Servitisation in Swedish Sawmills
–The Case of Computed Tomography

Tjänstifiering i Svenska Sågverk – En Studie av Datortomografi

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Summary

The Swedish sawmill industry faces rising competition due to increasing costs, efficiency pressures, and stricter traceability and sustainability standards. Sawmill organisations are adopting new technologies, such as Computed Tomography (CT), which scans logs to reveal internal structures, enabling better process optimisation, higher yields, and enhanced traceability. Despite these benefits, adoption is limited, primarily due to high initial costs, uncertain economic returns, and integration challenges.

This study examines how sawmill organisations evaluate CT technology when offered as a service, rather than through traditional ownership. The goal is to identify factors that influence decision-makers in sawmills to invest in CT technology via service-based models. A qualitative approach was used, involving semi-structured interviews with decision-makers from Swedish and Norwegian sawmills, including organisations with and without prior experience with CT technology. The interview data were analysed through thematic analysis.

The findings found that evaluations of service-based access are influenced more by how these arrangements fit with existing investment strategies, operational needs, and risk management practices than by the technological capabilities of the solution itself. Respondents highlighted key factors such as maintaining production continuity, controlling critical infrastructure, ensuring data governance, and cost predictability as central to their judgments. Prior experience with the technology affected confidence in its practicality, whereas lack of experience increased perceptions of uncertainty and risk. Overall, service-based access was regarded as conditionally viable, mainly serving as a supplement to ownership rather than a complete replacement.

Overall, the study concludes that adopting service-based business models to access advanced production technologies is limited by technological, organisational, and structural factors inherent in capital-intensive industries. Servitisation is not a simple linear transition toward fully outcome-based service models; instead, it is applied selectively within specific boundary conditions determined by asset embeddedness and operational criticality. This research clarifies how these conditions restrict and influence the scope of servitisation when applied to critical production technologies in industrial environments.

Keywords: computed tomography, sawmills, service-based business model, servitisation, innovation

Sammanfattning

Den svenska sågverksindustrin möter ökad konkurrens till följd av stigande kostnader, ökade effektivitetskrav samt skärpta krav på spårbarhet och hållbarhet. För att möta dessa utmaningar undersöker sågverksföretag nya teknologiska lösningar, däribland datortomografi, som möjliggör skanning av stockar för att identifiera deras interna egenskaper. Tekniken kan bidra till bättre processoptimering, högre utbyte och förbättrad spårbarhet. Trots dessa potentiella fördelar är användningen av datortomografiteknik fortfarande begränsad, främst på grund av höga initiala investeringskostnader, osäkerhet kring de ekonomiska effekterna samt svårigheter att integrera tekniken i befintliga produktionssystem.

Denna studie analyserar hur sågverksorganisationer utvärderar tillgång till datortomografi när den erbjuds genom tjänstebaserade affärsmodeller, i stället för genom traditionellt ägande. Syftet är att identifiera de faktorer som påverkar sågverksbeslutsfattares vilja att investera i datortomografi genom tjänstebaserade lösningar. Studien bygger på en kvalitativ forskning med semistrukturerade intervjuer med beslutsfattare från svenska och ett norskt sågverk, både med och utan tidigare erfarenhet av datortomografi. Det empiriska materialet har analyserats med tematisk analys.

Resultaten visar att bedömningen av tjänstebaserad tillgång till datortomografi i högre grad påverkas av hur sådana lösningar passar in i etablerade investeringslogiker, operativa krav och strategier för riskhantering än av teknikens tekniska potential i sig. Respondenterna lyfter särskilt fram vikten av driftsäkerhet, kontroll över kritisk produktionsinfrastruktur, hantering av produktionsdata samt förutsägbara kostnadsstrukturer. Tidigare erfarenhet av tekniken bidrog till större tilltro till dess genomförbarhet, medan avsaknad av erfarenhet förstärkte upplevelser av osäkerhet och risk. Sammantaget uppfattas tjänstebaserad tillgång till datortomografi som villkorligt genomförbar och främst som ett komplement till ägande snarare än som en fullständig ersättning.

Studien visar att införandet av tjänstebaserade affärsmodeller för tillgång till avancerade produktionsteknologier begränsas av en kombination av teknologiska, organisatoriska och strukturella faktorer som är typiska för kapitalintensiva industrier. Tjänstefiering framstår inte som en linjär utveckling mot fullt resultatbaserade tjänstemodeller, utan tillämpas selektivt inom tydligt avgränsade ramar som formas av tillgångarnas inbäddning i produktionen och deras operativa betydelse. Studien bidrar därmed till forskningen genom att tydliggöra hur dessa villkor påverkar möjligheterna att tillämpa tjänstebaserade affärsmodeller för kritiska produktionsteknologier i industriella sammanhang.

Nyckelord: datortomografi, innovation, sågverk, tjänstebaserade affärsmodeller, tjänstefiering

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1 Introduction

This chapter introduces the study by describing the context, purpose, and overall research approach.

1.1 Problem background

Traditional models for manufacturing build on a product-dominant logic (Vargo & Lusch 2004). These models emphasise physical production and sales. In a service dominant logic, on the other hand, customer needs are placed centrally, and these needs may be met by sales of physical products or combinations with various degrees of services (ibid).

The long-term viability of product-dominant business models has increasingly been questioned in manufacturing industries. Research indicates that growing competition, market saturation, and diminishing returns from incremental product innovation have made it difficult for firms to sustain profitability based solely on product sales (Kowalkowski and Ulaga, 2017 pp. 15). As a result, strategies that rely exclusively on selling physical products are becoming less effective in creating durable competitive advantage.

Product-focused business models are particularly constrained in capital-intensive industries, where high fixed costs and long investment cycles amplify firms' exposure to competitive pressure and market volatility. As Antioco *et al.* (2008) and Bustinza *et al.* (2015) point out, increasing competition and falling prices gradually erode profit margins, making it harder for companies to expand solely by developing new products to sell. In these environments, high fixed costs and lengthy investment cycles restrict strategic choices and increase firms' vulnerability to market fluctuations.

In capital-intensive manufacturing environments, tightly integrated and immobile production assets make investment decisions difficult to reverse and operational failures particularly costly. Frank *et al.* (2019) highlight that in manufacturing environments with large, immobile assets and tightly connected production systems, changing investments can be difficult, and mistakes can be costly. This close integration of production technologies increases financial risks and organisational reliance, highlighting the limitations of traditional ownership-based investment approaches. Therefore, creating value in capital-intensive industries depends not only on owning physical assets but also on how these assets are used, combined, and maintained throughout their operational life.

Servitisation represents a strategic transformation for manufacturing companies, moving from merely selling standalone products to offering combined product–service solutions that alter the ways in which value is generated, provided, and captured (Vandermerwe and Rada 1988). Vandermerwe and Rada (1988) originally introduced servitisation as a strategic approach in which companies move from standalone product sales towards offering value propositions that combine services, support, and knowledge. Servitisation is not limited to traditional service sectors; manufacturing firms are likewise encouraged to develop value-added services to strengthen competitiveness and strengthen their core capabilities. With this foundation, Baines et al. (2009) view manufacturing servitisation as a change in how companies organise their capabilities and implement their operations. Instead of seeing services as just additional features, they see servitisation as a shift from simply selling products to offering combined product and service solutions. This means manufacturing firms need new skills, processes, and ways of working together to design, deliver, and support their offerings. Kohtamäki *et al.* (2022) define servitisation as a change that influences how companies create, deliver, and capture value. This shift requires adjustments not only in their offerings but also in revenue strategies, organisational structures, and relationships with other firms.

Servitisation does not represent a linear or universally applicable transformation but instead develops through competing value logics that often coexist and create organisational tension. Despite the significance in academic and managerial debates, servitisation does not follow a simple or universal line. Palo *et al.* (2019) describe servitisation as a contested business model phenomenon where multiple, often conflicting, value logics coexist both within and across organisations. Instead of replacing product-centred approaches, service-oriented models frequently develop alongside them, resulting in organisational tensions and strategic ambiguity. Töytäri and Rajala (2015) similarly emphasize that value-driven and service-focused business models often are associated with increased uncertainty, relational dependence, and risk sharing. These issues become more critical when services are closely embedded in customers' core operations, where a disruption or failure in performance can cause immediate financial repercussions.

Service-oriented business models imply fundamental changes in how value and risk are structured, shifting focus from asset ownership toward long-term problem-solving and relational governance. From a business model perspective, shifts away from purely product-centric strategies imply changes in how value is created and captured. Rather than emphasizing ownership of physical assets, service-oriented business models frame value in terms of problem-solving, cost reduction, and risk reduction for the customer. Such models may involve alternative revenue logics, including usage-based fees, subscriptions, or leasing arrangements, which alter cost structures, redistribute risk between actors, and increase the importance of long-term partnerships between suppliers and customers (Osterwalder *et al.* 2013).

1.2 Problem

The Swedish sawmill industry is a large sector with stationary production facilities and long-term investment plans. There are approximately 140 sawmills operating in Sweden, supplying sawn wood products to various downstream industries (Freij 2023). The Swedish forest-based industries are a key part of the country's economy, accounting for around nine percent of the country's exports. Over the years, the industry structure has changed, with fewer but larger sawmills, more automation, and greater capital needs (ibid). These changes have effectively increased productivity, but they have also increased financial risks and made it harder to adapt quickly to new technologies. And at the same time, sawmills are facing higher external pressure. Volatile global markets, rising raw material costs, increasing customer demands for sustainability transparency, and new regulatory requirements such as the European Union Deforestation Regulation (**EUDR**). This has intensified the need for improved data availability, traceability, and process transparency in the whole supply chain (European Commission 2025; The Swedish Forest Agency 2025).

To meet these new challenges, the industry will have to adopt new technologies and strategies. Previous research indicates that Computed Tomography (**CT**) allows for detailed analysis of internal logs before sawing, which helps improve decision-making related to increasing yield, planning production, and ensuring traceability (Johansson 2015). Studies also show that CT-based optimisation can lead to notable improvements in yield over traditional sawing methods (Fredriksson 2015).

Despite its documented technical and economic potential, CT technology has not been widely adopted by Swedish sawmills due to high investment costs and the concentration of financial and operational risk under traditional ownership-based investment models (Nowik 2025). Prior studies identified CT-barriers such as high initial costs, the need for significant modifications to production lines, lack of knowledge, and uncertainty about long-term economic benefits, which made many not go further with adoption of the technology (ibid). Under traditional ownership-based investment models, the full financial and operational risk associated with CT adoption is only on the individual sawmill, which may delay modernisation even when performance benefits are evident.

Servitisation has been discussed as a potential strategy to decrease capital binding by shifting from owner-based investments to service-based models (Kowalkowski & Ulaga 2017, pp. 20-27). While research on servitisation covers strategic motives and value creation, less attention is given to applying these models for critical production technologies in traditional industries like sawmilling. In particular, there is limited empirical data on how advanced technologies, such as CT technology, could be effectively structured, offered, and adopted through service arrangements in traditional contexts, such as sawmills.

There is a lack of understanding of how servitisation theory, technological adoption, and the context of the sawmill industry intersect, particularly when such models are applied to critical and infrastructure-embedded production technologies in traditional process industries, such as sawmilling.

This gap motivates an investigation into the conditions under which servitisation may facilitate access to CT technology as a service, as well as the organisational, technological, and economic factors that may constrain or enable its adoption compared to ownership-based investment.

