TAKT PRODUCTION AND SYSTEMIC CHANGE IN FINLAND & USA

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Short resume – Joonas Lehtovaara

- **Doctoral Researcher @ Aalto University, Finland (2018-)**
  - *Visiting Researcher @ UC Berkeley (2021-2022)*
  - *M.Sc. (Tech), Structural Design & Construction Management (2016-2018)*

  - *Development & Project Engineer* *@ Fira Oy (2017-2021)*
  - *Structural Designer* *@ A-Insinöörit (2015-2017)*
  - *Engineering Trainee* *@ ELY-keskus (2014)*
  - *Production & Warehouse Worker* *@ Orion (2007-2014)*

- **~4 years of experience with takt production, both practical and academic viewpoints**

Agenda

- Briefly about (takt) research in Aalto & UC Berkeley
- About systemic change and takt
- How to move from the first success stories to systemic change

Aalto University
School of Engineering

Berkeley UNIVERSITY OF CALIFORNIA

P2SL

Stanford

CIFE CENTER FOR INTEGRATED FACILITY ENGINEERING

Lean construction

Last Planner System

Virtual Design & Construction / BIM

TFV-theory

Takt production

Collaborative contracts / IPD

BOLDT

Southland

Trimble

HERRERO BUILDERS

ALICE TECHNOLOGIES

WEBCOR BUILDERS

DPR Construction Inc.

AUTODESK

vPlanner

SWINERTON

Sutter Health We Plus You

The construction sector looks forward to 2030

Building 2030 is a consortium that develops a vision for the Finnish construction sector in the year 2030 and to work toward implementing it. This is undertaken to prepare for future changes in the field of construction – digitalisation, rapid urbanisation, climate change and more – and to ensure a sustainable foundation for business in the sector going forward.

The work going into Building 2030 is built on international benchmarks, adopting best practices from other fields and the transformation of operations brought on by digitalisation and new technologies.

The consortium consists of Aalto University and 21 companies from the construction sector: A-Insinöörit, Amplit, Consolis Parma, Fira, Fluent Progress, Granlund, Haahtela, Jatke, Lujatalo, Peab, Pohjola Rakennus, Ramboll, Ramirent, Rejlers, Skanska, SRV, Stark, Tocoman, Trimble, Vastuu Group ja YIT.

The Building 2030 project is open by nature and welcomes all organisations interested in the development of the construction sector.

Takt production in Finland

- **Growing interest towards takt in last ~5 years**
  - Dozens of documented cases, hundreds in total
- **Building 2030: Strong university-industry collaboration (20+ companies):**
  - Flow and waste in takt production
  - Takt in high-rise construction
  - Collaborative planning practices
  - Data-aided learning in takt production
  - Etc.

Recent takt production research highlights in Aalto and UCB

- **How takt plan can fail? (takt control and risk management)**
- **What flows we have in (takt) production?**
- **How takt and digitalization support each other?**
- **What different takt production approaches exist?**

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Lehtovaara, J., Tommelein, I. D., & Seppänen, O. (2022). How A Takt Plan Can Fail: Applying Failure Modes And Effects Analysis In Takt Control. *Proceedings of the 30th Annual Conference of the International Group for Lean Construction (IGLC30)*, 715–726. doi.org/10.24928/2022/0182

HOW A TAKT PLAN CAN FAIL: APPLYING FAILURE MODES AND EFFECTS ANALYSIS IN TAKT CONTROL

Joonas Lehtovaara[1], Iris D. Tommelein[2], and Olli Seppänen[3]

ABSTRACT

Construction projects need adequate planning to set a structure and direction for production, but simultaneously call for effective control to maintain the direction when something unexpected happens. Effective control is of utmost importance for takt production, which is especially vulnerable when disruptions occur. While previous takt production research has primarily focused on how to form a good takt plan, little attention has been given to how to control and continuously improve takt production systems effectively. Addressing the gap, this study inspects takt control through the lenses of failure modes and effects analysis (FMEA). First, we argue that takt control can be perceived through three different failure categories: failures within wagons, failures in handoffs, and failures in takt trains. We discuss the peculiarities of takt control through these categories and provide examples of failures with their respective failure mode(s) and possible control action(s). Second, we construct an FMEA-based framework for effective takt control that shows how to recover from failures and avoid them altogether. Future research may consider validating the failure categories and the framework through case studies or simulations, and examining their applicability in supporting digital takt production.

KEYWORDS

Lean construction, takt production, failure modes and effects analysis (FMEA), production planning, production control

INTRODUCTION

Takt production is a location-based method for planning, controlling, and continuously improving construction production systems (Lehtovaara et al. 2021). It has gained elevated attention in the last fifteen years or so among construction management professionals and scholars. Takt production focuses on planning production to advance with a consistent beat, or 'takt', vigorously controlling production to maintain the beat,

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Tommelein, I. D., Singh, V. V., Coelho, R. V., and Lehtovaara, J. (2022). So Many Flows! *Proceedings of the 30th Annual Conference of the International Group for Lean Construction (IGLC30)*, 878-889 doi.org/10.24928/2022/0199

SO MANY FLOWS!

