



ADAPTABLE DASHBOARD FOR VISUALIZATION OF ORIGIN-DESTINATION DATA PATTERNS

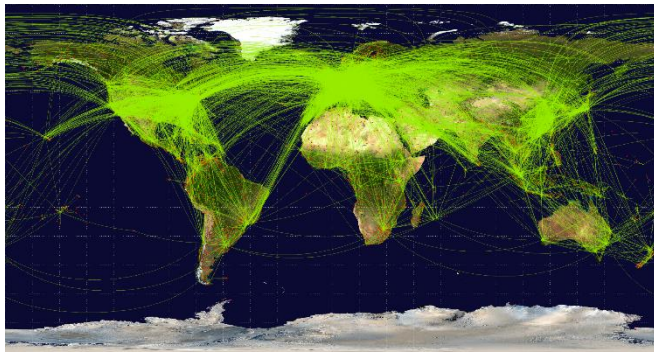
Ieva Dobrāja, PhD Candidate
Prof. Dr. Menno-Jan Kraak
Dr. Yuri Engelhardt

NCG Symposium 2017

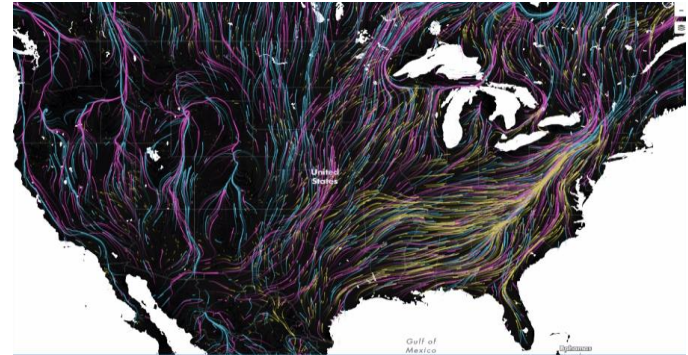


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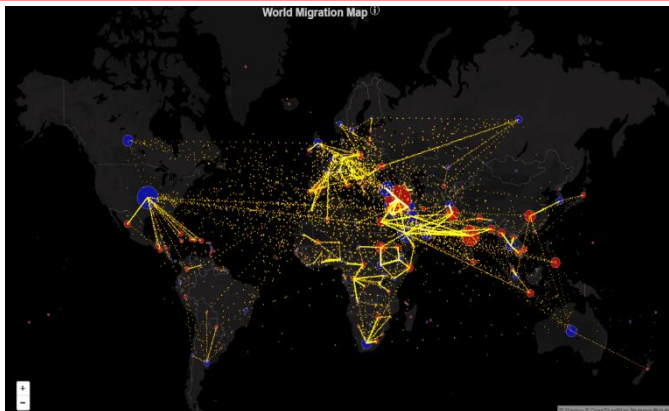
INTRODUCTION



Airplane Movements
(www.openflights.org)



Animal Movements
(www.washington.edu)



Human Movements
(Galka 2016)



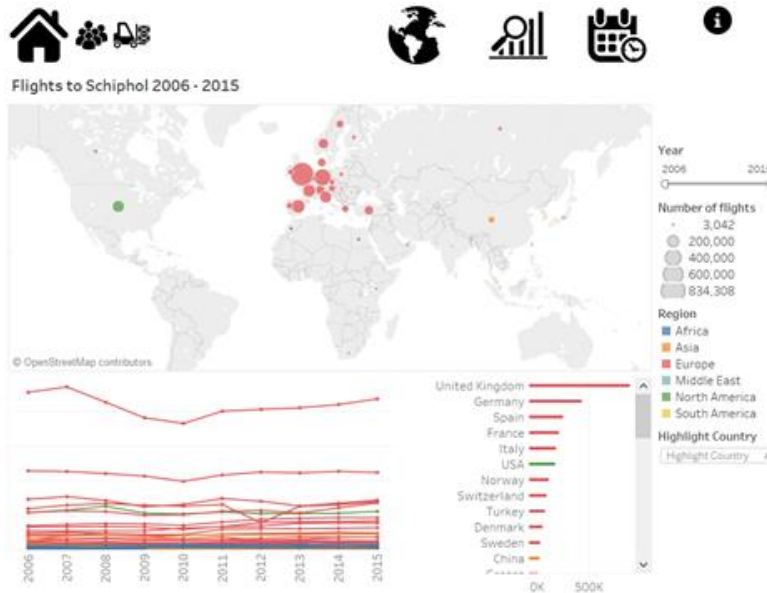
Ship Movements
(www.marinetraffic.com)

