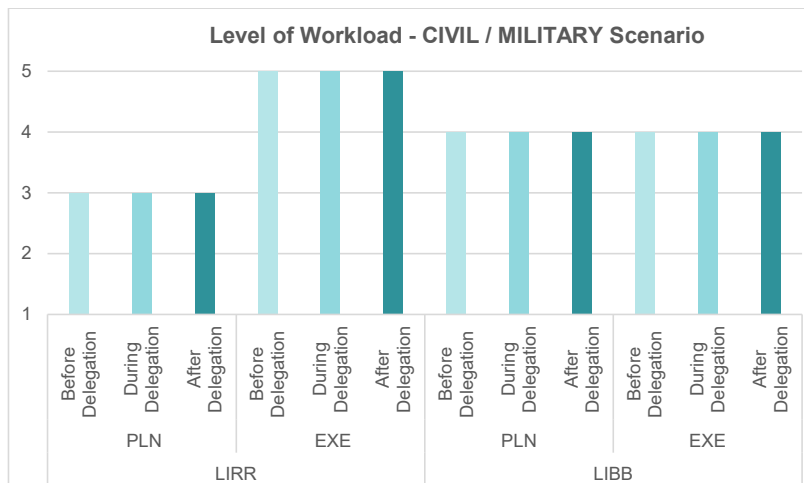


Figure 53535353535353 - Level of Workload - Civil Military Scenario

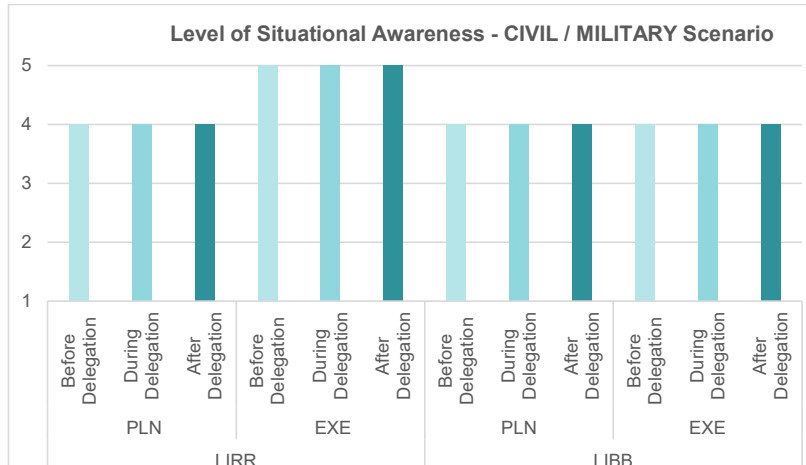


Figure 54545454545454. Level of Situational Awareness - Civil Military Scenario

The same questions were posed to the role of the SUP; the results obtained reinforced the idea that no deterioration in performance was recorded.

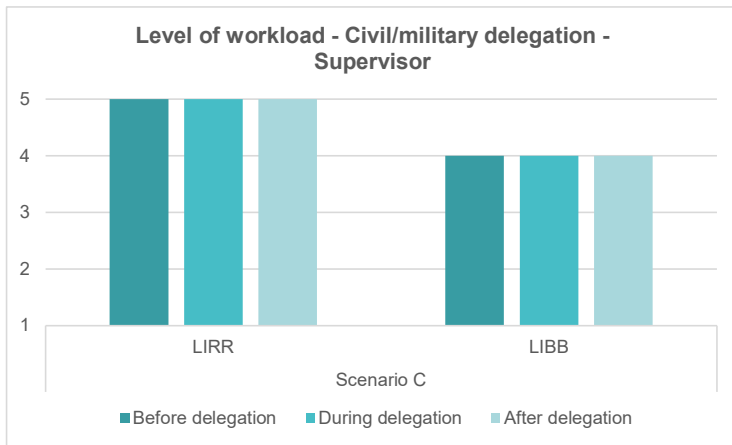


Figure 55555555555555. Supervisors' Level of Workload - Civil Military Scenario

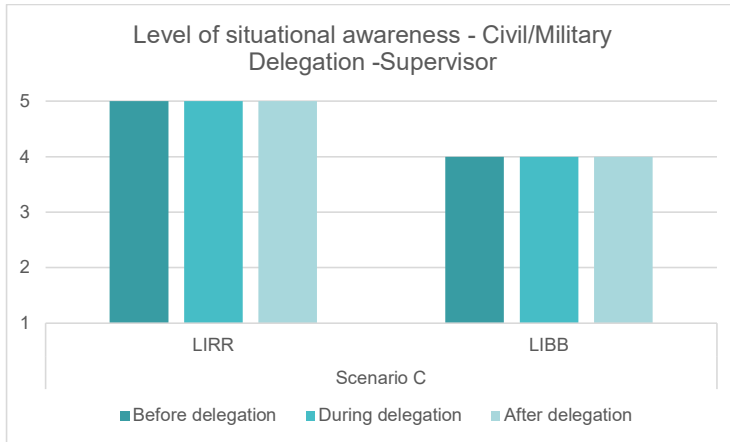


Figure 56565656565656. Supervisors' Level of Situational Awareness - Civil Military Scenario

Overall, during the run no problems or particular difficulties have been encountered. The controllers stated that the military areas were easily manageable, but some more coordination is expected for the supervisors. This might aggravate the WL a bit but remaining in an acceptable level. One highlighted problem could be aircraft that need to enter areas in case of weather problems. In fact, this involves various coordination steps by the supervisors which extend the activation/deactivation times.

*Findings on the system – Civil Military Delegation*

Some feedback was also obtained on the system supporting the delegation process in a Civil Military Scenario. An ad hoc questions was asked to understand the degree of trust of the ATCO in the system (from 1 to 5). The results obtained, both for the ATCO (PLN and EXE) and for the SUP, are in line with those obtained for the other scenarios with the same perplexities expressed in the previous scenarios. Controllers also reported during the debriefing that they might be better supported by the system considering further improvements especially in the preview phase.

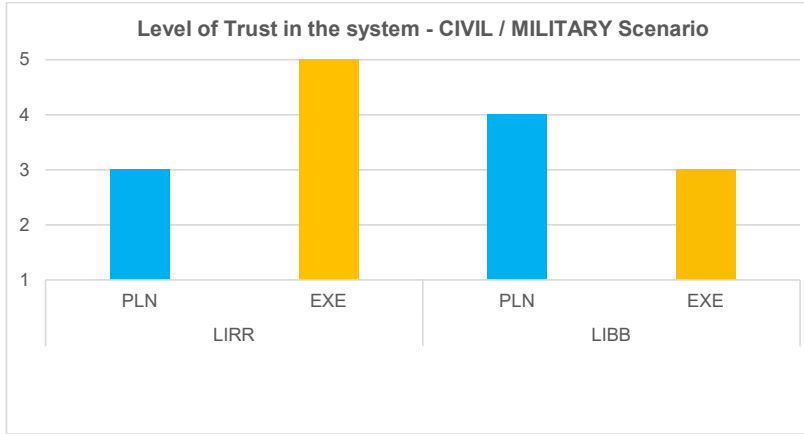


Figure 5757575757575757. Level of Trust in the system - Civil Military Scenario

Conversely, Supervisor managed the delegation process by phone, allowing them to safely perform their actions. As a consequence their level of trust was very good as well as for the system support.

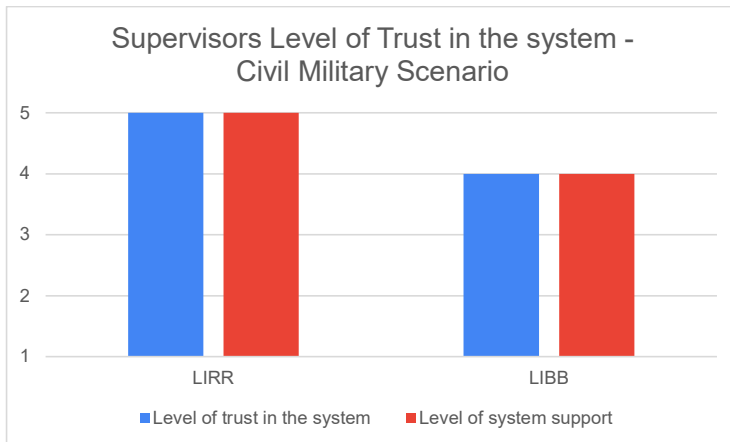


Figure 5858585858585858. Supervisors' Level of Trust in the system - Civil Military Scenario

## 6. EX4-OBJ-PJ.10-W2-93-V3-VALP-010 Results

### Findings on Workload

To complement the workload analysis performed in the previous sections, **Workload** was assessed considering the Bedford Scale. It was used to identify the ATCOs spare mental capacity while completing a task. The scale encompasses a hierarchical decision tree that guides the ATCO through a ten-point rating scale (1 lowest- 10 highest), where each point is accompanied by a descriptor of the

associated level of workload. For the interpretation of the results, scores in the range of 1-3 are considered as satisfactory workload, 4-6 represent tolerable but not satisfactory workload, responses above 6 require further investigation (the workload was not tolerable but it was possible to complete the task) and 9-10 are considered as unacceptable (it was not possible to complete the task).

The following questionnaire was used:

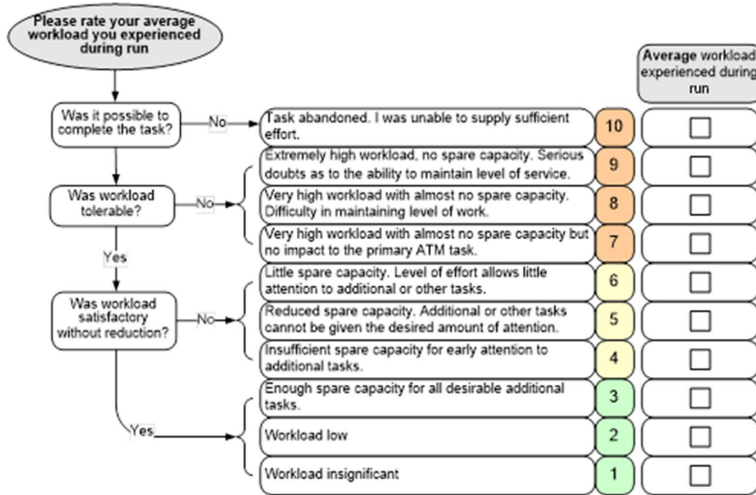


Figure 59595959595959. Bedford Scale

The figures below describe the results obtained throughout the runs experienced and all the scenarios tested collecting data on every phase of the delegation procedure (i.e. before, during, after).

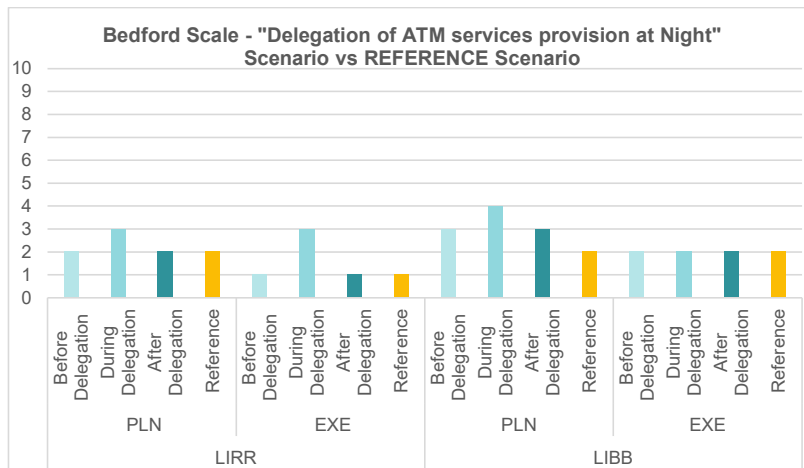


Figure 60606060606060. Bedford Scale ratings - Night Scenario



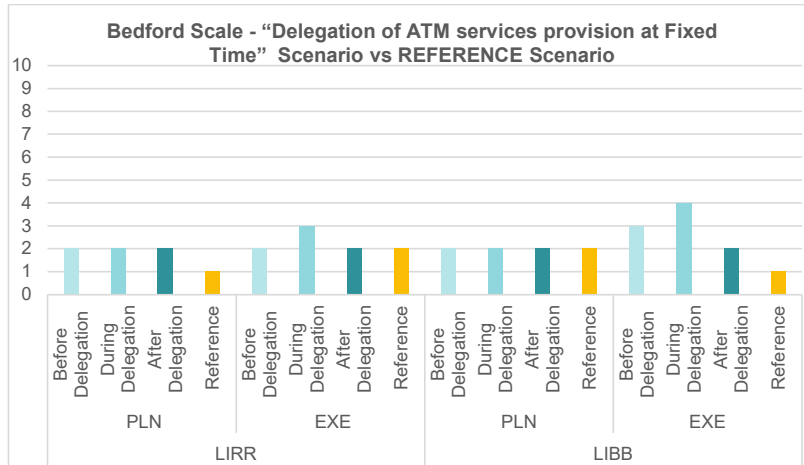


Figure 61616161616164. Bedford Scale ratings - Fixed Time Scenario

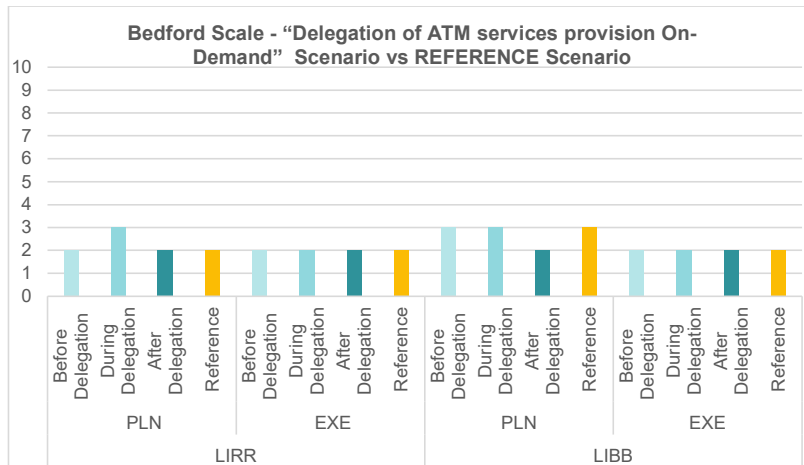


Figure 62626262626262. Bedford Scale ratings - On Demand Scenario

Most of the results fall within the range 1-3 of satisfactory workload. Only a few scores exceed this range but still remaining in the tolerable region. These scores are justified by some technical problems recorded by the simulation platform or in any case by some phases of the delegation process. In fact, during the debriefings, the controllers repeatedly stressed how essential it is to draw up a clear checklist of actions for the delegation procedures in order to avoid any kind of misunderstanding and overlapping.

*Findings on Situational Awareness*

As for the workload, also the situational awareness analysis was complemented by using the SASHA questionnaire that is a self-rating questionnaire for measuring Situational Awareness developed by EUROCONTROL within the framework of the SHAPE project (SHAPE = Solutions for Human Automation Partnerships in European ATM). The SASHA questions were included in the post-run questionnaire. . The SASHA questionnaire was used to assess the Controller’s **Situation Awareness**, considering questions that focus on key elements of SA which controllers have identified. Questionnaires were developed to assess the effect of automation on controller workload, situation awareness, teamwork and trust in the system. SASHA comprises 6 items and their responses are given on a seven-point Likert scale ranging from 0 to 6, corresponding to answers from “Never” to “Always” (negative to positive). The following figures describe the results obtained for all the Use Cases tested in the different phases of the delegation procedures.

The SASHA questionnaire assesses different aspects of the controllers’ situation awareness, such as their ability to plan and to be ahead of the traffic. It also considers controllers’ attention (e.g. too much focused or surprised by an event). By and large, the results of the SASHA questionnaire are in line with the mean ratings of the overall level of SA presented in the previous sections.

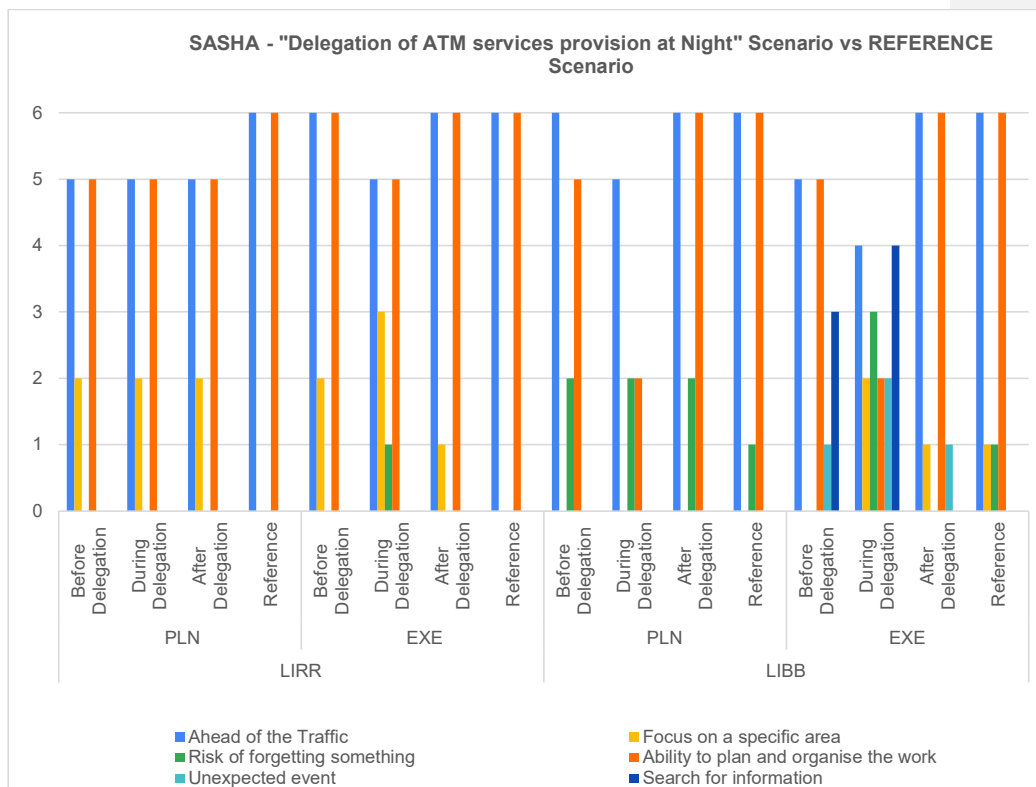


Figure 63636363636363. SASHA ratings - Night Scenario

The level of situational awareness performed during the Delegating of ATM services provision at Night was confirmed by the average score for each item touched in the SASHA questionnaire. The results show that the Controllers seldom (0,1) were **surprised by an event that they did not expect**; they were very often (5)/ always(6) **able to plan and organise work** as their wanted and on average seldom (0,2) they were **a risk of forgetting something important**. During the simulation **sometimes (0,2) they were focused on a single problem or a specific area of the sector** and the controllers affirmed that very often (5)/ always (6) they were **ahead of the traffic**.

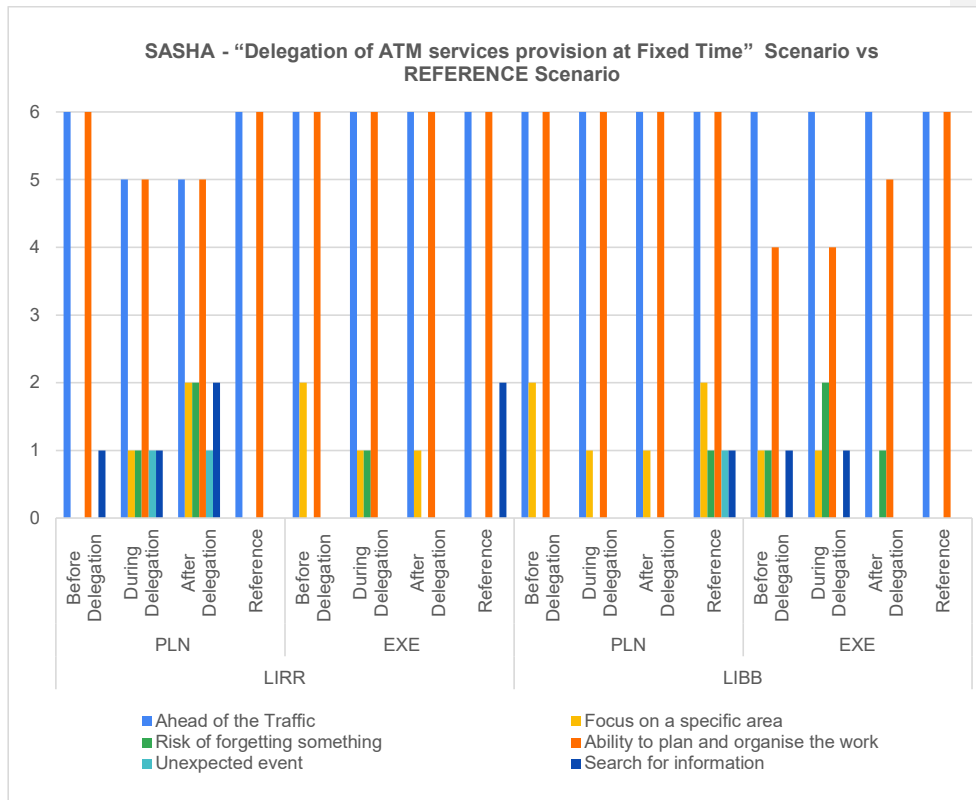


Figure 646464646464. SASHA ratings - Fixed Time Scenario

The average level of situational awareness assessed during the Delegation of ATM services provision at Fixed Time, which presents evidence. Controllers seldom (0,1) were **surprised by an event that they did not expect** but they were **able to plan and organise their work** (4,6) without a **risk of forgetting something important** (0,2). The controllers sometimes (0,2) were **focussed on a single problem or a specific area of the sector**, but they affirmed that despite some issues during the run they were **always (5,6) ahead of the traffic**.

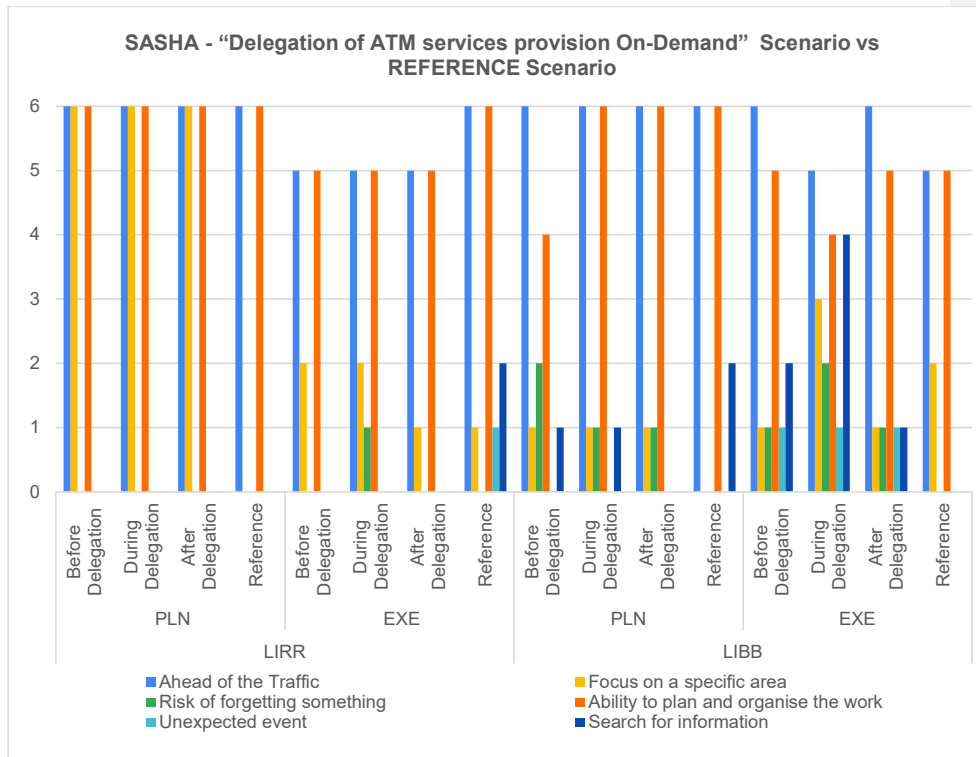


Figure 65656565656565. SASHA ratings - On Demand Scenario

The level of situational awareness performed during the Delegation of ATM services provision On-demand broadly follows the results obtained from the previous scenarios.

For all the tested scenarios, although neither significant impact related to the traffic flow nor of the working method was observed, it was noticeable that all the controllers felt slightly less ahead of the traffic during the execution of the delegation procedure. This may be explained by the system issues related to the preview phase and the need to search for information. These aspects led to a reduction of traffic picture and situational awareness, increasing controller workload and their availability to plan and to anticipate the traffic.

*Findings on Potential for human error*

An ad hoc question was asked to the ATCOs in the post run questionnaires to be answered with respect to a 5-point agreement scale from Strongly Disagree (1) to Strongly Agree (5) to assess whether the introduction of the tested procedures would keep the potential for human error at acceptable levels. The results show how this potential remains almost unchanged through the process despite the



During the exercise, it was observed that it was clear for each ATCO which tasks were their responsibility and which ones were carried out by the other team members. No changes in roles and responsibilities are foreseen with the execution of the delegation process. Coordination between LIRR (receiving ATSU) and LIBB (delegating ATSU) was ensured by Supervisors relying on telephone communications. Among internal teams all the tasks and coordination were executed in efficient way.

For further detail about Roles and responsibilities finding refer to OBJ-PJ.10-W2-93-V3-VALP-001.

#### *Findings on ATCO support tools*

No specific support tools were provided to the ATCOs during the simulation. However during the debriefings controllers stated that they would have felt more confident in case of total availability of supporting tools. These tools might help them in building the picture and maintain situational awareness, as well as predict conflict.

## **7. EX4-OBJ-PJ.10-W2-93-V3-VALP-011 Results**

Safety and Human performance assessments were performed considering both normal and abnormal situations. In fact, during the exercise, a Brindisi sector had a transmission frequency failure. There were no other usable consoles in the room. Consequently, Brindisi supervisor had to immediately inform all control positions and adjacent ATC units of the failure, starting with Roma ACC, informing them of the traffic in progress. Once Brindisi supervisor understood that the problem was local and not a complete failure of the ground radio equipment, he proceeded with a contingency delegation since there was a team available in Rome. Later, after solving the problem and restoring all the operating functionalities, the Brindisi supervisor contacted the Rome supervisor to inform him about it and giving availability to take charge of the delegated airspace again. Hence there was also a recovery delegation. Hence regarding the results on the contingency delegation, it was acceptable for the validation run, but contingency has a lot of variables and of course it cannot be planned and might occur in situations with for example high traffic, which might be not ideal for delegation. However, the possibility to delegate the traffic to another fully operating unit is totally considered as a mitigation protecting against propagation of effects.

#### *Finding on workload- Contingency delegation*

For Workload, the Bedford Scale was used to identify the ATCOs spare mental capacity while completing a task during the contingency procedures. The gathered data and feedback from the controllers confirmed that the level of Workload remained within acceptable levels during the contingency procedures. Obviously, there were quite a few issues with the technical aspect of the validation. Figures show an increase in the WL perceived by the ATCOs with respect to the Reference scenario but nevertheless it has remained in a region of tolerability.

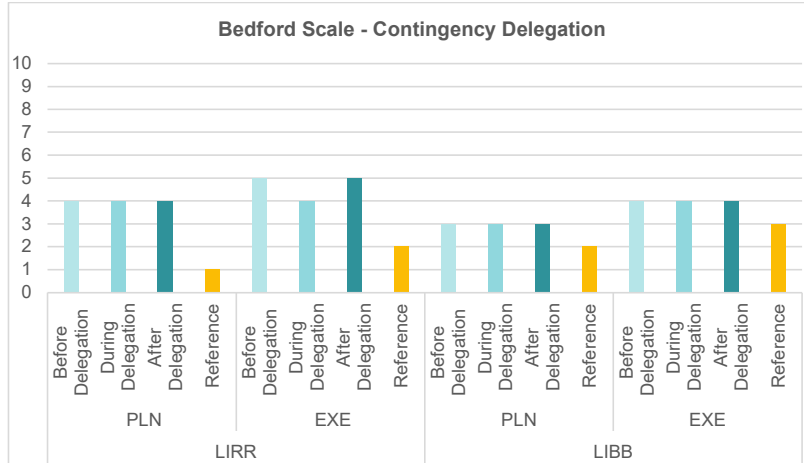


Figure 68686868686868. Bedford Scale ratings - Contingency Scenario

As shown in the chart above, the average Bedford scale is between 3 (enough spare capacity for all desirable additional tasks) and 5 (Reduced spare capacity. Additional or other tasks cannot be given the desired amount of attention) rating scale. The Bedford Scale workload results were supported by an additional question in the post run questionnaires that shows that the controllers` perceived workload remained at an acceptable level throughout all the experienced runs (refer to OBJ-PJ.10-W2-93-V3-VALP-007 /008 /009).

*Findings on Situational Awareness – Contingency delegation*

Also in this case, the level of **Situational Awareness** was assessed using the SASHA questionnaire.

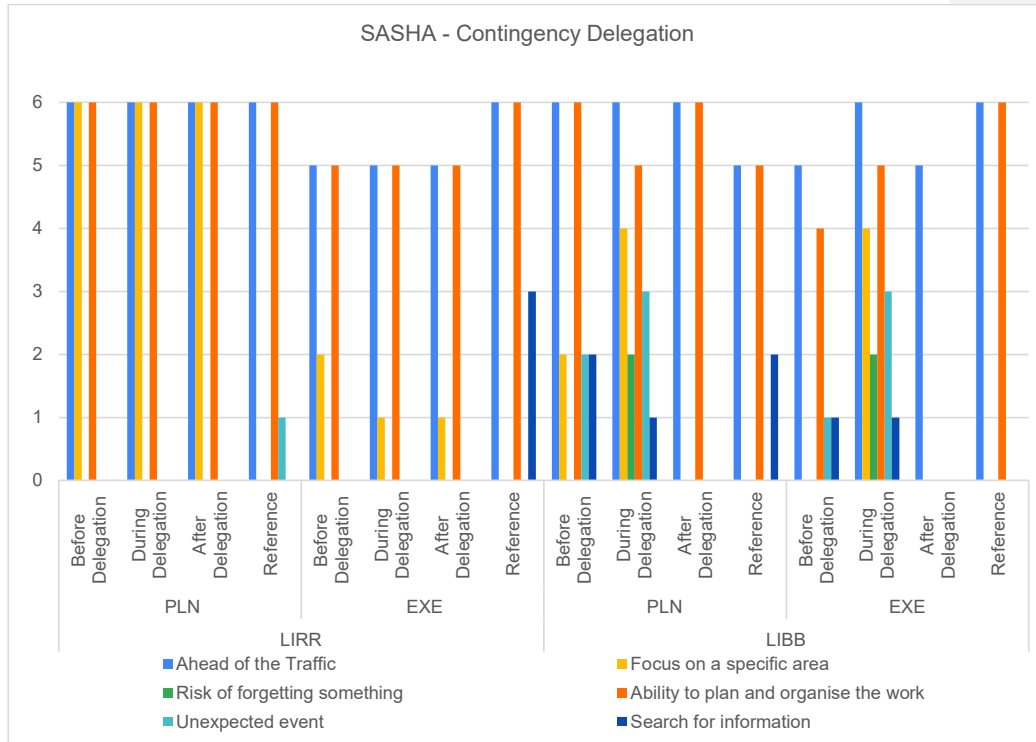


Figure 69696969696969. SASHA ratings - Contingency Scenario

The graph indicates that the Controllers had a “good” level of situational awareness during the contingency delegation. More in detail, the perceived Situational Awareness was assessed through the average of several item listed below. Concerning the good understanding of the situation the average was very often/always (5,6) and the controllers were **able to plan and organise** their work as they wanted. Furthermore, always considering the average, controllers conformed that they have **ahead of the traffic (5,6)** despite during the contingency situation, some events made sometimes difficult to maintain full control of the traffic situation. Despite the contingency event, the average on **the risk of forgetting something sector** and **unexpected event** was seldom (0,2). The contingency weighed more on the indicator related to **focus on a target or a specific area** that achieved a variable score from seldom (1) to always (6). Contingency Procedure was acceptable for the validation run, but contingency has a lot of variables that might impact on the level of situational awareness. These results are complemented by the ones related to safety presented in the next sections.

