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## Developing a project delivery system for construction project – a case study

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### Abstract

The project delivery system for a construction project is often selected according to project management team's previous experience. This might lead to a vicious circle where the same problems, such as cost and schedule overruns, are faced in successive projects. According to authors' experience, there is a lack of understanding on how the project delivery system is developed in a project to manage the recurring problems. The aim of this study is to describe how a project delivery system was developed in a real-life construction project utilizing the Innovation Management System for Construction Sector Companies. The research design of the study is based on descriptive embedded single case study.

The main finding of the study is that strategy, market input, development process and competences and resources are essential functions when developing a project delivery system for a construction project. Especially market input and technology scouting are needed to steer the strategical goal setting and to select the most suitable project management methods for the project. All the project parties found that the developed system provided additional value for the project and genuine novelties were found.

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## 1. Introduction

The facility user's functions, in other words how they use the building and its spaces, change constantly. During construction projects, such changes are often not effectively managed causing budget overruns and delays in schedule. In addition, the building does not always meet the user functions in the first use scenario. In the Finnish construction sector, it is common that the procurement of the building consists of two main parts which are procuring the design team and procuring the contractor. This is true especially when it comes to building new schools. It is typical for school projects that the design team is procured in a design competition, which have seen to lead to fancy but expensive architectural designs. Typically, the contractor is then procured based on the architect's plans, and the main criteria for selecting the contractor is price. This method of procurement and project organization has typically lead to following problems:

- The product tends to be expensive because no significant development for the design plans is made
- The owner cannot take in to account the changing user functions in construction phase because the building plans are locked before the procurement of the contractor
- Minor last minute changes in plans often lead to disputes between all parties

According to authors experience, there is a lack of understanding on how the project delivery system is developed in a project to manage these problems. Traditionally the project delivery system is selected according to project management team's previous experience leading to a vicious circle where the same problems are faced in every project. New innovative thinking in developing a project delivery systems is needed to answer this issue.

This study describes a real-life school project from Järvenpää, Finland. The aim of the study is to describe how a project delivery system was developed utilizing the Innovation Management System for Construction Sector Companies, which provides a systematic way to analyse and manage innovation activities in the construction sector. The authors lead the construction management team that developed the project delivery system. The project has a strict budget and schedule and at the same time the building must be of high quality and must be able to accommodate changing user functions. Hence ordinary project delivery methods could not be solely utilized.

The structure of the paper is as follows. After introduction, the research design is presented and project is introduced. Following that, the results of the case study are summarized. Finally, discussion and conclusions are presented.

## 2. Research design

The research design is based on descriptive embedded single case study [1]. The aim of the research is to describe how a new project delivery system was developed with help of the innovation management system for construction companies introduced by the authors [2]. The system is inspired on Chesbrough's open innovation theory [3], Deschamps' innovation leadership theory [4] and Cooper's innovation development processes [5]. The system was originally developed for managing innovation activities of companies. However, the authors have noticed that the system can be a helpful tool to analyze and categorize activities in project level. Hence the innovation management system was selected as framework for developing the project delivery system for the case project.

The analysis in this study is done according to the main functions of the innovation management system, which are:

- Strategy (steers the other functions in the innovation management system)
- Market input (steers the development process and to facilitate effective innovation investment decision-making)
- Development process (methods for developing the product or outcome)
- Competences and resources (e.g. intellectual property, partners and education and training)

Pöyhönen et al (2016) [2] state that the above-mentioned functions are required in innovation activities of construction sector companies. Especially market input is input is an essential function, which on the other hand is often the function that is missing from the innovation activities.

The main data used for the study is the procurement documentation developed during the case project, data collected in workshops with the client, users and bidders, interviews and direct observation by the authors. The analysis is conducted from the client's (building owner) perspective.

