



# The Possibilities and Circumstances Around Customization of Products Using Services

Product Service Systems in the Construction Industry

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This thesis is submitted to the Faculty of Engineering at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Industrial Management and Engineering. The thesis is equivalent to 20 weeks of full-time studies.

The authors declare that they are the sole authors of this thesis and that they have not used any sources other than those listed in the bibliography and identified as references. They further declare that they have not submitted this thesis at any other institution to obtain a degree.

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# Abstract

**Background:** In the era of emerging technology and services new constructions of value exchanges are made. The continuous value trade is a vital part of the service ecosystem with stakeholders ranging from platforms, to the planet on a larger scale. Product service systems (PSS) emphasize the use of the product rather than just the sale, when combining products and services. PSS also focuses on the proliferation of the product which makes it a sustainable practice as fewer new machines are needed. The business models of PSS are linked to the strategies of oligopoly firms, where differentiation yields competitive advantages.

**Purpose:** The thesis aims to analyze the conditions for introducing services to products based on the opinions of decision-makers in the construction industry.

**Methods:** In the study, semi-structured interviews with the customers of the construction equipment firms were carried out. The method aimed to identify recurring themes to generate results that are stronger when combined than the individual answers.

**Results:** The candidates showed a perceived value in adding services to products concerning accessibility and versatility. Since the industry is changing, the candidates highlighted the need to adapt and saw services aiding the transition. Services and digitization could potentially increase the attractiveness of firms, both the companies and their customers. For the candidates to use the service it would need to provide values that include: Flexibility, Accessibility, Differentiation, Communication, Relations, Sustainability, Visualization, Documentation, and Adaptability.

**Conclusions:** PSS expands upon the usability of products, and using services to differentiate from competitors can lock in customers. However, as there are many services available, communication of these becomes crucial to maximize the utilization of the competitive advantage that the service aims to provide.

**Keywords:** Differentiation, value, product service systems, oligopoly, the lock-in effect



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# Sammanfattning

**Bakgrund:** I eran av framväxande teknologi och tjänster skapas nya konstruktioner av värdeutbyten. Det kontinuerliga värdeutbytet är en viktig del av tjänstekosystemet med intressenter som sträcker sig från plattformar till planeten i stort. Produkttjänstesystem (PSS) betonar användningen av produkten snarare än bara försäljningen när man kombinerar produkter och tjänster. PSS fokuserar också på produktens spridning vilket gör det till en hållbar praxis då färre nya maskiner behövs. PSS affärsmodeller är kopplade till strategierna hos oligopol företag, där differentiering ger konkurrensfördelar.

**Syfte:** Studien syftar till att analysera förutsättningarna för att introducera tjänster till produkter baserat på åsikter från beslutsfattare inom byggbranschen.

**Metod:** I studien genomfördes semi-strukturerade intervjuer med kunder till företag som tillhandahåller byggutrustning. Metoden syftade till att identifiera återkommande teman för att generera resultat som är tydligare när de kombineras än de individuella svaren.

**Resultat:** Kandidaterna visade ett upplevt värde i att lägga till tjänster till produkter när det gäller tillgänglighet och mångsidighet. Eftersom branschen förändras betonade kandidaterna behovet av att anpassa sig och såg tjänster som en hjälp i den tekniska övergången. Tjänster och digitalisering skulle potentiellt kunna öka attraktiviteten för företagen, både för företagen själva och deras kunder. För att kandidaterna ska använda tjänsten skulle den behöva tillhandahålla värden som inkluderar: Flexibilitet, Tillgänglighet, Differentiering, Kommunikation, Relationer, Hållbarhet, Visualisering, Dokumentation och Anpassningsförmåga.

**Slutsatser:** PSS utökar användbarheten hos produkter, och att använda tjänster för att differentiera sig från konkurrenter kan få kunderna att stanna kvar. Dock, eftersom det finns så många tjänster tillgängliga, blir kommunikationen av dessa avgörande för att maximera utnyttjandet av den konkurrensfördel som tjänsten syftar till att skapa.

**Nyckelord:** Differentiering, värde, produkt-tjänstesystem, oligopol, lås-in-effekt



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Sincerely, Evelina Persson



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*This section offers a background and conducts a thorough investigation into the area of research. Additionally, it introduces the research question, objectives, and scope of the study.*

## 1.1 Background

Services stretch beyond the exchange happening between firm and customer, and it can be found in many human activities such as the travel industry according to Field et al. [13]. The authors define services as ecosystem of continuously offered value between multiple stakeholders, which include different platforms and societies, which in the end interact with the planet as a stakeholder.

Baines et al. [3] argue the concept of Product Service-Systems (PSS) is a specific aspect of servitization that combines services and products. This enables the proposition to extend beyond the traditional product functionality by incorporating additional services. Emphasizing the "sale of use" over the "sale of product," PSS redefines the transactional model to prioritize providing access to the product's benefits rather than ownership. Annarelli et al. [2] express that locking in customers through PSS offers is frequently discussed in literature by examining ways to improve the relationships with the customers. Relationships with customers can be social or contractual. By locking in the customers, a consequence is locking out the competitors. However, the strongest barriers are built by strong relationships with the customers, and therefore the lock effect is more discussed. Sjödin et al. [26] researched perceived switching costs which refers to the various expenses a customer faces when transitioning from one provider to another. These could be relational, operational or monetary.

PSS offerings often include services prolonging the lifetime of the product and thereby increasing the sustainability according to Annarelli et al. [2]. Prolonging life means expanding upon the time the product is usable according to the authors. The authors highlight that it remains an important topic within a broad area of business models such as construction equipment, furniture, and manufacturing. The authors continue discussing utilizing leasing, sharing, and/or pooling arrangements to optimize consumption rates by facilitating multiple uses, thereby transferring ownership and maintenance responsibilities to the provider are aspects that increase sustainability about production and material use. Another use of PSS within the construction industry is mentioned by Reim et al. [23], who examined how tracking fuel, emissions, and error codes, and examining service agreements and warranty options, are ways

to increase sustainability concerning maintenance.

The business models constructed for a PSS vary from focusing on product, use, and result as expressed by Reim et al. [22]. In the first model in the article, which focuses on the product, the provider assumes responsibility for the contracted services, sells and services the product, and customers pay for the physical product and the performed services. It allows for customization of the product without extensive changes to the product. This relates to the oligopoly model provided by Belleflamme and Toulemonde [4], where the final product has varieties. In an oligopoly market, almost perfect market conditions occur, and firms compete through product differentiation according to Smit and Trigeorgis [27]. Belleflamme and Toulemonde [4] state that the variety of oligopoly firms includes both downstream and upstream firms as expressed by the authors. Downstream firms opt for one specific variety to market in the final market. Upstream firms specialize in producing a particular input tailored specifically for this variety. They also manufacture the input for the alternative variety at an additional expense.

In the user-oriented model presented by Reim et al. [22], the provider assumes the usability of the product or service, assures the usability of the physical product along with the service, and customers can make continuous payments over time. In the result-oriented model, the provider assumes the responsibility for delivering the results, actually delivers the result, and customers pay based on outcome units, thereby paying for the result achieved.

Chiu et al. [5] presented the idea of a platform-oriented business model, which is created by producers, service providers, and customers. For this intermediary property, there are instances, particularly in renting or leasing arrangements, where ownership of the product or service rests with the service providers. A platform-oriented Product Service System (PSS) offers a comprehensive personalized solution through a virtual platform, allowing for co-creation between customers and other stakeholders within the system. This PSS type generates revenue from advertising, commissions, and transaction fees. Customers also pay a portion of the price of the product or service to access the convenience it offers.

## 1.2 Problem discussion

In the era of supporting services in society, there is an emergence of these within the construction industry. Studies show a lack of advanced supporting services in the construction industry, and a need for implementation of these in multiple stages of construction developments according to Schimanski et al. [24].

Whilst offering a PSS can add to the value of many different markets, Annarelli and Battistella [2] mention the construction industry as one of its main application areas. They also express a limitation of papers describing the design of a PSS business model. Schimanski et al. [24] highlight the lack of adaptations of services as the ones aiming to add value to the product in the construction and manufacturing industry. Because of the possible added value after adding a service to a product as expressed by Annarelli and Battistella [2], and the need for this type of complex services, as stated by Schimanski et al. [24], the area of research in this project is going to be the construction industry.

Baines et al. [3] highlights the possibility of unlocking new usage possibilities when adding a service to a product, offering the opportunity to modulate the product. Schimanski et al. [24] propose that a planning process utilizing Industry 4.0 technologies such as Digital Twins (DT) and Building Information Modeling (BIM) can be tailored to the project's characteristics and equipment capabilities, as well as other external factors which modifies the product to the needed application area. Additionally, they propose that BIM can optimize project layout, offering planners an additional source of insights for decision-making and visualizing the implications of various choices. Iben and Laryea [12] examine the digital technologies and found that they are complex and there is a large selection to choose from, creating many application areas throughout the construction projects.

Hohenschwert and Geiger [11] suggest that value can be created from the influence of the customer and processes of interpretation. The salesperson has the power to influence the customer to perceive the value of a product to be higher than they first may have thought. They do this by utilizing cognitive and emotional strategies. The study was performed on business-to-business (B2B) transactions and it was found that symbolic interactionism offers a framework for directing attention toward actions, therefore they will influence the use of the product, and thereby also how a service could change it.

Establishing strong customer relationships is crucial for creating loyalty and re-occurring customers. This could be done by having the customer experience the company and getting inspiration for how the product and services are produced and used. Svensson and Skarman [29] examined the value added by having customers visit the Volvo Construction Equipment (Volvo CE) Demo center in Eskilstuna, Sweden. The paper indicated that resellers perceived the benefits of embarking on trips to outweigh the associated costs. Furthermore, shared experiences between resellers and customers fostered trust and enhanced the relationship, consequently increasing sales. The main objective of customer visits to Sweden is to cultivate strong customer relations, therefore sales growth was a secondary priority, underscoring the importance of establishing a relationship with the customer. The customer also showed signs of being less price-sensitive after having taken the trip and more inclined to spend more based on the recommendation of the salesperson.

The strategy of offering the customer a trip which was analyzed by Svensson and Skarman [29] is a strategy utilizing the lock-in effect. As mentioned by Annarelli et al. [2], the lock-in effect can be used in PSS offerings in various ways. By creating exit barriers around the customers, a consequence is locking out the competitors. Building upon the relations and trust has proven important but contractual barriers are also a tool to keep the customers. Iben and Laryea [12] write that it can be combined with the available technology and services, which add to the value of existing products and make the construction process more efficient. However as expressed by the authors, the options to choose from are many and complex, and Hohenschwert and Geiger [11] highlight that the decisions are influenced by sales personnel and emotions. Therefore there is a need for guidance with regards to adding services to products. Smit and Trigeorgis [27] also highlight the importance of clearly communicated value to utilize differentiation in the product.

A barrier towards adaptation of PSS was identified by Annarelli et al. [2] which includes the acceptance from stakeholders. The authors state that the producers,

the firm, should be able to perceive the added value that comes from PSS whilst the customers should be able to accept the change in consumption. There are also different circumstances that might benefit more from servitization than others, although there is a limited amount of research around this according to the authors. As stated by Reim et al. [22], business models for PSS enable the customer to pay and own different parts of the offering, therefore they have to be comfortable with that change.

Adding value to a product by adding services is done in various areas as stated by the literature, hence the extensive research published about PSS. However, Annerelli et al. [2] have identified a research gap regarding the perceived value of servitization and Schimanski et al. [24] have identified an adaptation gap in the Construction Industry. By exploring the space regarding barriers and value-added customization by adding services to products, would provide valuable data both for companies selling construction equipment and construction companies looking to expand their resources. It would also add to the sustainable processes of the companies since PSS can be used to support those procedures.

### 1.3 Objectives and Thesis Question

The thesis aims to analyze the conditions for introducing services to products. The result is going to be based on the opinions of decision-makers active in different-sized companies in the construction industry. The conclusion will provide recommendations regarding the conditions of combining services and products in the construction industry in order to increase profit for firms providing services and products with regard to the needs of their customers.

Research question: *What affects the possibilities of adding services to a product?*

Conditions include factors and circumstances affecting the choice to add services to products. Decision-makers include subjects with experience and with current or previous power to affect decisions in construction projects. The firm entails companies providing services and products to the customers, which include the subjects of the interviews.

### 1.4 Delimitations

The scope of PSS is wide, therefore this research will focus on the area of construction equipment and the conditions for it to add value. It will not examine the technical aspects of the PSS but rather the value it adds and for who. It will also only have interviews with subjects from Sweden which narrows the scope nationally. It will also focus on a selection of interview candidates within the market, which will show how that sample perceives the problem area.

### 1.5 Outline

The remaining sections of this thesis are structured as follows: Chapter 2 provides the reader with an overview of the research topic and theoretical approach by reviewing

related work and theories. In Chapter 3, the choice of research methods is presented and justified, along with an evaluation of the validity and reliability of the research. Chapter 4 presents the results and analysis derived from the interviews. These findings are discussed in the theories in Chapter 5. Finally, Chapter 6 concludes the research findings by addressing the research question and offering recommendations for further research in the field.



*This section offers a background of the theory behind option valuation, game theory, and oligopoly which relates to the effect of locking in customers. It also presents a comprehensive guide of services offered which includes different systems, applications, software programs, and other technology. Since the aim of these is to provide continuous value, they will be named services in the chapters following this one.*

### 2.1 Option Valuation and Game Theory in the Service Ecosystems

Most markets have some kind of entry barrier, making the market less competitive. Smit and Trigeorgis [27] state that despite market imperfections, the firm can achieve profits that exceed the expected, given the level of risk involved or the returns foregone by investing in an alternative opportunity. The earnings of such excess can only be achieved by having a competitive advantage, such as having lower cost because of the economics of scale or having absolute cost advantage, or by having some advantage in prices, like differentiation in product or being the sole producer in a monopoly market according to the authors. The authors also state that product development and innovation aid firms in differentiating from competitors, and that the new technology is dependent on the customer's need for added value. The authors argue that product differentiation includes a portfolio consisting of compound options including research and development activities which are followed by prototypes tested in new markets. This relates to customization and value creation through added services to differentiate the product portfolio according to Baines et al. [3] and Iben and Laryea [12]. Baines et al. [3] state that adding a service can enhance certain benefits of the use of a product that would not be able through only ownership. PSS gives the user the ability to customize the access benefits through a product and therefore adds to the amount of available offerings according to the authors. Smit and Trigeorgis [27] state that this type of modular design is common in electronics and transportation production. Here a variation between products occurs but is built by standardized modular components. The portfolio of options in this product service system consists of options that allow for a switch between the different offerings on a broad base.