The core problem addressed in this thesis is the limited empirical understanding of how servitisation can support the adoption of advanced, infrastructure-embedded production technologies in capital-intensive process industries. While servitisation theory offers insights into alternative approaches to value creation and risk sharing, it remains uncertain how these models operate in contexts where technologies are deeply embedded in core manufacturing processes and associated with significant operational and financial risks. In the Swedish sawmill industry, this uncertainty is particularly evident for CT technology, which demonstrates technical and economic potential but has not been widely adopted under traditional ownership-based investment approaches.

1.3 Aim, research questions and delimitations

The aim of this study was to identify and structure the key factors influencing the adoption of alternative business models for accessing advanced production technologies in capital-intensive industries.

The industrial context for the empirical study is the forestry-based processing industry, specifically sawmills operating primarily in Sweden, with one supplementary interview from Norway. Particular interest is placed on sawmill companies' strategies to access a capital-intensive technology, using CT. Research questions relate to perceptions of CT technology, enabling factors for using it, and willingness to invest in a service offer to access CT capacity.

- How do sawmills perceive access to CT technology through service-based arrangements?
- What factors enable or constrain the transition from a product-based to a service-based business model in the sawmill industry?
- What factors influence sawmill owners' willingness to invest in CT technology as a service?

Together, the research questions address the phenomenon from three complementary perspectives: how service-based access to advanced production technologies is perceived in practice, which organisational and structural factors enable or constrain such arrangements, and how investment logic and risk considerations shape decision-making in capital-intensive contexts. These perspectives form the basis for the empirical, theoretical, and methodological delimitations presented below.

1.3.1 Empiric delimitations

This study focuses on softwood sawmills operating primarily in Sweden, with one supplementary interview from Norway, with an annual production larger than 200,000 cubic meters of sawn timber. Sawmills with lower annual production were deliberately excluded because CT scanning currently represents a system-level production technology that presupposes a certain scale of operations, data infrastructure, and organisational capacity, which smaller mills are less likely to possess. Furthermore, the study focuses exclusively on sawmill organisations and does not include technology or service providers as respondents. This choice was made to maintain a clear focus on demand-side decision logic; including suppliers would shift the study's focus toward provider strategy rather than understanding how sawmills perceive and evaluate CT as a service.

A Norwegian company was included because the organisation operates several sawmills in Sweden and is therefore embedded in the Swedish sawmill context. The interview was included as a supplementary empirical input to capture organisational reasoning that is relevant to Swedish operations, rather than to introduce a comparative Norwegian perspective. The study remains focused on Swedish sawmills, and the Norwegian interview does not alter the national scope of the analysis. The interview was conducted as a group interview with two organisational representatives present at the same interview occasion. The respondents held complementary roles and jointly reflected organisational decision-making processes, and the organisation remained the unit of analysis.

1.3.2 Theoretical delimitations

This study is limited to servitisation theory as an interpretive framework for analysing how service-based business models are perceived and constrained. This study is limited to servitisation theory to explore how decision makers reason about uncertainty, control, and value during the early stages of service development when the outcomes still cannot be measured. The study does not aim to create new servitisation models, existing theories are used as tools to interpret the empirical findings. The study is further delimited by the absence of a fully developed or operationalised CT-as-a-service business model in the empirical context.

1.3.3 Methodological delimitations

The study adopts a qualitative, interview-based research design and does not include quantitative measures. Quantitative analyses would require longitudinal production data and counterfactual modelling, both of which fall outside the scope of this study. Economic outcomes alone would fail to capture how uncertainty, operational risk, and governance concerns shape the willingness to engage in service-based agreements. The study aims to offer analytical insights into how CT-as-a-service is understood and limited within a particular industrial context. Therefore, the qualitative approach aligns with the study's goal: to examine organisational decision-making processes rather than to quantify adoption results.

As a qualitative study based on a limited number of interviews, the findings cannot be statistically generalised beyond the studied context. The results provide insightful analysis into the decision-making processes within organisations related to the adoption of CT. Furthermore, the study concentrates on reasoning at the organisational level, without examining the differences among individual actors within the same organisation in detail. Lastly, the interpretation of interview data involves the researcher's judgement; although systematic coding and a strong theoretical basis were employed to improve transparency, it is not possible to entirely rule out alternative interpretations of the empirical material.

2 Research review

This chapter presents an overview of relevant academic literature to position the study within existing research on servitisation and industrial technology adoption. It starts with some historical background that serves as understandings for the use of the concept, servitisation, in a forestry-based context.

2.1 Evolution of servitisation

The commonly described perception that servitisation follows a linear movement from product to service is challenged by (Kowalkowski *et al.* 2015). Instead, it is shown that manufacturing businesses develop multiple parallel service strategies, where roles such as accessibility, performance, and industrialised supplier can coexist and develop together. Servitisation is a dynamic and situation-based process rather than a sequential transition. Vargo and Lusch (2008a) strengthen this view by introducing Service Dominant Logic, where focus moves from value creation based on the product's inherent qualities to value creation realised through use. Together, the studies show that servitisation is not a limited phenomenon but an overarching logic for creating value in the interaction between producers and customers.

Prior research has shown that servitisation is a complex and multifaceted development influenced by different factors and research traditions, rather than a simple linear shift from products to services. Baines *et al.* (2009, pp. 1-2) define servitisation as a broad concept covering different service strategies used by manufacturers, influenced by competitive strategy, customer value considerations, organisational capabilities, and the configuration of the product-service offering. Research in this field draws on several academic areas, including operations management, service management, product-service systems, and service science. Each of these theoretical lenses emphasizes distinct approaches to value creation and differing frameworks for risk distribution (Baines *et al*. 2009, pp. 2–4). Manufacturers often integrate specific service components alongside product ownership rather than fully adopting result-oriented models, primarily due to concerns related to risk, organisational change, and the complexity of service delivery (Baines *et al*. 2009, pp. 9–11).

Kowalkowski *et al.* (2015) develop the theoretical foundations of servitisation by identifying several distinct strategic ways in which firms may pursue servitisation, rather than a single normative development trajectory. The research shows that firms must balance standardisation and customisation, while also managing organisational tensions that arise when new service-based logics coexist with traditional product-centric structures. These findings underline that servitisation not only requires new value propositions but also changes in organisational routines, capabilities, and internal alignment.

These foundational perspectives in the servitisation literature identify several strategic motives, such as securing more stable revenue streams, strengthening customer relationships, and managing risk and competitive pressure, that explain why firms in an increasingly competitive environment are complementing or replacing product-centric models with service-based models. Kowalkowski *et al.* (2015) argue that firms use servitisation to secure more stable revenue streams and strengthen customer relations through deeper involvement in customer operational processes. Service strategies enable a transition from isolated product transactions to long-term relational engagements where value is co-created and continually adapted to the customer's needs.

Further research develops the understanding of value creation in servitisation contexts by adopting a systemic perspective. Meynhardt *et al.* (2016) conceptualise value as a multi-dimensional and context-dependent phenomenon that is perceived differently by actors depending on their position within a broader service system. From this perspective, value is not an inherent property of a technology or business model. Instead, it depends on how actors perceive its contribution within their current organisational and institutional context. This view emphasizes that evaluations of value are subjective and vary depending on who benefits, rather than assuming outcomes are the same or objectively measurable.

Research on servitisation within industrial contexts signifies that the shift towards servitisation is not an extension of the product offering but a deep organisational reorientation. Palo *et al.* (2019) demonstrate that servitisation develops through practice-based interactions between organisational actors, where competing interpretations of what is considered a service shape the trajectory of business model development. Töytäri and Rajala (2015) showed that firms must develop new commercial and organisational capabilities, such as value-based selling, customer outcome understanding, and a deeper understanding of the customer outcome, to support this transition.

Servitisation has already been implemented in different industries and is well documented, like the example of Rolls-Royce, which provides aircraft engines through a power-by-the-hour business model. With this arrangement, customers like Airbus pay for the engine availability and usage rather than purchasing the engine (Rolls-Royce 2024). Other examples mentioned in Service Strategy in Action by Kowalkowski and Ulaga (2017, pp. 4-7) are Boeing and Xerox. The authors describe how the aerospace company Boeing has a central growth strategy, with the objective of having substantial service growth. Boeing aimed to improve service sales from about $15 billion in 2015 to $50 billion in 2025. This reflects the deliberate move to complement traditional product sales with more service-based offers. The case of Xerox, the multinational corporation historically known for manufacturing photocopying equipment, was a successful transition through servitisation. By acquiring a business service firm and expanding its service portfolio, the company transitioned from a pure product sales model to one that included business services. As a result, the revenue derived from services and the share of revenue from services increased from approximately 15% to 56% in 2014 (Kowalkowski & Ulaga 2017, pp. 4-6).

In Bustinza *et al.* (2015), it is highlighted how a firm`s structural position shaped its opportunities to capture value from service-based products. Firms that are closer to the end user can possess advantages in leveraging customer insights and co-creating value. In contrast, firms higher up in the chain can often experience higher levels of constraint because of weaker levels of customer interactions, which can limit the ability to develop advanced service offerings. Wang *et al.* (2024) illustrate how servitisation can connect operational decision-making by tying maintenance, quality management, and service levels into an integrated contractual framework.

Small to medium-sized industrial firms have a different result of implementing servitisation than larger firms. In Bonfanti *et al.* (2018) it is demonstrated that SMEs turn to service-based options as a way to implement differentiation, the limited financial resources restrict the development of more advanced solutions. Taipale-Erävala and Muhos (2018) show that micro enterprises face capability gaps that are related to service design, long-term planning, and customer integration, which can constrain the ability to move beyond basic service provisions.

Recent research has further extended these discussions by emphasising that value creation in service-based business models cannot be understood in isolation from the broader systems in which industrial actors operate. Vargo *et al.* (2020, pp. 529) conceptualise value co-creation as a systemic process that emerges through interactions among multiple actors within a service ecosystem, rather than through bilateral exchanges between a provider and a customer. From this perspective, co-creation is shaped by institutional arrangements, shared practices, and existing structures, meaning that the realisation of value depends on how new service-based models are integrated into established operational and organisational systems.

2.2 Servitisation in the forestry and sawmill industry

Research on the servitisation in the wood and sawmill industry has primarily been directed at how digital technologies, scanning systems, and potential service-oriented business can improve efficiency in the industry. In Makkonen (2018) findings, digitalisation in the wood products industry is perceived as a central driver for improved efficiency by using production data and making more informed decisions.

A significant body of studies is focused on CT scanning and internal quality detection technologies, primarily examining the technological and operational contributions rather than their role in a service-based business model. In Fredriksson *et al.* (2015), the use of CT in the sawing process could give a potential yield increase of more than 11% points in the cross-cutting process, where the length of timber is decided, referring to an absolute change rather than a relative percentage increase. Olofsson *et al.* (2019) show that CT scanning can improve grading accuracy and consistency along the sawmill process by linking high-resolution CT data of virtual planks to camera-based grading outcomes after drying. Their study demonstrates that CT data, when combined with multivariate PLS-based grading models, can significantly increase the alignment between grading systems and thereby enhance the reliability and value recovery of the sawmill process.

Studies about CT technology have demonstrated the benefits of CT scanning, and research has also indicated that the adoption of advanced digital systems in sawmills is shaped by organisational, structural, and value chain conditions that influence whether service-based models are practicable. Hoeben *et al.* (2023) review how innovation pathways in wood-based value chains highlight the importance of digital tools, stronger information flows, and collaborative practices for increasing adaptability and resilience. These system-level findings reinforce that the wood sector's shift toward more digitally connected, and service-oriented structures is underway, creating conditions that may influence how sawmills adopt advanced technologies in the future.