Iris D. Tommelein[1], Vishesh V. Singh[2], Rafael V. Coelho[3], and Joonas Lehtovaara[4]

ABSTRACT

Flow is one of three perspectives in the Transformation-Flow-Value (TFV) conceptualization of project production systems. Accordingly, many papers published in the IGLC proceedings and elsewhere have addressed flow on a theoretical or practical basis. This notwithstanding, quite a few of these papers describe various flows only loosely without defining them formally. For example, a term such as workflow is widely used in the Lean Construction literature, but what exactly does it refer to? This paper poses the question: What kinds of flow can be distinguished? In response, different kinds of flow are listed, some already well-described and others (e.g., assembly flow) seemingly overlooked in the Lean Construction literature. The contribution of this paper is distinguishing and defining a certain number of flows in construction, using a vocabulary that is internally consistent. Flows need comprehensive attention in the design and execution of Lean Construction systems, so it is important to be clear on terminology. The goal of providing definitions regarding flows in Lean Construction is to facilitate research and communication of ideas with scholars and practitioners around the world.

KEYWORDS

Flow, assembly flow, equipment flow, location flow, material flow, operation flow, process flow, product flow, resource flow, service flow, tool flow, trade flow, value flow, worker flow, workflow

INTRODUCTION

Koskela (1992, 2000) presented flow as one of three perspectives in the Transformation-Flow-Value (TFV) conceptualization of project production systems. Whereas the traditional view on construction is focused predominantly on transformation and correspondingly the efficiency of conversion processes, the flow view sheds light on the management of handoffs between and within conversions (Ballard and Howell 1994).

Focusing on the point of handoff between supply and demand, namely the start of an activity, Koskela (1999) identified seven flows as the preconditions for work. So, are there only seven flows in construction? Koskela (2000 p. 187) hints at more. "[O]ne may

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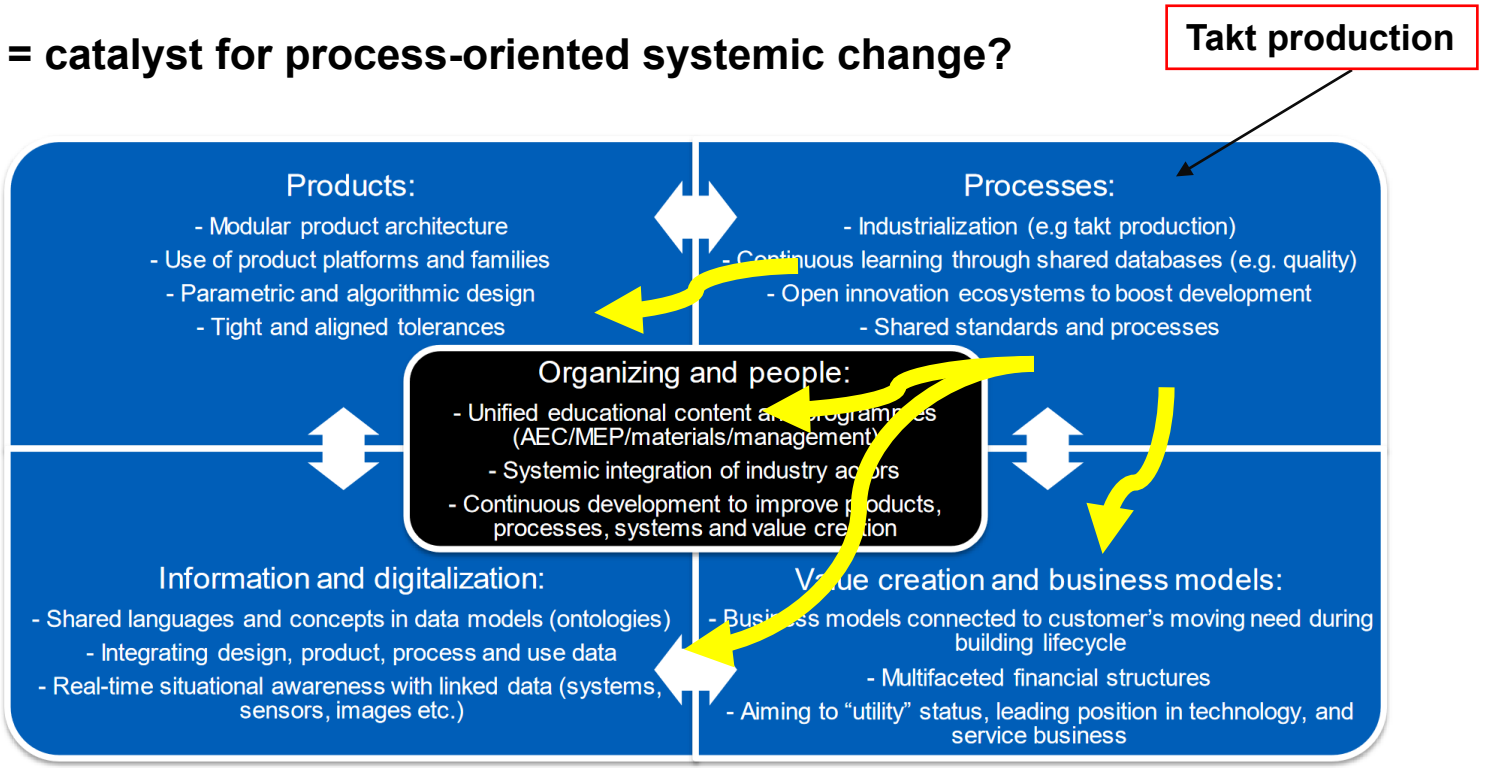
About systemic change

