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Stakeholder Perspectives on the Business Potential of Digitalization in the Wood Products Industry



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Abstract

Digitalization is reshaping traditional industries by interconnecting products, processes and services, and by transforming business models. Businesses able to leverage digitalization to improve customer value are in a better position to differentiate themselves. Development also provides opportunities for the wood products industry, where competitiveness has deteriorated throughout the 2010s. However, there is an apparent research gap in understanding how this industry could utilize digitalization to apply customer-oriented business strategies, and what development will be needed to achieve this goal. The present study aims to narrow this gap. This research analyzes qualitative interviews conducted among wood suppliers, sawmills, secondary wood processors, and the construction industry. The results show a seamless link between digitalization, improved customer orientation, and the functionality of wood value chains. Business development ideas generally focused on improving process efficiency with digitalization. Nevertheless, more knowledge is needed to unleash potential related to new product and service offerings, as well as to better understand innovative approaches to conducting business in the knowledge-based wood products industry.

Keywords: Digitalization; digital transformation; wood products industry; customer value; service logic

1. Introduction

The future success of the wood products industry depends entirely on progressively-minded entrepreneurs with customer-oriented management skills (Spetic et al., 2016). The industry should be “like any other high-end, highly technological, and knowledge-based business,” where managers are able to tailor their manufacturing competencies according to their target markets (Spetic et al., 2016, p. 25). This argumentation includes two interlinked perspectives on value creation that are disrupting prevailing business models in traditional manufacturing industries, namely service logic and digitalization. In the

sawmill and secondary wood products industries, hereafter referred to as the “wood products industry,” there is scant research addressing these topics. In particular, there is a lack of empirical studies demonstrating a clear connection between knowledge management and firm profitability. If emerging technological advancements are neglected, firms in highly competitive industries are at risk of losing business opportunities (Parviainen et al., 2017).

The service logic (Vargo & Lusch, 2004; Grönroos, 2008) emphasizes customer-firm interactions that contribute to improved customer orientation and higher customer value. It is a strategic business approach that manufacturing firms have increasingly adopted to differentiate from competitors with improved output (i.e., products and services) and to create customer value (Kohtamäki et al., 2013; Parida et al., 2015). The adoption of a customer-centered business approach may be enhanced by fast developing digital technologies and digitalization (Bharadwaj et al., 2013), as it is viewed as a way to address complex customer interactions (Lerch &

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Gotsch, 2015; Matt et al., 2015). It has even been claimed that digitalization is the core of the next industrial revolution (e.g. Brynjolfsson & McAfee, 2012). Interesting business development opportunities may also arise in the wood products industry, where competitiveness in countries such as Finland has deteriorated in the 2010s (Mattila et al., 2016). For example, Cohen and Kozak (2001) have suggested that knowledge orientation could be an upcoming trend within the industry, driven by the vast amount of information around us. However, despite the fact that digitalization has become a buzzword in today's business, many manufacturing firms struggle to understand its real potential (Parviainen et al., 2017).

Sawn timber value chains are long and complex, and include multiple log suppliers and sawn timber end users (Larsson et al., 2016). As it is, different stakeholders are interconnected, affecting each other's profitability. The industry also seems to consider itself customer-oriented, yet, in practice, it still relies strongly on high production volumes and efficient production, (Makkonen & Sundqvist-Andberg, 2017). Firms engage in little strategic cooperation (Toppinen et al., 2011), which means little consideration of their actions influence on others in the value chain, and on the overall profitability of the industry (Katunzi, 2011).

To maximize the overall benefit from a customer-oriented business approach, the customer-centered thinking should pass through the value chain instead of merely being applied by each individual firm. This means coordinated and efficient inter-firm and intra-firm communication (Han & Hansen, 2017) that ensures effective processes, accurate and timely understanding of customers' needs, and better opportunities to meet these needs. For instance, an information transfer from previous or subsequent processes can have a crucial effect on process efficiency in wood value chains (Uusitalo, 2005). Chain complexity, however, currently challenges information transformation about customers' needs along the value chain (Peltoniemi, 2013).

Although digitalization has increased interest among academic researchers, the present literature is fragmented, primarily covering topics related to technological innovations (e.g., mobile technologies, analytics solutions), and narrow in scope. Research focusing on organizational aspects, such as business strategy or business model transformation, needs more attention (Parviainen et al., 2017). In the wood products industry, related research

generally treats general process efficiency and cost-competitiveness, for example, in the fields of forest mapping and monitoring applications (e.g. Holopainen et al. 2014; Bohlin et al. 2017; Siipilehto et al. 2016), harvesting and logistics (e.g. Manner et al. 2016; Marques et al. 2014), and timber production (e.g. Todoroki & Rönqvist 2002). Having mainly similar motivations, such as operative efficiency and cost savings, previous research has also addressed business model renewal through developing collaborative transportation planning to improve coordination of wood fiber flows. In these studies, the focus has been on mathematical modeling (Audy et al., 2007; Beaudoin et al., 2007; Carlsson & Rönqvist, 2007; Frisk et al., 2010). Utilization of advanced technologies to improve customer focus and to stay competitive is rare. As a notable exception, Lehoux et al. (2014) investigated collaboration to reduce operational costs and better respond to market demand. More research is needed regarding the utilization of digitalization in a way that goes beyond a firm's boundaries and integrates products, business processes, sales channels, and value chains (Matt et al., 2015).

This study analyzes the potential benefits of digitalization in the wood products industry. The study complements and extends earlier research on the industry's performance by providing new knowledge on how customer orientation could be improved, and, consequently, how customer value could be generated through digitalization. Both theoretical and empirical analysis is applied. The empirical study was carried out in Finland, one of the countries in which the wood products industry occupies an important position in the overall industrial structure. The following research questions were formulated on the basis of the recognized research gap to guide the study: *how could the utilization of digitalization improve the customer-orientation and competitive advantage of firms within the wood value chains as defined by the industry stakeholders themselves, and how should business be developed?*

The article is structured as follows. The second section includes the literature review and the conceptual framework. The first two sub-sections review prior research on customer orientation, customer value, and digitalization. These approaches are then integrated into a conceptual framework presented in the third sub-section. The third main section includes the description of the empirical data and methods. The results are presented in the fourth

section, starting with results linked to the upstream value chain and continuing with results linked to the downstream value chain. The article concludes with a discussion, which includes a summary of the findings and an evaluation of the study. Suggestions for future research are offered in the fifth section.