In conclusion, while research indicates that digitalisation and CT technology can enhance sawmill efficiency, organisational and structural factors often limit the viability of implementing such solutions as services. Despite a gradual increase in digital collaboration within the industry, there remains a lack of knowledge regarding how advanced technologies, such as CT scanning, can be effectively offered and implemented through service-oriented models. This highlights a significant research gap: under what conditions could Swedish sawmills adopt CT technology through service-based business models?

2.3 Barriers to servitisation

While servitisation has been widely discussed as a strategic response to the rising competition within the manufacturing industry, prior research shows that the transition from product-centric to service-focused business models rarely follows a simple, linear path (West *et al.* 2022). Instead, organisations encounter several barriers that slow down, complicate, and even prevent the development of advanced service offerings. Research on industrial services highlights that these barriers are not primarily a result of resistance to change, but rather stem from structural, economic, and operational conditions that are inherent in manufacturing contexts. As a result, servitisation should be viewed as a gradual and context-dependent journey instead of a uniform strategic shift (ibid., pp. 1-4).

Prior research has shown that there are different types of barriers that make it hard for organisations to move towards service-based business models (West *et al.* 2022). These barriers relate to customers, organisational structure and culture, knowledge and information, products and activities, competitors and partners, economic and financial conditions, as well as broader societal and environmental factors. Rather than being independent of each other, the barriers interact and strengthen each other during the journey towards servitisation; their relative significance varies depending on the characteristics of the industry and organisation-specific conditions (ibid., pp. 4-10).

In capital-intensive industries that are characterised by high fixed costs, long investment horizons and critical processes, some barriers are particularly prominent (West *et al.* 2022). Economic and financial barriers are central because service-based business models often demand high initial investments, new pricing models and the assumption of performance-related risks, which differ greatly from traditional product sales. At the same time, barriers related to knowledge and information emerge because effective services often depend on gathering operational data and the specialised process knowledge found within the customer's own operations. Such factors increase worries about control and dependency, as well as the risk of exposing sensitive data. This makes companies less likely to outsource their main operational tasks to external partners (ibid., pp. 14-15).

Altogether, prior research suggests that the feasibility of servitisation is shaped less by technical capability than by the organisation's ability to handle risk allocation, economic uncertainty and the difficulties of sharing knowledge between different organisations. In contexts where continuity in production and process optimisation is critical for profitability, organisations tend to choose a hybrid model that retains ownership and control while selectively incorporating service elements. These barriers provide a relevant analytical lens for examining under what conditions advanced technologies, such as CT scanning, could be offered and adopted as services within Swedish sawmill operations (West *et al.* 2022, pp. 11-13).

3 Theory

This chapter is organised into three sections. It introduces the theoretical perspectives applied in the study and concludes by outlining the conceptual framework used in the analysis.

3.1 Servitisation theory

Servitisation is referred to as a business model transformation in how manufacturing businesses create and deliver value, where the shift from a traditional product manufacturing business model to a model that includes services and integrated product service offers. Instead of only focusing on sales and ownership of physical products, servitisation emphasizes value in use, functionality, and performance over time (Baines et al. 2009). This transformation is a strategy against growing competition, market saturation, and decreasing margins within many industries.

Research within servitisation underlines that service offers could take on multiple forms, basic product-related services such as maintenance and support, to more advanced service arrangements where suppliers assume greater responsibility for customer outcomes (Kowalkowski & Ulaga 2017, pp. 104). Arrangements like these often require closer and more long-term relationships between suppliers and customers, organisational structures, and new capabilities within service delivery, data management, and customer interaction.

Within industrial and capital-intensive environments, servitisation is often referred to as a gradual and non-linear development instead of a direct strategic shift. Earlier research shows that the speed and extent of servitisation can vary widely across different industries and organisations. This variation is because of differences in asset specificity, product complexity, and organisational capabilities. Within capital-intensive production environments, organisations often retain ownership-based business models while selectively introducing service components that support the physical product. As a result, servitisation is commonly manifested through hybrid or partial solutions rather than fully outcome-based and result-oriented service models (Baines *et al.* 2009).

Research on industrial services indicates that the gradual development of services is closely linked to structural conditions within the manufacturing organisation. This is including established investment logics, tightly integrated production systems, and a strong reliance on specialised technical knowledge (West *et al.* 2022, pp. 4-15). These conditions influence how services are designed, delivered, and governed, which in turn may limit the possibilities for transferring operational responsibility from the customer to the supplier.

Servitisation has also been conceptualised as a form of business model innovation that influences how value is created, delivered, and captured across organisational and contractual boundaries (Töytäri & Rajala 2015, pp. 103-106). This perspective highlights that service-oriented offerings often require changes in both external market relationships and internal processes, decision structures, and coordination between technical and commercial functions.

In industrial environments, such changes may challenge existing organisational routines and established roles, particularly when services are closely integrated with the operational core of the business and critical production data (West *et al.* 2022, pp. 43-47).

3.2 Innovation theory

Innovation theory creates a framework to understand how innovations, technology, and business models are spread and accepted within industries. In this study, innovation theory is used as a supporting perspective to understand how organisations perceive and evaluate new technologies and business models, rather than to predict diffusion or adoption outcomes. One of the most influential models in innovation technology is the Diffusion of innovations theory by Rogers (1962), which explains how and when innovations are adopted at different rates among individuals and organisations. Rogers defines diffusion as the process by which an innovation is communicated through some channels over time and between members of a social system.

According to Rogers (1962, pp. 211-240) five key attributes determine the likelihood and rate of an innovation to be adopted:

- Relative advantage: in what grade an innovation is perceived as better than existing solutions.
- Compatibility: How well the innovation fits into current values, methods, and needs.
- Complexity: The perceived difficulty in understanding and using the innovation
- Trialability: To what extent the innovation is tested before full implementation.
- Observability: How visible and demonstrative the results of the innovation are for others.

These dimensions provide an analytical lens on how decision makers evaluate innovations under uncertain conditions. Rogers (1962) emphasizes that diffusion is not only a technological process but also a social process, influenced by communication channels, trust, and opinion leaders within a network.

In traditional and capital-intensive industries such as sawmilling, these mechanisms are relevant for understanding how new technologies and business models are assessed at an organisational level. The *relative advantage* of a model like CT as a Service could be a lower financial risk and give access to more advanced technologies. *Compatibility* refers to how well such a model complies with current routines, economic practices and long-term customer relations. *Complexity* is related to the perceived difficulty of managing new contract-related and operative structures, while *trialability* could decrease uncertainty through pilot projects or temporary contracts. *Observability* is the visibility of successful results in other businesses, which can further accelerate the implementation through demonstration effects and social proof.

3.3 Conceptual framework

The conceptual framework in Figure 1 for this study combines the theoretical perspectives of servitisation and innovation theory to structure the analytical focus of the study. Servitisation theory provides the value-creation logic and emphasises how organisations move from product ownership toward more service-based agreements, where value is realised through functionality and performance rather than ownership (Baines *et al.* 2009; Kowalkowski & Ulaga 2017). In this study, servitisation theory is used to frame how sawmills reason about value, responsibility, and control when CT is offered as a service.

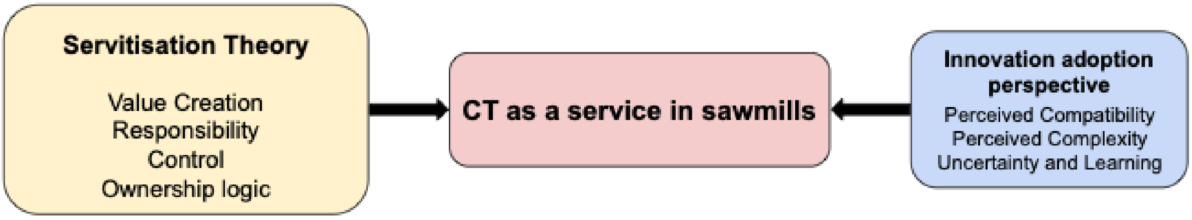

Figure 1.Conceptual framework illustrating how servitisation theory and an innovation adoption perspective are used to analyse the evaluation of CT technology as a service in capital-intensive sawmill operations.

Innovation adoption theory is employed to elucidate how decision-makers assess and adapt to emerging technologies and business models amid uncertainty, rather than to delineate technological progression or innovation processes. Drawing upon diffusion and adoption research, this perspective underscores how perceived characteristics such as relative advantage, compatibility, and complexity shape organisational evaluations and acceptance of new technologies (Rogers 1962). In this study, innovation adoption theory supports the analysis of how sawmill organisations, as decision-making entities, assess the feasibility, risks, and organisational implications of accessing CT technology through service-based arrangements.

Together, the two theoretical perspectives facilitate an analysis of how value-creation logics interact with organisational evaluation and adaptation processes within capital-intensive contexts. In line with existing research, neither servitisation nor technology adoption is regarded as a purely linear or universally applicable process; rather, these developments are understood as contingent, context-specific, and influenced by competing value logics and organisational structures (Töytäri & Rajala 2015; Palo *et al.* 2019). The conceptual framework is used to structure the relationship between theory and empirical analysis without implying deterministic adoption outcomes.

4 Method

This chapter describes the research design, data collection, and analytical approach used to address the research aim and research questions.

4.1 Research design

This study applied a qualitative research design using semi-structured interviews to explore how decision-making within sawmill organisations perceives, evaluates, and reasons about adopting CT technology through a service-based business model. The research was guided by the study's aim to understand how servitisation can be an alternative business model for the traditional manufacturing industry.

A qualitative approach was considered appropriate because CT-as-a-service represents an emerging and underexplored phenomenon within the sawmill industry. When research aims to examine how actors interpret uncertainty, risk, and value in relation to novel business models, qualitative methods are particularly suitable, as they enable in-depth exploration of meanings, experiences, and decision-making logics rather than measurement of predefined variables (Bryman 2011, pp. 390-391).

Semi-structured interviews were chosen to balance analytical focus with flexibility. This format allows the researcher to address theoretically relevant themes such as investment logic, risk perception, and organisational control while also giving respondents the opportunity to elaborate on issues they consider important in their specific organisational context. Compared to structured surveys, interviews enable richer insight into how strategic evaluations are constructed under conditions of uncertainty, but at the cost of statistical generalisability.

The unit of analysis in this study is the sawmill organisation as a decision-making entity with respect to investments in and access to CT technology. Individual respondents are treated as key informants who represent organisational perspectives rather than as analytical units in their own right. The study does not aim to compare organisations as distinct cases in a formal multiple-case research design; instead, it seeks to identify shared patterns and variations in how sawmill organisations reason about service-based access to critical production technologies.

By including respondents from several sawmill organisations with different production characteristics and levels of experience with CT technology, the study enables an analytical comparison across organisational contexts. This comparative logic supports theory development by highlighting recurring themes and contextual differences, while remaining exploratory in nature rather than explanatory or predictive (Bryman 2011, pp. 84-95).

4.2 Data collection method

Prior to the empirical data collection, a literature review was conducted to identify existing research on servitisation, digital technologies, and business model transformation in industrial contexts. The review focused on peer-reviewed academic literature and aimed to establish the theoretical foundation of the study. Academic literature was identified using Google Scholar and Web of Science, complemented by the AI-assisted academic search engine Sourcely, which was used to broaden the initial scope and support the identification of relevant studies.