BACKGROUND

THE ROLE OF A DASHBOARD

The main purpose – to communicate complex information and encourage user for further exploration

- Displays the most important information on one screen
- Contains multiple linked graphic representations
- Shows overview, patterns, trends, outliers
- Storytelling



BACKGROUND

ADAPTABILITY

Adaptation – the process to fit the system for current usage situation

Adaptable system – provides users with tools that change the system according to the required context of use

Levels – Information, Technology, User interface, Presentation

(Reichenbacher 2003)

▪ **When?** (in case of differences, change)

- User
- Tasks
- Context

(Reichenbacher 2001, 2003)

▪ **How?** (ways to adapt)

- Generalization level
- The way information is visualized

▪ **What?** (types of adaptation)

- User interface
- Content
- Presentation
- Function

(Zipf & Jöst 2006)

MOTIVATION AND PROBLEM STATEMENT

To get insights into O-D data

The need for visualization

Number of variables

Spatial and temporal components

Limitations of traditional dashboards



Spatial component
(www.martingrandjean.ch)

As far as direct connectivity is concerned, changes have also been substantial between 2007 and 2017. Most of the losses in direct connectivity are concentrated at larger hubs and in particular amongst the Majors (5 out of 6 Majors saw a decrease in direct connectivity over the period). This is consistent with the fact that as mentioned above, the number of direct connections since 2007.

Airline Attributes

- Amsterdam-Schiphol (+20%) is now the leading European airport in terms of direct connectivity, having moved from the 6th position to back in 1st and surpassed London Heathrow (LHR), which last year ranked number 2. While Amsterdam-Schiphol's direct connectivity performance relates in part to its hub connectivity gains, it is also reflective of the fact that LCCs now account for 21% of all direct connectivity – the high LCC direct connectivity share is a common feature amongst the Majors'.

Airplane Capacity

- Istanbul-Ataturk (+118%) jumped from the 20th position to the 5th, with the airport's direct connectivity gains. While London Heathrow's direct connectivity gains are attributable to a lack of airport capacity, the losses experienced by Paris-Charles de Gaulle (-6.4%), Frankfurt (-2.9%) and Munich (-4%) can be linked to their respective capacity constraints.

Ship age

- Other airports seeing direct connectivity decreases over the past 10 years include Madrid-Barajas (-3.2%), Rome-Fiumicino (-2.9%), Vienna-Schwechat (-25.6%) – the latter no longer being amongst the top 20 European airports.

Crew members (age, nationality)

- While Madrid's direct connectivity gains reflect its economic and aviation recovery, it is also reflective of its better ability to attract LCCs. This is evident from the LCC penetration in Madrid's direct connectivity (attributable to the hub connectivity gains experienced by Vienna airport).

