

FINNISH TRANSPORT AGENCY



Integration in Infrastructure Construction

Early integration has proven its value in large infrastructure projects but also in more traditional project deliveries.

Finnish Transport Agency is an early adaptor of lean construction in Finland. Pekka Petäjaniemi, Director of Major Projects, recalls where he got the spark for lean thinking: “We had small group from Finland attending the Lean in Public Sector seminar in Karlsruhe, Germany. We realized that the problems in construction were universal: poor collaboration and unsatisfactory procurement practices. We understood that the client has a big role in making construction better.”

Petäjaniemi has been in the

industry for 32 years. He started as a consultant and designer and worked for two years in Germany. For the last 15 years, he’s been a construction client at Finnish Transport Agency. His employer buys design and construction services for about 600 million euros annually.

The Agency’s strategic goal is improved efficiency. Kaizen, continuous improvement, is a key tactic the agency promotes. For example, they consider the punch list a kaizen tool, not the shame list. They have experience with other lean methodol-

ogies as well, including The Last Planner System and Target Value Design.

Finnish Transport Agency has experience on five integrated project deliveries, of which three have been completed. They use alliances for projects that have major technical, administrative, or third-party uncertainties.

Before choosing the final project consortium, the agency organizes workshops with the two most promising teams. During the two-day workshops, the client and the team can work on the overall project schedule and define a more detailed schedule for the first three months.

The other function of the workshops is to test the capabilities of the teams and the organizational skills of the project managers. The attendees receive preliminary assignments, but also get to solve impromptu problems during the workshops. Organizational psychologists, not the client, assess the performance of the teams.

Key goal indicators are essential for an alliance project. The consortium and the client start defining four to six indicators during the very first workshops and fix them at a development phase. Typical key goal indicators relate to schedule, environmental factors, project communication, usability, and safety. The risks and rewards are shared, even with the strategically important subcontractors.

Petäjaniemi has brought early integration to traditional projects as well: “We’ve noticed the contractor is eager to start building as soon as possible. Sometimes, the solutions that are done in haste turn out to be less successful later in the project. That’s why we start with a collaborative planning phase prior to the construction. It can take three or more months.”

Everyone in a project should internalize lean thinking. Young professionals are eager to work in an environment where the manager is a coach, not an authority looking for culprits. Finnish Transport Agency promotes lean project experiences internally and gives both their young and seasoned project managers a chance to update their skills.

Petäjaniemi says that the benefits of lean construction, especially early integration and the use of Big Rooms, are indisputable. The alliance projects have outperformed their schedule and cost goals, except for one that encountered an unforeseen risk. “We’ve required BIM in every project. Combined with lean construction methodologies, it has led to fewer mistakes and less process waste,” Petäjaniemi assures. ■

CONSTRUCTION REVIEW

LEAN CONSTRUCTION INSTITUTE - FI

AALTO UNIVERSITY

MAKING FINLAND THE WORLD LEADER

Aalto University is combining process development and digital technology to take Finnish construction to the next level.

Olli Seppänen is a serial entrepreneur, lean construction researcher, and Professor of Operations Management in Construction at Aalto University. He worked for several years in California and consulted for U.S. construction firms. He completed a PhD on construction production control in 2009. He’s been involved in lean construction since his first presentation at the IGLC conference in 2003: “I introduced the Finnish practice of flow-

line scheduling there and later wrote an international textbook on the subject. Flowline figures are now an established method in lean construction in many countries.”

Seppänen is happy with the growing enthusiasm that Finns have shown for lean construction during his tenure. Public-sector clients, especially, are using project alliancing, a form of Integrated project delivery.

“Most companies still see lean as a set of tools and methods, like a big room, for example. We have a long way to go in continuous improvement. And I don’t think that yet we have lean organizations in construction,” Seppänen maintained. He says that the most critical issue is to involve subcontractors in lean development. “We’ve researched globally what makes a project excellent.



Nobody in outstanding projects talks primarily about BIM or tools. They mention trust as the key success factor.”

Haste is a common complaint in construction. Seppänen has conducted research at Aalto on pilot projects that shows how haste can be avoided while halv-

ing the construction time. This is possible with takt production, in which the typical two-to three-week buffers between successive tasks are unnecessary. In traditional construction, the ROI for prefabrication has been questionable, whereas in takt production, the benefits are indisputable. There’s a huge untapped potential in involving material suppliers in lean development.

Seppänen’s research team has used indoor positioning to track the movements of workers and concluded that they create value 30%, or at best 40%, of their time on site. Installation teams use 20% of their time moving materials aside that obstruct their work. Seppänen says that empowering individuals with situational awareness and personal daily task instructions is essential if we want to improve productivity.

Aalto University, with Olli Seppänen in the lead, has started a project called Visio 2030 with 13 construction industry CEOs. The program will define a compelling vision for the Finnish construction industry and activate organizations to strive for it. Seppänen has a clear goal in mind: “I want to hear in future conferences that Finland is the world leader in lean construction.” ■

MITTAVIIVA

Why Lean?

Anssi Koskenvesa is a lean construction expert, educator, and CEO at Mittaviiva. Here are his top five reasons for construction industry businesses to start their lean journey.

- **Better Control** – Your business will become more predictable and results more reliable as you collaborate and share information timely and openly.
- **Increased Productivity** – You start identifying and eliminating activities that don’t add value in the process flow.
- **Delighted Customers** – You uncover your customer’s real problems and can delight them with your solutions.
- **Inspired Employees** – By listening to your employees’ ideas and empowering them you can achieve unprecedented results.
- **Better Decisions** – Early integration and BIM allow you to make smart decisions when it most matters.

Lean is a philosophy and strategy. It is also methods and tools, and a way of thinking. Take small steps and celebrate them. Be consistent and persistent. As an owner or top manager, be an example and show respect. ■

CONSTI

CONSTRUCTION IN THE FLOW

Flow production and takt time take renovations one step closer to industrial production.

“I THINK THAT IN 2017, WE FINALLY cracked it,” says Juha Salminen, Development Director at Consti. “Until then, we had just studied the theory of production flow and only applied it in use gradually. Now, we are at the forefront in Finland, but I would still say that this is just the beginning.”

Consti is one of the leading renovation and technical services companies in Finland. They’ve long been involved in lean construction development projects, including LCFIN₁ and LCFIN₂, and more recently in RAIN. Salminen, with a Ph.D. in construction economics, also has a long history with lean principles. In the early 1990s, he acquainted himself with the Last Planner System that Lauri Koskela brought from the USA to Finland. Unfortunately, at that time, the industry was not ready to embrace it.

Project Flow and Takt Time

Project flow and takt time are powerful lean manufacturing concepts, but using them in construction has been challenging. Consti has applied lean principles in projects with repeatable units, for example in pipeline renovation. In a residential area renovation in Turku, the company applied takt time production for facade refurbishments.

