



# Airport slot allocation: performance of the current system and options for reform

Towards a comprehensive performance framework

SESAR Innovation Days 27<sup>th</sup> November 2013



# Introduction: Problem statement

Capacity at all major Airports in the world is limiting the amount of traffic

## General Problem statement

Several ways of dealing with this problem:

- i. **Capacity enhancement programs**
- ii. **Demand control strategies**
- iii. **Queuing delays**

## The European Context

- Slot control dominant approach in Europe (Reg. 95/93 and 793/2004)
- Administrative slot control leads to inefficiencies and hinder competition
- The EC recently recognized the need to revise the Slot Regulation

## Aim of the paper

- Set the basis for an analytical framework for assessment of different slot allocation mechanisms
- First step within WP-E project



# Introduction: The ACCESS Project

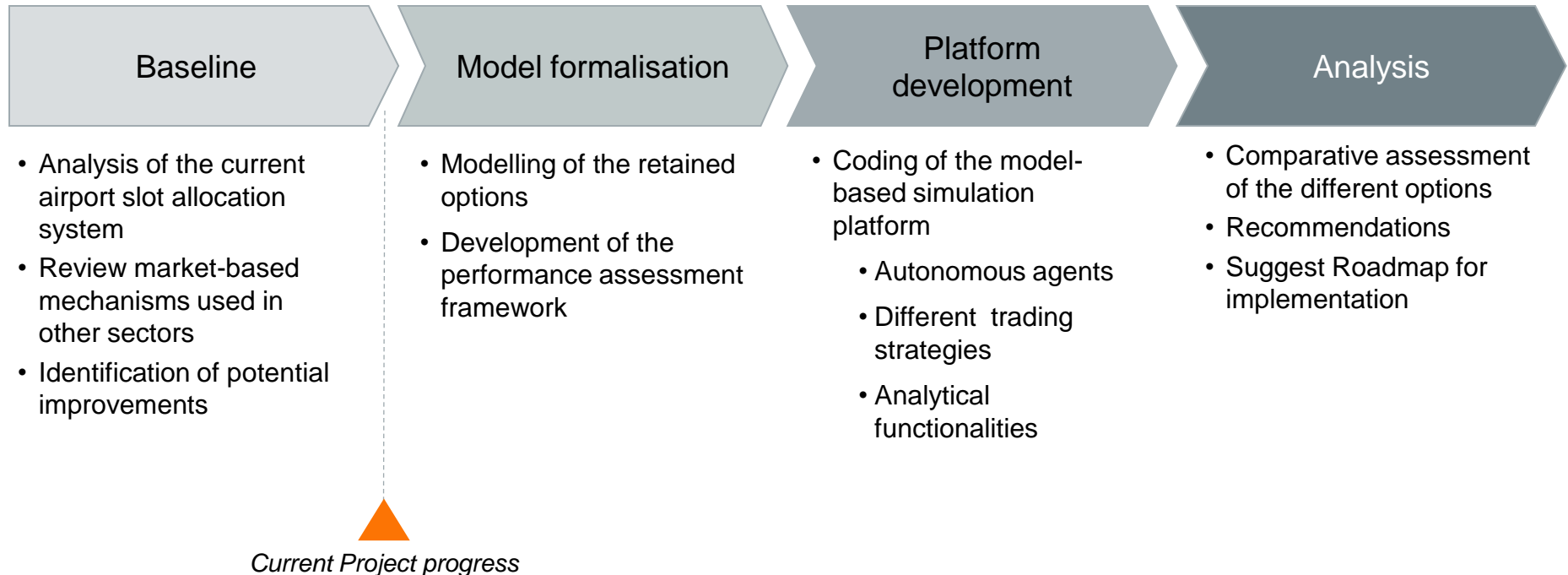


## Application of Agent Based Computational Economics to Strategic Slot Allocation

- **Four partners**
- **Launched in May 2013**
- **Duration: 30 months**



[www.access-sesar.eu](http://www.access-sesar.eu)



# The current system: Actors involved

## Regulators

- ✓ European Commission: proposes new regulations or amendments;
- ✓ European Parliament & European Council: adopts regulations;
- ✓ Member States: designate airports, appoint coordinator;
- International Air Transport Association (IATA): publishes the *Worldwide slot guidelines*.

