



Joint Human Machine Systems

Towards a human centred approach to
implementation of technology

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Toni Wäfler and Tom Laursen



DG of Eurocontrol Keith Mack, 1992

“Anyone surveying the air traffic control systems of today can observe that even the technology which has been available for many years is still far from being uniformly applied.

Technically we know, for example, how to engineer automatic data transfer between air traffic control centres; such facilities are not on the “leading edge” of advanced technology.

Yet controllers in much of Europe are still making telephone calls to pass boundary estimates on individual flights.



IFATCA and the future: *'We need to change our approach'*

- IFATCA would like to be part of the change process
 - Articles, Conference in January 2018, Workshop for members on AI, Conference in 2019,
- Suggestion to changed Master Plan approach in May 2018
- Reached out to Universities and Industry to find a way forward
 - Conceptual approach, necessary research, solutions and deployment
- We are now mature enough to suggest a way forward - JHMS

Defining A Human Centred System??

ATM Master Plan, 2015:

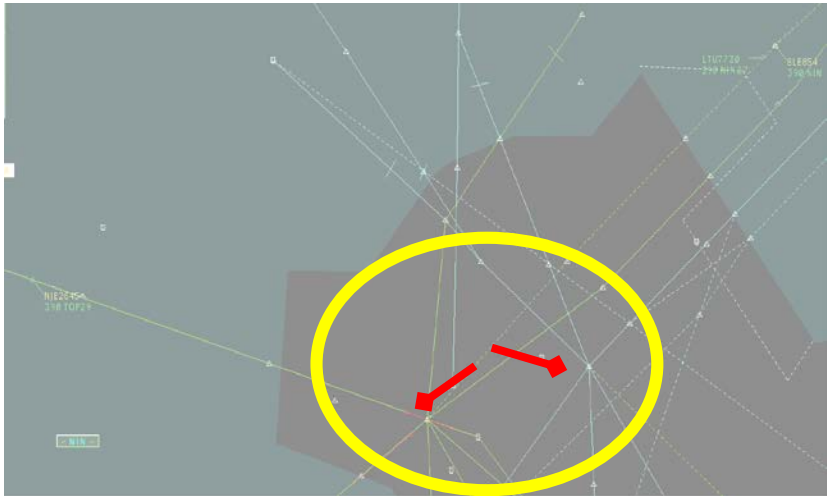
As in past and present operations, ATM performance will remain the result of a well-designed interaction between human, procedural, technological, environmental and organisational aspects.

ATM Master Plan, 2015:

ATCOs would thus be allowed to concentrate on tasks where human cognitive skills have added value

HALA, 2010:

Automation should not be Human versus machine, automation should be seen as human-machine coordination as a team.



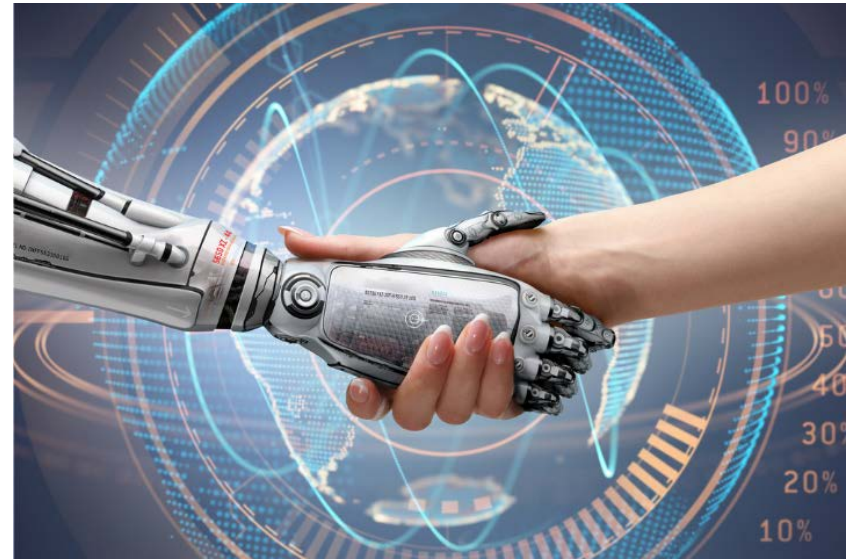
The Joint Human Machine System goal

A human centred approach to design and implementation of new technology

Closer collaboration between operators, system designers, system decision makers and the public

Human and machine compliment each other to achieve system goals

A humanistic design that allows humans to recover from the rare high-risk scenarios