A resource-based view of the firm focuses on creating excess profits by using internal resources and the capabilities that provide a competitive advantage beyond the costs of these resources according to Smit and Trigeorgis [27]. Koskela-Huotari

et al. [14] highlight the use of internal resources by integrating a combination of services into the business model to transform the perception of the company's offerings. This aligns with Smit and Trigeorgis [27] who also states that by isolating internal capabilities, they become harder for external sources to copy.

Smit and Trigeorgis [27] write that the firm has the option to adopt a conditional response rule to shape competitive behavior. With this approach, the firm acts second, following a predetermined rule. By employing threats or promises, the firm can influence the strategy of its competitors according to the authors. An example given is how Philips CD player would only succeed if CDs were produced, and therefore entered into an agreement with Sony to coordinate the product development. Koskela-Huotari et al. [14] state that partnering with other companies can help complement each other's offerings or create conflict which is the base for a service ecosystem where multiple actors integrate.

Smit and Trigeorgis [27] argue that option and games analysis can aid firms in recognizing the correlation between their internal capabilities and external opportunities, enabling them to strategically position themselves in the market. They explain that in options theory, investments should be seen as interconnected stages, where each stage contributes to future opportunities and uncertainties. By identifying mechanisms to secure future growth options, such as patents or unique assets, firms can keep their competitive edge and profit from future opportunities, while also keeping competitors from replicating their offerings.

Smit and Trigeorgis [27] show that an analysis based on game theory, studies how firms make decisions when their actions affect each other's outcomes. Game theory analyzes various scenarios, in the games, where players have different strategies and payoffs depending on the other's actions. The authors also state that a game has four different dimensions, the players, the activities they can perform, the timing of these, and the structure of the payoff which are the results of the activities. What can be categorized in these dimensions might not always be clear at first according to the text, therefore knowledge surrounding these aspects must be created and can often be based on estimations made about competitors, technological options, and costs. Field et al. [13] argue for a services ecosystem where the positioning with regards to interaction, takes not just the traditional ones between employee–customer and organization–customer, but also includes stakeholders such as different platforms, societies, and at the end the planet, into consideration. This opens up the game and adds to the dimensions stated by Smit and Trigeorgis [27].

## 2.2 Oligopoly

Game theory indicates that in oligopolistic markets, there is no price competition and firms may aim to prolong the life of a product, also called product proliferation, and differentiation to gain market shares according to Smit and Trigeorgis [27]. Annarelli et al. [2] suggest that PSS offerings can prolong the lifecycle of a product, which is the meaning of proliferation. Game theory can also be applied to an oligopolistic market to visualize the decisions made by the firm and how they affect the competitors, where the equilibrium is, and competitive tactics according to Smit and Trigeorgis [27]. An example given of oligopolistic competition by the authors is the internet-based book

market where there are a few large companies present. Amazon was first but Barnes and Noble through BN.com entered the market closely after while also sustaining their traditional way of offering books. The e-commerce industry is ever-changing and increased competition can start a war of exhaustion, the companies then have to fight to gain market shares according to the authors.

The oligopoly model provided by Belleflamme and Toulemonde [4], includes both upstream and downstream firms. Either final producers which are usually downstream firms, choose a specific version of the product that they will offer, or the suppliers, which can be both up and downstream firms, specialize in producing a particular input tailored for a specific version of the product. When they produce for a different variety, suppliers face additional costs. The authors show that if more final producers chose to specialize in one version, more suppliers also chose to specialize in specific inputs needed for that variety. The opposite has also been shown to exist. The authors state that by selecting a rare variety, i.e. utilizing product differentiation, the firm can increase their profits, with the cost of having fewer suppliers to choose from which is a form of network effect. This relates to the Smit and Trigeorgis [27] theory regarding products that work better with inputs from other firms.

## 2.3 Contractual and social customer barriers

Having a strong brand comes from having a leading position in the market and thereby differentiating from the competitors. Smit and Trigeorgis [27] state that this can create a portfolio of options that includes strategic investments in marketing which aims to generate opportunities for expansion in the future. The uncertainty is low about the complexity of technology and the commercial viability. It becomes a sort of lock-in effect as customers with imperfect information may choose to stay with a brand that they know satisfies their needs. Within the area of more advanced services such as PSS, the uniqueness of the provided resources, processes, and capabilities of the provider, increases customer dependency and increases both switching times and related costs according to Sjödin et al. [26].

Gao et al. [9] claim getting customers to stay loyal to a company can be done through barriers and locking them in. This includes contracts, complementing services that increase the value of the product, and other actions that increase the switching cost. Another way to lock customers into the company is through a more social construct, by building strong relations and improving the experience of the customer. The authors argue that both strategies have shown to be effective, and when combined they are powerful tools for salespersons when attracting new customers. When a relationship has been established, however, the maintenance of the relationship is more encapsulating than the barriers as stated by the authors.

As with other companies, construction companies strive to find more customers and increase their market share. Li et al. [15] is arguing that this has been done through offering equipment not just through buying, but also leasing and leasing to buy which is a type of PSS. This allows for small and medium enterprises (SMEs), who often have higher constraints, to become customers. The article shows that leasing often comes with added services such as software and maintenance, which

locks the customers to the company in more areas than the product itself. The customer gets more value, and the company gets a loyal customer.

From the customer's perspective, there is a perceived usefulness and perceived ease of use when talking about accepting new technology according to Davis Jr. [8]. Usefulness relates to how useful the subjects perceive it to be based on how it would enhance their performance, and ease of use is how easy it is to use based on the amount of effort it takes to use it. The technology acceptance model (TAM), focuses on explaining these two phenomena. Certain features might point towards one or the other, which in return points towards the subject has attitude to use the technology. The final part of the model is the subject actually using the technology according to the author. The author also states that the perceived ease of use affects the perceived usefulness as it affects the ability to increase performance. Factors affecting these cognitive activities may come from values, social circumstances, and the search for novelty according to the author. Utilizing the theory presented by Gao et al. [9] to reach customers socially, firms can increase the perceived usefulness and perceived ease of use as presented by Davis Jr. [8].

## 2.4 Services Available in the Construction Industry

Dallasega et al. [6] argue that the construction industry depends upon the competence of decision-making figures on site such as project or site managers. Unexpected occurrences during the project are common, therefore the planning done before must be modified to function as a supporting tool instead of something definite. This can in turn cause delays which affects the budget and can compromise the quality because of time constraints. When multiple companies or departments are working on the same site, coordination between the work processes and services is important. Therefore, the different parties need a shared understanding of the structure of work processes to optimize planning and execution according to the authors. A way to enable the integration of systems is through Application Programming Interfaces (APIs) according to Obinnaya Chikezie and Victor Nwosu [20]. The authors state that APIs serve as connectors between various software systems, offering the potential to integrate with specialized construction tools. This integration can eliminate data silos, manual data entry, and issues related to real-time information sharing.

With regards to services to add to a product and a project, it is beneficial to get an overview of available technology in the construction equipment industry, the following sections present examples of services used which collectively are called a service in the rest of the thesis. In 2014, Ibem and Laryea [12] presented a collection of different digital technologies that added value to the procurement process of construction equipment. The authors identified technologies available for use for procurement activities such as planning and determination of what is to be purchased, development of the procurement approach, requesting proposals from potential suppliers, evaluation of the proposals, contract assignment, and management of contracts ensuring compliance with the requirements.

These services are presented next to similar research in the following sections to give a comprehensive view of services providing different values.

### 2.4.1 Planning of the Project, Procurement and Approach

While determining what is supposed to be procured, Ibem and Laryea [12] proposed using software enabling clients to select appointments with a consultant specializing in the required area. Whilst mentioning Computer-Aided Design (CAD), Building Information Modeling (BIM) technology was also something to consider since it is a more advanced version that can be used for visualization, synchronization, examination, and integration within the supply chain according to the authors. Schimanski et al. [24] also argue for using BIM in the planning phase of the project. By modeling and visualizing the project, planners have another source of knowledge when making decisions, because of the visualization consequences of certain choices according to the article. The authors proposed a calculating BIM, providing times of delivery which will provide necessary data for the logistic departments of the site. Regona et al. [21] argue that artificial intelligence (AI) can be combined with BIM to mitigate the potential for unexpected expenses and delays. Furthermore, the authors argue that leveraging machine learning which uses statistical methods and predictive modeling along with human cognition, can enhance the accuracy of time and cost predictions. AI can also be used to generate designs and strategies because of the ability to handle larger amounts of data, which CAD is not able to according to the authors.

Ibem and Laryea [12] show that virtual reality technology (VR) can be used as an interactive and real-time 3D update during the initial phases of the project for client presentations. It can also be used to facilitate collaboration among stakeholders during the planning stages according to the research. Additionally, Regona et al. [21] highlight the power of AI to create information about the project which is easy to understand by all parties involved. AI can also be combined with VR to analyze the design accuracy based on the constraints of space and accessibility, which in return enables the assigning of resources based on what and who is available. Nassereddine et al. [18] propose augmented reality (AR) as a visualization tool that can be included in services related to the pre-construction phase of the project. It is argued by the authors, that AR can add value in the planning process through space validation and site logistics. It can also add value through the design process by visualizing the project and having a virtual walk-through in the office instead of having everyone go to the site. The authors also show added value by including the possibility of virtual overlays on 2D models and also showing the effect of design changes.

For the activities related to the development of the procurement approach, Ibem and Laryea [12] propose an Enterprise Resource Planning (ERP) tool that is based on the web enabling integration between departments and managing the supply chain.

Regona et al. [21] suggest using AI for parts of the planning process such as analysis of costs, different scenarios, and risks. By doing this it can also create automated schedules for the projects taking all aspects into account, for example, personnel and equipment. Therefore AI can be useful in the procurement process as it is also able to extract the needed information from complex sources and sort it based on patterns that can be used in the analysis according to the authors. The ability to do forecasts is one of the more powerful aspects of AI which makes it suitable for the planning phase according to the authors. This reduces the risk of delays and cost overruns.

A summary of the services presented in this section can be found in Table 2.1. The table also presents the value added by using the service at this stage in the construction project.

Table 2.1: Summary of services focusing on planning and procurement [12,18,21,24].

| Service | Value                                   |
|---------|---|
| CAD     | Visualization and modelling             |
| BIM     | Visualization and modelling             |
| AI      | Prediction and generation of strategies |
| VR      | Intractable visualization               |
| AR      | Intractable visualization               |
| ERP     | Communication and visualization         |

## 2.4.2 Procurement Contracts and Project Performance

Procurement contracts and project performance are often combined because contract often comes with performance requirements according to Ibem and Laryea [12]. The services and technologies discussed with regard to procurement contracts and the project performance are presented in Table 2.2 below. When requesting proposals from potential suppliers, Ibem and Laryea [12] present the following technologies which aim to facilitate communication between the different parties. Web-based project portals, Web 2.0 technology, and catalogs online enable organizations to provide information about their products and services, facilitate transactions, and exchange information among project parties. Cloud computing technology allows users to access computing resources and IT services, which includes specialized software for e-tendering, which is offered on a rental basis as Software-as-a-Service (SaaS), relieving the users from managing network resources. Finally, a combination of audio, visual, and textual data can be used for recording bid instructions.

When evaluating the contracts, Ibem and Laryea [12] write that video conferences can be used to clarify any uncertainties between the parties and cloud computing can be used for e-tendering by leveraging custom-built Internet-based software solutions delivered as SaaS. The award of contracts is proposed to be done through multimedia technology or wireless technology to enable communication of information related to contract awards. Regona et al. [21] however state that AI can be used to manage contracts, which takes away the risk of errors made by humans and expedites the process.

According to Ibem and Laryea [12] the management of contracts and ensuring compliance with requirements, involves various components and it is often linked to the performance of the project. Therefore different technologies are presented as the following. 3D scanners or laser distance, and ranging (LADAR) collaborate with photogrammetry to monitor the changes in work quantities at construction sites. Radio Frequency Identification (RFID) technology uses radio frequency waves for collecting data and is utilized to identify, monitor, and trace different documents and materials throughout the supply chain.

Regona et al. [21] suggest the flow in the supply chain can be optimized by overseeing product quality and site safety by including both AI and the Internet of

Things (IoT). The authors also state that AI can identify potential issues and ensure streamlined delivery by overseeing the entire supply chain.

Monitoring the progress is a part of having the contract complying the requirements according to Ibem and Laryea [12]. The authors suggest the following methods to increase that possibility, starting with cameras displaying the project to different members of the team can be used for monitoring the progress. Bar code technology is an automated data-collecting technology and can be used to get cost schedule information, and enhance the data entry process. Another way of communicating and collecting data is through sensors, which the authors state can be used for data on the physical and environmental conditions of construction sites. BIM and Electronic Data Interchange (EDI) are used during this phase to provide a link to different parties in the project according to the authors. Nassereddine et al. [18] propose services with AR to facilitate updates of the project instead of more traditional means. The authors state that AR can include a visualization of the system on the construction site, augmented drawings in the field, show the progress and monitoring, planning and position of construction equipment, and simulate the excavation area. This adds different amounts of value with the system visualization ranked the highest by the authors. They also argue that factors affecting the project which usually remain hidden such as underground facilities can be shown through AR. Ibem and Laryea [12] suggest facilitating updates of the project between active parties, multimedia technology, and online conferences. Sherafat et al. [25] argue for the value of having the updates easily accessed by construction managers, the example given is through an app on the phone.

Ibem and Laryea [12] states that technology related to information about locations is available according to the authors, through Internet-Based Geographic Information System (GIS) which manages data such as the location of suppliers and construction sites and enables a comparison between the suppliers. Another way of doing this shown by the authors is the Geographic Positioning System (GPS) which is satellite-based and can be used for material handling at construction sites for tasks like loading and unloading.

Sherafat et al. [25] mention sustainability as emissions also can be tracked and thereby improve the work environment and decrease pollution. The authors propose a hybrid use of kinematic and audio data which is more effective than using the data types separately. They also mention the use of visual data as a source of information. Construction sites are often equipped with multiple generations of machines and therefore there is a challenge in data collection based on the ability to collect it, both in the capability of the machines, the number of machines affecting each other, and environmental factors affecting the machines. Regona et al. [21] suggest monitoring the site using the sensors placed around the site. The data streams retain knowledge about activities, information about raw materials, and earthworks. The authors state that this will reduce emissions and increase efficiency.

