Co-ordinator Prof. Robert Kliger

Flexible Processes and Improved Technologies for Urban Infrastructure Construction Sites

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www.pantura-project.eu
12 Participants:
Two research institutes + one university
Three building contractors
Three SMEs
Three authorities

Duration: 2011-2013
OBJECTIVES

The main aim of PANTURA is to realise a radical breakthrough by equipping the authorities, stakeholders and experts with a comprehensive instrument (methods, tools and techniques) to prepare and perform bridge construction, maintenance, repair and renovation processes in the most effective and efficient way, in the shortest possible time, with the most efficient, sustainable use of resources and with zero disturbance and disruption for the urban environment and urban life of the inhabitants.

PANTURA aims to improve highly flexible off-site production and construction processes, while significantly reducing labour-, machine- and cost-intensive on-site activities in order to achieve the optimal performance with the most efficient use of resources and zero carbon emissions. To co-ordinate these processes in the most effective way, PANTURA aims to develop and use a proactive co-ordination strategy and integrated ICT tools in order to anticipate and prevent any disturbance in the areas surrounding the construction site and the city. These novel approaches and solutions will be validated through real case studies.
BACKGROUND AND VISION

What we want to achieve?

• Prove that very-low or even zero disturbance large-scale construction project in the urban environment is possible, feasible and practical

• Provide the project stakeholders with the necessary systems and knowhow:
  - Developing a toolbox containing methods, tools, standards
  - Creating know-how based on real projects as learning and testing cases
BACKGROUND AND VISION

How we will perform the project? the work packages

WP 1
Project management: CHALMERS

WP 2
Construction process management (strategies + methods)

WP 3
ICT coordination tools

WP 4
Construction techniques for new bridges + case study

WP 5
Refurbishment techniques for existing bridges + case study

WP 6
Sustainability benchmarking & measures

WP 7
Training & dissemination

Developing a toolbox containing methods, tools, standards

Creating new knowhow based on real projects

PANTURA
Low-disturbance sustainable urban construction
**WP2 Methods for flexible construction processes @ urban sites**

The goal is to propose an integrated process approach to achieve sustainable solution by avoiding the normal sub-optimization of sub processes using:

- **virtual planning** to avoid conflict and unnecessary transport and achieve zero inventory and zero waste at construction sites towards to zero carbon emission construction
- **system engineering** approach to identify the stakeholder values, opportunities and threats

![Diagram showing the process flow](image)
WP3 Integration of tools

The goal is to develop an interactive tool for monitoring, planning and co-ordinating complex urban projects, which will support the flexible method for construction processes to be developed in WP2.

- Open source BIMserver
- Urban Strategy
- Urban- & Build Environment Render Viewer
- C2B

Task 3.1 Meta-information modelling
Task 3.2 Open-source semantic web
WP 6: Sustainability benchmarking & measures

The goal is to use existing and improved sustainability assessment tools and indicators to analyse and benchmark the best practices and to extend measures and standards for the lifecycle sustainability of urban projects.

Task 6.1 Best practices and benchmarking
Task 6.2 Health, safety and urban sustainability measures and technical standardisation
**WP 6: Sustainability benchmarking & measures**

Example of indicators related to lifecycle phase

<table>
<thead>
<tr>
<th>Lifecycle phase</th>
<th>Top Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem statement</td>
<td>Mobility</td>
</tr>
<tr>
<td>Goals and objectives definition</td>
<td>Safety of residents</td>
</tr>
<tr>
<td>Stakeholder’s analysis</td>
<td>Mobility &amp; Safety of residents</td>
</tr>
<tr>
<td>Risks profiling</td>
<td>Safety during construction &amp; Total construction time</td>
</tr>
<tr>
<td>Requirements specification</td>
<td>Noise emissions</td>
</tr>
<tr>
<td>Procurement</td>
<td>Emission of GHG &amp; Reused/recycled materials</td>
</tr>
<tr>
<td>Design and conditioning</td>
<td>Total use of materials</td>
</tr>
<tr>
<td>Realisation</td>
<td>Safety during construction</td>
</tr>
</tbody>
</table>
Inter-WP coordination issues

Select / design data / BIM parameters to be included

WP6 Sustainability indicators and measures

Select / define indicators of “low-disturbance”

Data sources
- Manual data input
- Statistics, e.g. traffic data
- 3D GIS (urban area)
- BIM (bridge + site)

T3.1 Open source data & tools integration

Analysis tools
- Urban Strategy tool
- BIM-related analysis tools, e.g. planning, LCC

Analysis / calculation results
- Indicator 1
- Indicator 2
- Indicator 3
- Indicator 4
- Indicator 5
- etc.

WP3

T3.2 End-user application tool (software)

User input panel / user criteria definition

Dashboard visualisation & reporting

WP2

Request for information

WP2 Construction process, coordination & decision-making processes by the stakeholders

Gained knowledge & insight
WP4: Flexible construction techniques for new bridges

The goal is to develop methods and technologies that provide alternative, effective methods for the new construction of bridges in densely populated urban environments covering:

- **Task 4.1** Integral design and engineering
- **Task 4.2** Flexible off- & on-site techniques
- **Task 4.3** Flexible assembly methods
WP4: Objectives and scope

New construction process for new bridges in the densely populated urban area:
- Efficient off-site manufacturing
- Effective connections
- Rapid on-site assembly
- Standardised design solutions
- Long service life
- Low maintenance costs

Design ➔ Off-site manufacturing ➔ On-site assembly

- Implementation of BIM and DFMA concepts in the design process
- Selection of the best desk types
- Validation of the design through practical case study
- Off-site production of lightweight FRP bridges and LCA
- Definition of main connections and laboratory tests
- Catalogue of ready bride components
- On-site assembly process adjusted to the stakeholders needs and requirements
- Implementation of robotics, intelligent positioning system and ICT solutions
- Detailed description of assembly processes

Validation of the solutions through practical case study bridge in La Palma on the Canary Island
Example of new **integrated** design and engineering solutions for the **off-site** fabrication
WP5: Construction techniques for existing bridges

The goal is to develop new bridge strengthening and upgrading techniques and enhance existing ones that focus on avoiding traffic disruption and environmental disturbance in densely populated cities.

Task 5.1: Management of strengthening and repair of bridges
Task 5.2: Flexible refurbishment techniques
Task 5.1: Management of strengthening and repair of bridges

- Mapping the need for strengthening and repair
- Mapping the problems with existing solutions
- Identification of bottlenecks
Task 5.2: Flexible refurbishment techniques

Case study? → Rotterdam?

(a) Primer application
(b) Cleaning CFRP laminates
(c) Epoxy application on laminates
(d) Epoxy application on beam
(e) Placement of CFRP laminates
(f) CFRP laminates installed

(Phares et al. 2003)

Low-disturbance sustainable urban construction
WP 7: Dissemination and training

The goal is to assure the sustainable knowledge transfer and implementation of PANTURA results to clients, the construction industry and other stakeholders and to stimulate new market opportunities and knowledge development. The aim is actively to involve stakeholders to use the new knowledge in practice.

Task 7.1 Stakeholders’ Panel: It has been established
Task 7.2 Training documentation and pilot training courses
Task 7.3 PANTURA Public Website: www.pantura-project.eu
Task 7.4 Dissemination and implementation roadmap
Thank you for your attention!

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PANTURA Low-disturbance sustainable urban construction