In a traditional construction project, the process speed varies. That’s why buffers are often



“In flow production, prefabrication simplifies the process”



PICTURED Juha Salminen

added to the schedule to compensate for variations and to try to optimize the use of resources to try and keep everybody busy at all times.

However in takt time production, the project is divided into identical work packages that follow each other with an uninterrupted pace. The production speed is consistent throughout the project. The steady flow makes the project predictable. You can tell, down to the hour, what’s going to happen, and when, in the project. Having a feedback loop in the scheduling makes it possible to adjust the pace in case packages takes less time to complete than anticipated.

Measurable Benefits

Flow production provides several benefits; for instance, completing a bathroom takes at best one week whereas it could take over one month in a traditional project. The construction team can solve any production problems early in the process as they complete the very first unit. Through continuous learning, Consti has been able to reach a zero-defect quality.

Daily briefs make clear to the teams what they’re supposed to be doing during the day, which adds confidence and reduces work-related stress. All the building materials can be delivered to the right place, at the right time. With different craftspeople working in close vicinity, communication is very important and can be efficiently achieved in this process.

Consti makes great use of prefabrication, especially for mechanical installations. “People think of prefabrication as a time saver. However, in a traditional project, time savings often don’t materialize because of the slack in the schedule. In flow production, prefabrication simplifies the process, which is an essential benefit,” Salminen claims.

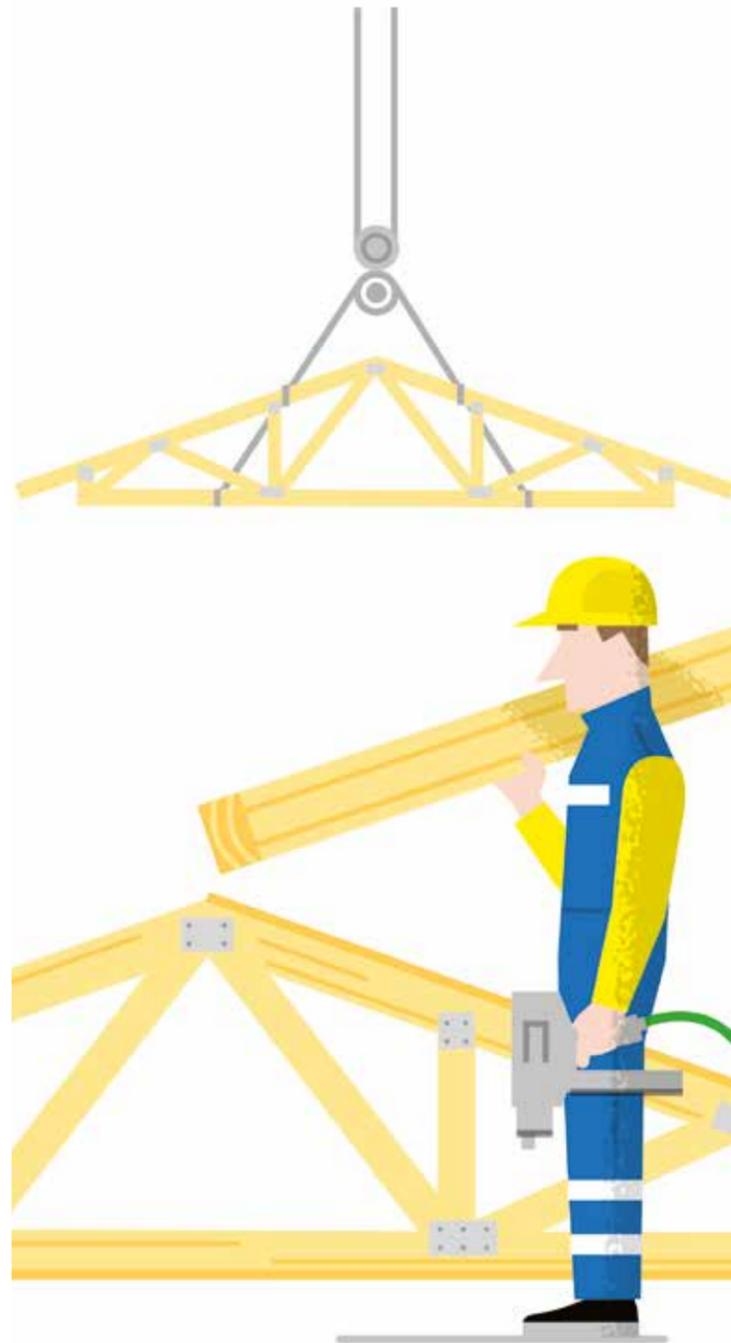
Salminen names three success factors in flow production:

- *Scrupulous planning and preparation;*
- *Committing to implementation of the takt time plan from the start;*
- *Continuous daily improvement.*

He points out that it’s critical to have employees and partners who are committed to reducing waste and willing to work in a very organized manner. After some initial doubts, most employees and partners are now very happy with the new way of working. ■

GRANLUND

How to Reduce Design Process Waste with Lean Construction



Granlund combines lean practices with technology to get more time for value creation.

“IN THE OLD DAYS WE HAD AMPLE time to create a complete design before the construction started. Those days are over,” says Jukka Tyni, Deputy Managing Director at Granlund. Big projects have become aggressively fast, with design and construction happening at the same time.

From Process Waste to Value Creation

Granlund is a leading Finnish design, consultancy, and software services company that specializes in energy efficiency. They’ve worked on several demanding projects, like the Helsinki Music Center, West Metro, and the renovation of

Stockmann’s department store in downtown Helsinki.

Tyni says that following lean thinking on large projects is challenging. He would like to see more time for design and see it advance at a logical pace, but these things don’t usually happen. He gives an example: to supply HVAC contractors with sufficiently accurate designs for the bidding process, Granlund must deliver working drawings early even though the architect is still doing preliminary design work. This leads to a lot of rework later in the project; in other words, process waste.

Tyni believes that there are ways to remedy these problems with lean practices and project re-engineering. Precise synchronization of the design and construction schedules can diminish process waste. It is essential that all the project



PICTURED Jukka Tyni

parties understand each other’s needs and opportunities. Project alliances, for example, have fixed many problems on big projects.

Towards Virtual Big Rooms

Big Rooms and workshops can improve communication within projects. If they are well-prepared, the participants are committed, and there are people present with authorization to make quick decisions, the process speeds up and innovative solutions are more likely to emerge.

Communication and design collaboration outside workshops are mostly digital. Only one or two from the design team out of a dozen typically attend a Big Room or meeting. That’s why Granlund is examining solutions for virtual Big Rooms that allow a larger number of people to be connected, regardless of their location.

Granlund has been exploring several collaboration and task management tools. They’ve used Trello, SharePoint, and OneNote for internal collaboration, while tools like Confluence, Jira, ModelSpace, SharePoint, and SmartSheet are good for task management.