2. Background Literature

2.1 Customer Orientation and Customer Value Creation

Customer orientation is considered to have a major impact on firm performance (Frambach et al., 2016; Kirca et al., 2005; Woodruff, 1997). Customer oriented firms may outperform their rivals by sensing fundamental changes in the business environment and by having an improved capability to recognize major technological shifts (Khanagha et al., 2017). Moreover, customer-oriented manufacturing firms are found to be more innovative (Wang et al., 2016). In order to transform the provider-customer interaction into customer value, firms need to identify, assess, and address specific customer needs as well as react proactively to customers' changing and emerging demands (Lenka et al., 2017).

Slater and Narver (1994) conceptualize customer orientation as the firm's actions to deliver superior value to their customers by utilizing knowledge about customer needs. Through these actions, the firm can improve its financial performance and remain competitive (Narver & Slater, 1990). Knowledge refers to customers' current, latent, or future needs, which are potentially important but difficult to describe by the customer (Blocker, 2011; Slater & Narver, 1998). An ability to respond to expressed needs refers to a firm's responsiveness to customers' current needs, whilst an ability to address customers' latent needs refers to proactivity (Narver et al., 2004). A firm can implement responsiveness, proactivity, or both dimensions simultaneously, but doing so may consume significant resources (Ketchen et al., 2007). Higher customer orientation does not always lead to higher customer value; the firm has to find an optimal level, where the added customer orientation does not offset the added value (Narver et al., 1990). As follows, companies can apply customer-oriented business strategies in many ways and decisions are always firm-specific (Korhonen, 2016).

The importance of customer orientation is noted by many forestry researchers, who have suggested customer

and service orientation (Hansen et al., 2015; Mattila, 2015; Uusitalo, 2005), inter-firm collaboration (Mattila et al., 2016; Toppinen et al., 2011), and innovation (Hansen et al., 2011) as sources of long-term competitiveness. For example, Lehoux et al. (2014) discuss collaborations with suppliers, distributors and retailers to create customer value. Their findings showed inter alia that sharing sensitive information and losing control over the supply chain were barriers for developing collaborations. By learning extensively from customers, manufacturers can improve their offerings and provide purposeful products and services (Han & Hansen, 2016; Spetic et al., 2016). This kind of a strategy deviates from the traditional approach, having a focus on commodity products and production efficiency (e.g. Brege et al., 2010; Toppinen et al., 2013; Pelli et al., 2017). In the marketing literature, such business logic is conceptualized as an industrial logic (Schlesinger & Heskett, 1991) or goods-dominant logic (Vargo & Lusch, 2004). Characteristic of this view is that value is seen as embedded in the offerings (e.g., products and services) resulting from the production process and customers are seen to "destroy" this value in the consumption process (Porter, 1985). According to this view, value is determined by an offering's tangible aspects, such as functionality and utility (Keränen & Jalkala, 2013). Goods-dominant logic is typical in traditional sectors, such as the wood products industry.

As customers' demands have become diverse and more complex (Gustafsson, 2003; Han & Hansen, 2016), manufacturing firms have increasingly added services to their products to differentiate themselves from competitors (Oliva & Kallenberg, 2003; Parida et al., 2014). Along with this development, many scholars in marketing have shifted their research agendas from goods-focused towards service-focused thinking (Vargo & Lusch, 2004). The latter focus emphasizes conducting business collaboratively, rather than just passing thoughts from a provider to the customer. The literature on marketing commonly conceptualizes the customer-oriented view as a service logic (SL) view (e.g. Grönroos, 2007; Grönroos & Voima, 2013) or a service-dominant logic (SDL) view (Vargo & Lusch, 2004). The service-dominant logic implies that value is primarily defined by the consumer and co-created by the customer and the provider (Vargo & Lusch, 2004).

The main principles of SL and SDL are alike, and they can be seen as complementary in many ways. However,

some differences exist. SDL explores the phenomenon of value creation, whereas SL provides more accurate managerial tools to implement it in business. One of the main differences between the two approaches relates to the realization of value creation. SDL highlights that both the provider and the customer participate in the value creation process (value co-creation) and the value-creating role of the customer is ubiquitous (Vargo & Lusch, 2004). SL considers the value-creating role of the customer primary and sees the co-creation as dependent on the actual interaction in the business relationship (Grönroos, 2007). According to SL, a firm only facilitates customer value creation by integrating monetary or non-monetary resources (e.g., knowledge, skills, raw materials, or technology) into an offering (Grönroos, 2011; Grönroos & Ravald, 2011; Lindic & da Silva, 2011). However, if a firm's and a customer's processes are integrated interactively, a firm becomes a value co-creator (Lehoux). Value as perceived by the customer may be constituted in the product range, performance, quality, cost, delivery and services, as well as in routines, processes and communication (La Rocca & Snehota, 2014).

2.2 Digitalization as a Way to Foster Customer Value

A major factor affecting manufacturing firms' performance in the increasingly complex business environment is their ability to utilize existing knowledge for innovativeness (Brockman & Morgan, 2003). As knowledge and technological resources are increasingly dispersed outside the firm's boundaries (Möller & Svahn, 2006), firms should aim at greater value chain collaboration through close and frequent interactions with partner firms (Cavusgil et al., 2003). These interactions provide access to partners' knowledge, and most importantly, to tacit knowledge (Cavusgil et al., 2003), which is widely agreed to have a major impact on a firm's competitive advantage (e.g. Cavusgil et al., 2003; Johannessen et al., 2001; Nonaka & Takeuchi, 1995; Teece et al., 1997). Tacit knowledge is realized through an individual's skills, techniques, know-how and routines (Lam, 2000), and consequently, is difficult to be coded, transferred or interpreted by competitors (Teece, 1998).

By transferring personal-level tacit knowledge into organizational-level explicit knowledge, firms can generate organizational knowledge (Johannessen et al., 2001). This, in turn, enables firms to adjust processes,

products and services to develop new offerings and/or innovations (Gassmann & Zeschky, 2008) and to build customer value (Martelo-Landroguez & Cegarra-Navarro, 2014). From the value creation perspective, the main challenge resides in identifying the appropriate knowledge (Malone, 2002). This identification is part of organizational learning, consisting of information acquisition, information dissemination, shared interpretation, and the development of organizational memory (Tippins & Sohi, 2003). In customer-centric business, firms need ways to gain information about customers' needs, the ability to generate new knowledge through constant learning (Tseng, 2016), and the ability to utilize this knowledge for the benefit of a customer.

