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TwinValue

Co-creation report

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Project overview

Aim and scope

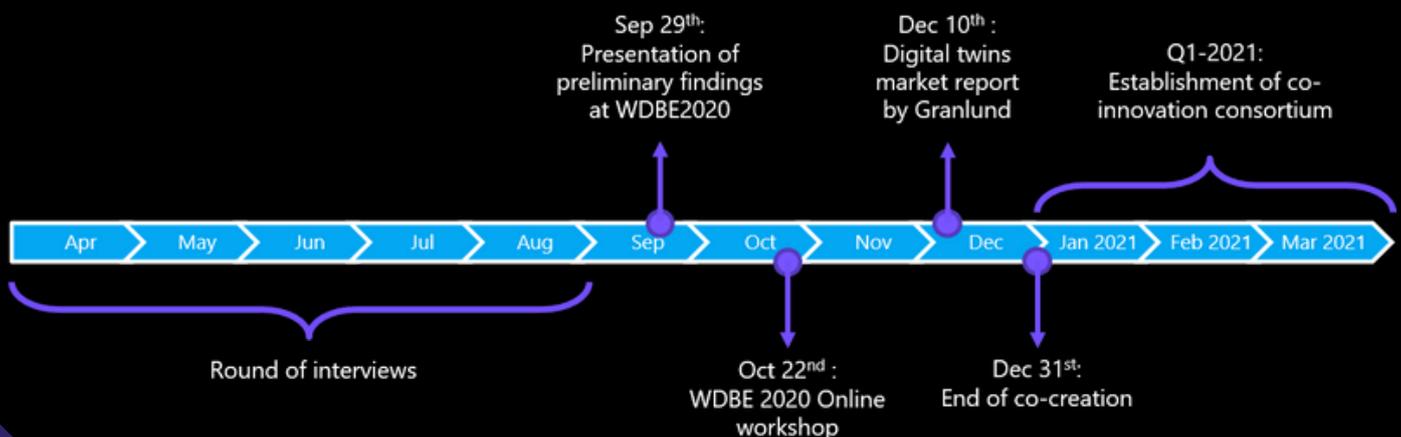
TwinValue is a co-creation project funded by Business Finland, which set to gauge the interest of Finnish built environment organisations on developing new businesses using digital twin technologies. This research initiative is aimed at clarifying the business value of different use cases for digital twins of buildings, as well as the organizational capabilities to implement and operate such solutions.

The co-creation phase described in this report had two main objectives. First, we gathered information about existing and planned use cases for digital twins, through semi-structured interviews and an interactive workshop. These activities allowed us to analyse how different practitioners understand and evaluate digital twins, in addition to outlining the technical, business, and institutional requirements that enable information exchange among the involved actors.

The second objective was to establish a network of relevant actors from business and academia in Finland. Through the collaboration of stakeholders from public and private sectors, we aim to elaborate on a viable model for the management and governance of building lifecycle information. This model will guide the implementation of the digital twin prototypes in the co-innovation stage of the project.

Timeline

The TwinValue project was initiated in April 2020 with the interview sessions. The succeeding activities and milestones are listed as follows:



Research activities

Interviews

Summary

During the period from April to August 2020, the TwinValue project had a series of interviews with different participants from the largest companies in engineering, construction and building operations in Finland. These interviews were conducted as semi-structured discussions, primarily addressing the questions of the business value of digital twins and the data governance in the built environment. The data collected during the interview sessions was anonymised to ensure the confidentiality of the participants.

Interviews were aimed at a sample group of participants, representing various stakeholders and organisations of the building industry.

Among 55 potential respondents identified in our initial list, we contacted 31 managers of 24 different organisations, who were invited for the interview sessions. 18 respondents confirmed their participation and were interviewed online.