The literature search was conducted in an exploratory manner rather than as a fully systematic review. It combined structured database searches with an iterative screening process, where keywords related to servitisation, digitalisation, and advanced production technologies were applied flexibly. Additional terms were introduced as the review progressed, and titles, abstracts, and reference lists were examined to assess relevance. The search primarily focused on literature published from the early 2000s onwards and prioritised relevance to the research aim rather than documenting the number of search results. The following keywords were used in the literature search:

- "Sawmill"
- "Servitisation"
- "CT "
- "Computed tomography"
- "Digitalisation"
- "Business model innovation"
- "Industrial services"

The purpose of this literature review is to identify existing knowledge within the research area and to position the study in relation to previous research. Through a thematic and comparative review of prior studies on servitisation and digital business model transformation in manufacturing and forest-industry contexts, the literature review establishes the theoretical foundations of the study and highlights areas where empirical knowledge remains limited, thereby motivating the examination of CT as a service in Swedish sawmills, while acknowledging relevance for similar Scandinavian sawmill contexts (Bryman 2011, pp. 111-113).

Following the literature review, the empirical data collection was conducted primarily through semi-structured interviews with representatives from Swedish and Norwegian sawmill organisations. In addition, one pilot interview and one site visit were conducted to support the interpretation of the interview data. Semi-structured interviews were chosen to capture in-depth perspectives on investment decision-making, perceptions of CT technology, and attitudes toward service-based business models. The study is exploratory and focuses on strategic reasoning and organisational conditions, for which interviews are well suited.

The unit of analysis in this study is the sawmill organisation, conceptualised as a decision-making unit regarding investments in and access to CT technology. Individual respondents constitute the units of observation and are treated as key informants representing organisational perspectives. The study does not aim to analyse individual attitudes as such, but to understand organisational decision-making logic related to technology adoption and service-based business models.

Interviews were conducted in Swedish between October and November 2025, and respondents answered in Swedish or Norwegian. Selected quotations were translated into English by the author using a largely literal translation approach to preserve the original wording and meaning. To minimise the risk of misinterpretation, the translated quotations were checked against the original transcripts to ensure consistency of meaning and context.

Before the interviews, one pilot interview was conducted to test interview questions and the thematic focus of the questions. In addition, one site visit was conducted after one interview to gain a better understanding of the production context and clarify practical aspects related to a CT implementation. These activities served as a complementary input to support the context to help understand the interviews, rather than as standalone data.

4.2.1 Selection of participants

Sawmill organisations were selected as analytical unit because decisions regarding CT technology involve substantial capital investment, long-term operational commitments, and integration into core production infrastructure. These characteristics make technology adoption a collective organisational decision rather than an individual one. The selected sawmills operate capital-intensive softwood production processes where CT technology is a relevant but not yet widely adopted option.

The selection of respondents was based on the size of the sawmill, production focus on softwood, and geographical location within Sweden. In addition, one interview was conducted with two representatives from a Norwegian sawmill. This interview was included to provide supplementary contextual insight from a closely related industrial setting and to reflect variation in organisational experience with CT technology, rather than to enable a systematic comparison between Swedish and Norwegian sawmills. The study focuses on sawmills with an annual production of between approximately 200,000 and 500,000 cubic meters of softwood timber. As this segment represents medium to large-sized sawmills.

Information regarding sawmill characteristics and production capacity was obtained from industry-based sources. Based on this information, sawmills were selected to ensure variation in organisational context, ownership structure, and regional location.
Representatives were chosen based on organisational role and involvement in investment strategies, technical adoption, business development, and knowledge of the sawmill. This selective approach ensured that the respondents had relevant knowledge and experience to contribute to the discussion of adopting CT as a Service and evaluate the service business

model in practice. In Table 1 below, the respondents are presented with their role, organisation during the time of the interview, and date of the interview.

Table 1. Presentation of the respondents of this study

Respondent	Role	Organisation
Per Andersson	Development Manager	Derome
Johan Oja	Head of Technical Staff	Norra Skog
Fredrik Löfgren	Operations Engineer	SCA
Victor Holmquist	Industrial Manager	Holmen Trävaror
Eivind Skaug	Project Manager	Moelven Wood
Martin Hillestad	Process Controller	Moelven Wood
Jonas Lantz	Site Manager	Setra Group

To find suitable respondents to the interviews, a recruitment process was carried out by contacting people from the sawmill industry to find the most suitable respondents. Most of the major sawmill organisations in Sweden were contacted with limited answers. When contact with a potential respondent was made, the aim and interview questions were presented to ensure that the respondent was suitable for the interview.

4.2.2 Semi-structured interviews

Semi-structured interviews were chosen to give flexibility to explore new subjects while ensuring comparability between respondents was possible. The design refers to capturing the sawmills stakeholders' interests perspective on what determines interest, perceived value, and practical feasibility when advanced technologies are offered through a service-based model (Robson 2002, pp. 290-291).

An interview guide was developed based on the study's conceptual framework, ensuring the questions were theoretically grounded while allowing respondents to speak freely about the relevant topics. The interview guide was structured around four main themes: investment logic and decision making, perceived value of CT technology, attitudes toward CT as a service, and organisational readiness for adopting service-based solutions. The full interview guide is presented in Appendix 1. The interview guide was theoretically grounded in servitisation theory and innovation theory. The full set of interview questions and their theoretical linkage is presented in Appendix 2.

The duration of the interviews ranged between 45 and 75 minutes, the flexible interview format allowed follow-up questions and clarification responses, strengthening the quality of the empirical material. One interview was conducted in written form, while the remaining five were conducted via Microsoft Teams. The interview dates and the approval dates for the use of quotations are presented in Table 2.

Table 2. Presentation of the Approval of quotations respondents of this study

Respondent	Date of interview	Date of receiving approval for quotations
Per Andersson	30 October 2025	19 December 2025
Johan Oja	31 October 2025	17 December 2025
Fredrik Löfgren	5 November 2025	18 December 2025
Victor Holmquist	13 November 2025	20 December 2025
Eivind Skaug	20 November 2025	17 December 2025
Martin Hillestad	20 November 2025	17 December 2025
Jonas Lantz	24 November 2025	17 December 2025

The approvals for using the quotations were sent via email, allowing the respondents to verify their accuracy.

4.3 Analysis method

The empirical material was analysed using thematic analysis. The analysis follows the approach described by Braun and Clarke (2006, pp. 77-93) where thematic analysis is defined as a qualitative method for identifying, analysing, and interpreting recurring patterns in the empirical material.

In line with Bryman (2011, pp. 299-321), qualitative analysis is understood as an interpretive process that combines systematic procedures with analytical flexibility. Thematic analysis was therefore applied as a structured yet interpretive analytical approach, in which themes were developed through systematic engagement with the interview data. The analysis is structured in accordance with the conceptual framework presented in Figure 2, which guides the thematic organisation and interpretation of the empirical material.

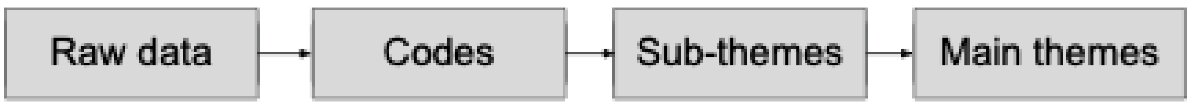

Figure 2. Overview of the thematic analysis process, illustrating the progression from interview data to codes, sub-themes, and final analytical themes.

All interviews were transcribed and analysed systematically to gain familiarity with the material, as illustrated in Figure 2. The meaningful segments were coded and grouped into sub-themes. These groups were analysed in relation to the conceptual framework based on servitisation and innovation theory, both individually and across cases, enabling a comparison between sawmill organisations. The interview themes were derived from the study's conceptual framework and research questions and were designed to capture how sawmill decision-makers reason about value creation, risk, and organisational implications associated with accessing CT technology through service-based arrangements.

The analysis was made with five main themes:

- Investment logic and decision making
- Perceived value of CT technology
- Attitudes toward CT as a service
- Risk perception
- Organisational readiness

The themes reflect key dimensions of servitisation theory and the innovation adoption perspective and were used to structure the interviews, while allowing respondents to elaborate on issues they considered particularly relevant. These themes structure the presentation of the empirical results and form the base of the analysis and discussion.

4.4 Quality of research

According to Bryman (2011) quality in qualitative research is ensured through the concept of trustworthiness, which consists of four dimensions: credibility, transferability, dependability, and confirmability.

Credibility was ensured through sampling of respondents with relevant knowledge in the subjects' investment decisions and technological adoption in Swedish sawmills, with one supplementary interview from a Norwegian sawmill. In addition, analytical triangulation was supported by relating the interview data to relevant academic literature. The use of an interview guide with a theoretical base further strengthened the alignment between the empirical data and the conceptual framework.

Transferability was addressed by providing a detailed description of the respondent selection criteria. Further information about the respondents' role in the organisation was presented. This enables the reader to evaluate the extent to which the findings may be relevant to similar industrial contexts.

Dependability was maintained by transparent documentation of the research process, including the interview guide and data collection process. The interview guide and original quotes were provided in the appendices, which ensured methodological transparency and auditability.

Confirmability was strengthened by basing the analysis on verbatim transcriptions. Interpretations were developed through systematic coding and by comparing different cases to make sure all claims were rooted in the empirical data. Direct quotes were included in the thesis to illustrate and support the findings. To avoid misinterpretation and researcher bias, the selected quotes were sent to the respondents via email, along with a description of how they would be used in the analysis. The date of the interview and approval of quotations are presented in Table 2. This allowed respondents to verify the context in which their quotations were used. The interview guide and the questions' theoretical connection are included in Appendix 2.

4.5 Ethics and moral

Participants were informed about the purpose of the study, their role, and their rights prior to each interview and provided informed consent to participate. Consent was also obtained to record and transcribe the interviews. Confidentiality was ensured by not disclosing respondents' names or other identifying information in the thesis. Respondents were referred to by organisational role rather than by name, and care was taken to avoid descriptions that could lead to individual identification. Full interview transcripts were used solely as the analytical basis for the thematic analysis and were not included in the appendix or shared externally. Selected quotations were used illustratively in the study and were sent to respondents via email, together with their contextual meaning, to allow verification of how they would be used in the analysis (Bryman 2011, pp. 136-159). Data protection was addressed by storing audio recordings securely during the thesis process and deleting them after transcription. Access to recordings and transcripts was restricted to the author.

5 Background

This chapter provides an empirical overview of the current adoption of CT technology in Swedish sawmills and outlines the national industry context for considering CT as a service.

5.1 Computed tomography in Swedish sawmills

The focus on Swedish sawmills reflects the primary empirical context of the study. While one interview was conducted with representatives from a Norwegian sawmill, this interview is treated as a supplementary empirical input and does not motivate a comparative background between national contexts. There is a limited number of CT scanners installed in Swedish sawmills; the CT is a relatively new technology in the context of sawmill operations. The first CT scanner for sawmill operations was installed and commissioned for use in 2018 by Norra Skogs in Sävar sawmill (Weichel 2018). Up until 2025, two additional organisations have installed CT technology in their production lines.

CT is an X-ray–based imaging technology that generates three-dimensional representations of objects by reconstructing their internal structure from multiple two-dimensional projections. In sawmilling, the CT scanning process produces a digital reconstruction of the log, including internal characteristics, which is not possible with traditional surface-based measuring. The reconstructed 3D model of the log allows for analysis of its internal composition before sawing, shifting the availability of information to an earlier stage in the production process. The technology enables high-resolution, three-dimensional imaging of internal log characteristics, such as knots, cracks, density variations, and fibre orientation, before sawing.