## Airports

- ✓ Coordinated: airports where air carriers need a slot to be able to operate flights;
- ✓ Schedule facilitated: airports where there is a potential for congestion in certain time windows and a schedules facilitator is appointed to facilitate operations.

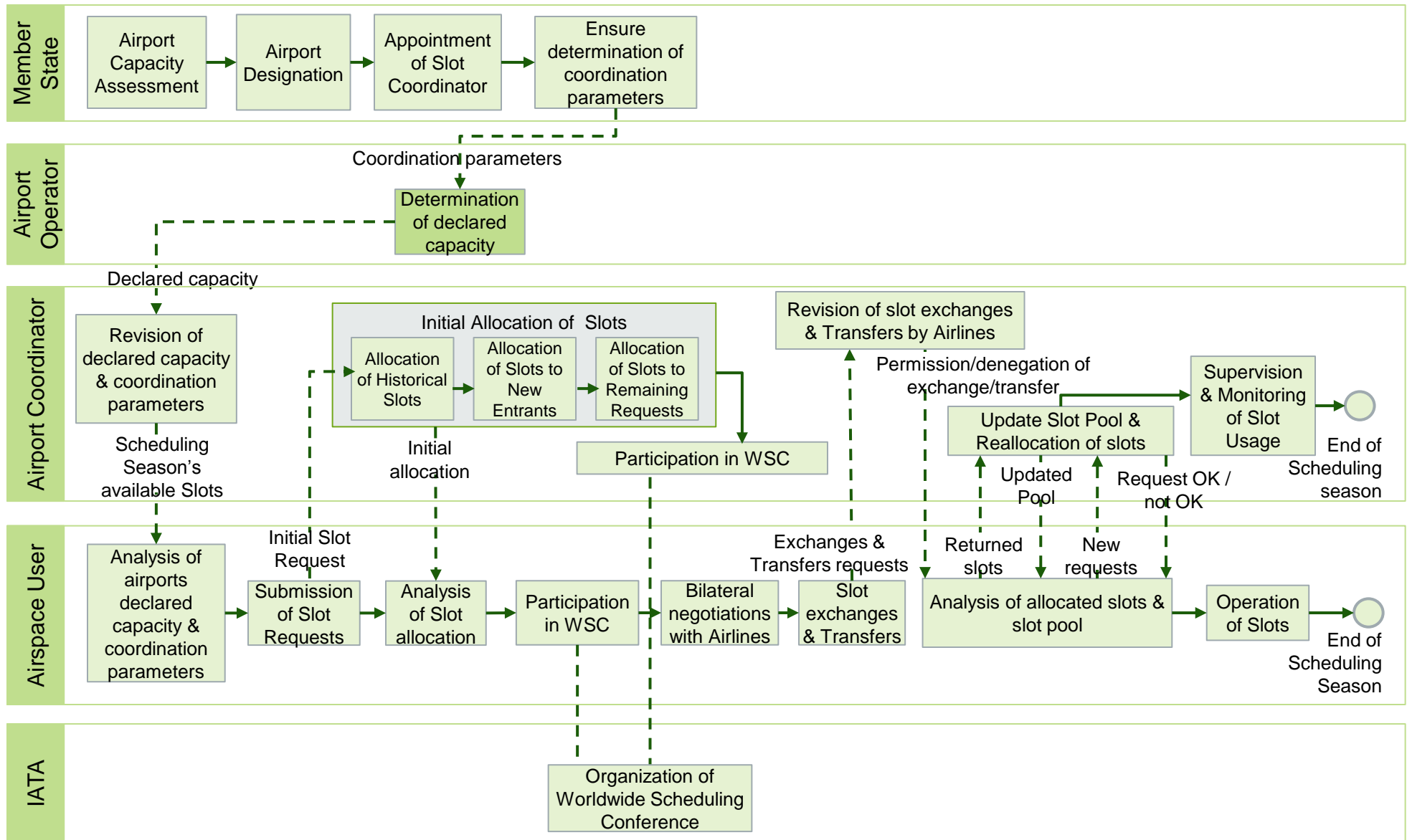
## Coordinators

- ✓ Coordinator: qualified natural or legal person whose neutrality should be unquestioned;
- ✓ Coordination Committee: to mediate, make proposals, guidelines, discuss
  - ✓ Airport managing body;
  - ✓ Air traffic control authorities;
  - ✓ Air carriers using the airport and their representative organisations;
  - ✓ General aviation using the airport regularly.

## Airspace Users

- ✓ Commercial Aviation
  - ✓ Network carriers;
  - ✓ Low cost operators;
  - ✓ Cargo operators;
  - ✓ Regional carriers;
  - ✓ Charter operators;
- ✓ General Aviation;
- ✓ Military is excluded from slot control.

# The current system: slot allocation process



# Perspectives for reform: Market-based approaches

## Objective

## Main options

### Primary allocation of slots

#### To reflect willingness to pay of the user

- ✗ Need for combinatorial auctions;
- ✗ High implementation costs;
- ✗ Not individual rational.

- Withdrawal of grandfather rights and auctioning of these slots;
- Auctions of pool slots when new capacity is created;
- Auctions for all pool slots.

### Secondary slot-trading

#### Redistribution to adjust allocation among airlines

- ✓ Reflects willingness to pay;
- ✓ Compatible with current system;
- ✓ Introduces opportunity costs to slots;
- ✗ Practically Airlines non perfect-rational agents.

- Bilateral trades between airlines;
- Central facilitator;
- External agencies allowed.

### Congestion pricing

#### Reflect the external costs generated by the user

- ✓ Peak/peak off charges;
- ✗ Estimation of price elasticity;
- ✗ Institutional barriers;
- ✗ Unsuccessful experiences.

- In association with slot control;
- In addition to slot control;
- In substitution of slot control.

