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MASTER'S THESIS

Creating Customer Value Using Digital Tools in Scaffolding Industry

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ABSRACT

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Scaffolding is a cornerstone in industrial construction. Scaffolds are built for access, position and safety purposes to make working possible, safer and/or more efficient. During large construction or maintenance projects, hundreds or even thousands of individual scaffolds are assembled and dismantled. Keeping record of scaffolds requires lot from supervisor to stay organized. Traditionally each supervisor has had their own methods to keep record of scaffolds. However, their methods have often lacked transparency, room for error has been large and no back-upping has been done. Digitalization helps to tackle these problems and at the same time create benefits for customer and supplier.

The purpose of this thesis was to investigate the value creation of the digitized follow-up system. The research was carried out using qualitative research methods. Primary data collection methods were semi-structured interviews and observation. Value was researched from customer and supplier perspectives and as a result framework that shows benefits, sacrifices and threats for customer and supplier was created. This framework can be used for further development and marketing the system.

The key conclusion of the research was that digitized scaffolding follow-up system creates value to customer and supplier. However, recognized benefits were mostly non-monetary and subjective, e.g. increased transparency, real time reporting and cloud-computing benefits. So also, the perceived value is subjective and depends on, how beneficiary values benefits. In addition to value creation, scaffolding ordering process was described and co-creation of value was recognized in interaction between supervisor, superintendent and user of the scaffold, especially in *order* phase of the scaffold.

TIIVISTELMÄ

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Rakennustelineet ovat yksi teollisen rakentamisen kulmakivistä. Telineitä rakennetaan, jotta työ voidaan suorittaa mahdollisimman turvallisesti ja tehokkaasti. Suurien rakennus- ja kunnossapitoprojektien aikana saatetaan rakentaa ja purkaa satoja, ellei jopa tuhansia yksittäisiä rakennustelineitä. Telineiden seurantaa vaatii paljon telinetyönjohtajalta, jotta telinetiedot saadaan pidettyä järjestyksessä. Perinteisesti jokainen työnjohtaja on rakentanut omat seurantamenetelmänsä, niistä kuitenkin puuttuu läpinäkyvyys, virheenmahdollisuus on suuri ja varmuuskopiointi haastavaa. Digitalisaatio auttaa näiden ongelmien selättämisessä ja samalla luo arvoa niin asiakkaalle, kuin toimittajallekin.

Tämän työn tarkoituksen oli tutkia, kuinka ja minkälaista arvoa kyseinen seurantaohjelma luo. Arvonluontia tutkittiin niin asiakkaan, kuin toimittajankin näkökulmista. Tutkimus suoritettiin laadullisia tutkimusmenetelmiä käyttäen. Primääridataa kerättiin teemahaastatteluilla ja tarkkailemalla. Tuloksien pohjalta muodostettiin viitekehys asiakkaan ja toimittajan kokemista hyödystä, uhrauksista ja uhista. Kyseistä viitekehystä voidaan käyttää jatkokehityksessä ja järjestelmän markkinoinnissa.

Työn päälöydöksenä voidaan todeta, että digitaalinen seurantajärjestelmä luo arvoa sekä asiakkaalle, että toimittajalle. Saadut hyödyt olivat kuitenkin pääasiassa subjektiivisia, eikä niitä voitu mitata rahassa, esim. lisääntynyt läpinäkyvyys, reaaliaikainen raportointi ja pilvipalveluiden hyödyt, kuten etäkäyttö. Joten myös koettu arvo on subjektiivista. Tämän lisäksi, tutkittiin arvon yhteiskehittelyä kuvaamalla telineidentilausprosessi. Arvon yhteiskehittelyä havaittiin erityisesti telineen *tilaus*-vaiheessa.

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In today's world, making a phone call is nothing special. Multiple calls per day are made and received and after a short moment they are forgotten. You don't remember, who you talked to, what you talked about and why you made the call at all. However, there is one phone call from summer 2015 that I can recall as it was made yesterday. I had had a summer job at my current job and we had agreed, that I would start working in a project in Pori after summer. The project would last for nine months. I was very excited and then out of blue I decided to give a call to my godfather that I had not talked to for years. We talked this and that and then he asked: "How about your thesis?" I had already finished all my courses and thesis was the only thing to do. I convinced him, that I would write it in Pori. But I was only fooling myself, and he knew it... Well now, almost three years later, it is finally done.

I would like to thank everyone who has been part of this journey starting from 2011; new friends that I received in LUT and Lappeenranta, basketball team mates, colleagues, mom, family, Viivi and especially Joona for his supervision and quick comments.

Thank you!

In Espoo 21.5.2018,

Roope Kinnunen

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1 INTRODUCTION

1.1 Background

This thesis was written during the development and implementation process of digitized scaffolding follow-up software. The purpose of this thesis was to look for benefits and the value creation of digitized scaffolding follow-up-system which leads to subject of the study; Creating Customer Value Using Digital Tools in Scaffolding Industry.

Scaffolding is the cornerstone in multiple, if not all construction industries. No matter if one goes to shipyard, oil refinery, paper mill or power plant, scaffolds have always been used. In many place scaffolds are the only way to execute e.g. piping work effectively and safely. However, after all work is completed are scaffolds removed with no hint that they ever existed there. Big construction and turnaround works may require hundreds or even thousands of individual scaffolds over short period of time for multiple different practices e.g. for electric, piping or insulation works. This with constant hurry leads to a problem that at some point no one knows where all scaffolds are located, who ordered them and if they are still needed. This is partly due to lack of use of technology in following the scaffolds.

Keeping record of scaffolds is usually done in Microsoft Excel, which is great tool, but gives too much power to the user to mess up for example some important formulas. At some point, there will be multiple revisions of same sheet of Excel and no one knows, which one is up to date. Also, if client or supplier's management wants the information they need specially to ask it. In some cases, all the information of some scaffolding work done might be on the sheet of paper or notebook. This leads to lack of transparency in industry and sometimes controversy over invoicing might happen.

This thesis consists two main concepts; digitalization and value creation. Both topics are quite studied during the recent years. Digitalization as a first concept has been examined e.g. by Taherdoost et al. (2015). They researched e-services in business-to-consumer context and they recognized 11 types of e-services, e.g. communication services and e-health. Smart services were investigated by Allmendinger and Lombreglia (2005), they proposed properties for product, that is not best candidate for networking. Töytäri et al. (2017) research barriers of implanting smart services to use. Cloud computing has also received strong focus, and it has even Nation Institute of Standards and Technology (NIST) definition by Mell and Grance (2011).

Value as a second concept is important part of this thesis. Value and its creation has also been quite much investigated subject. For example, Haksever et al. (2004) argued that value is not always financial/monetary value, it can also be non-financial or time value. They also recognized different stakeholder groups for who value may be created or destroyed. Smith and Colgate (2007) created framework for value creation which consisted four types of customer value and five sources of value. This framework will be later described more closely. Walter et al. (2001) researched value creation in business-relationship from supplier point of view. They argued that supplier can create in business-relationship either direct (e.g. money) or indirect (e.g. access to market) value. Their theory is also described more closely.

Vargo and Lusch (2004) were first ones to come up with idea, that value is always co-created. Since then it has been debated that if value co-creation means working together and using resources for common goal (Jaakkola & Hakanen, 2013) or if it means that supplier makes only value propositions which are then realized by customer and so value is co-created with customer (Vargo and Lusch, 2004;2008 and 2016).

Research on digitalization has focused heavily to more high-end technology, such as robotics, 3D-printing and medicines. Not much of research has been done on low-end technology industry such as scaffolding is. Value creation has also received quite much of research, however, studying value creation of digital services in low-end industry has not received that much of focus. The combination of digitalization and value creation of digital tools in low-tech industry creates research gap, that this thesis tries to fill. Also, there has not been much of a research of scaffolding industry.

From managerial perspective it is important to know what kind of benefits are created and sacrifices are required from using and developing the digitized follow-up system. Knowing this will be helpful in further development, marketing and introducing the system in use. Also, knowing the value, which is sum of benefits and sacrifices, of system helps to justify the investment and licensing costs.

Digitalization which is the hot subject in today's society, has not yet been that clearly present in industrial environment. However, at some point it is subject change and first signs of that are already visible. Knowing this, managers need to start preparing for it and on that, this thesis tries to take the first step.

1.2 Goals of the Study

The goal of this research is to find, what kind of value digitized scaffolding follow-up system creates to supplier and customer and if it enhances value co-creation. This information will be then used in further development process of the system and in implementing the follow-up system to use. Findings will be then used to create a framework that concludes what kind of value customer and supplier perceive using the follow-up system. This information will be later used in implementation and development process. Same framework can later be used also in project selling and marketing for communicating the value to customer.

To achieve these goals, concepts of digitalization and value creation are first opened in literature review, this will form the theoretical foundation of the research. The empirical data for research will be collected using qualitative research methods. Personnel from the client and supplier side were interviewed using semi-structured interviews, which are later in explained more closely in methodology section.

Following research questions were used to achieve the goal:

RQ1: How value is co-created in scaffolding projects?

RQ2: What kind of value digitized scaffolding follow-up system creates?

RQ3: Does digitized scaffolding follow-up system enhance value co-creation?

1.3 Limitations of the Study

Study is limited to scaffolding industry. The study will concentrate on developing and implementing the new follow-up system for scaffolds. Other digitalized systems and software for scaffolding industry can be mentioned in the study, but otherwise they are excluded.

In digitalization most of the recent studies concentrate on high-tech industries such as robotics, medicine or 3D-printing. The digital solutions in such industries are irrelevant for the study and therefore are excluded from the thesis, since they often rely on data that is collected automatically by censors. Data for scaffolding follow-up system is mainly input manually by person, with some automatic reporting and calculation, but not as much as in high-tech industries.

For value creation, study concentrates on dyadic relationship between client and scaffolding supplier, other actors such as service platform providers and service developers can be mentioned in the study, but are otherwise excluded. The study concentrates on customer's and supplier's perceived value on company level.

1.4 Structure of the Thesis

This thesis is structured as follows. Introducing chapter starts the thesis by providing background information for the research. Background consists basic information of the industry and concepts used in the thesis. Introducing chapter is also used to determine goals, research questions and limitations of the study. Then the structure of the thesis is described and finally findings of the study are briefly introduced.

Following two chapters, chapters two and three are used for literature review of theoretical concepts used in this thesis. First theoretical chapter describes the concept of digitalization and different forms of it such as e-services, smart services and cloud computing. The chapter is concluded with benefits of digitalization. The second literature review chapter describes the concept of value creation. The chapter covers different value dimensions recognized in literature, it also covers perceived value and lastly co-creation of the value is described.