According to the CT sawmill producer Microtec, CT technology enables optimisation based on internal log characteristics and the evaluation of different sawing alternatives using various criteria, allowing the outcome to be determined directly when the log is scanned. The technology can also be a part of a broader sawmill production system where you can follow each log through all stages of the sawmill process, leading to the possibility of traceability and digital sorting of logs (Microtec 2025).

5.2 The potential of computed tomography as a service

There is currently no experience with using CT as a service in sawmills, as the technology is still in the early stages of adoption. The investment requires substantial capital and involves significant changes to the production chain. There are only a few sawmills with the technology, but there is potential for more. Investments in new sawmill technology in Sweden have been substantial and increasing over time (Freij 2023).

Sawmills with access to enough capital for investments are better positioned to invest in new technology, while other sawmills may stay more conservative with their investment strategies. These conditions could create a possible market for alternative business models such as sawmill machinery offered as a service, this model could capital barrier associated to adopting new technology.

A previous study by Pernkopf *et al.* (2019) indicates that CT technology has the potential to generate a value uplift ranging from approximately 5% to 42%, depending on production assumptions. In simulation-based analyses, the greatest gains were associated with production strategies that reallocated output toward higher-value products. These findings illustrate that the economic impact of CT technology is highly context-dependent and linked to how production decisions are configured. As such, they are relevant for understanding how sawmills may evaluate both ownership-based investments and alternative access models, including service-based arrangements. Together, these conditions constitute the background against which the potential of CT as a service is examined in subsequent sections.

6 Results

This chapter is structured around five empirical themes, synthesising findings related to investment decision-making, perceived value, attitudes towards CT as a service, risk perceptions, and organisational readiness for innovation.

6.1 Investment logic and decision making

In sawmills, the investment decisions are governed by a stable long-term profitability, short payback time, and operational reliability. All respondents agreed that new investments must generate a stable income over time, and profitability was repeatedly mentioned as a primary threshold.

"Profitability. Will this investment generate money so that we actually make money from it?"

- Fredrik Löfgren, Operations Engineer, SCA

This statement indicates that investment decisions are primarily evaluated through a straightforward profitability logic, in which CT technology is assessed based on its ability to generate stable financial returns rather than on its technological sophistication. Another respondent answered that conservative investment calculations are important.

"We usually outperform our estimates when we do the evaluation afterwards. On the cost side, we tend to be in good shape in nine cases out of ten. But there is always the possibility that something completely unforeseen can happen."

- Johan Oja, Head of Technical Staff, Norra Skog

This quotation reflects a cautious, risk-aware investment approach, in which conservative calculations are used to manage uncertainty and protect the organisation against unforeseen operational or financial disruptions. Respondents highlighted that investments should not disrupt production continuity, as downtime is a critical risk. Production stoppages carry the second-largest cost for sawmills after raw materials, according to one respondent. About half of the respondents emphasized the importance of minimising downtime when evaluating CT technology.

Production volume was also identified as a decisive factor. Sawmills with lower output volumes were considered unsuitable for investment in CT technology, as the economic justification relies on high throughput to offset capital intensity and operational risks.

"Since we have so many units, it will most likely be the larger units where CT could be relevant, because we have sawmills that produce 50–60,000 cubic meters of sawn timber, and it would never be feasible. At least not with the level of investment that exists today."

- Eivind Skaug, Project Manager, Moelven Wood

This statement highlights that CT technology is perceived as economically viable only at higher production volumes, reinforcing the view that scale is a decisive condition for justifying capital-intensive investments. Another factor mentioned by two respondents was that sawmills that are focused on Scots pine rather than Norwegian spruce are more likely to have a shorter payback period with the CT technology.

"At a pine sawmill, it can probably be particularly profitable."

- Victor Holmquist, Industrial Manager, Holmen Trävaror

This quotation suggests that the perceived profitability of CT technology varies depending on production characteristics, indicating that investment decisions are contingent on raw material composition and expected value uplift rather than uniform across sawmills.

6.2 Perceived value of computed tomography

Perceptions differed notably between respondents with direct experience of CT technology and those without such experience, suggesting that feasibility assessments are partly shaped by familiarity and exposure rather than operational outcomes alone. Generally, the respondents described CT technology as having substantial potential to improve value recovery and decision-making in the sawmill. Respondents without CT technology were more careful in indicating whether the investment could be positive. Two respondents from organisations with CT technology reported positive experiences with it. This indicates that feasibility assessments are shaped not only by expected operational outcomes but also by familiarity and experiential learning, where a lack of hands-on experience contributes to more cautious evaluations.

"We cannot really hide the fact that we have bought another CT. Which means that we are satisfied."

- Johan Oja, Head of Technical Staff, Norra Skog

This statement indicates that direct experience with CT technology strongly influences perceived value, where repeated investment is interpreted as evidence of organisational satisfaction and confidence in the technology's benefits. One respondent stated that CT technology was a step towards a qualitative step in a sawmill beyond laser-based 3d systems and conventional X-ray solutions, primarily due to the possibilities in extracting internal information about the qualities from logs.

"And we already see a huge difference when moving from a standard 3D frame laser to an X-ray. A CT scan would therefore be a step up in terms of the level of detail in the information you obtain, and the possibilities that come with it."

- Martin Hillestad, Process Controller, Moelven Wood

This quotation illustrates how CT technology is perceived as qualitatively different from existing scanning solutions, particularly through its ability to provide more detailed internal information that can support improved decision-making in log breakdown and production planning. Multiple respondents described the connection between perceived value and specific wood species and product categories. The perceived value uplift was strongly linked to wood species and product mix. Sawmills working with Scots pine are expected to perceive the largest uplift rather than those working with Norwegian spruce, due to process and quality differences between the species.

"Pine and spruce differ quite a lot when it comes to sawn products. In CT scanning, you can place your boards more or less as you like to avoid defects within the log. And this is not as critical at spruce mills or spruce sawmills."

- Fredrik Löfgren, Operations Engineer, SCA

This statement highlights that the perceived value of CT technology is contingent on production characteristics, suggesting that expected benefits vary depending on wood species and product mix rather than being uniform across sawmills. Three respondents expressed some doubts about whether CT technology could be sufficient to justify investment. These doubts were only apparent with organisations without experience of the CT technology. Suggesting that uncertainty regarding the economic justification of CT technology is concentrated among organisations without prior experience, reinforcing the role of experiential knowledge in shaping investment confidence. Beyond direct yield and value recovery, several respondents also described the importance of how CT-generated data is used within the organisation.

6.3 Attitudes toward computed tomography as a service

The respondents expressed different attitudes toward accessing CT technology as a service in contrast to traditional ownership. Four respondents expressed openness to alternatives to traditional ownership, while others preferred owning the equipment. Two of those respondents preferred ownership but were positive for service models. One respondent noted that a service solution could be beneficial for organisations that do not want to commit capital to investments at this time.

"If you look around today, companies avoid tying up large volumes of capital."

- Fredrik Löfgren, Operations Engineer, SCA

This statement illustrates that openness to CT-as-a-service is linked to a broader financial logic where capital flexibility is valued, particularly under conditions of investment uncertainty. Three respondents expressed a clear preference for owning their equipment rather than using a leasing or a service-based arrangement. As one respondent stated:

"We usually always own the equipment."

- Per Andersson, Development Manager, Derome

This quotation reflects a deeply embedded ownership logic in which control and long-term cost considerations outweigh the perceived benefits of service-based arrangements. The other respondents were all a bit sceptical of the idea of leasing or a service-based arrangement of the CT technology. The respondents stated that they would rather own their equipment than obtain it as a service. As one respondent explained:

"If you have the money and believe in the technology, then it is cheaper to buy. It is the same thing. We do not lease vehicles either; we buy them."

- Johan Oja, Head of Technical Staff, Norra Skog

The statement highlights that scepticism toward CT-as-a-service is grounded in cost comparisons and established organisational practices, in which ownership is associated with economic rationality and operational autonomy. Five respondents indicated that a CT-as-a-service solution was feasible, and two expressed cautious optimism about this payment model.

"So we are not unfamiliar with the idea of paying for a service for the time that you use it."

- Eivind Skaug, Project Manager, Moelven Wood

This statement highlights that doubts about CT-as-a-service are based on cost analysis and long-standing organisational routines, where ownership is associated with financial viability and operational independence. Payment models for CT-as-a-service were discussed, including usage-based and leasing models. All but one respondent favoured payment per cubic meter, as this payment model is already a proven standard in the sawmill industry. This suggests that feasibility assessments of service-based payment models are influenced by alignment with existing industry pricing conventions rather than purely economic optimisation.

"Paying per cubic meter is so well established in the way of thinking."

- Victor Holmquist, Industrial Manager, Holmen Trävaror

This statement suggests that the preference for volume-based pricing reflects cognitive and institutional familiarity, reinforcing the attractiveness of payment models that fit established decision-making routines. Only one respondent proposed an alternative to volume-based pricing by a hybrid payment model that combined production volume with profitability outcomes. The volume-based fee would serve as a base and provide predictability, while the profitability component would create an incentive for the supplier to deliver measurable value. With this model, the risk would be distributed between the CT producer and the sawmill.

"If it were you as the seller and me as the buyer, I would try to structure it so that, for simplicity, we say one krona per cubic meter, where 50 öre is tied to the volume and 50 öre is tied to profitability. That way there is an incentive for you to deliver a good product in order to capture the full value, and we can trust that we will get the best handling because you have a really good solution."

- Fredrik Löfgren, Operations Engineer, SCA

This quotation illustrates an alternative service logic in which risk and incentives are shared between provider and customer, indicating a willingness to explore hybrid arrangements when value creation and accountability are aligned.

6.4 Risk perception in service models

Risk perception for the CT as a service was considered both financially and operationally. Also, the physical installation was considered. Respondents raised concerns about the uncertainty of production continuity, control, and usability. Indicating that risk assessments related to CT-as-a-service are multidimensional, encompassing financial exposure, operational continuity, and physical integration into existing production systems.

Operationality was an important factor, and for a lot of the respondents, production downtime was seen as one of the highest costs for the sawmill, which explained why the risk of production downtime was one of the most frequently mentioned.

"*Not producing at a sawmill is extremely costly*."

- Fredrik Löfgren, Operations Engineer, SCA

Illustrating that operational risk, particularly the risk of production downtime, is perceived as a central cost driver and a critical constraint in decisions related to CT-as-a-service. Regarding data management and the use of technology to optimise the sawmill, the respondents discussed whether production information should be shared with the provider. One respondent opposed external assistance, explaining that optimisation is what can give the sawmill a step ahead of the competition.

"When you start thinking about how to use the data, you end up right at the core of our business operations. That is what you compete on."

- Johan Oja, Head of Technical Staff, Norra Skog

This quotation highlights concerns related to control over production data, indicating that data sharing with a service provider is perceived as a strategic risk due to its close connection to competitive advantage. Two other respondents were open to exchanging information in the early phases to test approaches and optimise the sawmill. The internal resources are limited in the early phase, which made this more attractive for the respondents. Willingness to share data is conditional and context-dependent, with openness increasing in the early phases, when internal resource constraints limit in-house optimisation capabilities.

One respondent expressed the same concern that the CT equipment must operate continuously, regardless of operating conditions. Service from the producer must be available at all times, independent of the ownership model.

"Regardless of whether you decide to run on Christmas Eve, the measurement equipment has to work."