# Process performance: measurement along Performance areas

Need to establish a number of relevant performance areas

## Consistent with relevant frameworks...

ICAO

SESAR Performance Framework

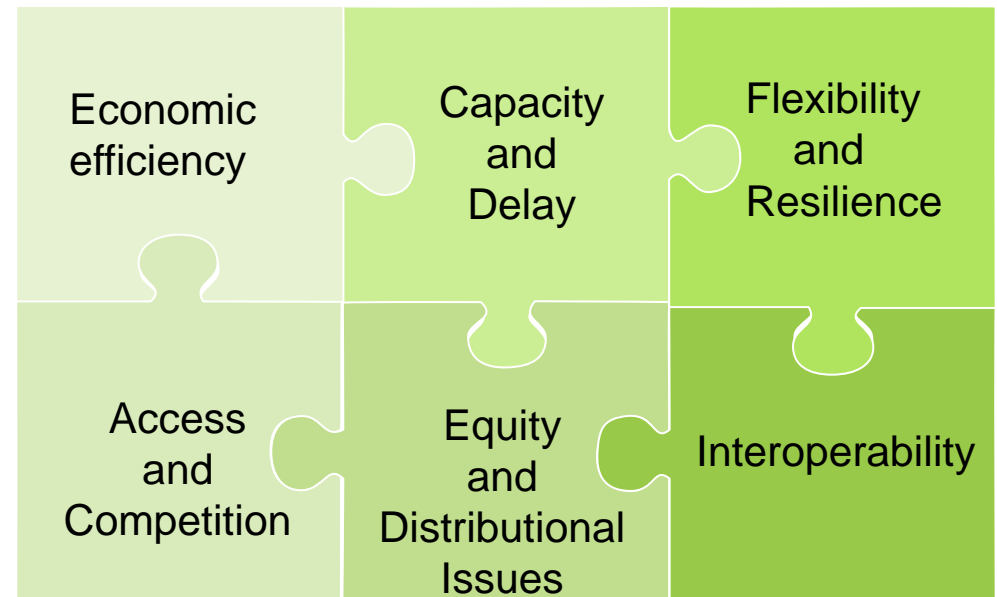
SES II Performance Scheme

## ...but adapted to the specific problem

Airport context

Long-term planning

Strategic decision making



# Process performance: measurement through indicators

Need to establish an objective, exhaustive and non overlapping set of indicators

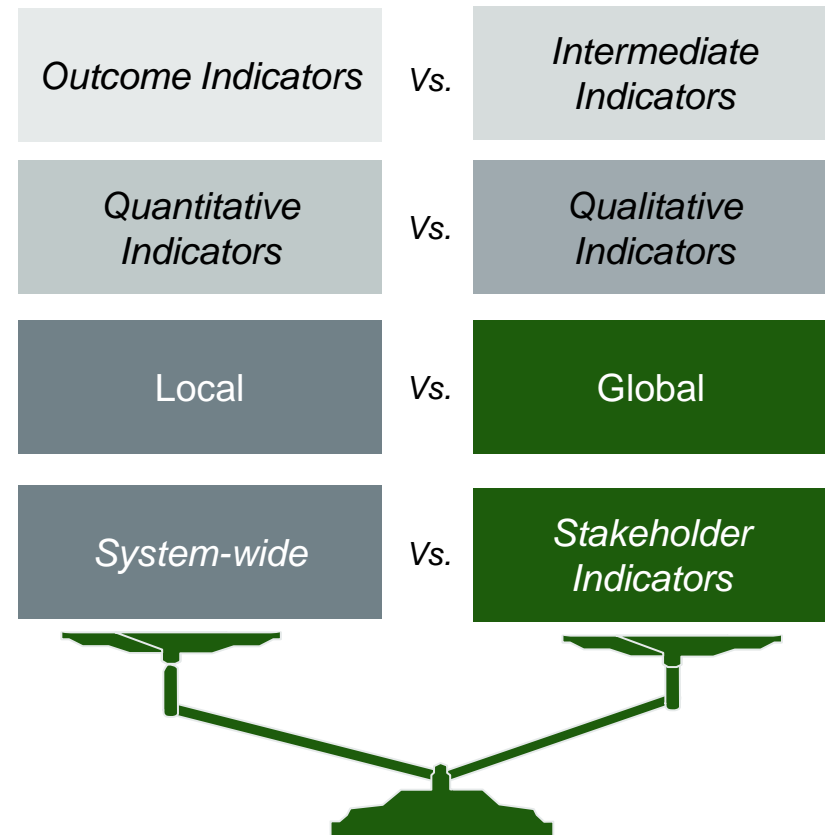
## Objective way of measuring performance