*Findings on potential for human error – Contingency delegation*

Below the results obtained regarding the potential to mislead controllers during the delegation procedure in case of contingency are depicted. It is clear from the graph that the risk of misleading remains controlled to acceptable levels.



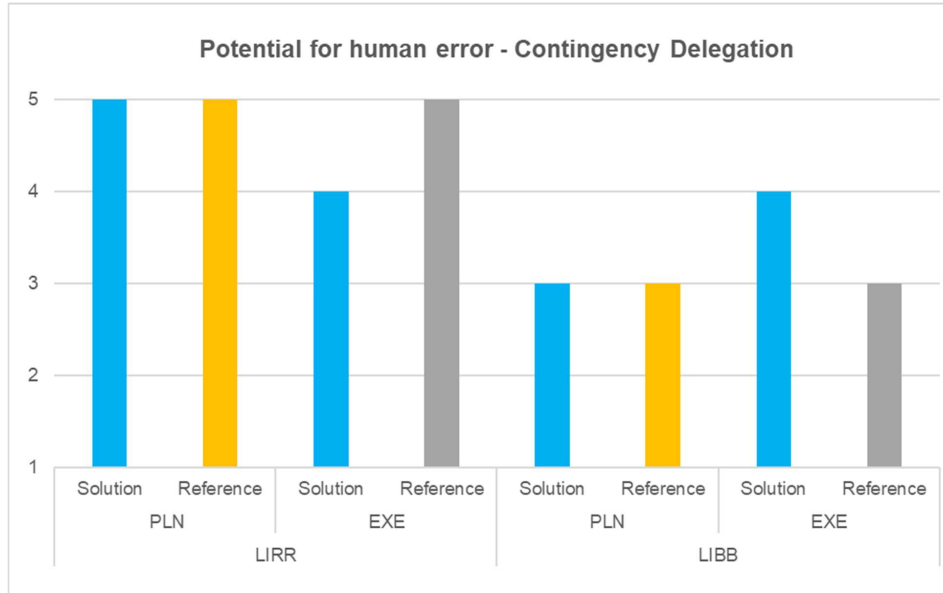


Figure 707070707070. Potential for Human Error - Contingency Scenarios

*Findings on communication load – Contingency delegation*

Below the results obtained regarding the risk of overloading the controllers from a communications point of view during the delegation procedure in case of contingency are depicted. It is clear from the graph that the communication load remains controlled to acceptable levels also during a contingency event.

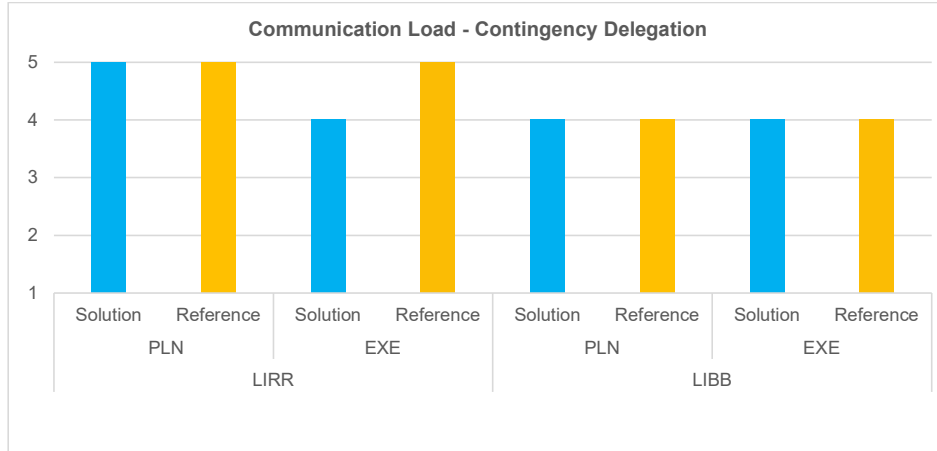


Figure 71717171717171. Communication Load - Contingency Scenarios

Findings on role and responsibilities – Contingency delegation

During the contingency scenario, no impact on the distribution of roles and responsibilities for the contingency delegation procedures was identified. The graph depicts a score between Neutral (3) and Agree (4) on the agreement scale.

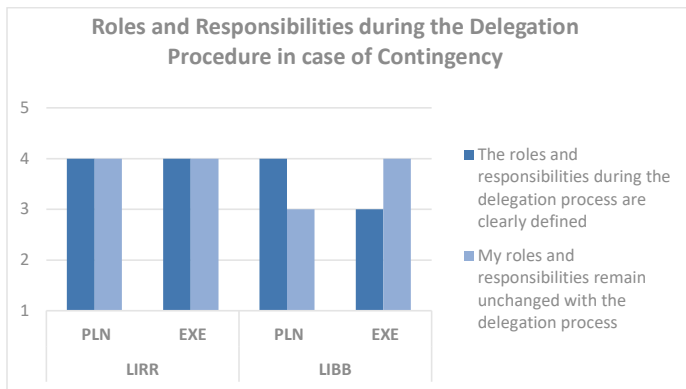


Figure 72727272727272. Roles and Responsibilities - Contingency Scenarios

Finding on ATCO support tools

Within the exercise, no ATCOs supporting tools were present (e.g. CD&R). However, their impact was analysed during debriefing sessions. In fact, it was highlighted that the possibility to have this kind of

tools would have supported controllers to manage their own work in a more efficient way. Please refer to OBJ-PJ.10-W2-93-V3-VALP-012.

## 8. EX4-OBJ-PJ.10-W2-93-V3-VALP-012 Results

### Findings on Safety

The objective addressed by SAF Assessment has been analysed providing evidence for the addressed success criteria. Results are supported by charts elaborated with data coming from Post Run Questionnaires.

On an agreement scale from 1 (“strongly disagree”) to 5 (“strongly agree”), all ATCOs had to answer if “the level of safety remains at acceptable levels” before, during and after the delegation procedure in nominal cases. The figure shows the scores registered by each controllers position during all the Use Cases scenarios tested and Reference scenario runs. In general, the level of safety was maintained acceptable throughout the runs. The procedure itself was considered quite safe.

Overall, although the global level of safety was felt quite good, the controllers expressed some safety concerns. However, these concerns were more linked to specific situations in which controllers experienced difficulties with the use of system rather than attributable to a specific working technique or whether the traffic was delegated or not. Also, during the delegation on demand LIBB EXE and the other executive ATC that was the one who was receiving the delegation reported the occurrence of a technical problem affecting all the traffic plots. Nevertheless, during the debriefings controllers reported that the concept of the delegation is feasible but need to be improved especially for what concern the systems and the systemic procedures. The system, in the version that we were allowed to use during the exercise was not so much useful and it sometimes did not help the ATC in the operative position. In addition during the fixed time scenario the EXE at LIRR reported that the flight BMS8FP (LICC-LIMF) was climbing to FL 360 but he/she did not see the CFL and this situation might cause a level burst.

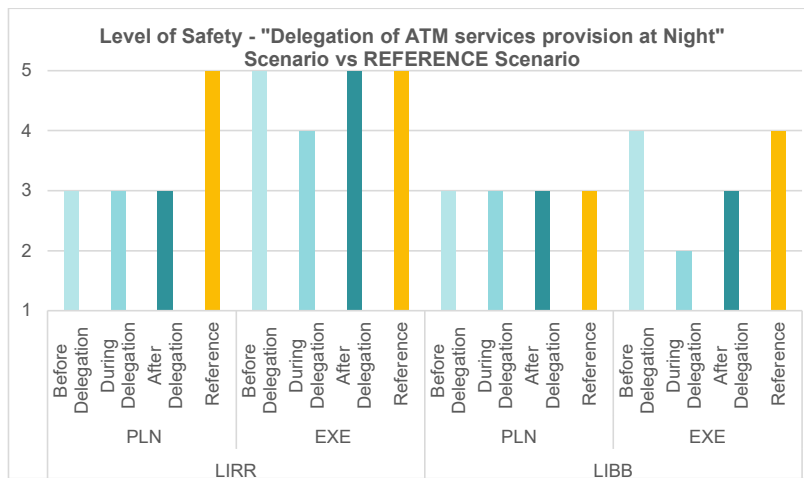


Figure 73737373737373. Level of Safety - Night Scenario

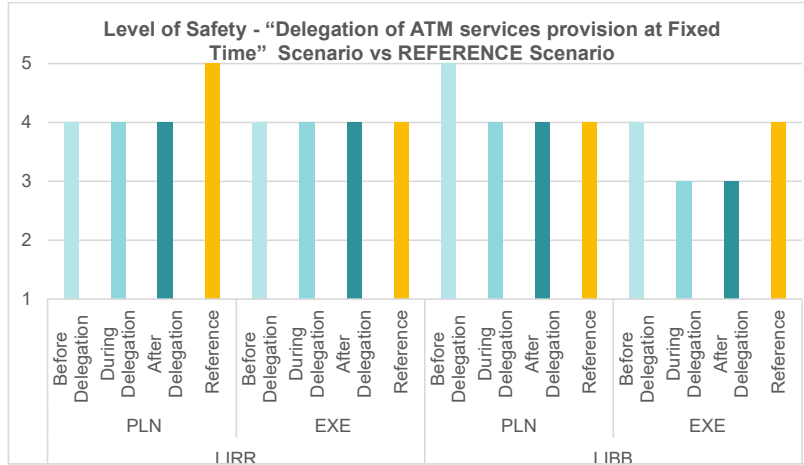


Figure 747474747474. Level of Safety – Fixed Time Scenario

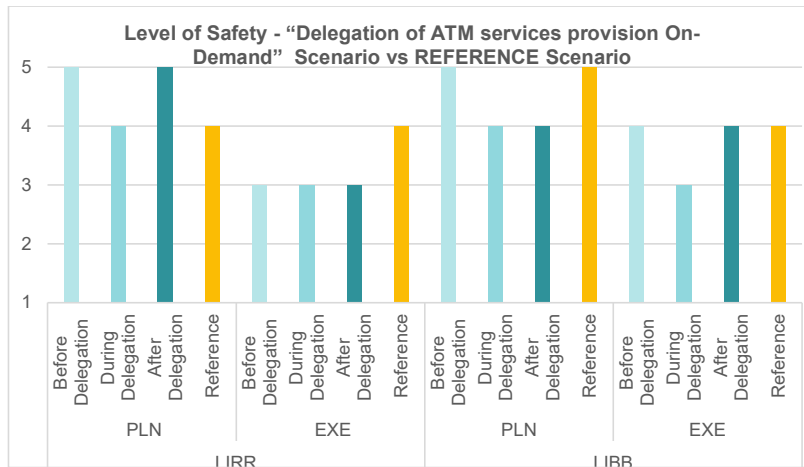


Figure 757575757575. Level of Safety – On Demand Scenario

*Findings on the management and provision of aircraft separation*

In post run questionnaires the ATCOs were asked if the management and provision of aircraft separation is acceptable answering to a 5-point agreement scale. The graph shows, according to ATCOs feedback, that controllers were able to manage traffic in a quite safe way during all the phases of the delegation process. Although there was no occurrence of safety-related events, controllers sometimes experienced difficulties in maintaining a clear traffic picture and managing traffic especially during the delegation process. This was strictly related to the preview phase issues (i.e. ATCOs would have needed

an improved preview mode with a cleared understanding on the switch to the operational mode and specific indications on the traffic to be gained and on the one to be delegated).

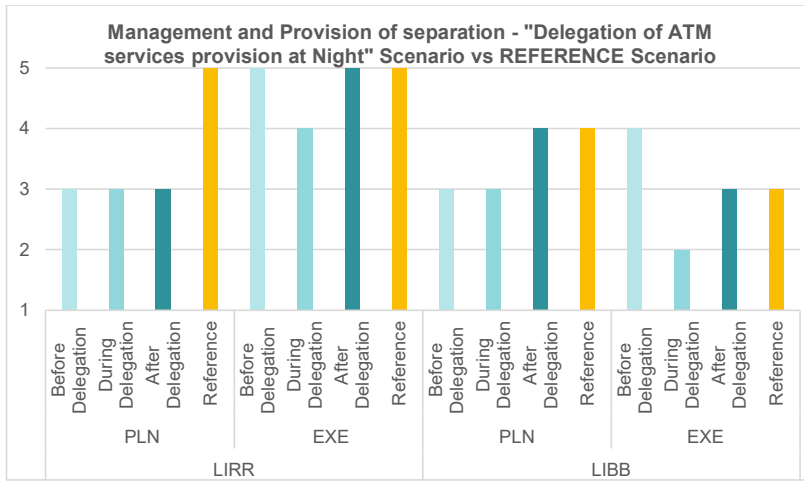


Figure ~~76767676767676~~. Separation Provision - Night Scenario

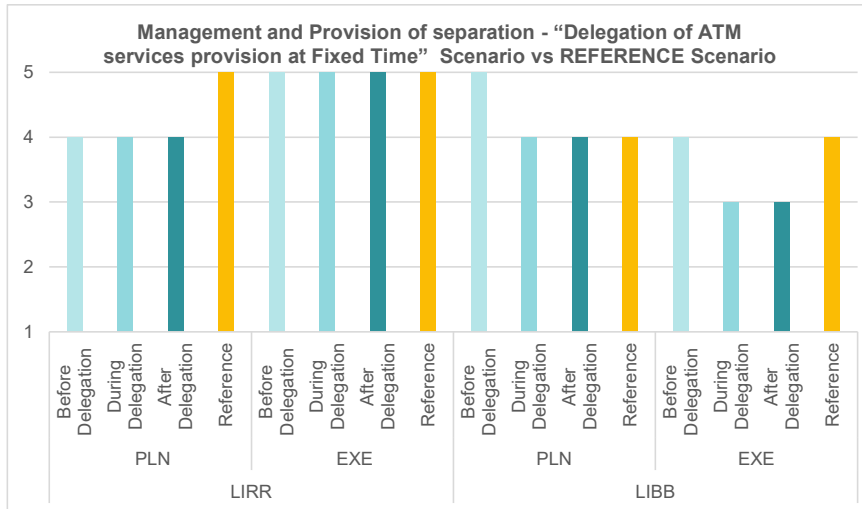


Figure ~~77777777777777~~. Separation Provision - Fixed Time Scenario

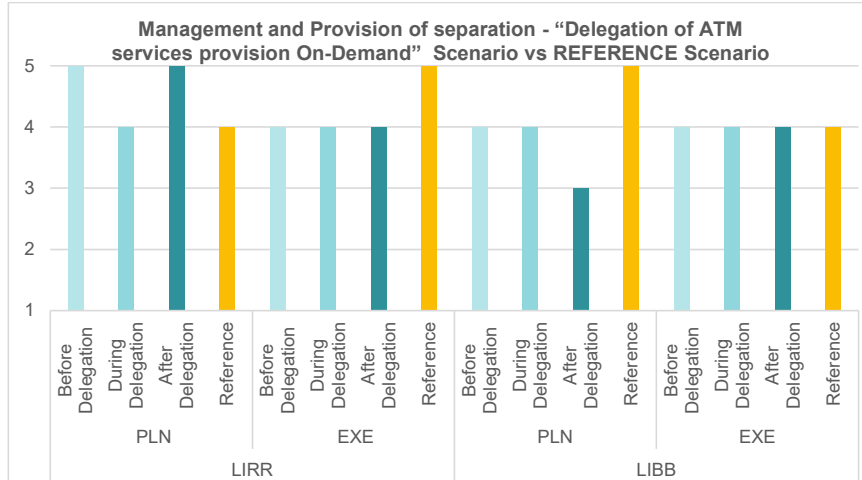


Figure 78787878787878. Separation Provision - On Demand Scenario

These results are also confirmed by the data obtained during the exercise, where in all the tested scenarios and traffic conditions the separation measured was compared to the required separation minimum. Hence no under separation and/or conflicts have been recorded as reported in the following table.

	Night		Fixed Time		On Demand		Civil Military	Contingency
	Medium Traffic	High Traffic	Medium Traffic	High Traffic	Medium Traffic	High Traffic	Medium Traffic	Medium Traffic
Under separation	0	0	0	0	0	0	0	0
Tactical Conflicts	0	0	0	0	0	0	0	0

Table 32323232323232. Safety Data on Under separations and Tactical Conflicts

### 9. EX4-OBJ-PJ.10-W2-93-V3-VALP-013 Results

#### Findings on Safety – Contingency delegation

On a Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"), all ATCOs had to answer if "the level of safety run was maintained at acceptable levels". The figure shows the scores registered by each controllers position during the contingency runs with respect to a Reference scenario. Overall, the level of safety was maintained at acceptable levels throughout the contingency run.

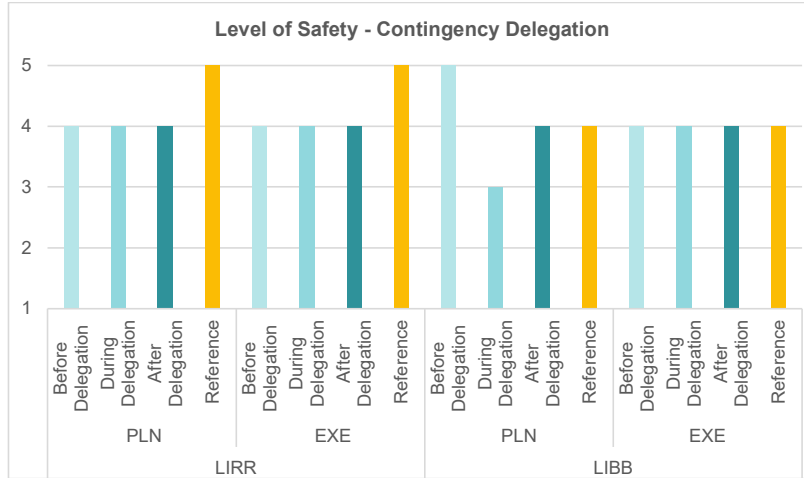


Figure 79797979797979. Level of Safety - Contingency Scenario

*Findings on the management and provision of aircraft separation -Contingency delegation*

In post run questionnaires the ATCOs were asked if the management and provision of aircraft separation in contingency delegation is acceptable answering a 5-point agreement scale. The graph shows, according to ATCOs feedback, that controllers were able to manage traffic in a safe way during all the phases of the delegation process also in case of contingency events.

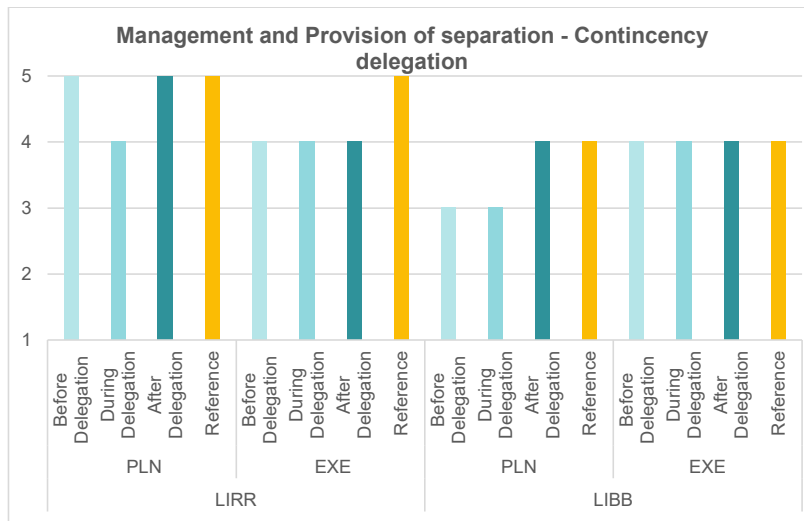


Figure 80808080808080. Separation Provision - Contingency Scenario

## 10. EX4-OBJ-PJ.10-W2-93-V3-VALP-014 Results

During the exercise two ATSEP were involved in the exercise: the ATSEP of the ADSP and the ATSEP of the VCS. At the very end of the exercise, ATSEP were asked to fill in an ad hoc questionnaire. As reported in the charts below, good response and feedback were gathered from them. The first and second charts respectively show the ability of ADSP ATSEP and VCS ATSEP to perform tasks assigned to him/her. ATSEP were asked to answer in a frequency scale ranging from 0 “Never” to 6 “Always”. ADSP ATSEP ensured that all interfaces and systems were in full operation and all required services and data were provided to the ATSUs, always ensuring the quality, accuracy, availability, and integrity of the data sensors. Regarding the VCS, he/she was able to tactically manage the technical aspects of the change of configuration during the delegation process.

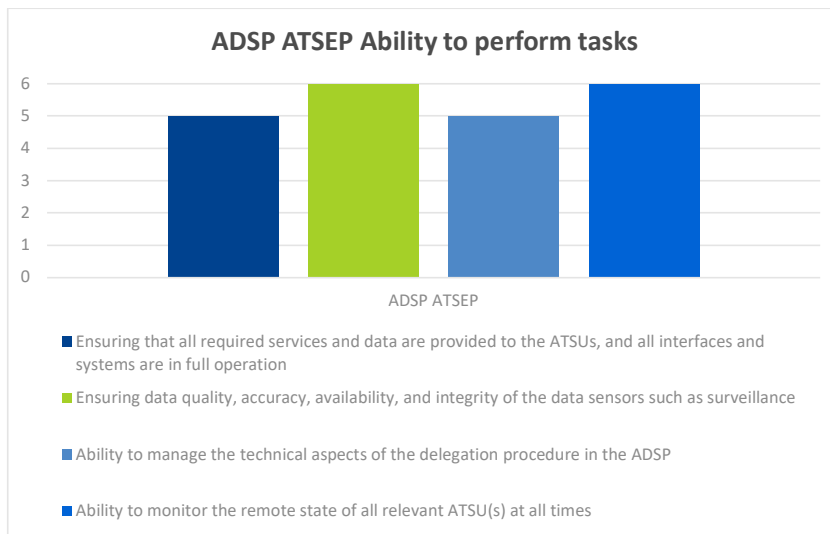


Figure 81818181818181. ADSP ATSEP Ability to perform tasks



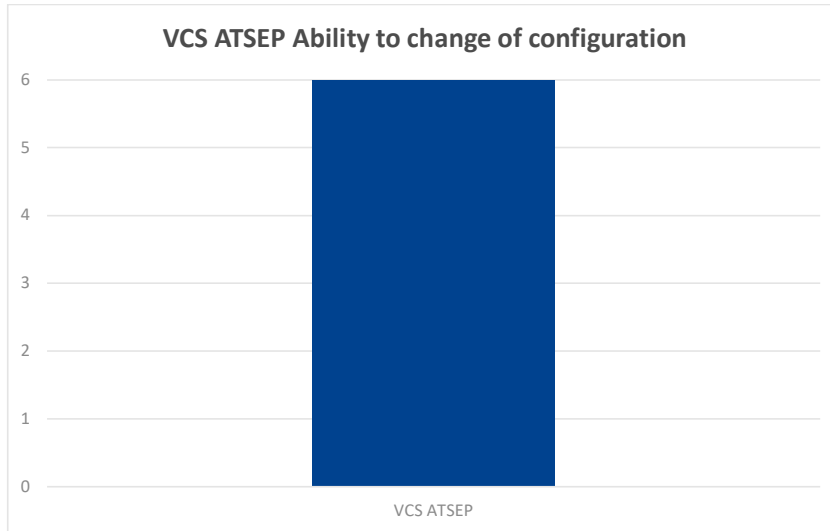


Figure 828282828282. VCS ATSEP Ability to change of configuration

Regarding ATSEP workload, it was always maintained within acceptable levels and no aspects were highlighted to be cause of additional stress and leading to fatigue and affecting job performance. Some aspects have been underlined such as that the chronological information of the services that might be aligned according to the target of the architecture. However, more complex environment might be also considered for the different ADSP.

## 11. EX4-PJ.10-W2-93-V3-VALP-015 Results

### Findings on Operational feasibility – Contingency – clearly Defined and documented

To complement the analysis already performed in EX4-OBJ-PJ.10-W2-93-V3-VALP-001, controllers during the debriefing highlighted that delegation procedure in case of contingency was feasible for the validation run, but contingency has a lot of variables that might impact the handover. Controllers highlighted that checklist, so mandatory steps to be followed shall be determined and they strongly requested to be trained on the procedures. In this case the checklist shall be reviewed, maybe there are some items which can be missed out depending on the case in which they are used. Of course, in contrast to the delegation, the contingency cannot be planned and might occur in situations with for example high traffic, which is not ideal for delegation.

### Findings on Roles and Responsibilities – Civil Military Delegation

As highlighted in the figure below, controllers were asked in a scale ranging from Strongly Disagree (1) to Strongly Agree (5) whether their roles and responsibilities were clearly defined when delegation procedures occurs in case of contingency. The results show that their roles were clear and quite exhaustive; operating methods were exhaustive and support human performance, and human actors were able to achieve their tasks in a timely and accurate way. These positive feedback from controllers were complemented with proofs of feasibility based on acceptable level of workload and situational awareness assessments.

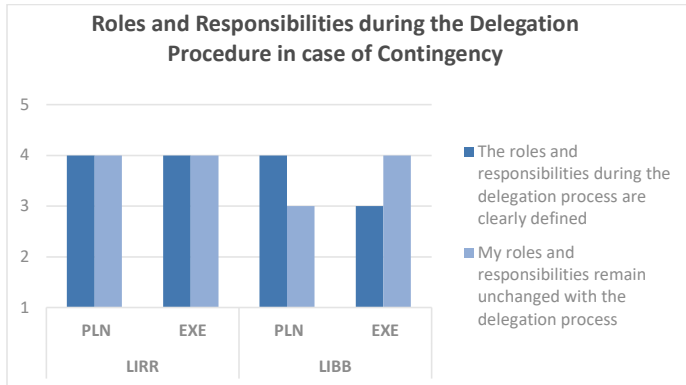


Figure 83838383838383. Roles and Responsibilities – Contingency Scenario

*Findings on Quality of Service – Delegation of ATM services in case of Contingency*

The Quality of Service was measured by means of post simulation questionnaire filled in just once by controllers at very end of the simulation week. According to ATCOs feedback, the quality of service and the sector coordination were acceptable.

## 12. EX4-OBJ-PJ.10-W2-93-V3-VALP-016 Results

*Findings on Operational Acceptability, Workload and Situational Awareness – Contingency Delegation*

As for the previous validation objectives, levels of workload and situational awareness were assessed in case of contingency. To complement the analysis on the operational feasibility of delegation procedure performed in EX4-OBJ-PJ.10-W2-93-V3-VALP-015, controllers were asked to rate their acceptability of the delegation procedure indicating how willingly they would operate with the concept and procedures under testing. Operational Acceptability was assessed in terms of workload and situational awareness experienced, also considering the impact of system support and level of trust in the system reported by controllers.

As reported in the figure below, considering an agreement scale ranging from Strongly Disagree (1) to Strongly Agree (5), both LIRR and LIBB controllers deemed the delegation process in case of contingency itself acceptable and workable.

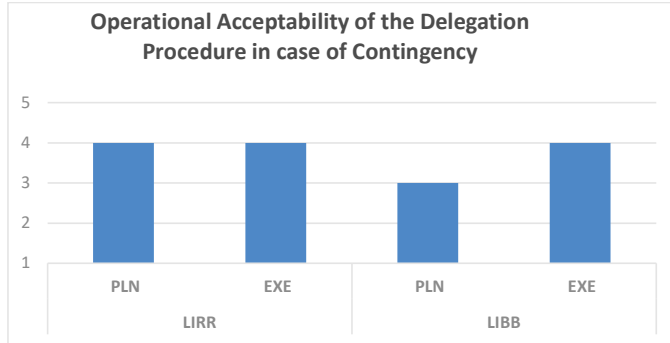


Figure 84848484848484. Operational Acceptability – Contingency Scenario

To complement the analysis already presented in the previous sections on Workload and Situational Awareness done using Bedford Scale and SASHA questionnaire, although the presence of some technical issues related to the system and the need for an improved preview mode, considering a comparison with the Reference Scenario (i.e. no delegation) the delegation process in case of contingency did not bring to a significative increase of workload or decrease of SA levels, as reported in the figures below.

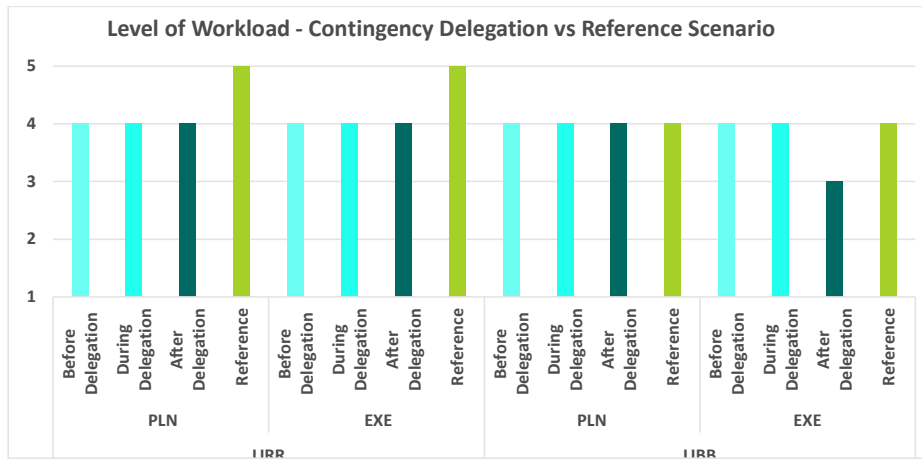


Figure 85858585858585. Level of Workload - Contingency Scenario

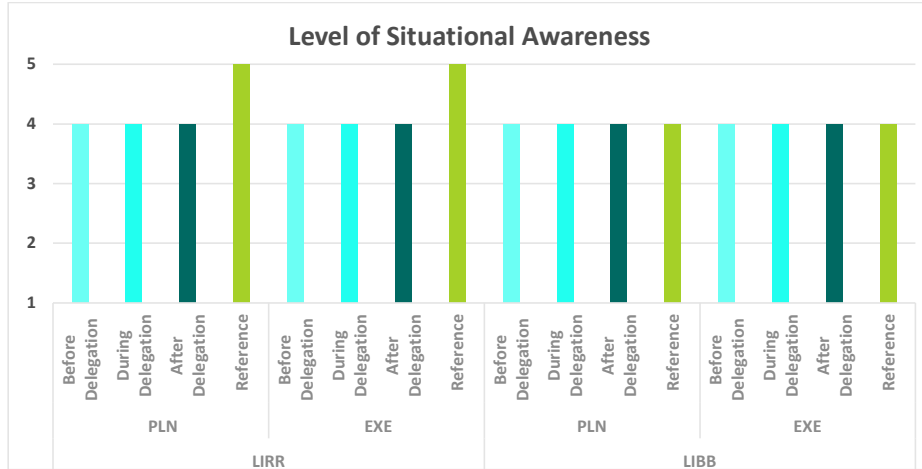


Figure 86868686868686. Level of Situational Awareness - Contingency Scenario

The same questions were posed to the role of the SUP; the results obtained reinforced the idea that no deterioration in performance was recorded with the occurrence of contingency.

Also, Situational Awareness of Supervisors was assessed during the contingency. Since Supervisors coordination was very important especially during the occurrence of a contingency, a focus has been posed on the assessment of SUP perceived level of situational awareness, considering the China Lakes Scale questionnaires. The scale encompasses a hierarchical decision tree that guides the Supervisor through a ten-point rating scale, where each point is accompanied by a descriptor of the associated level of SA.

The following questionnaire was used:

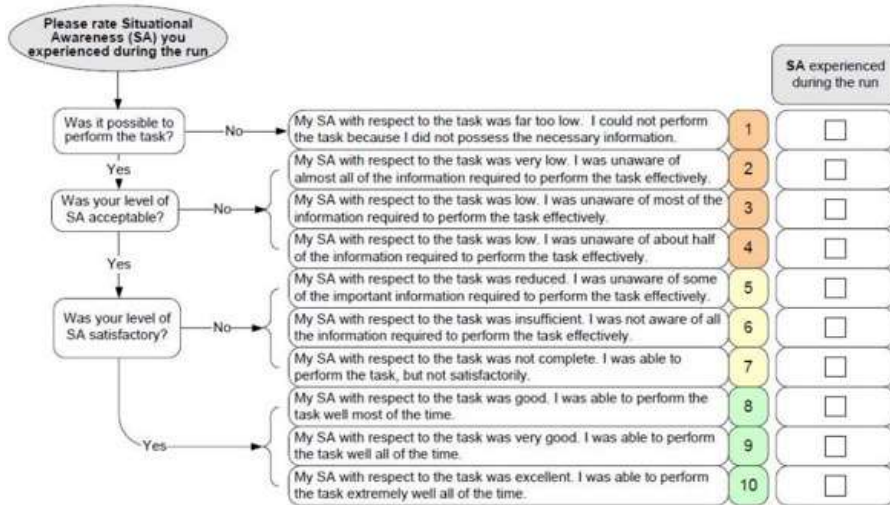


Figure 87878787878787. China Lakes Questionnaire

Figure below shows that results are comparable for both LIRR and LIBB SUP highlighting the fact that LIBB supervisor never loss his/her awareness when the contingency occurred being able to coordinate the delegation with LIRR in a smooth and safe way.