Collaborating with BIM

Every construction project nowadays uses centralized project servers for the exchange of BIMs, schedules, and documents. Projects start with an information management meeting where the attendees agree on guidelines, the standards to be used, and information management practices.

Modern BIM software enable practically real time multi-party collaboration on the same model. The challenge is how to communicate design changes to other project participants. Particular software can compare revisions and report on model changes automatically. Projects have specialized BIM coordinators whose job is to conduct weekly or bi-weekly reviews in order to ensure that the models on the shared server are compatible.

Granlund has used BIMs routinely since the mid-1990s. The company has learned that having the big picture on the whole project is critical in lean construction. “If you only work on a small part of the model, you can lose sight of where you’re headed, much like using a navigator that only shows you the next few blocks,” Tyni observes.

Granlund was founded in 1960 and ever since it has been in the technological vanguard. The company has used Virtual Reality, design automation, and many other cutting-edge technologies. Now, they’re looking into the possibilities of using artificial intelligence. “I see AI helping in BIM coordination and design optimization,” Tyni predicts. ■

YIT

MAKING A PERFORMANCE LEAP PUTTING PEOPLE FIRST

Removing silos will make construction better.

Maarit Sääksi is head of the Performance Leap program at YIT, the biggest construction company in Finland. She admits that explaining her goals to others in the company is sometimes challenging: “It is kind of funny that we’re talking about a performance leap after having made continuous improvements over so many years. Do we really need to leap?”

Sääksi knows her industry. She came into the business in 1993 and has worked as a site engineer and estimator, managed procurement, and controlled design. She has experience with project alliancing and is well-versed in lean construc-

tion, even if she does not promote the term herself. Sääksi remembers how lean construction entered the scene in the 1990s at a time when the industry was not ready to embrace it. Now, lean is an essential philosophy and practice in many companies, including YIT.

Working Across Borders

“My goal is improved productivity at the enterprise level. I’m trying to find common factors in all our segments and functions,” Sääksi explains.

A big contractor typically maintains different organizations for various types of new building, renovation, and infrastructure construction. Likewise functions like development, design, estimation, and production, form separate silos within a company and between organizations. YIT has discovered that

working toward the same goal necessitates mental and physical removal of these silos.

“We engage every employee in the performance leap. Titles don’t matter, everyone can participate, whatever their role is in the organization,” Sääksi says. “The days are over when someone could use their position or title to force adoption of his or her solution.”

Sääksi is currently mapping the value chains in each business segment, looking for ways to eliminate process waste. Pilot projects offer a quick way to test new ideas.

A recent pilot of interior construction showed that YIT could cut lead time by 50% without using any more resources than normal or investing in new technology. The pilot motivated craftspeople, and site safety and quality improved. The company incorporates the lessons from pilots like this into their production processes.

Construction projects have become complicated, but each one is not unique, Sääksi observes. For example, the process used to build a certain structure or a portion of a metro tunnel can be repeated on many projects, which enables continuous improvement of the solutions.

People First, Digitalization Later

Many in the industry see digitalization as a panacea for poor productivity. Sääksi’s main message is to start with people, not technology. “I don’t see any point in digitalizing underperforming processes and hope they become



more efficient,” Sääksi says. At its worst, digitalization can be an excuse for not changing unproductive behavior.

A construction project is a joint journey aimed at meeting customer expectations. YIT emphasizes that communication between the customer and the project team should begin early in the project. The company utilizes the Last Planner system widely and aims at pull planning and improving process and information flow.

Sääksi says that once shared processes are in place, digitalization makes sense. She sees

great value in making standardization visible with digital tools. Digitalization helps with open sharing of information and distributed learning, and it enables real-time control and performance measurement.

People fear mistakes in the construction business, which hampers innovation. “I want to make people realize that you can do things differently. I inspire them to ask ‘why,’ many times if necessary,” says Sääksi. “When people hear about the benefits we’ve gained so far, they become interested and are willing to collaborate.” ■

INDEPRO

FANCY WORDS OR NOT... Common Sense Leads to Lean Construction

Astute builders are starting to learn that early integration is a necessary ingredient of a successful construction project.

Matti Kruus, CEO of Indepro, a project management firm, has seen many construction sites. Not only as a project manager, but also as a jury member of the Construction Site of the Year competition. He recalls a site visit during which the contractor gave a presentation and didn’t once mention lean construction terms. When Kruus asked the contractor if they’d used integration in the wooden multi-story building, the presenter steadfastly denied doing so. It came out later in the discussion that the contractor, structur-

al designer, manufacturer, and installation crew had, in fact, discussed the installation well in advance to avoid any future problems. Integration at its best!

Kruus became interested in lean construction in the process of writing his PhD thesis on design management about 10 years ago. Over the years, the practice of lean construction has steadily gained ground. Last Planner*, for example, has become very popular in Finland.

Planning Together

“It makes a lot of sense for the main contractor to get all the subcontractors to plan the schedule together,” Kruus says. “The old way of collecting individual schedules and trying to combine them to create a project timeline is obsolete.”

Lean and Integrated Project Delivery, IPD, have almost



PICTURED Matti Kruus

become synonyms in the industry. In Finland, projects governed by IPDs are usually called “alliance projects.” Kruus does not like this merger of concepts. He thinks that an alliance makes for a great delivery system, but believes that companies can practice lean construction independent of the project model.

Some clients and project managers are open to new delivery models or even require them. Most often, contractors are able to take the initiative. They see an opportunity to start collaboration with the client before the bidding starts and they can win the bid by proving their lean capabilities. Once the project starts, contractors can save time and money by implementing lean methods.

Lean construction can be a cost saver in many ways. When contractors are involved at early stages of the project, they can come up with cost efficient solutions before creating a detailed design.

The modernization project of the headquarters of the Finnish phone operator Elisa serves as a good example. Using early integration, the Last Planner method, Big Room-working methods, hiring key subcontractor early and continuous improvement from phase to phase, the project was both on time and on budget, which is not often the case in a renovation. Good planning allowed the users of the building to stay operational on the premises during construction. That saved them money and increased their customers’ satisfaction.



“Happier workers are more productive workers”

People Make or Break the Project

Matti Kruus sees employee morale as an essential element of lean. “What I especially like about lean is the idea of a culture of respect,” Kruus says. A fine example of this was Manskun Rasti, an office project built by Skanska. A seasoned master builder showed respect for younger workers, not over-emphasizing his title, but was still firmly at the helm.

Systems and tools are necessary, but people make or break a project. “Happier workers are more productive workers,” Kruus suggests.