*Preliminary Proposal*

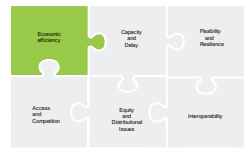
*Still Work in progress*

## Different types of indicators





# Economic Efficiency



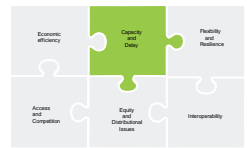
Outcome Indicator

$$\frac{\text{Total Social Welfare}}{\text{Max Attainable Social Welfare}}$$

This accounts for all  
Consumer Surplus + Producer Surplus

		Current System	Market Mechanisms
Cost Efficiency	<b>Allocative Efficiency</b>	<ul style="list-style-type: none"> <li>❌ Potential inefficient slot allocation: willingness to pay is not taken into account</li> </ul>	<ul style="list-style-type: none"> <li>✓ Slots assigned to the Airlines that value them most</li> </ul>
	<b>Cost of operating the system</b>	<ul style="list-style-type: none"> <li>✓ Simple and inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>❌ High cost for designing and operating an auction</li> <li>✓ Secondary trading easier and cheaper</li> </ul>
	<b>Dynamic efficiency</b>	<ul style="list-style-type: none"> <li>✓ Grandfather rights maintain stability and continuity in scheduling</li> </ul>	<ul style="list-style-type: none"> <li>❌ No continuity of schedule guaranteed by auctions</li> <li>✓ Secondary trading could take historic slots as baseline</li> </ul>
	<b>Cost of Delay</b>	<ul style="list-style-type: none"> <li>✓ Tactical delays are reduced in favour of scheduled delays</li> </ul>	
	<b>Revenues</b>	<ul style="list-style-type: none"> <li>✓ No additional revenues for Airports</li> </ul>	<ul style="list-style-type: none"> <li>❌ Allocation of revenues in case of auction is debated</li> </ul>
	<b>Externalities</b>	<ul style="list-style-type: none"> <li>❌ No account for externalities</li> </ul>	<ul style="list-style-type: none"> <li>✓ Congestion pricing accounts for externalities</li> </ul>

# Capacity and Delay



Outcome Indicator

$$\frac{\text{Total \# Slots}}{\text{Actually available \# Slots}}$$

Throughput of the airport  
Different temporal and spatial scales

## Current System

## Market Mechanisms

### Capacity specification

❌ The optimal choice of the number of slots at a given airport implies local interpretations and ad-hoc processes

### Incentives for capacity expansion

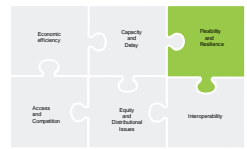
❌ Incumbent airlines have incentive to moderate their requests for capacity expansion

❌ Auctions or congestion pricing could create perverse incentives for airports to underinvest in new capacity

### Delay

❌ The trade-off between scheduled delay and tactical delay is sought by the slot allocation mechanism

# Flexibility and Resilience



Outcome Indicator

$$\frac{\# \text{ of slot request/exchanges/transfers accepted}}{\text{total \# of slot requests/exchange/transfers requests}}$$

Ability provided by the system to modify the allocation and use of slots in order to cater for a changing environment

Different temporal and spatial scales

## Current System

## Market Mechanisms

### Flexibility of allocation to match airline requests

- ✓ IATA conferences and hand back of unused slots provide flexibility
- ✗ No mechanism is implemented to link dependent (origin-destination) requests

- ✓ Combinatorial models could take into account dependent assignments
- ✗ Difficult for carriers with lower purchasing power to get slots at busiest airports

### Flexibility of use (in normal conditions)

- ✓ Some flexibility of use in normal conditions given by (80-20) rule

- ✓ Secondary slot trading could increase flexibility of use

### Flexibility of adaptation to disturbances (Resilience)

- ✗ Not adaptable to special circumstances (law amendments needed)

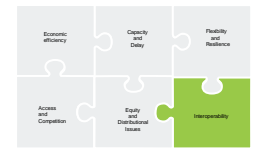
- ✓ The market would be able to self-adapt to these circumstances

### Flexibility of adaptation to local geographical conditions

- ✓ Definition of coordination parameters, the acceptance of a secondary market and the imposition of PSOs according to local needs

# Interoperability

Outcome Indicator



*Level of commonality/compatibility with the IATA guidelines*

The system is based on global standards and uniform principles to ensure technical and operational interoperability

## Current System

## Market Mechanisms

**Interoperability of slot allocation systems**

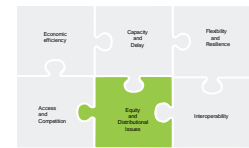
✓ Based on IATA guidelines universally applied (except in the U.S.)

