“What to say when: Guidelines for Decision Making”

An evaluation of a concept for cooperation in an APOC

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Motivation
Reasons for Implementing an Airport Operation Center

Airports
• a bottleneck in ATM System
• influencing overall performance
• operated by a variety of stakeholders

Airport Operation Center (APOC)
• improve airport performance (esp. efficiency) by optimized usage of resources
• coordination of airport stakeholders by improving communication
• likely to be effective when mitigating disturbances caused by weather, incidents or technical failures
State-of-the Art
Analysis of Stakeholder Cooperation at Airports

• Current situation:
  • No mutually shared goal for all stakeholders
  • Missing, imprecise information hinder coordination
  • Information sharing and confidentiality of data

• Resource planning of stakeholders is interdependent; but difficult to assess impact on other's plans

• Idea of more cooperation in general accepted, but framework/structure is needed
Guidelines for Cooperation

- Provide the relevant information and the right time: Who says what to whom and when.
Guidelines for Cooperation

Roles

Information, Action & Decision

Ground Handler:
- Determination of possible impact
- First handling sequence
- External information
- Discussion, final decision
- Fixation of final decision

Airline 1:
- Induced conflicts, wishlist
- Discussion, final decision

Airline 2:
- Induced conflicts, wishlist
- Discussion, final decision

Airport:
- Induced conflicts, wishlist
- Discussion, final decision

Phase 1: Information about event
- Conflict detection

Phase 2: First solution
- Induced secondary conflicts

Phase 5: Elaboration of final solution
- Conversion of the solution to operations

Phase 6: Conversion of the solution to operations
Guidelines for Cooperation
Guidelines for Cooperation

- Determination of possible impact
- First handling sequence
- Discussion, final decision
- Fixation of final decision
- Induced conflicts, wishlist
- Discussion, final decision

Groundhandler - Airline 1
Theoretical Background

- Decision making in the APOC
  - High quality of APOC decisions needed & efficient process
  - Reliable data and information, minimize uncertainty
  - take into account individual goals and strategies
  - Conflict of goals, resources, power and information

→ structured negotiation process improves quality of decision making

- Structuring interaction process
  - Interaction / communication as a meta-function of teamwork processes
→ structure influences team cognition

- Effect of guidelines: standardization vs. flexibility
Research Question

1) How satisfied are teams when applying the guidelines?

2) In how far do teams apply the rules for cooperation?

3) In how far do guidelines affect individual team members’ interaction behavior?
Method
Simulation Set-Up – Simulation Logic

- Airport management simulation
  - A-CDM milestones
  - database
  - generic airport model with standard times
  - Pre-departure sequencer

- RWY capacity = 30 a/c

- Turn-around as a single process
Method
Simulation Set-Up – User Interfaces
Method
Simulation Set-Up – User Interfaces

• Airport view
Method
Simulation Set-Up - Roles, responsibilities & goals

• All:
  • conflict free / „do-able“ plan
  • fulfil overall goal (PBAM in place)

• Airline
  • Set TOBTs
  • Punctual priority flights
  • Minimize delay

• Airport
  • Allocate stand & gates
  • Maximum a/c handled at gate

• Ground handler
  • Allocate ground handling teams
  • Fulfil contract with airlines (2 quick)
  • Minimize staff cost
Method
Data Gathering and Preparation

- Subjective data:
  - **Team effectiveness survey**
  - Tailor-made questionnaires
  - Personality & attitudes (BFI-K 5, BIP, FIT)
- Log Files
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- Observation via observation sheet
  - Coding of single unit of meaning
  - Time, Sender, Receiver, Function
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- Function:
  - Socio-emotional
  - Knowledge Combination (Information, Question, Decision, Coordination)
  - Control
Method
Experimental Design & Independent and Dependent Variables

• Independent Variables:
  • Guidelines for cooperation
  • (Scenario)

• Dependent Variables:
  • Team Effectiveness
  • Quantity of Interaction
  • Conformity of Process with Guideline
  • Style and Manner of Knowledge Combination
  • Passive vs. Active Communication Style

```
<table>
<thead>
<tr>
<th>Team</th>
<th>Run 1</th>
<th>Run 2</th>
<th>Run 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thunderstorm</td>
<td>Construction</td>
<td>Sector</td>
</tr>
<tr>
<td>2</td>
<td>Sector</td>
<td>Thunderstorm</td>
<td>Construction</td>
</tr>
<tr>
<td>3</td>
<td>Sector</td>
<td>Thunderstorm</td>
<td>Construction</td>
</tr>
<tr>
<td>4</td>
<td>Construction</td>
<td>Sector</td>
<td>Thunderstorm</td>
</tr>
</tbody>
</table>
```

free structure vs. guidelines
Method
Procedure & Sample

- 16 experts from German speaking airports (14 male)
- $\bar{\theta}$ age 42 years ($sd = 7$) and
- $\bar{\theta}$ professional experience 8 years ($sd = 8$)

- 10/2015 & 04/2016 in ACCES, Braunschweig, Germany

<table>
<thead>
<tr>
<th>Duration</th>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 min</td>
<td>Briefing on PBAM concept &amp; tasks</td>
</tr>
<tr>
<td>80 min</td>
<td>Training with simulation environment + training simulation run</td>
</tr>
<tr>
<td>45 min</td>
<td>Simulation run 1 (free structure) + observation of interaction</td>
</tr>
<tr>
<td></td>
<td>Team effectiveness questionnaire</td>
</tr>
<tr>
<td>45 min</td>
<td>Simulation run 2 (free structure) + observation of interaction</td>
</tr>
<tr>
<td></td>
<td>Team effectiveness questionnaire</td>
</tr>
<tr>
<td>25 min</td>
<td>Briefing and training guideline</td>
</tr>
<tr>
<td>45 min</td>
<td>Simulation run 3 (with guidelines for cooperation) + observation of interaction</td>
</tr>
<tr>
<td></td>
<td>Team effectiveness questionnaire</td>
</tr>
<tr>
<td>30 min</td>
<td>Final debriefing</td>
</tr>
</tbody>
</table>
Results
Overview