Information technology, and particularly digitalization, provides powerful tools and mechanisms to enhance the development of customer-oriented business models (Lenka et al., 2017). According to Parviainen et al. (2017, p. 64) digitalization can be conceptualized as *"changes in ways of working, roles, and business offering caused by adoption of digital technologies in an organization, or in the operation environment of the organization."* In essence, digitalization is more than just turning current processes into digital versions (Parviainen et al., 2017). It should be not confused with a firm's IT strategy, as it is business-centric, with the aim being to improve the customer focus (Matt et al., 2015).

Digitalization has created significant business opportunities, which have attracted a wide range of researchers. There is a growing body of literature indicating that digitalization, also known as digital transformation, is disrupting business models in manufacturing industries (e.g. Beier et al., 2017; Kowalkowski et al., 2013; Lerch & Gotsch, 2015). It can be applied for building infrastructures within value chains (Lejeune & Yakova, 2005; Zimmermann et al., 2016) that enable quick and effective ways to acquire and disseminate information from various sources (Tippins et al., 2003). The broader and deeper use of individuals' unique and dispersed knowledge following from digitalization provides better premises for innovation (Brynjolfsson & McAfee, 2012). In addition, interactive platforms enabled by digitalization foster engagement with customers and support the firm's role as a co-creator of customer value (Parida et al., 2015).

Digitalization as a concept is broad. It offers business opportunities for improved internal efficiency

(processes), new product-service offerings and/or the development of completely new ways of doing business (Parviainen et al., 2017). Firms can, for example, integrate monetary and non-monetary resources into their offerings (Grönroos, 2011; Grönroos & Ravald, 2011; Lindic et al., 2011) to improve their internal efficiency. In practice, this could mean eliminating manual steps, improving process accuracy, using data analytics for creating business intelligence, and managing production, storage and distribution (Parviainen et al., 2017). Furthermore, firms can shorten response times (Parviainen et al., 2017), find new ways to interact with customers (Matt et al., 2015), add new functionalities to offerings, improve reliability and efficiency, as well as optimize processes (Porter & Heppelmann, 2014).

According to Matt et al. (2015), successful digital transformation requires close alignment of four dimensions: (1) the use of technologies, addressing a firm's attitude toward new technologies as well as its ability to exploit them; (2) changes in value creation that are often connected to the adoption of new technologies; (3) structural changes concerning the integration of new digital activities into a firm's other structures; and (4) financial aspects, either as a driver or a bounding force for the transformation. Most importantly, digital transformation requires consistent processes and knowledge management in firms (Berman, 2012). It is not self-evident that investments in digital technologies always pay off. Several studies indicate that while technical understanding is required, organizational capabilities

are more critical to a successful outcome (Bharadwaj et al., 2013), including organizational learning (Tippins et al., 2003), leadership style (Seah et al., 2010; Verdú-Jover et al., 2014), and an adaptive organizational culture (Alos-Simo et al., 2017). The whole organization should be involved in the change process, including operational processes and resources, as well as internal and external users (Henriette et al., 2015). Figure 1 summarizes the benefits and barriers of digitalization in business.

Lenka et al. (2017) specified three digitalization capabilities that help firms to increase interaction between the provider and the customer, and to identify, assess, and address specific customer needs quickly and proactively. According to the authors, digital transformation often starts with developing intelligence capability, such as investments in hardware with smart subcomponents (e.g. sensors, digital user interfaces, software applications). Next, the focus moves to connect capability, which refers to ports, antennas, software and Internet protocols. The third capability, analytic capability, applies to the transformation of vast data as predictive insights and directions for actions through development rules, business logics and algorithms. Ultimately, customer value creation results from improved firm effectiveness (e.g., doing the right things) and efficiency (e.g., doing things right).

2.3 Conceptual Framework

Based on the constructs of customer orientation and digitalization, a conceptual framework was developed

Benefits of digitalization:	Challenges to digitalization:
<ul style="list-style-type: none"> - Provides an access to various data sources for business intelligence building (Tippins & Sohi, 2003; Parviainen et al. 2017) - Improves internal efficiency and enables renewal of an offering (Parviainen et al., 2017) - Fosters innovation (Brynjolfsson et al., 2012) - Improves engagement of customers and supports development of customer-centered business (Parida et al., 2015; Matt et al. 2015) 	<ul style="list-style-type: none"> - Cultural resistance to change (Alos-Simo et al., 2017) - Incapability to exploit novel technologies (Matt et al. 2015; Bharadwaj et al., 2013) - Deficiency in leadership, i.e. inconsistent processes and lacking knowledge management practices (Berman, 2012; Bharadwaj et al., 2013) - Financial constraints (Matt et al. 2015)

Figure 1. Benefits of challenges to digitalization.

to address the main objective of this study. Figure 2 illustrates the theoretical framework, forming the basis of the empirical work (i.e., interview protocols and data analysis). The framework suggests that digitalization aims to improve customer orientation in firms (Matt et al., 2015). Customer oriented firms, in turn, can deliver superior value to their customers, resulting in the improved financial performance of the firm (Slater et al., 1994).

Digitalization can benefit the firm in all those areas that have been considered essential in achieving the optimal level of customer orientation (Narver & Slater, 1990): internal efficiency, external opportunities, and disruptive change (Parviainen et al., 2017). New offerings and/or innovations can be developed by adjusting processes, products and services, based on integrating external and internal knowledge sources (Gassmann 2008). The critical sources are customers (Slater & Narver, 1994), suppliers, and other stakeholders (Gianiodis et al., 2010). Therefore, to gain access to the information that is increasingly dispersed outside the firm’s boundaries (Möller & Svahn, 2006), firms should collaborate with the value chain stakeholders (Cavusgil et al., 2003).