✗ Would require regional/global scope of application

**Interoperability of flight information**

✗ Historically a lack of consistency between Airport slots and flight plans registered due to poor info sharing between Airports and CFMU  
✓ SESAR is tackling this issue through Operational Improvement step (DCB-0301) and technical enablers

# Equity and Distributional Issues



Outcome Indicator

$$\frac{\text{Airline}_i \text{ Shift Costs} * \text{Total \# Slots}}{\text{Total Shift Costs} * \text{Airline}_i \# \text{ Slots}}$$

Shift cost between ideal and assigned slots for an Airline

Weighs the shift costs by the proportion of slot handled by the Airline

## Current System

## Market Mechanisms

**Equity of assignment**

✗ Historical precedence may harm equity of assignment

✓ Secondary trading just involves transactions if positive utility

**Fairness of assignment**

✓ Most incumbent consider historical precedence as proxy for fair assignment

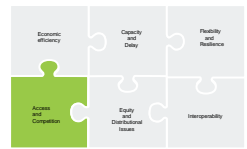
✓ Willingness to pay can be considered proxy for fairness

**Individual rationality**

✗ Historical precedence may harm equity of assignment

✗ Primary auctions & congestion pricing imply negative utility w.r.t. the current system  
 ✓ Secondary trading just involve transactions if positive utility

# Access and competition



Possible Outcome Indicators

$$\frac{\# \text{ Slots to new entrants}}{\text{Total \# slots}}$$

$$\frac{\# \text{ Slots to Airline}_i}{\text{Total \# slots}}$$

Need for more sophisticated indicators to grasp whether the slot allocation system prevents the entry of new competitors with a higher willingness-to-pay than those airlines operating the available slots

## Current System

## Market Mechanisms

### Access costs

- ✓ Free of charge
- ✗ Few and unattractive slots in the pool
- ✗ Airlines quickly fall outside "new entrant"

- ✓ Easier for airlines with strong business models to get into market
- ✗ Difficult for small carriers with lower purchasing power to get slots at the busiest airports

### Public Service Obligations

- ✓ Guarantees services to regional communities even if not profitable for airlines

- ✓ Could be maintained

### Transparency of slot information

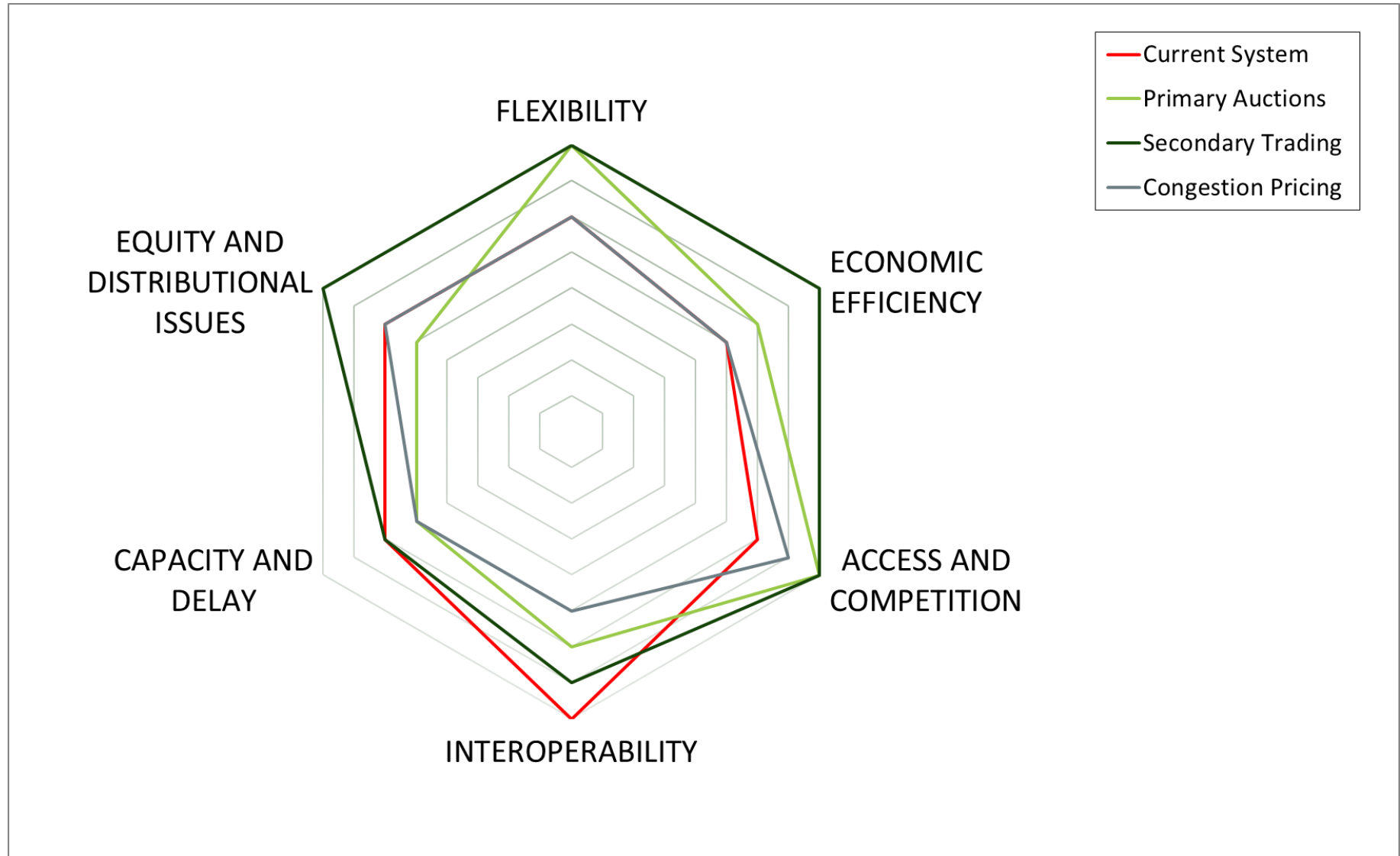
- ✗ Transparency and adequacy of slot information provided by coordinators could be improved