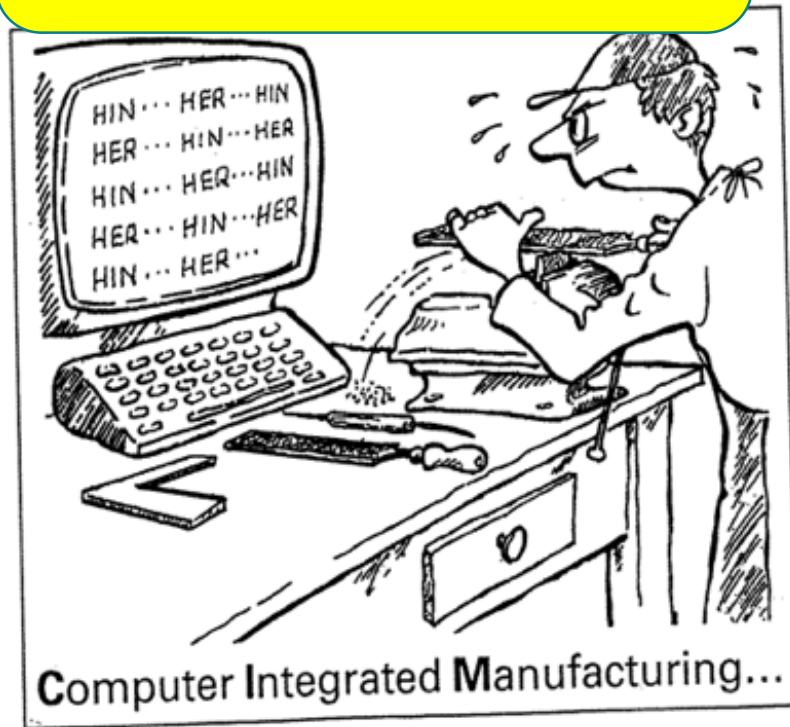


Joint: Human and Machine

(Wäfler et al., 2003)

Human vs. Machine

Human manages Machine
Or vice versa



Human and Machine

Complementarity of
Human and Machine



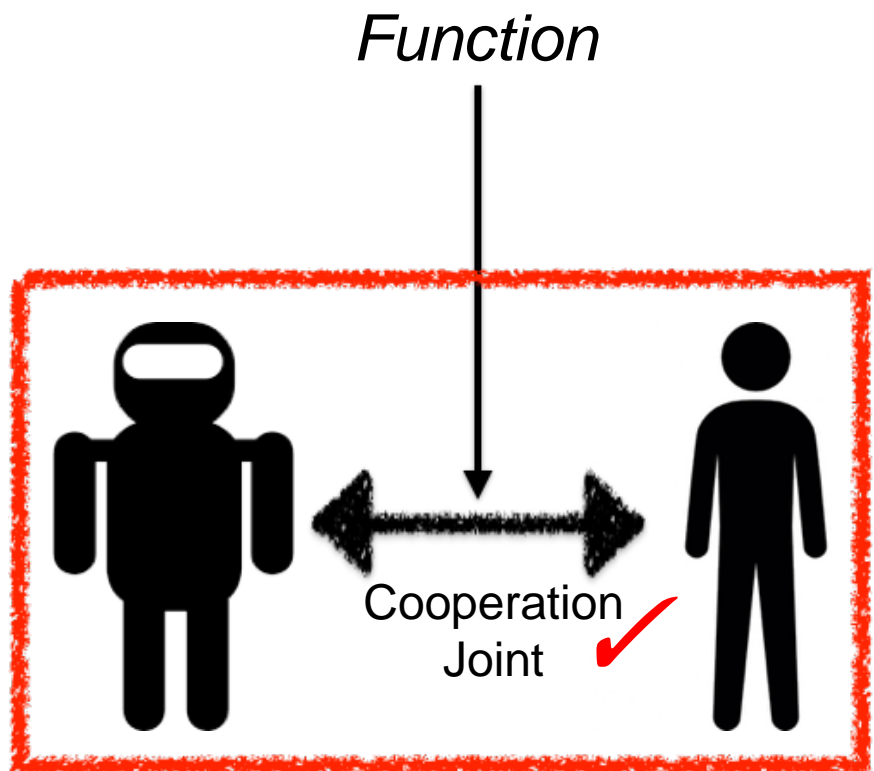
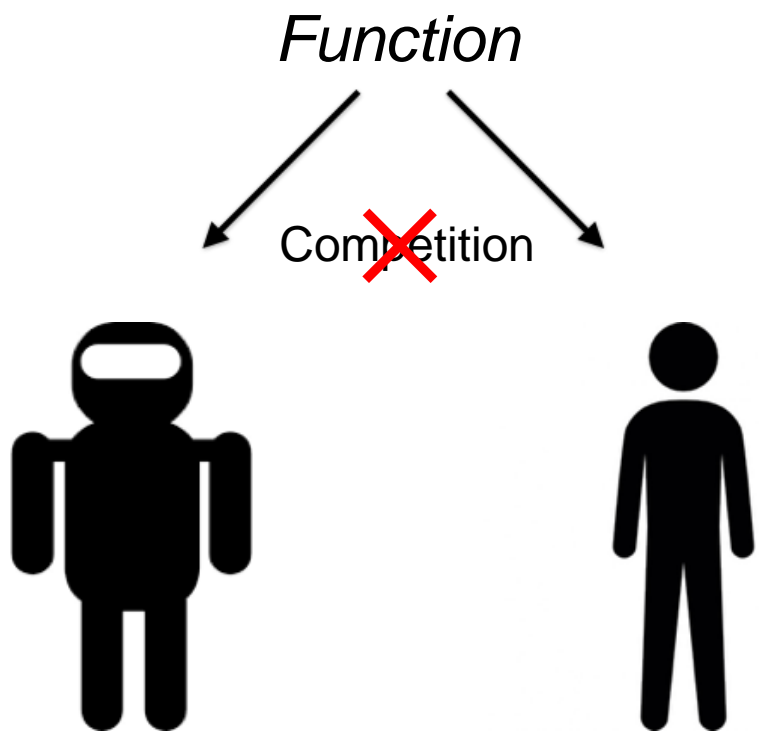
Hyundai