3. Data and Methods

The data included in this study was collected during a three-year international research project entitled VARMA (Value added by optimal wood raw material allocation and processing). The study is exploratory, utilizing marketing literature to provide insights to customer

orientation and customer value. Further, literature on digitalization and digital transformation was used to explain the renewal of the wood products industry’s business models towards knowledge-based business. The phenomena were studied through the lens of the service logic (SL), which provides a suitable theoretical background when the interest is to understand provider-customer interactions profoundly and to derive managerial implications.

The research was carried out as a qualitative interview study. This enabled an understanding of the context and meaning of subjects (Maxwell, 1996), which evolve over time (Gephart, 2004). In social and organizational research, interviewing is widely used to get an insight of people’s experiences, attitudes and perceptions (Yin, 2014). As the aim was to understand interviewees’ opinions regarding customer orientation and digitalization from their point of view, a semi-structured interview protocol was used. The themes were structured in a way that made it possible to draw conclusions about factors affecting customer value creation from an information sharing perspective. Digitalization as a concept was discussed to gain understanding about how the industry perceives its potential in business.

3.1 Sampling

The population of interest was criterion based, which, for a purposive sampling technique, was used to reach the target population (Patton, 2002). This strategy is suitable for small-scale and in-depth studies (Ritchie et al.,

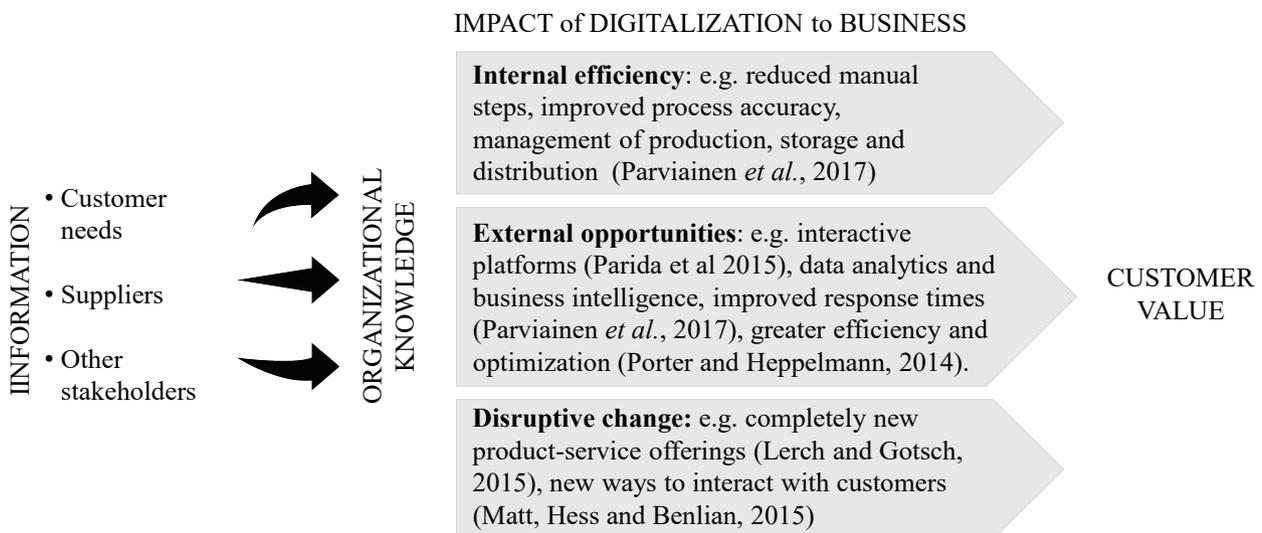


Figure 2. Conceptual framework of the study.

2003). The focus of this study was in the wood products industry, but because integrating supplier and customer processes is an essential part of customer value creation (Holbrook, 2006; La Rocca et al., 2014), data were collected throughout the wood value chain. In line with the research interest of the study, the scope was restricted, however, to business to business (B2B) relationships.

The wood value chain includes wood supply, sawmills, secondary wood processors, and industrial end-customers. By interviewing industry experts and executives throughout the value chain, a systematic and comprehensive understanding was achieved of the stakeholders' needs, firms' capability to meet these needs, and their interactions. For example, the wood suppliers were included to gain understanding of the raw material suppliers' impact on downstream value chain competitiveness. The industrial end-customers were restricted to construction, which represents the main customer segment of the wood products industry.

The sample was versatile in terms of interviewee positions and specialties. This versatility intended to ensure that all key categories relevant to the subject matter were covered and that each category was as diverse as possible (Ritchie et al., 2003). This enabled us to capture a wide range of different perspectives to detect differences within, as well as between, categories (Ritchie et al., 2003), as the aim was to gain a broader understanding of the phenomena studied. This is significant for the aims to improve the reliability and validity of the study. The forest owners and consumers were excluded from the study since the focus was in B2B relationships.

A researcher's reliance on his/her own expertise and judgment in the sample selection (Guarte & Barrios, 2006) increases the risk of a biased sample. Therefore, a subtype of purposive sampling, snowball sampling, was used during the interviews. In this method, the interviewee is asked for recommendations of other persons who fulfill the criteria defined by the researcher (Spren, 1992). In this study, the selection criterion included (1) the respondents had to represent upper management (e.g., top executives or experts of the wood products industry); (2) respondents of the firms were regarded as innovators or growth-oriented firms in respect to business development, which ensured that the most knowledgeable persons in the area of the research topic were incorporated into the sample (Guarte & Barrios, 2006); (3) firms of different size were incorporated to

ensure diversity among the informants; and (4) firms represented different downstream processed products and industrial end-uses.

A steering group was used as a starting point for the interviews by asking for suggestions from suitable interviewees. The group consisted of six people in the positions of Sawmill Manager, Sawmill Development Manager, Chief Technology Advisor at the Finnish Funding Agency for Innovation, Principal Scientist at VTT Technical Research Centre of Finland Ltd., Sawmill Industry Senior Advisor and Managing Director at the Federation of the Finnish Woodworking Industries. Thereafter, a snowball sampling technique was implemented in the following way. Interviews started within industry associations to gain a better understanding of the business and to get recommendations for other interviewees. Asking for recommendations continued during the rest of the interviews. More precisely, the respondents were asked who they could recommend to be interviewed based on the criteria of the study. The sample consisted of 14 firms in Finland: medium and large sized sawmills, small and large-sized secondary wood processors (e.g., manufacturers of wood components, glulam, windows and doors and planed timber), and small and large-sized industrial end-customers (e.g., construction firms of prefabricated houses and apartment buildings, specialized in wood buildings). The number of interviews in each group is shown in Table 1. The number in the wood supply sector is low. However, all sawmills had wood supply integrated into their other business, which enabled discussion of the limitations and possibilities of wood supply in the sawmill interviews. In addition, three persons from industry associations were interviewed, representing the sawmill industry (one interview) and secondary wood processing (two interviews). In the data analysis, these interviews were included in the sawmills group and the secondary wood processing group, respectively.