A summary of the services presented in this section can be found in Table 2.2. The table also presents the value added by using the service at this stage in the construction project.

Table 2.2: Summary of services focusing on contracts and project performance [12, 18, 21, 25].

| Service                            | Value                                       |
|------------------------------------|---|
| Web based platforms and catalogs   | Communication                               |
| Cloud computing technology         | Accessibility                               |
| SaaS                               | Logistics                                   |
| Data                               | Documentation                               |
| (audio, visual, text based)        |   |
| Online communication               | Visual communication                        |
| (video and text based)             |   |
| AI                                 | Logistics and prediction                    |
| 3D scans and LADAR                 | Documentation, monitoring and visualization |
|                                    |   |
| RFID                               | Documentation and logistics                 |
| IoT                                | Logistics                                   |
| Camera surveillance                | Documentation, monitoring and communication |
|                                    |   |
| Bar codes                          | Documentation and logistics                 |
| Sensors                            | Documentation and logistics                 |
| BIM                                | Communication, visualization and modelling  |
|                                    |   |
| EDI                                | Communication, visualization and modelling  |
|                                    |   |
| AR                                 | Intractable visualization                   |
| Application                        | Accessibility and logistics                 |
| GIS                                | Location                                    |
| GPS                                | Location and logistics                      |
| Emission tracking                  | Sustainability                              |
| Sensors                            | Documentation                               |
| (kinematic, audio and visual data) |   |

### 2.4.3 Maintenance Services and Technology

Sherafat et al. [25] highlight technology used for performance monitoring, which can enhance time spent on value-driving performance and therefore reduce downtime. Analyzing construction sites through real-time data can help managers see the performance and the cycle time of each moving part. More specifically, maintenance assessments can be done faster through monitoring of productivity according to the article.

Zasadzień et al. [32] investigated three services within the maintenance area provided by Hitachi, Volvo, and Komatsu. The technologies within the services were divided into the following activities. Communication with the machine is done by using Global System for Mobile Communication (GSM), WI-FI, satellite, radio, and SMS. The information is then communicated to the user or service team through email, system logs, or phone. The type of transmitted data includes fuel tracking, location of the machine, routes, speed, distance, fuel loss protection, error codes, work

times, and work parameters related to the engine, hydraulic assembly, wheels, and steering system. The authors also stated that some of the services include systems analyzing the data for forecasting and prevention purposes. The customer has access to the data collected as well through some of the services. The information based on the collected data is available for the service teams through messages on mobile devices, pop-up alarms within the system, or reported by the customers themselves. All of the firms offer services free of charge as a part of their maintenance offering according to the authors. Nassereddine et al. [18] state that during the COVID-19 pandemic, AR technology enable remote maintenance to construction sites and real-time support is something that was further investigated after that time. The AR services can locate systems that need repair without demolition or extensive investigations and are also able to train technicians according to the authors. The maintenance information could then be made available through AR.

A summary of the services presented in this section can be found in Table 2.3. The table also presents the value added by using the service at the maintenance stage of the construction project. Communicating the faults of the machine was the most common value provided while service agreements and AR are directly linked to the repair.

Table 2.3: Summary of services focusing on maintenance [18, 25, 32].

| Service                | Value                                    |
|------------------------|--|
| Performance monitoring | Monitoring                               |
| Real-time data         | Monitoring                               |
| GSM                    | Communication                            |
| WI-FI                  | Communication                            |
| Satellite              | Communication                            |
| Radio                  | Communication                            |
| SMS, e-mail, phone     | Communication                            |
| System logs            | Communication                            |
| Data transmission      | Communication                            |
| Forecasting system     | Prediction and prevention                |
| Service agreements     | Maintenance                              |
| AR                     | Remote maintenance and real-time support |

## 2.5 Summary of Related Works

Market imperfections can generate profit if the competitive advantage is utilized according to Smit and Trigeorgis [27]. The authors continue explaining that competitive advantage could range from having lower costs as a result of the economics of scale, or the firm could have absolute cost advantage from product differentiation or having a monopoly. The product differentiation and portfolio of products suggested by Smit and Trigeorgis [27] relates to the customization of products through services as proposed by Baines et al. [3] and Ibem and Laryea [12]. Baines et al. [3] state that certain values in a product can only be accessed by adding services and Smit and Trigeorgis [27] means that this type of customization with a core component that

customized is common in electronics and transportation production, which makes this applicable to the construction industry.

Using internal resources and services to transform the business model and the perception of the company's offerings as stated by Koskela-Huotari et al. [14] relates to the theory presented about the resourced-based firm presented by Smit and Trigeorgis [27]. This can, as mentioned by the authors, make the competitive advantage harder to copy by competitors. The behaviour of competitors can also be shaped according to the authors. There is the option to influence the decisions made by other firms by making promises or threats that affect their businesses. Sometimes other firms' products are vital to make a profit from a new product according to the authors.

According to Smit and Trigeorgis [27], game theory describes a strive for oligopoly beneficial for product proliferation. Annarelli et al. [2] state PSS offerings as a means of product proliferation which is more sustainable than the alternative.

Brand loyalty can come from having a strong position in the market, and creating a portfolio of options that satisfy the needs of customers making them choose the firm when uncertain according to Smit and Trigeorgis [27]. In more complex systems such as PSS, Sjödin et al. [26], the switching costs are higher which acts as a lock-in effect because of the uniqueness in resources, process, and other internal factors that makes the customer more dependent and is hard for competitors to copy. Gao et al. [9] suggest that customers can be locked in through barriers created through a business decision or a more social construct based on relations, the strategies are the most powerful when combined. Li et al. [15] suggest reaching SMEs through leasing, who otherwise usually face barriers of entry, creating a dependency through contracts at first, but an opportunity to build relations later.

Decision makers in the construction industry such as different types of managers are vital since they are placed on site where a lot of unexpected events occur according to Dallasega et al. [6]. The authors also state that because of the amount of different actors on site, coordination regarding processes and services is important. An extensive analysis of services available has been presented with the technology behind them based on the research of Ibem and Laryea [12], Schimanski et al. [24], Regona et al. [21], Nassereddine et al. [18], Sherafat et al. [25] and Zasadzień et al. [32]. The values provided by each service can be found in Tables 2.1, 2.2, and 2.3, where to most common values found were communication, visualization, monitoring, and documentation.

*This section presents the methods selected for data collection and analysis and rationale behind the decisions. The research design aims to provide a description behind the strategy chosen. The decisions made and the steps followed during the data collection are thoroughly described, likewise is the analysis process.*

### 3.1 Method Selection

This thesis aims to uncover the circumstances surrounding the value of adding a service to a product in the construction industry. The results will be based on the opinions and experiences of decision-makers in different-sized construction firms, ranging from private contractors to large firms with over 1000 employees, details about the candidates can be seen in Table 3.1. The sizes cover all sizes of companies in Sweden and have been categorized suitable to the study. The aim of the study is not to test any hypothesis or use quantitative data to measure effects, but rather to explore the experiences of the subjects within the given area of PSS and construction equipment. This will include the general aspects of PSS but put it in the context of the construction industry which remains an important topic within the industry as stated by Annarelli et al. [2]. The authors also highlight the sustainability factor of PSS in the construction industry which is an important factor to consider when developing products. Reim et al. [23] also highlighted opportunities for increased sustainability through PSS in the construction industry as stated in the background chapter, making this an interesting case to study.

Adeoye-Olatunde and Olenik [1] highlight the usage of semi-structured interviews to determine the usage and performance of services, and how this can be improved based on the customer's perspective. Semi-structured interviews are thereby a suitable method for collecting data for this study. According to Kallio et al. [10] semi-structured interviews also are considered trustworthy as a result of letting the subject speak freely.

In a study assessing how deep learning is currently used in construction management, with the perspective of deep learning as a digital technology, a thematic analysis was used by Elghaish et al. [7]. This is similar to the objective of this thesis as the use and benefit are to be determined. Ibem and Laryea [12] did a survey collecting articles in a set time frame, analyzing through content, and then categorizing based on usage which is similar to categorizing by theme. They, however, only included articles in their data and since this study combines articles and data from interviews to examine the value around usage, it requires further analysis than just

categorizing based on usage. The value investigated will relate to the barriers to implementing digital technology and services in the construction industry. Johansson and Svensson [28] used thematic analysis in combination with semi-structured interviews, to identify barriers to change in organizational cultures, fostering an understanding of how bio-inspired methods can contribute to a sustainable shift. This relates to this study because of the use of themes found through interviews, to find an understanding regarding usage based on the experiences of relevant parties which is what this study aims to do.

### 3.1.1 Trustworthiness and Transparency

To determine the usage of services and how they perform, Adeoye-Olatunde and Olenik [1] proposed the usage of semi-structured interviews to investigate how this can be improved based on the customer's perspective. This qualitative method ensures the ability for topics coming up during the interview to be discussed as well, giving more well-rounded results according to the authors. Kallio et al. [10] state that this method increases the trustworthiness which Olatunde and Olenik [1] also state but they also highlight that this also depends upon the candidate's knowledge of the subject. Therefore it is important to ensure that the candidates have a good knowledge and experience with what is to be discussed to ensure the trustworthiness of the results.

With regards to ethics, the study will follow the guide of Vetenskapsrådet [31]. To protect the subjects, four ethical requirements will be followed. Those are information, consent, confidentiality, and use. The subject will be presented with an information specification, providing the information regarding their part in the interview and what conditions are linked to the participation. The subjects are volunteers and can cancel the interview if they wish to. They are thereby asked to consent to participate in the interview. The interviewees' confidentiality will be protected by making them unrecognizable by others. The recording of the interview be kept securely and in the report, the aim is to make them hard to identify by other than the author. The use of the interview will only be for the study and thereby the study fulfills all four ethical requirements.

## 3.2 Research Design

With regards to the design of the research, it will focus on comparing the collected data from the interviews with the previous research within the area. The interview subjects will be chosen based on them having current occupations within the area. The subjects may have different backgrounds and that will add value and perspective to the study. Adeoye-Olatunde and Olenik [1] highlighted the importance of customer perspective on the usage and performance of services and therefore versatile perspective will add more value. Therefore it is preferable if the subjects also hold different roles.

Hohenschwert and Geiger [11] suggest that the salesperson holds a certain influence over the customer, something that is supported by Annarelli et al. [2] and Svensson and Skarman [29]. This suggests that an area of the perceived value of

service is influenced by the salesperson if the subjects were to choose the same dealer when procuring equipment. Investigating the weight of an added service when buying a new machine is therefore of interest.

As the construction industry is a developing market with the emergence of services available according to Schimanski et al. [24], it is interesting to investigate what is used and what services are wanted and needed by the customers. To give a proper overview, the project planning, performance monitoring, and maintenance will be taken into consideration when asking about use and needs. Feedback about used services will also be investigated to analyze what the customers value in a service.

The aim is to compare the findings with the theory to aid construction equipment firms in meeting the needs of their customer whilst basing their strategy upon research. Therefore the study will present a recommendation in the conclusion on how to add value by adding services to products with regard to barriers and market strategy.

## **3.3 Data Collection**

### **3.3.1 Sample Collection**

The subjects for the interviews are decision-makers at different levels in the construction industry in Sweden. Because of the different sizes of firms operating in the selected market, a range between private contractors, and small, medium, and large enterprises has been created. The firms considered as private contractors are those who employ 1-9 people. Small businesses typically encompass those with employee numbers ranging from 10 to 99. The firms considered as medium enterprises have between 100-999 employees and the large enterprises are the ones with 1000 or more employees.

All the interviewees have the power to affect the decision of procurement of construction equipment and services. Thereby they can provide insights on the possible added value provided by adding a service to a product from the customer's and sometimes the user's perspective. The users of the services range from operators using services directly correlated with the machine, to managers planning and monitoring the process. To find suitable subjects some were provided through the project within the Sugar Network and some were found by looking at firms within the size range. The number of interviewees was set to 8, including 2 from each category, thereby validating or diversifying the opinions with more perspectives and experiences.

### **3.3.2 Interviews**

The method chosen for the research is semi-structured interviews which as stated by Kallio et al. [10], aims to create a deeper understanding of the subject's answers. Adeoye-Olatunde and Olenik [1] also state that semi-structured interviews are suitable for analyzing more intricate social-behavioral questions. According to both Kallio et al. [10] and Adeoye-Olatunde and Olenik [1], semi-structured interviews consist of main questions which are directly aimed at examining the theme at hand. The interviewees will then be able to speak freely about their experiences

using questions moving from icebreakers to more in-depth questions according to the method. Depending on the flow of the interview and the subject's familiarity with the theme of the study, the articles [1,10] states that follow-up questions can be used to get a better discussion and more optimized answer whilst still having the subject speaking about their experiences. Kallio et al. [10] suggest that some of the follow-up questions can be pre-determined and some can be asked depending on the answers given. To ensure that the subjects are fully able to express themselves the interviews will be conducted in Swedish as it is the native language. Tsang [30] states that this will enable a shared understanding between the interviewer and the subject and minimize misunderstandings.

Kallio et al. [10] provided a guide for executing a semi-structured interview with the following five steps.

1. Establishing the necessary conditions for using semi-structured interviews
2. Retaining and use previous research within the area
3. Establishing the preliminary guide
4. Testing the guide
5. Presenting the complete guide

Adeoye-Olatunde and Olenik [1] presents a similar guide and also include a step for steps around participant recruitment. The authors also included steps for how the interviews are going to be conducted and analyzed. Since most of the interviewees were sampled through the parallel project, there was no need for such a step. About the analysis, a method has been chosen and argued for under 3.4. Therefore the guide presented by Kallio et al. [10] has been chosen for this study.

### 3.3.3 Interview Execution

Before the interviews, the author will introduce themselves and the purpose of the interview. They will also provide a short background of the scope of the thesis and clarify the term service and product service system. They will also make sure the terms of participation are clear and the right to stop at any given time. The subject will also be assured that the material is only used for this research purpose. The subject may also decide if they are willing to be recorded and if direct quotes can be used. All material is anonymously presented in the study and of this, the subject is going to be informed, no name, title, or company shall be mentioned in the study.

The first step of the guide provided by Kallio et al. [10], is establishing the necessity of a semi-structured interview which has been done in this chapter. The next step is to retain previous research which is presented under chapter 2 *Related Work*. The next step is to design the preliminary guide using this knowledge which is done through the following questions. A comprehensive interview guide can be found in the appendix.