After literature review, in the fourth chapter framework for analysis is formed using theoretical foundation founded in previous chapters. Different frameworks are used for value co-creation and value perceptions.

The fifth chapter is used to describe the methodology of the research. Research approach, case description and data collection methods are opened more precisely. In this chapter, some more information of scaffolding as an industry is provided.

The sixth chapter is used to address the findings of the research. Findings chapter is divided into three sub-chapters to answer for each research question. First sub-chapter describes the co-creation of value in scaffolding industry. Second chapter describes the value perceptions from using digital tools and the last sub-chapter is used to address, how co-creation of value can be enhanced using digital tools. Frameworks are used to illustrate findings.

The seventh chapter is used to conclude the thesis and present academical and managerial contributions and make future research propositions. Finally, used references are listed.

1.5 Findings

Main findings of the thesis can be concluded followingly; value in scaffolding works is always co-created, digitized follow-up system creates value to supplier and customer and to enhance co-creation with digital tools, it requires active participation by customer.

Co-creation of the value happens mainly in the order phase of the scaffold. Supervisor, superintendent and user of the scaffolding inspect the need on site and decide together what kind of scaffold is built. User and superintendent can for example, have an influence on floor size, working height and entrance. Customizing possibilities are endless.

Perceived value created by digitized follow-up system is subjective and depends on beneficiary, because no monetary benefits were recognized. All benefits were non-monetary, like building trust through increased transparency, accessibility to software though cloud, back-upping and real-time reporting. Sacrifices were mostly monetary cost, like developing and licensing costs. Some threats were also recognized, for example, dependency on platform provider. Supplier and customer perceived similar benefits.

At the current state of development, digitized follow-up system does not have large impact on co-creation of value. However, different possibilities for value co-creation were identified, e.g. ordering through the follow-up system. The biggest reason that high level of value co-creation was not achieved was probably the lack of training and support to use the system. Users need to be well introduced to system to know all features and possibilities. The user support is also important, especially at the beginning.

2 DIGITALIZATION

Digitization means converting analogical information into digital format. For example, by scanning a paper into pdf-file one is digitizing the information of the paper. Digitization helps to preserve the data and enhances the access. Data can be accessed anywhere with internet connection and it can be back-upped (Bandi et al. 2015). Lot of research on digitization focuses on digitizing printed media, such as newspapers and books to digital formats, even entire library collections are digitized to access to benefits of digitization.

Bandi et al. (2015) recognized two major benefits of digitized data over printed and analogical data, which are; access to and preservation of data. In addition to this Bandi et al. (2015) recognized two more benefits, which are: reduced cost of handling the data and organization and dissemination. Benefits by Bandi et al. (2015) are illustrated in figure (Fig.1) below.

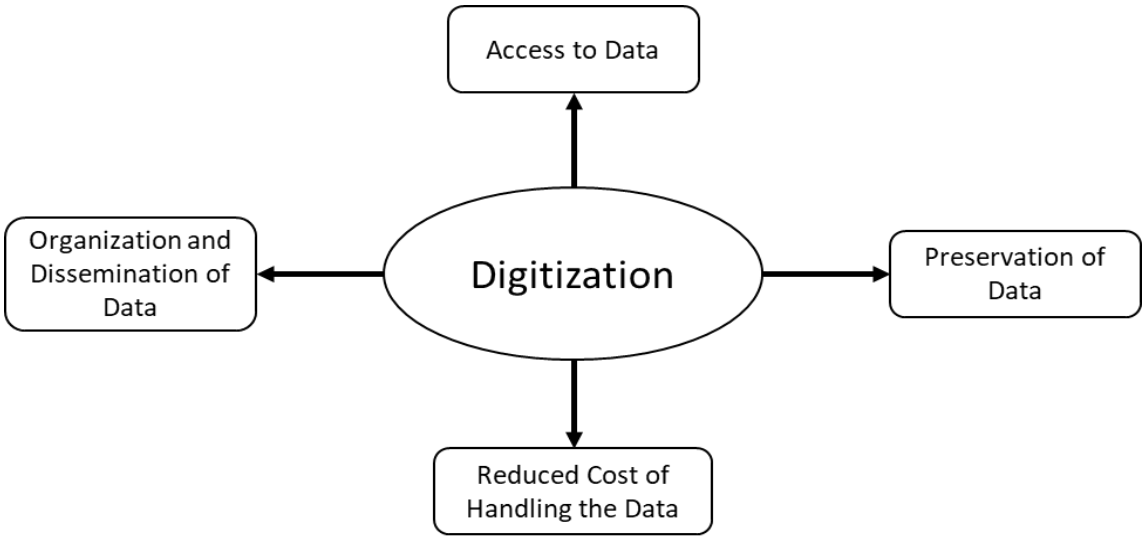

Figure 1 Benefits of Digitization

When digitization means digitizing one specific analogical data object, like scanning a paper, a book or a newspaper, digitalization refers to digitizing entire process, like providing news or books primarily in digital format. Fichman et al. (2014) explained that "digitalization refers to the practice of taking processes, content or objects that used to be primarily (or entirely) physical or analog and transforming them to be primarily (or entirely) digital." Gray and Rumpe (2015) have stated that "trend of digitalization which represents all aspects of daily life that can be digitized." The goal of the digitalization is to harness the benefits of digitization by digitizing processes.

Parviainen et al. (2017) described digitalization similarly, they used Finnish Tax Administration's digital reform as an example. If Tax Administration had digitized their tax collecting process, they would have just implemented digitized form for citizen to report their income for taxation purpose with ability to attach receipts and certificates also in digital format. However, Tax Administration decided to digitalize and renew their entire process so that administration receives the information straight from employers and then sends tax proposals to citizens. If proposal is correct, citizen does not have to do anything. Digitalization is a process of digitization to make life easier. Fitzgerald et al. (2017) recognized that creating new business opportunities is driving force for companies to digitalize. Figure below (Fig. 2) illustrates the relationship of digitization and digitalization.

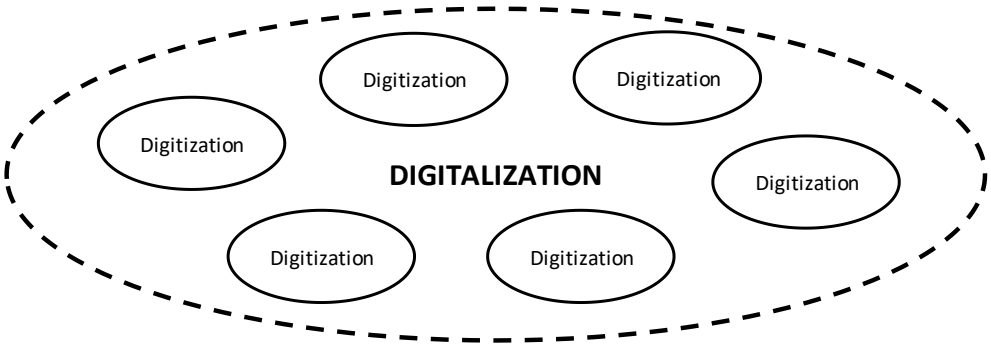

Figure 2 Digitization and digitalization

Digitalization is most concrete in companies that whole operations are in digital format and the level of digitization is high, like streaming services of music and video. However, even though company's main product is physical and tangible its process can be enhanced by digitalizing processes and operations relating to it, e.g. by developing smart services for industrial companies. (Taherdoost et al. 2015)

Scaffold as a product is very tangible and most likely can never be fully digitalized. However, the supporting processes such as planning and follow-up can be enhanced with digital solutions and therefore extra value can be created and competitive advantage gained. E-services, smart services and cloud computing are all related to digitalization and they can be used for digitalization of scaffolding-related processes.

2.1 E-services

Taherdoost et al. (2015) recognized that e-services have been examined from various viewpoints and that is why they have do not have not been uniquely defined. However, the consensus is that e-services use technology to simplify the transfer of services, using electronic networks. E-services are the most concrete form of digitalization in today's people's everyday life. Technological advancements in electronics and internet connections have boosted the use of e-services during the 21st century (Koiranen et al. 2016). Taherdoost et al. (2013) have examined e-services in business-to-consumer context. E-services are examples of digitalization, in which some of the previously analogical data or entire processes have been digitized to get enhanced access, preservation, handling and organizing. E-services help to cut cost and time-consummation and so make services available for larger masses.

Taherdoost et al. (2013) identified 11 different types of e-service applications; e-health, e-ticketing, e-booking, e-banking, e-education, e-commerce, entertainment, social networking, communication services and information access. For many consumers, nearly each one of these e-services are almost in everyday use. See table below (Tab. 1) for examples of each e-service:

E-service	**Example of service**
E-health	Doctor visit through Skype
E-ticketing	Buying concert tickets online e.g. tiketti.fi
E-booking	Booking hotel online e.g. hotels.com
E-banking	Paying bills in online bank
E-education	Taking online courses
E-commerce	Buying shoes or clothes online e.g. Zalando
Entertainment	Streaming TV-series online e.g. Netflix
Social networking	E.g. Facebook, LinkedIn
Communication services	Internet calls e.g. Skype
Information access	Using internet search engines e.g. Google

Table 1 Eleven e-services recognized by Taherdoost et al. (2013)

Some of the services are fully digitalized and they totally operate in digital environment, e.g. Netflix. There is no physical product involved, instead everything is digitized, even the product, in this case movies and TV-series that are streamed to customer's device such as TV. In contrast, for some companies' product is physical and digitalized systems are for supportive purposes. For example, buying shoes. Even though selecting, ordering and paying are all in digital environment the product still must be delivered physically to customer. (Taherdoost et al. 2013)

This same applies in digitalizing scaffolding business; even though the product itself is tangible other supportive operations such as follow-up, planning, ordering and charging can be digitized. For example, if scaffold ordering process could be started with mobile app by customer, some of the ordering data such data and contact person would be saved right away and ordering process would be smoother.

