VISUALISATION OF COMPLEXITY AND RISK IN MEGA CONSTRUCTION PROJECTS

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PROJECT BACKGROUND

• **Project Name:** Development of a Computer-Based Tool For Visualization of Complexity in Mega Construction Projects

• Funded by: “The Scientific and Technological Research Council of Turkey”

• Total budget of € 75,000

• **36 months** duration
INTRODUCTION AND PROBLEM STATEMENT

- Construction projects have characteristic problems:
  - Time and cost limitations
  - Physical constraints
  - Ambiguity in scope
  - Multitude of stakeholders
  - Communication issues
INTRODUCTION AND PROBLEM STATEMENT

• For 9 high-speed train line projects selected from mega-projects in the European Union,
  → Cost deviations range from 8% to 116% (Boateng, et al. 2015)

• 7 sample mega projects conducted in Korea,
  → Have average cost increase of $ 2.9 billion
  → Have average time extension of 3.6 years (Han, et al. 2009)
RESEARCH OBJECTIVE

- Develop a method to visualise risk and complexity in mega construction projects.
### MEGA PROJECTS

<table>
<thead>
<tr>
<th>Cost Threshold</th>
<th>Budget-GDP Ratio Threshold</th>
<th>Duration Threshold</th>
<th>Reference Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1$ billion</td>
<td>-</td>
<td>Several years</td>
<td>Beehler (2009)</td>
</tr>
<tr>
<td>$0.3$-$20$ billion</td>
<td>% $0.01$</td>
<td>Construction: 5-12 years, Operation: 7-30 years</td>
<td>Eweje et al. (2012)</td>
</tr>
<tr>
<td>$1$ billion</td>
<td>-</td>
<td>5 years</td>
<td>Han et al. (2009)</td>
</tr>
<tr>
<td>$1$ billion</td>
<td>-</td>
<td></td>
<td>Flyvbjerg et al. (2003), Capka (2004), Marrewijk et al. (2008), Kim (2010)</td>
</tr>
<tr>
<td>$1$ billion (United States)</td>
<td>% $0.01$</td>
<td></td>
<td>Hu et al. (2015)</td>
</tr>
<tr>
<td>€$0.133$ billion (EU Countries)</td>
<td>% $0.02$</td>
<td></td>
<td>Hu et al. (2015)</td>
</tr>
<tr>
<td>$0.5$ billion</td>
<td>-</td>
<td></td>
<td>Flyvbjerg (2009)</td>
</tr>
</tbody>
</table>
RESEARCH PLAN - STEP 1

**INPUTS**
- Questions based on the literature findings
- Conceptual model

**STEPS**
- Interviews with Mega Project Stakeholders
## RESEARCH PLAN - CASE STUDY PROJECTS

<table>
<thead>
<tr>
<th>Project</th>
<th>Estimated Cost</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Istanbul 3rd Airport</td>
<td>EUR 22 Billion</td>
<td>Under the construction</td>
</tr>
<tr>
<td>Akkuyu Nuclear Power Plant</td>
<td>USD 20 Billion</td>
<td>Initiation stage</td>
</tr>
<tr>
<td>Istanbul-Izmir Highway</td>
<td>USD 16 Billion</td>
<td>Under the construction</td>
</tr>
<tr>
<td>Trans-Anatolian Pipeline (TANAP)</td>
<td>USD 12 Billion</td>
<td>Under the construction</td>
</tr>
<tr>
<td>Marmaray Railway</td>
<td>USD 5 Billion</td>
<td>Completed</td>
</tr>
<tr>
<td>Ankara-Izmir High Speed Train</td>
<td>USD 4.2 Billion</td>
<td>Under the construction</td>
</tr>
<tr>
<td>Eurasia Tunnel</td>
<td>USD 1.3 Billion</td>
<td>Completed</td>
</tr>
<tr>
<td>Ankara Etlik Integrated Healthcare Campus</td>
<td>USD 1.2 Billion</td>
<td>Under the construction</td>
</tr>
</tbody>
</table>
RESEARCH PLAN - CONCEPTUAL MODEL
RESEARCH PLAN - STEP 2

**INPUTS**
- Questions based on the literature findings
- Conceptual model
- Interview data

**STEPS**
- Interviews with Mega Project Stakeholders
- Development of a Conceptual Map
RESEARCH PLAN - STEP 3

**INPUTS**

- Questions based on the literature findings
- Conceptual model
- Interview data
- Options for visualisation techniques

**STEPS**

- Interviews with Mega Project Stakeholders
- Development of a Conceptual Map
- Focus Group Study
RESEARCH PLAN - STEP 4

**INPUTS**
- Questions based on the literature findings
- Conceptual model
- Interview data
- Options for visualisation techniques
- Needs analysis

**STEPS**
- Interviews with Mega Project Stakeholders
- Development of a Conceptual Map
- Focus Group Study
- Development of a Visualisation Tool
COMPUTER TOOL

- The tool will use the visualization technique(s) determined in focus group meetings to reflect the effects of changes in complexity levels on project performance.

- Users can perform scenario analysis by changing threshold values of complexity factors.

- Tool can be utilised for trend analysis by recording the performance at different stages of the project.
CONCLUSIONS

• This study is expected to help mega project practitioners:
  
  ➢ to understand propagation behaviour of risk-related events,
  
  ➢ to enhance the decision-making,
  
  ➢ to improve the risk communication between the stakeholders.
QUESTIONS AND COMMENTS

THANK YOU FOR YOUR KIND ATTENTION

For your further questions: herol@metu.edu.tr