Travelled distance

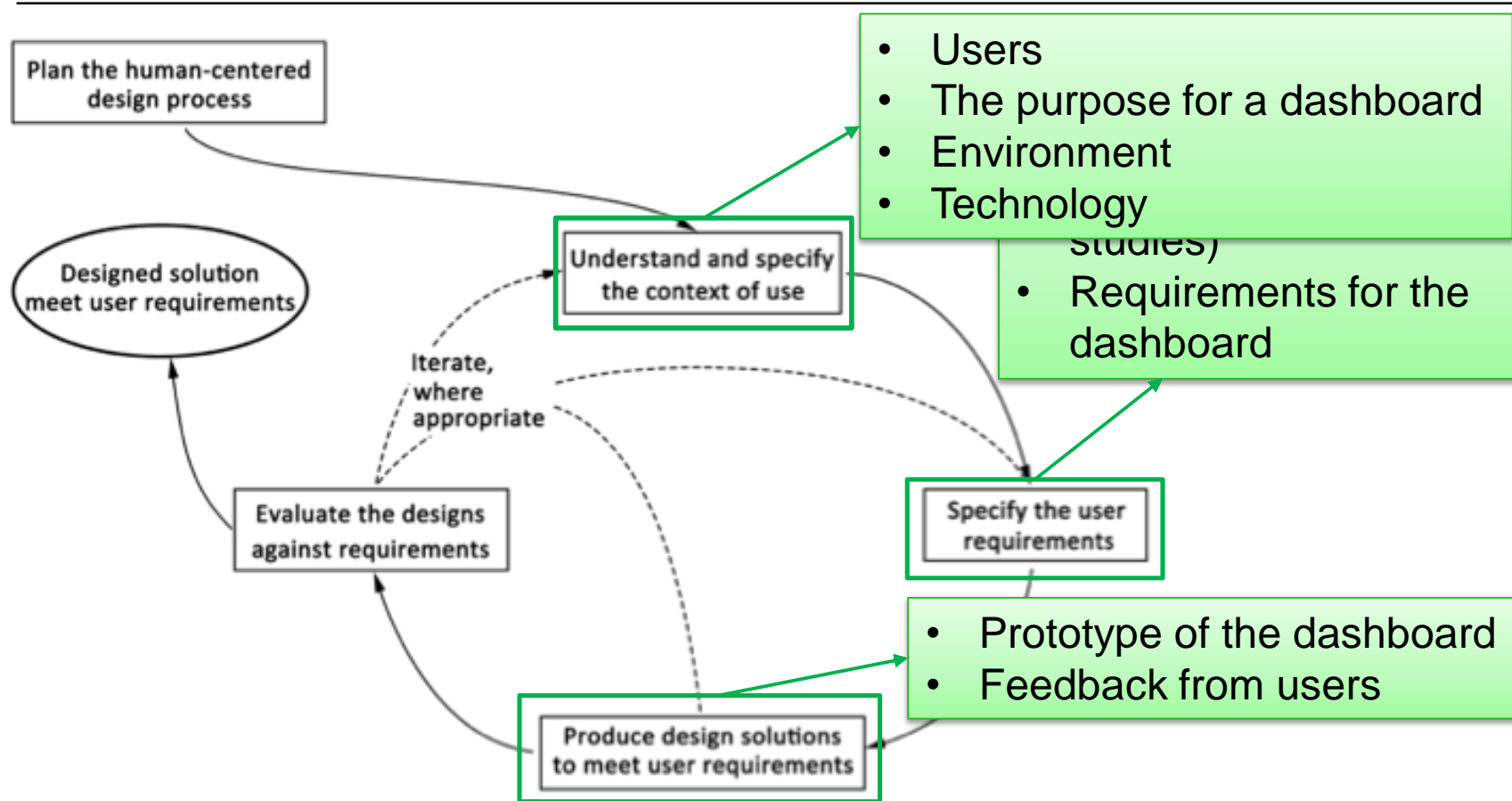
- de-hubbing of Alitalia (March 2016, www.alitalia.com) after 9 years – a very significant penetration of LCCs'.