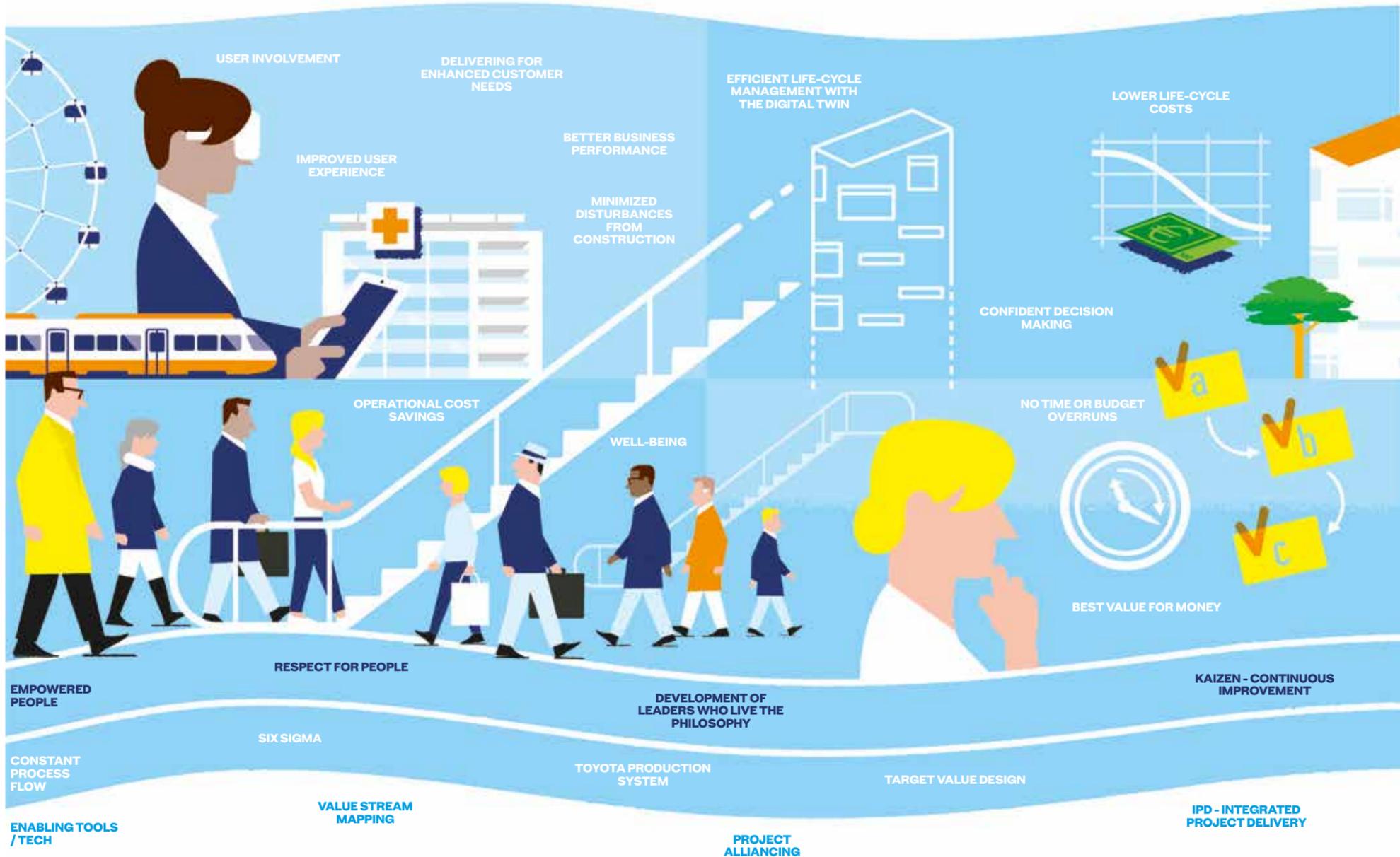
Kruus thinks that main contractors treating their subcontractors well is an essential element of lean. If the cheapest subcontractor always gets the job, chances of building an efficient project flow are very slim.

Kruus sees prefabrication as a key factor in making construction both lean and productive. Forward-looking Finnish contractors have already shown that prefabrication does not have to mean inflexibility. Good design and efficient production can go hand in hand. ■

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MAXIMIZED VALUE FOR THE USER-CUSTOMER

REDUCED PROJECT RISKS FOR THE OWNER / INVESTOR



UNIVERSITY OF OULU

Busting Lean Construction Myths

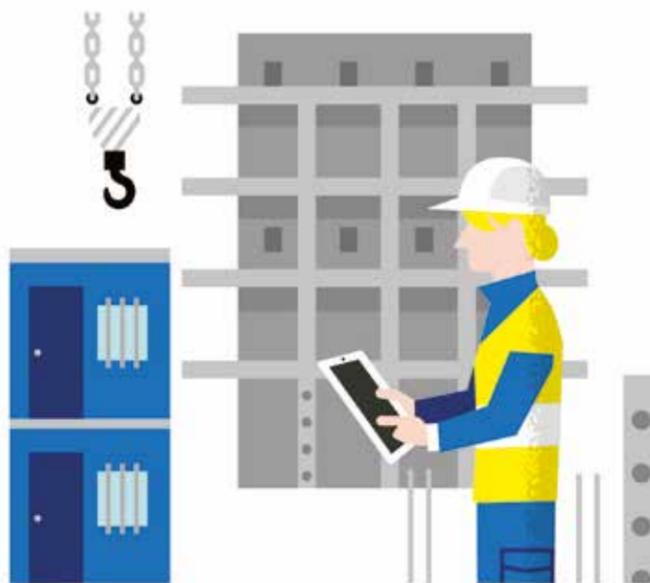
Today, several big construction projects in Finland follow lean principles and use project alliances. We've come far very quickly thanks to trailblazers like Professor Harri Haapasalo.

Harri Haapasalo is the Head of Industrial Engineering and Management at the University of Oulu. After graduating with an M.Sc. in construction economics, he began work on developing and researching computer-aided design processes. He earned his Doctor's degree in Industrial Engineering and management and has since received several scientific awards in lean construction.

Lean construction originated in the manufacturing industry, and specifically at Toyota. Haapasalo realized that its principles could be applied to the construction industry as a remedy for its poor track record in productivity. "We understood that suppliers alone could not solve the productivity challenge. Clients and the way in



"Don't deliver what the customer wants. Deliver what the customer needs."



which they procure services are essential pieces in the puzzle," Haapasalo says.

What followed from this insight was a series of efforts to bring the lean philosophy to Finnish construction including the founding of Lean Construction Institute Finland and a sequence of industry-wide development projects. As a result, Finns have been able to implement lean construction in record time.

Six Myths About Lean Construction

There are many beliefs about lean construction that are not quite accurate. We asked Professor Haapasalo about these

lean construction myths that he'd like to bust based on his research and experience. Here are six of them:

The Customer is Always Right

Haapasalo says that the essence of lean is to deliver value to the customer. Here's the caveat: "Don't deliver what the customer wants. Deliver what the customer needs." Project preparation done right will uncover true needs that may be quite different than what the customer originally imagined.