Influence of Guidelines for Cooperation on:
1. Experienced Effectiveness

2. Interaction Behavior - Knowledge Combination

3. Mitigation of individual characteristics through Guidelines
Results

Experiences Team Effectiveness

Team effectiveness rated significantly higher with guidelines

- \( mean_{\text{free}} = 3.6, \ sd = 1.0, \ mean_{\text{guide}} = 4.1, \ sd = 1.1 \)
- \( F(1,12) = 9.35, \ p = .01, \ \eta^2 = 0.44 \)

TOP 3 biggest impact:

- the team has clear agreements about how decision will be made \( (mean_{\text{free}} = 3.13, \ sd = 1.16, \ mean_{\text{guide}} = 4.19, \ sd = 1.22, \Delta = 1.06) \)
- with guidelines there are effective procedures to guide team functioning \( (mean_{\text{free}} = 2.97, \ sd = 1.15, \ mean_{\text{guide}} = 3.81, \ sd = 1.05, \Delta = 0.84) \)
- the team works constructively on issues until they are resolved \( (mean_{\text{free}} = 3.38, \ sd = 1.45, \ mean_{\text{guide}} = 4.06, \ sd = 1.39, \Delta = 0.68) \)
Result

Interaction Behavior - Style and Manner of Knowledge Combination

- Knowledge combination is most frequently used interaction function

<table>
<thead>
<tr>
<th></th>
<th>free structure</th>
<th>sd</th>
<th>guidelines</th>
<th>sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>35,88</td>
<td>(14,19)</td>
<td>39,25</td>
<td>(10,63)</td>
</tr>
<tr>
<td>Question</td>
<td>28,38</td>
<td>(6,59)</td>
<td>15,50</td>
<td>(5,26)</td>
</tr>
<tr>
<td>Decision</td>
<td>11,25</td>
<td>(2,82)</td>
<td>9,00</td>
<td>(5,60)</td>
</tr>
<tr>
<td>Coordination</td>
<td>19,00</td>
<td>(13,54)</td>
<td>12,25</td>
<td>(8,85)</td>
</tr>
<tr>
<td>Sum</td>
<td>94,51</td>
<td></td>
<td>76,00</td>
<td></td>
</tr>
</tbody>
</table>

- With guidelines more **pro-active** style of knowledge combination
Result

Interaction Behavior - Style and Manner of Knowledge Combination

- Amount of Questions reduced, increase in pro-active behaviors (information, decisions)

![Chart 23](chart.png)

Ratio information + decisions vs. number of questions raised

- Team 1
- Team 2
- Team 3
- Team 4

- free structure (Run 1, Run 2)
- guidelines (Run 3)
Result
Interaction Behavior - Style and Manner of Knowledge Combination

Interaction Quantity

<table>
<thead>
<tr>
<th>Team</th>
<th>free structure (Run 1, Run 2)</th>
<th>guidelines (Run 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>81</td>
<td>98</td>
</tr>
<tr>
<td>2</td>
<td>153</td>
<td>128</td>
</tr>
<tr>
<td>3</td>
<td>101</td>
<td>85</td>
</tr>
<tr>
<td>4</td>
<td>128</td>
<td>120</td>
</tr>
</tbody>
</table>
Result
Mitigation of individual characteristics through guidelines

- passive → more addressed than speaking
- active → more speaking than being addressed

- passive team members tend to rate team effectiveness better
- correlation strongest in second run
- with guidelines even active team members rate team effectiveness better

<table>
<thead>
<tr>
<th>Run</th>
<th>r</th>
<th>$R^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run 1 (free structure)</td>
<td>-0.4</td>
<td>0.16</td>
<td>.16</td>
</tr>
<tr>
<td>Run 2 (free structure)</td>
<td>-0.5</td>
<td>0.24</td>
<td>.06</td>
</tr>
<tr>
<td>Run 3 (guidelines)</td>
<td>-0.4</td>
<td>0.16</td>
<td>.12</td>
</tr>
</tbody>
</table>
Conclusion
Guidelines for cooperation in an APOC

1. How satisfied are teams when applying the guidelines?
   - team effectiveness significantly improved with guidelines ✓
   - clear agreements for decision making, effective procedure, constructive manner ✓
   - Performance improved? 😄

2. In how far do teams apply the rules for cooperation?
   - With guidelines knowledge combination is conducted in a more pro-active manner ✓
   - communication patterns are likely to be much influenced by other factors, e.g. individual attitudes and team composition
   - analysis of data on personality, larger sample size required 😄

3. In how far do guidelines affect individual team members' interaction behavior?
   - Team members with active interaction style tend to be less satisfied with decision making process
   - guidelines seem to have the potential to mitigate this effect ✓
Outlook

• Reduced complexity of airport simulation and scenario vs. transfer of results to airport performance
  • Influence of culture, airport characteristics…
  • Influence of number of stakeholders, connection of planning phase and implementation phase

• Does cooperation always lead to mathematically optimized solution?
  • vs.

• Structured guidelines = mechanism to implement concept of cooperation and to ensure suitability for daily use.
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COCO
Collaborative Operations in COntrCrol Rooms