2.2 Smart Services

Smart services refer to digitized services that enhance the operation of physical product. They are run with the help of "machine intelligence", intelligence in this context means awareness and connectivity of the product. Smart services can be used to e.g. monitor the status of the product, diagnose the failure, upgrade the product or control and automate the operation. Data (e.g. vibration, temperature, rotation speed) is usually the foundation of smart services and it is collected by censors and analyzed in real-time. If any anomaly occurs, it can be sign of upcoming breakdown or problem in operation of product and needed actions can be taken. If upcoming failures are detected in forehand, the downtime can be shortened thanks to planned shutdown and service. (Allmendinger & Lombreglia, 2005)

Smart services are an ideal solution for product that e.g. in case of breakdown would cause large financial damage. Allmendinger and Lombreglia (2005) described some properties for product that is not the best candidate for networking such as:

- It is not mechanical or electromechanical
- It is very simple and/or inexpensive and thus cost of networking would heighten the total price of the product
- It has not important information to share
- It has not reliable network access
- Product life-span is very short or very long (over 15 years)

Allmendinger's and Lombreglia's (2005) used as an example refrigerator in home and in grocery store. If refrigerator at store breaks during the night, it can cause large financial losses, but at home the losses would be only minor. Since 2005 technology has advanced a lot and got cheaper which has introduced smart services and connectivity to cheaper products like home refrigerators.

Already in 2005 Allmendinger and Lombreglia recognized that the technology was enough developed to create smart services and network devices, they recognized the biggest challenge for transferring from "dummy" to smart was getting senior management to adopt new nature of the business. It can be assumed that technology has since developed much more and the attitude of senior management is still a greater challenge than technology capability.

Töytäri et al. (2017) researched the institutional barriers of implementing smart services into the product-based companies' business. They came up with sixteen barriers that were on the way of adopting smart services, these barriers were classified into the three main classes; internal barriers (e.g. management culture), capability caps and resources (e.g. lack of resources like capable personnel) and external barriers (e.g. reputation and brand image).

With current technology smart services are not the best solution for digitalization of scaffolding industry, since they basically apply to all properties that Allmendinger and Lombreglia (2005) recognized. However, as censors develop and get cheaper, new possibilities will appear. For example, adding censors to entrances to monitor usage and keep track of people on the scaffold or each scaffolding piece could be attached with a censor which would help to keep inventory of the material.

2.3 Cloud Computing

Cloud computing offers ubiquitous and on-demand network access to a computing resources, such as networks, servers, storage and applications. The basic idea of the cloud computing is that computing resources are located on a server outside the operating computer and they are accessed by using internet connection. (Mell & Grance, 2011)

Mell and Grance (2011) proposed a definition for cloud computing in NIST's (National Institute of Standards and Technology) report. Their proposed model for definition of cloud computing was composed of five essential characteristics, three service models, and four deployment models. NIST definition is supported by multiple authors, such as Rawai et al. (2013) and Amarnath et al. (2011).

Five essential characteristics for cloud computing by Mell and Grance (2011):

- On-demand self-service
  - Cloud user can increase computing capabilities by himself without requiring human action. For example, if he needs more cloud storage, it can be purchased directly.
- Broad network access
  - Computing can be accessed over the internet using different client platforms, like PC's, tablets and mobile phones.
- Resource pooling
  - Cloud computing provider can serve multiple customers using same resources and receive the economics of scale.
- Rapid elasticity
  - Capabilities can be scaled rapidly and sometimes even automatically. Updated services are available to users right away.
- Measured service
  - Cloud services optimize the usage by leveraging a metering capability. The cost for using the system is easily measured, such as pay-per-use or charge-per use.

Three service models of cloud computing by Mell and Grance (2011):

- Software as a Service (SaaS)
  - User can use provider's software and applications that are running in cloud infrastructure. The user does not manage or control capabilities, such as applications, storage or infrastructure.
- Platform as a Service (PaaS)
  - Platform provider provides the infrastructure for customer, that can manage, control and create own capabilities using programming languages and in-built functionalities of the platform. Scaffolding follow-up system is built in Salesforce. Follow-up system is built using built-in blocks and functionalities of the platform.
- Infrastructure as a Service (IaaS)
  - Infrastructure provider provides just infrastructure like servers, networking, hard drives and other hardware. User can build and run software it wants. User might also have limited control to networking controls, for example, specific firewall can be chosen.

Three deployment models of cloud computing by Mell and Grance (2011):

- Private cloud
    - The cloud is exclusively for one organization only. It can be owned and managed by organization or by third party and it can locate in or out of organizations facilities. Good example of private cloud would be organizations that work for national security like intelligence or police services.
- Community cloud
    - Community cloud is similar to private cloud with difference that it can consist multiple organizations that are part of same community. For example, cloud for authorities, cloud could be for police, health care and fire department, which all are their own organizations, but are part of community.
- Public cloud
    - The cloud infrastructure is open for public use. For example, Dropbox for storage.
- Hybrid cloud
    - The mix of above mentioned models. Different cloud models are using same standardization and technology which enables data and application portability.

Kumar and Cheng (2010) investigated cloud computing's implications to enhance construction companies work. They recognized that cloud computing can be applied to various aspects in construction industry, for example, architectural design, structural analysis, cost estimating, project planning and estimation, and procurement management.

Rawai et al. (2013) stated that in construction industry physical presence is very important, for example, site meetings and supervising should be done in person. However, they recognized that cloud computing could enhance the supportive back-office operations like billing, payrolls, logistic planning and running financial reports. Cloud computing is making business applications available anywhere, with internet connection, this is important for construction industry where building locations can be many and they change as soon as work in one location finishes. (Rawai et al. 2013)

2.4 Benefits of Digitalization

2.4.1 Benefits to Supplier

Digitalization has great potential of creating benefits. Parviainen et al. (2017) stated that companies can achieve up to 90 percent of cost savings by digitizing their information-intensive processes. Also replacing paper and manual process with digital software helps companies to analyze, collect and mine their data easier to better understand the general performance of the company. Companies receive real-time reports which help managers to make better decisions. They also stated that digitalization increases economic growth and transparency.

Digitalization impacts entire operation environment and internal functioning of companies' and neglecting it may result of losing game in highly competitive markets (Parviainen et al. 2017). Parviainen et al. (2017) recognized benefits and impacts of digitalization from three different viewpoints; internal efficiency, external opportunities and disruptive change, benefits and impacts are listed in the table (Tab. 2) below.

Viewpoint	Benefits and impacts
Internal Efficiency	- Improved business process efficiency. - Improved process quality. - Consistency via eliminating manual steps. - Improved accuracy. - Real-time reporting. - Integrating data from multiple sources. - Freeing employees to develop new skill by automating routines. - Enhancing data back-upping and recovering.
External opportunities	- Improved response time and client service. - Possibilities for new ways of doing business. - New services for customers. - Advanced offerings for customers.
Disruptive change	- Making company's current business obsolete. - Creating completely new business.

Table 2 Benefits of digitalization by Parviainen et al. (2017)

Schuh et al. (2013) identified that digitalization offers a solution for coordinating value creation networks in tool making industry. They proposed three basic and four advanced digitalization instruments for coordination of cooperation with customers. Basic instruments were; order status tracking, digital mock-up and online design platform. Advanced instruments were co-innovation platform, digital mobile services, life-data analysis and internet of things. Some of these instruments, such as order status tracking and digital mobile services could also enhance cooperation in scaffolding industry.

Amarnath et al. (2011) investigated cloud computing's effects to collaboration, coordination and communication (3C's) in construction industry. Their focus was on building information model (BIM) and how running it in cloud would benefit 3C's. They recognized that BIM is important tool for engineers, architects, decision makers and builders, it helps stakeholders to visualize the construction in 3D-model. They recognized that the biggest benefit for transferring the BIM to cloud was cost savings, in addition to that they recognized other potential benefits, such as integrating supply chain, product modelling, site data management, better quality and better collaboration. Cost savings were created by, for example, centralizing the computing hardware to one place.

Taherdoost et al. (2014) used SWOT-analysis (Internal strengths and weaknesses and external opportunities and threats) to describe advantages and barriers of e-services for companies. They recognized multiple factors for each part of the matrix. As internal strength factors they recognized; time savings, cost effectiveness, improved customer interaction, increased responsiveness, accessibility and so on. On the contradictory, as weakness factors they recognized; lack of education, technical errors, privacy and so on. As external opportunities they recognized, for example, improved customer satisfaction, raised accountability and economic growth and on the other hand as external threats, for example, complexity of service and security concerns. Their main finding was that helpful factors exceed the harmful ones and e-services create competitive benefits to companies. See the full SWOT-analysis of Taherdoost et al. (2014) in the table (Tab. 3) on the next page.

	Helpful	Harmful
Internal origin	**Strengths** - Time saving - Cost Effectiveness - Improved Customer Interaction - Increased Responsiveness - Easy Transaction - Simple and Easy Information Gathering - Faster Delivery of the Service - Portability - Accessibility - Useful service offering - Reduce Human Intervention - Ease of Scalability	**Weaknesses** - Junk websites - Privacy - Lack of Personal Service - Technical Errors - Recovery - Access Fees - Layout - Lack of education - Compatibility - Heterogeneity - Perishability
External origin	**Opportunities** - Improve customer Satisfaction - Improved Service Quality - Raised Accountability - Increase Convenience - Attract New Clients - Economic Growth - Rapid Development of Technology - Efficient Information Management - Advertising - Perceived Company Image	**Threats** - Fraud - Security and Privacy Concerns - Fake Websites - Complexity of Service

Table 3 SWOT-analysis of advantages and barriers of e-services by Taherdoost et al. (2014)

Morabito (2013) argued that digitalization can boost company's performance. Performance improvements can happen in two levels, operational and strategic. Operational performance relates to efficiency and effectiveness improvements originating from how company processes are carried out. Single process improvements like quality improvements, customer satisfaction, productivity and efficiency are often associated with operational performance, these processes are improved with digital solutions which then can lead to cost-savings, better communication between departments and better-quality products. Strategic performance relates to overall competitiveness of the company compared to its competitors and it is related to competitive advantage of the company. Morabito (2013) recognized that digitalization creates competitive advantage to companies, however, he also recognized that unique digital resources are quickly copied by competitors and therefore competitive advantage created by innovative new digital solution does not last long.

2.4.2 Benefits to Customer

Gathering and analyzing data is the focus that helps suppliers to maximize the value while interacting with clients (Opresnik & Taisch, 2015). Lenka et al. (2017) argue that digitalization boosts value co-creation with customers by integrating them to value process more earlier, which will help suppliers to make more customized offerings for customers. Customized offerings then provide better value-in-use to customers, since the product or service will fit to their needs (Jaakkola & Hakanen, 2013).

Digitalization can be used to develop customized solutions to customers. Solutions are individualized offers for specific customer problems. They are designed by combining different components such as products and/or services to create value that is greater than the sum of the value of the components (Storbacka, 2011). Benefits of digitalization are often common for supplier and customer and therefore creates win-win situation for both customer and supplier (Lenka et al. 2017).