### **3. Project introduction**

The study is based on a real-life construction project in city of Järvenpää, Finland. The case project is a new elementary school. The property owner and client of the project is city of Järvenpää. Hence the procurement of the building was done according the procurement law of Finland and procurement directive of the European Union. The construction management team of the project consisted of the authors and a real estate management company owned by the city of Järvenpää.

The project delivery system was developed during the project brief phase and procurement phase. The project brief phase lasted from September 2016 to December 2016. The procurement phase lasted from December 2016 to March 2017. The procurement process consisted of two main phases which were selecting the bidders and facilitating three workshops with the bidders based on which the contractor and architect were selected.

Based on the initial call for tenders, three bidders were included in the workshop phase. The first workshop was focused on developing the project delivery system. This was the most important phase of the procurement – based on the results of the workshop the procurement documentation was finalised. The two other workshops were focused on the assessment of competence and cooperativeness of the candidates. The call for tenders was published in January 2017 and the members of the project alliance were selected in March 2017 purely by qualitative grounds.

### **4. Results of the study**

In this section, the results of the study are presented.

#### *4.1. Strategy*

According to Pöyhönen et al [2] the strategy –function aims to steer the other functions of the innovation management system. At the beginning of the project it was clear that the project's strategic goals could not be met with traditional project delivery systems. The schedule for the design and construction work is very challenging and it is essential that the budget of the project is not exceeded. In addition, the new building must meet the high-quality user needs and the building must be safe to use in terms of high indoor air quality. In the project briefing phase, following ambitious strategic goals were set for the project:

1. the school must be Finland's best school for the citizens of Järvenpää
2. the building must facilitate the changing need of the users (school and other use)
3. best international practice in construction management and school design is researched
4. budget and schedule for the project will be strict

Based on the strategical goals the capacity and the pedagogical vision for the school were decided. Decisions on the strategical aspects of the project were ultimately made by the politicians of the municipality. However, the decisions were made based on suggestions made by the construction management team and the users. Especially market input was utilized in forming the strategy and providing information for the decision makers. Market input also helped the users and the building owner to formulate the goals and to commit to them. Hence market input was found to be essential to form the strategical guidelines for the project.

#### *4.2. Market input*

The market input function aims to steer the development process and to facilitate effective innovation investment decision-making [2]. Market input was essential for providing best practices and decision-making information

throughout the whole process. During the development of the project delivery system, market input was utilized in following ways:

- Technology scanning [6] – approximately 20 international school construction project examples were scanned to provide examples of different kind of school designs, materials, furniture, ICT-solutions, classroom layouts, acoustic design, central lobby design and sports facility design
- Construction management team and users visited more than ten schools in both Finland and abroad
- Literature overview of different advanced construction project management methods was conducted
- The construction management team interviewed approximately 15 construction management experts and potential bidders to identify problems and potential solutions in new school projects and to identify potential project delivery systems
- Bidders in the tendering process could both criticize and develop the project delivery system during the procurement phase

First school and technology examples were scouted through technology scanning –method. Technology scanning refers to investigating innovations new to the industry or outside the traditional industry practices [6]. Flexible room program for the building was based on analysis of existing schools' room programs. First the authors searched for interesting international examples of modern school buildings that are built to facilitate the newest pedagogical trends. Several existing schools were analyzed with the users in workshops. For example, following aspects in the schools were analyzed: overall space efficiency (m<sup>2</sup>/student), layout of the class rooms (traditional versus new pedagogical trends), overall form of the building (simple versus diverse) layout of the administrative spaces (distinctive rooms versus multi-use office) and sports facilities of the buildings. Based on the findings, the flexible room program was formulated. Flexible room program provides the range of values in where the designers can manage the functional change during the design process and the type of spaces the base building and infill must enable in use [7].

During this work, the users decided that the new building must be designed to facilitate the new trends of pedagogical thinking instead of the traditional way. This decision had great implications for project, especially the budget. Had this been decided during the design phase, the budget would have probably been exceeded significantly. This assumption is based on cost estimates done based on the new way of pedagogical thinking and the traditional way. Also, the main qualitative requirements for the building were set based on the market input.