Fixed layout
Not meant for exploration purposes



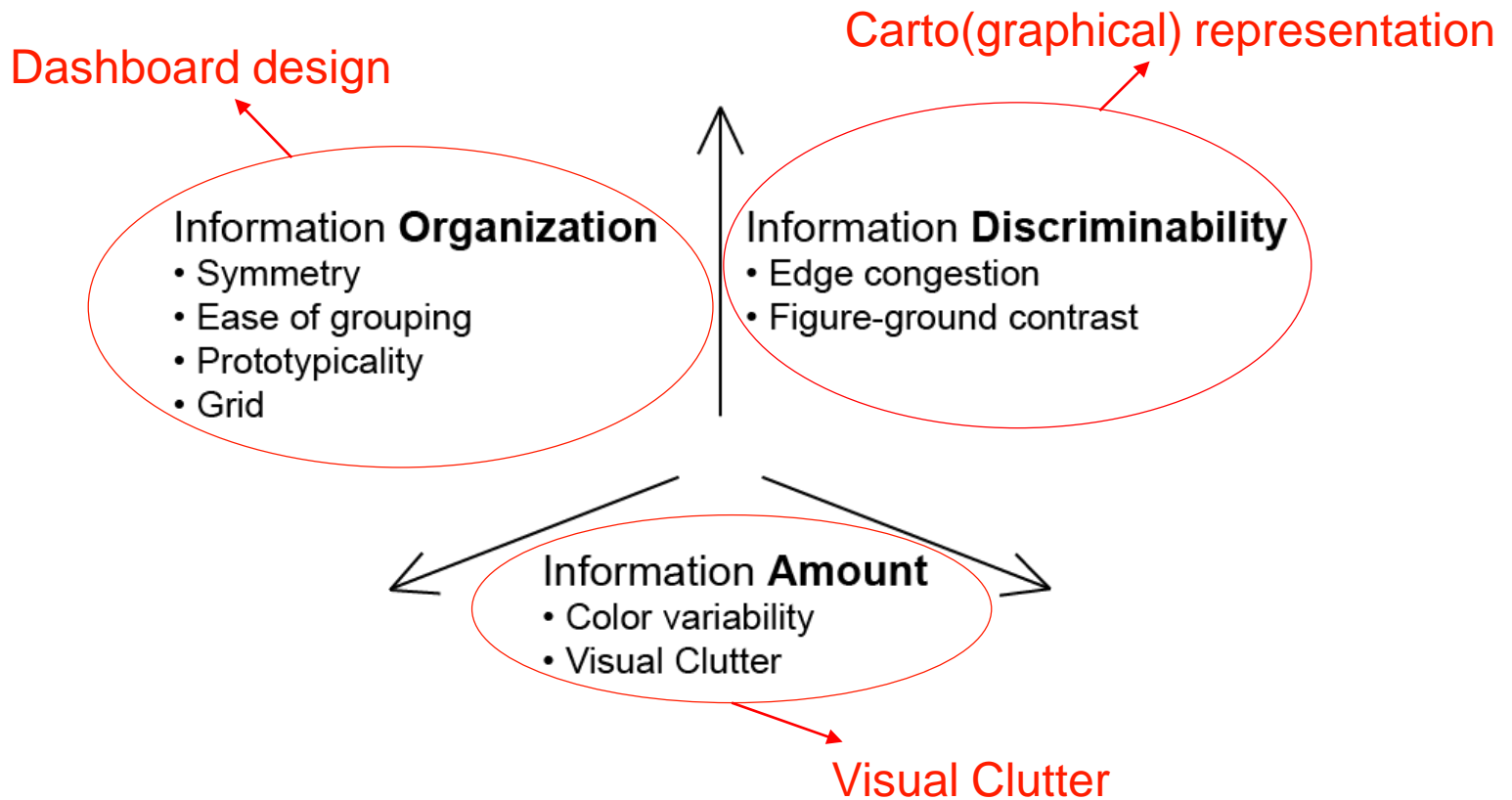
USER-CENTERED DESIGN (UCD)



Activities and iterative process of UCD

(ISO 9241-210 2010)

THE MAIN CHALLENGES IN VISUALIZATION OF O-D DATA



Determinants of Visual Complexity

(Miniukovich & De Angeli 2014)



CASE STUDIES

SUB CASE STUDIES

Case Study 1 *Airport Connectivity* →

- Global connectivity of world airports
- Connectivity of an airport of interest
- Development over time
- Trends:
 - Connectivity between Europe and Asia Pacific
 - Development of low cost carriers (LCC)

Storytelling

(to represent known information)

- Growth patterns
- Developments

Case Study 2 *Maritime Migration* →

- Connectivity
 - Labor migration patterns
 - Shipping patterns
 - Temporal patterns
- Links between ship efficiency and literacy level of crew members

Exploration

(to discover new information)

- What are the main flow patterns?
- Are there changes over time periods?
- Are there relations between parameters?