3.2 Data Collection

The empirical data was collected between September 2015 and September 2016, consisting of 18 in-depth interviews in Finland. Compared to questionnaires, interviews allow a greater depth of information and the ability to detect contextual variations in meaning. The key informants were industry experts, CEOs, Development Managers, and other Vice President level executives. The unit of analysis was the input provided by an individual

Table 1. List of interviewees

Interview	Sector	Interviewees' position	Turnover, M EUR
1	Industry association (sawmills)	CEO	-
2	Industry association (secondary processing)	CEO	-
3	Industry association (secondary processing)	Wood construction specialist	-
4	Wood supply	Business development manager	> 1 000
5	Wood supply	Development manager	> 1 000
6	Sawmill	CEO	16
7	Sawmill	CEO	30
8	Sawmill	Development manager	264
9	Sawmill	SVP, Timber business	> 1 000
10	Sawmill	Manager, Investments & Technology	> 1 000
11	Secondary wood processing (planing of wood)	CEO	1
12	Secondary wood processing (components)	CEO	1
13	Secondary wood processing (glulam)	CEO	5
14	Secondary wood processing (windows, doors)	Manager, Operations and sales	135
15	Industrial end customer (prefabricated houses)	CEO	9
16	Industrial end customer (prefab. houses)	CEO	12
17	Industrial end customer (prefab. houses)	CEO	21
18	Industrial end customer (construction firm)	CEO	25

informant and more precisely, perspectives related to digitalization. The interviews lasted between 47 and 129 minutes. One of the interviews was conducted via telephone due to geographical reasons and the rest were conducted face-to-face. Both face-to-face and telephone interviews are generally considered as acceptable methods for data gathering (Aday & Cornelius, 2006), but as in all methods, both have advantages and disadvantages that may affect the quality of the research. Telephone interviews are cost-efficient and enable a wider geographical accessibility (Sturges & Hanrahan, 2004; Sweet, 2002), but they lack an ability to observe the respondent and adapt to the situation, both of which are a strength of face-to-face interviews (Szolnoki & Hoffmann, 2013). Moreover, a telephone interview lacks the opportunity of using visual aids (Garbett & McCormack, 2001). On the other hand, a face-to-face interview may be biased if the interviewee's responses are affected by the interviewer's characteristics, or the interviewer gives signals of approval or disapproval (Kreuter, 2008).

13 interviews were conducted by two interviewers whereas the rest of the five interviews were conducted by one interviewer. All interviews were recorded, tran-

scribed, and coded. Also, field notes were taken during each interview, containing key comments and points made by the interviewer. By incorporating two interviewers, potential sources of error caused by the interviewing method were diminished in two ways. Firstly, this practice enabled one interviewer to focus on the questions while the other interviewer took notes. Secondly, the second interviewer was able to ask specifying questions referring to additional questions during the interviews to gain better understanding of the subject matter.

The interview protocols contained four key thematic blocks: (1) a general overview of the business and sources of future competitiveness, (2) customer orientation and customer value, (3) internal and external information needs, and (4) digitalization transforming the business. The first block aimed at providing necessary background knowledge; the other blocks were based on the theoretical ideas of this study. Their aim was to provide knowledge about how improved information sharing and digitalization could improve the business from the perspectives of internal efficiency, external opportunities and disruptive change, in a way that customer orientation could be improved. The second, third,

and fourth thematic blocks are linked to the main issues that were later (in the analysis stage) specified to form the theoretical framework of the study (Figure 2). The interview protocols were modified for each segment (wood supply, sawmills, further processing, and industrial end-customers), resulting in a total of four partly overlapping protocols. The thematic blocks remained the same in all interview protocols. However, the questions were modified according to the organization and position in the value chain. For example, the sawmills were asked what improvements in their business could improve the customer orientation, and what information would be needed from the wood supply or from the downstream supply chain actors to implement such actions. The industrial end-customers, in turn, were asked, for example, what kind of information from the upstream supply chain actors (e.g., suppliers) would improve their value perception. In sum, the questions for the wood suppliers, sawmills and secondary wood processors focused on the ways to improve the customer orientation within the wood value chain, whereas the focus in industrial end customers' interviews was the development needs of the upstream value chain actors so that their own value could be maximized.

3.3 Data Analysis

The data were analyzed according to qualitative research principles in four phases, as suggested by Miles and Huberman (1994): data reduction, data display, drawing conclusions, and verifying those conclusions. In the first phase, the interviews were read through several times by two researchers, after which the key phrases and points were summarized. The benefit of summaries is in detecting unique patterns before further analysis (Eisenhardt, 1989). Next, the data were categorized into three potential levels of digitalization impacting the business and corporate ways of working. These levels were derived from the research framework of this study and originally based on Parviainen et al. (2017). They include: (1) internal efficiency, (2) external opportunities, and (3) disruptive change. Internal efficiency relates to process efficiency by renewing internal processes through digital means (e.g., improved quality and consistency, a real-time view on operations, and data integration from internal and external sources). External opportunities refer to new ways of doing business and to the emergence of new business opportunities in existing business domains (e.g., new customers, new services or advanced offerings

to customers, and improved response time). Disruptive changes transform business roles completely (e.g., the termination of old business and the emergence of new business). All of the interviews were conducted in Finnish and were translated to English. To avoid interpretation errors the translations were verified by two researchers. In the preliminary illustration of the results, the levels of digitalization were presented in columns whereas organizations (i.e., wood supply, sawmills, secondary wood processing, and industrial end customers) were presented in rows. Furthermore, the rows were divided into the potential benefits of digitalization and into the development needs to achieve these benefits, as perceived by the interviewees. This division provided a clear and straightforward way of discovering the interviewees' perceptions about the meaning and potential benefits of digitalization in customer value creation, as well as development needs within the value chain.