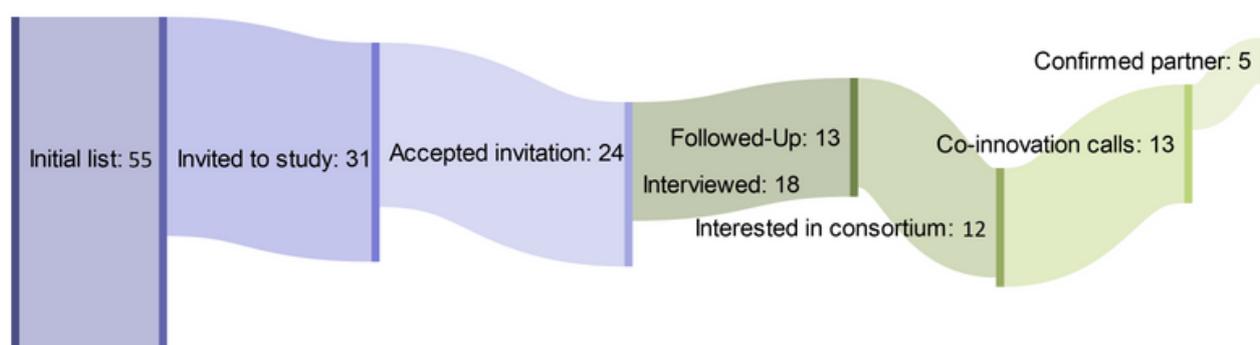


Figure 1. Interviews and follow-up discussions

Interviews

Results

The interviewees participating in our research project represented organizations from different domains of the built environment, which are currently operating on different phases across the lifecycle of buildings. All participants were asked about the same topics, based on an interview protocol containing closed and open-ended questions. We summarize in this section some of the main findings from these semi-structured interviews.

Interviewees were mostly aware about the concept of digital twins of buildings. However, they also indicated that it was difficult to persuade decision makers about the financing of digital twin solutions, because the expected financial returns for their companies were often unclear. One of the main reasons for this difficulty is digital twins were thought as a tool for obtaining **new business benefits** and added value that cannot be immediately quantified in monetary terms, such as improved customer satisfaction or better coordination with partners and suppliers.

The importance of **graphical user interfaces** was another topic frequently addressed by interviewees. The implementation of digital twins requires carrying over large volumes of building data from design and construction processes into the operations and maintenance phase, to support the tasks of building owners, facility managers and service companies. In this context, the information about a building was considered easier to understand if it were to be

displayed on a graphical visual interface representing that building.

Interviewees were also asked to compare digital twins with their current software solutions for designing and visualizing buildings on 2D floor plans or 3D models. Study participants generally described their present solutions as “commodities” that support their ongoing business operations, but which could also be easily substituted by similar products from other software vendors.

We collected a list of expected features of digital twins and analysed the underlying business goals that study participants were aiming at accomplishing with such features. As a result of this analysis, we identified the following non-exhaustive list of **high-level business goals** or focus areas of digital twin solutions, according to their intended application or use case scenarios:

- Adjusting indoor space conditions to occupants' comfort and well-being
- Informing decisions about the acquisition, sale, or rental of properties
- Forecasting renovation or maintenance needs of the building
- Maximizing space utilization rate or room occupancy
- Reducing energy consumption, improving energy efficiency
- Enhancing property safety and compliance with regulations
- Improving coordination and communication with partners or providers

WDBE 2020 partner session

LUT University Software Engineering Department established a service agreement with the Finnish Association of Civil Engineers RIL ry and KIRA-InnoHub ry, to coordinate the organization of a partner session and virtual showroom for the TwinValue project during the WDBE2020 Summit. The participation in this online gathering of key representatives of the local built environment sector in Finland was primarily aimed at identifying new contacts who could be interested in joining the co-innovation consortium. During the partner session on September 29th, Prof. Kari Smolander presented the research department and project team, and José Camposano summarized some preliminary findings from the co-creation phase. Besides this presentation, the TwinValue project had its own virtual showroom area inside a 3D map simulation, which the conference attendees could explore through their web browsers during both days of the conference.

Online workshop

On October 22nd, the TwinValue team held a workshop organised in cooperation with KIRAHub, following the presentation of the preliminary findings of the project during the WDBE2020 Summit. The purpose of the workshop was to enable an exchange of experiences and opinions about digital twins among different stakeholder groups of the built environment.

Participants' expectations from the workshop

"To meet people from the field and learn about what different perspectives are being taken to meet the tasks about future lifecycle problems in digitalized building environments"

"An insight into the research that has taken place and bring the experience I have gained working in a complex commercial environment to the discussion"

"Learning new things about smart city solutions"

Online workshop

Arrangement and background

The workshop was conducted remotely via Zoom and consisted of three parts, which included different aspects to discuss.

Participants were divided into teams and took part in a set of exercises, using a digital whiteboard tool for collecting and organising their ideas. To facilitate collaboration, registered participants were allocated beforehand to multidisciplinary groups, based on the stakeholder group they belonged to (e.g., AEC consulting companies, contractors, professional associations, etc.). To avoid clusters of two and more participants of the same stakeholder group within a team, we used a semi-randomised division. A notable exception of stakeholder category that had more than one participant per group was the software vendors, who provide different types of IT services, thus bringing also different visions of the topic.

Workshop outline

In the first part of the workshop, participants were invited to list the advantages that their companies could obtain from implementing digital twins and the ongoing organizational challenges that could be solved that way. These viewpoints had to be classified into one of three high-level stages of the built-environment lifecycle: (1) Land Use, Project Planning & Policy Making, (2) Design & Construction, and (3) Operation & Maintenance. After completing this task, the teams returned to the main room to share their reflections with all the other participants.