Function Allocation

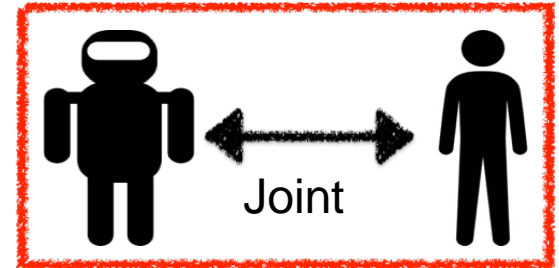
(Wäfler et al., 2003)

Human vs. Machine
Human manages Machine
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Human and Machine
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From MABA-MABA to Joint Teaming



OECD

Everyday math

11% of adults
better than AI

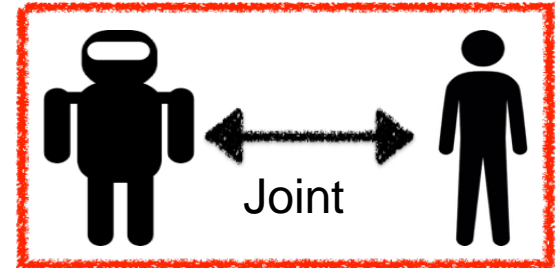
Japan: 37%
Sweden: 36%

(Elliott, 2017)

- Machines show amazing capability
- Still humans and machines are complementary
- Machine
 - Has deep knowledge
 - Calculates: May give good answers
- Human
 - Has cross-linked knowledge
 - Thinks: May ask good questions

(Brynjolfsson & McAfee, 2017; Floridi, 2015)

The Human Contribution



- Verification of technical decisions
- Improving technical system
- Learning from technical system

- Manage uncertainty

- Take responsibility
- Show commitment and dedication

- ...
- Empathy, creativity, improvisation

Preconditions

Clear human role in the system

Respective system design

- Avoiding deskilling
- Allowing continuous development of expertise (80% tacit)

- Job design required
- Ergonomics, UI/UX not enough

- Participatory approach a must

(Brynjolfsson & McAfee, 2017; Faust, 2007; Floridi, 2015, Manzey, 2012; Samek et al., 2017; Shively et al., 2017, Wäfler et al., 2003)

It is the most successful automated systems, with rare need for manual intervention, which may need the greatest investment in human operator training.

Lisanne Bainbridge, 1982.



Daily Mail, Thursday, April 11, 2002
mac



'We apologise to passengers for the severe delays. Rest assured our engineers are working flat out to fix the computer fault'





What is needed?

- Planning for the future - we have to prepare the current system, with the people in the system, to the upcoming changes.
- Future SESAR work needs to assure that technical improvements and a realization of the digitalization happens in an orderly way.

IFATCA suggests:

A research project based on the principles of the JHMS