- Can you introduce yourself and tell me about your role?

Follow-up questions: How long have you had this role? Have you worked in other roles within the construction industry before your current role?

This question aims to give context regarding the person and their experience in construction. The answer reveals their knowledge about and interest in the area. As stated by Lewrick et al. [16], starting with general questions allows for breaking the ice and creating a background of the candidate.

- How do you purchase your machines? Who are you buying them from?

Follow-up question if they purchase the machine directly from the company or a dealer: Have you bought several machines in this way? Do you contact the same person or is it different each time?

Follow-up questions if they purchase the machine from a secondary source: Have you bought several machines in this way? Why do you choose a second-hand machine over a brand-new one?

This question aims to examine the purchasing process to find out the amount of personal contact involved and by whom. By finding out who, learning regarding who influences the sale is found. It is also important to determine their value of having a relation to the salesperson since the theory provided by Gao et al. [9] has highlighted that as an important factor. There is a second-hand market for machines and therefore this has to be explored as well.

- How would you describe services within the machine industry?

This question aims to investigate the subject's view and definition of services. This will open up the discussion around services in the construction industry and create a shared meaning of the word. As stated by Field et al. [13], services stretch far beyond the exchange between company and customer and therefore, it is interesting to see how the candidates would describe it.

- When you bought your last machine, did you choose to add any services?

Follow-up questions: What weight does an added service carry in your decision when procuring the equipment? Are the services provided by the company behind the machine or a third party?

These questions aim to investigate the combined sale of products and services from the customer's perspective. The first question is directly related to the purchase of the machine, if they did not buy an additional service it is interesting to know if they knew that it was a possibility or not. If they did buy an additional service with the machine, it is interesting to know why they made that decision and how the offered service affected their decision. Thereby investigating the perceived need as mentioned by Schimanski et al. [24]. The second follow-up investigates how the services are purchased. It also will provide insight into whether the service is directly correlated to the machine or if it can be applied to any machine.

- Do you use any services to plan your projects or monitor the execution? If so, which or what type and who provided it?

Follow-up questions: How has this service supported you in your projects? Can you give some examples of how you are using it?

These questions aim to provide an understanding of planning technology and services. The main question is aimed at getting the interviewee to talk about the services they use for planning and getting examples. The service might not be provided by the dealer and therefore it is important to ask who the provider is. The follow-up question is asked to get the interviewee to reflect upon the usage and value provided to the project. There are many services available for planning and monitoring the project as mentioned by the literature [12, 18, 21, 24, 25], therefore it is of interest to analyze the practical usage.

- Do you use any services related to the maintenance of the machine? If so, which or what type and who provided it?

Follow-up questions: How has this service supported you in your projects? Can you give some examples of how you are using it?

These questions aim to provide an understanding of maintenance technology and services. The main question is aimed at getting the interviewee to talk about the services they use for maintenance and getting examples to enable comparing them to the ones mentioned by the literature [18, 25, 32]. The service might not be provided by the dealer and therefore it is important to ask who the provider is. The follow-up question is asked to get the interviewee to reflect upon the usage and value provided to the project.

- What is the feedback on the usage of services and from whom?

Follow-up questions: Which services are used the most and are seen as adding value? In what way are these services adding value to a project?

These questions aim to figure out what the feedback of the usage of services looks like and how they feel that it has added value, thereby analyzing if they can experience the added value which is the meaning of adding a service to a product as stated by Baines et al. [3]. By having actual examples of value-adding activities, knowledge regarding applications is gained and can be compared to the theory. It is also interesting to analyze what they consider to be value-adding services and in what way.

- Are there any services that you would like to have and how would they add value?

Since Baines et al. [3] highlight the increased usage of a product by adding a service, and Smit and Trigeorgis [27] state a diverse product portfolio is profitable, it is necessary to uncover what the users of the PSS think they want. Lewrick et al. [16] also support asking the subjects about what they wish for as concluding remarks.

- Is there anything you want to add or clarify? And is it possible to reach out again if any questions arise?

By having them reflect upon their answers new findings may arise or clarifications may be added if they feel like they did not get their point across. By asking if it is possible to contact the subject again, any questions from the analysis can be answered which makes sure that the answers are interpreted correctly.

In Table 3.1 the interview subjects are presented. The criteria set for the subjects were that they had to be active or have been active in the construction industry and could or were able to affect decisions related to machines and services. The subjects were given a thorough introduction to the study and requirements before agreeing to participate, therefore the suitability was able to be assessed before the interview. The size of the companies was categorized based on the distribution of companies in Sweden. As there were several different sizes, these categories were chosen to include a representative selection. Candidate A, D, and H have their firm or own part of it. They all worked in construction before becoming business owners. Candidate H is not an operator anymore but has recent experience working on projects with machines as they now work as a carpenter. Candidates B and C both have prior experience in the construction industry before stepping in as managers. Candidates B and C work at the same company but in different departments and with different tasks. Candidate B works on-site but is not involved in the procurement process. Candidate C focuses on the procurement process for a certain region in Sweden which is the same as the one Candidate B operates. Candidate E had no prior knowledge of construction before stepping in as site manager. This person was hired to digitize the firm and had prior experience in management roles and IT. Candidates E and F work at the same small business but in separate departments. The department that Candidate E works at, has its operators but rents or leases their machines, whilst the department that Candidate F works at, has its operators and owns their machines. Candidate G works in a medium-scale firm and has prior experience in a construction firm. Candidate G has been in the construction industry for over 30 years.

Table 3.1: The candidates for the interview presented with their role and the company size.

| Candidate | Role                               | Company size       | Number of employees |
|-----------|------------------------------------|--------------------|---------------------|
| A         | Owner/Operator                     | Private contractor | <10                 |
| B         | Block Manager                      | Large              | >1000               |
| C         | Purchasing Manager                 | Large              | >1000               |
| D         | Owner/Operator                     | Private contractor | <10                 |
| E         | Site Manager                       | Small              | 10-100              |
| F         | Site Manager                       | Small              | 10-100              |
| G         | Site Manager                       | Medium             | 100-1000            |
| H         | Owner/Previous operator/ Carpenter | Private contractor | <10                 |

### 3.4 Analysis

After conducting the interviews, a thematic analysis of the data will be conducted. This approach offers flexibility, making it ideal for examining diverse perspectives

within interview results. Nowell et al. [19] claim this method aims to extract key features, illuminate distinctions, and ultimately create a clear and concise report. They however also state that the disadvantage of using this type of analysis is that flexibility can result in incoherent empirical claims which is something to consider. A downside is also expressed by Naeem et al. [17], which points to the confusion around the final presentation of the result.

Nowell et al. [19] argue that six steps are to be followed when conducting a thematic analysis and this is also supported by Naeem et al. [17]. The first step is to become acquainted with the data according to Nowell et al. [19] whilst Naeem et al. [17] also highlights the importance of selecting important quotations as this stage to find important sections and initially perceived themes. Nowell et al. [19] argue that the second step is to create preliminary codes which allow for finding specific characteristics and highlighting important sections. This is similar to the second step in the process presented by Naeem et al. [17], as they focus on reoccurring patterns and keywords in the material, however, they start the coding process in step three. Nowell et al. [19] third step is to search for the themes in the answers which is how Naeem et al. [17] describes their coding step, focusing on identifying themes related to the research question. The themes make the answers more important as they point to something that would not have been visible while looking at the data separately. The fourth step according to Nowell et al. [19], is to review and refine the themes, which aims to create more trustworthiness. This entails ensuring that each theme reflects its intended meaning based on the gathered data. Naeem et al. [17] also argue for theme creation at this stage, to link the collected data to the research question by analyzing the codes and categories created in the previous steps. The fifth step is to name and define the themes, capturing their unique and interesting aspects according to Nowell et al. [19] and Naeem et al. [17], the later authors also express the need to conceptualize the findings at this stage. Nowell et al. [19] presents the sixth and final step as the creation of the report while Naeem et al. [17] finishes off with a conceptual model guided by previous studies, which is similar to a report. The thematic analysis will help answer the research questions according to both articles [17,19] by examining the answers to find patterns and present insights from the collected data.

*This section will present the findings from the interviews sectioned by the themes found through analyzing the material. Certain quotations will be used to support the stated findings. It will start off with defining the term, moving on to barriers and relations, and then to use and adaptation, ending with feedback and wants for the future. The structure is made with the discussion in mind.*

### 4.1 Perceived Meaning of Service

When setting up the interview a question regarding what a service is was raised by all subjects, showing that it is not an established term within the construction industry in Sweden. All interview subjects claim to use services in their projects to a certain extent. However, what a service should be defined as, differs among the subjects although receiving the same explanation beforehand. The ones with background knowledge could see it as something that can add value and relate it more directly to the performance of the machine or project. Candidate E was brought on to digitize the firm and had a more broad perspective on the matter as can be seen in the quote below. The discussion regarding purchasing through a phone call was mentioned both by candidates E and G when explaining the meaning of service, highlighting the accessibility that is perceived by them as customers.

Candidate E: *"It should always work because time is money, flexibility is a word that comes to mind since it can be used in machines, projects, or by the firm as a whole. Also short lead times and fast delivery, often you can just call and then start using them the next day."*

Some of the interviewees named the topic as broad and used examples to define what they meant by services. The surveillance of the fuel consumption was brought up as an example by two of the subjects and maintenance services were mentioned three times when asked about defining the term service. These quotes and examples were given by some of the subjects before being asked about specific usage of services, the others gave similar answers showing that the subjects knew about services in the industry.

Candidate C: *"Give me as much digital information as possible about fuel and other things, you can flag for service, have theft marking on the machines, and GPS tracking so you can track them during projects. Warning codes on machines are another example."*

Candidate D: *"There are services that companies like Volvo offer with new machine purchases from them, but since we buy second-hand machines and not straight*

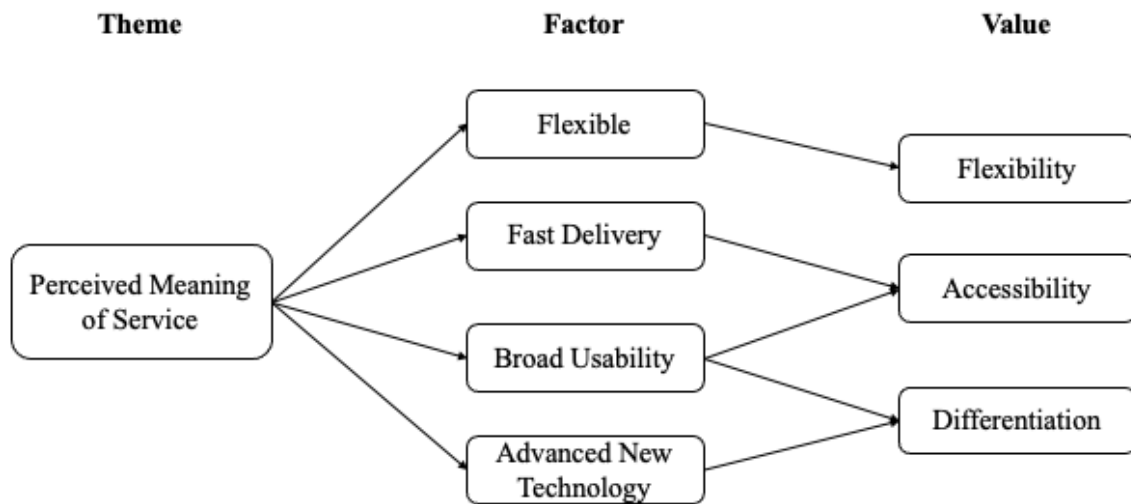


Figure 4.1: Summary of factors mentioned within the theme of perceived meaning of services pointing towards values wanted by the candidates.

*from the dealer, it is usually not included. I have seen programs in machines that measure digging depth, and I have also seen AR and VR simulations online, which seem cool. In any case, it is a broad topic."*

The recent development of the construction industry was mentioned by a sample of the candidates (A, C, G, and H). They referred both to the number of projects and the capacity of the machines. Candidate H mentioned not being aware of services just a few years ago but knew they could see the value it could add.

Candidate H: *"Incredibly broad, just a few years ago I would not have had any idea at all, but now there are programs and systems that can facilitate projects in several ways."*

In Figure 4.1, a summary of the factors discussed by the candidates is shown, also showing what type of value they need based on their answers. According to the candidates, flexibility, accessibility, and differentiation are values they expect from a service.

## 4.2 Barriers and Relations

In this section, the theme Barriers and Relations will be explored, the results are summarized in Table 4.2 further below, because of the extensive findings within this area it has been placed there. Candidates A, D, and H raised the topic of services coming with purchases of the machines and it is a connection to the dealer and company producing the machine in the previous section. Therefore it shows that there is a perceived barrier around the use of services related to the machine and, therefore the accessibility. Some candidates, however, preferred it coming with the machine and saw it as a benefit. There is an additional benefit if a secondhand machine comes with a service, as it may convince the customer to choose that machine over another without that service, as stated by Candidate H. Another perspective on this was raised when being asked about the procurement process. Candidates A,

D, and H raised the question about new machinery being expensive which can be a barrier for small businesses and private contractors.

Candidate D: *"I choose a second-hand machine because of the purchase price. New machines in those sizes are too expensive for a company our size, even though there are services that could be useful for us. Right now, we have to rely on our expertise instead of programs that for example show digging depth."*

Candidate A, however, being in the industry longer, had an example of a time when second-hand was the better choice based both on price and lead time showing that new machines are not always the better choice.

Candidate A: *"Our latest acquisition was an interesting story. We received a request to participate in a large project but lacked a machine that met the requirements for emission class and GPS. We looked at new ones through the dealer, but the waiting list was 14 months long. A used machine became available for sale and was purchased."*

When asked about the importance of service when purchasing a machine the answers differed from focusing on sustainability to relations with the dealer. Demands regarding the environment created the demand for the machine in that situation and it is becoming more common for projects to have these types of demands. Type of fuel is a question that is being raised in the industry and Candidate C mentioned HVO (Hydro-treated Vegetable Oil) and electric as fuel types being requested. Fuel types are out of the scope of this thesis but as part of the quote and the raised question around services related to environment, it is important to address the issue.