Lean Does Not Work in a Business Where Every Project is Unique

"This is a typical claim that

works as an excuse for not doing anything," Haapasalo says. He admits that applying lean to project delivery is initially demanding. But no one can argue against the benefits of lean in construction: process efficiency, shorter lead times, elimination of waste, reduction of inventory, and improvements in resource utilization.

Lean is All About Methods and Tools

The Toyota production system is based on three cornerstones: the value-creation process, people, and tools. Management must give its employees the tools they need so that they can follow the established processes. Last Planner, for example, is a great tool for planning production schedules collaboratively. A simple suggestion box can be enough to collect ideas leading to continuous improvement. These, in turn, follow the collaborative contribution and continuous improvement philosophies.

Lean Works Only in Big Companies

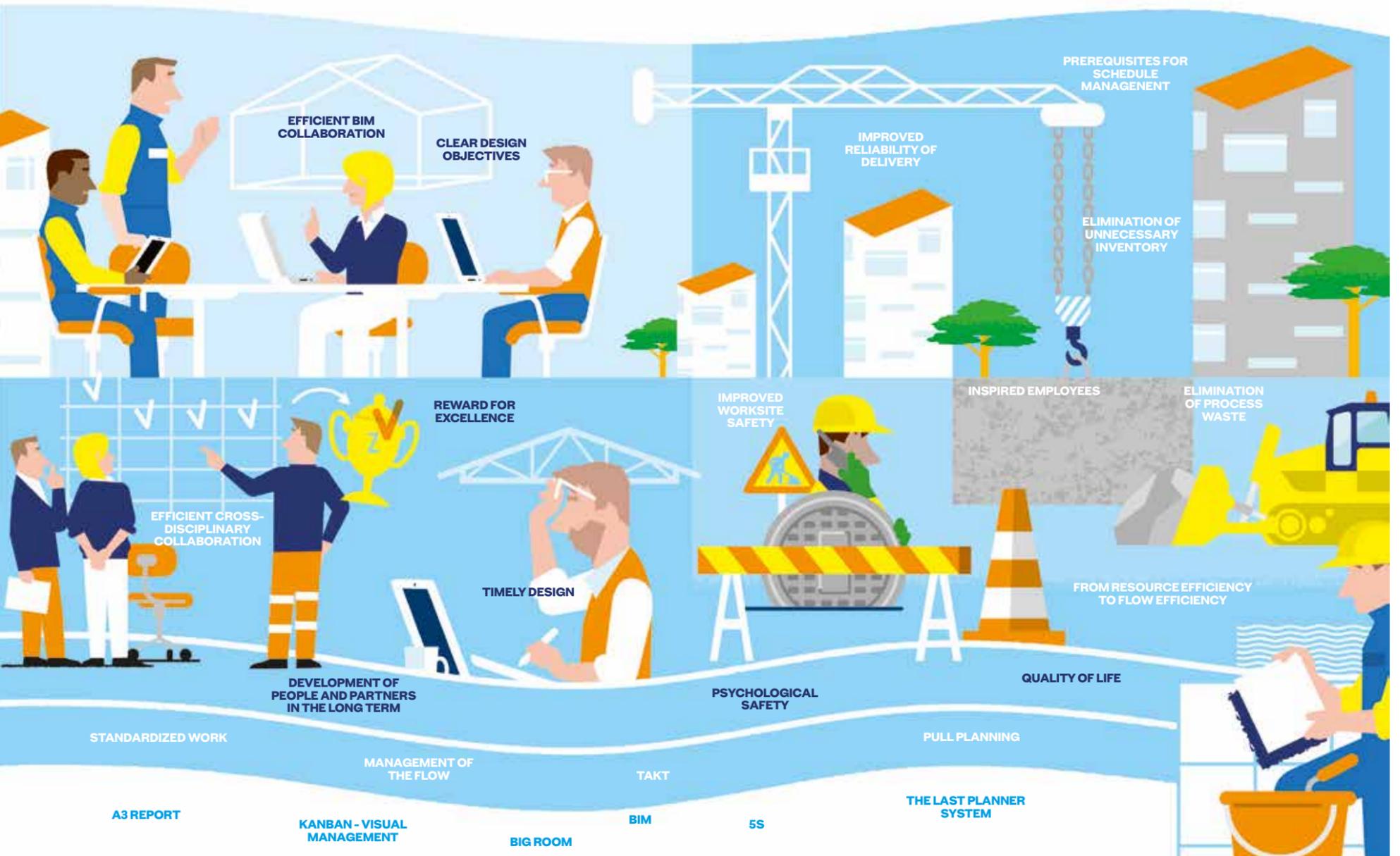
Company size does not matter. What matters most are the number of outputs and process repetition. A small company performing 100 installations annually can implement lean more easily than a huge company producing one nuclear power plant every 10 years.

Lean is Costly

Every new initiative – for example, the implementation of quality management or BIM – requires initial investment. You need to first understand what

EFFICIENT PROCESS FOR THE DESIGN TEAMS

PERFORMANCE BOOST FOR CONTRACTORS



waste you're trying to eliminate. You can then calculate the lifetime benefits of and investments needed for lean construction, and come up with a business case supporting it. Everything about lean construction points to a positive ROI.

Lean Equals an Alliance

In Finland, we've managed to create a sweet spot for lean construction in alliance projects. But any project can benefit greatly from early collaboration between the client, designers, and contractors. Project-level thinking is the most important factor for success, not the "lean-ness" of individual companies.

Employing Lean Construction is a Project

"Implementing lean as a one-off project is like deciding to run a marathon without any practice. Your feet will hurt and you will give up running because of the bad experience," Haapasalo observes. Finns have practiced and run the first marathon successfully, but companies have involved their most motivated people, the best "runners," to participate in the process. Sustainable success requires getting everybody in the company on board.

Haapasalo says that the next step is to digitalize the lean construction process. He sees huge potential in building the digital twin of physical construction. "User-oriented digitalization combined with lean construction will eventually provide a tenfold improvement," he predicts. ■

VISON

HOW FINNS DEVELOP LEAN CONSTRUCTION TOGETHER

The Finnish construction industry is exceptional. Businesses, the government, and cities collaborate openly to learn and develop smarter and leaner ways of construction.

The office of Lauri Merikallio, a Partner at Vison Oy, epitomizes this new way of doing construction. BIM Kampus, as it's called, provides various spaces for cross-functional collaboration. It has a Big Room with movable white boards, a virtual reality cave, break-out spaces, a fast wireless network, and desks for individual work. These spaces facilitate both the company's projects and educational events.

"I've presented at various international events and talked about how we've advanced with lean construction in Finland. I point out that our strength is our small size. All the key players fit in a conference hall," says Merikallio. That's exactly what hap-

pened in 2010 when infrastructure construction front-runners decided to learn about lean construction and Integrated Project Delivery (IPD). That gathering set off a process of pilot testing, with the Finnish Transport Agency leading the way.

Taking Steps Towards Lean

Lean Construction Institute Finland was founded in 2008. Its mission is to research, develop, and apply lean thinking and lean management principles in construction. Under the auspices of the Institute, several joint development projects have emerged.