CASE STUDIES

DATA SETS

- **Airport Connectivity**

Data set of flights from European airports

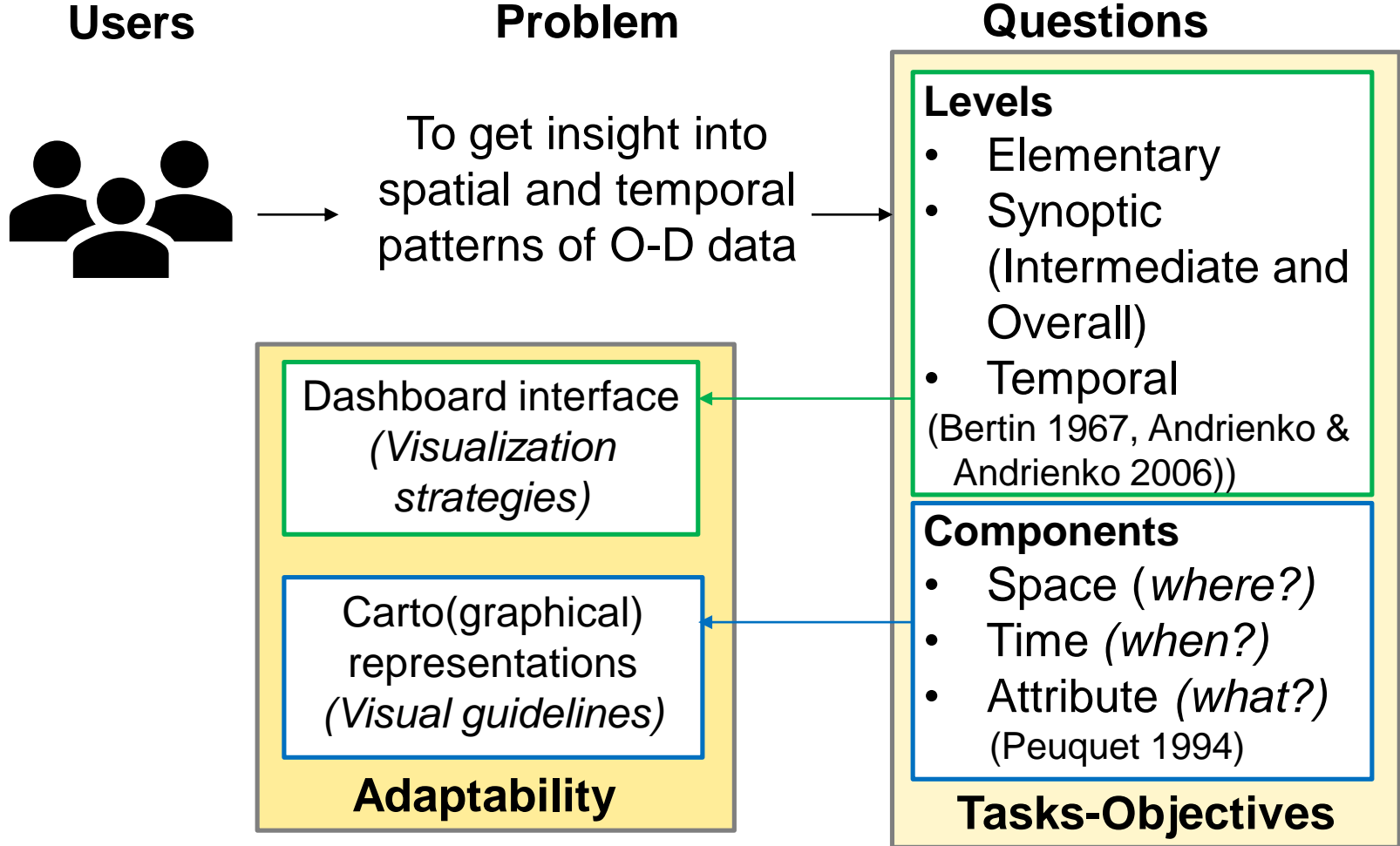
- Scheduled flights for 1 week (3rd week of June) for several years
- Direct and indirect flights

- **Maritime Migration**

2 data sets:

- Ships
- Crew members of the ships

CONCEPTUAL FRAMEWORK



DASHBOARDS FOR BOTH CASE STUDIES

Storytelling
Airport Connectivity



Sub case studies
as storylines



- Dashboard helps to tell the story behind the data
- Storylines lead the user through dashboard based on the user questions

How to represent patterns in a graphical way so that **it tells the story** behind data?

Exploration
Maritime Migration



Sub case studies
and hypothesis
based questions
as potential
storylines



- Dashboard helps to see patterns and links of involved components
- Sub case studies and hypothesis based questions help to ensure exploration approach

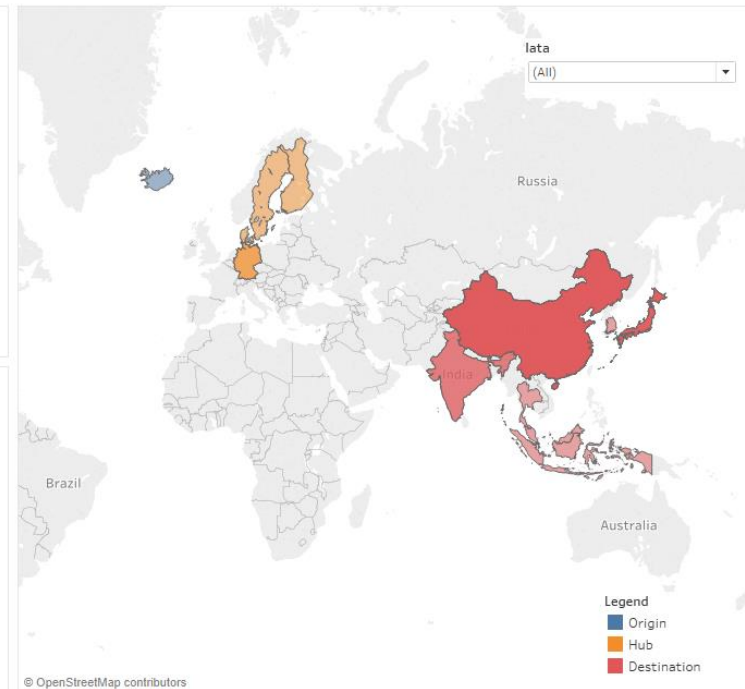
Which graphical representations to use to **show the patterns and links**?