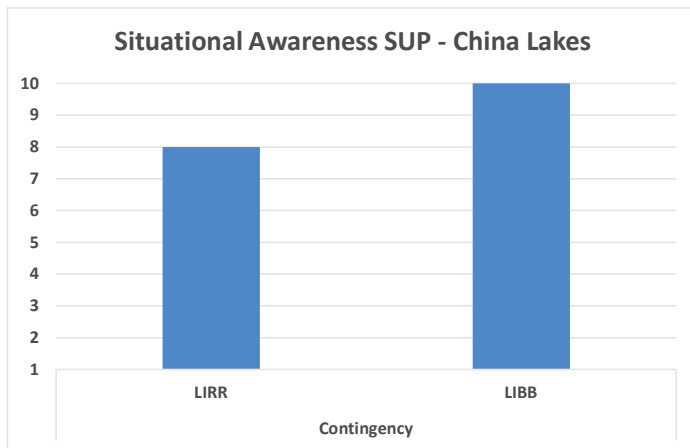


Figure 88888888888888. Supervisors China Lakes Ratings - Contingency Scenario

These results are confirmed by the workload levels, remained in an acceptable level.

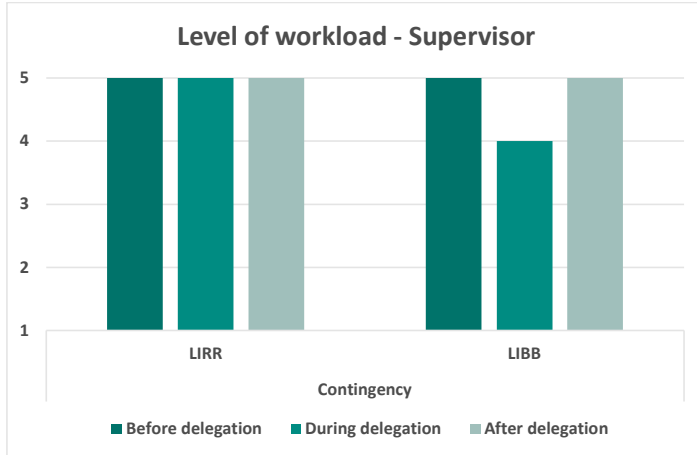


Figure 89898989898989. Supervisors Level of Workload - Contingency Scenario

*Findings on the system – Contingency Delegation*

Some feedback was also obtained on the system supporting the delegation process in case of Contingency Scenario. An ad hoc question was asked to understand the degree of trust of the ATCO in the system (from 1 to 5). Figure below reports the comparison between the ratings obtained during the Reference Scenario and the ones obtained in case of Contingency Delegation. Results are totally comparable. Of course, controllers might feel more confident in case of total availability of supporting tools.

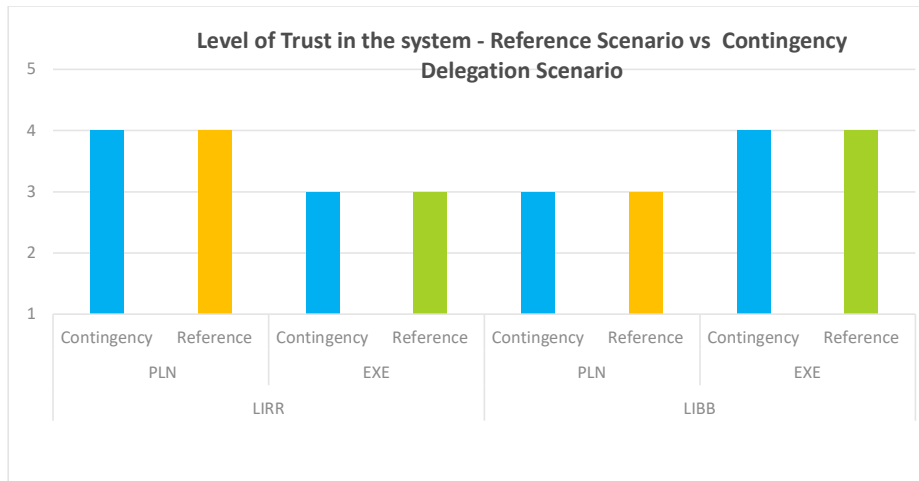


Figure 90909090909090. Level of Trust in the system - Contingency Scenario

From Supervisors point of view, the trust in the system was always maintained at high level, all the coordination actions to safely perform the delegation in case of failure were timely performed as they felt supported by the system.

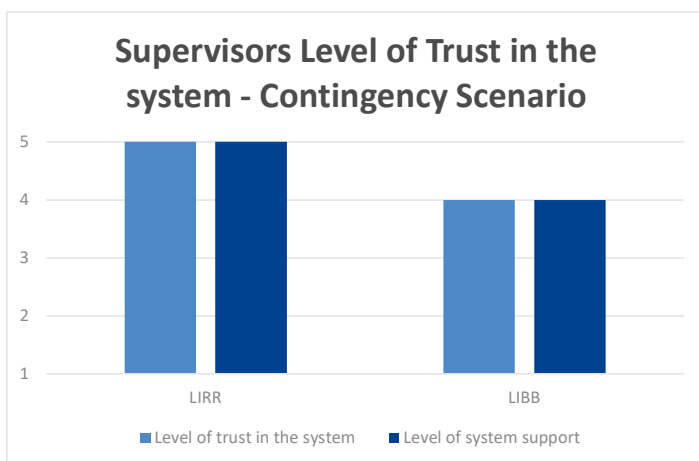


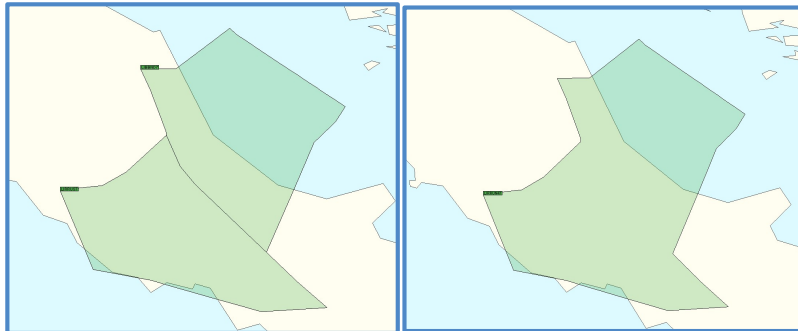
Figure 91919191919194. Supervisors Level of Trust in the system - Contingency Scenario

### 13. EX4-OBJ-PJ.10-W2-93-V3-VALP-017 Results

Before of the RTS execution a proper study have been considered with the scope to quantify through qualitative evaluation and downstream of previous studies performed and validated with Model Based Simulation (MBS), the Maximum Theoretical Hourly Capacity of the new ATC Sector (hereinafter capacity of the LIRRUD47 Sector) defined downstream of the optimization of the En-Route ATC Sectorisation, pending and within the scope of the design of the operational scenarios for the design purposes of PJ10-W2.SOL 93.

The assessment of the Maximum Theoretical Capacity of the new ATC Sector was determined by analysing:

- Maximum Theoretical Hourly Capacity already established for the two pre-existing ATC Sector identified in the Reference Scenario (LIRRUS47 & LIBBND47), defined both on the basis of MBS studies and considering both the structural and technical characteristics (vertical limit FL 335 and prevailing type of traffic in transit at cruising level with homogeneous characteristics for all 24 hours of the day), as well as confirmed by the values found during Live Operations;
- The number of the traffic sample used for the Validation EXE in the RTS, both BASELINE and INCREMENTED;
- The complexity of the two traffic samples, identified for the purposes of the RTS but with characteristics likely to the real traffic insistent in the same ATC Sectors, i.e. overflight traffic, stabilized at cruising level and speed and/or close to the leveling before cruise phase;
- The operational characteristics that the new ATC Sector will have to maintain, i.e. the same structural peculiarities of the two original ATC sectors, while enjoying a reduction in complexity due to the elimination of the boundary constraints.



The qualitative considerations detailed for the study lead to the conclusion that, pending the design specifications of Solution 93 (Delegation of Airspace amongst ATSUs) and valid only for the objectives and needs of the estimate itself, the Maximum Capacity Theoretical hourly capacity of the LIRRSD47 ATC sector will not be less than the maximum capacity of the LIBBND47 sector, i.e. 59 aircraft per hour.

Below is reported a table based on CAP2:

CAP2 - SOL 93		
REfERENCE	SOLution	CAP_2
57	59	3.51%

#### 14. EX4-OBJ-PJ.10-W2-93-V3-VALP-018 Results

The following table presents the FEFF1 results for the relevant use cases considered taking into account the solution Benefit Impact Mechanisms, i.e., the on-demand use case (ATFM), where a fuel efficiency positive impact is expected due to the avoidance of ATFM measures and the optimisation of flight profiles in cross-border delegations (skip of inter-sector coordination). This analysis was compared with reference and solution scenario.

Fuel Efficiency	AVG x flight
FEFF1	-19.79



### 15. EX4-OBJ-PJ.10-W2-93-V3-VALP-019 Results

The benefit in the Predictability KPA is only considered for the on the AFTCM uses cases , where the avoidance of ATFM measures and inter-sector coordination could lead to better levels of predictability.

The following table summarizes the results obtained for the predictability KPI.

As it can be observed, on average, **the Predictability KPI (PRD2) improves a 0.5%**, being the specification of this two ATSUs Border use case the one contributing the most to this improvement.

Predictability	AVG x flight
PRD1 (mins x flight)	-0.57

### 16. EX4-OBJ-PJ.10-W2-93-V3-VALP-020 Results

Based on the same approach used to determine the change in airspace capacity on Model Based simulation, potential savings in the cost and time efficiency of ANSP operations can be identified by first calculating the change in mean controller workload. This short benefits have been identified with a medium and High traffic sample depending on the Trajectory during the delegation process.

The following table summarizes the results obtained for the Time efficiency KPI

Time Efficiency	AVG x flight
TEFF1 (mm:ss)	00:34

**Assessment of the Technology Costs (CEF3):**

According to CEF 3 KPA output, It was performed and associated to EXE 4. Moreover, the CEF3 has been considered for the scope of the VALR and the PAR to be compliant with the expected VTs addressed to SOL 93 by PJ19.4.

In additional, it has been provided with the aim to quantify the technology-related ANS Cost efficiency improvements that are usually expected from a reduction, in operating costs, resulting from SESAR-related changes to technology and systems required to deliver ANS.

This type of analysis was considered to compare the current infrastructures, with no Delegation of the ATS (Do Nothing Scenario), compared with a VC infrastructure.

The approach was based on the cost invested from a different basis. It started for the investments required for the development of ATM system and associated maintenance, communication, navigation, and surveillance infrastructure.

The assessment is based on following Cost Types:

	Description	Cost Type
<p>SESAR vision aims at exploiting the available technological innovations, as enabling factors for the implementation of advanced operational concepts, improving the efficiency, and reduce emissions of the European Air Traffic Navigation System. These technologies make it possible to simplify and rationalize the deployment of technological systems, optimize and reduce maintenance costs including the management of the spare parts warehouse.</p>	Costs related to the investments required for the development of ATM system, communication, navigation and surveillance infrastructure supporting the provision of the navigation services (ACC, APP, Tower)	Development
	Costs related to the management of the ATM system and communication, navigation and surveillance infrastructure to support the operations for the provision of the Air navigation Services.	Operations
	Costs related to corrective and evolutionary maintenance of ATM systems and communication, navigation and surveillance infrastructure supporting the provision of air navigation services	Maintenance
	Depreciation costs of assets acquired by the company related to ATM System and communications, navigation and surveillance infrastructure necessary for the provision of air navigation services	Asset Depreciation
	Costs for the training of operational staff required for the continued validity of the certification, and the implementation of new operating concepts and related system capabilities	Operational staff Training
	Costs for the continuous training of the technical staff required to oversee the innovations relating to the technological domains involving the ATM systems, and communication, navigation, and surveillance infrastructures for the provision of air navigation services.	Technical staff training

The Technology Costs have been assessed within a range [MIN..MAX] values by the Experts from ENAV and LEONARDO, as follows:

Deployment Effectiveness		Interoperability and Standardization		Capabilities Deployment		Efficiency	
MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
5.587 M€	12.300 M€	0.630 M€	1.260 M€	0.297 M€	0.632 M€	0.397 M€	0.795 M€
12.63%	27.80%	7.12%	14.24%	10.08%	21.44%	13.47%	26.95%

The extrapolated technology Costs until 2043, show the following values for the Legacy "Do Nothing" Scenario vs the VC infrastructure at ENAV. We observe a diminution of the Technology Costs (CEF3) of about CEF3 = -5%

<b>LEGACY COSTS</b> (Estimated by Expert Judgement)	<b>SOL #93 COSTS REDUCTION</b>	
59 000 000.00 €	6 912 500.00 €	
	11.72%	Local Output
	5.14%	Corect Extrapolation

### C.3.3 Summary of Validation Exercise #04 Results for the PJ.10-W2-93a Technological Solution

Following are the results from EXE-PJ.10-W2-93-V3-VALP-004 exercise for the PJ.10-W2-93a Technological Solution.

Validation Exercise #04 Objective ID	Validation Exercise #04 Objective Title	Validation Exercise #04 Success Criterion ID	Validation Exercise #04 Success Criterion	Sub-operating environment	Exercise Validation Results	#04 Validation Exercise #04 Validation Objective Status
EX4-OBJ-PJ.10-W2-93a-V3-VALP-001	To assess the maturity of the Virtual Centre architecture and services environment conditions	EX4-CRT-PJ.10-W2-93a-V3-VALP-01-001	A "VC maturity assessment report" is provided	ER Medium to High Complexity	Updated the VC Services in the Maturity Report PJ32 WP3	OK
EX4-OBJ-PJ.10-W2-93a-V3-VALP-002	To produce and complement/provide the technical validation platform	EX4-CRT-PJ.10-W2-93a-V3-VALP-02-001	A Virtual Centre (VC) validation platform based on the Y architecture is put in place and supports the validation of the delegation scenarios dedicated to the Y architecture	ER Medium to High Complexity	Reported in the EXE 4 Availability Note based on a VC Architectures	OK
		EX4-CRT-PJ.10-W2-93a-V3-VALP-02-002	A Technical Supervision service is put in place to monitor the status of the ATC ADSP and its services			
	To increase the number of defined as	EX4-CRT-PJ.10-W2-	A Technical Supervision service is			

	well as implemented Virtual Centre services	93a-V3-VALP-02-003	put in place to monitor the status of the Voice ADSP			
EX4-OBJ-PJ.10-W2-93a-V3-VALP-003		EX4-CRT-PJ.10-W2-93a-V3-VALP-03-001	Operational Supervision Management & Distribution (OPSUPM/D) services can support delegation scenarios in all their phases (Initial, Preview and final operational modes)	ER Medium to High Complexity	One ADSP with 2 different ATSUs were considered in the Validation.  Several List of the operation in the appropriate services Have been validated (OSUP and Technical Supervision)	OK
		EX4-CRT-PJ.10-W2-93a-V3-VALP-03-002	Additional services OR already defined services under PJ16.03 but not yet validated, have been validated			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-03-003	Additional - or updated operations within existing services- have been implemented and validated			
EX4-OBJ-PJ.10-W2-93a-V3-VALP-004	To increase the number of defined as well as implemented Virtual Centre services	EX4-CRT-PJ.10-W2-93a-V3-VALP-04-001	Services from one ADSP have been provided to CWPs from different vendors/ANSPs	ER Medium to High Complexity	Standard services are used between CCS ADSP and the various CWPs of LIBB and LIRR ATSUs provided by LEONARDO with a "Y" Architecture	OK
		EX4-CRT-PJ.10-W2-93a-V3-VALP-04-002	CWPs of a vendor/ATSU have consumed the same services from ADSPs of different vendors			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-04-003	Performance of the A/G and G/G communications between CWPs of a same or of different voice ADSP(s) are judged acceptable by End users (ATCOs, SPVRs, ATSEPs)			

EX4-OBJ-PJ.10-W2-93a-V3-VALP-005	Virtual Centre services performance  To complement the performance assessment of the Virtual Centre architecture and services	EX4-CRT-PJ.10-W2-93a-V3-VALP-05-001	Response time from the ADSP(s) to CWP's requests remains within a defined threshold	ER Medium to High Complexity	Starting from the Verification, integration and Validation the overall performances of the system were measured with an appropriate analysis resulted acceptable range of QoS.	OK
		EX4-CRT-PJ.10-W2-93a-V3-VALP-05-002	Network capacity has been evaluated as being sufficient to support data flows within the Validation Platform			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-05-003	Quality of Service (QoS) during the EXE runs has been evaluated			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-05-004	Average time for a CWP switch to a Preview Mode is acceptable and Safe for the operations			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-05-005	Average time for a CWP switch from a Preview to Operational Mode is acceptable and Safe for the operations			
		EX4-CRT-PJ.10-W2-93a-V3-VALP-05-006	The Global time to perform the overall delegation process is acceptable for the operations			

Table ~~33333333333333~~. Validation Results for EXE-PJ.10-W2-93a-V3-VALP-004

### C.3.4 Analysis of Exercise 4 Results per Validation objective for the PJ.10-W2-93a Technological Solution

#### 1. EX4-OBJ-PJ.10-W2-93a-V3-VALP-001 Results

##### EX4-OBJ-PJ.10-W2-93a-V3-VALP-001 Maturity Assessment Report

Success criteria	Summary of the Results	Success criteria
EX4-OBJ-PJ.10-W2-93a-V3-VALP-001	Reported the outcomes and the QoS in the Maturity Report	OK

## 2. EX4-OBJ-PJ.10-W2-93a-V3-VALP-002 Results

### EX4-OBJ-PJ.10-W2-93a-V3-VALP-002 Validation Platform

Success criteria	Summary of Results	Suc. Status	Crit.
EX4-CRT-PJ.10-W2-93a-V3-VALP-02-002	<ul style="list-style-type: none"> <li>- ENAV IBP Validation Platform included the ATM system components and the infrastructure supporting the operational concepts validation of the target solutions in ENAV Ciampino NTF Status of CCS ADSP is monitored through 3 different supervision tools               <ul style="list-style-type: none"> <li>o CCS</li> <li>o AFTCM via local implementation in a Virtual Centre from CCS IBP</li> <li>o Web application with IDSAirNav</li> <li>o Tech SUP for the monitoring of the services</li> <li>o Civil Military module integrated in FDP Dataset</li> <li>o Integrated with EATG</li> </ul> </li> </ul>	OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-02-003	Status of SITTI voice ATSUs are monitored via local supervision tools. They were interfaced both radio and telephone (intercom) communication links, for allowing connection to pilots and other controllers, respectively. Radio links between controllers and pilots were also simulated through native embedded features of the MULTIFONO® system	OK	

## 3. EX4-OBJ-PJ.10-W2-93a-V3-VALP-003 Results

### EX4-OBJ-PJ.10-W2-93a-V3-VALP-003 Virtual Centre Services

Success criteria	Summary of Results	Suc. Status	Crit.
------------------	--------------------	-------------	-------

EX4-CRT-PJ.10-W2-93a-V3-VALP-03-001	<p>From the various CWP's (SG, DFS and NATS), and thanks to the data sent by the CCS/iTEC ADSPs regarding the current configuration of the CWP's at different ATSUs, it was possible to follow all the phases of delegation:</p> <ul style="list-style-type: none"> <li>- The Switch from Operation to Preview modes is clearly indicated as well as the switch from Preview to Operational modes at the receiving ATSU</li> <li>- The ATSEPs at both the delegating and receiving ATSUs, have a full control on the remote ADSPs and can continue or interrupt the delegation procedure at any time.</li> </ul>	OK
EX4-CRT-PJ.10-W2-93a-V3-VALP-03-002	<p>New developed and validated services at TRL6:</p> <ul style="list-style-type: none"> <li>- <b>ER APP ATC 193 - 194:</b> Management in the VC ATSU of a CWP preview mode during delegation of ATS Provision between ATUs n a TWO Different ATSUs for Static and Dynamic Delegation.</li> </ul>	OK
EX4-CRT-PJ.10-W2-93a-V3-VALP-03-003	<p>The following existing services were further developed to reach a TRL6 maturity:</p> <ul style="list-style-type: none"> <li>- OPSUP: Operational Configuration Management &amp; Distribution</li> <li>- TECHSUP: Technical Supervision Management &amp; Distribution</li> </ul>	OK

#### 4. EX4-OBJ-PJ.10-W2-93a-V3-VALP-004 Results

##### EX4-OBJ-PJ.10-W2-93a-V3-VALP-004 Virtual Centre Services

Success criteria	Summary of Results	Suc. Status	Crit.
EX4-CRT-PJ.10-W2-93a-V3-VALP-04-001	The CCS ADSP provided its services to both CWP's at ATSUs LIBB and LIRR	OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-04-002	N/A in Y	N/A	
EX4-CRT-PJ.10-W2-93a-V3-VALP-04-003	A positive feedback is received from all involved actors (Pseudo-pilots, ATCOs and SVPRs) about the performance of the G/G and A/G communications.	OK	

## 5. EX4-OBJ-PJ.10-W2-93a-V3-VALP-005 Results

### EX4-OBJ-PJ.10-W2-93a-V3-VALP-005 Virtual Centre services performance

Success criteria	Summary of Results	Suc. Status	Crit.
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-001		OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-002		OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-003	Removed as it is the same as EX3-CRT-PJ.10-W2-93a-V3-VALP-05-001	N/A	
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-004		OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-005		OK	
EX4-CRT-PJ.10-W2-93a-V3-VALP-05-006	The Global time to perform the overall delegation process was judged acceptable by the involved ATCOs and SPVRs, although different for various UC#, see Table below.	OK	

### C.3.5 Unexpected Behaviours/Results

No unexpected behaviours/results have been identified, analysed or evaluated during the validation exercise execution.

### C.3.6 Confidence in Results of Validation Exercise 4

#### 1. Level of significance/limitations of Validation Exercise Results

Five different scenarios (i.e. Night, Fixed Time, On Demand, Civil Military Delegation and Contingency Delegation) have been simulated during the validation exercise. The simulation environment was not completely representative for the controllers as there were some tool lacking.

The results have been derived from data obtained through questionnaires and integrated with comments provided by all the actors involved (operative experts and exercise experts) through debriefing sessions.



The validation platform is based on a single shared ADSP that is used by different ATSUs. The results are then valid only on this specific “Y” architecture. The exercise provides qualitative results to show a trend, order of magnitude, to complement additional conclusions obtained by the other V3 exercise, providing results on the other architectures.

## 2. Quality of Validation Exercises Results

This kind of analysis allowed verifying the consistency and confidence of data collected and provided a good quality of exercise results. The highly experienced ATCOs involved in the Real Time Simulation were familiar with the operating environment under testing and contributed in a decisive manner to debriefing sessions and discussions, by offering interesting insights and consistent advice. Also, during the exercise, controllers rotated over the measured positions so as to allow them to familiarise themselves with each controller working position and obtain data from different controllers per position in each condition, representing more comprehensive measures and more balanced and informed feed-back. Their subjective feedback provided deep reflection on the concept.

## 3. Significance of Validation Exercises Results

The level of confidence in the results is satisfactory.

Results regarding the Human Performance and Safety can be considered as representative of the overall operational concepts thanks to the evidence given also from observation conducted during the exercise execution.

Due to the limited number of exercise runs, the findings are based on the comparison of a small number of exercises. Thus no meaningful statistical analysis could be performed. The findings provided in this report should be considered with caution due to limited data sample.

### C.3.7 Conclusions

Overall, the validation exercise was very successful. The overall feedback coming from the Post simulation questionnaire are presented considering the controllers overall thoughts regarding the investigated KPIs, not taking into account their position since they have experienced all the positions during the exercise; in fact, during the exercise, controllers rotated over the measured positions so as to allow them to familiarise themselves with each controller working position.

#### 1. Conclusions on concept clarification

The validation exercise successfully validated the delegation procedure. Nevertheless, there are still open points to be clarified on the conceptual level. For ATCOs the concept of delegation is useful at an operational level but needs some refinement and clarification especially in the usage of system supporting the execution of tasks to try to minimize the possibility of misunderstandings or overlapping. Suggestions and improvements will be proposed in the next sections.

#### 2. Conclusions on technical feasibility

*This section shall capture all conclusions related to technical feasibility of the SESAR Solution that can be extracted from this validation exercise.*

*These conclusions need to be consolidated at SESAR Solution level in section 5 together with those extracted from other activities on the same SESAR Solution.*

Exercise 4 relied on CCS Virtual Centre, that was used to emulate the virtual centre concept (“Y” architecture). The necessary service interface for supporting the delegation procedure (management of preview mode and operational mode) were implemented and successfully validated. During the exercise the QoS was acceptable, because of the service vulnerability and interoperability when delegation is in place. Thus, the platform demonstrated its feasibility and will provide a sound basis for the future validation exercise, where there will be the need to validate the final architecture with a more realistic scenario also considering the legal aspect of delegation, especially when an aeronautical accident occurs during the delegation process.

### 3. Conclusions on performance assessments

These conclusions provide a summary of the HP and SAF analysis. The conclusions are supported by charts elaborated from data gathered through Post Simulation Questionnaires the controllers had to fill in just once at the very end of simulation week. In this section, the overall feedback coming from the Post simulation questionnaire are presented considering the controllers overall thoughts regarding the investigated KPIs, not taking into account their position since they have experienced all the positions during the exercise. As a consequence, the following graphs will present on the horizontal axis each controllers chosen ID, while on the vertical axis the different used Likert scales.

#### Conclusion on Workload

The results show that, the **overall workload** in terms of attention, skill or effort experienced during the simulation on a scale from 1 “completely undemanding” to 6 “very demanding” was *moderately demanding* as confirmed by the figure below.

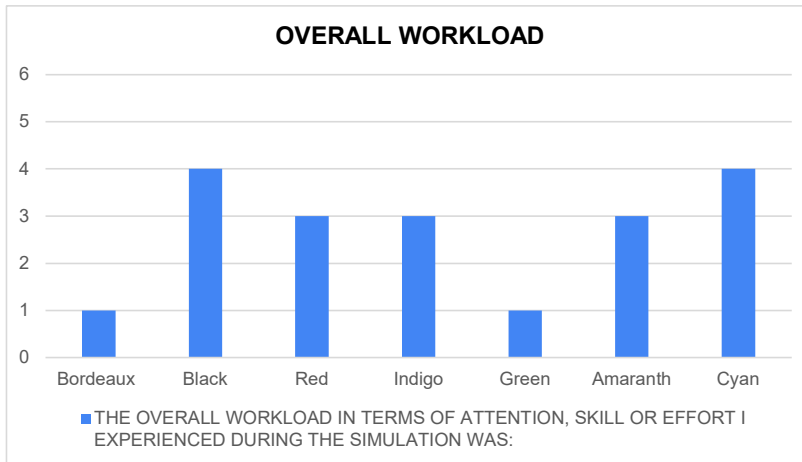


Figure 929292929292. Overall Workload

ATCOs were able to accomplish their tasks within average tolerable levels of attention and effort. Otherwise, some situations have been highlighted to be cause of higher workload (e.g. no clear automatic indication of the traffic that was “going to be gained” and the one that was “going to be lost” during the preview phase -> hard/frustrating situation -> higher workload). Of course, the results

obtained through the data gathered have shown that the delegation process itself was considered acceptable and viable from ATCOs, despite some events caused a stressful situation. As already detailed in a specific objective, all actors highlighted that there were some issues with the technical aspect of the validation (e.g. basic implementation of preview mode and lack of some controllers support tools) that sometimes led to more demanding situations.

**Conclusion on Situational Awareness**

As shown in the figure below, the controllers were asked to rate their overall situational awareness from 1 for very bad situational awareness to 5 for excellent situational awareness. On average, all the involved actors experienced good level of individual situational awareness. Generally, ATCOs were able to plan and organise their work as they wanted. An improved preview mode could support ATCOs to have a clearer traffic picture after the delegation and planning, organising their work as they wanted. This aspect is reflected also in the workload results were considering Mental, Physical, Temporal Demands but also Effort, Performance and Frustration.

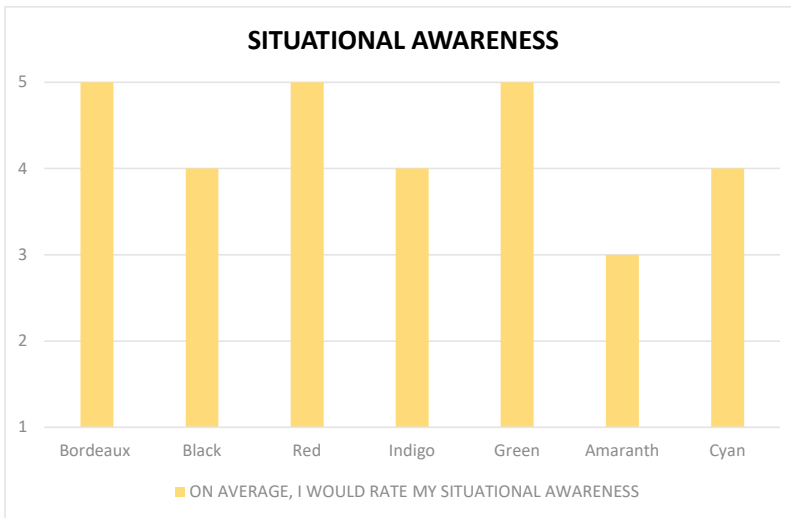


Figure 93939393939393. Average Situational Awareness

Some issues were related to the fact the simulation system was not the one the controllers are used to but we can consider the further improvements that controllers proposed for the next validation, especially for the preview phase. So the HMI had some differences and sometimes controllers had to search for an information. There was no colour coding of the aircraft indicating the status (concerned, assumed, etc.) during the delegation phase. However, training and the execution of different runs throughout the simulation week allowed to familiarise, having a sort of learning effect during the week, with clear improvements run by run. In fact, since the controllers were trained on the procedures during the last days at least the main points of the procedure were memorized and helped the controllers to handover the aircraft in a structured way.

**Conclusion on Safety**

The real-time simulation allowed to positively assess the Safety validation objectives and related success criteria defined in the Validation Plan. Identified Validation Objectives have been met. Qualitative and subjective quantitative data allowed to assess very important results. In this case the controllers were asked to answer about their ability to safely manage critical situations and solve conflicts, their ability to prevent critical situations and timely detect conflicts and to rate if the Introduced Concept is acceptable and safe. In fact, ATCOs were asked to rate, on a scale from 0 “Never” to 6 “Always”, their overall ability to manage or prevent control of traffic situation and eventual critical situation. Taking into account the traffic samples, ATCOs considered the concept quite safe and they were quite able to safely manage situations. Otherwise some events made sometimes difficult to maintain full control of the traffic situation and this was strictly related to the preview phase issues. It was highlighted that controllers were not familiar with the system used. Hence the system issues during the delegation process and also the fact that in the first days the delegation process didn’t have a short duration contributed sometimes to not maintain a full mental picture of the traffic situation. Also during contingency runs although the occurrence of VCS failure prevented the controller to have access to all functionalities required to safely manage traffic, the possibility to delegate ATC to another fully operating unit can be considered as a mitigation to improve the situation. Nevertheless, also during contingency run, most of the controllers’ concerns were not related to the procedure itself but to simulation setup issues. Controllers also highlighted the importance of the checklist and training.