LCIFIN₁ kicked off lean construction development in Finland in 2010. Seven organizations took part in the project, led by the University of Oulu. The project introduced lean methods and tools and pilot-tested lean construction methodologies.

The second project, LCIFIN₂, occurred in 2014-2015 and focused on construction process development. Over ten organizations joined in, including a public-sector client, the Finnish Transport Agency, and

the project received governmental funding. The participants soon realized that lean is not just about tools, but is also very much about developing cross-functional processes.

During work on the joint development projects, the Australian variant of IPD, or project alliance, gained a foothold in Finland. A new development project called IPT invited client organizations to start developing a standard for the new delivery model. The project organized workshops on procurement and the clients provided pilot projects. As a result, Finland will soon have a standard for process integration.

"When I talked about these projects abroad, the audience was amazed," Merikallio says. "By taking small steps, we've been able to develop both people and processes systematically within the whole industry."

Finnish construction industry leaders had set the flywheel of development rolling. The RAIN project centers on integration and human resource development. Unlike its prede-

cessors, all the funding for this two-and-a-half-year project has come from participating businesses.

In the IPT₂ project, construction and real estate client organizations aim at continuous improvement of construction and service processes through IPD. "Last Friday, around 30 people convened here to devise ways to make Big Room collaboration better," says Merikallio. "Working in a Big Room setting is one of the many ways to continuously improve your performance. It makes your processes transparent, bringing inefficiencies to light."

Focus on People

Merikallio believes that lean thinking has made the industry aware of the value that it creates. It has highlighted the importance of collaboration and respect for people. Upcoming norms applicable to public procurement will further push the ideas of lean construction.

Merikallio thinks that the emphasis should now be on developing mind-sets and people. Companies should make lean part of their strategic plans and introduce lean to every employee and manager. Finnish universities, trade schools, and training institutes already provide lean construction education. The conditions are there, and now it's time to move forward.

"I think we've still to grasp the potential of lean. I know it is huge, and we are in the middle of a breakthrough," Merikallio proclaims. ■

LEHTO GROUP

From Projects to Production



Industrial processes and systemization can solve many of construction's productivity challenges, as the Lehto Group Plc has demonstrated.



PICTURED Tiina Talvitie

Lehto's mission is to be an innovative trailblazer in the construction industry. The company uses digitalization and prefabrication to improve productivity and cost efficiency in construction. They've also devised new operating models that add value for the customer. "We're pioneering a digital revolution in the industry," says Tiina Talvitie, Digital Director of Lehto. "Instead of waiting for the industry to change, we change it ourselves. To me, courage is the most telling of our values."

The Business Model is the Key

Talvitie oversees Lehto's strategic development project called LEKA, which aims to digitalize the whole Lehto production process. BIM, lean methodologies, and systematization are its key ingredients. Since its IPO in 2016, the company has

grown rapidly. From early 2017, the number of employees has doubled to 1,200. In the same year, the group's net sales increased by 64.2% to 594.1 million euros.

A lean philosophy—value for the customer and the elimination of waste—is at the heart of Lehto's business. They don't take part in competitive tendering. Instead, they offer an individual agreement to each client for work at a specified price and quality, to be performed to a specified schedule. They're able to keep their promises because they maintain full control over the production process: design, manufacturing, assembly, and handover. Instead of being preoccupied with individual projects, Lehto optimizes the whole of their business, using systems-based thinking.

Concepts and Prefabrication

"We don't believe in building

prototypes," Talvitie states. "We re-use the same designs dynamically and continuously improve them." Lehto has created concepts for affordable housing, social care, and education. Talvitie points out that standardization does not mean inflexibility when it comes to architectural expression or compliance with local building codes.

Lehto has replaced on-site work with automated factory production in their own plants. They make modules containing, for example, a complete kitchen-bathroom element. The company produces complete modular homes for gallery apartment complexes.

The Roadmap for Digitalization

Lehto has a roadmap for digitalizing the construction process. It starts with establishing a digital construction process. In the next phase, it reaches out to the whole life cycle of a building utilizing a so-called digital twin. It also looks at the eventual deployment of new digital services for the construction ecosystem.

"Our development happens agilely in pilot projects. We create project-specific BIM strategies that describe the usage of the models, what the design and production require, if and how we use 4D design, the level of detail, and so on," Talvitie explains. Models must be exact and appropriate for cost estimation, procurement, and production. "We intend to offer designers variable 'Lego blocks' that contain all the necessary technical and cost information." Visualization for customers also necessitates detailed modeling.

People, Process, Technology

Talvitie sees her main job as leading people and the company culture. She emphasizes that the key prerequisite for a successful change management project is to deeply understand the essentials of the company culture and the owner strategy. The top management is committed to and so far has provided sufficient resources for digitalization. Employee education is a critical factor in the success of new processes, and Lehto accomplishes this systematically through what they call LEKA Akatemia: Lehto's Growth Academy. Talvitie's own team organizes Lehto Way of Working training for BIM experts, design and production management, and project and site management.

The joining of BIM and lean construction processes has already shown significant potential in pilot projects. When BIMs are detailed and accurate, the quality of the construction process improves significantly. No errors remain hidden and costly rework at the factory or the site can be avoided. Early integration is especially valuable, as are many other lean methodologies employed by Lehto.

The open flow of information, process flow, and standardization are the cornerstones of Lehto's success. The company is committed to being a leader in digitalizing construction; Talvitie describes the determination of Hannu Lehto, the CEO: "He says that we no longer have an alternative if we want to stay competitive. This is our future." ■

SWECO

Design Can Become a Lean Process

Atte Leppänen, Business Development Director at Sweco Structures, got a glimpse of lean thinking when he worked as a kid at his father's sheet metal workshop. He became familiar with process flow and making sure every piece would be impeccable for the next production phase.

"I started to use the same production line thinking early in my career," says Leppänen. "In the year 2000, at Suunnittelukortet, we standardized pipe profiles and connection types that we used in design. A few years later, we automated the process and saved one third of the time required to design the connections."

Positive Laziness as a Driver

Leppänen talks jokingly about positive laziness as a driver for lean design: "We're looking for solutions that allow us to do things easier and simpler, avoiding waste." Sweco Structures has trained their employees to collaborate better and used Last



PICTURED Atte Leppänen

Planner simulation to visualize process flow. They employ their own version of Scrum, an agile management framework, with weekly sprints and daily scrum events. They're also studying how artificial intelligence and machine learning would help in design work.

Big Rooms

Big Rooms are becoming popular in Finnish construction. In a Big Room, designers communicate with the customer directly and visualize designs for them using virtual reality. That speeds up the work and reduces misunderstandings that often lead to rework later in the project.

Playing with alternative designs during the development phase is all right; it adds value to the customer. After all, the early decisions essentially determine the final cost of the construction. Trying to find cost savings through alterations later in the process only creates process waste and results in marginal cost savings, if any.