All sectors (i.e., wood supply, sawmills, secondary wood processors, and industrial end customers) were analyzed in order to gain a comprehensive understanding of the factors that possibly impact the competitiveness of the wood products industry. The analysis took into account that the sawmills' and secondary wood processors' comments could refer to the development needs of either the upstream or the downstream value chain. In the presentation of the results, quotes from the key findings are presented to help the reader determine the accuracy of the interpretation. The conclusions were validated through discussions with the industry experts and the steering group of the project.

4. Results

This section addresses the results of this study, showing the potential benefits of digitalization in the business environment and corporate ways of working in the wood value chain. The results are presented starting from the upstream towards the downstream value chain. All of the quotes are from the interviews and are translated from Finnish. Table 2 summarizes the results according to the three impact levels of digitalization described in the former section and in the conceptual framework (cf. Parviainen et al., 2017). The items in the table represent issues that were identified either by one or several interviewees. This allowed us to find weak signals regarding benefits. Similar topics emerged in the subsequent interviews within each segment when internal efficiency

Table 2. Summary of the potential benefits and development needs linked to digitalization: views of different sectors in the wood value chain

Sector	The impact level of digitalization into business		
	Focus on internal efficiency	Focus on external opportunities	Focus on disruptive change
Wood supply			
<i>Potential benefits of digitalization</i>	<ul style="list-style-type: none"> Improved raw material efficiency (via better match between customers' orders and tree stands) Reduced logistic costs 	<ul style="list-style-type: none"> Demand predictability New, customer-oriented services (e.g. forest visualization and virtual tours, specific orders at the individual log -level) 	<ul style="list-style-type: none"> Strategic planning decades ahead (e.g. mill locations, product portfolio) Dynamic forest management planning
<i>Development needs to achieve potential benefits</i>	<ul style="list-style-type: none"> Digitalized and more precise forest inventory data Value chain collaboration, system integration and information transfer 	<ul style="list-style-type: none"> Collaboration, willingness to change System integration and information transfer Analytics and visualization tools, new applications 	<ul style="list-style-type: none"> Information transfer and system interoperability within the value chain Applications and analytic tools for forecasting future forest resources
Sawmills			
<i>Potential benefits of digitalization</i>	<ul style="list-style-type: none"> Avoidance of re-measurement of data Better match between customers' orders and tree stands Improved pricing Process optimization 	<ul style="list-style-type: none"> Demand predictability and shorter reaction times Reduced transportation cost by process streamlining (c.f. "Uber") 	<ul style="list-style-type: none"> Renewal of business models (e.g. business network utilizing common demand hub and transportation) Removal of unnecessary intermediaries
<i>Development needs to achieve potential benefits</i>	<ul style="list-style-type: none"> Digital log identification system Retention and transfer of measured data Information transfer and system interoperability More precise forest inventory data, forecasts of the inner quality of wood 	<ul style="list-style-type: none"> Information transfer and system interoperability (e.g. customers' demand data) both within a firm and between firms Trust among the value chain partners Applications and analytic tools 	<ul style="list-style-type: none"> Information transfer and system interoperability Applications and analytic tools
Secondary wood processing			
<i>Potential benefits of digitalization</i>	<ul style="list-style-type: none"> Improved process efficiency (e.g. compatible formats of designs, streamlined processes) 	<ul style="list-style-type: none"> Growth of large-scale wood construction Improved customer satisfaction by integrating the customer to manufacturer's process 	<ul style="list-style-type: none"> —
<i>Development needs to achieve potential benefits</i>	<ul style="list-style-type: none"> Compatible information systems within value chain and information integration Common product standards Sound product tracing method(s) 	<ul style="list-style-type: none"> Information transfer and system interoperability, common product standards New applications linking production into customer's processes 	<ul style="list-style-type: none"> —
Industrial end-customer			
<i>Potential benefits of digitalization</i>	<ul style="list-style-type: none"> Minimized raw material loss Efficient transportation 	<ul style="list-style-type: none"> Improved predictability and responsiveness to changes in demand Better understanding of cost effects 	<ul style="list-style-type: none"> —
<i>Development needs to achieve potential benefits</i>	<ul style="list-style-type: none"> Information transfer and system interoperability New applications and analytics Real-time information sharing within a firm and with external partners 	<ul style="list-style-type: none"> Compatible information systems and information transfer Applications and analytic tools Genuine intent of firms to exploit information for mutual success 	<ul style="list-style-type: none"> —

and external business opportunities were discussed. However, there were remarkably less ideas concerning the disruptive change-category. The potential of digitalization in improving current business was probably easier to comprehend by the respondents. Although there is indication of data saturation, the results can be regarded as indicative only.

4.1 Wood Supply

The interviewed wood suppliers pointed out two interlinked ways to improve value creation through digitalization: by means of digitalized forest inventory data and by improved interaction between wood value chain actors. The wood supply, sawmills and secondary wood processors were seen to operate too independently, which creates sub-optimization and inflexible value chains. Closer collaboration should be conceived in a new way: as a practice in which all actors benefit from the success of one. More efficient transportation and improved operational planning were mentioned as examples.

Currently, decisions on harvesting are based on stand-level averages of wood volumes and qualities per hectare. During the purchase of a stand, it is not very well known how suitable the wood raw material is for a certain customer's needs. This is not cost-efficient, and neither is it customer oriented. With an integrated control system and analytic tools, the customer's order could be divided into sawn timber pieces, and further optimized into logs. Thereafter, harvesting could be targeted more effectively to appropriate stands. The issue of how to organize interfirm collaboration requires research attention as the following quote emphasizes:

"Information flows will likely transfer quite easily, but the challenge is in making common applications. Not enough research has been carried out."
(Business Development Manager, Wood Supply)

In the interviews, forest visualization and the ability to "walk" in the forest with virtual glasses was mentioned as an interesting possibility. Improved forest data were also seen as important since the demands of the future industrial customer are expected to become more complex. The respondents anticipated that orders will likely request individual logs with specific characteristics. Such orders have already been presented to wood supply agents, but technical capabilities have not yet been sufficient to enable the service.