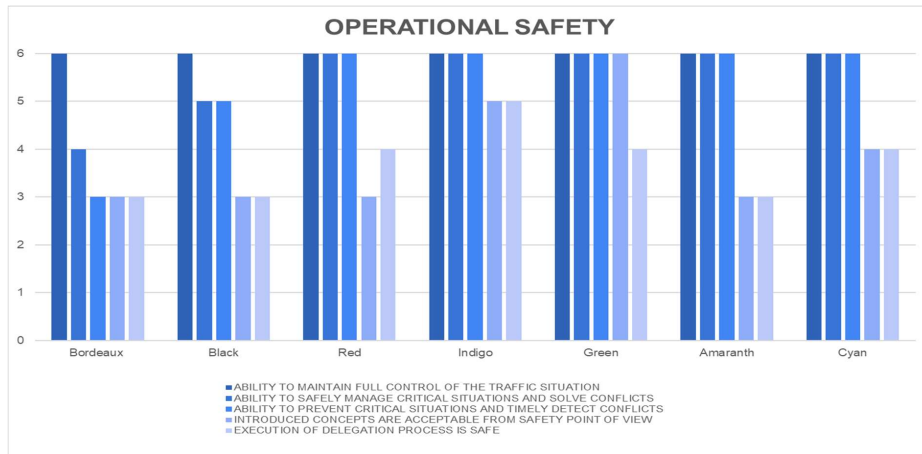


Figure 94949494949494. Operational Safety

### Conclusion on Roles and Responsibilities

It was observed and confirmed by the controllers in post-simulation questionnaire that it was clear for each ATCO which tasks were their responsibility and which ones were carried out by the other team members. A set of relevant questions from the STQ (SHAPE Teamwork Questionnaire) questionnaire were used to assess various aspects of teamwork. STQ responses are given on a seven-point Likert scale ranging from 0 to 6, corresponding to answers from “Never” to “Always”. The several aspects evaluated using the STQ were team prioritization of tasks, understand their responsibility,

synchronicity, sharing of information between human actors involved, in particular there were two positions, respectively executive and planner for each situ in the simulation. Overall, about team working and communication most of involved controllers considered the procedures useful to prioritize tasks efficiently and to synchronize their actions most of the time.

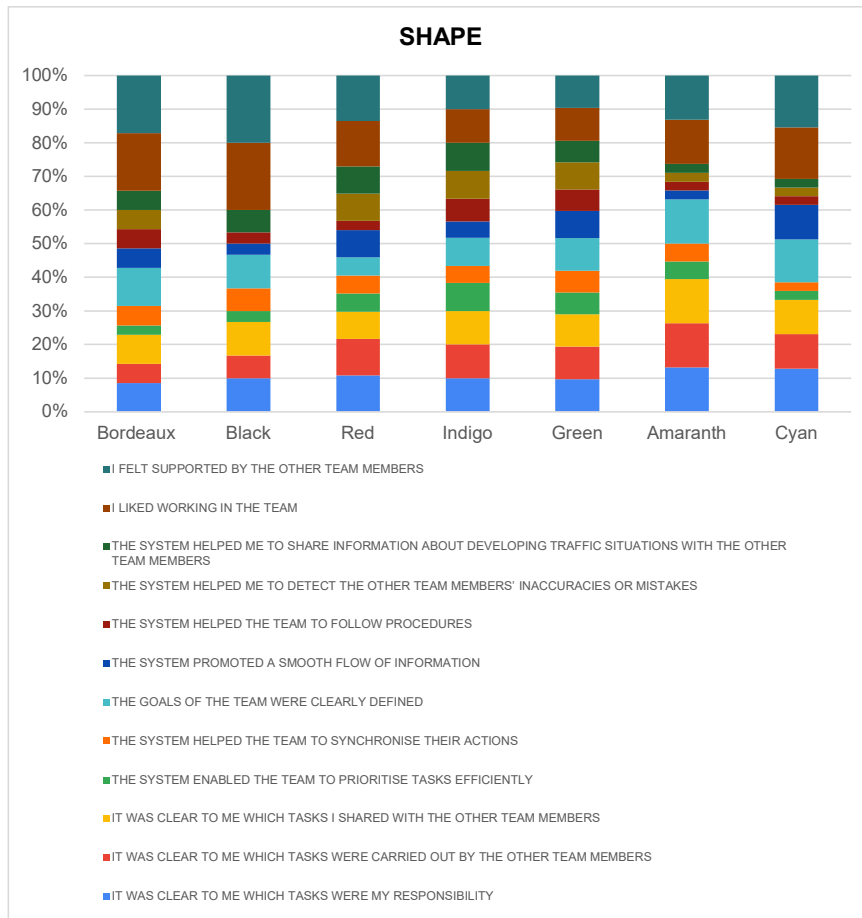


Figure 95959595959595. SHAPE Teamwork ratings

### Conclusion on Phraseology

During the real-time simulation the controllers used the standard phraseology that did not lead to errors. In fact the controllers highlighted they do not perceive as a need to introduce a new phraseology for delegation procedures and contingency procedures and they showed how the used

phraseology support in an efficient way the delegation procedures, also in contingency conditions. Furthermore, according to the ATCOs feedback, a checklist that unequivocally clarifies where one person's duties end and the other's tasks begin is very useful to avoid any kind of mistake or misunderstanding and at the same time speed up the process.

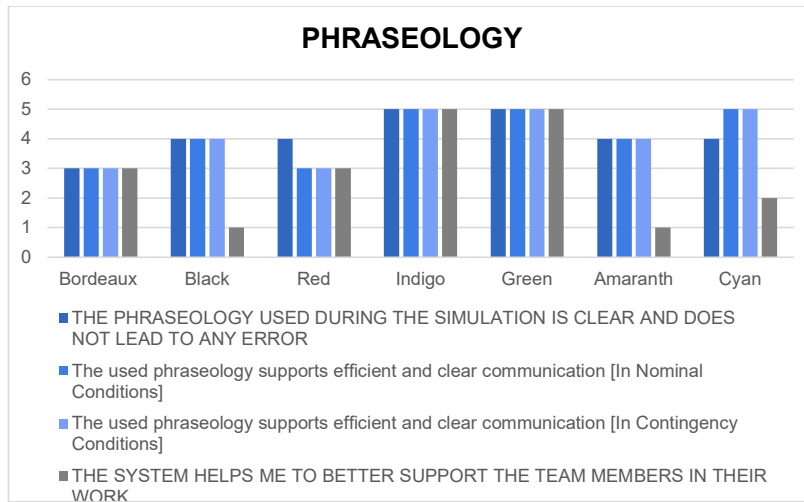


Figure 96969696969696. Phraseology results

### Conclusion on Procedures acceptability

Based on the gathered data, the delegation procedures can be considered fine, acceptable and feasible by all involved actors.. In order to avoid some critical events, controllers proposed further refinements on the procedure. According to the ATCOs feedback, a checklist that unequivocally clarifies where one person's duties end and the other's tasks begin would be very useful to avoid any kind of mistake or misunderstanding and at the same time speed up the process. Furthermore, they have suggested a real pre-delegation phase (enhanced preview mode) with well-defined colour codes and well-defined responsibilities in handover phase in order to provide to "receiving ATCOs" an overall picture of the traffic situation. The ATCOs have also evaluated this procedure as very useful because it allowed to work with a "flexible" airspace and this allowed them to mediate workloads especially in contingency phases. Regarding controller training and licensing on delegated sectors, it is a prerequisite for operating. Also the importance of controllers recurrent training has been highlighted to guarantee an optimal maintenance of competence by reinforcing and broadening the knowledge necessary to perform effectively in their role. Some lower scores are justified by the fact that the platform used for the simulation was still in the prototype stage and it did not allow the full operation they are used to on a daily basis.

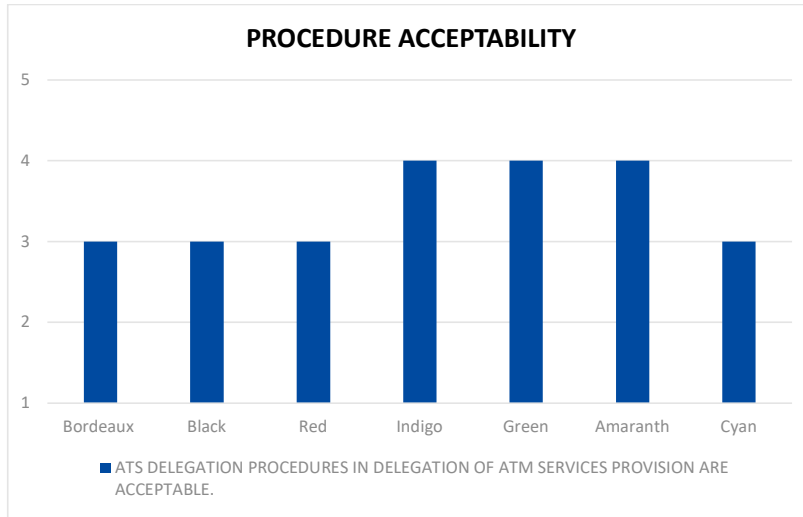


Figure 97979797979797. Overall Procedure Acceptability

**Conclusion on Performance**

In addition to Safety and Human Performance, a performance assessment was performed in terms of Capacity, Flight Efficiency, Predictability and Cost Efficiency.

Performance results have been positive, and the following table summarises the results obtained for each analysed KPIs.

	CAP2 - En-Route Capacity	TEFF1 - Time Efficiency	CEF3 - Technology Costs	FEEF1 - Fuel Efficiency	PRD1 - Predictability
EXE4	-0,04	00:34	-5%	-20%	+0.5%

**C.3.8 Recommendations**

All recommendations were obtained by data gathering through questionnaires and debriefing sessions after each validation run. Finally, a focus group involving all experts identified refinements and improvements of the delegation procedure. Despite the positive feedback and overall operational acceptability of the proposed procedures with no major concerns related to safety and Human Performance, some minor and general refinements or consideration have to be taken into account.

From the focus groups, observations and questionnaires held during the exercise, the following recommendations resulted:

- in order to improve the coordination between the ATSUs, the ATCOs suggested to draw up a clear delegation procedure in which tasks, responsibilities and timing of each actor are defined in all phases

- ATCOs suggested to have a clearer indication of the traffic status during the preview phase. At the time being they are all displayed in grey colour but the suggestion is to display the traffic assumed in green and the other in grey;
- ATCOs suggested to improve the preview mode phase by inserting colour codes or a video alarm to make the traffic situation clearer for the “receiving ATCOs”; this would greatly improve the situational awareness of the actors by speeding up the delegation process itself;
- ATCOs suggested to expand the collaboration from operational point of view and technical point of view in order to smooth the existing gaps between the two parties and make the platform easier to use and more suitable for controllers working methods;
- ATCOs highlighted the importance of recurrent training in order to guarantee an optimal maintenance of competence by reinforcing and broadening the knowledge necessary to perform effectively in their role;
- ATSEP highlighted that chronological information of the services might be aligned according to the target of the architecture depending on the Business cases suitable for the different stakeholders. Also, more complex environment might be considered for the different ADSP.





## Appendix D Validation Exercise #05 Report

### D.1 Summary of the Validation Exercise #05 Plan

The following minor deviations with respect to the EXE-PJ.10-W2-93-V3-VALP-005 have been found:

- In the VALP, the exercise is expected to validate the impact on SUP and FDO before, during and after the ATS delegation. In the exercise, the FDO-position was included in the platform (as depicted in picture in section A.1.1) but was not always operated due lack off personnel. The function was evaluated off-line by an FDO operator who also worked as pseudo-pilot in some runs.
- In the VALP, it's declared that one Copenhagen sector (UA/UC) will be delegated to Malmoe sectors. In the exercise we managed to increase the granularity and have 8 independent airspace volumes that could be combined according to the prevailing needs (Copenhagen A, C, UA & UC; Malmoe 2, 3, 8 & 9).

#### D.1.1 Validation Exercise description, scope

The validation exercise EXE-PJ.10-W2-93-V3-VALP-005 demonstrated the feasibility of the operational concept for ATS delegation addressed in PJ.10-93 W2 OSED.

Delegation of airspace (by use of a VC architecture) is expected to reduce airspace complexity/ATCO workload by finding the most suitable sector combinations between ATSUs as well as optimizing the operational efficiency/use of ATCOs. This exercise was mainly focused on the operational aspects, human acceptability and feasibility in relation to delegation between ATSUs to support workload distribution.

The exercise was conducted by means of Real Time Simulations (RTS) in Copenhagen, Malmoe and Paris using a TopSky ATC platform, during week 43, October 2022.

Workshops were conducted with both controllers and technical experts to refine the concept described by PJ.10-93 to meet the SESAR targeted maturity of V3.

Topics being examined to determine feasibility of the concept included among other:

- The impact on controller workload when ATS delegation are in effect,
- The impact on SUP and FDO before, during and after the ATS delegation
- The impact on tactical and strategic staff optimization,
- How a VC architecture can support delegation of ATS service
- How to prevail the look and feel during a delegation situation
- Potential impact on human performance during a delegation situation supported by the VC architecture.

The exercise allowed to assess potential reduction of airspace complexity/ATCO workload by investigating delegation of ATS between neighbouring ATSUs.

The management of the different sector configurations was managed by the SUPs located in Malmoe and Copenhagen respectively. The operational procedures needed to provide a safe and efficient delegation of ATS was evaluated to find any gaps or areas for improvement

The research prototypes used for this V3 validation exercise consisted of THALES TopSky ATC Platform. TopSky-ATC is a coherent set of concepts and capabilities deployed on an advanced technology platform that:

- Enhances safety and system security
- Provides quantifiable efficiency and productivity gains, and minimizes training time
- Supports operations in the different ATM domains and operational environments on a single system
- Provides integrated capabilities to meet current and emerging operational and technical needs

The following features were integrated:

- TopSky-Sim: The simulator used for generating the Air Situation, Flight Plans & pseudo-pilots.
- Safety Nets
- Controller Human Machine Interaction Management ER/APP
- Coordination and Transfer
- Trajectory Prediction and Management

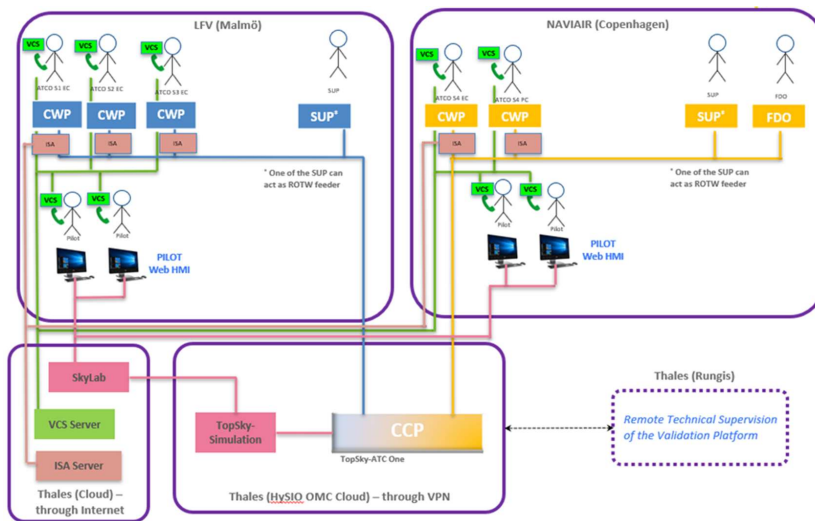


Figure 98989898989898 – EXE Validation Platform overview

**Validation scenarios**

The validation scenario took place in Danish (Copenhagen) and Swedish (Malmö) medium complexity airspace on THALES AIRSYS TopSky ATC platform. The exercise environment was En-Route airspace with a standard 5NM separation and RVSM, with inbound/outbound traffic to Copenhagen as well as overflying en-route traffic.

The platform used during the validation was a distributed platform built on Y-architecture with CWPs located in Copenhagen and Malmoe respectively. The ADSP (cloud) was located in Élancourt, Paris. Aside from the ATCO CWPs, specific CWPs for the SUP and FDO were used during the validation. A rest of the world (ROW) position was located in Rungis and one in Copenhagen. In the exercise, traffic/complexity increased in the Copenhagen sectors e.g., higher number of arriving/departing traffic to/from Copenhagen. To ease the workload on Copenhagen ATCOs, the ATS for the upper sectors (UA/UC) was delegated to Malmoe, who provided ATS for the high level en-route traffic. The delegated sector was also consolidated/collapsed with one of the original Malmoe sectors. Once the traffic/complexity was reducing again, the ATS was delegated back to Copenhagen sectors already managing traffic. This allowed to cover delegation to an "idle CWP" (not already handling traffic) as well as delegation to a CWP already providing ATM service. Traffic was a realistic sample of medium density traffic based on real time operations.

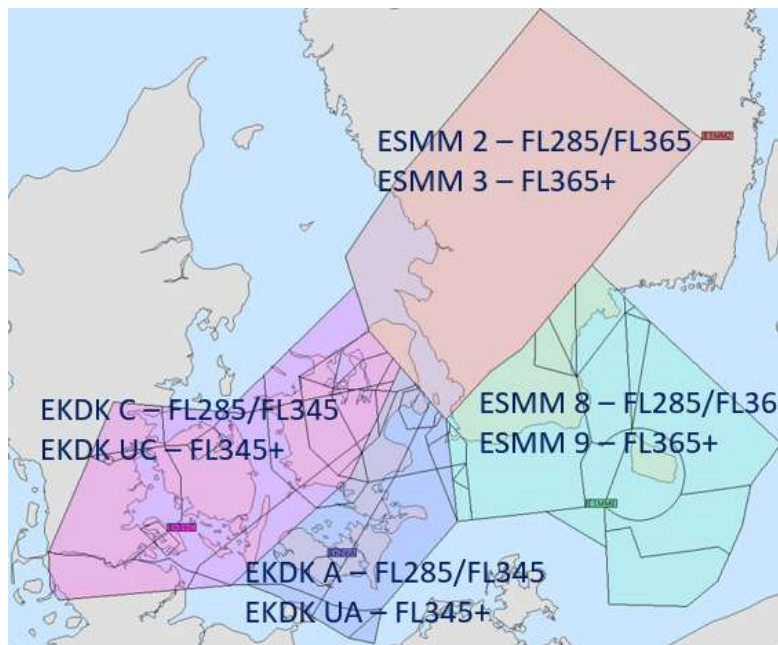


Figure 99999999999999999999 - ENE Validation environment - geographical area

Two scenarios were used to assess the performance:

- A Reference Scenario that included today's OPS environment and 2019 traffic level, without PJ.10-93 operational improvements, e.g., no possibility to delegate ATS. It should be noted that given the COVID crisis and its impact on traffic level, 2019 will be used as a relevant reference as current traffic counts are still below that level.
- A Solution Scenario which included the same OPS environment, plus PJ.10-93 operational improvements (ATS delegation capabilities). This solution scenario was also played with the 2019 traffic level, to assess the benefits of the solution under validation by distinct comparison with the reference scenario. According to SESAR PJ19.04 Validation Guidance,

the traffic in the solution scenario should correspond to 2024 expected traffic level. However, COVID impact have reduced the traffic levels in Europe in such way that the “normal” reference 2024 now is expected to correspond to 2019 traffic levels, and hence this approach must be considered as reasonable.

In the reference scenario, Thales TopSky ATC platform was used, but the capability to delegate ATS was not exercised. In turn, this allowed to mimic the current system environment and capabilities. The TopSky ATC platform remind of the legacy usage of the COOPANS TopSky ATC system, even if some capabilities/tools were not available.

The capability to internally open/collapse a sector was available in the reference scenario, e.g., to combine the different airspace volumes and sector roles to meet demand with available resources.

In the reference scenario, controllers had access to a limited toolset (given the new developed platform) compared to what’s available within the current COOPANS/TopSky system. Those tools were also available in the solution scenario and included:

- MinSep – Showing minimum distance between two or more aircraft using the aircraft’s current trajectory and speed
- QDM vector – Which displays distance and time and bearing to two selected points.
- MONA tools (RAM, CLAM)
- Graphical flight leg

In the solution scenario, Thales TopSky ATC platform including PJ.10-93 operational improvements was used and exercised. The same Swedish and Danish ENR airspace was used and different sector combinations exercised.

The solution scenario offered the new possibility to delegate/open/collapse sector(s) across the boundary of two ATSUs, e.g., to combine the different airspace volumes/sectors to meet demand with available resources in a more flexible way, even considering resources in both ATSUs. The main difference compared to the reference scenario was that the underlying technical architecture, allowed the CWP currently in need of any specific data to gain access to it, irrespectively of FIR/AoR/national boundaries. This capability allowed geographical decoupling of the CWP and catered for a more flexible delivery of ATS. AoRs was adaptable to prevailing needs and resources availability among the two collaborating ATSUs

In the solution scenario, Controllers had access to the same toolset as mentioned in the reference scenario.

Aspects of interest for the validation was the operational acceptability and feasibility related to the operational concept of ATS delegation, the possibility to reduce workload/complexity and (as a result hereof) potential increase the capacity.

#### **RTS Configuration**

The primary actors in the simulation were the ATCOs of these EKDK and ESMM Sectors as well as SUP EKDK and FSUP ESMM who were active when preparing/delegating the ATS:

- Executive Controller (EC) EKDK;
- Planner controller (PC) EKDK;
- Executive Controller (EC) ESMM 1;

- Executive Controller (EC) ESMM 2;
- Executive Controller (EC) ESMM3;
- SUP EKDK;
- SUP ESMM;
- FDO Copenhagen;

A simplified LoA was implemented in the exercise, with few limitations. Even so, participating ATCOs applied “normal operations”, e.g., adherence of regular LoAs, throughout most of the exercise (DCT points, agreed FLs, etc.). Some existing constraints was also replicated manually by ROW and/or pseudo-pilots. (e.g., traffic inbound specific WPY was descending from previous sector).

Participant concept and platform training was conducted prior to the exercise during the platform dry run. However, some of the originally planned participants had to be exchanged before the validation, going back to operational duties.

Some additional training runs were conducted the first day of the RTS allowing for specific theoretical and practical training activities, especially for the new participants.

No runs were allocated to simulating the SESAR features under non-nominal conditions.

#### Validation exercise technique related to Human Performance

As a new concept, understanding the ATS cross border delegations’ impact on human performance is vital. The concept must not deteriorate the controller in the execution of their tasks. Based on the concept and operational methodology, a set of human performance measures were developed in order to uncover the overall impact. These were:

- Impact on ATCO Workload;
- Impact on Task Allocation;
- Impact on Team Communication;
- Impact on Situational Awareness;
- Impact on ATCO Mental Model;
- Impact on ATCO Trust;
- Impact on Job Satisfaction and Performance.

A combination of both qualitative and quantitative data collection techniques was used prior and post the validation exercise.

One type of questionnaire has been used per ATCO on each validation day.

- **Post-Run Questionnaire - PRQ** (executed after each exercise, both reference and solution runs) containing following:
  - Bedford Workload Scale and Workload Explanation
  - China Lake (Situational Awareness)
  - AIM-S (Assessing the Impact of Automation on Mental Workload)
  - SATI (SHAPE Automation Trust Index)

- **Post-Simulation Questionnaire - PSQ** (executed once in the afternoon of the second day after all runs) containing
  - 17 statements to be rated regarding validation objectives for human performance, Acceptability, and Implementation factors.

The following techniques were used:

- ISA workload ratings (measured for reference and solution runs, measurements during the training runs were not retained)
- Over the shoulder observations
- Structured debriefings following each simulation run

The debriefings conducted with the participants after each exercise run were organized according to the following KPAs:

- Human Performance,
- Safety.

In the list below are all stated HP arguments that are taken into consideration:

Arg. 1.3.2: Tasks can be achieved in a timely manner.
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.
Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate.
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.
Arg. 2.1.2: Changes to the task allocation between human and machine support human performance.
Arg. 2.1.4: The level of workload (induced by the allocation of tasks between the human and the machine) is acceptable.
Arg. 2.1.5: Human actors can acquire an adequate mental model of the machine and its automated functions.
Arg. 2.1.6: The level of trust in automated functions is appropriate.
Arg. 2.2.1: The accuracy of information provided by the system is adequate for carrying out the task.
Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task.
Arg. 2.3.1: The type of information provided satisfies the information requirements of the human.
Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable.
Arg. 2.3.8: The user interface design supports a sufficient level of individual situation awareness.

Arg. 2.3.9 The user Interface design supports a sufficient level of team situational awareness.
Arg. 3.2.4: Team tasks can be achieved in a timely and efficient manner.
Arg. 3.3.4: The communication load of team members is acceptable in normal and abnormal conditions and degraded mode of operations.
Arg. 4.1.1: Changes in roles and responsibilities are acceptable to the affected human actors.

### D.1.2 Summary of Validation Exercise #05 Validation Objectives and success criteria

Validation objective and success criteria for EXE#5 are described in the VALP, and in section [Error! Reference source not found.](#) of this document.

### D.1.3 Summary of Validation Exercise #05 Validation scenarios

As previously mentioned, two scenarios were used to assess the performance:

- A Reference Scenario that included today's OPS environment and 2019 traffic level, without PJ.10-93 operational improvements, e.g., no possibility to delegate ATS. It should be noted that given the COVID crisis and its impact on traffic level, 2019 will be used as a relevant reference as current traffic counts are still below that level.
- A Solution Scenario which included the same OPS environment, plus PJ.10-93 operational improvements (ATS delegation capabilities). This solution scenario was also played with the 2019 traffic level, to assess the benefits of the solution under validation by distinct comparison with the reference scenario.

### D.1.4 Summary of Validation Exercise #05 Validation Assumptions

Beside from the validation assumptions listed in section 3.2.3, an additional 4 assumptions (listed in section 5.1.1.5 of the VALP) are applicable to EXE-05

Identifier	Title	Description	Justification	Impact on Assessment
ASS-PJ.10-W2-93-V3-001	Traffic characteristics	It is assumed that the results obtained for medium, high, and very high complexity environments will be also applicable to low complexity environments.	Low complexity environments are not addressed by any of the validation exercises. The extrapolation of the results should cover the gap.	Low



ASS-PJ.10-W2-93-V3-002	Regulatory	It is assumed that a new ATCO licensing and competences framework will be in place.	The exercises are conducted considering the current ATCO licensing framework. Training has been planned to avoid the lack of ATCO sector-based knowledge.	Medium
ASS-PJ.10-W2-93-V3-003	Ground tools/technology	It is assumed that ATCO and SUP support tools will be available to compensate the lack of ATCO sector-based knowledge.	The ATCO and SUP support tools available for the validation activities cover only limited functionalities (e.g., CD&R, conformance monitoring).	Medium
ASS-PJ.10-W2-93-V3-004	Letter of Agreements	It is assumed that a legal framework, and operational Letter of Agreement (LoA), around an existing ATS delegation exists to ensure that the cross-border services are built on robust legal and operational foundations.	Adaptation/dynamic adaptation of LoA to new sector boundaries/new ATSU will be needed to support safe and efficient operations	Medium

Table 34343434343434: Validation Assumptions overview

## D.2 Deviation from the planned activities

As already highlighted in section A.1, the following minor deviations with respect to the VALP have been found:

- In the VALP, the exercise is expected to validate the impact on SUP and FDO before, during and after the ATS delegation. In the exercise, the FDO-position was included in the platform (as depicted in picture in section XXX) but was not always operated due lack off personnel. The function was evaluated off-line by an FDO operator who also worked as pseudo-pilot in some runs.
- In the VALP, it's declared that one Copenhagen sector (UA/UC) will be delegated to Malmoe sectors. In the exercise we managed to increase the granularity and have 8 independent airspace volumes that could be combined according to the prevailing needs (Copenhagen A, C, UA & UC; Malmoe 2, 3, 8 & 9).

### D.3 Validation Exercise EXE#5 Results

Following are the results from EXE-PJ.10-W2-93-V3-VALP-005 exercise under Solution PJ.10-W2-93

#### D.3.1 Summary of Validation Exercise #05 Results

Validation Exercise EXE-005 Validation Objective ID	Validation Exercise EXE-005 Validation Objective Title	Validation Exercise EXE-005 Success Criterion ID	Validation Exercise EXE-004 Success Criterion	Sub-operating environment	Exercise EXE-005 Validation Results	Validation Exercise EXE-005 Validation Objective Status
EXE5-OBJ-PJ.10-W2-93-V3-VALP-001	To demonstrate the operational feasibility of the delegation of ATM services provision in medium complexity environment conditions	EXE5-CRT-PJ.10-W2-93-V3-VALP-001-001	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in medium complexity environment is gathered for the “on demand” use case in nominal conditions.	ER MD MC	The concept and operational requirements developed for the exercise was overall considered as sufficient/suitable	OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-001-002	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in medium complexity	ER MD MC	The supporting tools was considered as supportive and helped the actors to achieve their tasks. Some proposal for improvements was discussed during the exercise.	OK

			environment is gathered for the different use cases in nominal conditions according to ATCO's expert judgment.				
		EXE5-CRT-PJ.10-W2-93-V3-VALP-001-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.			OK	
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-004</b>	To validate the operational acceptance of the delegation procedures for the different use cases in nominal conditions.	EXE5-CRT-PJ.10-W2-93-V3-VALP-004-001	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.	ER MD	MC	ATCOs considered the concept acceptable	OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-004-002	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	ER MD	MC	The overall impact on human performance was acceptable. ATCOs were positive about the concept, tool and methodology and didn't have difficulties to fulfill their task.	OK

		EXE5-CRT-PJ.10-W2-93-V3-VALP-004-003	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.			OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-004-004	Impact remains acceptable according to ATCO expert judgment with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.			OK
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-009</b>	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services	EXE5-CRT-PJ.10-W2-93-V3-VALP-009-001	The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.	ER MD	MC KPI: Runway Throughput: + 3 movements/hour	OK

provision On-Demand" use case	EXE5-CRT-PJ.10-W2-93-V3-VALP-009-002	The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.			OK
	EXE5-CRT-PJ.10-W2-93-V3-VALP-009-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.			OK
	EXE5-CRT-PJ.10-W2-93-V3-VALP-009-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case			OK
	EXE5-CRT-PJ.10-W2-93-V3-VALP-009-005	The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.			OK

		EXE5-CRT-PJ.10-W2-93-V3-VALP-009-006	The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case			OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-009-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.			OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-009-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.			OK
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-012</b>	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in	EXE5-CRT-PJ.10-W2-93-V3-VALP-012-001	Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in nominal conditions.			OK

nominal conditions	EXE5-CRT-PJ.10-W2-93-V3-VALP-012-002	Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.			OK
	EXE5-CRT-PJ.10-W2-93-V3-VALP-012-003	Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in nominal conditions.			OK
	EXE5-CRT-PJ.10-W2-93-V3-VALP-012-004	Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.			OK



		EXE5-CRT-PJ.10-W2-93-V3-VALP-012-005	Impact remains acceptable according to ATCO expert judgment in terms of communication load before, during and after the delegation procedure of ATM services provision the delegation procedure in nominal conditions.			OK
		EXE5-CRT-PJ.10-W2-93-V3-VALP-012-006	ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.			NOK
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-014</b>	To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions	EXE5-CRT-PJ.10-W2-93-V3-VALP-014-001	The level of safety remains at an acceptable level according to ATCO's expert judgment before, during and after the delegation of ATM services provision in nominal conditions.			OK
		EXE5-CRT-PJ.10-W2-93-	Impact remains acceptable according to ATCO expert judgment in terms of the management			OK



		V3-VALP-014-002	and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions.			
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-016</b>	To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept	EXE5-CRT-PJ.10-W2-93-V3-VALP-016-001	A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.			OK
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-019</b>	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept	EXE5-CRT-PJ.10-W2-93-V3-VALP-019-001	A positive increase on ATCO productivity is demonstrated.			POK
<b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-022</b>	To support validation of PJ10-W2-93					OK

<p><b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-024</b></p>	<p>To assess the maturity of the Virtual Centre architecture and services</p>					<p>OK</p>
<p><b>EXE5-OBJ-PJ.10-W2-93-V3-VALP-025</b></p>	<p>To produce and complement/provide the technical validation platform</p>	<p>EXE5-CRT-PJ.10-W2-93-V3-VALP-025-001</p>	<p>Validation platforms based on a "legacy Y" architecture are put in place and are ready for use to play the identified operational scenarios under PJ10.93</p>			<p>OK</p>

Table ~~353535353535~~: Validation Results for Exercise EXE5

### D.3.2 Analysis of Exercise #05 Results per Validation objective

The results per Exercise Objectives and Success Criteria summarized in the section [Error! Reference source not found.](#) [Error! Reference source not found.](#) [Error! Reference source not found.](#) [D.3.2.](#) are further explained in the following sub-sections.