CASE STUDY 1 (EXAMPLES)

ELEMENTARY QUESTIONS

- Where is airport X located? (*space*) (*Lookup/Locate/Search*)
- Where are located airports with which airport X has connections? (*space*) (*Lookup*)

Connectivity between Europe and Asia Pacific (2004-2016)
(Location of Connected Airports and Countries)

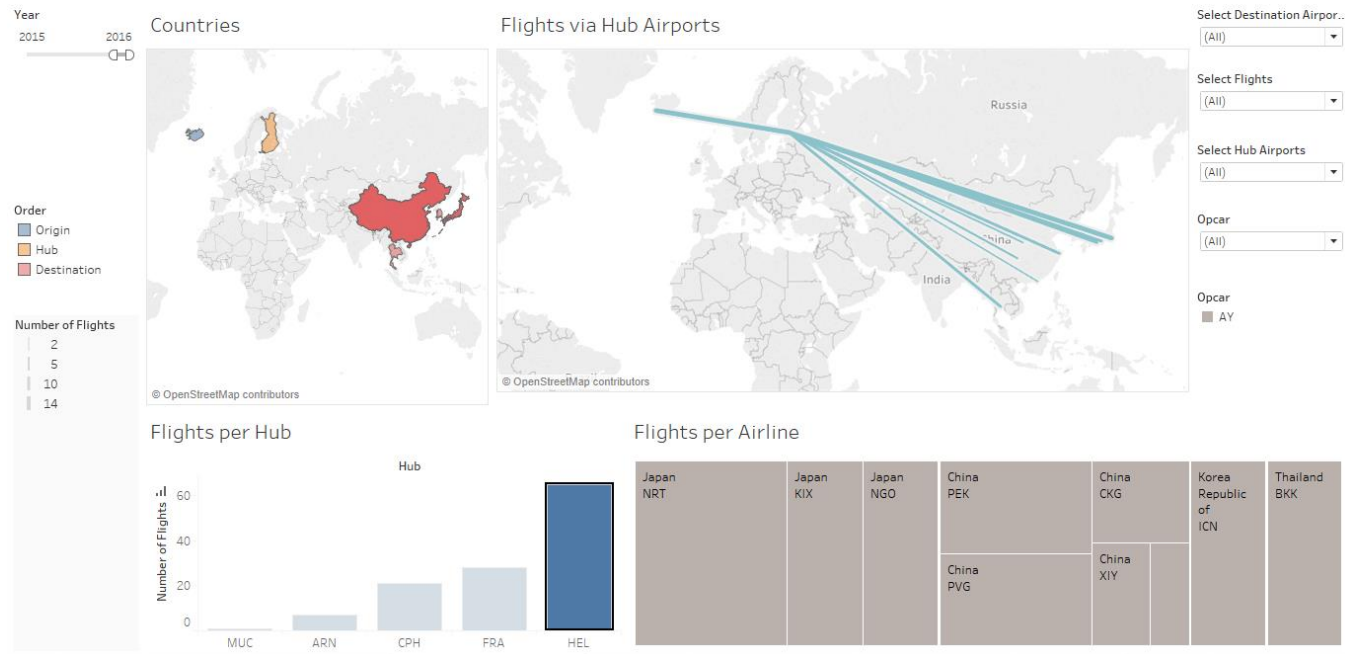


CASE STUDY 1 (EXAMPLES)

SYNOPTIC QUESTIONS

- Which hub airport provides the most onward connections to Asia Pacific from airport X? (*space and attribute*) (*Compare*)
- Which airlines provide connections between airport X and Asia Pacific? (*attribute*) (*Identify*)

Connectivity between Europe and Asia Pacific (2004-2016)
(Connectivity by Hubs and Countries of Destination)





FUTURE WORK

- Prototype of the dashboards for both case studies
- Feedback from users
- Usability test



Thank you!

Questions?

i.dobraja@utwente.nl



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