To meet the strict budget, the construction management team decided to utilize target value design. Target value design regards to process where building is designed in collaboration with users, designers, contractors and other relevant stakeholders. [9] describe target value design as follows: “The main idea of TVD is to make a client's value (specific design criteria, cost, schedule and constructability) a driver of design, thereby reducing waste and satisfying or even exceeding the client's expectations.” In practice, the building is designed based on qualitative and quantitative criteria that is set for the building. The criteria can include for example budget, room program, materials, service flexibility e.g. TVD usually requires high level of collaboration between stakeholders as well as high commitment to the goals of the project. The roots of the method lie in the manufacturing industry, and often the managerial philosophy of lean is associated with TVD [9].

After the team chose to utilize TVD, it was clear that the contractor should be included in the design phase. This would allow the contractor to help developing the architect's plans and make the contractor to commit to the goals of the project and provide market information about the costs. The construction management team decided that the best project delivery method would be Project Alliance (PA). According to Ross (2003) [10], PA is especially beneficial in projects that are complex, have great deal of uncertainty and when it is important that all the parties must generate value for money. Based on the decision of implementing PA, the aim of the procurement was to find the contractor and the architect. The parties of the project alliance contract would be the client, user of the building, contractor and the architect. Another important decision regarding project alliance -method was that a maintenance alliance would be formed by the contractor, client and user. In maintenance alliance, the contractor is responsible for the maintenance work of the building for ten years after the project alliance -phase has ended. The hypothesis of the construction management team was that the maintenance alliance will give the contractor incentives to build a high-quality building since they are responsible for the maintenance of the building.

### 4.3. Development process

Significant effort was put in developing the pedagogical vision of the user, flexible room program of the building and the procurement documentation. Two most important methods used in the development process were desktop research and workshops with users and the client. First desktop research was conducted to generate ideas, examples and decision making information for the workshops and drafts of the procurement documentation. Next the discussed material was further developed during the workshops. Based on the results, the documents were finalized and approved by the client. Outcome of the initial development process was the procurement documentation, the flexible room program and pedagogical vision.

The development process continued in the tender phase where the bidders could give comments to the procurement documentation. Based on the comments, the documentation was finalized. Final tenders were given according to the procurement documentation developed by the client, construction management team, user and bidders. Development of the procurement documentation was done in the first workshop with the bidders. The negotiations were focused on the project plan, commercial terms of the project and the project alliance contracts. Negotiations were done with the bidders distinctively. During the negotiations, the bidders were instructed to inform whether there are any obstacles in leaving the final tender and to suggest changes in the procurement documentation.

The bidders did make several suggestions to enhance the procurement documents and hence the project delivery system. The three bidders made altogether 50 comments on the procurement documentation. About 50% of the comments lead to changes in the project delivery system and the procurement documentation. Two of the bidders first stated that if the bonus pool and overhead expense level are not raised, the bidders will not offer their final bids. Interestingly, even though the bonus pool and overhead expense level were not changed, all the bidders did indeed leave the final bids.

Based on the market input from bidders, it is extremely important to set the project budget right – not too high or too low. In this case, the budget was validated by all the bidders. Out of couple of hundred pages of procurement documentation, the comments mainly addressed the commercial terms (about ten pages) of the project alliance contract. Setting the commercial terms of the contract unambiguously and in balance for all the parties in the project alliance was found to be extremely important. Interestingly, other areas of the documentation, such as flexible room program, open building approach, intense user participation in the design phase and other qualitative objectives were not discussed in detail. Also, open building approach was not discussed in detail with the bidders.

### 4.4. Competences and resources

According to Pöyhönen et al (2016) [2], competences and resources can be found both in-house or from the outside. Competences and resources consist of intellectual property (IP) acquisitions, recruiting, education and training, and partners. In this project, it was clear that diverse set of competences and resources had to be utilized. Setting the budget is one of the most important decisions in the project when using TVD. IP had to be licensed in form of cost estimation software, which was utilized in calculating the budget for the project. In Finland, it is typical that construction companies have aggregated extensive cost information that can be used for cost estimation for the building. However, the companies are not willing to give that information to the building owners.