Some other interesting opportunities to utilize information in business were mentioned. For example, future forest resources are well known already, and will become better understood in the future. This could be used in planning sawmills' and other facilities' locations, production portfolio, etc. Moreover, improved forest inventory data would also enable dynamic forest management planning, providing potential for new service offerings to forest owners. The interviewees emphasized that the data have already been available for some time in different files and organizations, but traditional attitudes and the unwillingness to change have been big challenges. The following quote illustrates the generality of this problem.

"... the attitudes of all persons within the value chain should be changed away from traditional way of thinking" (Development Manager, Wood Supply)

4.2 Sawmills

The interviews of sawmill representatives revealed that a massive amount of data is produced in wood value chains, but only a fraction of it is utilized. The emergence of technologies and applications supporting the exploitation of these data was considered to offer a remarkable potential for the sawmill industry. Firstly, the data produced via measurements at different phases (forest, log sorting, sawing, etc.) should be retained so as to avoid re-measurement of the parameters in latter phases. This would require a log identification system that works digitally without physical marking. Information about the position of the log during the measurements should be included for later decisions. To reduce waste wood and to improve wood pricing, several respondents pointed out the importance of better predicting the quality of standing trees, and especially their inner characteristics before sawing, as the following quote shows.

"If you could know the inner characteristics of wood before sawing, it would be a huge advancement."
(CEO, industry association)

In general, an integrated information transfer both within a firm and between firms was considered to include remarkable business potential. For example, a sawmill interacting with a group of several secondary wood processing firms could optimize its production, since it could use known sales data well in advance. Unavoidable changes in consumer orders could be easily updated in the system, and the big picture would remain

fairly stable, easing the sawmill's production planning. This would be a considerable improvement compared to the prevailing operating model; the respondents judged that currently the wood processors work more to ensure their own flexibility by sending orders to the sawmill at the very last moment. The benefit of integrated information transfer would not only contribute to internal efficiency, but it would improve reactivity and customer orientation, and enable completely new business models. A sawmill representative described the change need as follows.

"The overall business should be renewed quite significantly by streamlining value chains as much as possible so that intermediate money takers would be removed. But it should be done so that the consumer could get what they want – which is a house rather than just cladding, for example. This would improve customer satisfaction... there should be a hub, which includes all needs and locations where the products are needed. The products could be somehow allocated to different manufactures so that the whole chain would become cost efficient." (CEO, Sawmill)

The removal of intermediaries was seen as possible and also important, and so was the reduction of transportation costs. The sawmill business was compared to the taxi business Uber, having the same potential for streamlining transportation between different factories. Some respondents highlighted the leap that digitalization has already taken within the industry. Electronic wood trading, pre-harvest inventory methods, and the vast amounts of data collected during harvesting were mentioned as examples. The opposite view was crystallized in the comment "two terms – sawmills and digitalization – have a poor fit together." This comment referred to industry practices that were regarded as conservative, being based above all on trust.

4.3 Secondary Wood Processing

The interviews revealed that a lot of data transfer in the wood products industry still takes place in the paper format. The data may be sent electronically but, due to its unsuitability, the receiver modifies it manually within a system. An example was provided by a wood component manufacturer. In most cases, this company received drawings in 2D-format from architects, electricity designers and HVAC (heating, ventilation and air conditioning) designers. However, these drawings were needed in 3D-format in their process. This caused

process inefficiency and customer dissatisfaction, as the following quote illustrates.

"The 2D-designs tend to cause delays in our production process. If one of the designs changes, everybody has to make modifications to their designs... another consequence is poor design. Because we usually get the designs at the last minute, we don't have time to give feedback. Then, unnecessary processing steps mean double work for us." (CEO, Component manufacturer)

In general, it seems that compatible information systems are lacking between different organizations, particularly in wood construction value chains. Based on the interviews, no change was anticipated in the near future. As the wood construction of elements/prefabricated units is fairly new in Finland, there is a considerable lack of knowledge, uniform standards, and previous experience. Means to improve information transfer and knowledge levels are needed to support the expansion of firms to large-scale wood construction to maximize benefits. The following quote summarizes the current problems.

"There are many sites in Finland that are originally earmarked for wood construction, but they are built in concrete just because there is not the know-how, experience, raw material or necessary systems." (CEO, Component manufacturer)

In many cases, the secondary processors of wood re-sort the sawn timber to ensure quality, strength, etc. This stage could be avoided with more exact product information, which the customer could scan into his/her own process. For the secondary wood processors' customers, product quality and production efficiency are becoming increasingly important, and current systems should be developed to support this trend. As an example, one of the interviewees described a situation in which their customer in the key export market asked for pictures to ensure their own quality requirements. Instead of sending random pictures via email, the interviewed manufacturer got an idea of a system where the customer could select the products by themselves in their own location, but one is not yet in use.

4.4 Industrial End-Customers

Improving the process efficiency by means of digital tools was mentioned in many interviews. Digitalization and the better information transfer linked to it were considered to have large potential to enhance respon-

siveness, predictability, and operational efficiency. These enhancements imply an improved ability to react to reclamations, to exploit sensor technology in inventory management, and to transfer up-to-date information between the supplier and the customer. For example, the interviewed prefabricated house manufacturer stated that he often seeks suitable raw materials after the order, without having precise pre-information about suppliers' delivery capacity. The respondents emphasized that the information flows should be two-directional, also helping the supplier to improve their own planning and operations. If the supplier is informed as early as possible about the customer's raw material needs, the customer benefits through more accurate delivery times and is more satisfied. An interviewee described this development need as follows.

"Information transfer from our side is not at all as good as it could be. We should have real-time knowledge about our short-term needs and it should be shared with our suppliers as early as possible. In the end, the question is how we could help our suppliers to succeed...we already have a lot of data, so if desired, the information would be available at a fairly early stage.... I don't see any reason why we could not act in this way. The precondition is that the information would be really utilized on both sides." (Manager, window and door manufacturer)

Examples of operational efficiency focused mainly on cost savings, such as ways to minimize raw material loss, the integration of transportation with external actors, and a more profound understanding of the costs per unit. In prefabricated house manufacturing, the majority of raw material loss is wood. By exploiting new technologies and information integration, wood pieces could be pre-cut by the supplier or the cutting could be optimized in the customer's process. The interviews showed that this method is already in use at one of the construction firm's suppliers. Their information systems were compatible, which enabled the supplier to pre-cut the needed pieces into the right dimensions and shapes, according to the constructor's CAD-designs.