Services and products can be enhanced to create value for customers by using radio frequency identification (RFID). RFID-tags can be embedded to objects to identify them, applications are e.g. credit cards, stickers, passports and wristbands (Heim et al. 2009). Heim et al. recognized that radio frequency identification can create various benefits to customer, for example, enhancing the quality of information, minimizing cost and maximizing privacy of the information. RFID-technology could also be used to identify scaffolds.

3 VALUE CREATION

3.1 Value Dimensions

Definition of value by Haksever et al. (2004) cerates solid base for analyzing value as a concept; “value is the capacity of a good, service or activity to satisfy a need or provide a benefit to a person or legal entity.” Vargo and Lusch (2016) argued that, value is uniquely determined by customer and is depending on their needs, skills and desires. Value can be financial, non-financial or timely value (Haksever et al. 2004). Smith and Colgate (2007) recognized, that value can be functional/instrumental, experimental/hedonic, symbolic/ expressive or costs/sacrifices.

Haksever et al. (2004) investigated, what kind of value creation happens in organizations and how it affects to stakeholders of the company. Stakeholder is “any group or individual who affect or is affected by the organization’s activities.” They can be, for example, owners, employees, customers, suppliers and society at large. Haksever et al. recognized, that organization’s decisions can either destroy or create value to its stakeholders. They divided value into three dimensions; financial, non-financial and timely value. Financial value is e.g. wages for employees, dividends for owners and price reduction or cost-savings to customers. Non-financial value can be, for example, safe and friendly working environment for employees, reliable source of income for owners and good customer service for customers. Timely value can be, for example, time-savings for customer and long-term financial security for employees and owners.

Of four values Smith and Colgate (2007) recognized, functional/instrumental value is the most relevant for this thesis. Functional/instrumental value is formed of three value dimensions, which are 1) correctness; service or product has right and appropriate functions and features to create benefits for customer. 2) appropriate performance, for example, reliability and performance quality. 3) appropriate outcomes or consequences, e.g. strategic value and operational benefits. (Smith & Colgate, 2007)

Walter et al. (2001) researched supplier value perceptions in business relationship. Supplier perceived value was divided into direct and indirect value, which were then divided into value dimensions. Direct value dimensions are profit, volume and safeguard dimensions. Profit is the monetary value received in business exchange as a sum of income and expenses. Volume dimension is achieved by scaling up the production, the more supplier produces and serves, the smaller the fixed costs per unit are. Safeguarding means, that supplier does long-term contracts with smaller profits, to guarantee work also during times, when there is not that much of work. Indirect value is divided into four dimensions which are innovation, market, scout and access to new market. Supplier can, for example, make new innovations through relationship or it can help supplier to access new markets.

Value of the product, service or activity is always determined by customer, supplier can only make value propositions. The value depends on what kind of skills or desires customers have and how they perceive benefits and sacrifices (Vargo & Lusch, 2016). Value apart from financial or monetary value is hard to measure and it is often subjective.

3.2 Perceived Value

As Vargo and Lusch (2016) mentioned, value is always subjective and based on experience of beneficiary, so perceived value is always about how value is experienced. The simple definition of perceived value, whether it is customer's or supplier's, is that perceived value is the sum of positive benefits and negative sacrifices, both monetary and non-monetary. Non-monetary sacrifices can be e.g. time/effort/energy and benefits pleasure, satisfaction etc. (e.g. Lapierre, 2000; MacDougall & Levesque, 2000; Lin et al. 2005).

Perceived value is a multidimensional construct in which benefits and sacrifices are a result of drivers or dimensions (Lin et al. 2005). Lapierre (2000) recognized 13 service, product and relationship related drivers in IT industry, 10 of them were identified as drivers for benefits and three was identified as drivers for sacrifices. These drivers are listed in the table (Tab. 4) in the next page.

Value-based drivers identified as benefits	Value-based drivers identified as sacrifices
1. Alternative solutions – Product 2. Product quality – Product 3. Product customization – Product 4. Responsiveness – Service 5. Flexibility – Service 6. Reliability – Service 7. Technical competence – Service 8. Supplier's image – Relationship 9. Trust – Relationship 10. Supplier solidarity with customers – Relationship	1 Price – Product and Service 2 Time/effort/energy – Relationship 3 Conflict – Relationship

Table 4 Value-based drivers in IT industry by Lapierre (2000)

Lin et al. (2005) built a model (Fig. 3) of second-order multidimensional perceived value construct. The overall perceived value is at the second-order, the first-order consists benefit and sacrifice components which are reflected by questionnaire, see figure three below. Lin et al. (2005) used e-retail service value survey data to illustrate the model. In e-retail service first-order components were; monetary sacrifices, web site design, fulfillment/reliability, security/privacy and customer service. Questionnaire to reflect first-order components was e.g. "do you think you paid much money?" (monetary sacrifice), "do you get what you ordered from this site?" (fulfillment/reliability) and "do you feel like your privacy is protected at this site?" (security/privacy). First-order dimensions sum up the perceived value on the second-order which then affects to satisfaction and behavioral intentions such as positive word-of-mouth.

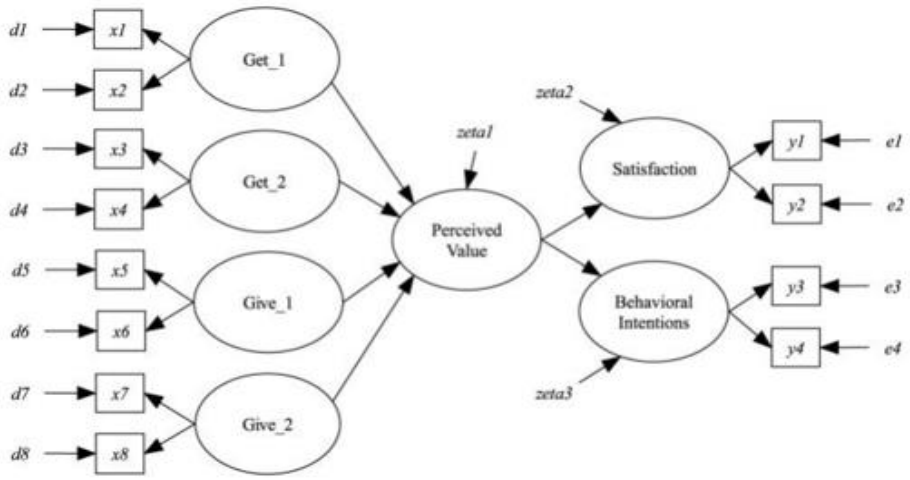

Figure 3 Multidimensional perceived value construct by Lin et al. (2005)

Customer perceives value is important factor in building the customer relationship. For example, MacDougall and Levesque (2000) argue that perceived value is the one of the three drivers that build up the customer satisfaction, other two are core quality and relational quality. It also enables positive word-of-mouth and helps create new customer relationships.

3.3 Value Co-Creation

Value co-creation has received enormous interest in B2B service and solution research lately (Kohtamäki & Rajala, 2016). It basically started with Vargo's and Lusch's (2004) FP6 stating that customer is always co-producer. This lead to interpretation by some scholars e.g. Prahalad and Ramaswamy (2004) that customer is integrated to development and production process of the offering and so to value would be co-created. Payne et al. (2008) used IKEA as an example of the value co-creation. IKEA has involved customer to key value creation processes of their furniture, like transportation and assembly. Jaakkola and Hakanen (2013) had a bit different interpretation on value co-creation, they argued that value was co-created in networks containing actors, potential customers and integrating actors. Integrating actors would work as middlemen in the network bringing together other actors and customers to co-create value through interaction and collaboration which would enable a customized product for customer. In 2008 Vargo and Lusch re-defined foundational premise and argued that customer is always a co-creator of the value. They also argued that involving customer to value creating process such as transportation and assembly is co-production which is just a component of value co-creation and is not mandatory.

Even after decade of research there is not strong consensus among scholars, how value co-creation should be defined. Vargo and Lusch (2016) state that value co-creation is based on customer's unique experience on offering. Value is perceived by customer and it depends on customer's special skills, needs and desire. According to them value is always co-created, even though without direct interaction between company and customer. Ramaswamy and Ozcan (2018) however emphasize the interaction between customer and company in value co-creation process. According to interactive actors should "open up" their activities to enable co-creation of value. Reypens et al. (2016) stated that value co-creation happens in collaborative networks in which actors are creating value through coordination, consultation and compromise. They recognized three value outcomes in multi-actor networks; innovation, knowledge and relational value outcomes.

Kohtamäki and Rajala (2016) recognized this dilemma in their article and divided collaboration in b2b-systems for value creation into two; to coproduction which creates *value in exchange* and to co-creation of value which creates *value in use.* Coproduction practices can be e.g. contracting for complementary resources, organization of resources integration and cultivation of the output of coproduction. Value co-creation practices are e.g. co-creation of the conceptions of value, controlling the contingencies of use and assessment of the outcome. Figure (Fig. 4) below illustrates Kohtamäki and Rajala's (2016) framework.

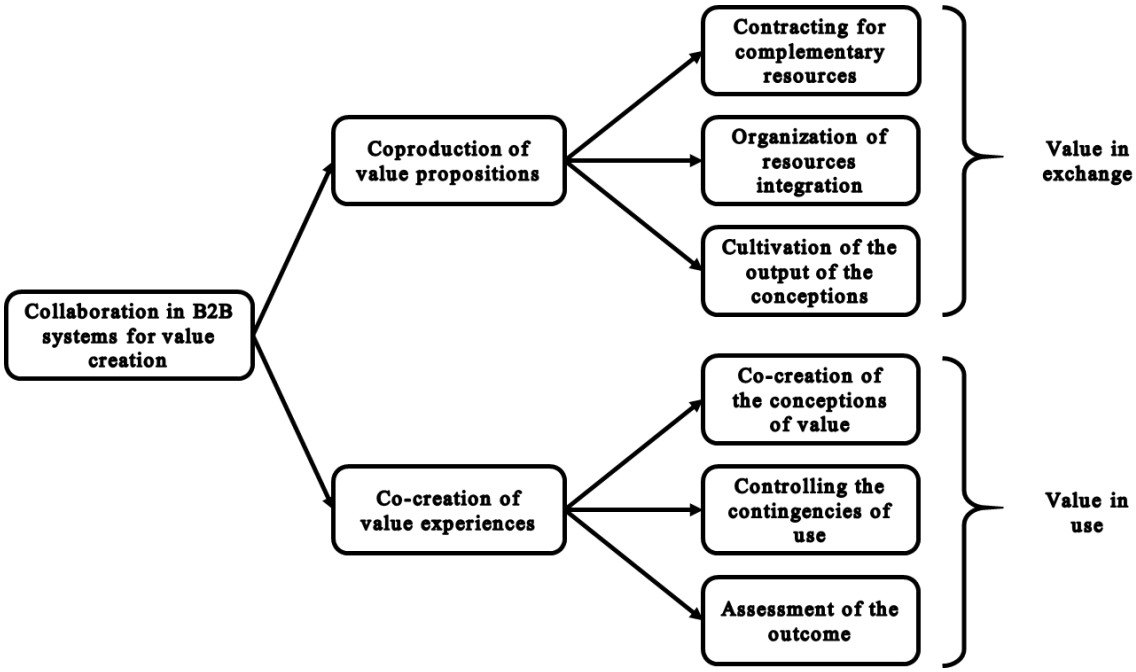

Figure 4 Practices of collaboration in B-to-B systems for value creation by Kohtamäki and Rajala (2016)