- ✓ What information is shared, when and with whom are key design parameters

### Independence of the coordinator

- ✗ The limits of this independence are sometimes vague and may not be clear at first sight.

# Indicative summary of performance features



# Conclusions and next steps

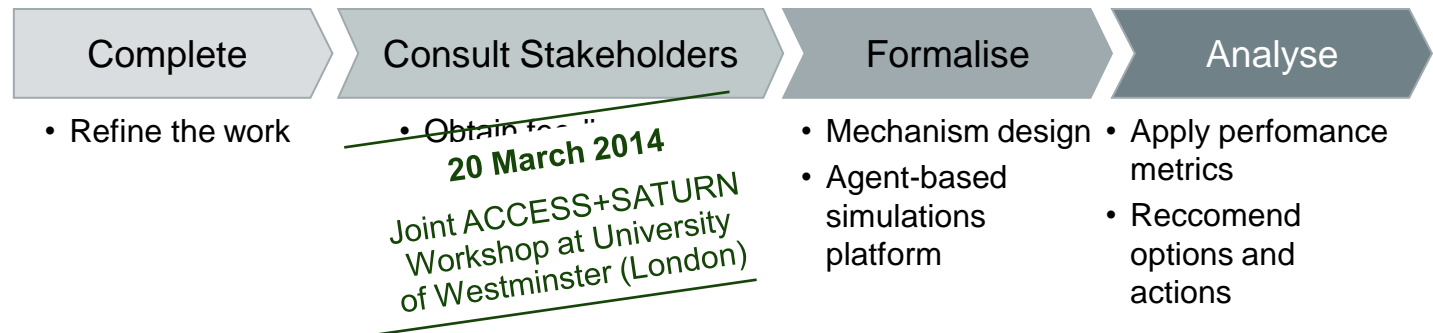
## Preliminary Conclusions

- Complex issue, involving different and sometimes contrasting:
  - Perspectives;
  - Goals;
  - Strategies.
- Need for an objective performance framework extending along multiple dimensions;

## A first step towards the ultimate ACCESS goals

- Several types of indicators identified:
  - Different nature and scope;
  - Along six interdependent Performance areas.
- Preliminary high level assessment:
  - Secondary trading outperforms;
  - Interoperability is the main concern.

## Next Steps







**Andrea Ranieri**

[aranieri@alg-global.com](mailto:aranieri@alg-global.com)

[www.alg-global.com](http://www.alg-global.com)