Another important function was found to be partners. From the building owner's view, the most important partners were the construction management team and juridical advisors. The construction management team consisted of the authors and a city-owned company that is responsible for managing all the city-owned properties. In this case, it was essential to utilize outside competences and resources, in other words the authors, since the necessary competence was not found by the client. Especially knowledge on the project delivery method and cost estimation had to be acquired from partners. When it comes to traditional project delivery methods, typically competence needed can be found in-house. However, competence in open building approach, Project Alliance and TVD are not typically found from clients in Finland.

Also, juridical advisors were found to be essential during the procurement phase. For example, the bidders made such suggestions to change the procurement documentation that were not allowed to be done within the procurement legislation. It was found during the project that the bidders' knowledge on procurement laws were not entirely

adequate. The procurement team found the juridical advice especially important to analyze and solve possible problems based on industry best practice during the procurement phase instead of solving them afterwards in court of law.

Significant education and training were implemented before the procurement phase. Especially new pedagogical trends were researched and analyzed with the user. The user's pedagogical vision for the building was developed radically throughout the process based on the findings. Also, the competences and resources of the building user were utilized to great extent in the development process. The users gave extensive input for the project delivery system procurement documentation in terms of the pedagogical vision and flexible room program.

#### *4.5. Summary of developing the project delivery system*

At the beginning of the project, four main strategic goals were set. Based on these strategic goals, best practices of school design and project management methods were researched. Following minimum requirements were set for the building:

- The building must facilitate changing user needs and changing pedagogical principles
- The building must be designed according to principles of open building approach and the flexible room programme
- The building must facilitate 576 students in the first use scenario
- Budget for the project is 21 200 000 €
- The building must be ready and fully operational 6/2019

To meet the strategic goals and to fulfil the minimum requirements set for the building, following project management methods were selected:

- Technology scanning
- Project alliance
- Target value design
- Open building approach
- User's pedagogical vision
- Building information modelling
- Maintenance alliance

The winning contractor and the architect were selected completely on qualitative grounds. The project management team set the target cost for the building and it was not negotiated. The outcome of the procurement was that all three bidders did leave their final bids. The contractor and the architect were successfully selected in March 2017.

### **5. Summary of the results**

The purpose of the study was to describe how a new project delivery system was developed in a real-life construction project utilizing the innovation management system for construction sector companies. The main finding of the study is that the authors could develop a new project delivery system with the help of the innovation management system for construction sector companies. Strategy, market input, development process and competences and resources were essential functions when developing the system. The new project delivery system was validated by the client, user and bidders. All the parties found that the developed system provided additional value for the project and genuine novelties were found. The main findings of this case study are summarized in the following table.

Table 1. Summary of main findings of the study

Corresponding function of innovation management framework	Outcome	Novelty
Strategy	Project strategy that guided the development of project delivery system, utilizing market input in forming the strategy	Forming project strategy based on multiple point of view's
Market input	Utilizing technology scanning, TVD, PA, open building approach, BIM, pedagogical vision, maintenance alliance	Utilizing market input in finding the best project management methods and developing the procurement documentation
Development process	Desktop research, workshops with client, user and bidders	Workshops with client, user and bidders provided significant value for the project
Competences and resources	Construction management team, user, juridical advice, client's strategical decision-making, bidders	Utilizing user's and bidders' competences in development of procurement documents

Interestingly, utilizing market input in setting the strategic goals for the project and selecting the most suitable project management methods was essential. Market input also steered the strategical decisions made in the process. It was also found that external competences and resources can be needed in the procurement preparation and in the bidding phase. Further research topics include describing how market input –function can be further utilized when developing new project delivery systems.

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