Leppänen reminds us that Big Room is not a panacea. It requires rigorous management so that it doesn't become just a hang-around place.

Stop the Snowball of Unfinished Work

Lack of initial data in various design phases is a recurring problem and Leppänen's pet peeve. He likens the work in a typical design process to a rolling snowball. Typically, when the designer is approaching the first milestone on the schedule, the task is incomplete. Since the project deadline is far in the future, the problem does not seem that critical. However, the work for the next milestone cannot



start on time. The same happens with all consequent milestones, and finally the small snowball of belated work has grown huge and unstoppable. Eventually, the design team faces the reality and the final weeks before the deadline are hectic and exhausting.

"The snowball scenario would be unrealizable in a manufacturing or construction process. But since design deals with abstract entities instead of concrete, it's easy to accept," Leppänen regrets.

Leppänen emphasizes that people and their attitudes are key success factors in lean con-

struction, not tools or techniques. Project managers must be two steps ahead of the process, make sure that prerequisites are in place, and intervene right away if anything threatens the process flow. Designers should also have the courage to require that clients do their part as well.

Leppänen sees great potential in lean construction and digitalization. He believes the construction industry can become leaner if the owners and leaders decide to do so. We have sufficient proof of success, now we need to scale up the efforts. ■

FIRA

How to Empower Craftspeople with Data

“The nonexistent flow of information is our industry’s biggest problem”

Fira, a Finnish building contractor, has transformed itself from a construction company into a service company. Now, it wants to become an information company empowering on-site workers with data.

“The nonexistent flow of information is our industry’s biggest problem. The flow stops at the construction site’s office trailer,” says Otto Alhava, CTO of Fira. “We design with BIM and talk about VDC, but what does that matter to a craftsman at the site? Does he or she get the essential information from a BIM to do the job at hand? I think not.”

Poor Support for Daily Work

“On a building construction site, we carry the information to the work face in a paper notebook and on printouts,” Alhava observes. “In the telecom infrastructure business, competition

has forced companies to increase field worker productivity. Their employers care about their field workers’ success: everyone has a car, proper clothing, a tablet, a computer, and a smartphone on which they receive detailed work instructions.”

BIM could provide accurate and detailed data from any spot in the model. Alhava maintains that’s not happening: “You need to be a Master of Science in Technology to extract the information that a supervisor or a technician needs at a certain time in a certain place.”

When employees don’t have the means to work efficiently, they become a costly expense. A plumber, for example, creates value only two hours a day. Construction workers spend one day a week just moving or clearing away the stuff of their co-workers. Companies try to compensate for poor productivity by

hiring a cheaper workforce from abroad.

From Point Solutions to an Ecosystem

Of the lean construction methodologies, Last Planner has had the greatest impact on Fira’s construction sites. It has brought to light a problem with site management: if a supervisor spends two-thirds of his or her time walking around a site to manage it and collect information, that’s process waste. That’s why Fira implemented Sitedrive, a mobile tool for communication between supervisors and craftspeople. Previously, some sites had used WhatsApp for the same purpose.

Sitedrive gives everyone a real-time overview of what’s going on at a construction site. It allows an individual craftsman to plan his or her tasks for the day and shows what others are working on. Alhava calls Sit-

edrive a resource management tool for field work. The start-up that developed it brought IT developers to construction sites and inspired the company to start “speaking IT.”

As good as any single app may be, it is still a point solution. Fira is now promoting Open Data Platform, which allows the sharing of information between different systems. It may be able to create a software and data ecosystem for the construction industry. Finland is known for clean tech, health tech, and gaming. Alhava envisions that in two years we’ll be known for world-class construction software development.

From Projects to Production

Fira is also making construction lean in other ways. It has developed a strategic partnership with CarinaFour, a shipbuilding company with experience using Product Information Management, PIM. They’ve shown how constructing a building on-site that normally takes four hours can be done in one hour in a manufacturing facility. Fira has its own modular bathroom plant in Hämeenlinna. It provides one delivery instead of having each subcontractor contribute its own.

Alhava believes that we must move from project thinking to partnership thinking. Fira wants to be able to open a dashboard that would provide one view on each subcontractor working on all their sites. “Only after we influence the productivity of subcontractors can we improve the productivity of the whole industry,” Alhava wraps up. ■

A-KONSULTIT

Increasing Complexity Challenges Lean Construction



Lean principles are penetrating the Finnish construction industry.

“Lean design should mean fewer meetings and less red tape”

Architect Jyrki Iso-Aho, CEO and partner at A-konsultit, has been in the industry since the early 1980s. He has noticed that recently almost every project is borrowing features from the alliance model, especially early integration.

A-konsultit, established in 1962, was an early integrated BIM user. “We did the first BIM pilot project in 2000. It was an extension to the University of Technology’s main building in Otaniemi. Back then, I gave several presentations about the project and predicted that BIM would be mainstream in five

years. Today, I think we still have five years to reach that,” Iso-Aho says smilingly. He wishes that clients especially would make more use of BIM. Nevertheless, he’s noticed that BIM is now out in the field and site engineers increasingly use BIM models on their tablet computers instead of traditional 2D drawings.

The Complexity Challenge

Today’s project organizations are much more complex than a few decades ago. In addition to designers, there are specialists for every aspect of a project; for fire safety, BIM coordination, and elevator design, to mention

just three. Iso-Aho counted 40 specialists on one recent project. The same project had 125 programmed meetings where the architect should have been present, not to mention all the unplanned meetings. “Lean design should mean fewer meetings and less red tape, which cancel out the productivity improvements of digital design,” Iso-Aho observes.

Clients, engineering firms, and contractors are getting bigger and move into a more hierarchical environment, which may create internal communication barriers. Hierarchical organizations conceive hierarchical planning and decision-making processes. Iso-Aho believes that Big Rooms will solve many problems in communication and decision-making in all kinds of projects, provided that decision-making happens also in the Big Room and not somewhere else. For him, the biggest value of early integration is that the contractor –and also end-users– joins in before production design.

Process Improvement Requires Continuity

“Continuous improvement is easier to realize within a single organization than in construction projects which always see new combinations of companies. That’s even true in alliance projects,” Iso-Aho says. Every company has its own internal processes and project models. To make those work together and systematically improve them on projects, you need sustained cooperation between companies.



PICTURED Jyrki Iso-Aho

Senate Properties, the Finnish governmental client, uses long-term partnerships with suppliers. ATT, the City of Helsinki’s housing organization, is moving toward a model where the architect assembles and oversees the design team as the lead designer. Models like these encourage continuous improvement even with irregular collaborations between companies.

Lean Calls for New Practices

Iso-Aho believes that lean construction has a lot to offer, especially to project scheduling and production methodologies. “Our current practice of long subcontractor chains creates unnecessary delays in the process. A better scheduling system is needed. Also, the choice of subcontractors should not be based on the lowest price, but on the ability to be present to play his part just when needed, which would save both money and time,” he says.