3.4 Value Co-Creation in Digital Context

The development of internet and other technology such as 3D-printing has provided vast new opportunities for value co-creation Zwass (2010). Zwass recognized, for example, co-production of the content like writing knowledge compendia (e.g. Wikipedia), consumer reviews and blogs or creating multimedia content (e.g. YouTube). He also mentioned hardware co-creation using e.g. 3D-printers. Zwass recognized that trust is one of the important factors for e-service and can work as an entry barrier for competitors. He used term *sponsored co-creation* to describe the situation where the customer is included in value chain activities, he recognized e.g. following co-creation methods; ideation and idea evaluation, product co-design (e.g. LEGO Design), product testing (e.g. beta-version of games) and product promotion (e.g. electronical word-of-mouth).

Haile and Altmann (2016) investigated value creation in software service platforms. They recognized stakeholders and parameters of platform value. Service platforms include three stakeholders; service platform provider, service developers and application users. Parameters for platform value were; cost, quality of service, service variety and installed base. Cost would include cost of usage, offering and support. Quality of service include speed, interoperability, functionalities and efficiency of transactions. Service variety includes all services offered to customers and installed base the number of all users. Haile and Altmann (2016) recognized that the installed base or the number of the users is the most important value generator in the framework and it would benefit all stakeholders. Application users would receive value due to availability of more connections, service developers would have more income due to increase in service sales and platform provider would create more income through service sales and hosting fees. They also argued that current value creation model in service platform industry benefits most the platform providers and if the licensing and hosting fees are not proper, it can mean the collapse of the whole ecosystem. (Haile & Altmann, 2016)

4 FRAMEWORK FOR ANALYSIS

4.1 Analyzing the Value Co-Creation

To recognize value co-creation practices in scaffolding industry, framework by Kohtamäki and Rajala (2016) will be used, see figure below (Fig. 5). The focus will be in co-creation of value experiences and so concentration is in *value in use.*

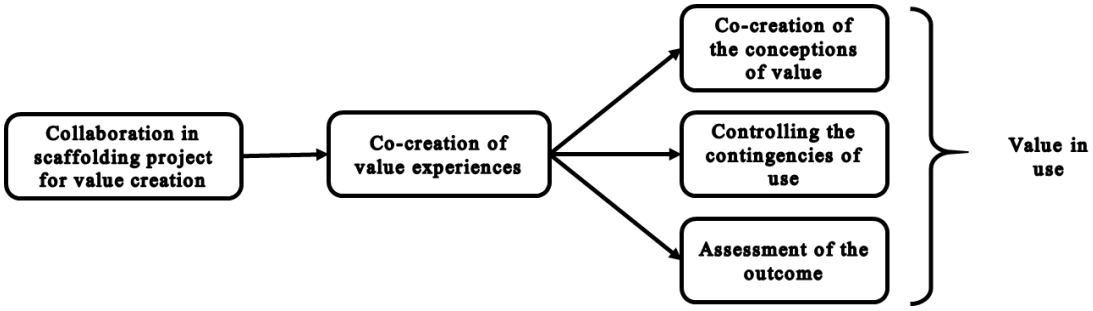

Figure 5 Framework for analyzing value co-creation by Kohtamäki and Rajala (2016)

Value co-creating practices will be identified and illustrated as a framework. Once the practices have been recognized the collected data will be used to recognize practices that are enhanced by digitizing the follow-up of scaffolds.

4.2 Analyzing the Perceived Value

Illustrating the information helps to understand it better (Austin et al. 1995). This was kept in mind when choosing the framework for analyzing the perceived value of digitized scaffolding follow-up system. Jaakkola and Hakanen (2013) used in their research a framework to analyze the actor-level value perceptions in the industrial solution network. The framework (Tab. 5) consisted three columns; the first one in the left had the information of the actor and its position in the network, the middle column was about experienced benefits and the last column on the right was about experienced sacrifices.

Actor, network position	Experienced benefits	Experienced sacrifices
Supplier A		
Supplier B		
Customer A		
Customer B		
Actor n		

Table 5 Actor-level value perceptions in the industrial solution network by Jaakkola and Hakanen (2013)

Framework in the previous page (Tab. 5) was used as a base to build framework for analyzing perceived value of digitized scaffolding follow-up system. In this thesis value creation and perceptions are inspected in dyadic relationship between supplier and customer, so network aspect was left out of the framework. Framework (Tab. 6) consists three perceived value components; benefits, sacrifices and threats. These components are formed of value drivers which were found identified from the data.

Actor	Perceived value components	Value drivers
Supplier		
	Benefits	
	Sacrifices	
	Threats	
Customer		
	Benefits	
	Sacrifices	
	Threats	

Table 6 Framework for analyzing customer and supplier perceived value

Chosen framework is very illustrative and helps to compare the benefits, sacrifices and threats perceived by customer and supplier.

5 METHODOLOGY

5.1 Research Approach

The research was carried out as a qualitative study. The reasons for choosing the qualitative research approach was to receive in-depth data from stakeholders involved in process. This Also the idea of the study was to find out what kind of value was created using the digitized follow-up system and this required qualitative research methods such as semi-structured interviews with stakeholders involved the process. The nature of the study was case study and the unit of analysis was company (supplier and customer). The case was to enhance scaffolding ordering process in small-and-many scaffolding project using digitized follow-up system. As context of the case, three different industrial work sites were used; shipyard, oil refinery and pulp and paper factory. Three different sites were chosen to see, if different industries have different working methods or not, no matter the environment. Stakeholders involved in scaffolding ordering process were interviewed to find out, how the daily works are carried out, how they could be enhanced with digitized follow-up system and what kind of value it would create.

5.2 Case Description

In 2014 the Company decided to start developing software to digitize follow-up of scaffolding which would increase the transparency in industry and boost the efficiency of its own operations. The software would digitize all the information and take care of the administration works such as charging of building, dismantling and rental costs, supervisor only needs to enter the correct data. Rental costs are charged in agreed period e.g. in two-week intervals which prevents the formation of large bills at the end of the project. Also, other administration works like weekly inspections of scaffolds and reporting would be done through the software. The advantage of software is its ability to involve also client's superintendents by creating them an account which they can use to follow scaffolds they are responsible of. With software, they would have access to the information at anytime, anywhere without asking, which gives them ability to follow and predict costs more easily, make better decisions and build trust with scaffolding supplier.

In the late 2016 the software was taken in full-scale use in the shipyard. Billing, charging and following were all functional properties. However, due to resignation of Company's key person in the beginning of 2017 and contradictory actions of software supplier, further development and implementing was frozen. At this point schedule and budget had been exceeded multiple times. There were also some contractual difficulties about the ownership of the software. As result these reasons the further development of the software was frozen.

At the same time of these problems there were changes in the ownership of the Company. Together with new owners the development process was started over with another software supplier and another software platform. Learning from the mistakes of the first software development process, the budget and schedule for development process was strictly determined. Also, the scope of the software was scaled down to make sure it would not swell as it did in the first project and, for example, billing functions was intentionally left for future development.

The development team consisted two coders and one digitalization consult from software supplier, me as a middleman to help coders understand the industry, build the functionalities and to test the software and CEO of the new owner to determine the scope together with his project manager. The software was first to take in test use in pulp and paper factory.

5.2.1 Scaffolding Industry

Scaffolds are temporary structure that provide three benefits; access, safety and position (Bromley Scaffolding, 2015). Scaffolds are integral part of any construction operation that is done in heights. Scaffolding works account significant number of man-hours in projects but still they are often over-looked being less-important compared to other disciplines. This leads to importance of proper planning and estimation of scaffolding costs already in bidding stage, but also proper follow-up during the project. (Kumar et al. 2013)

In industrial environment scaffolds are often needed in day-to-day basis which leads to problem of predicting costs (Kumar et al. 2013). Large number of individual scaffolds in project also demands from supervisor and superintendent strict and precise follow-up of scaffolds. Digitalization can help to estimate scaffolding cost by using building information modeling (BIM) (Kumar et al. 2013).

By using digitalized follow-up system of the scaffolds company can create cost-savings and enhance safety. Finnish scaffolding contractor states, that their scaffolding follow-up system has created 14 percent of cost-savings, reduced 40 percent of safety incidents and boosted the efficiency of scaffolding usage to 100 percent (KAS-Telineet Oy, 2017).

5.3 Data Collection

The primary data for this thesis was collected through semi-structured interviews with stakeholders involved in scaffolding ordering process and by observing the daily working practices, interaction and working behavior between scaffolder supplier and customer. Semi-structured interviews were chosen because of their benefits. Cohen and Crabtree (2006) recognized three main benefits for semi-structured interviews: 1) questions can be prepared ahead of time, which allows interviewer to appear competent during interview, 2) semi-structured interviews allow interviewees to express themselves on their own terms and 3) semi-structured interviews can provide qualitative, comparable and reliable data. Some nuances would have been missed if e.g. survey had been used. The observation was done while working as a project engineer in various scaffolding and insulation projects. Total time of observation was 15 months, 50 hours a week in three different projects, sometimes working also as a substitute supervisor, total duration approximately for two months.

Interviewed stakeholders were supervisors and superintendents who were involved in the ordering process in daily basis and management which was involved in weekly or monthly basis. Stakeholders from case projects, that had had follow-up system already in use or it was planned to take in use, were chosen to interview. Interviews were recorded, transcribed and then sent to interviewees by email for final acceptation. Three types of interview structures were thought fore-hand; structure for client, for Company supervisor and for management. Even though there was structure for interview, often the discussion ended up being quite informal. Total sum of interviews was eight.

Interviews were carried out face-to-face, usually at the interviewees' work place. This would help guiding the conversation and analyzing body language was possible and would provide data, how people really thought of introducing digitized follow-up system.