#### 1. EXE5-OBJ-PJ.10-W2-93-V3-VALP-001 Results

*To demonstrate the operational feasibility of the delegation of ATM services provision in medium complexity environment conditions*

**Overall conclusion:**

This Validation Objective status is OK.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-001-001**

- *Positive feedback concerning the operational feasibility of the delegation of ATM services provision in medium complexity environment is gathered for the “on demand” use case in nominal conditions.*

This Success Criteria status is ■

**EXE5-CRT- PJ.10-W2-93-V3-VALP-001-002**

- *Positive feedback concerning the operational feasibility of the delegation of ATM services provision in medium complexity environment is gathered for the different use cases in nominal conditions according to ATCO’s expert judgment.*

This Success Criteria status is ■

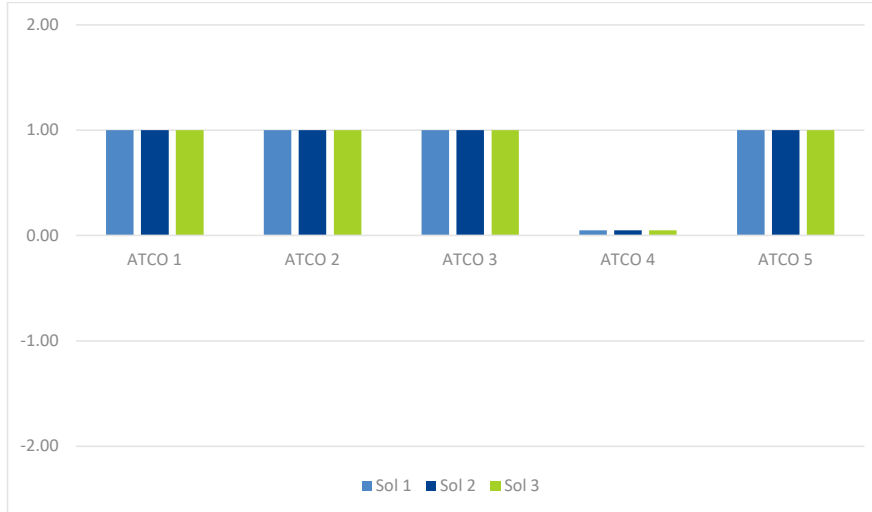


Figure 100100100100100100100 EXES OPS feasibility per SOL run

Chart below represents Post SIM overall score on operational feasibility by each ATCO participated in both roles, executive and planner.

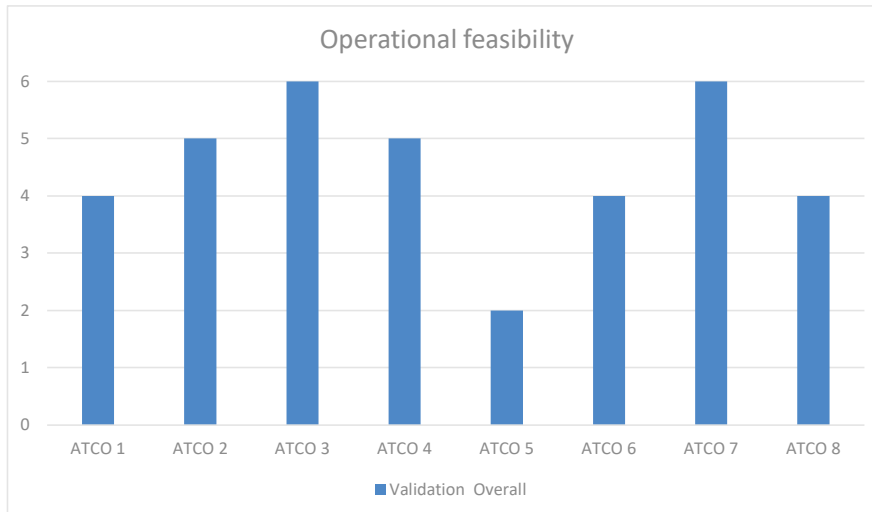


Figure 101101101101101101101 - EXE5 Operational Feasibility

According to expert judgement the concept is OK, but the system used in this EXE had some limitations, e.g., a limited tool set, delay in inputs – network latency, no easy way to highlight track being handed over. Planner ATCO felt somewhat limited in respect of tactical traffic management, but the role in the delegation process was clear and useful.

For delegation process, additional tools like highlight/preview mode or similar is of interest for the concerned parties.

The concept should work with some training/familiarization with delegated airspace

#### **EXE5-CRT- PJ.10-W2-93-V3-VALP-001-005**

- *Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.*

This Success Criteria status is ■

There are several potential limitations:

- Licensing – there is potential problem with maintaining competence for cross border sectors which are not used or regular basis,
- Political/authority issues – providing ATM service outside national boundaries (e.g., military traffic, insurance)
- LoAs – harmonized LoAs should be implemented in order to unify inter-sector coordination conditions (e.g., conditions for EFL, XFL, entry/exit points which should be automatically implemented into ATM system), separation minima, contingency procedures etc.
- Language barrier – In general, all lower airspace operations require also native language communication
- Technical limitations – CPDLC connections and management of CPDLC must be further evolved
- How to manage the unit callsign (during and) after a delegation have taken place is something that need clarification. In the exercise we only delegated between neighbours (and not across ECAC), but even then, it might cause confusion if the ATCOs providing ATS in Copenhagen answer with “Malmoe control”.

## **2. EXE5-OBJ-PJ.10-W2-93-V3-VALP-004 Results**

***To validate the operational acceptance of the delegation procedures for the different use cases in nominal conditions.***

#### **Overall conclusion:**

This Validation Objective status is OK.

#### **EXE5-CRT- PJ.10-W2-93-V3-VALP-004-001**

- *The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.*

This Success Criteria status is ■

#### **EXE5-CRT- PJ.10-W2-93-V3-VALP-004-002**





Figure 103103103103103103103103 - EXE5 Acceptability on roles and responsibilities

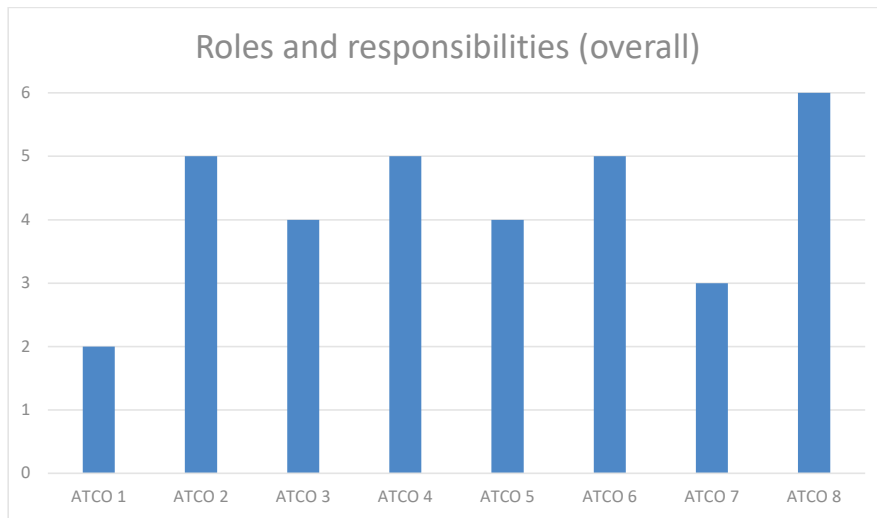


Figure 104104104104104104104104 - EXE5 Acceptability of roles and responsibilities (Overall)

Based on the items evaluating roles and responsibilities, we can assert that roles and responsibilities are clear and consistent.





- The level of ATCO workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-002**

- The level of ATCO situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-003**

- The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-004**

- The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-005**

- The level of SUP workload remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-006**

- The level of SUP situation awareness remains within acceptable levels according to ATCO's expert judgment during the delegation procedure for the On-Demand Use Case

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-007**

- The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

**EXE5-CRT- PJ.10-W2-93-V3-VALP-009-008**

- The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.

This Success Criteria status is 

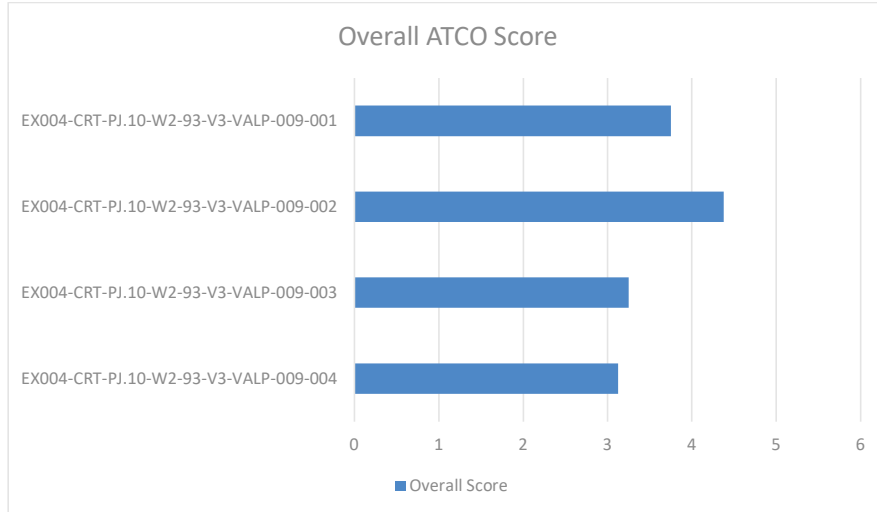


Figure [106106106106106106106106](#) - EXE5, Workload, SA, Trust and System Support (ATCO)

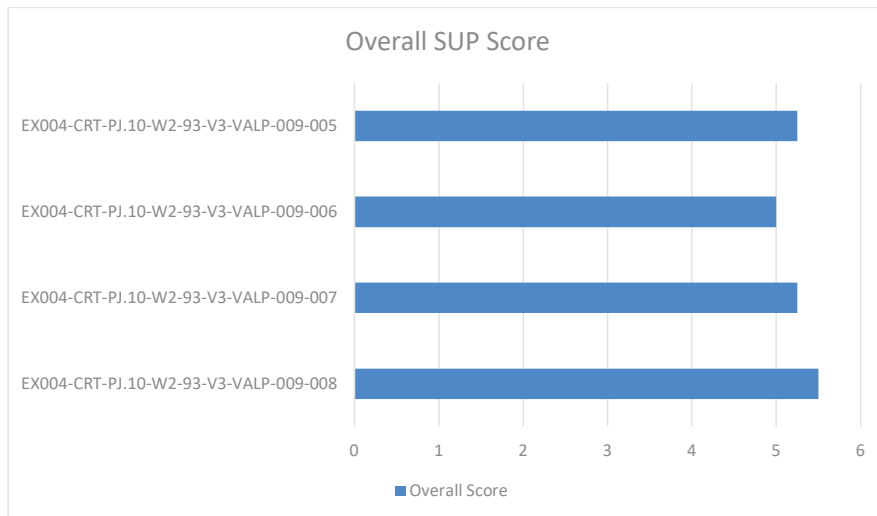


Figure [107107107107107107107107](#) - EXE5, Workload, SA, Trust and System Support (SUP)

Overall ATCO score is lower than SUP score which can be explained with lack of some system functionalities (system support) and system latency which were not part of SUP position. This had an impact on overall workload, situation awareness and trust in system for the ATCOs.

According to Bedford Scale, workload during delegation process was rated as “enough spare capacity for all desirable additional tasks” on delegator positions and rated as “a little spare capacity, level of effort allows little attention to additional tasks” on receiver positions.

#### 4. EXE5-OBJ-PJ.10-W2-93-V3-VALP-012 Results

*To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions*

**Overall conclusion:**

This Validation Objective status is OK.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-012-001**

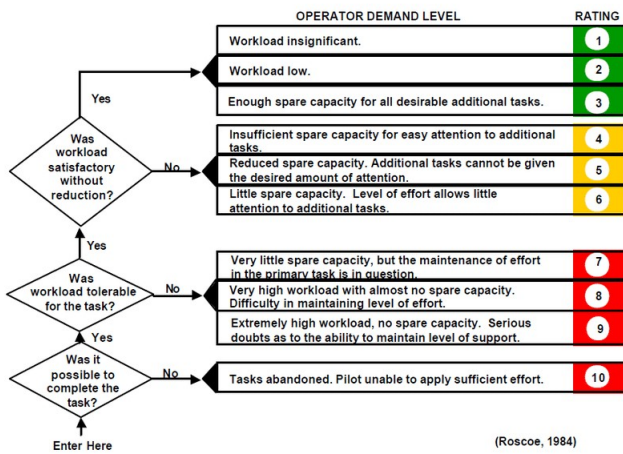
- Impact remains acceptable according to ATCO expert judgment in terms of workload before, during and after the delegation procedure of ATM services provision in nominal conditions.

This Success Criteria status is OK

ATSU	Pre-delegation	Delegation process	After-delegation
EKDK	3-4	4-5	2-3
ESMM	3-4	4-5	5

Figure ~~108108108108108108~~ - EXE5 Bedford result

## Bedford Workload Scale



The overall workload experienced during the simulation can be found in the results in Bedford workload scale in the table above. The ATCOs opinion was that the simulator lag was the main issue for higher-than-expected workload (e.g. waiting 3-5 sec for a simple input system response, such as assume, takes too much time and draws attention from tasks that have to be done next). Also, level of mimic with operational system can be crucial to reduce ATCO workload. In order for the delegation of the ATM service to be operationally acceptable, platform tools and latency need to be improved.

The operational procedures worked fine. Workload will naturally vary a lot, depending on whether you are a delegator or receiver.

### EXE5-CRT- PJ.10-W2-93-V3-VALP-012-002

- Impact remains acceptable according to ATCO expert judgment in terms of situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.

This Success Criteria status is ■

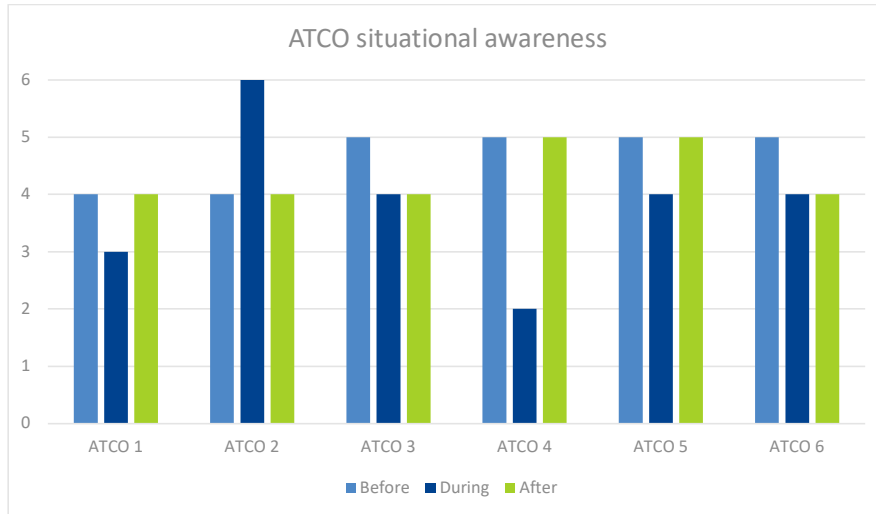
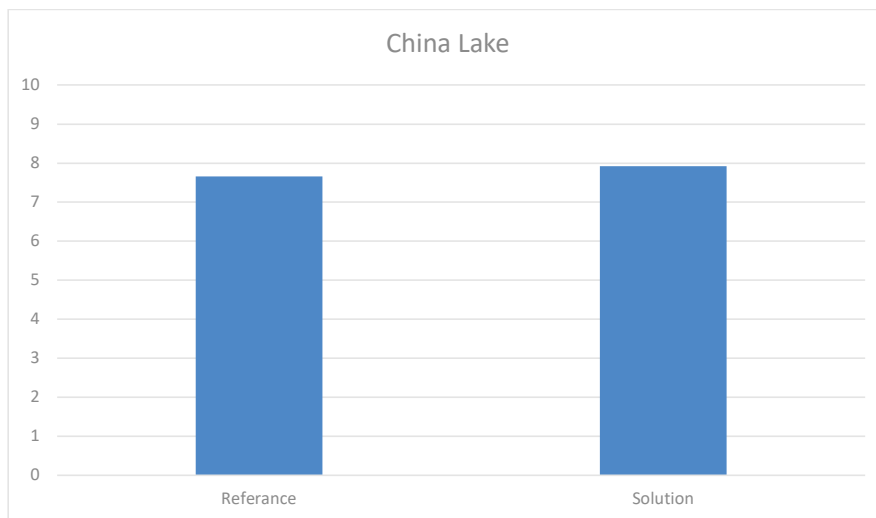


Figure 109109109109109109109 - EXE5 Situational Awareness during delegation process

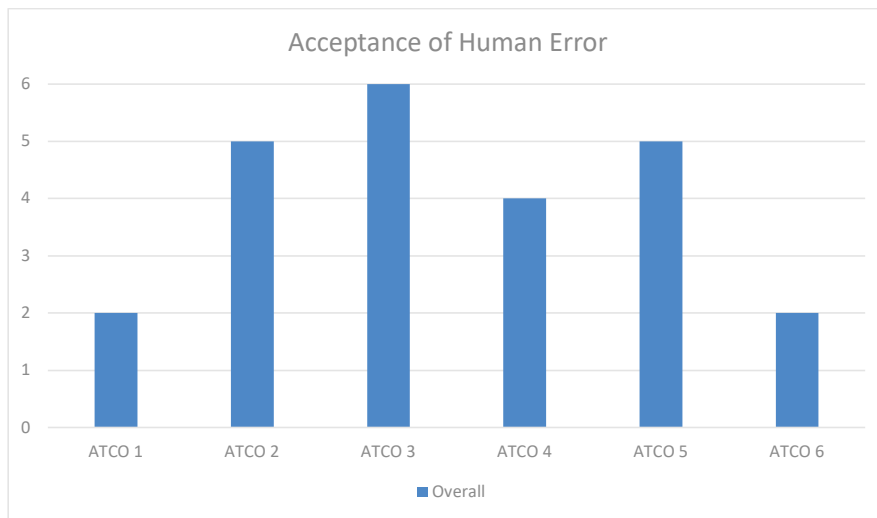


Results obtained as overall situational awareness (SA) on reference and solution scenario show that there is no difference from operational point of view. When analyzing SA in periods before/during/after delegation, it is obvious that situational awareness varies, as a result of system maturity, network speed and initial acquaintance with new sector boundaries.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-012-003**

→ Impact remains acceptable according to ATCO expert judgment in terms of potential human errors before, during and after the delegation procedure of ATM services provision in nominal conditions

This Success Criteria status is ■



During post-sim debriefings, the general conclusion was that the impact of human errors remains at an acceptable level. Some participant results show lower score, the reason for this was lag in system input response.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-012-004**

→ Impact remains acceptable according to ATCO expert judgment with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.

This Success Criteria status is ■











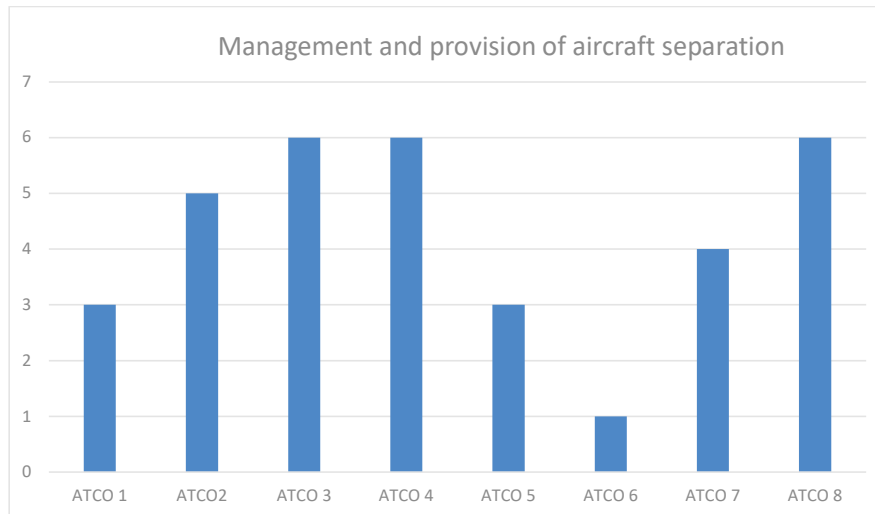


Figure ~~11411411411411411414~~ EXE5 Separation Management

In general, separation management was not impaired by the delegation of ATS concept. Only one ATCO considered that the concept and system didn't support the task.

## 6. EXE5-OBJ-PJ.10-W2-93-V3-VALP-016 Results

*To assess the performance benefits in terms of Airspace Capacity of the delegation of ATM services provision among ATSUs concept*

### Overall conclusion:

This Validation Objective status is OK.

### **EXE5-CRT- PJ.10-W2-93-V3-VALP-016-001**

- A positive increase on En-Route Capacity without degrading the current level of safety is demonstrated.

This Success Criteria status is ■



REF	2,10	0,15	8,1%
SOL	1,95		

Table ~~36363636363636~~ - En-route Airspace Capacity Increase – ISA

However, it should be noted that the outcomes suffer from some limitations related to the concept (associated to capacity calculations). The result is calculated from a low number of runs, an additional ATCO handled the delegated airspace, only a part (time) of the SOL run was executed with a delegated sector. Two, out of three, REF runs had the lowest ISA scoring of all runs, while the last REF had the highest score. The SOL runs had a more equal distribution when it comes to ISA ratings. On ATCO individual level, the (5) lowest ratings are to be found in the SOL runs.

Considering the collected feedback from ATCOs, HP expert and SAF expert, a reasonable assumption is that there could be a positive effect on workload that should cater for a corresponding minor increase in capacity. This assumes however, that the delegation optimizes the number of aircrafts managed by each ATCO, e.g., to maximize the use of the human resource. This is essentially how internal sector configurations (split/collapse) are managed today, but the concept includes cross border alternatives. In real life it may prove to be difficult as flights not always end up in the sector were they are most wanted. Higher granularity (DAC) in the delegation capability could potentially improve the situation.

In essence, the delegation of ATS capability allows to delegate the request for ATS to where there is capacity (humans) available and if sufficiently optimized, it might have a positive effect on network level. In many cases it's rather a shuffling of service delivery between different service units, but without a real capacity increase.

The overall result is positive but given the slightly contradictory results and the debriefing discussion related to capacity, this result should not be considered as significant.

## 7. EXE5-OBJ-PJ.10-W2-93-V3-VALP-019 Results

*To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept*

**Overall conclusion:**

This Validation Objective status is OK.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-019-001**

- A positive increase on ATCO productivity is demonstrated.

This Success Criteria status is ■

Through the same approach used to determine the change in airspace capacity, potential savings in the cost efficiency of ANSP operations can be identified by first calculating the change in mean controller workload. This benefit mechanism is built on the model that if a controller has more capacity due to reduced workload, they can safely handle a greater number of flights per hour. This represents



**Overall conclusion:**

This Validation Objective status is OK.

The operational procedures depicted in PJ.10-93 OSED was exercised during the validation and found feasible. This OBJ relates from PJ.32 and are more directed against the platform development to support the operational procedures. Even if some limitations were available in the platform, it was considered mature enough to support the operational validation and prove the operational feasibility of the concept.

## 9. EXE5-OBJ-PJ.10-W2-93-V3-VALP-024 Results

*To assess the maturity of the Virtual Centre architecture and services*

**Overall conclusion:**

This Validation Objective status is OK.

Overall, the Y-architecture based platform was mature enough and provided the requested services to the operators.

## 10. EXE5-OBJ-PJ.10-W2-93-V3-VALP-025 Results

*To produce and complement/provide the technical validation platform*

**Overall conclusion:**

This Validation Objective status is OK.

**EXE5-CRT- PJ.10-W2-93-V3-VALP-025-001**

- Validation platforms based on a "legacy Y" architecture are put in place and are ready for use to play the identified operational scenarios under PJ10.93

This Success Criteria status is ■

The main identified limitation in the virtual centre architecture that was found under the validation was the speed in transfer of data. A VPN connection via public internet was used, and delays in data transmission was observed during all runs, especially in the later part of the runs, when a lot of data occupied the available connection.

A dedicated connection/network or wider bandwidth would most likely have mitigated this problem.

### D.3.3 Unexpected Behaviours/Results

In general, there were no unexpected behaviours during the validation. One technical problem occurred during the first day, were one of the solution runs had to be dismissed as the platform problems made the continuation of the run impossible.

The only other unexpected behaviour was the latency/delay in data transfer that occurred during many runs. The data connection consisted of VPN connections over public internet, and this fact caused some delay, especially in the later part of the runs, when a lot of traffic (e.g., bigger data volume) were present. The delay annoyed the ATCOs a bit, as they had to wait for inputs to be accepted and confirmed by the system.

### D.3.4 Confidence in Results of Validation Exercise EXE-05

#### 1. Level of significance/limitations of Validation Exercise Results

The relatively high representativeness of the exercise results is justified through the tuning and testing conducted prior to the RTS and the effort taken to replicate real-life conditions. The validation environment was accurately reproduced on the TopSky simulation platform, including sector dimensions, aerodrome/waypoint positions and some basic LOA. The simulated traffic was based on real data using traffic scenarios tuned for the exercise. Furthermore, participating ATCOs had many years of experience and valid ratings in the sector they were working (excluding the delegated part).

Prior to the execution of the validation activity, testing activities were undertaken to ensure the realism and stability of the working environment for the controllers. This included scenario tests, traffic sample tests and technical integration testing prior to testing runs (dry runs) taking place one month before the EXE.

The on-the-job training during the first day of the RTS also allowed the participants to familiarize themselves further with the platform HMI and baseline functions. Although the controllers stated before beginning measured runs that they were adequately familiarized, operating with a system for a relatively short time prior to the RTS was maybe a limitation. The lack of the “normal toolset” from the COOPANS system might have been a limitation as controllers had to compensate with new working methods and/or methodology to compensate. Even if controllers felt confident when working, additional training (e.g., more platform experience) might have impacted the final result.

The pseudo-pilots that took part in the exercise were consistent throughout the dates but had little experience in performing the required tasks. Theirs roles were simple and limited during the runs.

The limited number of days available for the RTS restricted the number of matched runs that could be conducted. The impact of this was that only one traffic sample (representing 2024) could be covered in matched sets of runs. Having multiple samples of traffic would have reduced the potential learning effect that can artificially improve controller performance.

No differentiation of rules and regulations were made in the different national airspaces during the exercise runs. It's not unlikely that a significant harmonization on NSA level is needed to make the concept become a reality. Different rules may apply in different airspaces, but if the concept should be deployable, a considerable harmonization must first have taken place to allow the controllers to perform their task in an efficient way. If current national rules had been applied during the exercise, it would have complicated the work for the ATCOs as they (maybe) should have considered different rules in the different sectors (even if combined as one continuous airspace).

The HMI was close to COOPANS operational look and feel, but some proposals for improvement was identified. Especially the methodology for transfer/assume was considered as cumbersome. Network delays and some missing tools also impacted the evaluation of the HMI, even if those functions are not directly HMI topics. XFL was only visible in expanded label.



No live/shadow traffic was used, but a single simulator sample which was tailored for the exercise. Hence, the SUPs (and ATCOs) on both sides knew approximately at what time the delegation of ATS should be executed and was prepared for the delegation request coordination. With higher fluctuation in traffic and an ad-hoc based decision to launch the delegation request proposal might have impacted the speed and easiness with which the SUPs could act during the validation.

The delegation procedure was considered as feasible by the participants, but with more training and potentially more/specific tools it might even be improved. In essence the ATCOs considered the procedure to be close to an internal opening/collapse of a sector, but the fact that they were in different countries without F2F capabilities was a limiting factor, why the procedure need training, and additional tools (highlight functions, lists) might be needed.

ATCOs, yet being familiar with the airspace, didn't have the current license to work in all sectors, and sometimes felt they had difficulties to maintain their situational awareness related to the environment – e.g., to know location of airports, waypoints, coordination partners, frequencies, etc. by heart. If ATCOs had been more used to the concept and airspace, alternatively if the system had provided more information, it might have improved the situation. The same is applicable to the level of trust in the concept which would be likely to increase if ATCOs would have worked with it for a longer time.

The delay in the data transmission in the platform had a negative impact on the overall assessment. Delay increased slowly during the different runs, as more and more data was included in the transmissions. Using platforms connected via VPN over public internet didn't achieve the required performance and impacted the assessment.

## 2. Quality of Validation Exercises Results

The group worked really well together throughout the RTS. The participants were skilled and experienced, and very interested in participating to the exercise. The high-level of motivation/involvement observed before and during the RTS directly contributed to the quality of the validation exercise results.

The participants were trained (during the RTS) and briefed (prior to and during the RTS) about the specificities associated with a research and design environment. Moreover, the controllers were briefed about the HP and SAF questionnaires during the training to ensure that the questions were properly understood.

Despite the lack system integration of realistic LOAs (detailed with specific flight levels, DCT points, constraints,) the ATCOs applied a normal working methodology, e.g., applying the "real" LOAs during the exercise. This made the exercise realistic, and the operations reflected reality in a good way and strengthens the result.

Finally, we did not encounter any major technical issue during the RTS, which ensured a good overall realism and the availability/reliability of the data generated by this exercise (logs, etc.).

## 3. Significance of Validation Exercises Results

As discussed above in relation to the level of significance, the limited number of simulations runs limits the operational significance of the reported results. The problem with the data transfer related to the

use of public internet connection limits the operational significance. Overall, sufficient operational significance for this maturity phase (V3) was nevertheless attained to support inclusion at solution level.

### D.3.5 Conclusions

Following the assessment of the success criteria linked to each of the exercise-level objectives reported on in section [Error! Reference source not found.](#)[Error! Reference source not found.](#)[Error! Reference source not found.](#)[D-3-1](#):

- Six objectives were entirely satisfied by the analysis findings.
- One objective received the status of Partially OK.
- None objectives received the status of NOK.

The following section sets out the conclusions that can be drawn based on the entirety of results collected.

## 1. Conclusions on concept clarification

### Cross border delegation of ATS

The capability to delegate ATS across national boundaries offers a wider selection of solutions to solve traffic imbalances, staff shortage and more evenly distribute workload.

The participating ATCOs considered the concept of ATS delegation to be feasible and acceptable. In essence, they compared it with a “regular” split/collapse of internal sectors but agreed there might be a need for some capability to highlight or mark flights on the screen or in a list to make sure the handover is complete and that no flights are missed.

The use of the ATS delegation to distribute workload/lower complexity proved to be feasible, yet further fine tuning need to be done to achieve full operational acceptance. Many HP aspects was considered feasible by participants, but some further tuning is needed to mature further.

As the participating ATCOs are used to work with advanced tools like 4D-MTCD and trajectory management tools, they sometimes had to compensate for the lack of this tool set during the runs. To have an even stronger result, a fully matured platform should be used (including advanced tools). Also, the delay in data transmissions were at times an unacceptable level, causing frustration to the ATCOs. Better, high speed connections should be used to realize the concept in the future.

## 2. Conclusions on technical feasibility

From a technical perspective, the concepts brought by PJ.10-93 were perceived by ATCOs as promising, and mature. There are expectations that they will be supportive in workload distribution, traffic flow optimization and management of traffic. The capability to acquire an adequate mental model of the platform status and functionalities was suitable. This is globally confirmed by the results on systems acceptability in section [Error! Reference source not found.](#)[Error! Reference source not found.](#)[Error! Reference source not found.](#)[D-3-1](#). Some improvements/adjustments are nevertheless possible and

recommended to mature the concept even further towards deployment, and will be captured in section D.3.6 (e.g. HMI features, data transmission, ...).

### 3. Conclusions on performance assessments

Performance assessments for this exercise were undertaken for the following KPAs:

→ **Safety; SAF1.x:**

- **SAF1.1; Mid-air collisions – En-route**
- **SAF1.3; Imminent Separation infringements – En-Route**
- **SAF1.5; Planned Conflicts**
- **SAF1.6; ATC Induced tactical conflicts**

The impact from PJ.10-93 features maintained current safety levels without any noticeable change.

→ **En-route Airspace Capacity; CAP2:** PJ.10-93 features did produce a minor benefit of capacity increase based on workload reduction. This result is nevertheless not considered as significant.

→ **Cost Efficiency En Route; CEF2:** TBD

→ **HP; Human Performance**

- HP1; Consistency of human role with respect to human capabilities and limitations
- HP2; Suitability of technical system in supporting the tasks of human actors
- HP3; Adequacy of team structure and team communication in supporting the human actors
- HP4; Feasibility with regard to HP-related transition factors

The impact of PJ.10-93 features didn't have a detrimental effect on Human Performance.

