ADAPTABLE DASHBOARD FOR VISUALIZATION OF ORIGIN-DESTINATION DATA PATTERNS

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

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FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
INTRODUCTION

ADAPTABLE DASHBOARD FOR VISUALIZATION OF ORIGIN-DESTINATION DATA PATTERNS

Airplane Movements
(www.openflights.org)

Human Movements
(Galka 2016)

Animal Movements
(www.washington.edu)

Ship Movements
(www.marinetracking.com)

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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
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

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Source: ACI EUROPE & SEO AVIATION ECONOMICS (2017)
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

Location
- Origin
- Destination

Time
- Arrival
- Departure
- Travel time
- Transfer time

Attributes
- Airline
- Type
- Airplane capacity
- Ship age
- Crew members (age, nationality)
- Travelled distance
- Ownership
MOTIVATION AND PROBLEM STATEMENT

To get insights into O-D data

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Limitations of traditional dashboards

Spatial component
(www.martingrandjean.ch)

Temporal component
(www.metrocosm.com)
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

- Fixed layout
- Not meant for exploration purposes
USER-CENTERED DESIGN (UCD)

Activities and iterative process of UCD

(ISO 9241-210 2010)

• Users
• The purpose for a dashboard
• Environment
• Technology
USER-CENTERED DESIGN (UCD)

Activities and iterative process of UCD

(ISO 9241-210 2010)

- User questions of interest (sub-case studies)
- Requirements for the dashboard
USER-CENTERED DESIGN (UCD)

Activities and iterative process of UCD

(ISO 9241-210 2010)

- Prototype of the dashboard
- Feedback from users
THE MAIN CHALLENGES IN VISUALIZATION OF O-D DATA

Dashboard design

Carto(graphical) representation

Information Organization
- Symmetry
- Ease of grouping
- Prototypicality
- Grid

Information Discriminability
- Edge congestion
- Figure-ground contrast

Information Amount
- Color variability
- Visual Clutter

Visual Clutter

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)

Case Study 2 Maritime Migration
- Connectivity
  - Labor migration patterns
  - Shipping patterns
  - Temporal patterns
- Links between ship efficiency and literacy level of crew members

Storytelling (to represent known information)
- Growth patterns
- Developments

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

Users ➔ Problem ➔ Questions

Users ➔ Dashboard interface
(Visualization strategies)

Problem ➔ To get insight into spatial and temporal patterns of O-D data

Questions

Levels
• Elementary
• Synoptic (Intermediate and Overall)
• Temporal (Bertin 1967, Andrienko & Andrienko 2006))

Components
• Space (where?)
• Time (when?)
• Attribute (what?) (Peuquet 1994)

Adaptability ➔ Carto(graphical) representations
(Visual guidelines)
DASHBOARDS FOR BOTH CASE STUDIES

**Storytelling**
*Airport Connectivity*

- Sub case studies as storylines

**Exploration**
*Maritime Migration*

- Sub case studies and hypothesis based questions as potential storylines

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

- 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?**

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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)*
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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