Interviews were recorded, then transcribed and sent for interviewee to check and comment. If interviewees had any comment on transcript, it was changed according to that. As mentioned before, the total number of interviewees was eight. Of the eight, five was contractor's representatives such as supervisors or management. Three interviewees were client's representatives, such as superintendents or management.

The idea of interviewing supervisors and superintendents was to recognize different working methods and phases in the daily situations; how scaffoldings are ordered, who orders them, how invoicing permits are prepared and accepted, how weekly inspections are carried out. Interviews gave good picture of the supervisors' and superintendents' general day-to-day work in projects. They were also asked, if they felt their work challenging and how they felt using the digitized follow-up system.

When interviewing managers, the focus was on reporting. They were asked for example, how supervisors or superintendents reported about scaffolding works to them, what kind reports they wanted, what kind of value they thought digitized follow-up system would create and what they saw as some biggest obstacles in implementing the follow-up system.

Interviews created a good picture to analyze benefits and sacrifice of digital follow-up system and to analyze the value co-creation in scaffolding industry.

Interview structures will be shown in appendixes.

Table (Tab. 7) on the next page lists all interviewees, their working experiences in industry and the duration of interviews.

Interviewee	Supplier/ Customer	Working experience	Duration of interview
Supervisor at shipyard	Supplier	Half a year as supervisor, before that foreman and scaffoler	25min
Supervisor at pulp and paper factory	Supplier	Eight years as a supervisor before that around 30 years as a worker	30min
Project manager, multiple projects	Supplier	Two years in scaffolding industry.	25min
Project manager/former supervisor, multiple projects	Supplier	Over ten-year experience of scaffolding works as a manager, supervisor and scaffolder	30min
Senior supervisor at oil refinery	Supplier	Over 30 years of experience in scaffolding and insulation industry	20min
Superintendent at shipyard	Customer	Over ten-year experience of scaffolding works as a supervisor, superintendent and scaffolder	35min
Area manager/superintendent at oil refinery	Customer	Multi-year experience as a superintendent and area manager	35min
Planning director at shipyard	Customer	Over 20 years of experience in shipbuilding	25min
Total number of interviewees	**8**		

Table 7 Information of interviews

The secondary data was collect by keeping diary of follow-up system development meetings and of meetings that were somehow related to follow-up system. The diary consists total of 13 notes from different meetings with supervisors, managers and software developers. In addition to diary, one workshop was held after one of meetings. The workshop consisted project managers, top management, software developer and software owner. The subject of the work shop was benefits and sacrifices/threats of digitized follow-up system to supplier and customer. As base of the workshop, above-mentioned Jaakkola and Hakanen (2013) framework was used. Data-collection methods are concluded into the table (Tab. 8) below.

Method	Description	Amount / Duration
Primary data		
Semi-structured interviews	Supervisors, superintendents and managers were interviewed to analyze the benefits and sacrifices and to analyze value co-creation.	Total number of interviews was eight.
Observation	Working as a project engineer in three different projects and observing interaction, working methods and working practices of supervisors and customers.	Total duration of observation was 15 months, 50 hours a week.
Secondary data		
Diary notes	Diary notes were taken in meetings that related to development or commissioning of the software.	Total number of diary notes was 13.
Workshop	One workshop was held to discuss about benefits and sacrifices to customer and supplier. Participants Top management, software development and software owner.	One workshop was held.

Table 8 Data collection methods

6 FINDINGS

6.1 Value Co-Creation in Scaffolding Industry

The interviews with scaffolding supervisors and superintendents gave good picture of scaffolding ordering process in industrial environment. It did not matter whether the scaffolding was ordered in oil refinery, shipyard or pulp and paper factory, scaffolding ordering process was very similar. To make it easier to describe the ordering process, main stakeholders involved in it are first described:

- *Scaffolding supervisor* is working on site. His responsibilities include all scaffolding related works. Supervisor usually has 10-20 scaffolders under him, 3-6 groups. He controls scaffolders and assigns them works, receives orders from client, prepares invoice permits, reports to management and so on.
- *Scaffolder* is the one who builds the scaffolding assigned to him by scaffolding supervisor. The typical size of scaffolding group is 3 scaffolders.
- *Client's superintendent* is monitoring the scaffolding contractor. Superintendent's tasks include ordering scaffolds, scheduling works and accepting invoice permits. Superintendent can be full-time or part-time depending on size of the site. If site does not have full-time superintendent, the construction foreman, for example, can work as one alongside his own tasks. If the site does not have superintendent, the user (i.e. other contractors) are responsible of use of scaffoldings by themselves.
- *User of a scaffold* can be for example piping or electric contractor or oil refinery operator. Someone who needs to access a place, which cannot be done safely without. In this case stakeholder means the whole contractor on the site.

Every scaffolding order starts with a need. User of a scaffold realizes that there is spot he cannot work safely or effectively without scaffolding. User then contacts the superintendent who forwards the order to scaffolding supervisor. Usually the information of the order comes face-to-face if supervisor is close by, by phone, by walkie-talkie or by e-mail. In interviews phone was the most common communication device. If the need is not crystal clear, it is usually inspected on site with supervisor, user and superintendent. During the inspection user tells, what he needs to and according to that supervisor makes a proposal, what kind of scaffolding could be built. User then accepts it as proposed or can ask for specific properties like larger working platform, specific entrance and so on.

After the detail have been agreed, supervisor gives a rough estimation when the scaffolding could be ready according the size of the scaffolding and current job queue, if there is an urgent need some prioritization for jobs might be done. However, after contractors and personnel on site have been established and the trust has been built, the user of the scaffolding can contact straight to supervisor of scaffolding supplier, this was mentioned by both superintendents interviewed at shipyard and oil refinery.

After meeting with user and superintendent, the supervisor has clear vision of the scaffold and the schedule. Supervisors have different methods of keeping track of job queue, however, traditional notebook appeared to be the most popular. When the order is next on job queue, supervisor shows the need to scaffolders, explains it and assigns the work to them. If the need is simple and easy to describe, supervisor can assign the job even by calling to workers. When scaffold is ready, scaffolders inform supervisor about it and supervisor makes a final check. In some projects scaffolders did the first inspection. If scaffold is okay and legal (safety railings, toe boards etc. on place), supervisor will accept the scaffolding and place scaffolding card to entrance. Every scaffolding must have a scaffolding card for identification purposes. If scaffolding card is missing, using of the scaffolding is prohibited. After scaffolding is ready and inspected, supervisor informs the client that scaffold is ready and then saves the information; build date, size, client, contact person etc., to scaffolding register. Every supervisor had their own method of keeping record of scaffolds. Some supervisors preferred Excel when others liked manual notebook.

When there is no more need for the scaffold, client will give it a dismantling permit which means that rental expenses stop to that date and scaffolding company can start dismantling the scaffold and use the material for another purpose. To give dismantling permit, same communication device was used, phone being the most popular one. Usually supervisor was able to decide, when to dismantle the scaffold, however, if it was on way dismantling could be prioritized just like building. Table (Tab. 9) on the next page is used to illustrate scaffolding ordering process from scaffolding need to recording of information.

Scaffolding Need	Order	Job Queue	Building the Scaffold	Inspection	Recording the Info
The User realizes that he needs scaffolding to access certain place to execute his work safely and effectively.	**The User** contacts **the Superintendent** or **the Supervisor** for need. Contact happens usually by phone/face-to-face/by walkie-talkie or by e-mail. The need is checked and at the place and the schedule is agreed.	**The Supervisor** marks the order to his job queue, which he usually keeps track in small notebook.	**The Supervisor** assigns the work to **Scaffolders,** when it is the first in job queue. If needed, **Supervisor** and **Scaffolders** check the need together before starting to build.	When **Scaffolders** have finished the work, they will inform **Supervisor,** who inspects the scaffolding and informs **the User** and/or **the Superintendent** about competition.	**The Supervisor** then enters the scaffolding info to his scaffolding register. Every supervisor basically had their own method of keeping track of scaffolds. Some used Excel some notebook.

Table 9 Scaffolding ordering process in industrial environment

Co-creation of value in scaffolding ordering process happens only in the second phase, *order*. Inspecting the need with supervisor, superintendent and the user of scaffold is the place for co-creation. If the superintendent only tells supervisor that they need to build a scaffold in place X, the built scaffold could have zero *value in use*. However, when the need is inspected on site together with users and superintendent, the scaffold will be built according to need and it will serve users and provide good *value in use.* User and superintendent can, for example, determine the working height, size of the platform, the position of the entrance, extensions and so on. Options for customization of scaffold are endless. Illustrative example of value co-creation is that two fully identical scaffolds are built; one so that user can do his work of it and other one couple meters off target. Both scaffolds cost the same, however the second has zero *value in use* while the first one has provided *value in use* for the user.

6.2 Perceived Value of Digitized Scaffolding Follow-up System

Collected data gave good opportunity to analyze the perceived value of digitized scaffolding follow-up system. This chapter will start with introducing the results of the workshop that was held to look for benefits, sacrifices and threats that supplier and customer would face as digitized follow-up system was introduced. Total number of benefits exceeds the number of threats and sacrifices for both actors. For supplier 15 benefits (e.g. transparence, real time reporting and time savings) and seven threats/sacrifices (e.g. development and licensing costs) were recognized. For customer side eight benefits and only two sacrifices/threats were recognized. Table (Tab. 10) below illustrates the results of workshop.

	Benefits	Threats/sacrifices
Supplier	• The quality of data • Analyzing of the business data • Forecasting demand • HR management • Material management • Safety • Quality control • Transparency • Real time reporting • Easier reporting • Access from anywhere • Back-upping of the data • Time savings • Standardized system, substituting is easier. • Communication	• Development costs • Licensing costs • Device costs • Change resistance among employees • Training • Privacy and security • Platform dependency
Customer	• The quality of data • Reporting • Site management • Transparency → Trust • Safety • Time savings • Optimizing the number of scaffolds • Active participation e.g. dismantling permits and ordering	• May form a switching barrier • Licensing costs in active use

Table 10 Results of work shop

Supplier's benefits. Quality of the data is important benefit that is achieved by digitizing follow-up system. The software can be built so that guides and informs the supervisor to input the data in correct form. One of the observation projects had five different scaffolding contracts with different clients, and required a complex Excel sheet that was used for follow-up and billing, however if the supervisor had made a spelling typo, the price could be incorrect. The quality of the data also helps supervisors to report scaffolding works to their managers, however neither one of the interviewed supervisor had to report frequently to their managers. Quality data also allows deeper analysis of the business data and forecasting the future demand, common value driver for these benefits is enhanced *data management.*

Better data helps in managing the resources, such as manpower and management. Software could easily tell, whether site has too many or too few scaffolders. It also helps to analyze the material amount of material needed on site. These conclude to *resource management.*

Nowadays HSE-actions (health, safety and environment) have a bigger and bigger role in industrial and construction industry, actually the wide use of the scaffolds is mostly result of tightening HSE-regulations, since they guarantee safe and solid platform for working in heights. Nowadays HSE-regulations demand that scaffolds need to be inspected weekly to make sure that they fulfill all the regulations (e.g. safety railings and kick boards on place). Digitized scaffolding follow-up system keeps record of the inspections and reminds supervisors if the inspections is due to date. Good example of the safety feature comes from the shipyard, where another disciplinary worker fell into hole of five meters and seriously injured even though it had safety railings build out of scaffolds around it. Supervisor was able to prove to investigating authorities that scaffold, or in this case safety railing had been frequently inspected and the dangerous modification (removing lower safety railing) had been done by somebody else.