- Johan Oja, Head of Technical Staff, Norra Skog

This statement reflects expectations of continuous operational reliability, suggesting that service-based arrangements are considered viable only if they can guarantee uninterrupted functionality under all operating conditions. Another prominent risk concerned dependency on the service provider. When two organisations enter into a service agreement, mutual commitment and active collaboration from both parties are essential. Another risk and concern was dependence on the service provider. One respondent explained that entering a service agreement for CT could be likened to a long-term commitment with uncertain outcomes.

"It is a bit like entering into a marriage with some reservations. And then you hope that the marriage works out. But say that it does not. Then you could end up with a problem right in the middle of your production line."

- Victor Holmquist, Industrial Manager, Holmen Trävaror

This quotation illustrates how dependency on a service provider is perceived as a significant relational and operational risk, where long-term commitment under uncertainty raises concerns about loss of control and potential disruption to core production processes. Another associated risk of the as-a-Service paradigm pertains to the potential withdrawal of a subscribing enterprise. The process of dismantling the machinery could prove to be intricate, potentially leading to disruptions within the production line.

6.5 Organisational readiness and innovation culture

All organisations demonstrated openness to innovation and new technology, with all respondents reporting significant technological investments in their sawmills over the past five years. Three respondents indicated that their organisations possess internal expertise to operate advanced technology and data systems. These respondents identified data analysis and technological control as key elements of their competitive advantage. While most of the sawmill process involves standard mechanical operations, optimisation is driven by technological advancements, as one respondent explained.

"The mechanical operations are fairly simple. A chain that moves, something that pushes it. So it is in the technology that profitability lies."

- Fredrik Löfgren, Operations Engineer, SCA

Despite this general readiness, respondents also identified several constraints that could limit the adoption of new technologies in sawmills. One recurring theme was the market fluctuations. Fluctuations in market demand and profitability directly affected the willingness and ability to undertake new large-scale technological commitments. Another factor was that the technology was not yet widely adopted in the sawmill industry, which limited opportunities for benchmarking and increased uncertainty in investment decision-making. Indicating that organisations with strong internal technological capabilities perceive greater control over advanced systems, which in turn shapes their confidence in adopting and operating complex production technologies.

“The uncertainty factors may mean that no one dares to make the decision.”

- Jonas Lantz, Site Manager, Nyby Sawmill, Setra Group

This reflects how market volatility and limited industry adoption contribute to decision paralysis, in which uncertainty constrains the willingness to commit to large-scale technological investments despite acknowledged potential benefits.

7 Analysis and discussion

This chapter is structured in three parts. The first part relates the empirical findings to the theoretical framework by revisiting the research questions. The second part discusses the results in light of existing research and highlights key patterns and tensions. The final part synthesises the findings by outlining their implications for the adoption of service-based business models in capital-intensive industrial contexts.

7.1 Infrastructure logic

Investment decisions in Swedish sawmills, which constitute the primary empirical context of the study, are characterised by conservative and stability-seeking logics. The dominant strategies include long-term profitability, operational continuity, and predictable performance. The CT technology is generally perceived as value-creating; however, the findings indicate that this characteristic alone is insufficient to motivate adoption unless it aligns with established investment criteria and acceptable levels of operational risk. In this context, CT is evaluated as a critical production asset that affects the stability of the entire production rather than as a discrete technological innovation.

The investment logic is closely linked to how value is operationalised within sawmill operations. Rather than defining value primarily in terms of efficiency gains or technological advancement, respondents repeatedly emphasised stable profitability over time as the central criterion for evaluation. This orientation towards long-term financial stability is consistent with classical views of strategy, which highlight sustained profitability and control over key assets as primary drivers of strategic decision-making (Whittington & Nilsson 2002, pp. 19-23). From this perspective, technological investments are evaluated not by their peak performance potential but by their ability to support reliable, continuous operation under fluctuating market and product conditions.

Conservative investment calculations and restrained expectations were described as deliberate strategies rather than as scepticism towards technology. Underestimating expected benefits was portrayed as a method of managing uncertainty and as a protection against downside risk. This reflects an organisational approach in which investments are prioritising downside protection over aggressive optimisation. Within capital-intensive industrial contexts, such decision-making logics tend to prioritize predictability and robustness over flexibility and experimentation. High fixed costs, long investment horizons, and limited reversibility tend to make operational failures particularly costly (Baines *et al.* 2009; Frank *et al.* 2019). Such risk-averse investment logics are also consistent with resilience-oriented strategies identified in wood-based value chains (Hoeben *et al.* 2023).

Interpreted through a servitisation lens, the findings suggest that value in use extends beyond improved functionality or higher output to encompass reliable performance that supports long-term financial stability. Servitisation research emphasizes that value in use is realised through consistent, dependable outcomes rather than through isolated performance improvements (Kowalkowski & Ulaga 2017, pp. 45-47). In this context, the cautious evaluation of CT reflects concern that introducing uncertainty into critical operations may undermine rather than enhance value creation.

A key factor in evaluating CT technology is the operational role within the production system. Once installed, CT becomes deeply embedded in the sawmill's production infrastructure, integrating sorting, sawing optimisation, data transparency, and downstream production planning. As a result, adopting CT involves risks beyond financial costs and can disrupt production continuity. Consequently, the risks associated with adoption go beyond mere financial investment, potentially disrupting ongoing production processes. Similar themes have been observed in earlier research on infrastructure-linked technologies, where the unique nature of assets and the interconnectedness of systems heighten the impact of failures and lead to cautious decision-making (Baines *et al.* 2009). This is consistent with industrial service research highlighting that failures in infrastructure-linked technologies tend to have system-wide consequences (West *et al.* 2022).

The expected value of CT technology was found to depend on the specific operational context rather than to be uniform across all sawmills. Respondents consistently linked CT's economic potential to variations in wood species and product mix, particularly highlighting greater relevance for pine-oriented sawmills. The adoption of CT is closely tied to production strategy and raw material characteristics, a finding that aligns with earlier studies demonstrating that optimisation technologies generate uneven benefits depending on material properties and sawing strategies (Fredriksson *et al.* 2015; Pernkopf *et al.* 2019). From an innovation adoption perspective, this highlights how the perceived fit between new technology and current production setups influences the decision to adopt (Rogers 1962).

Understanding these findings through an infrastructure perspective helps explain why CT technology is not evaluated according to conventional innovation adoption logic. In capital-intensive process industries, infrastructure assets are characterised by high asset specificity, deep integration into production flows, and irreversible consequences of failure. Prior research shows that such assets are governed by decision logics that prioritise reliability and continuity over flexibility and experimentation (Baines *et al.* 2009, pp. 547).

7.2 Servitisation constrains

The results indicate that offering CT technology as a service is possible but constrained by certain structural limitations. Although respondents valued the potential of service-based models to reduce initial investment and enhance adaptability in uncertain market environments, these benefits were frequently tempered by concerns about operational reliability, control, and accountability once CT technology is integrated into routine production processes. Interpreted through the conceptual framework, this suggests that servitisation is evaluated in relation to its compatibility with existing investment logics rather than as a straightforward alternative to ownership (Rogers 1962; Palo *et al.* 2019).

Operational reliability is now an essential requirement, no matter the ownership structure. Given the significant costs associated with production downtime in sawmill operations, CT technology is regarded as an integral part of the core production infrastructure rather than a mere peripheral support service. Within the conceptual framework, this suggests that servitisation is evaluated in terms of its compatibility with existing investment logics rather than as a straightforward alternative to ownership (Frank *et al.* 2019). From an innovation adoption perspective, the limited tolerance for uncertainty related to services highlights how failures in essential measurement and control technologies are seen as having lasting and system-wide impacts once they are integrated into core production processes.

Early research on servitisation viewed the shift from product-focused to service-oriented business models as a strategic response to rising competition and shrinking margins, highlighting the importance of creating value through integrated product service packages rather than simply transferring ownership (Vandermerwe & Rada 1988; Baines *et al.* 2009). From this viewpoint, providing sawmills with access to advanced technologies such as CT on a service basis could, in theory, help them realize value without bearing the full cost of investment. However, later studies have shown that servitisation doesn't follow a single, straightforward path instead, it evolves through different, sometimes competing value ideas within organisations (Bustinza *et al.* 2015; Palo *et al.* 2019). The empirical findings of this study reflect these tensions, where service-based access is considered attractive in theory but constrained in practice by established investment logics.

These competing logics become particularly visible in discussions of pricing and risk distribution. While service-oriented business models offer advantages such as shared risk and greater flexibility, most respondents favoured pricing methods that offer predictability and align with traditional investment approaches, particularly by cubic metre, which was the most familiar. This preference is consistent with prior research highlighting how uncertainty, relational dependence, and risk redistribution complicate the adoption of value-based service agreements in industrial contexts (Töytäri & Rajala 2015). In the case of CT technology, the difficulty of separating the technology's economic impact from fluctuations in raw materials and markets, as well as internal optimisation efforts, makes outcome-based pricing particularly challenging.

Fully outcome-based payment models were largely rejected due to the difficulty of isolating the economic contribution of CT technology from other influencing factors. Variability in raw material quality, market conditions, and internal optimisation strategies was perceived to introduce substantial uncertainty into pricing outcomes, thereby increasing financial risk. In this context, hybrid pricing models were viewed as more viable alternatives, as they allow for partial risk sharing without transferring full responsibility for value creation to the CT technology alone.

One respondent proposed a balanced risk-sharing hybrid price model. In this arrangement, a fixed-volume component provides financial predictability for the sawmill, while a performance-based component incentivises the technology provider to contribute to value creation. Such hybrid arrangements can be interpreted as pragmatic responses to the service paradox in capital-intensive industries, where uncertainty surrounding value-based pricing often constrains adoption. This interpretation is consistent with prior research indicating that firms in complex industrial environments rarely transition directly to fully outcome-based contracts (Baines *et al.* 2009; Bustinza *et al.* 2015).

The pricing categories discussed in servitisation research provide a useful conceptual lens for analysing alternative service configurations. In particular, the classification presented by Kowalkowski and Ulaga (2017, pp. 124-146) distinguishes between product lifecycle services, asset efficiency services, and outcome-based models with increasing degrees of risk transfer and provider responsibility. This study's empirical findings indicate that CT as a service does not fit into a single category. Instead, it primarily shows characteristics of product lifecycle services and, to a lesser extent, process support services. On the other hand, service models that focus on asset efficiency or delegate all processes face practical challenges in this context, which makes implementation more straightforward.

While the sawmills' high competence and digital maturity support the technical adoption of CT scanning, these same internal strengths also limit their willingness to pursue more advanced servitisation. Since the firms have the expertise to manage the technology internally, they see shared governance or external control as an unnecessary risk to their operational autonomy. This perspective expands upon earlier research that considers organisational readiness only as a facilitator. In this context, readiness not only supports the adoption of technology but can also hinder the implementation of more sophisticated, service-driven business models.

From a value creation standpoint, these findings challenge simplified applications of value-in-use that are sometimes associated with service-dominant logic. While service-dominant logic emphasises value co-creation through use and interaction rather than ownership (Vargo & Lusch 2008b).

This tension supports Osterwalder *et al.* (2013) view that changing business models involves more than just new value propositions; it also requires shifts in costs, revenue models, and governance. With CT technology, service-based approaches change how risk and control are shared, often conflicting with the stable, investment-focused mindset of sawmill organisations. Therefore, servitisation is likely to be most effective when it complements existing ownership arrangements instead of replacing them.