Candidate A: *"What's important in the purchase is the emission class, ease of use, GPS assistance for collaboration, and fuel efficiency. I prefer a versatile machine over the perfect one."*

Candidate E: *"The machine's environmental class is important, as well as the type of fuel it uses. The client might demand that machines use HVO or electricity. If you have a Volvo machine that costs 2 million, you might not want to use HVO and prefer diesel, which means the machine cannot be used in that particular project."*

Private contractors often rely on relations with companies when taking part in larger projects. The companies that did not own their machines, heavily relied on the ability to hire private contractors. This is also part of a service offering between construction companies, so-called business-to-business, highlighting the importance of relations within the industry. Candidate H also stated the importance of local relations, especially in a smaller town.

Candidate A: *"A large part of our business relies on providing services to larger companies with local projects that require assistance."*

Candidate E: *"We usually lease machines locally, often from the same reliable sources with whom we have a good relationship. We often have breakfast together and build upon that relationship."*

Candidate H: *"In a small town like this, relationships are incredibly important, and it's also important to stand out as it can create a reputation."*

The emphasis on good relations between firms leasing machines or hiring smaller firms to work for them, and the smaller firms, was raised by Candidate G. This candidate went as far as stating that the person operating the machine is more important than the machine itself. This shows that they value their internal capabilities highly and see it as a core of their business.

Candidate G: *"The relationship with the person behind the wheel is the most important, not the class of the machine."*

Larger firms have an account at the dealer and often contact the same key account manager or the same small business in the area for the project because of relations and loyalty. Being satisfied with the brand was a factor considered by both private contractors and companies of different sizes. Candidate A specified only using Volvo machines and Candidate H admitted to also prefer the Swedish brand, while Candidate C declared that as something general that could occur after establishing a connection and providing good machines and services.

Candidate F also expressed relations playing a role in the procurement of machines and services, having a good experience with the brand was a need from the candidate. Candidate F also added that their procurement is decided by a larger group and that the machine operator also takes part in buying the machine. This process is designed to get opinions on what is going to be purchased, build relations, and have the operator know the capability of the machine.

Candidate F: *"The person who will be using it should be involved so they understand what tasks are expected to be performed by the machine and the specifications regarding the machine's capabilities, which includes the services that come with the machine."*

The term differentiation was mentioned by a sample of the candidates (C, D, F, and H) and pointed to as important when choosing a dealer. However, all candidates spoke about versatility as a significant factor when choosing a machine. Although Candidate D pointed to quality being the most important factor, differentiation of the machine and service was a part of that. Candidate C mentions service offers next to the machine being more important before whilst now everyone has similar offerings. Differentiation is now really important because of that as expressed in the quote below.

Candidate C: *"In the beginning, extra offerings beyond the machine were crucial. Now that everyone has similar services, it's less important. That is why differentiation is key; being first makes the service more attractive, and likewise, the machines."*

In Figure 4.2 below, the factors related to barriers and relations have been summarized to show which value the candidates want the firm to offer based on the theme. It is important for the firms to provide accessibility, communicate, create relations, differentiate from competitors, and keep sustainability in mind according to the candidates.

### 4.3 Use of Services

The most common service used for planning is Excel och similar services, all candidates mentioned using it or something in the same format. Candidates D, F, and H mentioned using Excel and highlighting the value added from filling out the information by hand which gives an overview of resources.

Candidate D: *"We record all revenues and expenses, as well as hours worked, costs, and margins. This helps us ensure that everything is accurately invoiced and that we adhere to budgets while maintaining margins in the projects."*

Candidates A, B, and C are all working on the same project currently and thereby

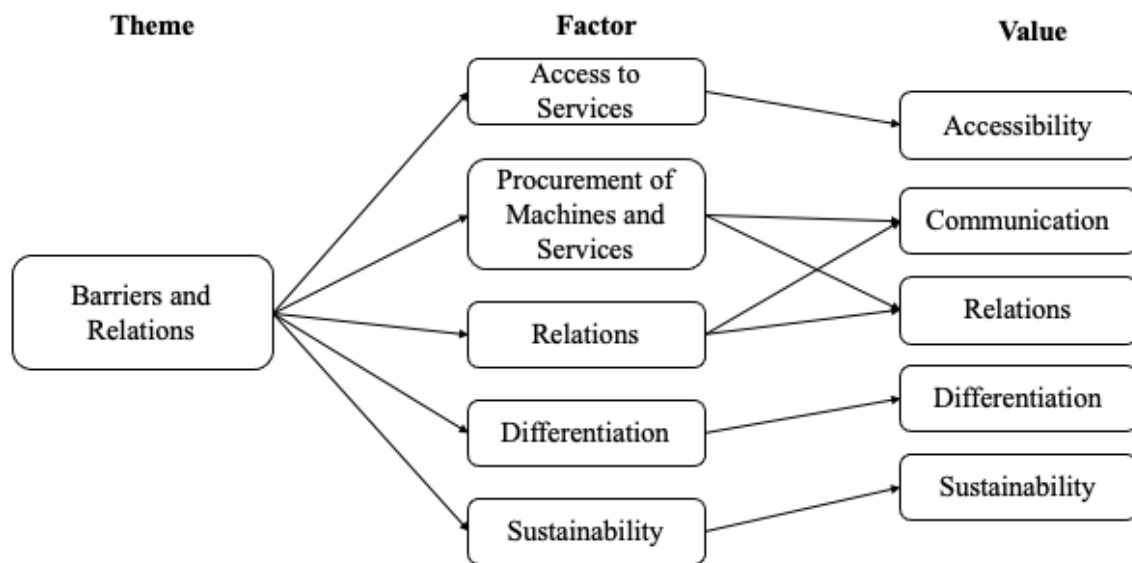


Figure 4.2: Summary of factors mentioned within the theme of barriers and relations pointing towards values wanted by the candidates.

are using the same service for planning which is a customized program operating similarly to Excel but also includes GPS-tracking of the machine which can be followed in real-time throughout the project.

Candidate B: *"We use a program that generates a type of Gantt chart where input is done manually. There are also some visualization tools available. It provides a very good overview of the schedule and budget. Input is done from the office, not on-site. The program is customized according to our preferences and project requirements."*

Candidates E and F also use services that allow for real-time tracking of the machine, utilizing GPS technologies and geotagging. The department where Candidate F works has created an app linked to Google Maps where they can follow the machines in real-time which is appreciated. The department where Candidate E works uses a service called Next which helps them plan their projects, document multiple parts of the project, and also track the machines.

Candidate E: *"The service we use allows us to track the machines in real-time, and the clients sometimes require specific documentation such as deliveries, costs, follow-ups, and invoicing, so it's convenient to have everything in one place."*

A question regarding the need for real-time updates was raised by one of the candidates. They planned to take part in a trial for real-time updates but it fell through, it was also concluded that weekly updates were enough to follow the progression. They did not see the value of real-time updates.

Candidate G: *"What value is there really in watching the machine while it's running? Is not the progression more interesting?"*

The Next service also provides an app where operators can perform their daily checkups of the machine and log it digitally. Candidate E explained that the operators each use an app to write a daily journal about activities and machine health. Candidate F expressed that their operators write a journal as a group digitally to give an overview of daily operations. They are all stored on Dropbox together with

additional information about the project.

Candidate E: *"We use diaries and checklists available on all workers' iPads. They fill in the lists, write in the diary, and take relevant pictures that are logged for the specific project."*

Candidate F: *"The operators write a digital diary, one per team, and use Dropbox or email to submit a PDF detailing what has been accomplished during the day."*

Candidate G mentioned using the service Skymap to plan and oversee the project. Skymap incorporates digital twin technology and geotagging to create a tool to be used throughout the entire project. The visualization communicates relevant information to stakeholders involved in the project. It also incorporates drone scans which helps with modelling and forecasting.

Candidate G: *"You can create cross-sections and delve into different levels to see how the work should be carried out, which provides more information than traditional drawings. Models are integrated into all excavators, so they have the groundwork inputted, and based on that, they can build, and everything is GPS-controlled."*

With regards to the maintenance of the machine, their use of services is limited. Service agreements with dealers are mentioned by all the candidates and the ones using diaries to track daily operations use that to support the service.

Candidate F: *"Like many others, we have service agreements with dealers, which are often utilized for major repairs. Otherwise, there are manuals containing all the information about the machine. Diaries also come in handy here if something special has occurred."*

The ones who do not have something like a diary to provide extra context to the error codes, state that time is spent on locating what is wrong with the machine.

Candidate B: *"We have scheduled maintenance on Fridays as per the agreement, although it takes a lot of time to investigate what needs to be done, even though the operators are familiar with their machines."*

The knowledge around the machine seems to be built after performing smaller maintenance tasks. These are often performed by the operators themselves as stated by several candidates (A, B, C, D, E, G, and H). Candidates E and G mentioned not performing the service themselves on machines they do not own, the service agreement is made with the company providing the machine and operator.

Candidate A: *"I perform a lot of the service myself, which helps me better understand the condition of the machine and how often things need to be repaired or replaced, thus helping to avoid downtime."*

Avoiding downtime and the machines standing still is something that costs a lot of money as expressed by all candidates. Project delays and added costs were common words used when talking about this theme.

Candidate C: *"The worst thing that can happen is for it to break down and the machine to be idle, the project can be delayed and there is a bunch of added costs when a machine breaks down"*

In Figure 4.3 below, the factors discussed by the candidates with the focus on usage of services, have been presented with regards to which value that factor or service aims to provide to the customers which are the candidates. Monitoring, visualization, accessibility, documentation, and communication were the values that the candidates perceived from the services that they are using currently.

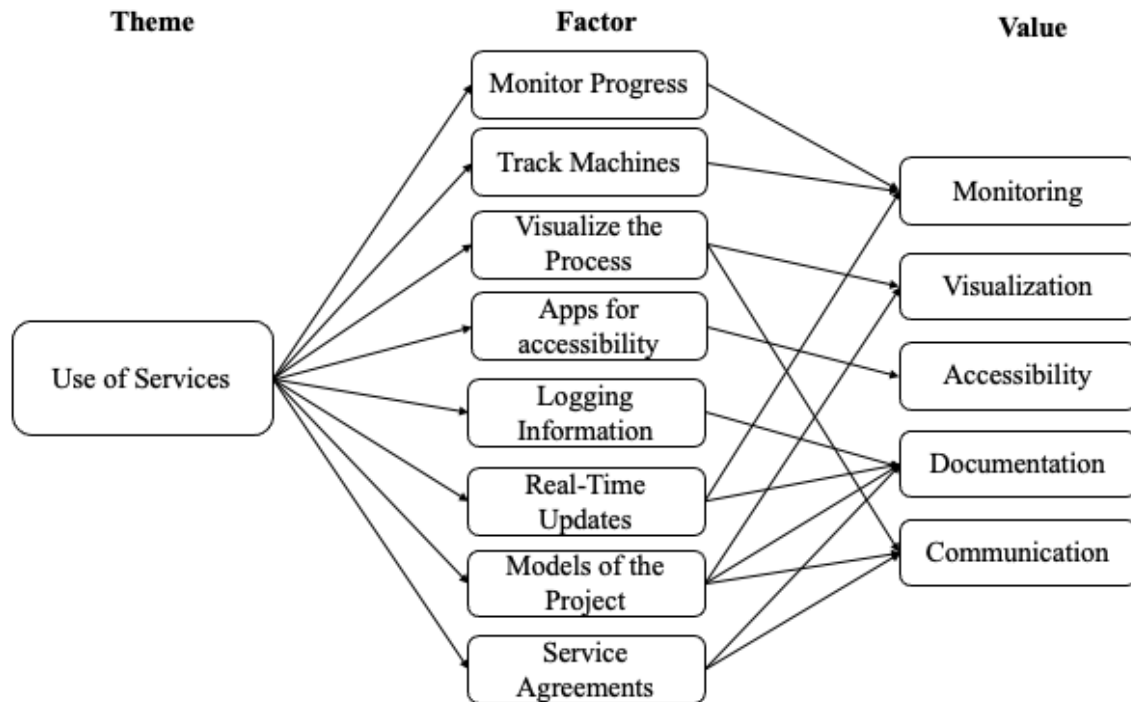


Figure 4.3: Summary of factors mentioned within the theme of use of services pointing towards values experienced by the candidates.

## 4.4 Generational Adaptation of Services

A theme that quickly emerged when discussing digitization was the varying attitudes toward services among different generations. There is an operational gap because young people do not aspire to become machine operators and remain in the position but rather see it as something temporary according to multiple candidates (B, C, and E). Therefore the value added through offering services in the machine can add value through increasing the attractiveness of the machine and occupation.

Candidate E: *"The younger ones ask where the computer and iPad are, while the older ones question why the process needs to change."*

Candidate C: *"I believe a large iPad would be interesting for young people, especially if it is turned into a game or competition. It is also important to have sleek design, fast acceleration, and trendy technology in the machine."*

People in their early twenties being born with a phone was something that was mentioned by candidates C, E, and F. It was therefore thought that they could adapt and use the services quicker than the ones who are older. Although no age was specified during the phrase "older people" the subjects often referred to themselves or people older than themselves, which categorizes people around 50 and 60 years old as older people according to the candidates.

Candidate F: *"20-22-year-olds were born with phones, while those of us who are 50 years old were not; we got our first phones when we were 22 instead."*

Another interesting barrier against adopting digital services was that older people who have operated in the construction industry for a longer period have a physical reason for not using technology. Candidate E expressed that some of the older

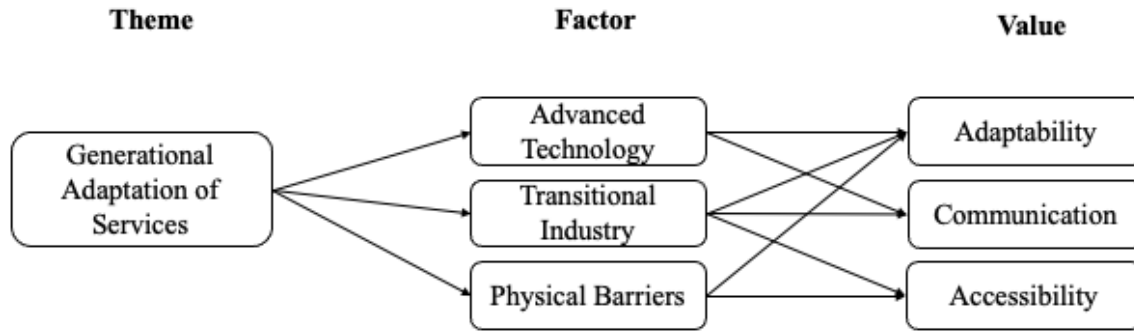


Figure 4.4: A summary of the factors discussed with regards to the theme generational adaptation of services, pointing towards values to combat the related challenges.

operators had large thumbs and were therefore unable to use the mobile service provided. The physical obstacle affects the attitude towards change.