The second part of the workshop was focused on ideating possible solutions for the challenges mentioned in the previous exercise. In the breakout rooms, the teams had to prioritise the issues and propose big picture solutions for each of the challenges, in addition to the goals which they intended to accomplish. Those solutions were later discussed by all the participants in the main room.

The main insights of the collaboration work were summarized during the third part of the workshop. The TwinValue team concluded the session presenting the next steps of the project.

Results

The workshop provided insightful outcomes from the participants' joint discussions. The exercises helped to reveal key challenges currently faced by the built environment sector, and some measures that can be taken to address them.

Workshop results

Digital twin as a platform

In the first part of the workshop, the participants demonstrated a certain degree of interest in application of digital twins in their organisations. In the shared perspectives, they considered **digital twins as platforms** that can collect and consolidate all the data of interest to all stakeholder groups, providing a better understanding of the processes between different actors. This platform could also support compliance with regulations and policies for construction and building maintenance, provide better process performance, and customer service.

Current challenges

The participants emphasised the problems of data quality and choice of standards for secure and reliable information exchange. Another question was how to align digital twins into their **existing business models** and which organisations should financially support this transition. The participants concluded that digital twins are ambiguous in the building industry, because it is not clear whether there is a **technology push or market pull** for such complex software solution.

Required conditions for digital twins

In the second part, the participants shared their views on the **regulations and policies** which should establish data governance in the building industry. Referring to legacy systems issues, they proposed developing standards on the national- or EU-level through open cooperation of the stakeholder groups. To ensure the **harmonisation of these standards**, they need to be systematically updated and cover well-defined roles and responsibilities, as well as different aspects of **data quality** such as master data sources, security, and access based on process roles. The participants argued that digital twin standards could be defined by law and required by governmental authorities.

Recap

The overall outcome of the workshop indicates the potential interest and challenges that digital twins elicit in the building industry. There are actual issues in the legislation system as well as in the transition to new business models around digital twins, yet these challenges can be resolved with better coordination of all actors within the built environment.

Other activities

Public sector collaboration

The TwinValue team maintained conversations with the City of Lappeenranta and Platform of Trust about the opportunities for research collaboration in the context of this project. The municipality is currently implementing a software platform that centralizes the data generated by a proprietary third-party Building Automation System and integrates it with data from other external public sources. Future research opportunities could involve participants from companies collaborating in building automation, facility management and facility services in public buildings owned by the City of Lappeenranta.

Granlund market report

On December 10th, the TwinValue project partner Granlund Oy launched the report titled "Building Digital Twins". The study proposes four categories of digital twins with varying levels of complexity and showcases examples provided by companies of each digital twin category. Some of the key findings and testimonials presented in the report are based on the TwinValue interviews conducted in 2020.

Follow-up discussions

One of the aims of the co-creation phase was to identify suitable industry partners to establish a co-innovation consortium. From the initial list of organizations, we contacted again some of the interviewees that expressed clearer interest in the research topic of digital twins. In November and December 2020, the TwinValue team held extensive follow-up calls with these interviewees, their company associates, and representatives of other organizations that directly contacted us, in order to identify their synergies and define the individual role and future contribution of each member in the consortium. The following key areas were identified for the distribution of the work packages during the co-innovation stage:

- Tech development, standardization, and integration
- Information management and ecosystem governance
- New business models, service design and value creation
- Market growth, commercialization, and internationalization roadmap
- Use case piloting, customer testing and site reporting
- Project coordination, research outputs and general reporting

Project outputs

Publications

The findings of the co-creation phase were summarized by the project team in two publications, an academic paper and a [market report](#).

- Camposano, J.C., Hagshenas, M., & Smolander, K. (2021). "Evaluating the Value of Emerging Digital Platform Ecosystems: Lessons from the Construction Industry". Submitted for peer review to Information Systems conference. Publication channel and date to be confirmed
- Dooley, K., & Camposano, J.C. (2020). "Building Digital Twins" Market Report. Publisher: Granlund Oy

Co-innovation consortium

From our full list of contacts and based on the answers given by interviewees, we identified a subset of suitable organizations to be invited to the co-innovation consortium. The main criteria for eligibility were:

- The company should have or be willing to develop new organizational capabilities to create scalable product and service solutions using digital twin technologies
- The organization must not be involved in similar existing research projects, particularly those funded by Business Finland under the co-innovation model
- Existing collaborations and potential new synergies between the involved companies, e.g. through some ongoing partnership on R&D project or contact referrals from previous interviewees
- The invited organizations must altogether cover as many phases of the whole building life-cycle

In total, 12 companies expressed interest in the opportunity to join the TwinValue project. Between October and December 2020, we scheduled 13 follow-up calls with representatives of these organizations, to explain the aims and intended structure of the co-innovation consortium. Five organizations confirmed they will continue in the process of preparing their partner application.

Research team

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