7.3 Implications for servitisation

The findings show that organisations' perceptions of the value of CT technology depend on the organisation and the specific situation of each sawmill. While CT technology is generally regarded as beneficial for providing better information and supporting optimisation, respondents judged its value primarily based on its contribution to operational stability, control, and long-term profitability in their specific production environment. The CT technology was not evaluated on the technological features, but also on how well it could fit into the existing sawmill setups and production goals.

Interpreted through the conceptual framework, these factors are linked to the CT technology's role as an integral component of the sawmill's production infrastructure. Because the technology is deeply integrated into the core process, transferring risk broadly or solely based on outcomes is challenging. This is due to its operational importance, sensitivity to downtime, and difficulty distinguishing the CT technology's economic contribution from that of overall production and market conditions. Similar patterns have been noted in earlier studies of servitisation in capital-intensive, infrastructure-heavy systems, where the embedded nature of assets limits the ability to externalise and use performance-based agreements (West *et al.* 2022, pp. 10-15).

More generally, the findings suggest that servitisation in capital-intensive process industries does not follow a simple trajectory toward more outcome-based service models. Instead, servitisation emerges as a selective and conditional approach shaped not only by asset characteristics and organisational capabilities, but also by a strong preference for maintaining control over critical production infrastructure. When technologies are highly asset-specific, immobile, and permanently embedded in production systems, the ability to fully outsource responsibilities and shift risks is naturally limited. The transfer of responsibility and risk to external service providers is therefore structurally constrained, a pattern that aligns with servitisation research emphasising the central role of control, governance, and asset embeddedness in capital-intensive contexts (Kowalkowski *et al.* 2015; Hoeben *et al.* 2023).

From a servitisation perspective, this research contributes by empirically demonstrating how factors such as asset embeddedness, sensitivity to downtime, and challenges in assigning value affect the scope of service-based business models. Although some parts of the servitisation literature emphasize value co-creation and relational governance in service exchanges, the current findings indicate that these principles are only applied selectively in capital-intensive industrial settings where infrastructure heavily influences organisational decisions.

From an innovation theory perspective, the findings indicate that CT technology is evaluated less for novelty and more for perceived compatibility with existing production practices and organisational routines, which aligns with Rogers (1962) on compatibility as a key factor in innovation evaluation. Respondents emphasized the extent to which the technology aligned with existing systems, investment plans, and operational responsibilities. This indicates that perceptions of CT's value are shaped by how decision-makers interpret the technology under conditions of uncertainty, particularly regarding its alignment with current work practices and risk management approaches. In this context, innovation is understood not merely as the adoption of new practices but as the evaluation of whether such novelty can be integrated into existing production systems without compromising stability.

7.4 Limitations of the study

The study was based on qualitative interviews with a limited number of respondents. In total, seven respondents from six organisations participated. All organisations are sawmills operating primarily in Sweden, with one organisation also having operations in Norway. The sample is limited in size and reflects a specific industrial and geographical context.

Respondents were selected based on their strategic roles and their knowledge of investment decision-making related to technology adoption. This approach ensured access to relevant perspectives on decision-making; however, it also meant that the findings predominantly reflect managerial and strategic viewpoints rather than operational experiences. Consequently, the findings should be interpreted as representing organisational decision logics rather than detailed implementation practices.

Further, this study is limited in scope, concentrating specifically on servitisation and investment decision-making related to the evaluation and adoption of access to CT technology through service-based business models. It does not explore alternative technological solutions, competing scanning technologies, or broader digitalisation strategies within sawmill operations, as the primary aim was to analyse a specific phenomenon rather than to map the entire technological landscape of the industry.

The qualitative research design excludes quantitative data on operational or financial performance. Although such data could facilitate additional analyses of production efficiency, yield, or economic outcomes, access to detailed operational information is rarely permitted beyond organisational boundaries, especially for emerging and strategically sensitive technologies like CT scanning. This limitation stems from practical issues related to data governance, confidentiality, and competitive concerns, rather than deficiencies in the research approach. It aligns with previous qualitative studies in capital-intensive sectors. Consequently, the study emphasizes perceived value, risk evaluation, and decision-making processes over actual performance metrics.

The findings should not be generalised beyond contexts with similar characteristics. Variations in production scale, technological maturity, ownership structures, and regulatory environments are likely to affect evaluations of servitisation and service-based access to production technologies. Consequently, the results may not be directly applicable to smaller sawmills, sawmills operating in different national contexts, or industries with lower levels of capital intensity and infrastructural reliance, where the adoption trajectories of service-based models may differ.

The competitive nature of the sawmill industry may have limited the level of detail shared by respondents, particularly regarding sensitive information related to investments and operational practices. Despite this, the study identified consistent patterns by focusing on shared decision-making processes and strategic considerations across organisations. While the findings do not cover all aspects of service implementation, such as detailed pricing mechanisms or long-term performance outcomes, they provide coherent insights into how organisations reason about servitisation risk and control within a capital-intensive context.

8 Conclusions

The last chapter of this study is intended to address the research question in chapter one, summarising key findings and their implications. Concluding with recommendations for further studies.

8.1 Critique of communication models

The findings show that the studied sawmill organisations perceive access to CT through service models as a conditionally feasible rather than attractive approach. Service-based access is valued primarily for reducing high initial capital costs, reducing investment risk, and increasing flexibility during periods of market uncertainty. At the same time, respondents emphasised concerns related to loss of control, dependency, and external actors. These concerns are especially evident in the fact that CT technology is deeply embedded in production infrastructure, where downtime sensitivity and integration into core production processes make operational continuity crucial. As a result, service-based access is perceived as a traditional complement to ownership.

8.2 Factors affecting transitions in business models

The transition toward service-based business models within the sawmill industry is driven by a combination of technological, organisational, and operational factors. Key elements include the high investment costs associated with CT technology, increasing pressure to manage financial risks, and a growing familiarity with usage-based pricing models already established in the industry. At the same time, several factors limit the scope of servitisation.

Transition towards more service-based business models in the sawmill industry is driven by a combination of technological, organisational, and operational factors. Some key factors are the high investment costs associated with CT technology, increasing pressure to manage financial risks, and a growing familiarity with usage-based pricing models already established in the industry. At the same time, several factors limit the scope of servitisation. These include asset entrenchment, immobility, and the integration of CT technology into production systems deeply intertwined with other technologies, which restrict the feasibility of risk transfer and a fully outcome-based pricing model. Organisational capabilities, such as experience in service governance and data management, further influence the extent to which servitisation can be pursued. Overall, servitisation appears as a selective and context-dependent strategy rather than a straightforward shift toward advanced service models.

8.3 Willingness to invest in computed tomography services

The most important factors influencing willingness to invest in a service incorporating CT technology were perceived value potential, risk exposure, and compatibility with existing investment infrastructure. Respondents also pressed on the importance of predictable cost structures, operational reliability, and alignment with established decision-making processes. Already known pricing models, such as payment per cubic meter, are increasing the willingness to adopt a service-based business model because they are expected to allow more control over core production processes. Differences in willingness were also linked to prior experience with CT technology; respondents with direct experience tended to express greater confidence in the technology's value and feasibility than those without such experience. This indicates

8.4 Recommendations for future studies

The sawmill industry has significant development potential and is facing growing demands for efficiency, transparency, and traceability. In the area of CT technology, future research could examine whether sawmills that have adopted CT scanners have achieved improvements in yield, production efficiency, and product quality compared with conventional systems. Such studies could combine operational performance data with economic analyses to assess the long-term return on investment associated with CT technology.

Future studies could investigate how CT-enabled data supports traceability and documentation requirements in response to evolving regulatory frameworks, such as the EUDR. In this context, future studies could examine how integrating CT data with other digital production and information systems contributes to transparency across the value chain and whether such integration creates additional value beyond process optimisation alone. From a servitisation perspective, future research could develop and empirically test payment models for CT as a service, including hybrid pricing arrangements that combine volume-based and performance-related components.

Future research could expand beyond softwood sawmills to explore the potential of CT technology in hardwood industries, such as flooring and furniture manufacturing, where material variability and quality differences might increase the value of detailed internal log information. Comparing softwood and hardwood sawmills could offer insights into how raw material properties affect the economic viability and added value of CT technology.

Additionally, future studies could look into how greater competition for forest resources and higher raw material costs influence the importance of extracting maximum value from each log. In times of resource scarcity, technologies that improve yield and enable more precise product allocation may become essential for maintaining profitability. Research could also examine how different wood types, like pine and spruce, impact profitability and how these factors interact with decisions to invest in advanced scanning technologies.

Finally, future work might consider how the size of a sawmill, its production levels, and product range influence the time needed to see a return on investment. Such studies could help managers and policymakers promote efficient resource use and technological progress in the sawmill sector. They could also explore how policies and incentives support investments in technologies that improve traceability, transparency, and resource efficiency across the forest product chain.

References

Antioco, Michael Moenaert, Rudy, L. & Adam. Wetzels, M. (2008). Organizational Antecedents to and Consequences of Service Business Orientations in Manufacturing Companies. *Journal of the Academy of marketing Science,* 36, 337-358. https://doi.org/10.1007/s11747-008-0085-1

Baines, T., Lightfoot, H., Benedettini, O. & Kay, J.M. (2009). The servitization of manufacturing: A review of literature and reflection on future challenges. *Journal of Manufacturing Technology Management,* 20, 547-567. https://doi.org/10.1108/17410380910960984

Bonfanti, A., Del Giudice, M. & Papa, A. (2018). Italian craft firms between digital manufacturing, open innovation, and servitization. *Journal of the Knowledge Economy,* 9(1), 136-149

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Bryman, A. (2011). Samhällsvetenskapliga metoder. 2: a upplagan. Malmö: Liber. Bryman, A. & Bell, A.(2013). *Företagsekonomiska forskningsmetoder,* 2

Bustinza, O., Ziaee Bigdeli, A., Baines, T. & Elliot, C. (2015). Servitization and Competitive Advantage: The Importance of Organizational Structure and Value Chain Position. *Research Technology Management,* 58, 53-60. https://doi.org/10.5437/08956308X5805354

European Commission (2025). *Commission Notice: Guidance Document for Regulation (EU) 2023/1115 on Deforestation-Free Products (C/2025/4524)*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C_202504524

Frank, A.G., Mendes, G.H., Ayala, N.F. & Ghezzi, A. (2019). Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. *Technological Forecasting and Social Change,* 141, 341-351.

Fredriksson, M. (2015). Optimizing sawing of boards for furniture production using CT log scanning. *The Japan Wood Research Society*.

Fredriksson, M., Berglund, A. & Broman, O. (2015). Validating a crosscutting simulation program based on computed tomography scanning of logs. *European Journal of Wood and Wood Products,* 73, 143-150.

Freij, J. (2023). *Skog & Ekonomi*. (Nyheter från Danske Bank).

Hoeben, A.D., Stern, T. & Lloret, F. (2023). A review of potential innovation pathways to enhance resilience in wood-based value chains. *Current Forestry Reports,* 9(5), 301-318.

Johansson, E. (2015). *Computed Tomography and Fingerprint Traceability in the Wood Industry.* Luleå tekniska universitet.

Kohtamäki, M., Rabetino, R., Parida, V., Sjödin, D. & Henneberg, S. (2022). Managing digital servitization toward smart solutions: Framing the connections between technologies, business models, and ecosystems. Elsevier, 253-267.

Kowalkowski, C. & Ulaga, W. (2017). *Service strategy in action: A practical guide for growing your B2B service and solution business*. Service strategy press.