Iso-Aho sees great potential in increased prefabrication and precise material logistics. These would remedy many product quality issues that we currently see. ■

LCI FINLAND

Scaling Up Lean Construction

The Finnish lean construction community has set the ball rolling. Now it's time to scale up.

"I'M PROUD OF WHAT OUR LEAN construction community has achieved so far," says Jyrki Laurikainen, Chairman of LCI Finland. "Now, I want to challenge the forerunners to make lean part of the everyday."

As the Managing Director at RAKLI (The Finnish Association of Building Owners and Construction Clients), Laurikainen has seen how, especially, public sector clients have embraced project alliancing in Finland. He's happy that the Finnish construction industry is now formalizing the contract documents and guidelines for project alliances. However, Laurikainen is adamant in his view that early integration and other lean methodologies provide value for



PICTURED Jyrki Laurikainen

all project delivery models.

Education is one way to infuse new practices into the industry. Lean philosophy should be part of all curricula. The Lean Construction Congress 2018 in Helsinki is a great example of combining hands-on training with international networking.

Laurikainen talks about the six tenets of lean construction based on his own experiences in leading positions at Wärtsilä, Hewlett-Packard, and the City of Helsinki.

Respect for People

Lean construction must extend to the individual employee. "To me, people are at the center. If you empower individuals, they will do their best, and more," Laurikainen believes. Change employees need a direction, sufficient resources, and appreciation of their efforts.

Removal of Waste

The concept of waste is so critical that it should be introduced during all basic professional education. An empty worksite is a visible testimony of inefficiency, but waste comes in many forms. It does not limit itself to the builders; clients and users experience it as well.

Generation of Value

The construction industry should be able to create WOW experiences; give the customers something more and better than what they expected. With simulation and operational design, we can uncover needs and solve customer problems in the early stages when 80% of the project costs are first determined.

Optimize the Whole

"How can you optimize the whole if you don't collaborate," Laurikainen asks. Clients hold the key to enabling collaboration in any type of project delivery model. Laurikainen sees digitalization as an enabler for managing the whole; whereby design BIMs evolve into production BIMs and further to digital twins that constitute complete city models. Laurikainen urges LCI Finland to introduce lean

thinking to building permit processes and urban planning in cities.

Focus on the Process and Flow

"We need to start managing the flow instead of managing resources," Laurikainen reminds. He wonders if clients and contractors together could start reviewing how to better make project schedules. Today's schedules don't reflect the possibilities and requirements of flow production.

Continuous Improvement

"Continuous improvement should be a part of organizational culture, but it also matters in projects and networks. Some may disparage suggestion box-

es, but they are, in fact, Kaizen at work," Laurikainen says. Employees are the experts in their own work. Management should actively listen to them and give them sufficient resources to fix any flaws in the process.

Laurikainen links prefabrication with continuous improvement. As an industrial process, it's inherently evolving. However, you cannot prefabricate without early integration, a key lean practice. Prefabrication can also boost construction safety, which is still inferior compared to other industries.

Laurikainen sums up: "If you want a better environment, happier customers and employees, and improved productivity, go lean!" ■



OYS 2030

Hospital of the Future

Future Hospital OYS 2030 is a development program that aims to radically modernize the facilities of Oulu University Hospital. To Kari-Pekka Tampio, the Program Director, lean construction is not just a theory but the only feasible way to build for the future.

The Oulu University Hospital facilities were completed in the 1970s. Since then, operational models and technologies have leapfrogged and the old buildings have become outdated. The extensive development program aims at increased productivity and more efficient operations. Increased flexibility, standardization of facilities and operations, use of information technology, and employment of renewable energy are some of the ways to achieve these goals.

Tampio assumed his present position four-and-a-half years ago and built the program organization from scratch. Today, they have a dozen or so experts in the office and over 100 on design teams. The unit is responsible for program development, concept planning, and construction on the hospital campus. So far, they've completed small projects, and major new construction is on its way.

"Operational development and reduction of process waste are at the heart of the hospital

world," says Tampio. "We begin with operational design and then move on to the design of physical facilities." Value-stream mapping is an everyday tool in the program office, as is "Kaizen," or continuous improvement.

Target Value Design

Target Value Design, TVD, is near to Tampio's heart. He has studied it extensively and sought advice from Glenn Ballard, a leading U.S. authority in the field. To Tampio, TVD is more than a cost-reduction tactic. He sees TVD as an overarching principle that considers not only construction costs, but the whole life cycle of a facility, including operability.

The program office uses the IPD model in their construction projects. On their first project, right after goal-setting, they called in designers. Later, the contractor joined the alliance and started collaborating with the designers on solutions that would meet constructability and operational requirements. Subcontractors also joined early. This approach has improved confidence in the decision-making on the project, especially relating to foundations, the building frame, and HVAC installations.

A big advantage of lean over a traditional construction project

WHAT HEALTHCARE CUSTOMERS REALLY NEED

ANNUAL COSTS



BUSINESS COSTS

42

HEALTHCARE OUTCOMES

- CLINICAL OUTCOMES
- HOSPITAL ACQUIRED INFECTION RATES
- SAFETY OUTCOMES
- MEDICATION ERROR RATES
- MEDICATION RATES
- RE-HOSPITALISATION RATES
- LENGTH OF STAYS
- PATIENT TRANSFERS
- COSTS PER UNIT OF SERVICE
- PATIENT SATISFACTION
- VISITOR SATISFACTION
- STAFF MORALE
- STAFF TURNOVER

is that design solutions are not finalized before bidding. Designers are not allowed to deliver too early even during construction. Last Planner Sessions (LPS) set the pace for designers. "We hold weekly meetings where we plan the objectives for the week and for the near future, and reflect on the previous week's achievements," Tampio explains.

Lessons Learned

"Now that we are in the construction phase, I can admit that we could have calculated the risk and reward levels in a smarter way. We ended up using traditional risk reserve percentages," Tampio expresses with regret. "To fix that, we've decided to revisit some earlier design choices before making the final decisions."

Tampio says that for upcoming projects he's considering involving both designers and

contractors from day one. Early integration is a key component of success for such a demanding project.

In hospital construction, change is the only constant. Technologies can become obsolete during a four-year construction period. Being able to design and build flexibly maximizes the value potential of the end product.

"There's still a lot to do when it comes to lean in Finnish design and construction. I'm eager to share and develop my knowledge. We've been a partner in the national construction productivity project, IPT, since 2014," says Tampio. He's happy that Finnish clients are beginning to understand the value of

lean construction. They need to commit to using lean principles, eliminating waste, and maximizing customer value.

Open, collaborative development has borne fruit. "In just a few years, we've been able to make Finland number one in lean construction in Europe," Tampio concludes. ■



FROM EVANS, ET AL 1998