DEVELOPING A FRAMEWORK FOR SYSTEMIC TRANSFORMATION OF THE CONSTRUCTION INDUSTRY

Antti Peltokorpi  Assistant Professor, Aalto University
Olli Seppänen  Associate Professor, Aalto University
Joonas Lehtovaara  Doctoral Student, Aalto University
Ergo Pikas  Assistant Professor, Tallinn University of Technology
Otto Alhava  CTO, Fira Group Ltd.
RESEARCH BACKGROUND

• Lack of innovation and future-oriented investments in construction
• Contractors having enormous project management problems, which has traditionally been the general contractors’ key capability

→ Why in the era of customer-driven and disruptive digitalized businesses, the construction industry has demonstrated an unsatisfactory development?

• Systemic innovations (SI) as industry-defining changes that diffuse across companies, resulting in fundamental changes in companies’ operations
• SIs requires commitment from several actors in the supply network
• The construction industry’s fragmented and risk-averse nature sets barriers for employing SIs
OBJECTIVES AND METHODS

Objectives:
• to disentangle the industry’s problems and present justified paths toward sustainable improvement
• In practice, to develop a conceptual framework about the path toward the **systemic transformation** of the construction industry

Design Science Research approach:
1. Describing the status of the construction system
2. Defining the principles for solution
3. Conceiving a solution framework for construction industry transformation
4. Presenting partial solutions of actual cases
5. Concluding by discussing on implications on research and practice

Data: literature, 20 CEOs representing various AEC companies of the Finnish construction ecosystem
## DIAGNOSIS – A SINGLE-PROJECT MINDSET LEADING TO LACK OF SCALABILITY AND CONTINUOUS IMPROVEMENT

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>PROCESS</th>
<th>PEOPLE &amp; ORG.</th>
<th>INFORMATION</th>
<th>VALUE CREATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incompatible sub-products and materials</td>
<td>• Ad hoc processes and practices</td>
<td>• Traditional contracting models leading to distrust</td>
<td>• No adequate information management standards</td>
<td>• Lack of customer-driven business models and services</td>
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<td>• Complex interfaces and coordination issues</td>
<td>• Lack of integration of value chains and limited engagement and integration of stakeholders</td>
<td>• Professional and cultural silos originating from the education system</td>
<td>• Lack of interoperable systems</td>
<td>• No differentiation</td>
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<td>• Large and unaligned engineering tolerances</td>
<td>• Lack of flow in design and production processes</td>
<td>• Users and material suppliers not integrated into the process</td>
<td>• Manual data entry and updating</td>
<td>• Asset-dependence and outdated financing instruments</td>
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*Table 1. Five broken subsystems of construction*
PRINCIPLES FOR SOLUTION

1. **Principle**: Not only fixing visible and obvious problems but identifying *root causes* for symptoms and acting on them

   Examples:
   - Instead of controlling production on-site, asking why these activities are done on-site
   - Instead of solving quality issues on site, asking why the issue emerged and was not detected in earlier stages
   - Instead of managing multi-specialty teams, asking why we have so many professions with siloed cultures and languages

2. **Principle**: Looking for solutions that exist at the *boundaries* of the sub-systems
FRAMEWORK FOR SYSTEMIC TRANSFORMATION AS A SOLUTION

Products:
- Modular product architecture
- Use of product platforms and families
- Parametric and algorithmic design
- Tight and aligned tolerances

Processes:
- Industrialization (e.g. takt production)
- Continuous learning through shared databases (e.g. quality)
- Open innovation ecosystems to boost development
- Shared standards and processes

Organizing and people:
- Unified educational content and programmes (AEC/MEP/materials/management)
- Systemic integration of industry actors
- Continuous development to improve products, processes, systems and value creation

Information and digitalization:
- Shared languages and concepts in data models (ontologies)
- Integrating design, product, process and use data
- Real-time situational awareness with linked data (systems, sensors, images etc.)

Value creation and business models:
- Business models connected to customer’s moving need during building lifecycle
- Multifaceted financial structures
- Aiming to “utility” status, leading position in technology, and service business
PARTIAL SOLUTIONS

- PROJECT FROG: ECOSYSTEM AROUND DIGITAL DESIGN CONFIGURATOR

- BRYDEN WOOD: PLATFORM APPROACH TO CONSTRUCTION

source: https://www.projectfrog.com/

source: https://www.brydenwood.co.uk/
PARTIAL SOLUTIONS

• DIGITAL TAKT PRODUCTION

• Takt production process development is linked to:
  A. **Product development** (pull-based design management, constructability of designs),
  B. **Value creation** (production pacing is matched with client’s needs),
  C. **Information flow and digitalization** (real-time situational awareness aided with digital tools), and
  D. **Learning of organizations and people** (a collaboration between actors, continuous improvement, and holistic understanding on how effective project systems operate)
Innovation may originate in a specific sub-system. Still, to achieve a **sustainable transformation**, modifications are also needed in other sub-systems.

Simultaneous improvements in multiple sub-systems lead to **competitive advantage** that other firms cannot easily imitate.

Takt production could work as a key **driver for many systemic changes** in the construction ecosystem.
THANK YOU!

anntti.peltokorpi@aalto.fi