Kowalkowski, C., Windahl, C., Kindström, D. & Gebauer, H. (2015). What service transition? Rethinking established assumptions about manufacturers' service-led growth strategies. *Industrial Marketing Management,* 45, 59-69.

Makkonen, M. (2018). Stakeholder perspectives on the business potential of digitalization in the wood products industry. *BioProducts Business*, 63-80.

Meynhardt, T., Chandler, J.D. & Strathoff, P. (2016). Systemic principles of value co-creation: Synergetics of value and service ecosystems. *Journal of Business Research,* 69(8), 2981-2989.
Microtec (2025). *Computer Tomography*. https://www.microtec.com/en/technology/computer-tomography [18 December 2025]
Nowik, J. (2025). The adoption process of CT scanning in sawmills: motives, acquisition, challenges and benefits. SLU, Dept. of Forest Economics.
Olofsson, L., Möller, C.-J., Wendel, C., Oja, J. & Broman, O. (2019). New possibilities with CT scanning in the forest value chain. I: *21st international nondestructive testing and evaluation of wood symposium, Freiburg, Germany, September 24-2, 2019*, US Department of Agriculture. 569-576.
Osterwalder, A., Pigneur, Y., Clark, T. & Sjösten, L. (2013). *Business model generation : en handbok för visionärer, banbrytare och utmanare*. 2. uppl. uppl., Studentlitteratur.
Palo, T., Åkesson, M. & Löfberg, N. (2019). Servitization as business model contestation: A practice approach. *Journal of Business Research,* 104, 486-496.
Pernkopf, M., Riegler, M. & Gronalt, M. (2019). Profitability gain expectations for computed tomography of sawn logs. *European Journal of Wood and Wood Products,* 77(4), 619-631. https://doi.org/10.1007/s00107-019-01414-x
Robson, C. (2002). Real world research. Blackwell.
Rogers, E.M. (1962). *Diffusion of innovations*. Free Press of Glencoe.
Rolls-Royce (2024). Rolls-Royce and Vietjet sign TotalCare agreement for 40 Trent 7000 engines.
Taipale-Erävala, K. & Muhos, M. (2018). Competence-related challenges for micro-enterprises entering the field of servitization. I: *Proceedings of the 13th European Conference on Innovation and Entrepreneurship ECIE 2018, Aveiro, Portugal, 20-21 September 2018*, Academic Conferences and Publishing International.
The Swedish Forest Agency (2025). *Virkespriserna steg första kvartalet*. https://www.skogsstyrelsen.se/nyhetslista/virkespriserna-steg-forsta-kvartalet2/ [19 August 2025]
Töytäri, P. & Rajala, R. (2015). Value-based selling: An organizational capability perspective. *Industrial Marketing Management,* 45, 101-112. https://doi.org/https://doi.org/10.1016/j.indmarman.2015.02.009
Vandermerwe, S. & Rada, J. (1988). Servitization of business: Adding value by adding services. *European Management Journal,* 6(4), 314-324. https://doi.org/https://doi.org/10.1016/0263-2373(88)90033-3
Vargo, S.L., Akaka, M.A. & Wieland, H. (2020). Rethinking the process of diffusion in innovation: A service-ecosystems and institutional perspective. *Journal of Business Research,* 116, 526-534.
Vargo, S.L. & Lusch, R.F. (2004). Evolving to a New Dominant Logic for Marketing. *Journal of Marketing,* 68(1), 1-17. https://doi.org/10.1509/jmkg.68.1.1.24036
Vargo, S.L. & Lusch, R.F. (2008a). Service-dominant logic: continuing the evolution. *Journal of the Academy of marketing Science,* 36(1), 1-10.
Vargo, S.L. & Lusch, R.F. (2008b). From goods to service(s): Divergences and convergences of logics. *Industrial Marketing Management,* 37(3), 254-259. https://doi.org/https://doi.org/10.1016/j.indmarman.2007.07.004
Wang, K., Jing, H., Wang, D.-d. & Jiang, F. (2024). Joint quality and maintenance decisions under servitization business model. *International Journal of Production Research,* 62(5), 1567-1585.
Weichel, K. (2018). Toppmodernt sågverk invigt. Tillgänglig: https://www.svt.se/nyheter/lokalt/vasterbotten/toppmodernt-sagverk-invigt

West, S., Gaiardelli, P. & Saccani, N. (2022). *Modern industrial services: A cookbook for design, delivery, and management*. Springer Nature.
Whittington, R. & Nilsson, B. (2002). *Vad är strategi-och spelar den någon roll?* , Liber ekonomi.

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Appendix 1 Interview guide

Jag vill börja med att fråga om det skulle vara okej att jag spelar in ljudet från intervjun för att underlätta transkriberingen efter intervjun för mig?
Ja/Nej

Du väljer givetvis själv om du vill vara anonym i intervjun. Känner Du ett behov av att vara anonym i redovisningen av intervjun?
Ja/Nej

Skulle det vara okej att jag nämner i rapporten att jag intervjuat en representant från … (Företag)?
Ja/Nej

Jag kommer kontakta dig om användning av eventuella citat och inom vilket sammanhang de används om de används. Vill ha svar så snabbt som möjligt om eventuella åsikter och förändringar.

Så nu till frågorna – som är uppdelade i fyra delar. Den första delen handlar om vem Du är och vilken del Du har i investeringsbeslut. Den andra delen fokuseras på Din syn på CT. Den tredje delen handlar om alternativa betalningsformer – och avslutningsvis har jag några övergripande frågor om organisation och förändring för att möta framtida behov.

Del 1 – Bakgrund och investeringsbeslut

- Hur länge har du jobbat inom skogsbranschen eller inom sågverksbranschen?
- Vilka befattningar har du haft de fem senaste åren?
- Vilken befattning har du nu?
- Hur skulle Du beskriva Er nuvarande produktionsteknologi?
- Vilka investeringar i utrustning har ni gjort de senaste fem åren?
- Hur ser era kriterier ut för att investera i ny teknik (avkastning, risk, strategisk nytta, kundkrav)?

Del 2 – Syn på CT-teknologi

- Hur ser du på möjligheten att få tillgång till CT som en tjänst?
- Som tjänst tänker jag då hyra, prenumeration eller pay-per-use?
- Vilka fördelar skulle en modell genom att hyra, prenumeration eller pay-per-use kunna ge ert företag?
- Vilka risker eller nackdelar skulle du förknippa med en sådan lösning?
- (När det står still)?

- ❖ Hur skulle ni vilja kunna påverka av service erbjudanden? serviceinnehåll, datatillgång, och uppföljning?

Del 3 – Betalningsmodell och riskhantering
Syfte: Utforska betalningslogik, incitament och riskfördelning.

- ❖ Om man skulle införa CT som tjänst, vilken typ av betalningsmodell skulle ni se som mest rimlig eller attraktiv?

- ❖ Till exempel: att betala utifrån ökningen i värde (value uplift), antalet kubikmeter som skannas/sågas, eller antal arbetstimmar?

- ❖ Vad borde ingå till CTn?

- ❖ Hur skulle ni vilja att betalningen kopplades till den nytta ni faktiskt upplever av teknologin?

- ❖ Om ni skulle använda CT som en tjänst, vad skulle vara lagom långa avtalstider?

- ❖ Skulle ni vilja ha möjlighet att exempelvis köpa loss utrustningen eller avbryta tjänsten efter en viss tid?

- ❖ Vilka typer av risker skulle ni helst *inte* vilja ta i en sådan modell – exempelvis driftstopp, felmätning, garanti, prisförändringar eller beroende av leverantören?

- ❖ Om du fick utforma en ideal betalnings- och tjänsteutformning för CT-scanning, hur skulle den se ut för att passa er verksamhet?

Del 4 – Organisation, förändringsvilja och framtid

- ❖ Hur uppmuntras teknologisk utveckling och nya idéer i er organisation?

- ❖ Vilka hinder finns internt, som du ser det, (kompetens, resurser, ledning, tradition) för att testa nya affärsmodeller? känsligt

- ❖ Finns det aktörer (branschorganisationer, leverantörer, forskningsmiljöer) som påverkar era beslut att investera eller förändra affärsmodell?

Appendix 2 Translated questions and theory connection

How long have you worked in the forestry or sawmill industry?	Provides contextual understanding of the respondent's experience, which, according to **Innovation Theory**
Which positions have you held during the past five years?	Linked to organisational position and previous decision-making roles, which shape perspectives on innovation adoption according to **Innovation Theory**.
What position do you currently hold?	Related to the respondent's current decision-making authority and influence over investment and business model decisions, as explained by **Innovation Theory**.
How would you describe your current production technology?	Connected to the I**nnovation adoption** concept of compatibility between new technologies and existing organisational systems and practices.
What investments in equipment have you made during the past five years?	Provides insight into the organisation's historical patterns of innovation and investment, as discussed in **Innovation Theory**.
What criteria do you apply when deciding to invest in new technology?	Relates to how organisations evaluate risk, return, and strategic value in innovation decisions, as emphasised in **Innovation Theory**.
How do you view the possibility of accessing CT as a service?	Linked to **Servitisation Theory** as a form of business model innovation and the initial acceptance of new value propositions.
By "as a service," do you mean rental, subscription, or pay-per-use models?	Relates to different degrees of servitisation and how usage-based logics influence perceived value, as discussed in **Servitisation Theory**.
What advantages could a rental, subscription, or pay-per-use model offer your company?	Connected to value creation and flexibility in servitised business models, in line with **Servitisation Theory**.
What risks or disadvantages would you associate with such a solution?	Relates to **Innovation Theory**, particularly its focus on perceived risk and uncertainty in innovation adoption.
How is your operation affected by production downtime?	Connected to production criticality and operational risk in capital-intensive systems, as addressed in **Innovation Theory**.
How would you like to influence service offerings in terms of service content, data access, and performance follow-up?	Relates to control, governance, and data management in servitised solutions, as conceptualised in **Servitisation Theory**.

If CT were introduced as a service, which payment model would you consider most reasonable or attractive?	Linked to value capture logic and risk distribution in **Servitisation Theory**.
For example, payment based on value uplift, processed volume, or operating hours?	Relates to incentive structures and performance-based compensation within **Servitisation Theory**.
What should be included in the CT service offering?	Connected to service design and the scope of the value proposition, as discussed in **Servitisation Theory**.
How would you like payment to be linked to the benefits you actually experience from the technology?	Relates to outcome-based contracting within **Servitisation Theory**.
What contract lengths would be considered reasonable?	Connected to uncertainty, flexibility, and long-term commitment in innovation adoption, as explained by **Innovation Theory**.
Would you want the option to purchase the equipment or terminate the service after a certain period?	Relates to real-options thinking in innovation adoption, as described in **Innovation Theory**.
Which types of risks would you prefer not to assume in such a model?	Linked to risk allocation between customer and provider, a core concern in **Servitisation Theory.**
If you could design an ideal payment and service configuration for CT scanning, what would it look like for your operation?	Relates to the adaptation of business models in capital-intensive contexts, as discussed in **Servitisation Theory**.
How is technological development and the generation of new ideas encouraged within your organisation?	Connected to innovation climate and organisational capacity for change, as explained by **Innovation Theory**.
What internal barriers exist to testing new business models?	Related to organisational resistance to change and established procedures, as addressed in **Innovation Theory**.
Are there external actors that influence your investment decisions?	Connected to institutional influences on innovation and adoption processes, as discussed within **Innovation Theory**.

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