Transparency is one of the most important benefits digitized follow-up system creates, it was mentioned by interviewed supervisors and managers and also emphasized as top three most important benefits in workshop. Increasing transparency will help building trust between supplier and customer which makes daily routines and work easier. Trust especially between supervisor and superintendent is important since it makes works more convenient, because there no need for constant suspicion from customer-side. Superintendent at oil refinery mentioned that once the trust is built between customer and supplier, users (e.g. operators) can order scaffolds straight from supervisor and only informing the superintendent.

Interviewed managers did not demand reporting, even though one of them said that it could be better. At the moment supervisors did not have to report how works are going on the site and so managers had to trust verbal and informal reporting of quantities and manpower. Follow-up software allows dashboard like metering which managers could follow to see, how works are going on their project sites. This would give extra information for managers and free supervisors from reporting. Real time reporting is consequence of quality data that is input correctly to software.

The software has been built in Salesforce platform which is PaaS-based cloud computing platform. Cloud computing enables various benefits to supplier, for example, access to software is possible from anywhere with internet connection and data is back-upped to servers. Accessing the software anywhere helps managers to follow real time reporting that the software allows. Back-upping the information is also important and it has not received much of an attention among supervisors and managers as it should have. The scaffolding follow-up have been done in either in notebook or in Excel file that has been saved to hard disk, which both are hard to recover in case they go missing or are destroyed. One of the managers told that in one of his projects scaffolding data was saved on the hard disk of the laptop, which was then stolen and all the information was lost. This caused lot of trouble when back-upping had to be done manually using other notes and memorizing.

One of the most important benefits that surfaced during the interviews and in workshop was time savings for supervisor. By using digitized follow-up software, they could concentrate on their work without needing to think about building their own Excel files for follow-up. Supervisor at the shipyard told that he could not think of using anything else than digitized follow-up system. At the pulp and paper factory scaffolding register was held in notebook that located at the workshop, foremen filled the register after their scaffolding group had finished the scaffold. However, not all foremen marked the scaffolds to register. After introducing mobile digitized scaffolding follow-up system to work site, registering scaffolds to system was much easier and larger percentage of scaffolds were registered because supervisor and foremen were able to register newly built scaffolds directly to follow-up system by using their mobile phones.

Supplier's sacrifices include mostly monetary costs like development, licensing and device costs, which are easy to measure. Development cost is the largest of sacrifices and it comes early in the development process. Significant part of the development costs is man hours used to for coding. The problem which increases the development costs is that software developers usually are not familiar with the industry and some things that are taken for granted by supplier are new for software developer. This requires good communication with software developer to get specifications correct and avoid unnecessary work. Total amount of development costs are some tens of thousands of euros.

Licensing costs are formed of Salesforce licenses. Each user needs their own license to use the software. The more users are using the system, the cheaper the unit price of the license is. Approximately the annual cost of licensing is some thousand euros, but not more than EUR 10 000, when total number of licenses is under 60.

Device costs are the smallest of costs. Each user needs a device to use software, however, often they would anyways need it (mobile phone and computer) so the cost is not significant.

Supplier's threats are relating to use and implementation of the system. One of threats is change resistance among employees, even though every interviewed supervisor and manager told that they would like to use or at least try digitized scaffolding follow-up system. In many informal discussions was mentioned that if the system works and is easy to use supervisors would be happy to use it. However, if there are any problems to take the software into use, the change resistance can increase. Training of the supervisors needs to be well planned and carried out in order to guarantee smooth start. If supervisors are left alone with their problems and question there is big chance that they will keep working the old way.

Using third party platform creates always threats which may increase sacrifices, for example, platform provider can increase their license prices which goes directly to licensing costs. Privacy and security is always big question and giving sensitive information, such as pricing information to third party platform provider may rise question.

Intellectual properties should be well agreed before starting the development process with software developer. If agreement is unclear, there can be problems later with ownership of the program. This happened to the Company before.

Customer's benefits. Many of the customer's perceived benefits are similar to supplier's benefits and they are related to each other e.g. time-savings, transparency and safety. Time-savings are received, for example, when the operation of the software has been verified and the billing data can be trusted without strict checking (Planning director at shipyard). Also when superintendent can follow what supervisor is marking to system in real time he is able to spot errors earlier and they can be fixed while freshly in mind. This increases transparency and helps creating trust between supplier and customer. Cloud computing creates benefits also to customer, when they can access the software from anywhere.

Customer also benefits of the better-quality data provided by software. Better data allows customer to forecast and estimate short-term cost of scaffolding as superintendent at the shipyard mentioned. His manager had asked for estimations of scaffolding costs for following two weeks and in this digitized follow-up system had helped him. The software did not provide any pre-made forecasts, but superintendent had been looking for past costs and so estimating the upcoming costs.

When customer is actively included to software by giving them their own accounts they can easier manage and optimize the number of scaffolds on site. Superintendent can, for example, give dismantling permit in the software with single click when the traditional way has been giving it by phone call, email or face-to-face, it also leaves a mark to system and date is registered, which means the end of rental costs. Both supervisor and superintendent will receive time-savings by reducing, e.g. phone calls which is the most common communication method in scaffolding ordering process. One of the supervisors told that on a busy day, he can have over 100 calls.

Customer's sacrifices. At the current model in which software is supplier-based, customer does not have many sacrifices. Development costs and most of the licensing costs are paid by supplier. Customer might have to pay their own licenses to use the software,

Some customers have a will to get customer-based software that would be specially used at their sites. This was mentioned by area manager at the oil refinery. Oil refinery has multiple scaffolding contractors and having multiple different systems is not reasonable and would create extra work for superintendents. Running customer-based software would demand more sacrifices from customer e.g. development/purchasing, licensing and maintenance costs.

Customer's threats. Like sacrifices, not many threats were recognized. Well working digitized follow-up system may increase the contractor switching barrier when all superintendents and users have learnt to use the system. Switching to new contractor means, that operative personnel would have to learn new systems, however, this threat is eliminated in customer-based software.

Benefits, sacrifices and threats are illustrated in framework (Tab 11) below.

Actor	Perceived value components	Value drivers
Supplier		
	Benefits	• Data management • Resource management • Health, safety and environment (HSE) • Transparency • Real time reporting • Cloud benefits (e.g. access from anywhere, back-ups) • Time-savings
	Sacrifices	• Monetary sacrifice (e.g. development, licensing and device costs)
	Threats	• Dependency on platform provider • Security and privacy • Intellectual properties • Change resistance
Customer		•
	Benefits	• Health, safety and environment (HSE) • Transparency • Real time reporting • Time-savings • Forecasting need • Cloud benefits (e.g. access from anywhere)
	Sacrifices	• Minor monetary cost (e.g. licensing costs) – applies in supplier-based model.
	Threats	• Dependency on supplier → switching barrier may increase

Table 11 Perceived benefits, sacrifices and threats by supplier and customer

As one can see from the framework (Tab. 11), benefits created by follow-up system are all very subjective and hard to measure. Monetary benefits, like cost-savings were not recognized. When value is sum of positive benefits and negative threats and sacrifices, the total perceived value depends on, how each actor value benefits they perceive. In current supplier-based model, customer does not have to make big sacrifices, so even though they did not value the benefits high, most-likely the total value would be positive. Supplier's sacrifices are much larger which, raises the question, if the total value is positive or negative. Interviews and informal discussions with supplier's top management revealed, that recognized benefits are valued high. Also, possibility was recognized, that in near future digitized follow-up system might be a requirement to attend the tender for large scaffolding projects. With these points combined with the fact that total investment compared to revenue and profit is not very high, it is safe to say that also supplier's perceived benefits will exceed perceived threats and sacrifices and so the total perceived value will be positive.

6.3 Digital Follow-up System to Enhance Value Co-Creation

Co-creation in scaffolding project is evident and it mostly happens during inspecting the need. One of the research questions was to recognize, if co-creation is enhanced by using the digitized follow-up system. To enhance co-creation of value using the follow-up system, it requires active participation by customer. During interviews, the follow-up system was in use at the shipyard and customer's personnel had rights to use the system. However, the level of participation by customer was quite low. Even though customer had e.g. chance to give dismantling permits by using the software, they still preferred traditional communication methods, like mobile phone and e-mail. According to observations, the lack of participation might have been due to fact that client's personnel were not that familiar using IT-systems and tools, they did not receive enough training to use the follow-up system and therefore they were afraid to use it in case of mistake and would prefer the traditional methods.

Even though, value co-creation was not really enhanced in shipyard project, follow-up system still has a lot of potential to do it. This was noticed during observations, discussions and development meetings. One of the co-creation possibilities was even mentioned in the commercial video by another scaffolding company. In KAS-telineet (2017) video they mentioned, that customer can start ordering process by taking picture of the need and it would be directly delivered to scaffolding company.

This kind of ordering would work at least for simpler orders and would create time-savings, when the inspections of need would not have to be done physically on site. Order through follow-up system would also save the locations data and order date straight to the system and so reduce supervisor's work and make ordering more efficient.

Another co-creation possibility is in tracking and changing the scaffolding statuses. Finnish law requires scaffolds to be checked weekly to make sure they are in safe and legal condition (Finlex, 2008). Checking is done weekly by scaffolding supervisor and/or by assigned scaffolding inspector. Traditionally check date has only been written on scaffolding tag, which is special identification card at the entrance of each scaffold, however, inspections have not been recorded anywhere. Tag has two sides, red and green. Green means, that scaffolding is inspected and safe to use. If inspection is late or someone notices, that scaffolding is not in good condition, tag is turned to red, which means using it is prohibited.