Candidate E: *"You can tell from the hands of some of the older operators that they've been working in the industry for a long time, their hands are usually quite rough, and they feel that their thumbs are too big to press the small buttons in the app."*

Although there are instances where the elders are adapting and can see the value added from a service. Candidate F said that although the barrier exists, the elders are adapting and after a while able to prefer the ease of entering information digitally compared to writing it down with a pen. Candidate G also emphasized the shown ability to adapt by the elders, however, they also mentioned that some have retired and younger people have been hired.

Candidate G: *"The digitization was initially more challenging for the older generation, but now the transition has worked better. Some have retired, and new girls and boys who are used to technology have joined."*

In Figure 4.4 presented above, the values needed to combat the challenges of generational adaptation of services are presented. The firms need to aid in adaptability, communication, and accessibility to aid in the transitional phase of the construction industry as expressed by the candidates.

## 4.5 Feedback and Wishes for Added Value

The candidates wanted more services providing different kinds of values, however only under certain conditions. A general statement regarding feedback around services given by the candidates was that the services should not interfere with the operator's process too much but rather support and enhance it. Candidate E connected the interference of a service to the interference of someone from the office.

Candidate E: *"In the end, it is the operators who do the job it is their work environment. I cannot just come in from the office and tell them what to do. This also applies to services. It is the operator's knowledge that should be used primarily."*

Multiple candidates (A, C, E, F, G, and H) expressed that the construction industry is in a transition phase, moving from the traditional ways of doing things to

a more digitized market. Candidate E also expressed the value added through service to the brand of the company, making it a more attractive workplace. Candidate C mentioned social media as a way of attracting employees and therefore branding is important. Trending services can be a way of drawing in potential new hires.

Candidate C: *"Many are interested in the machines because of how they are showcased on social media. This can be used to attract new employees, so we must be active there and demonstrate that we are part of the transition to a more digital market."*

Lastly, the topic of data collection and service integration in the ecosystem on-site was raised. Candidate D raised the question about data interpretation, it has to be easy. Candidates C and F discussed different brands of machines interacting on-site, the systems have to be able to integrate.

When asked about what service they would like in the future there was a wide range of needs expressed by the candidates. An assortment of candidates (B, D, E, F, and H) wanted services enabling visualization of some sort, candidate D mentioned AR and VR as services that add value to the construction industry. The others did not specify their preferred visualization type. However, based on the intended application, it appears that options such as VR or digital twins may be appropriate adaptations.

Candidate E: *"... being able to visualize different parts of the project before they are executed would also be beneficial."*

Candidate B: *"More visualization tools would be beneficial. It would be useful to visualize which operator is where and when during project planning and follow-up."*

Another want as expressed by Candidate C, is an application connected to the machine. Candidate E showed examples of an application used in the company that had gotten positive feedback, showing that there is a possibility for a service like that to be adapted and used to add value.

Candidate C: *"The younger ones are more digital and want to use the services offered, often wishing for some kind of app related to the machine."*

A topic found when talking about possible services that the candidates wanted, was a want for services that already are available on the market. Visualizing excavation depth and digital twins are available as shown by Candidate G and expressed as a want by Candidate E as an example. The desire for an app expressed by Candidate C could be met by the apps Candidate E and E use. A gap in the communication of services has been identified, opening up a future research space. Since the candidates seem to have a working relationship with their dealers, there could be an opening to utilize that to enhance the communication of existing services.

In Figure 4.5 presented below, the factors discussed by the candidates have been presented pointing towards the value that they want the services to provide. The candidates wanted services to further enable monitoring of the process, communication channels, ease of access, visualization of the project and progress made, documentation, and relations with the firm providing these.

## 4.6 Summary of Results

Defining a service was perceived as difficult and a unified definition was not reached among the candidates. However, accessibility was mentioned by a few candidates and

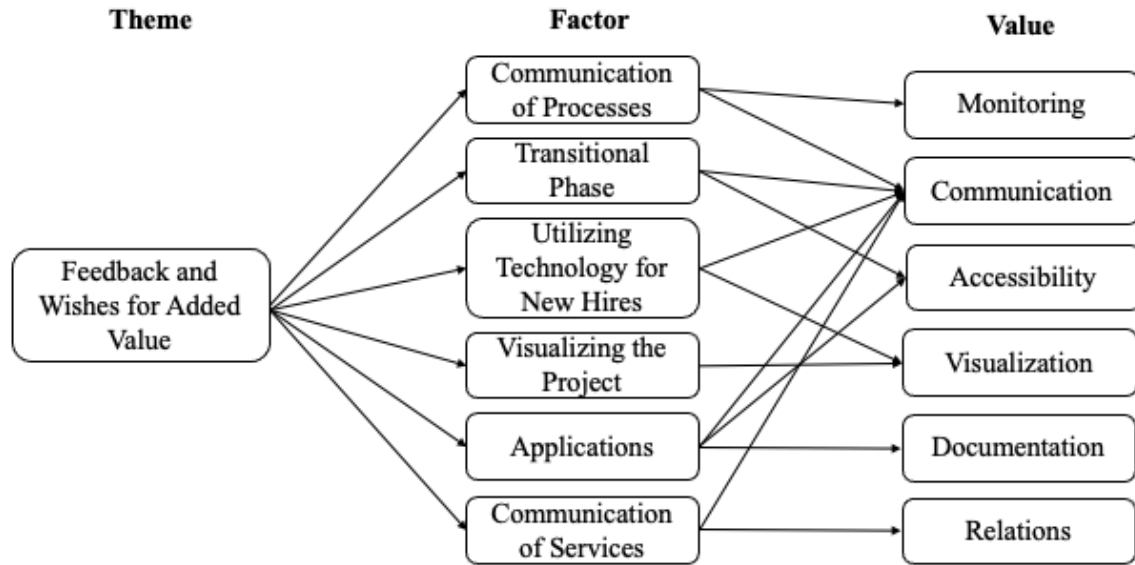


Figure 4.5: Summary of factors mentioned within the theme of feedback and wishes for added value, pointing towards the values wanted by the candidates.

the broadness of the term was mentioned by some. When giving examples as a means of explaining the term, it ranges from data collection and communication to GPS tracking, maintenance agreements, fuel consumption, different visualization tools, and many more. Most of the candidates could, however, agree that the industry is changing and becoming more digitized and adapting more services.

As some services come directly with the machine this was a topic that was brought up by multiple candidates, but with both positive and negative reactions. The positive was that it could increase the perceived value of a machine, especially if it was a used machine. However, it was also perceived as something that excluded firms with a lower budget since they often buy machines second-hand and then believe that services are not available.

The service or even the machine itself did not seem to carry the most weight when procuring new equipment. The relationship between the company and the customer was the most important even though sustainability also was brought up which relates to the machine. The company offering the service or machine includes dealers offering services and machines for purchase or leasing, and small companies and private contractors offering operators and/or machines for larger companies to hire or lease. Another aspect of procurement relations is when the operator can be a part of the process to strengthen internal relations whilst simultaneously opening up the possibility for the salesperson to connect with yet another person. The relation was highlighted as important when larger firms employ smaller actors, especially in smaller communities. When larger firms contact dealers, they often have a relationship with the salesperson because of an existing account.

Brand loyalty was another topic that was discussed. Some had their preferences while it also was mentioned as something that could occur after being satisfied with services and products.

Differentiation and versatility were important among multiple candidates. Quality still carries weight in the procurement process but it is a part of the machine that

can be designed in different ways. The amount of available services was discussed, before there were fewer available, making differentiation more important today.

Some of the candidates used more basic services such as Excel or something similar and preferred manual input as it gave them an overview of the data. Some had more advanced services like applications enabling multiple ways of input, drones, real-time updates, and GPS tracking. These services gained positive feedback and were expressed as easy to use. There was a lack of services except for contracts related to the maintenance of the machine.

There was also a lack of context to the error codes and mechanical data. Some had diaries and visual documentation as a complement which were useful to the ones performing the repair. They otherwise had to rely on their knowledge of the machine to figure out what needed to be done. The worst thing that could happen according to one of the candidates, is that the machine breaks down and becomes unusable as the cost related to an occurrence like this, is high.

There was a perceived barrier between generations to adapting services in the firm. However, in most cases, the elders seemed to adapt even though most highlighted that it is easier for the younger workers to use the services. The input methods may have to be considered when purchasing a service as a firm, even though there is a generational shift happening with new people arriving and older ones retiring. The level of interference of the service is important to consider when adapting a service according to the results.

The transitional stage of the industry was discussed about the feedback from used services. It was concluded that services could be a means of adding value to the firm in ways of making it more attractive. Demonstrating the capabilities of the firm and thereby the services was mentioned as a way of attracting new employees.

To summarize the results, Figure 4.6 is presented below to showcase the values wanted by the candidates for the firm to provide. According to the candidates, these are values that they perceive a need for and can encourage them to use a service.

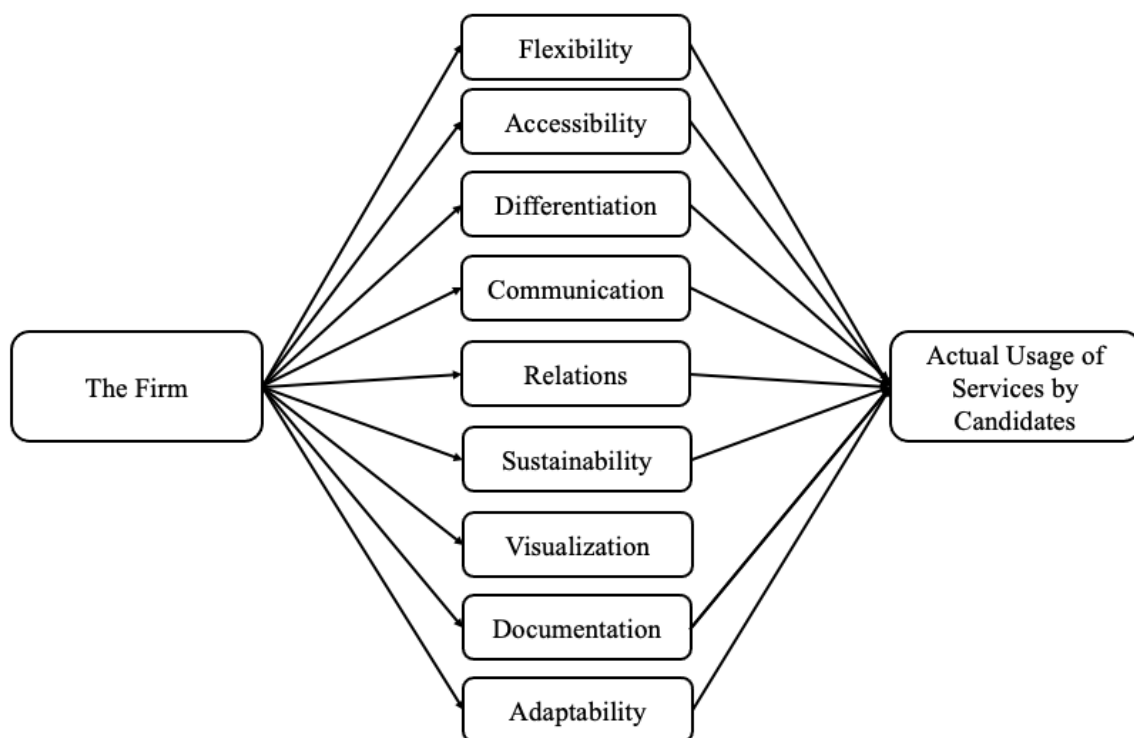


Figure 4.6: Summary of values that the candidates expressed a need for and therefore will make them use a service.

*This section presents the analysis and discussion of the presented results and combines them with the theory to answer the research question. It is structured similarly to the results, starting with an investigation of service as a term, moving to value and barriers, and ending with usage.*

### 5.1 Defining PSS in the Construction Industry

The study aimed to investigate the circumstances surrounding adding a service to a product thereby there is a need to investigate the meaning of PSS and services in the construction industry. The described service ecosystem by Field et al. [13] highlights the complex system with multiple stakeholders, ranging from platforms and societies to the planet. The continuous value provided throughout the system seemed to be what the candidates referred to as they were tasked to describe the term service. Some candidates (E and A) mentioned the exchange at the beginning when the service was purchased and the accessibility, pointing to the fast delivery. All candidates also gave examples of possible adaptations and exchanges of value during the performance of the project. This would provide value for different stakeholders, fuel consumption will be valuable for the managers and operators while GPS-tracking mostly helps the managers. A statement made by Candidate D discussed the service is directly linked to the machine which enhanced the usability of the machine, which is similar to what Baines et al. [3] describe as extending the proposition of a product beyond the traditional usage by adding a service, which is a PSS.

#### 5.1.1 An Industry in Transition

The candidates initially had a hard time grasping the meaning of the term service, which pointed to the novelty of the concept in the Swedish construction market. This relates to the shown lack of supported services by Schimanski et al. [24], however Annarelli and Battistella [2] showed that the construction equipment industry is one of the most suitable areas of application of PSS. It all depends on the choices of decision-makers according to Dallasega et al. [6]. The candidates support this as candidate E was brought in to digitize the firm and thereby be in charge of implementing technology and services to support the new digitized vision of the firm. It is also confirmed by the ones working with purchases of equipment and services, (A, C, D, E, and F), pointing to budgets and management deciding on what is going to be procured. Because of the stressed nature of the candidates interviewed, all

expressed a larger workload than before, diverse services enhancing the process are in demand.

Multiple candidates (A, C, E, F, G, and H) talked about the construction industry being in a transitional phase, as they are moving from traditional processes to more digital ones. This is supported by the theory by Schimanski et al. [24] which stated that the construction industry is a developing market with newly available services. Candidate C highlighted that the firm could be viewed as a more attractive place to work if they demonstrated the capabilities of the machines and thereby the services related to them. The different generations on site are a part of the transition and according to Candidates B, C, and E, younger people see the operator profession as something temporary and services can serve as a way to make them stay longer. Candidates C, E, and F, people in their early twenties are "born with a phone in their hand", and therefore faster learners with regards to the services which allows them to experience the value added by the service faster. Although this barrier exists, Candidates F and G expressed that the elders on site are adapting and learning, and thereby they are going to be able to experience the value as well. Dallasega et al. [6] highlight the complexity of having multiple actors on the same site. The need for coordination between the work process and services is crucial. A shared understanding with candidates C and F who raised the question about the service's ability to integrate with other machines. The assortment of services presented by the literature [12, 18, 21, 24, 25, 32] shows many services that work on a higher level and do not require direct integration with the systems to provide the needed value. There is a possibility of integrating systems using APIs according to Obinnaya Chikezie and Victor Nwosu [20]. The authors also highlight that APIs offer the potential to integrate with specialized construction systems which is vital moving forward in the industry as the fleet continues to have different brands and the firms want to move towards a more digitized future as stated by multiple candidates.