### D.3.6 Recommendations

During the exercise, recommendations for further areas in tool development and validation were recorded by both the participants and simulation team. These enhancements will enable the technical and operationally feasibility of the PJ.10-93 features to move closer to industrialization.

**PJ.10-93 features/concept:**

→ Additional validations including legal, regulatory, military (data sharing) and certification aspects are recommended to fully discover benefits and drawbacks with the concept. Safety and HP was not perceived as a limiting factor from the participating operators, but to gain

further assurance, several different environments and traffic scenarios should be considered, and then also considering the legal, regulatory, military and certification aspects.

#### **Experimental design:**

- As mentioned in the limitations, the limited number of days available for the RTS restricted the number of matched runs that could be conducted. The impact of this was that only one traffic sample could be covered in matched sets of runs. Having multiple samples would have reduced the potential learning effect that can artificially improve controller performance.
- As mentioned in the limitations, the SUPs were familiar with the scenario and prepared for when the delegation could be expected. To have several different traffic scenarios would make the delegation process more realistic and unprepared between SUPs (and ATCOs).

#### **Operational procedures and ATCO training:**

- As mentioned in the limitations, the on-the-job training during the first day of the RTS allowed the participants to familiarize themselves with the platform HMI and baseline functions. Although the controllers stated before beginning measured runs that they were adequately familiarized, operating with a system for a relatively short time prior to the RTS was maybe a limitation.
- All participating ATCOs had status in their respective airspace, but not for the airspace in which they provided service during/after the ATS delegation process. A certification framework needs to be put in place and appropriate training needs should be investigated.
- Pre-agreed delegation scenarios between partners - number of/which sectors - would certainly help all operators in the process. It's likely to believe that a future implementation of the concept will build on pre-agreed scenarios, at least initially, as this would help in licensing, regulatory and training aspects.

#### **Technical platform and HMI improvements:**

- Due to time limitations, there was a limited set of LOAs/constraints integrated in the platform. Especially in a delegation scenario, operators could be expected to have a greater need of system support (being less familiar with the environment) why specific care must be taken to integrate all necessary information in the technical system(s).
- The HMI for some of the tool was sufficiently developed, while others might need further consideration. The TopSky ATC used during the validation didn't have all functionalities the operators were used to, and the differences in comparison with the legacy COOPANS system caused some additional work for the ATCOs. HMI for remaining tools should be carefully designed to not impact the ATCOs/operational procedures more than necessary.
- For coordinated flights the XFL should be shown in the label, that would provide a better planning.
- The procedure for transfer/assume involved too many clicks and should be revised.
- The management of CPDLC during ATS delegation should be considered by the entire community.



## Appendix E Validation Exercise #06 Report

### E.1 Summary of the Validation Exercise #06 Plan

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I.

#### E.1.1 Validation Exercise description, scope

The validation exercise EXE-PJ10-W2-93-V3-VALP-006 “Delegation of ATM services provision among ATSU’s” was a V3 phase real-time simulation (RTS), which addressed the OI step SDM-0217.

Operational need for validating aspects of delegation of operational sectors between Poland and Lithuania, the exercise focused on delegation of airspace:

- Realistic operational environment (ANSP perspective)
- Representative users i.e. ATCOs using their usual CWP’s and tools
- Development of delegation procedures and training to ATCOs
- Possibility to delegate part of the airspace to several ANSPs
- Supported by multi-customer ADSPs from several providers for both ATM and for Voice services (e.g., CCS provided from TLS for DSNA and skyguide)
- Several operationally representative scenarios with the purpose of optimizing ATCOs engagement:
  - Low / late shift with average workload.

Objectives addressed:

- To validate new operational procedures necessary for the delegation of airspace
- The measure the Cost-Effectiveness: when traffic demand is low, full transfer of responsibility of one or more sectors from one ATSU to another ATSU will improve the Cost-Efficiency as the number of ATCOs on duty might decrease.

Use cases addressed:

- Delegation of provision of ATS services – Cross Border
- Night delegation of provision of ATS services.

The exercise took place in Warsaw (PANSAs) and in Vilnius (ON). Controllers who took part in the validation worked together in pairs, as in the operational environment. Each pair was responsible for one operational sector and consisted of the planning controller and the executive controller. During both scenarios (reference and solution), sector team was asked to follow current operational methods and they did not have to change the way in which they perform their job. The task of the PC was to coordinate with other sectors (inside and outside FIR EPWW) all aircrafts that are to enter the sector. The PC all the time was searching for potential conflicts – inside and outside AoR. The task of the EC was to pass instructions and clearances to the aircraft inside the sector. Each run of exercise was carried out using existing procedures and current working methods.

The results of the exercise (including quantitative and qualitative data collected) were summarised and will be used as a guideline to build an enhanced MTCD tool.

## E.1.2 Summary of Validation Exercise #06 Validation Objectives and success criteria

As in SESAR Solution PJ.10-W2-93: Final VALP for V3 - Part I.

## E.1.3 Summary of Validation Exercise #06 Validation scenarios

### Validation scenarios

The validation consisted of a Real Time Simulation during which the operational feasibility was addressed with the help of Air Traffic Controllers located in PANSA and Oro Navigacija.

The Exercise addressed the Area Control environment.

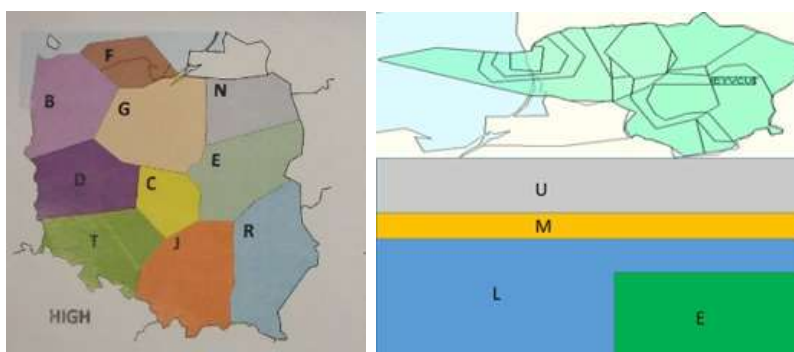


Figure [117117117117117117117117447](#) Validation Scenarios EXE-PJ.10-W2-93-V3-VALP-006

The sectors to be delegated were a combination of upper layers of N, E, sectors in FIR Warsaw, EYU in FIR Vilnius. The traffic scenery mainly covered the flow Lithuania to/from Poland.

Feeders: Not needed in Lithuania, 2 feeders in Poland. Therefore, it will be needed:

- 4 CWPs in Lithuania (2 local, 2 to connect to Poland)
- 6 CWPs in Poland (2 local, 2 connected to Lithuania, 2 feeders)

Six pseudo pilots were needed: Pseudo pilots assignment to sectors was determined during dry-runs.

The traffic sample corresponded to traffic from July 2019 (pre-SARs-CoV-2):

- Night Delegation low-traffic sample: 52 flights over the course of 1 hr crossing Warsaw NEZR or Vilnius UM sectors.
- Night Delegation medium-traffic sample: 134 flights over the course of 2 hrs crossing Warsaw NEZR or Vilnius UM sectors.

On-Demand PANSA to ON delegation: 92 flights over the course of 1 hr crossing Warsaw NEZR.

On-Demand ON to PANSA delegation: 81 flights over the course of 1 hr crossing Vilnius UM.

## Reference Scenario(s)

Reference scenarios for the exercise was:

- Normal operational conditions in FIR Warsaw and in FIR Vilnius during low traffic night period.
- Normal operational conditions in FIR Warsaw and in FIR Vilnius requiring re-sectorization due to traffic patterns.

Reference scenarios are assumed to have standard tools available for the controller's working position.

The Reference Scenario is as per current operating method in the Polish airspace, that is, with no possibility to consider the delegation of ATM services provision.

The main characteristics of the Reference Scenario to be considered for each one of the use cases addressed by the validation activity is described below:

- Delegation of ATM services provision at Night
  - No delegation
  - Consolidation of sectors at night within the same ATSU
  - No cross-border sectorisation
- Delegation of ATM services provision on-demand
  - No delegation
  - No cross-border sectorisation
  - ATFCM measures: ATFM regulations, ATFM scenarios, capacity measures, tactical STAM



## E.1.4 Summary of Validation Exercise #06 Validation Assumptions

Identifier	Title	Description	Justification	Impact on Assessment
ASM-PJ10-W2-93-V2-EXE-005.001	Traffic density and complexity	The exercise will be carried out using low to medium traffic density and complexity scenarios.	Only 5 ATCOs are available for the entire exercise.	Validation results will be formulated only based on low to medium traffic scenarios.
ASM-PJ10-W2-93-V2-EXE-005.002	Voice communication system	The voice communication system impact will not be taken into account in the validation results	As there is no existing established VCS connection between PANSa and ORO Navigacija, the connection between ATCOs and pseudo pilots will be provided by an external system.	The impact of a non-standard communication on human performance.

Table ~~373737373737~~: Validation Assumptions overview

## E.2 Deviation from the planned activities

Internal PANSa issues regarding ATCOs' general strike as well as Russian terrorist invasion in Ukraine and its consequences in increased workload in all operational segments have led to almost zero availability of personnel from PANSa. Validation was carried out with ON ATCOs working both in PANSa and ON airspace. Only 4 ATCOs were available at once, 2 in Poland and 2 in Lithuania, which led to airspace outside of delegated sectors to be unattended throughout the validation runs.

Differences in GAT/OAT licencing between PANSa and ON were identified and mitigated by not including any OAT traffic in traffic samples.

Traffic samples from 2019 included aircraft types not present in INDRA's software. As a result traffic types in the sample had to be substituted to supported types and traffic sample realism was slightly diminished.

ATC SUP role was not included in the validation, FMP specialists from PANSa were not available.

## E.3 Validation Exercise #06 Results

### E.3.1 Summary of Validation Exercise #06 Results



The following table summarises the results of the Validation Exercise EXE-PJ10-W2-93-V3-VALP-006 compared to the success criteria identified within the Validation Plan per validation objective.

Results obtained were assessed against the success criteria to decide if the Validation Objective Analysis Status is OK, partially OK, NOK or Not Applicable (N/A).

The following terminology has been used:

- OK
  - Validation objective achieves the expectations
- NOK
  - Validation objective does not achieve the expectations
- Partially OK
  - Validation objective does not fully achieve the expectation

Validation Exercise #0 Validation Objective ID	Validation Exercise #06 Validation Objective Title	Validation Exercise #06 Success Criterion ID	Validation Exercise #06 Success Criterion	Sub-operating environment	Validation Exercise #06 Results	Validation Exercise #06 Success Criterion Status	Validation Exercise #06 Validation Objective Status
EXE6-OBJ-PJ.10-W2-93-V3-VALP-001	To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.	EXE6-CRT-PJ.10-W2-93-V3-VALP-001-001	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to medium density is	Low to Medium complexity	Criterion has been met. The controllers/experts confirmed that in environments from low to medium density the operational feasibility was	OK	POK



			gathered for the different use cases in nominal conditions.		achieved bringing benefits in terms of Flight Efficiency.	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-001-002	Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to medium complexity is gathered for the different use cases in nominal conditions.	Medium Complexity	Criterion has been partially met. Although the complexity remained acceptable with the introduction of delegation of ATM services provision among ATSUS, the number of conflict areas increased with it.	Partially OK
		EXE6-CRT-PJ.10-W2-93-V3-VALP-001-005	Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.	Medium Complexity	Criterion has been met. Even if the controllers were able to perform their tasks properly, they pointed out some limitations regarding the platform, the Flight Efficiency and the traffic predictability.	OK
EXE6-OBJ-PJ.10-W2-93-V3-VALP-002	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night" use case.	EXE6-CRT-PJ.10-W2-93-V3-VALP-002-001	The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined and documented.	Medium Complexity	Criterion has been met. Although controllers were not always familiar with the delegated sector configuration, the delegation procedure, including handover dialogue, was clearly defined and documented for	OK

					the Night delegation use case.		
		EXE6-CRT-PJ.10-W2-93-V3-VALP-002-002	The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	Medium Complexity	Criterion has been met. Controllers agreed that the delegation procedure, including handover dialogue, was operationally feasible for the Night delegation use case.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-002-003	No negative impact is identified with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.	Medium Complexity	Criterion has been met. Since there were no changes in roles and responsibilities, no negative impact was reported on the delegation process.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-002-004	No negative impact is identified with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.	Medium Complexity	Criterion has been met. There was no impact on ATM services quality during the delegation procedure for the Night delegation use case.	OK	
EXE6-OBJ-PJ.10-W2-93-V3-VALP-004	To demonstrate the operational feasibility of the ATM services provision delegation procedure for the	EXE6-CRT-PJ.10-W2-93-V3-	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is	Medium Complexity	Criterion has been met. All ATCOs considered the delegation procedure well defined and documented.	OK	OK

	"Delegation of ATM services provision On-Demand" use case.	VALP-004-001	clearly defined and documented.				
		EXE6-CRT-PJ.10-W2-93-V3-VALP-004-002	The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	Medium Complexity	Criterion has been met. Although some difficulties were met due to high traffic density and weather conditions, all the controllers found that for the on-demand use case the delegation procedure was operationally feasible.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-004-003	No negative impact is identified with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.	Medium Complexity	Criterion has been met. Since there were no changes in roles and responsibilities, no negative impact was reported on the delegation process.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-004-004	No negative impact is identified with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.	Medium Complexity	Criterion has been met. All controllers agreed that the ATM services quality was not impacted during the on-demand delegation use case.	OK	
EXE6-OBJ-PJ.10-W2-93-V3-VALP-007	To demonstrate the operational acceptance of the delegation	EXE6-CRT-PJ.10-W2-	The level of ATCO workload remains within	Medium Complexity	Criterion has been partially met.	Partially OK	POK



procedure for the "Delegation of ATM services provision at Night" use case.	93-V3-VALP-007-001	acceptable levels during the delegation procedure for the Night Use Case.		The level of ATCO workload remained acceptable to low in all the Night delegation scenario except in the Night delegation from ON to PANSA in which the controllers experienced a high level of workload.		
	EXE6-CRT-PJ.10-W2-93-V3-VALP-007-002	The level of ATCO situation awareness remains within acceptable levels during the delegation procedure for the Night Use Case.	Medium Complexity	Criterion has been met. Globally the situation awareness was positively assessed by all the ATCOs.	OK	
	EXE6-CRT-PJ.10-W2-93-V3-VALP-007-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.	Medium Complexity	Criterion has been met. Controller that used the system stated their trust in it.	OK	
	EXE6-CRT-PJ.10-W2-93-V3-VALP-007-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.	Medium Complexity	Criterion has been partially met. ATCOs were able to perform their tasks properly thanks to reliable information and the absence of latency problem. However, the robustness of the system	Partially OK	



				was considered as not good enough.		
EXE6-CRT-PJ.10-W2-93-V3-VALP-007-005	The level of SUP workload remains within acceptable levels during the delegation procedure for the Night Use Case.	Medium Complexity	This success criterion has not been covered.	N/A		
EXE6-CRT-PJ.10-W2-93-V3-VALP-007-006	The level of SUP situation awareness remains within acceptable levels during the delegation procedure for the Night Use Case.	Medium Complexity	This success criterion has not been covered.	N/A		
EXE6-CRT-PJ.10-W2-93-V3-VALP-007-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.	Medium Complexity	This success criterion has not been covered.	N/A		
EXE6-CRT-PJ.10-W2-93-V3-VALP-007-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.	Medium Complexity	This success criterion has not been covered.	N/A		

EXE6-OBJ-PJ.10-W2-93-V3-VALP-009	To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand" use case.	EXE6-CRT-PJ.10-W2-93-V3-VALP-009-001	The level of ATCO workload remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Medium Complexity	Criterion has been partially met. The level of workload was high in the on-demand delegation use case. Although the ATCOs were able to perform their tasks, they had little spare capacity to additional tasks.	Partially OK	POK
		EXE6-CRT-PJ.10-W2-93-V3-VALP-009-002	The level of ATCO situation awareness remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Medium Complexity	Criterion has been partially met. Although the ATCOs succeeded in performing their tasks, their situation awareness during the On-Demand delegation was not the optimal.	Partially OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-009-003	The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.	Medium Complexity	Criterion has been met. ATCOs that used the system had complete trust in it to support their tasks efficiently.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-009-004	The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.	Medium Complexity	Criterion has been partially met. ATCOs were able to perform their tasks properly thanks to reliable information and the absence of latency problem. However, the robustness of the system	Partially OK	



				was considered as not good enough.		
EXE6-CRT-PJ.10-W2-93-V3-VALP-009-005	The level of SUP workload remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Medium Complexity		This success criterion has not been covered.	N/A	
EXE6-CRT-PJ.10-W2-93-V3-VALP-009-006	The level of SUP situation awareness remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Medium Complexity		This success criterion has not been covered.	N/A	
EXE6-CRT-PJ.10-W2-93-V3-VALP-009-007	The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.	Medium Complexity		This success criterion has not been covered.	N/A	
EXE6-CRT-PJ.10-W2-93-V3-VALP-009-008	The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.	Medium Complexity		This success criterion has not been covered.	N/A	



EXE6-OBJ-PJ.10-W2-93-V3-VALP-012	To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions.	EXE6-CRT-PJ.10-W2-93-V3-VALP-012-001	No negative impacts in terms of workload are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Medium Complexity	Criterion has been met. In nominal conditions, the level of workload remained acceptable and ATCOs could perform their tasks easily.	OK	POK
		EXE6-CRT-PJ.10-W2-93-V3-VALP-012-002	No negative impacts in terms of situation awareness are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Medium Complexity	Criterion has been met. Globally the ATCOs positively assessed their situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-012-003	No negative impacts in terms of potential human errors are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Medium Complexity	Criterion has been met. ATCOS agreed that the delegation process had impact in terms of human errors, their likelihood and frequency depending on the traffic load.	OK	
		EXE6-CRT-PJ.10-W2-93-V3-VALP-012-004	No negative impacts are identified with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.	Medium Complexity	Criterion has been met. Since there were no changes in roles and responsibilities, no impact was reported on the delegation process.	OK	

		<p>EXE6-CRT-PJ.10-W2-93-V3-VALP-012-005</p>	<p>No negative impacts in terms of communication load are identified before, during and after the delegation procedure of ATM services provision the delegation procedure in nominal conditions.</p>	<p>Medium Complexity</p>	<p>Criterion has been met. ATCOs did no experienced difficulties in terms of communication either of traffic information or coordination from a delegated sector to a non-delegated sector.</p>	<p>OK</p>	<p style="background-color: yellow;"></p>
		<p>EXE6-CRT-PJ.10-W2-93-V3-VALP-012-006</p>	<p>ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.</p>	<p>Medium Complexity</p>	<p>Criterion has been partially achieved. ATCOs were able to perform their tasks, however, they stated system related issues that impacted their activity.</p>	<p>Partially OK</p>	
<p>EXE6-OBJ-PJ.10-W2-93-V3-VALP-014</p>	<p>To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions.</p>	<p>EXE6-CRT-PJ.10-W2-93-V3-VALP-014-001</p>	<p>The level of safety remains at an acceptable level before, during and after the delegation of ATM services provision in nominal conditions.</p>	<p>Medium Complexity</p>	<p>Criterion has been met. Controllers agreed that the level of safety remained acceptable with the introduction of the new operating method particularly in terms of coordination between executive and planner ATCOs.</p>	<p>OK</p>	<p style="background-color: green;"></p>
		<p>EXE6-CRT-PJ.10-W2-93-V3-VALP-014-002</p>	<p>No negative impacts in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in</p>	<p>Medium Complexity</p>	<p>Criterion has been met. ATCOs were able to ensure the management and provision of aircraft separation thanks to a good situational awareness and efficient coordination</p>	<p>OK</p>	

			nominal conditions are identified.		between planner and executive ATCOs.		
EXE6-OBJ-PJ.10-W2-93-V3-VALP-018	To assess the performance benefits in terms of Predictability of the delegation of ATM services provision among ATSUs concept.	EXE6-OBJ-PJ.10-W2-93-V3-VALP-018-001	A positive increase on predictability is demonstrated.	Medium Complexity	Criterion has been partially met. Although the ATCOs could anticipate predictability increase, they also estimated that it would take more training and system improvement to achieve this goal.	Partially OK	POK
EXE6-OBJ-PJ.10-W2-93-V3-VALP-019	To assess the performance benefits in terms of Cost-Efficiency of the delegation of ATM services provision among ATSUs concept.	EXE6-CRT-PJ.10-W2-93-V3-VALP-019-001	A positive increase on ATCO productivity is demonstrated.	Medium Complexity	Criterion has been met. Some ATCOs reported a possible increase of productivity with the introduction of ATM services provision among ATSUS for delegation purposes.	OK	OK

Table ~~383838383838~~: Validation Results for Exercise 6

### E.3.2 Analysis of Exercise 6 Results per Validation objective

For Validation EXE-PJ10-W2-93-V3-VALP-006 data were collected by SAF and HP questionnaires, end of the day questionnaires, Debriefings and recorded data of planned trajectory.

HP questionnaires include:

- Post run-questionnaires: this questionnaire was proposed at the end of each run.
- Post Simulation Questionnaire: this questionnaire was proposed at the end of each day. They are referred to as “End of the day questionnaire”

#### 1. EX006-OBJ-PJ.10-W2-93-V3-VALP-001 Results – To demonstrate the operational feasibility of the delegation of ATM services provision for different traffic environment conditions.

##### a. CRT-10.02a-V2-VALP-001-001

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	GEN	EX6-OBJ-PJ.10-W2-93-V3-VALP-001 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-001-001  Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to medium density is gathered for the different use cases in nominal conditions.	Criterion has been met. The controllers/experts confirmed that in environments from low to medium density the operational feasibility was achieved bringing benefits in terms of Flight Efficiency.	OK

The operational feasibility of the delegation of ATM services provision in environments from low to medium density was assessed through several end-of-the day questions. The controllers' feedback is summarised as follows:

Page | 517

ATCOS agreed that the delegation of ATM services provision among ATSUs could bring benefits in terms of Flight Efficiency for AU with low to medium traffic density. They indicated that it would add value in terms of direct routing.

ATCOs disagreed that the delegation of ATM services provision among ATSUs could be suitable and/or appropriate during high density traffic. The situation awareness might be lost and the level of workload would increase therefore, it might get difficult to maintain the safety level. It should be used only in case of emergency because mistake would be likely to happen.

Recommendation 1: ATCOs should be trained to handle high traffic density in case of delegation of ATM services provision for emergency reason.

**b. CRT-10.02a-V2-VALP-001-002**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary Results	Suc. Crit. of Status
SDM-0217	GEN	EX6-OBJ-PJ.10-W2-93-V3-VALP-001 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-001-002  Positive feedback concerning the operational feasibility of the delegation of ATM services provision in environments from low to medium complexity is gathered for the different use cases in nominal conditions.	Criterion has been partially met. Although the complexity remained acceptable with the introduction of delegation of ATM services provision among ATSUS, the number of conflict areas increased with it.	POK

The operational feasibility of the delegation of ATM services provision in environments from low to medium complexity was assessed through an end-of-the day questionnaire, whose feedback is summarised as follows.

ATCOs agreed that the number of conflict areas increased with introduction of delegation of ATM services provision among ATSUs, even though the complexity remained acceptable.

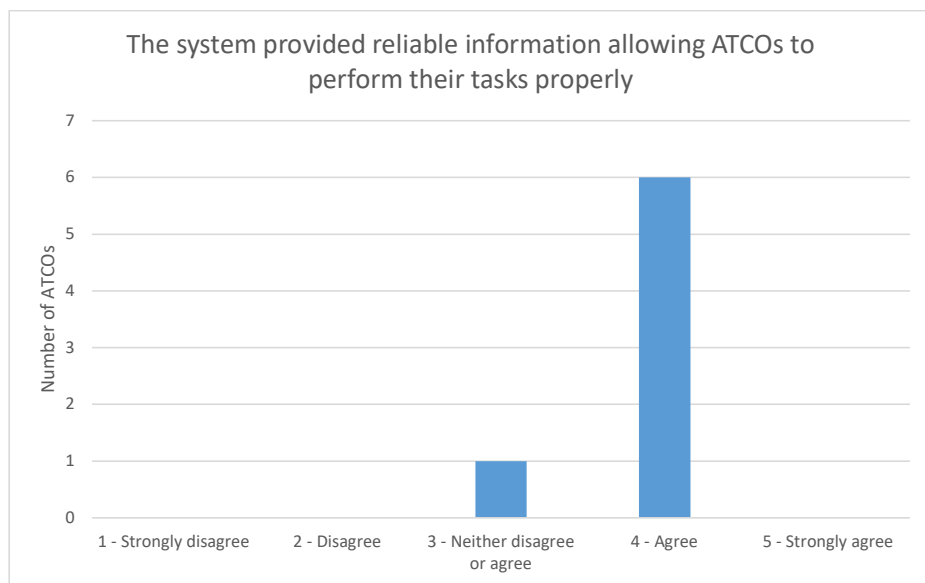
**c. CRT-10.02a-V2-VALP-001-005**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	GEN	EX6-OBJ-PJ.10-W2-93-V3-VALP-001 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-001-005  Potential limitations for the applicability of the delegation of ATM services provision are identified and documented for the different use cases in nominal conditions.	Criterion has been met. Even if the controllers were able to perform their tasks properly, they pointed out some limitations regarding the platform, the Flight Efficiency and the traffic predictability.	OK

The identification of the limitations for the applicability of the delegation of ATM services provision was assessed through an end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

Six out of seven ATCOs agreed (4) that the system provided reliable information allowing them to perform their tasks properly. The other ATCO neither agreed or disagreed (3) and indicated that STCA information and real radar data separation were missing.



ATCOs agreed that the delegation of ATM services provision among ATSUs could bring drawbacks in terms of Traffic Predictability (for ATC and AU). Since the procedures still need improvement, there might be some issues during the cases. Also, more training of ATCOs would be needed, specially to control bigger geographical areas.

Three out of seven ATCOs agreed that the delegation of ATM services provision among ATSUs could bring drawbacks in terms of Flight Efficiency for AU. One ATCO indicated that with huge traffic density the delegation might be delayed and it might become difficult for pilots.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-001 and the relative criteria can be considered partially achieved.*

**2. EX006-OBJ-PJ.10-W2-93-V3-VALP-002 Results – To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision at Night" use case.**



**a. CRT-10.02a-V2-VALP-002-001**

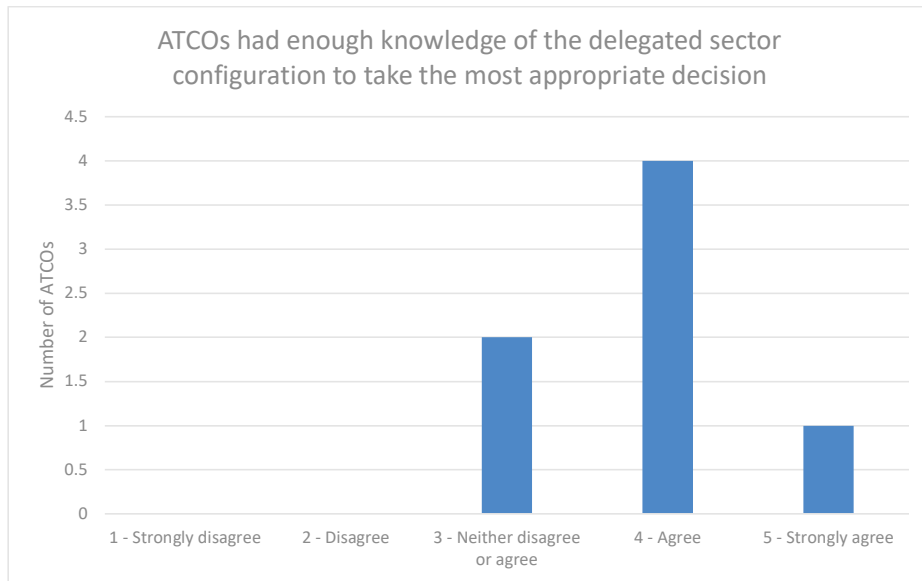
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-002 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-002-001 The delegation procedure for the Night Use Case, including the handover dialogue, is clearly defined and documented.	Criterion has been met. Although controllers were not always familiar with the delegated sector configuration, the delegation procedure, including handover dialogue, was clearly defined and documented for the Night delegation use case.	OK

The delegation procedure for the Night Use Case was assessed through an end-of-the day question with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

All ATCOs agreed that the delegation procedure, including handover dialogue, was clearly defined and documented for the Night Delegation use case.

ATCOs were not always familiar (3,4) with the delegated sector configuration to take the most appropriate decision, but it could be trained.



Recommendation 2: Practical and theoretical training on delegated sector configuration should be provided to the ATCOs.

**b. CRT-10.02a-V2-VALP-002-002**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-002 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-002-002 The delegation procedure for the Night Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	Criterion has been met. Controllers agreed that the delegation procedure, including handover dialogue, was operationally feasible for	OK

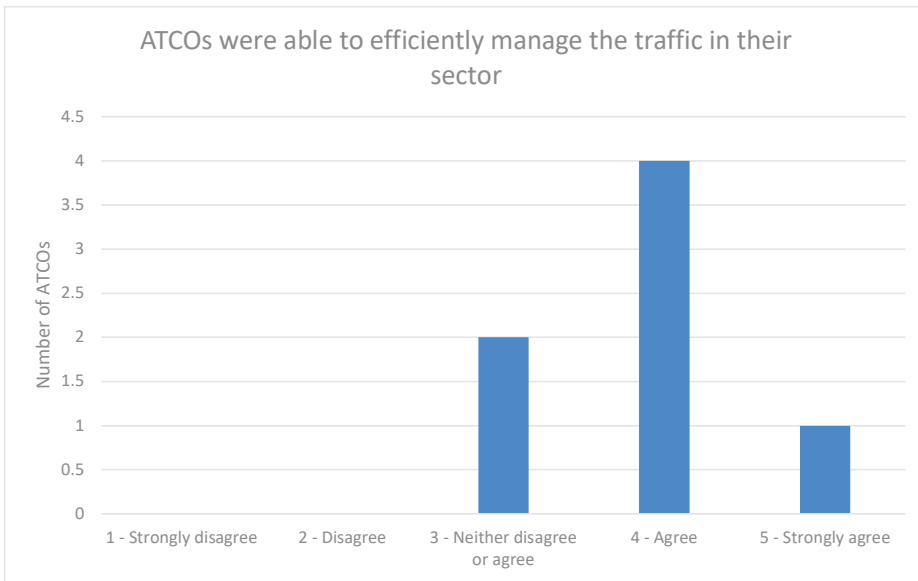
				the Night delegation use case.	
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The operational feasibility of the delegation procedure for the Night delegation use case was assessed through several questions from a post run questionnaire and an end-of-the day-questionnaire. The last, with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

In general, all ATCOs thought that the procedure delegation, including handover dialogue, for the Night delegation use case was operationally feasible for them and that the delegation was smooth. Two ATCOs mentioned that they needed more time to coordinate between sectors.

Two ATCOs agreed (4,5) that they were able to execute the new ATM delegation procedure all along the airspace delegation process. The other two ATCOs did not test it.

One ATCO strongly agreed (5) that he was able to efficiently manage the traffic in his sector. Four other ATCOs also agreed (4) that the delegation was manageable, despite some issues due to the weather conditions and the high level of traffic. The last two ATCO (3) thought that in very dense traffic it is difficult to manage traffic efficiently.



**c. CRT-10.02a-V2-VALP-002-003**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-002 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-002-003  No negative impact is identified with regards to the distribution of roles and responsibilities for the delegation procedure for the Night Use Case, including the handover dialogue.	Criterion has been met. Since there were no changes in roles and responsibilities, no negative impact was reported on the delegation process.	OK

Changes in roles and responsibilities were not foreseen in this exercise, therefore no impact was reported on the delegation process. The coordination between two ATCOs from a delegated sector to a non-delegated sector was assessed as efficient by the ATCOs, meaning that their roles and responsibilities were well defined during the delegation process.

**d. CRT-10.02a-V2-VALP-002-004**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary Results	Suc. Crit. of Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-002 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-002-004  No negative impact is identified with regards to the quality of the ATM services provision for the delegation procedure for the Night Use Case, including the handover dialogue.	Criterion has been met. There was no impact on ATM services quality during the delegation procedure for the Night delegation use case.	OK

All ATCOs agreed that for the Night use case there was no impact on ATM services quality during the delegation procedure (short term conflicts alert, Area proximity warnings).