- **Industry-wide, mold breaking change**
- **Calls for extended effort but results in sustainable benefits**
- **Takt production = catalyst for process-oriented systemic change?**



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Peltokorpi, Seppänen, Lehtovaara, Pikas, Alhava (2021):
Developing a framework for systemic transformation of the construction industry

Takt maturity model for systemic change in Finland

BEGINNER: TECHNICAL TAKT PLANNING

Balanced plan: takt areas, takt time, wagons, and buffers

Plan aligns with the client's needs

Visual representation of the plan

INTERMEDIATE: INTEGRATION AND TAKT CONTROL

Training and onboarding of key participants

Integration of design and material flows

Paced, collaborative problem solving and quality control

ADVANCED: CONTINUOUS IMPROVEMENT

Development of high-performing teams

Systematic waste elimination over projects

Data-driven decision making

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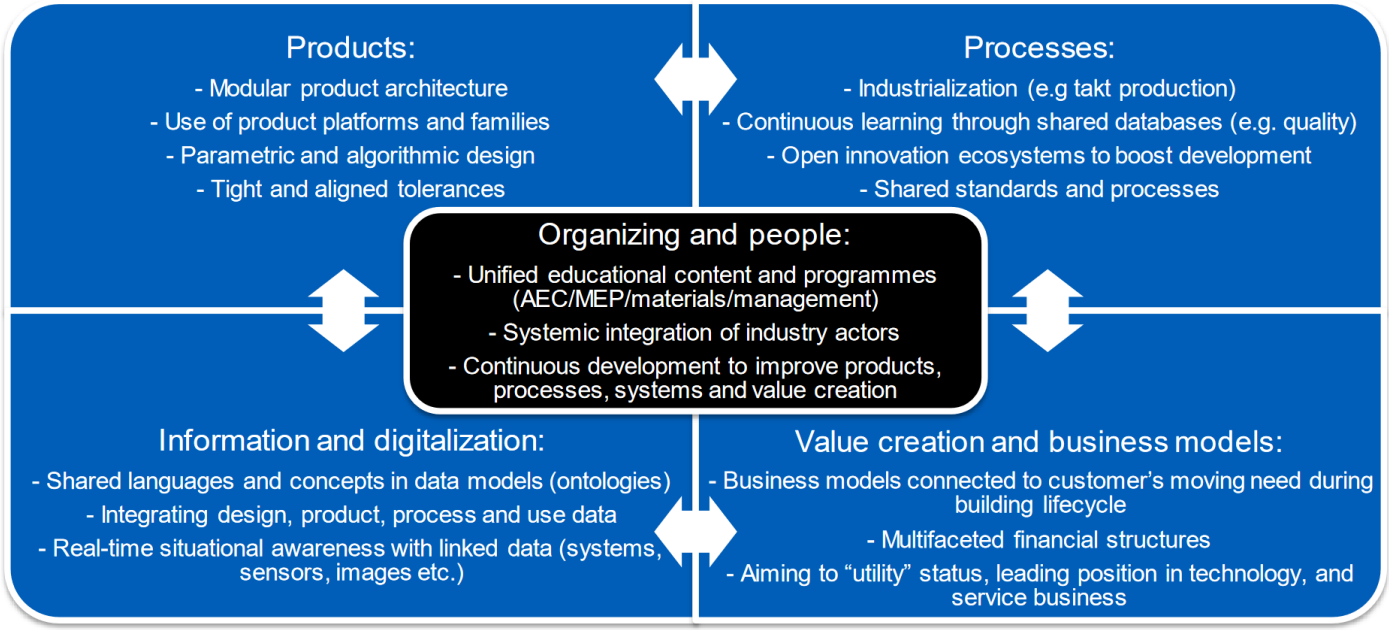
Lehtovaara, Heinonen, Lavikka, Ronkainen, Kujansuu, Ruohomäki, Örmä, Seppänen, Peltokorpi (2020): Takt Maturity Model: From Individual Successes Towards Systemic Change in Finland

However: are there different paths?