## 5.2 Creating value by differentiation

According to the findings in the results, to add value, the service has to be diverse since it has been proven that the different sizes of firms, require their machines to perform different things. According to Smit and Trigeorgis [27] state that even though the markets' conditions are imperfect, profits that exceed the expected can be earned. Alternative investment strategies include according to the authors, differentiation which is one of the values the candidates expressed a need for. Baines et al. [3] and Ibem and Laryea [12] also highlights the competitive advantage added by differentiation through adding services to products. Candidate C supports this claim by stating that differentiation is the key factor to stand out among the similar services being offered at the moment.

Baines et al. [3] argue that adding a service unlocks new usages, expanding upon the value already provided by the product. Smit and Trigeorgis [27] argue that this type of customization is common in electronics where the same core components are used which is the case for the service described by Candidate E, which offers different parts to different users but the core offer is still the same.

Construction machines differ in capability which relates to the services that are

a part of the machine packages as stated by Candidates A, D, and H. The perceived barrier around new machine purchases stated by Candidates A, D, and H with the point of view that new machines are expensive is supported by the literature as Li et al. [15] states that small and medium enterprises often have constraints that hinder them from purchasing new machines. A solution to this proposed by the authors, was leasing machines to gain access to service otherwise inaccessible. This would also lock the customer to the company as argued by the authors, the customers would get more value and the company gets a loyal customer. Candidate A gave an example of smaller companies gaining access to services in reality. They described how a new machine with the service needed was expensive and had a long lead-time, whereas the second-hand machine was cheaper and had the necessary services, and another service that they did not need but wanted and used since it came with the machine.

Factors influencing the weight carried by service when purchasing the machines include environmental class and fuel types as stated by Candidates A and E. Schimanski et al. [24] expressed a need for implementation of services in multiple stages of construction developments, however, the candidates seemed to focus more on the versatility of the machine when purchasing. They did not seem to realize that versatility could be achieved by added services as stated by Baines et al. [3].

Candidate G stated frequent use of services, showing that their medium-sized firm does not conform to constraints like the ones described by Li et al. [15], there might be differences in what categories as a medium-sized company. Also in this study, only one candidate from that category was interviewed. In future research, a focus could be placed on the SMEs and investigating under which circumstances they benefit from adding a service. This study is more high-level, including a more general view of the problem.

A core offer from private contractors and small firms is the service of leasing machinery or assisting larger firms in projects, as stated by Candidates A, E, and H. This is a way of using internalized resources to provide services that are not easily copied by competitors. This shapes the competitors' behavior since it is hard to copy internal resources as stated by Smit and Trigeorgis [27]. Koskela-Huotari et al. [14] state that services based on internal resources could help transform the perception of the company's offerings. Candidate G went as far as stating that the person behind the wheel is more important than the machine and together with Candidate H, also highlighted the importance of relations which often seemed to be a part of transforming the view on the offerings.

### 5.2.1 **The Lock-In Effect**

Smit and Trigeorgis [27] state that a strong brand comes from differentiating from competitors which leads to having a leading position in the market. The authors state that locking in customers through this method is low in complexity and the uncertainty is low. Candidates mentioned having been locked into brands because of this, but also something that occurred after being satisfied with their services. Therefore the candidates had a perceived usefulness and perceived ease of use as stated by Davis Jr. [8], which affected their decision. Knowing that their needs are going to be satisfied was also mentioned by Smit and Trigeorgis [27], which was mentioned as a factor that could affect customers with imperfect information

to make a decision. As shown by the study, the candidates did not have sufficient information about services when making a purchase and therefore this could affect their decision. Within the area of more advanced services such as PSS, getting the customer to depend upon the company to create high switching costs is an effective method according to Sjödin et al. [26]. Candidates using more complex services are going to lean on the providers for support and development, whereas the ones using Excel, easily could switch to something else.

Gao et al. [9] argue for using both barriers and relations to lock in customers. The social construct proposed by the author includes building strong relations which the candidates gave examples of, Candidate E even highlighted that they eat breakfasts with their suppliers of machines. It was also emphasized by Candidate H, that in small towns, relationships are extra important.

Relations were also proven to have a larger role in the procurement process for larger firms as expressed by Candidate F, it was important to have a good experience with the brand. The same candidate also expressed that the purchasing processing in their company is managed by a larger group which means that the salesperson has to cater to multiple people. On the other hand, it enables the opportunity to create multiple relations at the same time. The investigation on value-added and relations built after having customers visit the Volvo CE Demo center in Eskilstuna by Svensson and Skarman [29] showed that a positive experience with the brand deeply affects the relationship with the customer. The authors argued that the customer showed signs of being less sensitive to price and more inclined to purchase more based on the recommendation of the salesperson.

As mentioned by Annarelli et al. [2], the lock-in effect can be used in PSS offerings in various ways however, creating exit barriers is less effective than building relations and contractual agreements. Something resembling an exit barrier was never mentioned by the candidates who also stated the importance of relations. Therefore the theory about locking in customers through relations is confirmed by the candidates. The candidates also mentioned maintenance agreements with the dealers showing the effectiveness of contractual agreements.

Lastly, Hohenschwert and Geiger [11] highlighted how value could be created from how the salesperson influences the customer and affects their perception of the product. Utilizing these cognitive and emotional strategies has been proven effective according to the authors, and the candidates themselves have highlighted that they may choose someone because of the relationship between them. The candidates working at larger companies also referenced having a contact person at the dealers. Therefore, according to Hohenschwert and Geiger [11], there is an opportunity for the sales person to influence the person making the purchase.

As the study performed by Hohenschwert and Geiger [11] was on B2B, it is highly applicable to this since the businesses brought up by the candidates are B2B. The salesperson's influence over the customer shows their ability to highlight the value added by adding a service to a product. As the candidate has expressed, this is something that they want, but as the study has also shown, they want a lot of things but do not know what is out there or how it actually will aid them. Therefore the power lies with the salesperson to convey that.

### 5.2.2 Striving for Oligopoly Through Product Service Systems

In oligopolistic markets, there is no price competition and according to Smit and Trigeorgis [27] there is also a focus on the proliferation of a product which Annarelli et al. [2] states that PSS enables. For smaller firms, price has shown to be a factor, but the larger firms are more focused on relationships in the study. However, all sizes can join against the common enemy of downtime because of broken machines. This argues for an oligopolistic market in the construction equipment industry.

The game theory in play for oligopolistic markets is how business decisions affect competitors as stated by Smit and Trigeorgis [27]. As stated by Candidate C, most services offered resemble each other, therefore differentiation is important cause it makes the company stand out. If one company for example, enables API integration which allows for integration between machines according to Obinnaya Chikezie and Victor Nwosu [20], then other companies are going to be forced to follow since most larger fleets are a mix of brand as shown in the study. This is also supported by Smit and Trigeorgis [27], who argued that a part of game theory is the investments that enable the firm to strategically position itself on the market while securing future growth options. The authors also highlight the investments' effects on other firms' outcomes which also affects the return on investment. Belleflamme and Toulemonde [4] state that to be cost-effective, firms should specialize in one product, or suppliers specialize in one variety because different alternatives create additional costs. However, they also argue for product differentiation that requires fewer suppliers to increase profits in an oligopolistic market. This opens up an adaptation of PSS in the construction industry, which also has been argued for by Schimanski et al. [24]. The candidates in the study want variety and PSS has proven to be an effective way of doing that according to Baines et al. [3] and Ibem and Laryea [12]. Therefore PSS should be able to provide value to construction equipment development, and because of that services also are going to add value to the products used.

## 5.3 Usage of PSS in Construction Projects

When PSS models are used, the business models are going to vary and the customers' way of accessing the services is going to differ as well as shown by the candidates by looking at the different services they are using. As stated by Reim et al. [22] and Chiu et al. [5], the PSS models focus on product, use, result, and a platform-oriented one. Starting with the ones focusing on the product focuses on the customization of the product as described by Reim et al. [22], which Candidate G gave an example of when talking about the added service that allows for cross-sectioning, which is a way of using the machine, but notably, the machine also has the capability of integrating systems like that which is a customization of the product.

As also proven in the study, this type of customization is not available, or at least not prioritized by the private contractors, as both Candidate A and D stated the limitations that come with the higher costs of new machines. Li et al. [15] stated that leasing can help smaller businesses overcome this hurdle, which is related to the use-oriented model. Reim et al. [22] state that the provider would be responsible

for the usability of the physical product along with the service and the customer makes continuous payments to get access. Another example of this is maintenance services offered together with the machine, like the service agreements mentioned by Candidate F where the dealer sends someone to repair the machine and therefore takes responsibility for the use of the machine.

In the result-oriented model given by Reim et al. [22], the provider has the responsibility to deliver the results and the customer pay is based on outcome units. Paying for the results achieved relates to the service offered by the smaller business to the larger firms of leasing machines or hiring them to perform tasks in projects as mentioned by Candidates A and E. Here the larger firms would pay for the used resources for that performed task, but not necessarily the results as it often is a small part of a much larger project. An argument could be made that the drone service described by Candidate G, where they would pay to get it done to access the model, therefore in the end they pay for the results of using the service since the result of the service performed is the value which they want.

The platform-oriented business model was described by Chiu et al. [5] which is created by the producers, service providers, and the customers themselves, the ownership often lies with the service providers. The co-creation allows for a comprehensive personalized service, which relates to candidates (B, E, and G) mentioning larger services that act as platforms for multiple parts. There are also multiple actors adding to the value of those services, allowing for co-creation. Having all of the information available in the same place was highlighted as a benefit by Candidate E.

The amount of available services in the industry as described by the theory [12, 18, 21, 24, 25, 32] might seem overwhelming as many of the candidates described the topic as broad. That might affect the perceived usefulness and perceived ease of use, which Davis Jr. [8] argued for. The following subsections are going to discuss the usages based on the value the candidates have expressed a need for.

### 5.3.1 Planning the Procurement Strategy and Project

Visualization during the planning process was a need expressed by the candidates, and Ibem and Laryea [12] and Schimanski et al. [24] suggested using BIM which would enable layout optimization, synchronization between actors and integration, which would add the value sought by the candidates. CAD and BIM use models [12] which for example Candidate G effectively used for their projects.

Other ways to add visualization value are by using interactable visualization services incorporating VR according to Ibem and Laryea [12], and AR according to Nassereddine et al. [18]. Candidate D mentioned seeing VR services online but none of the candidates mentioned using VR or AR, showing a gap in the Swedish construction equipment market. Regona et al. [21] argued for integrating AI to analyze and predict scenarios to aid decisions and create strategies. More complex services could be a part of the digital transition occurring in the industry currently according to Schimanski et al. [24], however as expressed by certain candidates, it might take a while to adapt to new technology. Although some might adapt faster since they were born with phones in their hands as stated by Candidates C, E, and F.

ERP was described by Ibem and Laryea [12] as a web-integrated service enabling

communication and visualization between departments. The candidates mentioned using service adding the same value and being satisfied, showing a space for this in the market.

### 5.3.2 Procurement Contracts and Project Monitoring

Web-based platforms and online catalogs could add communication value to a project during the procurement process, because of the ability to communicate offerings and facilitate transactions according to Ibem and Laryea [12]. The authors also stated that cloud computing allows for accessibility to resources and IT services such as SaaS which aids in project logistics. Data can be used at this stage to record bid instructions according to the authors.

However, the Candidates did not express a need for services in the procurement phase, possibly because they did not see the value. This relates to the TAM model presented by Davis Jr. [8] which shows that the perception of usefulness and ease of use affects the actual usage.

When evaluating contracts Ibem and Laryea [12] proposed services such as video conferences, cloud computing, SaaS, and then multimedia services to communicate the final decision. Regona et al. [21] proposed AI to manage contracts in order to take away the risk of the human factor affecting the decision. Because the candidates highlighted the relational aspect of procurement, digital services were not expressed as a need during this part of the project. Catalogs accessed through websites may be used for doing research, but as the candidates working with procurement said, the relations are the most important. Therefore based on the candidates' answers, they do not see the value of services provided by the literature [12,21] added at this stage.

With regards to monitoring the process of the project, Ibem and Laryea [12] have proposed using 3D scans and LADAR to track the process. It relates to Candidate G's usage of Skymap who used drones to scan and from that produce models to track the progress. Candidate D however, does not use these types of technologies and even though expressed that it would be nice to have, they have to rely on the competence of the operator. Candidate E also said that services should not interfere too much and that the operators' knowledge should be used primarily. Systems can malfunction and provide inaccurate data, and that will affect the 3D scans provided. There is a value in using these services as proven by Ibem and Laryea [12], however, the operators' knowledge should be the primary source of information according to the candidates.

Another way to look at the process is through RFID, bar codes, and sensors, all services providing value through documentation and logistics. Regona et al. [21] argue for IoT to aid with logistics and AI to optimize logistics in the supply chain, again removing the human factor. Candidate D says that manually tracking resources gives an overview of progression and budget, a value also expressed by Candidates F and H. However, since the transition from pen and paper to digital input methods took a while for some to get used to according to Candidate F, it might come a time when automated logistics are more appreciated. More extensive research could be done with regard to which human factors to keep and replace since the candidates do not see the same value as the literature.

Modeling is a vital part of visualizing the process and BIM and EDI are tools offering that value according to Ibem and Laryea [12]. If the need is to have a more modular visualization of the process, AR is an alternative according to Nassereddine et al. [18]. Ibem and Laryea also proposed more traditional multimedia technology such as online conferences to update stakeholders. Sherafat et al. [25] instead argued for having the updates accessed through an app. Although the candidates were not asked about using conference calls, all interviews were performed through Microsoft Teams, therefore showing that the candidates are using that as a means of communication. Candidate E and F use an app to provide updates and they are very pleased with those services that align with the literature [25]. As mentioned before, none of the candidates are using AR but they did express a want for services providing value through visualization. Candidate D had seen the value it and VR could provide. As proven by Candidate G, digital twins, and modeling tools could be a powerful tool to visualize progress. Therefore there is an opportunity to add services within this area at this stage of the project.