However, ATCOS stated that there was both benefits and drawbacks in terms of Flight Efficiency for AU. The main benefit concerns giving more direct routing. The main drawback implies a high traffic density (cf. 1.a.CRT-10.02a-V2-VALP-001-001 and 1.c.CRT-10.02a-V2-VALP-001-005).

*EXE6-OBJ-PJ10-W3-93-V2-VALP-002 and the relative criteria can be considered achieved.*

**3. EX006-OBJ-PJ.10-W2-93-V3-VALP-004 Results – To demonstrate the operational feasibility of the ATM services provision delegation procedure for the "Delegation of ATM services provision On-Demand" use case.**

**a. CRT-10.02a-V2-VALP-004-001**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On-Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-004 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-004-001 The delegation procedure for the On-Demand Use Case, including the handover dialogue, is clearly defined and documented.	Criterion has been met. All ATCOs considered the delegation procedure well defined and documented.	OK

All ATCOs agreed that the delegation procedure for the On-Demand Use Case, including handover dialogue, was clearly defined and documented, except for one ATCO who reported that the documentation was not prepared for the exact scenario.

Although the ATCOs considered that the delegation procedure was well defined, they would have benefited from more training to get familiar with its implementation (cf. 2.a.CRT-10.02a-V2-VALP-002-001).

#### b. CRT-10.02a-V2-VALP-004-002

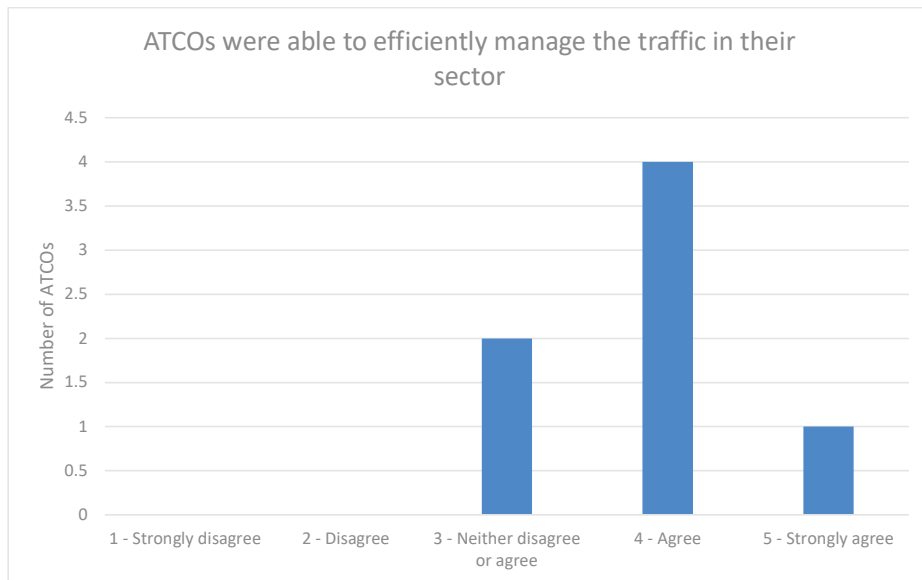
##### Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On-Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-004 Operational Feasibility Assessment	EX6-CRT-PJ.10-W2-93-V3-VALP-004-002 The delegation procedure for the On-Demand Use Case, including the handover dialogue, is judged as operationally feasible by the different actors involved in the delegation process.	Criterion has been met. Although some difficulties were met due to high traffic density and weather conditions, all the controllers found that for the on-demand use case the delegation procedure was operationally feasible.	OK

Regarding the On-Demand use case, ATCOs agreed that the situation was still manageable and feasible, even though they had some weather situation of turbulence. ATCOs were able to coordinate and provide all the information despite the fact that, due to an experimental limitation, the free text functionality was not working and they had to write down the information somewhere else.

ATCOs agreed that the delegation procedure, including handover dialogue, was operationally feasible, except for two ATCOs that experienced a loss of situation awareness where they did not know if the traffic was sent or not.

One ATCO strongly agreed (5) that he was able to efficiently manage the traffic in his sector. Four other ATCOS also agreed (4) that the delegation was manageable, despite some issues due to the weather conditions and the high traffic level. Lastly, two ATCOs thought that the feasibility depended (3) upon the traffic load, since in very high traffic level it was difficult to manage it efficiently.



**c. CRT-10.02a-V2-VALP-004-003**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status

SDM-0217	On-Demand	<p><b>EX6-OBJ-PJ.10-W2-93-V3-VALP-004</b></p> <p>Operational Feasibility Assessment</p>	<p><b>EX6-CRT-PJ.10-W2-93-V3-VALP-004-003</b></p> <p>No negative impact is identified with regards to the distribution of roles and responsibilities for the delegation procedure for the On-Demand Use Case, including the handover dialogue.</p>	<p>Criterion has been met. Since there were no changes in roles and responsibilities, no negative impact was reported on the delegation process.</p>	OK
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Changes in roles and responsibilities were not foreseen in this exercise, therefore there was no impact on the delegation process (cf. CRT-10.02a-V2-VALP-002-002).

**d. CRT-10.02a-V2-VALP-004-004**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On-Demand	<p><b>EX6-OBJ-PJ.10-W2-93-V3-VALP-004</b></p> <p>Operational Feasibility Assessment</p>	<p><b>EX6-CRT-PJ.10-W2-93-V3-VALP-004-004</b></p> <p>No negative impact is identified with regards to the quality of the ATM services provision for the delegation procedure for the On-Demand Use Case, including the handover dialogue.</p>	<p>Criterion has been met. All controllers agreed that the ATM services quality was not impacted during the on-demand delegation use case.</p>	OK

ATCOs agreed that for the On-Demand use case there was no impact on the ATM services quality during the delegation procedure (short term conflicts alert, Area proximity warnings).

For instance, in order to check the STCA behaviour and actions between two controllers, one ATCO allowed a descent on an aircraft already transferred to the Polish control.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-004 and the relative criteria can be considered achieved.*

**4. EX006-OBJ-PJ.10-W2-93-V3-VALP-007 Results – To demonstrate the operational acceptance of the**



delegation procedure for the "Delegation of ATM services provision at Night" use case.

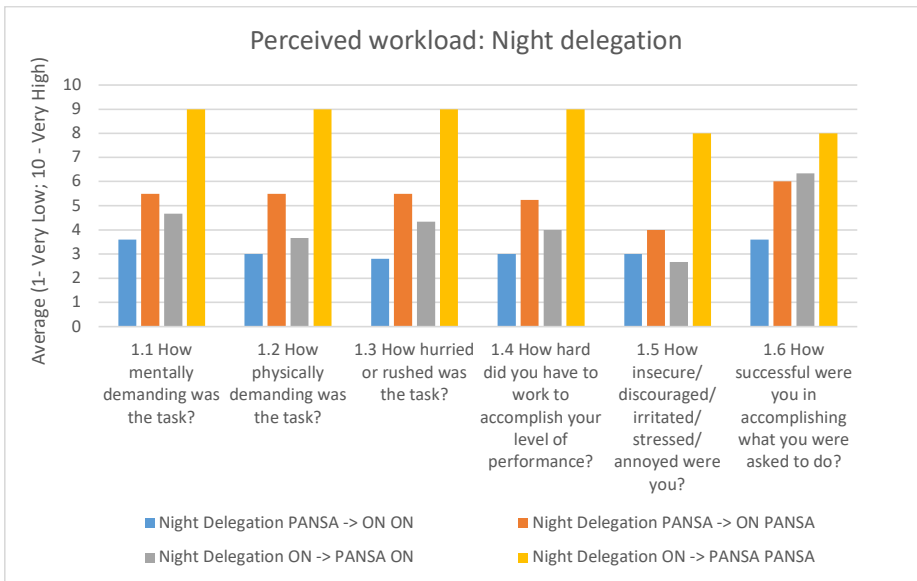
a. CRT-10.02a-V2-VALP-007-001

Overview

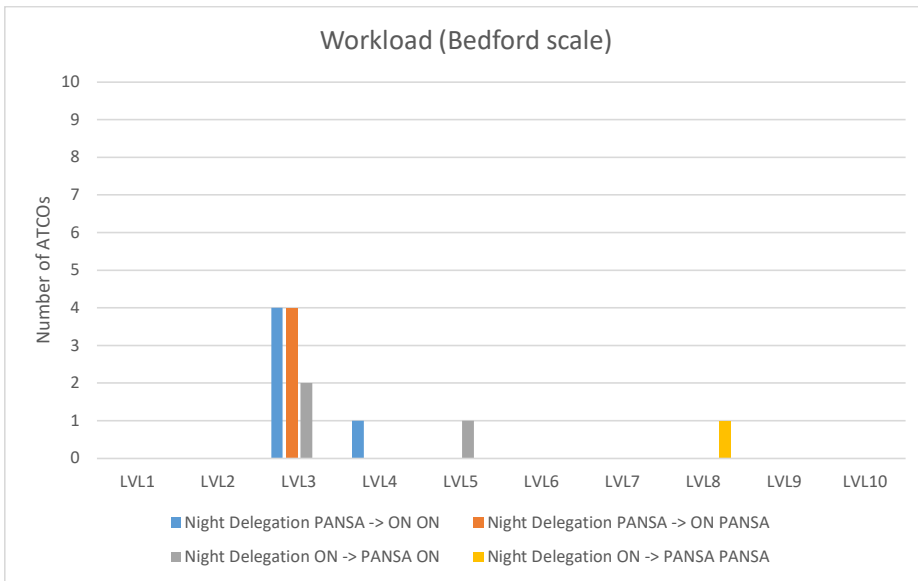
OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-001 The level of ATCO workload remains within acceptable levels during the delegation procedure for the Night Use Case.	Criterion has been partially met. The level of ATCO workload remained acceptable to low in all the Night delegation scenario except in the Night delegation from ON to PANSAs in which the controllers experienced a high level of workload.	POK

The level of workload was assessed through several post run questions with 10 response options ranging from Very Low (1) to Very High (10). Different Night delegation scenarios have been played, therefore different feedbacks have been obtained.

The following figure shows that the level of ATCO workload remained acceptable to low in all the Night delegation scenario except in the Night delegation from ON to PANSAs in which the controllers experienced a high level of workload.



The level of workload for the Night delegation use case was also assessed using the Bedford scale. The figure below shows that almost all the ATCOs had enough spare capacity for all desirable additional tasks, which in the Bedford scale means that the workload was not significant. One ATCO experienced a very high workload in the Night delegation scenario with almost no spare capacity which implied a difficulty in maintaining the level of work.



**b. CRT-10.02a-V2-VALP-007-002**

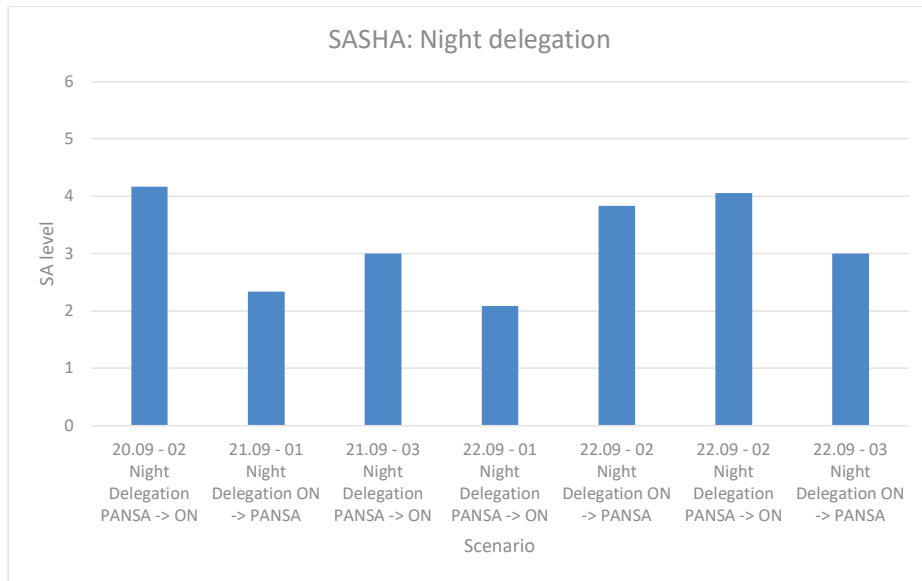
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-002 The level of ATCO situational awareness remains within acceptable levels during the delegation procedure for the Night Use Case.	Criterion has been met. Globally the situational awareness was positively assessed by all ATCOs	OK

The level of situational awareness induced by the delegation of ATM services was assessed through several post-run questions (SASHA) with 6 response options ranging from Never (0) to Always (6).

ATCOs were able to predict the evolution of the traffic; they rarely thought that there was a risk of forgetting important tasks; they were able to plan and organise their work as they want; they were

rarely surprised by an event they did not expect; and they rarely had to search for an item of information. Globally, situation awareness has been positively evaluated by all ATCOs:



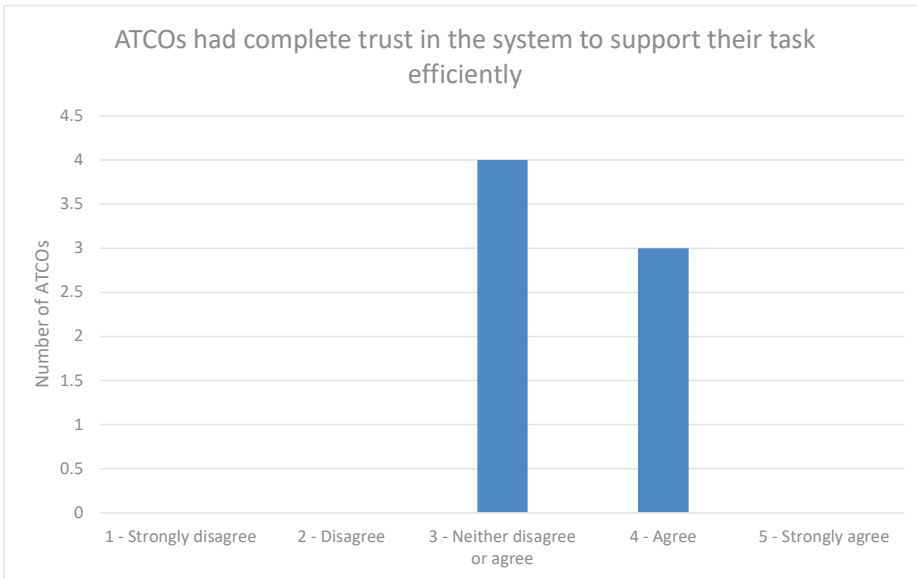
**c. CRT-10.02a-V2-VALP-007-003**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-003 The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.	Criterion has been met. The controllers that used the system stated their trust in it.	OK

The level of trust in the system was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

Two ATCOs reported having had trust (4) in the system to support their task efficiently. The other two ATCOs did not use the system (3).



**d. CRT-10.02a-V2-VALP-007-004**

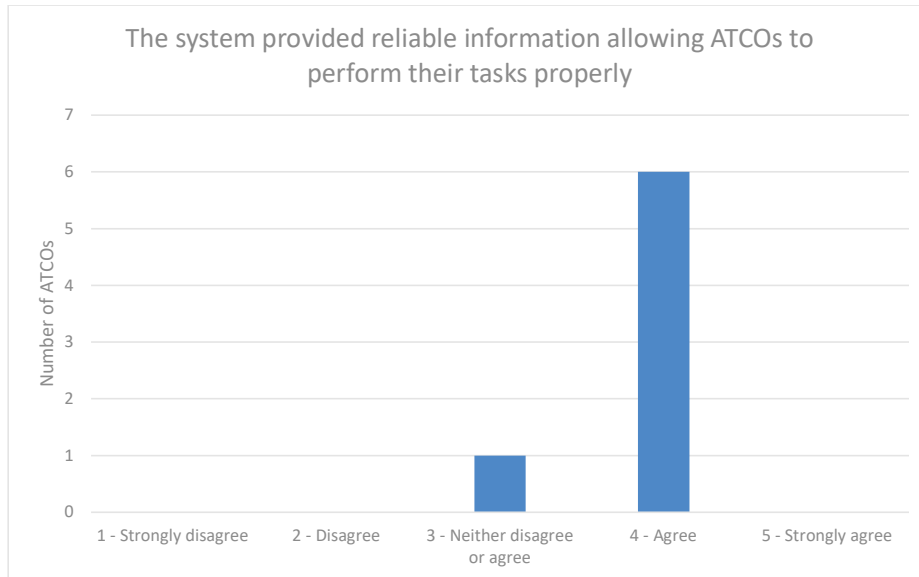
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status

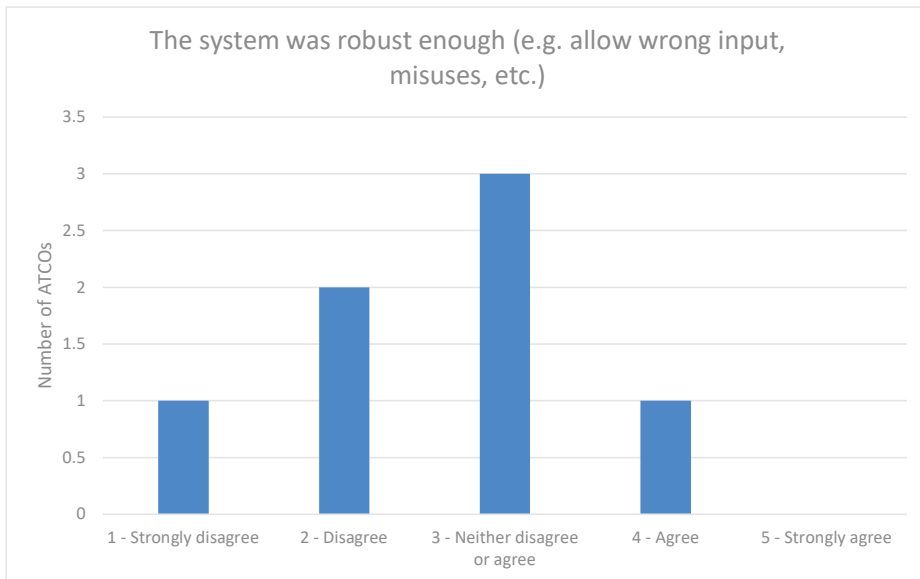
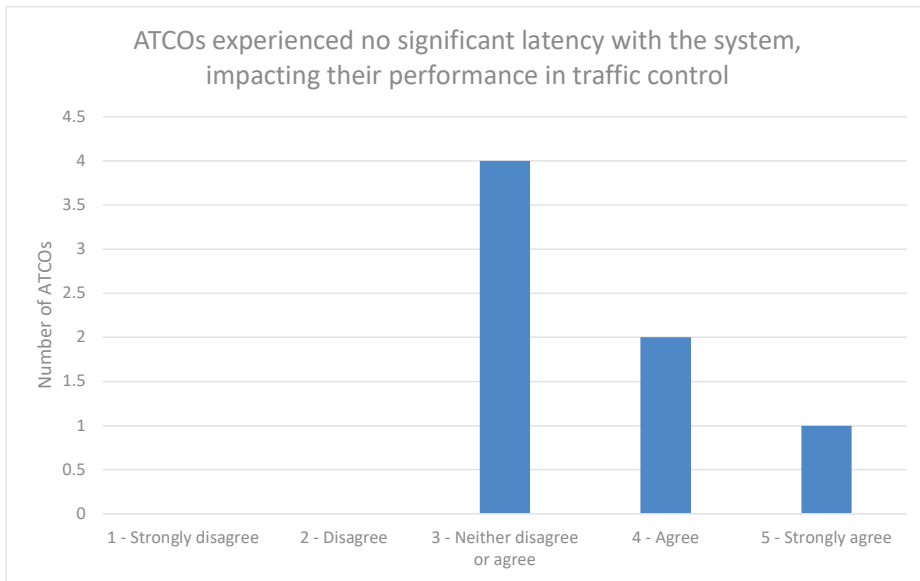
<b>SDM-0217</b>	<b>Night</b>	<p><b>EX6-OBJ-PJ.10-W2-93-V3-VALP-007</b></p> <p>Operational Acceptance</p>	<p><b>EX6-CRT-PJ.10-W2-93-V3-VALP-007-004</b></p> <p>The level of system support is judged as sufficient by the ATCO during the delegation procedure for the Night Use Case.</p>	<p>Criterion has been partially met. ATCOs were able to perform their tasks properly thanks to reliable information and the absence of latency problem. However, the robustness of the system was considered as not good enough.</p>	<b>POK</b>
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The level of system support was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

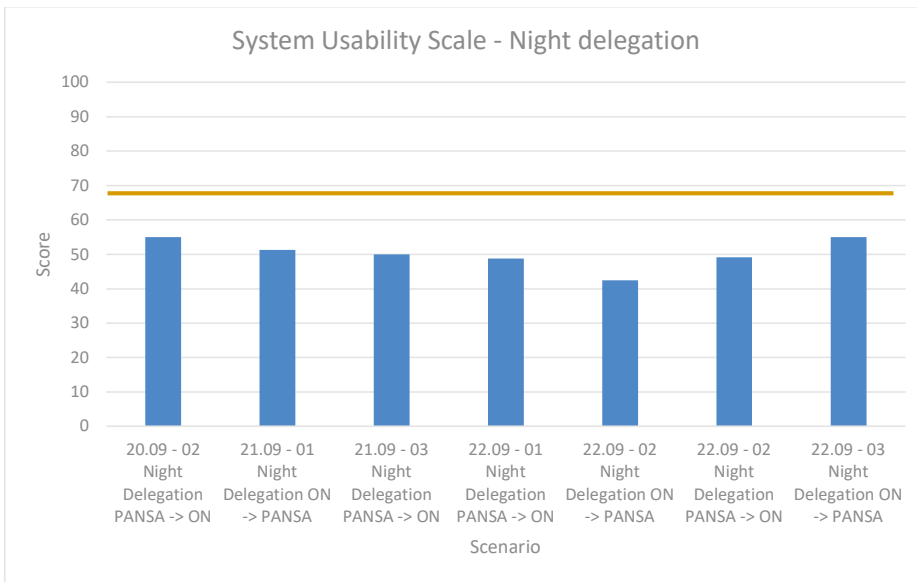
Some ATCOs felt that the system helped them to perform their activity (reliable information and no latency), while others were bothered by the lack of information (STCA) and the slowness of the system. All ATCOs agreed that the system is not robust enough.



One ATCO out of four fully agreed (5) that he/she experienced no significant latency with the system, impacting their performance in traffic control. The three other ATCOs neither disagreed or agreed (3).



The system support was assessed through the System Usability Scale (SUS). The figure below presents the scores obtained for each scenario. The orange horizontal line represents the standard average of SUS score (i.e. 68) under which the system usability is considered needing improvement.



According to the SUS scores, regarding all the Night delegation scenarios, the system usability should be improved in order to efficiently support the ATCOs in their tasks.

Recommendation 3: Improvement of the system usability should be made to better support the ATCOs in achieving their tasks during night delegation procedure.

**e. CRT-10.02a-V2-VALP-007-005**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status



SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-005 The level of SUP workload remains within acceptable levels during the delegation procedure for the Night Use Case.	This success criterion has not been covered.	N/A
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This success criterion is not covered. Only responses from ATCOs have been gathered.

#### f. CRT-10.02a-V2-VALP-007-006

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-006 The level of SUP situation awareness remains within acceptable levels during the delegation procedure for the Night Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

#### g. CRT-10.02a-V2-VALP-007-007

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-007 The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

**h. CRT-10.02a-V2-VALP-007-008**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Night	EX6-OBJ-PJ.10-W2-93-V3-VALP-007 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-007-008 The level of system support is judged as sufficient by the SUP during the delegation procedure for the Night Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-007 and the relative criteria can be considered partially achieved.*

**5. EX006-OBJ-PJ.10-W2-93-V3-VALP-009 Results – To demonstrate the operational acceptance of the delegation procedure for the "Delegation of ATM services provision On-Demand" use case.**

**a. CRT-10.02a-V2-VALP-009-001**

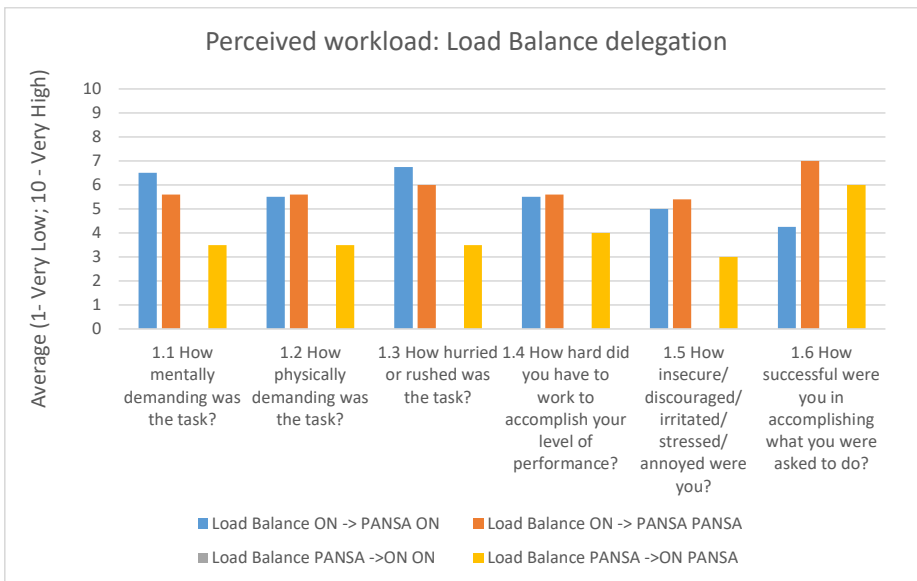
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
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<b>SDM-0217</b>	<b>On Demand</b>	<b>EX6-OBJ-PJ.10-W2-93-V3-VALP-009</b>  Operational Acceptance	<b>EX6-CRT-PJ.10-W2-93-V3-VALP-009-001</b>  The level of ATCO workload remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Criterion has been partially met. The level of workload was high in the on-demand delegation use case. Although the ATCOs were able to perform their tasks, they had little spare capacity to additional tasks.	<b>POK</b>
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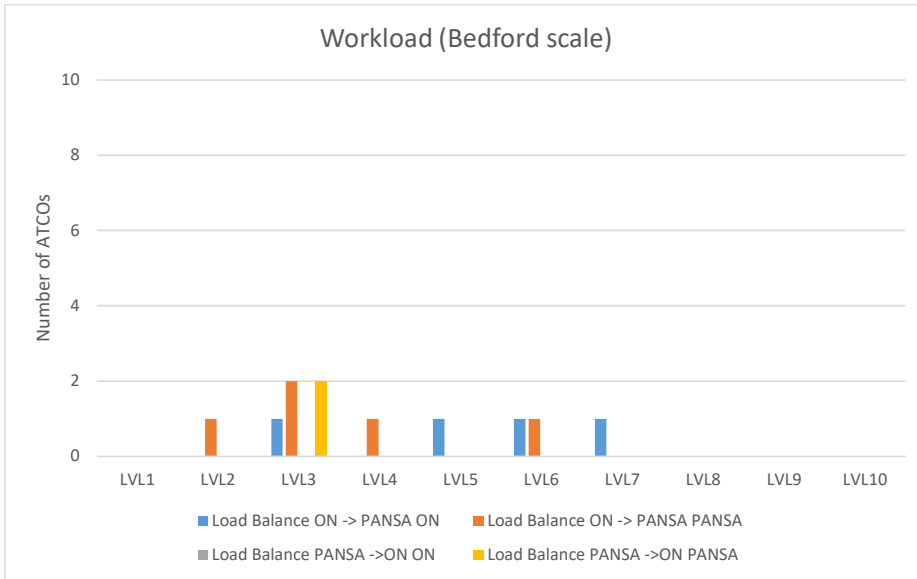
The level of workload was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

ATCOs agreed (4) that the workload during the delegation of ATSU services was manageable. Despite some issues due to weather conditions such as turbulences, the situation was still manageable. It depended also upon the traffic load.



The level of workload regarding the On-Demand delegation use case was also assessed using the Bedford Scale. The majority of ATCOs reported having had enough space capacity for all desirable additional tasks and considered that the workload was satisfactory without reduction. Other ATCOs

experienced little or reduced spare capacity to manage additional tasks. Lastly, one ATCO felt a very high workload with almost no spare capacity but with no impact to the primary ATM tasks.



**b. CRT-10.02a-V2-VALP-009-002**

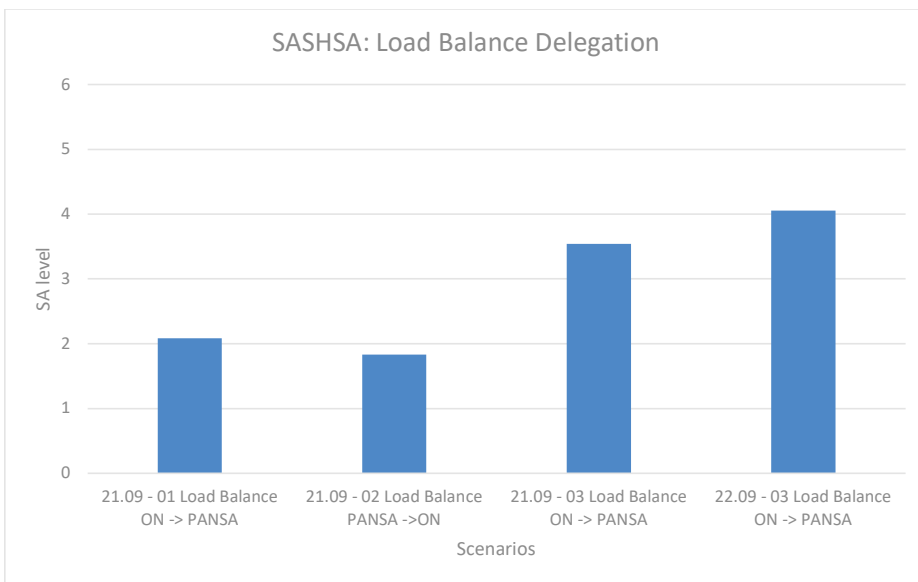
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009	EX6-CRT-PJ.10-W2-93-V3-VALP-009-002  The level of ATCO situation awareness remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	Criterion has been partially met. Although the ATCOs succeeded in performing their tasks, their situation awareness during the procedure for the On-Demand delegation was not optimal.	POK

The level of situational awareness induced by the delegation of ATM services for the On-Demand use case was assessed through several post-run questions with 6 response options ranging from Never (0) to Always (6).

ATCOs felt neutral in terms of being able to predict the evolution of the traffic; they often thought that there was a risk of forgetting an important task; they were often surprised by an event they did not expect; and they had almost always to search for an item of information to perform their tasks.

Compared to Night delegation us case, for the on-demand delegation scenario, situation awareness was evaluated less positively by ATCOs.



**c. CRT-10.02a-V2-VALP-009-003**

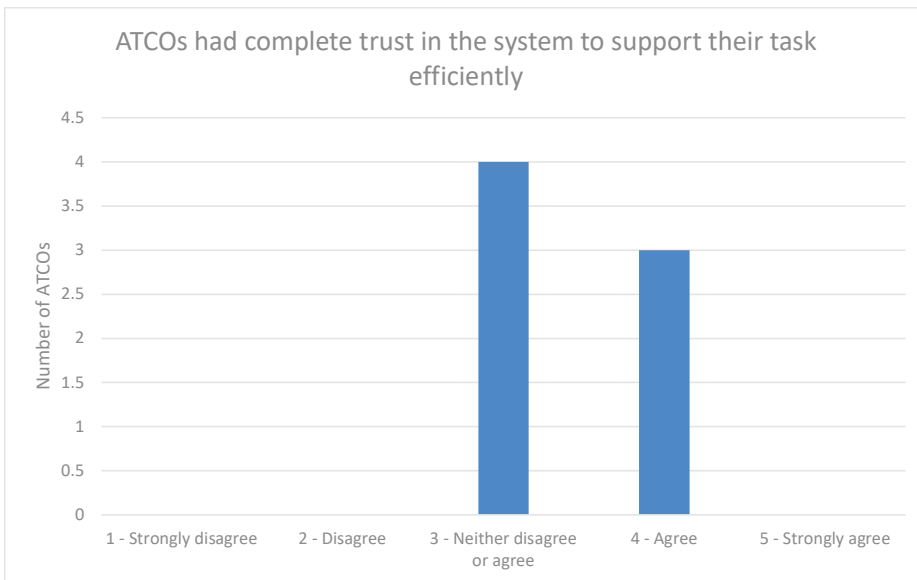
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status

<b>SDM-0217</b>	<b>On Demand</b>	<p><b>EX6-OBJ-PJ.10-W2-93-V3-VALP-009</b></p> <p>Operational Acceptance</p>	<p><b>EX6-CRT-PJ.10-W2-93-V3-VALP-009-003</b></p> <p>The level of trust in the system is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.</p>	<p>Criterion has been met. ATCOs that used the system had complete trust in it to support their tasks efficiently.</p>	<b>OK</b>
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The level of trust in the system was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

Two ATCOs reported having had trust (4) in the system to support their task efficiently. The other two ATCOs did not use the system (3).