When follow-up system is used, each inspection is recorded to system and they are retrievable for later use to check if inspections have been done on time and if scaffolding has had any problems in the past. With follow-up system each user has chance to report dangerous scaffold that has any flaws. This will notify supervisor, that the scaffold needs to be fixed, but also leave a mark to system. Co-creation of value is enhanced when customer is integrated to system to report flaw and follow inspection frequencies.

As mentioned before, at the current phase co-creation of value has not been very significant. To create better chances for co-creation of value to happen, customer should be better engaged to system. This could be achieved by integrating customer-side personnel to development process earlier which would also provide customer point of view to development process and how they would like the system should work. When follow-up system has been taken in to use and more personnel are to be integrated, the proper introduction and training should be taken. At the beginning support should be easy to get, because if users face any problems and they are not getting help, there is high chance that they will go back to old working methods. This will most likely also increase the change resistance for future changes. As one supervisor, that was not interviewed for this thesis, said that digitized follow-up system would be great if it works and reduces work load. However, if it increased their work load even for short-period of time, they would be very hard to convince to use it. Most likely this same applies for customer-side personnel. The goal of implementing and developing digital tools should not be to enhance digitalization itself, but to make site personnel's work easier and more efficient.

To enhance value co-creation all users, need to be introduced to system properly. They need to understand, but most importantly to perceive the benefits, like time-savings from using the system. If users are not introduced properly they will most likely go back to their old working methods to keep things running.

7 CONCLUSIONS

Scaffolding is the cornerstone for building, maintaining and repairing in industrial environment, where scaffolds are used for access, safety and position purposes. During the building or maintenance project hundreds of individual scaffolds are built and dismantled over the duration of the project. To follow and keep record of built and dismantled scaffolds, scaffolding supervisor needs proper follow-up tools. Traditionally each supervisor has had their own way to keep record of scaffolds, whether it has been in notebook or in Excel file. Various and unstandardized methods have led, for example, to lack of transparency in industry. To tackle this problem, digitized and cloud-based scaffolding follow-up system was developed.

The main goal of this research was to find, what kind of value digitized scaffolding follow-up system creates to supplier and customer and if it enhances value co-creation. Research was carried out as qualitative study, data was collected by semi-structured interviews and observing. To reach the goal, following research questions were formed:

RQ1: How value is co-created in scaffolding projects?

RQ2: What kind of value digitized scaffolding follow-up system creates?

RQ3: Does digitized scaffolding follow-up system enhance value co-creation?

Data collection revealed that in industrial environment value co-creation in scaffolding works is evident. However, it happens only in the *order* phase of the scaffolding ordering process, when supervisor, superintendent and user inspect the need on site. The properties, like working height, size of the platform, type of the entrance etc. are agreed during the inspection meeting. Customizability options are endless and many customer wishes can be executed. Value co-creation happens during the inspection meeting and it can be crucial whether the *value in use* of the scaffold is high or low.

To analyze perceived value created by digitized follow-up system, value was split into three components; benefits, sacrifices and threats. Using these components, framework was formed to inspect the perceived value for customer and supplier. The most important benefits were increased transparency, data management, real time reporting and cloud benefits. Both supplier and customer had very similar benefits. Sacrifice mostly consisted monetary costs, like developing and licensing costs, which applied only to supplier. Supplier's threats consisted intellectual properties, security and privacy concerns and dependency on platform provider. For customer only one minor threat was recognized and it was that switching barrier could be increased.

Perceived benefits were all subjective and not measurable in monetary terms, so to determine total perceived value depends on, how benefits are valued by customer and supplier. In supplier-based model, customer's sacrifices were so little, it was assumed, that value would be positive even though customer did not value benefits high. Supplier's sacrifices were larger due to development and licensing costs, however in larger picture they were not that large when comparing to revenue or profit. Perceived benefits were valued high by supplier's top management and question was raised, that in future digitized and real-time follow-up system could be requirement to attend the tender. These points clarified that, the supplier's perceived value would also be positive.

Now follow-up system did not seem to have big effect on co-creation of value. This was due to fact, that customers were not using the system actively enough and even minor co-creation possibilities, like giving dismantling permits, were done otherwise. However, other value co-creation possibilities were recognized, for example, in order phase. Co-creation of value requires that all users are properly introduced to system. Its importance is especially high when the system is first taken in use. Users, from customer and supplier-side, need to have easy access for help and support when the system is taken into use. If they feel, that new system only increases their work load, they are more likely to go back to their old working methods.

7.1 Academical and Managerial Contribution

Despite its importance in industrial construction, scaffolding industry has received barely any attention in academical research. Kumar et al. (2013) researched the difficulty of estimating scaffolding costs during the tender phase and how it could be improved by using building information model, a part to their research no other significant research was found. Since scaffolding industry has not received much attention, the research gap is quite large. However, this thesis attempted to make the gap little bit smaller, by describing the scaffolding ordering process in industrial environment and recognizing, how different stakeholders interact and communicate.

Another research gap for this thesis was recognized in value creation using digitized tools in low-tech industry such scaffolding industry is. The study revealed, that digitalization can create benefits also in industry that is highly dependent on physical product and in which physical presence is very important. Digitalization supports main activities and creates non-monetary benefits that are valued higher than monetary sacrifices and threats and so the perceived value is positive.

From managerial perspective this whole subject is very interesting. Digitalization has swept over many businesses like a wave and scaffolding industry will be no different, even though it might try to stick to old habits. When the wave of digitalization hits, companies and managers should be prepared. The further they are in developing their digital systems and better they know and understand benefits provided by it, the better chance they have surviving. This thesis has created a tool for decision making and it helps top management to decide, if and how to invest in digital tools that support the core business. Knowing the benefits and sacrifices makes deciding easier, but also helps in marketing these new services to customers and convincing employees to use them.

Knowing the benefits of digital tools, also helps to concentrate on right things, when developing the new digital services and further developing existing tools. Well-working digitized follow-up system can create a standard for industry and at some point, it may be requirement to even attend the tenders. Then it is good have systems ready and know, what kind of benefits are created and what kind of sacrifices are required to develop and maintain the system.

Scaffolding industry is very competed and there are not many ways to differentiate and often the cheapest price on paper wins. Digitized scaffolding follow-up system integrates the customer to ordering process and makes it more transparent and easier for customer to manage and follow their scaffolds. This thesis helps managers to recognize the value creation to customer and makes communicating it easier. Digitized scaffolding follow-up system may create a competitive advantage for company and help to win future contracts. However, this needs more research.

7.2 Limitations and Future Research

This thesis concentrated in value creation of digitized tools in scaffolding industry, more specific in industrial environment, such as oil refineries, ship yards and paper and pulp factories. Digital tool that was investigated was quite simple and its purpose was to replace old and outdated follow-up methods, such as Excel and notebook. More sophisticated technology was left out of the research, even though they might have been mentioned. This kind of technology is for example, computer-aided design (CAD), building information model (BIM), artificial intelligence (AI), robotics and 3D-printing.

The value created was inspected from two different perspectives; from customer and supplier perspectives. The research concentrated the value perceptions on company-level, so value was not analyzed on employee-level, even though many of the identified benefits would also apply on employee-level.

Primary data collected in interviews was quite narrow, totally eight persons was interviewed. Of those eight, only three had hands-on experience using functioning digitized follow-up system. To the rest of interviewees functionalities of software were described properly and some of them had participated to development meetings. However, the responses from all interviewees were similar, so for this thesis conclusions could be made. Benefits and sacrifices should be researched later after the software has been in company-wide use for couple years. Then responses would be more accurate and perhaps some new benefits could be recognized.

In this thesis, the follow-up system was delivered by supplier, it was so called supplier-based model. However, customers with multiple suppliers might want to have customer-based model, in which customer would deliver the software and take responsibility of maintaining and developing it. It can be assumed that, benefits, sacrifices and threats would be different in customer-based model. For example, integrating all suppliers to same system could create controversy and demand privacy and security enhancements. Researching, how customer-based digital tools and systems that are used by multiple suppliers create value could be a subject for future research.

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APPENDIXES

Appendix 1, Interview Structures

These interview questions were used as a foundation for interviews. Interviews were carried out more as a conversation with these questions to prevent silent moments and keep the discussion alive.

Supervisors

- How many scaffolders on average are working for you?
- Please describe the scaffolding ordering process from order to inspection?
    - How order comes?
    - How do you divide works among scaffolders?
    - How do you record the order?
- How do you keep record of scaffolds on site?
- How do you keep record of done extra and modification works?
- How do you get invoice permit from customer?
- How do you calculate building and dismantling costs for scaffolds?
    - How about rental cost?
- How do you take care of weekly inspections?
    - Do you register weekly inspections to any system for later use?
- Do you feel paper work related to your work challenging?
    - Why?
- How much time you use on average to paper works?
- Do you think you company should have centralized and digitalized follow-up system for scaffolds?
- Do you think mobile follow-up system would ease your work?
- Would you like to take digitized scaffolding follow-up system into use or would you prefer traditional follow-up?
    - Why/why not?

Managers

- How many supervisors and scaffolders are working for you?
- How supervisors report you about works done?
- Is reporting clear and easy to follow?
    - How it could be enhanced?
- Do you feel that it is challenging to get the reporting information from supervisors?
    - Why?
- Is material reports easy to achieve?
    - e.g. how many scaffolds are standing?
    - how many cubic meters of scaffolds has been built?
- Do you think digitized scaffolding follow-up system would help you at your work?
- Do you think digitized scaffolding follow-up systems creates value for customer?
    - How the possible value would be communicated to customer=?
    - Could it be used to justify higher price?
- What do you see as the biggest challenges and obstacles in development?

Superintendents / Client

- How much time you use for scaffolding superintending per day?
- Please, describe scaffolding ordering process from customer point of view.
- How do you get information that ordered scaffold is ready?
- How does supplier report you about scaffolding works?
- How do you accept scaffolds to be invoiced?
- Do you feel that paper works related to scaffolds are challenging or time-consuming?
- How do you order modification work for scaffold?
- Do you have had any disagreement about extra and modification works with supplier?
- How do you give a dismantling permit to scaffold?
- Has there been any surprising costs related to scaffolds? E.g. large rental cost
- Do you think, forecasting upcoming scaffolding need is challenging?
- Do you think superintending is challenging or time-consuming?
    - How it could be enhanced?
- Do you think, you would benefit from digitized follow-up system?
- Do you think, that digitized follow-up system should be an extra service?
- Do you think, that in future digitized follow-up system will be a requirement?
- Do you think, you could use digitized follow-up system?
- What kind of value digitized follow-up system would create to you?