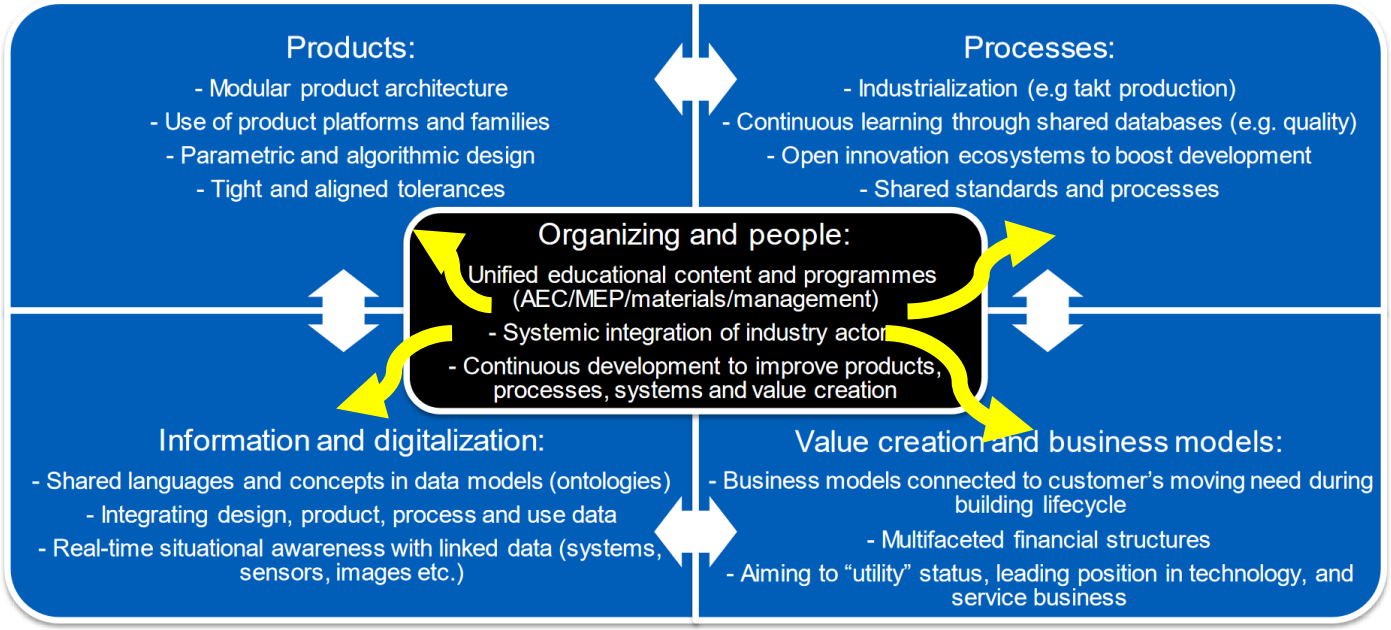
- **Change path can be affected by various parameters**
  - *History: what has been on the focus before?*
  - *Timing: what external inputs are present, and is there a clear catalyst?*
  - *Visionaries: decision on what needs to change first?*



Peltokorpi, Seppänen, Lehtovaara, Pikas, Alhava (2021):
Developing a framework for systemic transformation of the construction industry

In the Bay Area, path forms differently

- **Takt production is more a "feature" of LPS, a holistic planning system**
  - *Strong background on LPS implementation & research*
  - *Decision to pursue cultural, people-oriented change first -> catalyst for change*
  - *Slower results, but longer-lasting outcome? Basis for learning, trust, cultural change*



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From first successes to systemic change

- **Multiple paths for systemic change exist**
  - *No ”ultimate right way”*
  - *Understand your own context and learn from others*
  - *You dont have to do everything same time*
- **Definitions matter!**
  - *Takt production is an umbrella concept*
  - *Takt can be the a catalyst or other vital part of change*
- **Extended collaboration is always needed**
  - *Systemic change always needs the effort from several supply network members*
  - *University-Industry collaboration can offer valuable help and a platform*
  - *Strong vision but compromises are both vital*

Final takeaways

- **”Finnish way”** towards systemic change offers one viable path for achieving long-lasting benefits of takt production
- However, other paths exist, such as the ”**Bay Area**” way, promoting people as the catalyst
- For starting systemic change, understanding your **history**, **external inputs** and **possible catalysts** help

Kiitos!

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