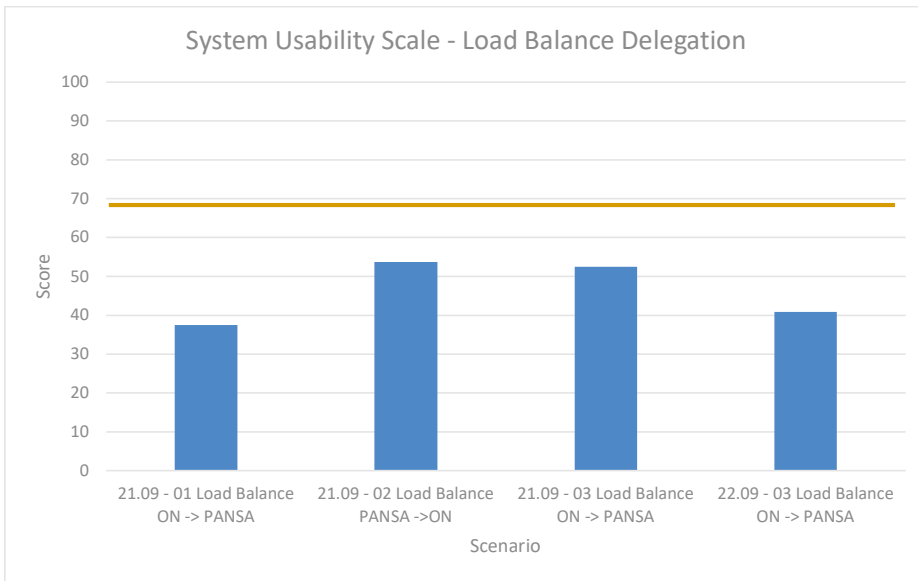
**d. CRT-10.02a-V2-VALP-009-004**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009	Operational Acceptance	<p>EX6-CRT-PJ.10-W2-93-V3-VALP-009-004</p> <p>The level of system support is judged as sufficient by the ATCO during the delegation procedure for the On-Demand Use Case.</p>	<p>Criterion has been partially met. ATCOs were able to perform their tasks properly thanks to reliable information and the absence of latency problem. However, the robustness of the system was considered as not good enough.</p> <p>POK</p>

The level of system support was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5). The end of the day questionnaire involves both use cases Night and On-demand delegation. The feedback about the level of system support can be found in section 4.d.CRT-10.02a-V2-VALP-007-004.

The system support was assessed through the System Usability Scale (SUS). The figure below presents the scores obtained for each scenario. The orange horizontal line represents the standard average of SUS score (i.e. 68) under which the system usability is considered needing improvement.



According to the SUS scores, regarding all the On-Demand delegation scenarios, the system usability should be improved in order to efficiently support the ATCOs in their tasks.

Recommendation 4: Improvement of the System Usability should be made to support the ATCOs in achieving their tasks during on-demand delegation procedure.

**e. CRT-10.02a-V2-VALP-009-005**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009	EX6-CRT-PJ.10-W2-93-V3-VALP-009-005  The level of SUP workload remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	This success criterion has not been covered.	N/A



This success criterion is not covered. Only responses from ATCOs have been gathered.

#### f. CRT-10.02a-V2-VALP-009-006

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-009-006  The level of SUP situation awareness remains within acceptable levels during the delegation procedure for the On-Demand Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

#### g. CRT-10.02a-V2-VALP-009-007

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-009-007  The level of trust in the system is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

#### h. CRT-10.02a-V2-VALP-009-008

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	On Demand	EX6-OBJ-PJ.10-W2-93-V3-VALP-009 Operational Acceptance	EX6-CRT-PJ.10-W2-93-V3-VALP-009-007  The level of system support is judged as sufficient by the SUP during the delegation procedure for the On-Demand Use Case.	This success criterion has not been covered.	N/A

This success criterion is not covered. Only responses from ATCOs have been gathered.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-009 and the relative criteria can be considered partially achieved.*

## 6. EX006-OBJ-PJ.10-W2-93-V3-VALP-012 Results – To assess the impact in terms of Human Performance of the ATM services provision delegation concept in nominal conditions.

### a. CRT-10.02a-V2-VALP-012-001

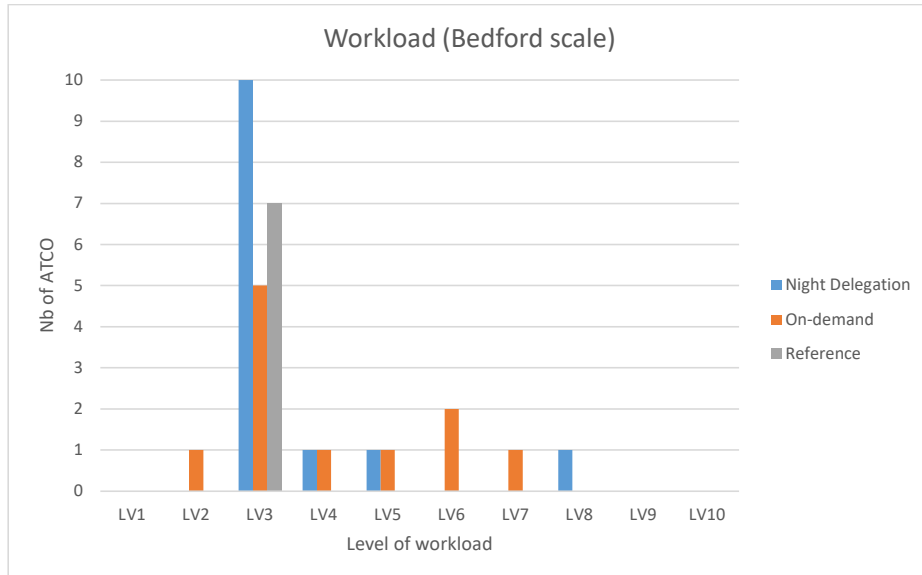
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Nominal Conditions	EX6-OBJ-PJ.10-W2-93-V3-VALP-012 Human Performance	EX6-CRT-PJ.10-W2-93-V3-VALP-012-001  No negative impacts in terms of workload are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Criterion has been met. In nominal conditions, the level of workload remained acceptable and ATCOs could perform their tasks easily.	OK

The level of workload was assessed through several end-of-the day questions with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

ATCOs agreed (4) that the workload during the delegation of ATSU services was manageable. Despite some issues due to weather conditions such as turbulences, the situation was still manageable. It depended also upon the traffic load.

The level of workload was also assessed using the Bedford scale. The following graph shows that for both Night and On-demand delegations, the workload was satisfactory without performance reduction. Level 3 in the Bedford scale means that there was enough spare capacity for all desirable additional tasks.



**b. CRT-10.02a-V2-VALP-012-002**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status

<b>SDM-0217</b>	<b>Nominal Conditions</b>	<b>EX6-OBJ-PJ.10-W2-93-V3-VALP-012</b>  Human Performance	<b>EX6-CRT-PJ.10-W2-93-V3-VALP-012-002</b>  No negative impacts in terms of situation awareness are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Criterion has been met. Globally the ATCOs positively assessed their situation awareness before, during and after the delegation procedure of ATM services provision in nominal conditions.	OK
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The situational awareness was assessed through several post run questions (SASHA) with 6 response options ranging from Never (1) to Always (6).

Situational awareness was better evaluated for the Night Use case than for the On-demand use case. The result of a general situation awareness is neutral. Therefore, even though the situation awareness was more positive for the Night use case, it was still positive for the On-demand use case. To sum up, situation awareness was assessed positively by ATCOS for both scenarios (cf. 4.b CRT-10.02a-V2-VALP-007-002 and 5.b CRT-10.02a-V2-VALP-009-002).

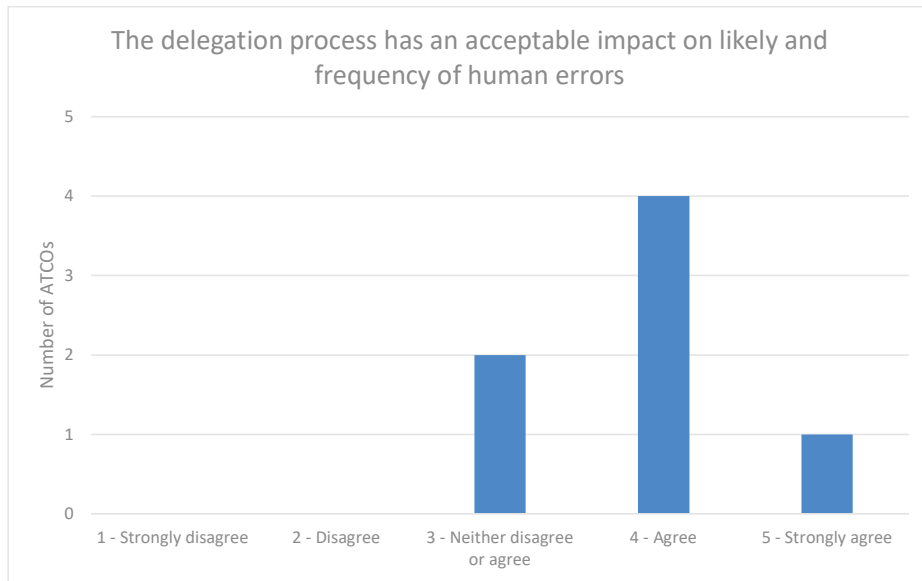
**c. CRT-10.02a-V2-VALP-012-003**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
<b>SDM-0217</b>	<b>Nominal Conditions</b>	<b>EX6-OBJ-PJ.10-W2-93-V3-VALP-012</b>  Human Performance	<b>EX6-CRT-PJ.10-W2-93-V3-VALP-012-003</b>  No negative impacts in terms of potential human errors are identified before, during and after the delegation procedure of ATM services provision in nominal conditions.	Criterion has been met. ATCOS agreed that the delegation process had an acceptable impact in terms of human errors, 548 their likelihood and frequency depending on the traffic load.	OK

The impact of human errors was assessed through an end-of-the day question with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

A majority of ATCOs reported that the delegation process had an acceptable impact on likely and frequency of human errors. They felt that human errors were strongly dependent on the traffic load.



**d. CRT-10.02a-V2-VALP-012-004**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Nominal Conditions	EX6-OBJ-PJ.10-W2-93-V3-VALP-012 Human Performance	EX6-CRT-PJ.10-W2-93-V3-VALP-012-004 No negative impacts are identified with regards to the distribution of roles and responsibilities before, during and after the delegation procedure of ATM services provision in nominal conditions.	Criterion has been met. Since there were no changes in roles and responsibilities, no impact was reported on the delegation process.	OK

Changes in roles and responsibilities were not foreseen in this exercise, therefore there was no impact on the delegation process. The coordination between two ATCOs from a delegated sector to a non-delegated sector was assessed as efficient by the ATCOs, meaning that their roles and responsibilities were well defined during the delegation process.

**e. CRT-10.02a-V2-VALP-012-005**

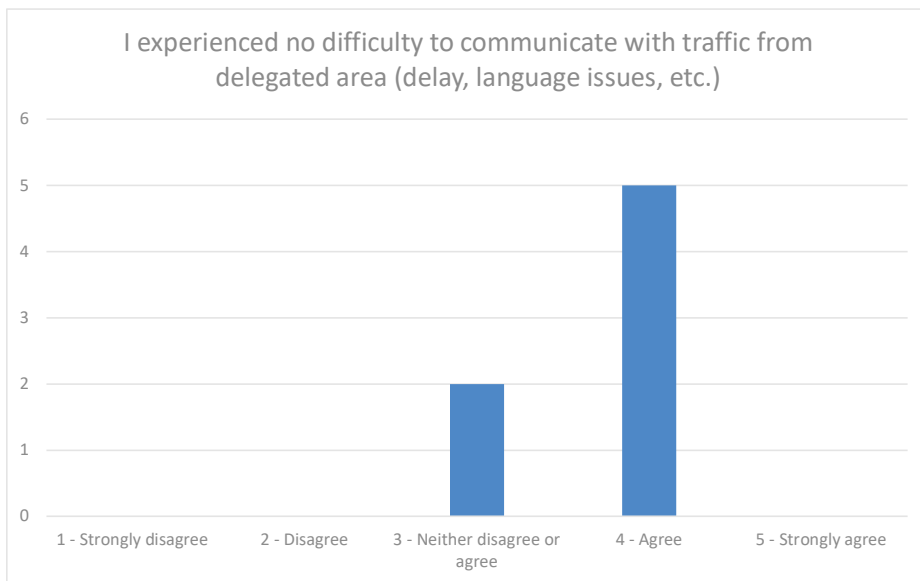
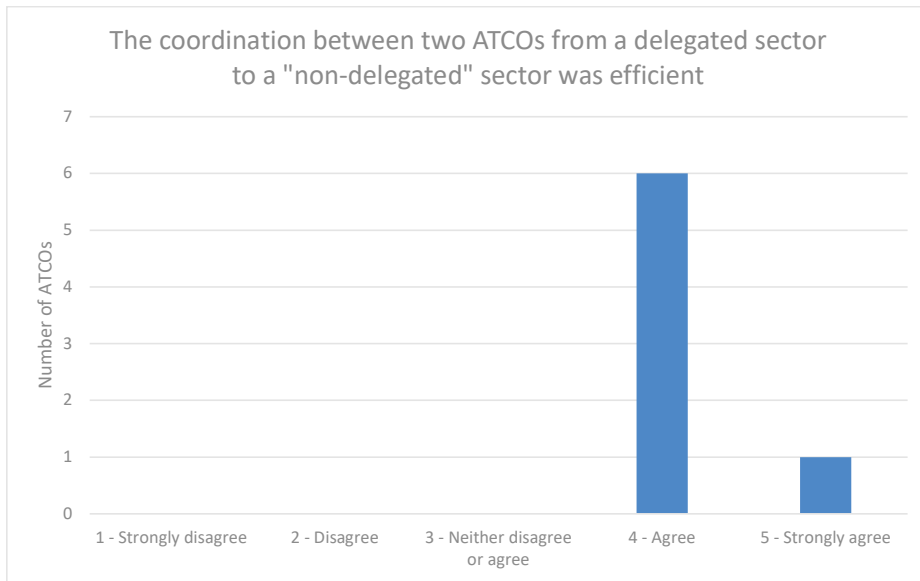
Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Nominal Conditions	EX6-OBJ-PJ.10-W2-93-V3-VALP-012 Human Performance	EX6-CRT-PJ.10-W2-93-V3-VALP-012-005 No negative impacts in terms of communication load are identified before, during and after the delegation procedure of ATM services provision the delegation procedure in nominal conditions.	Criterion has been met. ATCOs did not experienced difficulties in terms of communication either of traffic information or coordination from a delegated sector to a non-delegated sector.	OK

The communication load was assessed through an end-of-the day question with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

The ATCOs agreed (4) that the coordination between two ATCOs from a delegated sector to a “non-delegated” sector was efficient. One ATCO reported an unusual situation where there was a lot of information to coordinate, however it remained manageable.

They also agreed (4) that they experienced no difficulty to communicate with the traffic from a delegated area (delay, language issues, etc.) Two ATCOs (3) experienced some issues with the frequencies: a lot of pilots were showing up on the frequency at the same time or were not showing up at all. There were also some delays, but it remained generally manageable.



**f. CRT-10.02a-V2-VALP-012-006**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Nominal Conditions	EX6-OBJ-PJ.10-W2-93-V3-VALP-012	Human Performance	<p>EX6-CRT-PJ.10-W2-93-V3-VALP-012-006</p> <p>ATCO support tools provided before, during and after the delegation of ATM services provision in nominal conditions do not impair ATCO human performance.</p> <p>Criterion has been partially achieved. ATCOs were able to perform their tasks, however, they stated system related issues that impacted their activity.</p>	POK

Although ATCOs were able to perform their tasks, they stated some robustness issues of the system as well as some slowness problems. In addition, ATCOs were involved with different HMIs and limited support visibility of information was available (cf. 4.d CRT-10.02a-V2-VALP-007-004 and 5.d CRT-10.02a-V2-VALP-009-004).

Recommendation 5: ATCOs should be trained to the new operating method and the related new functionalities provided to support the delegation and control process.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-012 and the relative criteria can be considered partially achieved.*

**7. EX006-OBJ-PJ.10-W2-93-V3-VALP-014 Results – To assess the impact in terms of Safety of the ATM services provision delegation concept in nominal conditions**

**a. CRT-10.02a-V2-VALP-014-001**

Overview

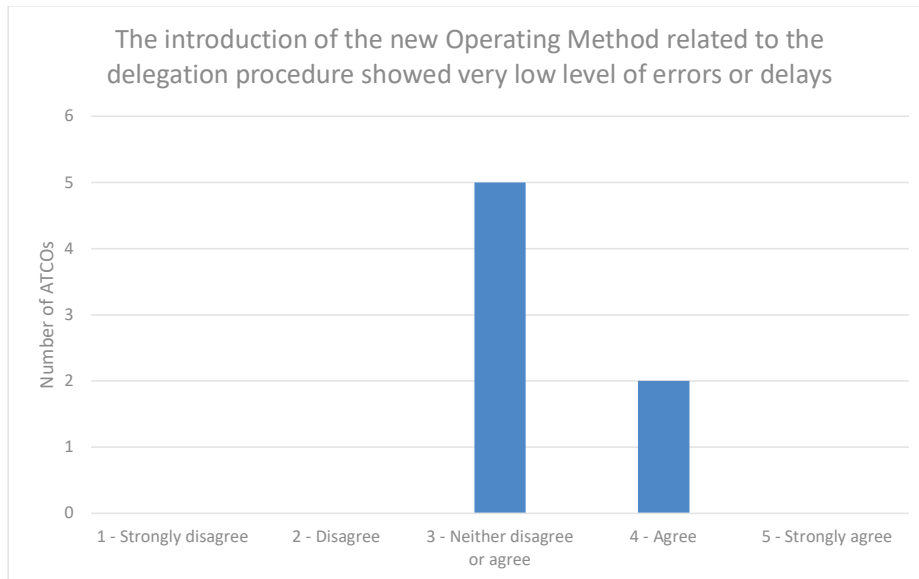
OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
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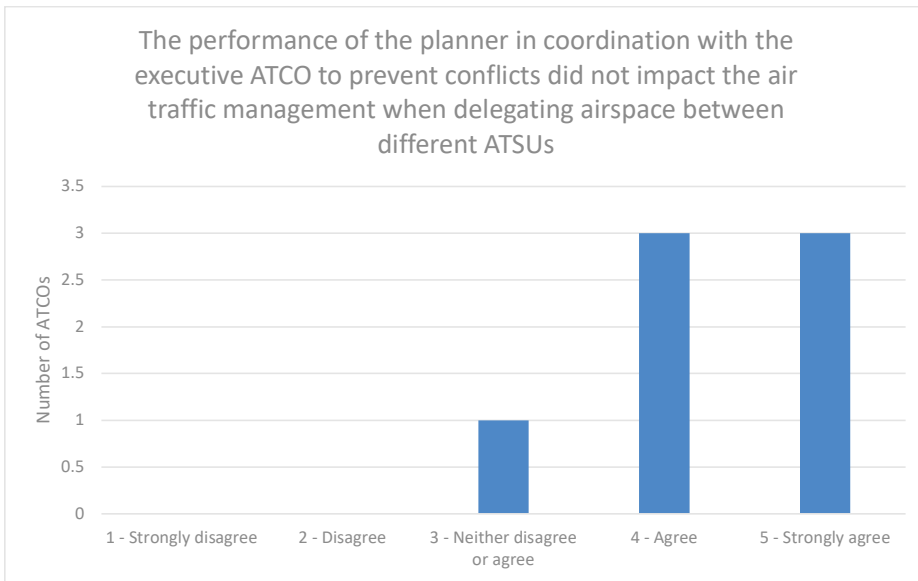
<b>SDM-0217</b>	<b>Nominal Conditions</b>	<p><b>EX6-OBJ-PJ.10-W2-93-V3-VALP-014</b></p> <p>Safety</p>	<p><b>EX6-CRT-PJ.10-W2-93-V3-VALP-014-001</b></p> <p>The level of safety remains at an acceptable level before, during and after the delegation of ATM services provision in nominal conditions.</p>	<p>Criterion has been met. Controllers agreed that the level of safety remained acceptable with the introduction of the new operating method particularly in terms of coordination between executive and planner ATCOs.</p>	OK
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The level of safety was assessed through an end-of-the day question with 5 response options ranging from Strongly disagree (1) to Strongly agree (5).

The ATCOs agreed (3,4) that the introduction of the new Operating Method related to the delegation procedure showed very low level of errors or delays.



The ATCOs agreed (4,5) that the performance of the planner in coordination with the executive ATCO to prevent conflicts did not impact the air traffic management when delegating airspace between different ATSUs.



**b. CRT-10.02a-V2-VALP-014-002**

Overview

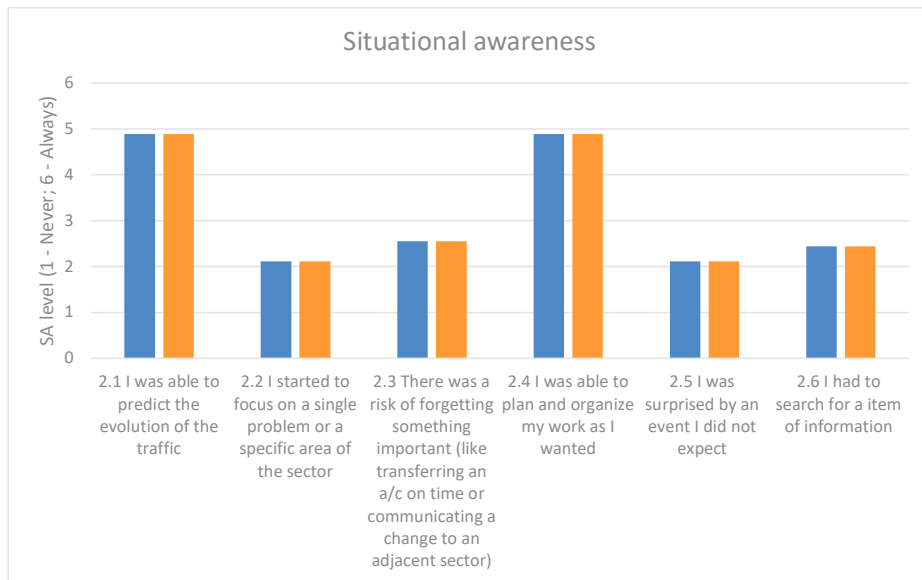
OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217	Nominal Conditions	EX6-OBJ-PJ.10-W2-93-V3-VALP-014 Safety	EX6-CRT-PJ.10-W2-93-V3-VALP-014-002 No negative impacts in terms of the management and provision of aircraft separation before, during and after the delegation of ATM services provision in nominal conditions are identified.	Criterion has been met. ATCOs were able to ensure the management and provision of aircraft separation thanks to a good situational awareness and efficient coordination between planner and executive ATCOs.	OK

As mentioned previously, the air traffic management was not impacted during the delegation by the performance of the planner in coordination with the executive controller to prevent conflicts. Also, the introduction of new operating method related to delegations showed very low level of errors or

delays (cf. [CRT-10.02a-V2-VALP-014-001](#)[CRT-10.02a-V2-VALP-014-001](#)[CRT-10.02a-V2-VALP-014-001](#)[CRT-10.02a-V2-VALP-014-001](#)).

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The figure below shows the ATCOs responses about the situational awareness regarding safety aspects involving the management and provision of aircraft separation. Being able to predict the evolution of the traffic and being able to plan and organise the ATCOs tasks, allowed for an efficient safety management of the delegations. In addition, controllers stated that they were rarely focused on a single problem, or surprised by an event they did not expect.



*EXE6-OBJ-PJ10-W3-93-V2-VALP-014 and the relative criteria can be considered partially achieved.*

**8. EX006-OBJ-PJ.10-W2-93-V3-VALP-018 Results – Performance - PRD**

**a. CRT-10.02a-V2-VALP-018-001**

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
SDM-0217		EX6-OBJ-PJ.10-W2-93-V3-VALP-018 Performance	EX6-CRT-PJ.10-W2-93-V3-VALP-018-001 A positive increase on predictability is demonstrated.	Criterion has partially been met. Although the ATCOs could anticipate predictability increase, they also estimated that it would take more training and system improvement to achieve this goal.	POK

The increase on predictability was assessed through end-of-the day questions, whose feedback is summarised as follows.

All ATCOs except one agreed that the delegation of ATM services provision among ATSUs could bring benefits in terms of Traffic Predictability (for ATC and AU). They also mentioned that the traffic in a controlled single sector would always be more predictable. One ATCO thought that it would be the same, but with less coordination when controlling the delegated sector.

All ATCOs except one also agreed that the delegation of ATM services provision among ATSUs could bring drawbacks in terms of Traffic Predictability (for ATC and AU). Since the procedures still need improvement, there might be some issues during the cases. Also, more training of ATCOs would be needed, especially to control bigger geographical areas. One ATCO estimated that there was no negative effect.

*EXE6-OBJ-PJ10-W3-93-V2-VALP-0018 and the relative criteria can be considered partially achieved.*

## 9. EX006-OBJ-PJ.10-W2-93-V3-VALP-019 Results – Performance - CEF

### a. CRT-10.02a-V2-VALP-019-001

Overview

OI	Use Case	Validation Objective	Success criteria	Summary of Results	Suc. Crit. Status
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SDM-0217		EX6-OBJ-PJ.10-W2-93-V3-VALP-019 Performance	EX6-CRT-PJ.10-W2-93-V3-VALP-019-001 A positive increase on ATCO productivity is demonstrated.	Criterion has been met. Some ATCOs reported a possible increase of productivity with the introduction of ATM services provision among ATSUS for delegation purposes.	OK
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The positive increase on ATCO productivity was assessed through end-of-the day questions, whose feedback is summarised as follows.

The productivity is linked to the Flight Efficiency, traffic predictability, level of workload and situational awareness. All these aspects have already been mentioned in the previous sections and the feedback was globally positive. Therefore, the introduction of ATM service provision among ATSUs for delegation purposes was demonstrated (cf. 1.a.CRT-10.02a-V2-VALP-001-001 and 1.c.CRT-10.02a-V2-VALP-001-005 and 8.a CRT-10.02a-V2-VALP-018-001 and 6.a CRT-10.02a-V2-VALP-012-001 and 6.b CRT-10.02a-V2-VALP-012-002).

*EXE6-OBJ-PJ10-W3-93-V2-VALP-019 and the relative criteria can be considered achieved.*

### E.3.3 Unexpected Behaviours/Results

- During validation preparation differences in licencing between PANSAs and ON transpired .
- In PANSAs GAT and OAT ATC services are split to two separate services, ATCOs of GAT ACC are not rated for OAT and vice-versa. In ON ACC ATCOs are rated for both OAT and GAT. That creates legislative and technological issues. Namely delegation from ON to PANSAs would require two pairs of ATCOs to receive a sector. This could be mitigated by receiving delegation of a sector to an already existing airspace by means of consolidation of sectors, but that method of airspace management is declared by INDRA as too much effort to develop required technology and overcome obstacles deriving from consolidating airspace from different OLDI and AFTN regions to one ADSP. Resulting licencing and technological issues would require significant effort to reach operational readiness.
- iTEC system version chosen for the solution proved to be underdeveloped for the validation. Amount of errors, system messages requiring override and other issues like inability to set an XFL above vertical level of the sector was commented by every ATCO as workload inducing and distracting. Further ATCO comments in the debriefing sessions compared system performance to video game level of realism, ATCOs didn't feel that delegation process reflects operational standards of system reliability, some of the normal operational procedures had to be neglected for the validation.
- Above does not apply to presentation of simulated radar data, which was displayed accurately.

- ATCOs had to deal with a great deal of confusion when using another FIR radar callsign. During low workload proper callsign was used, but as workload increased and more tasks were done in automated way ACC callsign confusion happened more often.
- ATCOs didn't come to a consensus whether to use callsign of Delegating ATSU or maintain own callsign, with an even distribution of opinions.
- Emergency situations were exercised during the validation additionally to solution scenarios.
- Emergency on an aircraft brought conclusions of a thorough training needed for another ATSU airspace and aerodrome knowledge, with a separate rating and licencing included.
- Emergency regarding another ATSU of providing ATC service i.e. fire in the OPS room was exercised, with similar conclusions.
- ATCOs named some system functionalities that could be of use in-system regarding another ATSU airspace and aerodromes like runway in use designators, procedures, RWY characteristics etc.
- General conclusion "If everything was in place delegation would be operationally viable." was stated by ATCOs.
- Proper validation of such delegation should include all out coordination capabilities with all surrounding FIRs and services, large number of ATCOs, thorough training of airspace, dedicated VSC system, etc.

## E.3.4 Confidence in Results of Validation Exercise 6

### 1. Level of significance/limitations of Validation Exercise Results

The validation had to be carried out in a limited scope. Due to the technical problems in April, it was impossible to carry out the exercise in first appointed date. Unfortunately, it was known that ATCO strike is brewing due to internal PANSA affairs. Validation was postponed to September as the latest available slot in PANSA ITEC platform calendar in hope of waiting out the strike and resuming SESAR activities when operational personnel availability will stabilize. That did not happen until mid-October and joint PJ.10/32 validation was executed only due to Oronavigacija lending their ATCOs to PANSA to substitute missing personnel. All of the above may have impact on confidence in results

### 2. Quality of Validation Exercises Results

High quality and representative results were obtained during the exercise.

Fully trained and operationally active controllers with 3 to 10 years of operational experience participated in the exercise.

The exercise was conducted at V2 level hence the impact of external factors such as weather, or differences in procedures between airlines was not tested.

During the exercise each pseudo-pilot controlled several aircraft. Under operational conditions the diversity of piloting styles would be higher.

Finally, the platform used during validations was different compared to the one which is in operation at PANSA.

### 3. Significance of Validation Exercises Results

The obtained results are operationally significant as the solution was tested in a range of realistic scenarios and traffic density conditions. At least two runs for each set of conditions were performed. Data was gathered and analysed using a range of well-established and industry accepted methodologies:

- EUROCONTROL SHAPE questionnaires: AIMs, SASHA, SATI (Trust), were used to monitor Human Performance aspects.
- Specific questionnaire items were developed for both the post run and the debriefing sessions. These items complemented the above methods and to maximise the collection of operational feedback specific for the validation objectives under investigation.

These considerations suggest that the results reported in this EXE are operationally significant.

#### E.3.5 Conclusions

- General conclusion “If everything was in place delegation would be operationally viable.” was stated by ATCOs.
- Significant licencing and procedural negotiations and workshops between each ATSU willing to implement such delegation should be exercised.
- If possible differences between operational procedures of ATSUs should be minimised, e.g. conditions for non-coordinated SKIP.
- It was very confusing to ATCOs to use another unit’s callsign, especially during high load.
- Possible mistakes in ATC unit callsign by ATCOs could confuse Pilots.
- Delegation should be planned 5-15 minutes in advance of increase in traffic.
- iTEC system should enable both sides of the delegation to input data in the Track Labels during the delegation procedure.

- Delegation during high load e.g. fire in the ops room, very high traffic, could lead to loss of situational awareness.
- Delegation procedure should be as simplified as possible.
- It is a good idea to delegate in layers i.e. top-down or bottom-up for safety reasons.TBC

### E.3.6 Recommendations

Recommendation 1: ATCOs should be trained to handle high traffic density in case of delegation of ATM services provision for emergency reason.

Recommendation 2: Practical and theoretical training on delegated sector configuration should be provided to the ATCOs.

Recommendation 3: Improvement of the system usability should be made to better support the ATCOs in achieving their tasks during night delegation procedure.

Recommendation 4: Improvement of the System Usability should be made to support the ATCOs in achieving their tasks during on-demand delegation procedure.

Recommendation 5: ATCOs should be trained to the new operating method and the related new functionalities provided to support the delegation and control process.



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