Ibem and Laryea [12] proposed using GIS to compare the location of suppliers, which is useful to the candidates since some companies operate more locally and could then be seen as attractive alternatives for projects. The authors also mentioned GPS tracking as an alternative to tracking resources during the project process, which could be useful since some wanted an overview of what was going on and some already have effective GPS services tracking the machines. However, Candidate G raised the question of what the added value is from watching the machines in real-time, but the others seemed to be interested in this type of monitoring. A comprise might have the option to choose different intervals of monitoring, the core service would be the same, and the amount of data would however be different.

With regards to the sustainability value, Sherafat et al. [25] argue for emission tracking to provide value by adding a service. The authors stated that this could improve the work environment and decrease pollution. The authors and Regona et al. [21] suggest using sensors and different kinds of data to track the emissions and increase efficiency. Candidate C said that fuel data is interesting concerning sustainability. As projects can come with environmental requirements as stated by A, C, and E, the focus seemed to be fuel consumption and fuel type. Candidate A even went as far as stating that they had to procure a new machine to fit the requirements. Candidate E stated that there are instances where the user of the machine, might not want to put the environmentally friendly fuel in the machine, and rather refrain from taking part in the project. There seems to be a glitch between the available machines and the requirements of the projects. It is possible that emissions were included in the requirements but the candidates may have been more focused on the fuel since the emissions come from the fuels. However, with the increased sustainability requirements as stated by the candidates, sustainability services are going to be more attractive.

### 5.3.3 Maintenance

Sherafat et al. [25] argue for performance tracking to decrease downtime. They also state that maintenance assessment can be done faster by tracking productivity. The documentation and performance tracking related to maintenance mentioned by the

candidates are the diaries that provide extra context to the data collected by the sensors. However, documentation of the project as a whole could also aid maintenance of the machine if it focuses on tracking performance as stated by Sherafat et al. [25]. Zasadzień et al. [32] propose different services related to maintenance communication such as GSM, WI-FI, satellite, radio, text communication and phone calls, and data transmissions. Forecasting based on collected data to predict and prevent maintenance was also something that was mentioned by the authors which aligns with the need for prediction and prevention as expressed by the candidates. The authors also mentioned service agreements which most candidates seemed to use.

Ibem and Laryea [12] proposed using GIS to compare the location of suppliers during the procurement process, this could be used for maintenance as well since projects can be delayed because of malfunctioning machines, therefore local dealers or suppliers of parts could minimize lead time. Another way of decreasing lead times is remote maintenance. Nassereddine et al. [18] argue for incorporating AR to perform remote maintenance showing the capability of providing that value.

## 5.4 Closing Discussion

To summarize the discussion, this study aimed to analyze the circumstances affecting the ability to add services to products with the case being the construction industry in Sweden. The answer is that value is going to be perceived differently because of circumstances like the perceived meaning of the term and use, the influence of the salesperson, the background and relations of the decision-makers, budgets, attitudes towards services on site, and the capability of the machine fleet as proven by the study. However, it has also become clear that the industry is shifting towards a more digitized version where services are going to add value to the project based on the candidates' answers and the theory [2, 3, 6, 12, 24].

It has become evident that differentiation and variety are some of the more requested values from the candidates. This would add value for the users and also for the firms providing the service as the service itself provides a competitive advantage by focusing on differentiation according to Smit and Trigeorgis [27], and locks the customers to the firm according to Sjödin et al. [26]. Other ways of locking in the customers are through building relations as stated by the candidates who are the customers and also by the theory [2, 9, 11, 26, 27, 29] which highlights the firms perspective. A final way is to tap in to the perceived usefulness and ease of use as stated by Davis Jr. [8] who brings in the customer perspective.

The proliferation of a product becomes more important as sustainability becomes more important. In an oligopolistic market, Smit and Trigeorgis [27] state that that is one of the focuses, and PSS enables this according to Annarelli et al. [2]. However, another part is again product differentiation and because of the mixed fleets currently on sites as stated by the candidates, firms are going to have to adapt to each other's strategies as stated by Smit and Trigeorgis [27]. The variety need could be met by PSS according to Baines et al. [3] and Ibem and Laryea [12], therefore implementing PSS in the construction equipment industry is going to add value.

Currently, the different types of business models described by the theory [5, 22] are used for services currently available, showing the possibility of adaptations. For the

planning part of the project, the candidates' need for services providing value through visualization is aligned with the literature, even though it might take a while to adapt. With regards to the procurement contracts, and services presented in the literature [12, 21] was not going to meet the value needed from the candidates at this stage, since the candidates mostly focused on relations when procuring equipment and services. Since there seem to be no particular services currently in place, salespersons might need to use their influence to shape the perception of services as expressed by Hohenschwert and Geiger [11]. However, concerning the monitoring of the project, the possibilities of adding services are greater as the candidates want or are already using services providing the same values as expressed by the literature [12, 18, 21, 25]. The services related to maintenance presented in the theory [18, 25, 32] align with what values the candidates expressed a need for, with the opportunity to include more predictive and AR services.

## Chapter 6

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# Conclusions and Future Work

*This chapter offers a thorough examination of the aims pursued and the implications of the study. It covers the findings along with their contributions to prior research and society. Finally, the chapter closes with suggestions for future research and assesses the research limitations.*

## 6.1 Concluding Discussion

This study has explored the circumstances around value through adding a service to a product. The aim was to provide recommendations for firms offering the services from the perspective of their customers, the companies needing construction equipment and services. Therefore further research that emerged during the process is to compare the perspective of the firm to the perspective of the customers could add value to this research area as it lies out of the scope of this study. The term service itself although a part of a larger system, proved to be a broad subject by the candidates and literature. However, it can be defined as something able to specifically enhance the use over just another type of transactional product.

The interviews concluded with three main themes in the discussion. The first one is *Defining PSS in the Construction Industry*, where the candidates generally got introduced to the area and were able to discuss their experiences which on a general basis, were divided and quite slim. Most of the candidates were not acquainted with the term but after exploring it a bit more gave examples of uses and everyone could see the value it could bring.

The second, *Creating value by differentiation*, came from the candidates wanting variety and the theory stating that differentiation is an effective way of gaining a competitive advantage. As stated by one of the candidates, having services as a part of the business may attract new higher, showing a competitive advantage customers can gain. An unexpected finding during this theme was the lack of knowledge about existing services since a selection of the candidates asked for services that already are available. This shows that the salespersons can use their influence more to make more sales through communication.

The third one, *Usage of PSS in Construction Projects* came from exploring the examples of services given in the theory, and comparing them with the ones used by the candidates to find what values are needed on the market which are summarized in Table 4.1.

On a general basis the candidates, who included companies of different sizes, were able to consider services as value-enhancing concerning their products and business.

Therefore, it is up to the firms offering services to communicate the value added through services to gain the most from their competitive advantage. Game theory can be used to help the firms position themselves on the market with regards to this as the actions of other competitors can have direct influence over the design of the service. If the service needs to be integrated with external systems, a plan for that should be in place before launching.

## 6.2 Answer to the Research Question and Implications of the Study

This study concluded with several significant findings that separately answer the research question of *What affects the possibilities of adding services to a product?*, from different perspectives, and combined provide a more comprehensive understanding of the problem area. However, to sum the following conclusions, the research question can be answered by stating that *Adding a service to a product is beneficial when it enhances usability and creates competitive differentiation and loyalty, while being communicated well.* This answer is further explored below.

The first conclusion is that a PSS can be defined as something that expands the usability of a product beyond traditional usage by being a value-adding service. Both the candidates and the literature agreed upon the ability to add value by adding to the usability of the product. The industry as it is transitioning towards a more digitized one, has shown its ability to adapt to these changes, and a need for more.

The second conclusion to be drawn is differentiation is a competitive advantage that can be created from PSS. Additionally, it can act as a lock-in effect which can be combined relations to gain loyal customers, a strategy proved effective in the construction industry.

The third one concerns service usage, several services are providing the value needed on the market, there are also several services yet to be seen as value-adding by the users, and lastly, there are services that are not communicated well to the customers.

Knowing when to add a service is important for the first to consider as well. The study suggests adding services in the planning, monitoring, and maintenance phase of the project. During the procurement phase there lies more opportunity in exploring the relations and communications aspect rather than solely focusing on adding a service. However, a service adding relational and communications values might be worth exploring to differentiate from the competitors.

The study offers support for adding services to products to add value. The candidates showed positive indications towards the subject both when discussing circumstances around the term and also user cases. After concluding the results, it is apparent that the transitional stage of the industry combined with the need for diversity, opens up the market for more PSS. As shown by the previous research, there is an opportunity for firms to utilize product differentiation and game theory to gain market share and increase profits. However, when doing so, utilizing internal resources makes the competitive advantage harder to replicate, which is vital for it to keep being an advantage. Considering the actions of other firms in the industry

is also important to take the ability to integrate systems into account which could be another competitive advantage.

## 6.3 Societal and Scientific Contribution

In this study, there are recommendations for firms to consider when adding services to products that will affect the surrounding circumstances. Previous studies have focused more generally on PSS and the functionality of services, leaving out the circumstances around value. By adding the values needed by the customer to the theory focusing on the perspective of firms, the study bridges the gap between the need for adaptation and the intended offering from the firm. As shown, the intended use of the service might not be what the customer needs every time but there are ways to convince the customer of the value of PSS offerings. As services expand upon usage, services can add value to products if communicated and used properly. This shows the societal contribution to the firm, where this study solidifies the theory that relations can affect the decisions made by stakeholders in the construction industry.

As discussed, there is a sustainability aspect as PSS can enable the proliferation of a product that can be utilized during oligopolistic market conditions, thus enhancing sustainability through reduced environmental impact. Another aspect is the sustainability enhancing services like fuel and emission tracking which can be explored more. Since the candidates showed that they have environmental requirements to follow during projects, there is an opportunity for firms to continue developing those types of services to comply with the needs of companies engaged in similar environmentally-conscious projects.

On a societal level, the study implicates how construction firms can improve their processes. As the industry itself is growing larger with more projects as expressed by the candidates, there is a need for process development. Furthermore, the study highlights the imperative for ongoing innovation processes within the construction equipment industry and how they can adhere to the demands of their customers whilst also growing their business.

Process development also applies to smaller companies competing for projects on a local level. Whilst cultivating relations, it is important to differentiate from fellow actors in the industry, which possibly could be done through services enabling unique machine usage.

Investing in differentiation practices applies to other areas of business as well. Using differentiation as a competitive advantage is advantageous when trying to gain more market share since it often includes a unique process that competitors struggle to copy. As PSS is proven to generally enable that, exploring value-creating services can unlock potential new uses for other types of products as well.

The study also shows that although some employees are hesitant to adapt to new processes, they are going to be more receptive when provided with support and training, which ultimately fosters a culture of continuous improvement within the organization. This underscores the significance of investing in employee development to successfully implement new services and technologies.

## 6.4 Future Research and limitations

To summarize, the study has given insights into value-adding services and differentiation as a competitive advantage. Although showing application opportunities, there are instances where the customers do not value the services offered. However, as strong relations were mentioned as effective ways to conduct business, there is an opportunity to explore how to use them to communicate the value of services in order for firms to make more profits from their available services.

This study looked at the opinions of different sizes of companies, therefore deeper research could be done to analyze the needs of the different sizes. There is also an opportunity to analyze the area of research in other areas than Sweden as it is going to differ. For example, in Sweden, there is access to the internet everywhere which is needed for certain services. In an area without the same conditions, the value needed is going to differ, and the ability of firms to adhere to those conditions and needs is going to be different.

An area of research that emerged during the process is the perspective of the firm to compare it to the perspective of the customers. This would investigate further if the value and use intended of the service is perceived by the consumers as it is an emerging field. This would aid firms in their development of services.

As expanding upon the lifecycle of the product is a part of oligopoly and PSS, this could be further investigated concerning sustainability as a value provided through a service. This would potentially relate to maintenance which is another area that could be explored more. Fixing products prolongs the life of the product which is better for the environment than buying a new one.

### 6.4.1 Limitations of the Study

The study is limited by the scope as it only covers a small part of the market. The interviews were conducted online, if the study were to be conducted again, they would have been carried out in person at the site to gain more knowledge about the services. Although some were able to share their screen and show it, that was not possible for the services directly integrated with the machine or other devices on site.

Focusing on the sales process, by not having spoken to more people directly related to the procurement, the knowledge around that is limited and only a sample of the area is shown in the study.

As the relational aspects are a part of the process, it is difficult to interview someone being influenced as they might not want to admit to being pursued to make a decision. It is also important not to control the candidate during the interview as the interviews only are semi-structured. Therefore it is difficult to investigate the customers' perspective during this phase of the process.

The different sizes of companies differed a lot, making it harder to compare since the budgets have a large effect on procuring machines and services. Also since only one medium-sized candidate's opinion and experience was taken into consideration, only a sample from that market was represented in the study. The amount of companies of that size working directly with construction equipment is limited as found when searching for candidates, it was more common to work with portable tools which is important to keep in mind.

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- Can you introduce yourself and tell me about your role?  
Follow-up questions: How long have you had this role? Have you worked in other roles within the construction industry before your current role?
- How do you purchase your machines? Who are you buying them from?  
Follow-up question if they purchase the machine directly from the company or a dealer: Have you bought several machines in this way? Do you contact the same person or is it different each time?  
Follow-up questions if they purchase the machine from a secondary source: Have you bought several machines in this way? Why do you choose a second-hand machine over a brand-new one?
- How would you describe services within the machine industry?  
Follow-up questions: What weight does an added service carry in your decision when procuring the equipment? Are the services provided by the company behind the machine or a third party?
- When you bought your last machine, did you choose to add any services?  
Follow-up questions: What weight does an added service carry in your decision when procuring the equipment? Are the services provided by the company behind the machine or a third party?
- Do you use any services to plan your projects or monitor the execution? If so, which or what type and who provided it?  
Follow-up questions: How has this service supported you in your projects? Can you give some examples of how you are using it?
- Do you use any services related to the maintenance of the machine? If so, which or what type and who provided it?  
Follow-up questions: How has this service supported you in your projects? Can you give some examples of how you are using it?
- What is the feedback on the usage of services and from whom?  
Follow-up questions: Which services are used the most and are seen as adding value? In what way are these services adding value to a project?

- Are there any services that you would like to have and how would they add value?
- Is there anything you want to add or clarify? And is it possible to reach out again if any questions arise?