The interviewees suggested that there is high potential for improving transportation efficiency, and said developments have already partly begun. Instead of making separate agreements with transport firms, a group of manufacturers had started to develop a common system for transportation optimization. Regarding a more profound understanding of unit costs, the interviewees

emphasized the significance of real-time cost analysis that could be traced back to production time, personnel, raw materials, and suppliers. Real-time information allows an immediate intervention directed to the right cause, instead of using general-level weekly reports.

Based on the interview results, digital technologies seem to foster better customer understanding and satisfaction. Firstly, real-time market studies make the manufacturer's reaction time shorter in the increasingly competitive business environment. Digital systems ensure that all necessary parts are included in the delivery, save firms' resources, and improve customer satisfaction. In this way, post-deliveries can be avoided or at least known about beforehand, which is important as small inefficiencies can lead to significant damage in customer relationships.

5. Discussion

This study has examined the potential benefits of digitalization for firms in wood products industry. The study's primary goal was finding ways to improve the wood products industry's long-term competitiveness. A broader goal was gathering knowledge about how manufacturing firms in traditional industries could transform their business towards customer orientation via digitalization. The starting points of the study involve the views about the role of knowledge and customer orientation in today's business. These views highlight that profitability is primarily affected by the firm's ability to generate new knowledge through constant learning (Tseng, 2016) and to exploit knowledge to create superior customer value (Woodruff, 1997). Digitalization is in the core of these strivings: it enables the analysis of vast amounts of data and interlinks actors throughout the value chain. It requires a fundamental change in current business operations (Parviainen et al., 2017).

The results of this study indicate that the wood products industry has interesting opportunities to leverage digitalization to derive customer value. Customers seem to expect increasingly versatile offerings that go beyond improved product quality, delivery and price (Makkonen & Sundqvist-Andberg, 2017). These customers' needs drive change towards customer orientation; digitalization is a powerful tool to accelerate this change. On the other hand, the study reveals that the industry is still in the early stages of this development. Depending on the firm's goals, a firm can use digital tools to streamline

operations and/or to develop products and services that stand out from rivals. In general, the interviewees' attitudes towards digitalization were positive, and some interviewees considered the transformation urgent. However, the term "digitalization" was understood in different ways. There are many actors in the value chain who have not yet internalized what digitalization actually means, which leaves plenty of untapped business potential. Some respondents perceived it to mean a change of currently existing processes into a digital format and, consequently, into a more efficient transfer of data. Others expressed more comprehensive and profound views about its potential, including a new way of thinking about business models.

Regarding the ways in which digitalization can be exploited, many interviewees recognized that customer demands are increasingly complex, and the industry should prepare for it. It was foreseen that wood suppliers should be able to supply individual logs to meet specific demands. This is not possible without efficient interaction and information sharing between different stakeholders. The main emphasis in the development of ideas was, however, in the ways to improve internal or operational efficiency (e.g., monitoring costs, improving the pricing of wood raw material, resource optimization, improved process efficiency, transportation efficiency, warehouse monitoring, or faster reaction times). New ways to develop business in the existing domain, or to transform the business roles completely, were also discussed but significantly less so. Consequently, the results indicate that the industry is still very production-focused, which is widely supported by previous research (e.g. Brege et al., 2010; Toppinen et al., 2013; Pelli et al., 2017).

Some actions had already been taken to exploit information and digital technologies more effectively. For example, collaboration practices and information transfer were developed to optimize raw material utilization. R&D projects were launched to improve transportation efficiency and to gain more precise forest inventory data. Wood suppliers were one of the most advanced sectors in pursuing this development. This is not surprising, as the forest industry has traditionally invested in developing wood procurement operations with efficient information exploitation.

The views of the sawmill industry were more unexpected. They presented advanced ideas on the utilization of information to renew business models completely.

For example, the creation of "a hub," integrating demand information and optimizing deliveries in a business network, and virtual "forest tours" would break existing business models. A novel approach to business was also presented by the secondary wood processor, who considered a real-time integration of customers into the manufacturer's production process. This would imply a new service provided to the customer, where a customer with a specific need could select the suitable products. Here, the manufacturer would have an opportunity to interact with customers and become a co-creator of customer value (Grönroos & Voima, 2013).

The wood suppliers, sawmills and secondary wood processors considered it particularly important to achieve information from the downstream value chain to improve their process predictability. The respondents strongly emphasized the need for more precise forest inventory data that could be utilized, for example, in matching the customers' orders and tree stands better, and hence, to improve raw material efficiency. One reason for this strong emphasis may be the fact that research and development in this direction is underway and the issue has been widely discussed within the industry (see "Data-Driven Bioeconomy" and "Forest Big Data" projects). Practical benefits in these areas are likely to emerge in a relatively short term.

The industrial end-customers were the only sector emphasizing the importance of two-directional information transfer within the value chain. In addition to the possibility of benefiting from better information from the suppliers (e.g., delivery capacity), they would have an opportunity to help their suppliers succeed by providing timely information (e.g., demand information). This was expected to have two primary effects on business. Firstly, operational efficiency would increase, and secondly, customer satisfaction could be improved via faster deliveries. This sector also differed from the other groups in considering the options to gain new knowledge from their customers.

In all sectors, most of the future actions seemed to target cost competitiveness, leaving remarkable potential to differentiate from rivals. New applications based on digitalization could enhance, for example, learning from customers, the dynamic development of new product-service offerings, innovating, and domestic and global marketing. The results show that there is an urgent need to develop standards, compatible information systems

for information transfer, and new applications based on digital technologies. As all the needed skills and knowledge are seldom found inside a single firm's boundaries (Möller & Svahn, 2006), collaboration with other value chain partners is essential if a firm aims to exploit the full potential of digitalization. This supports the earlier discussion that links together strategic collaboration and a firm's long-term competitiveness in wood value chains (e.g. Mattila et al., 2016; Toppinen et al., 2011). The need for collaboration was also acknowledged by the interviewees of this study. The expected benefits were seen as being realized on the basis of the improved internal efficiency and of the improved profitability of the whole wood value chain.

As each firm is different, there are also different ways to implement digitalization. The financial aspects and a firm's strategy are decisive in defining goals for a digital strategy. Berman (2012) suggests that many firms start their digital transformation by discovering the factors that generate value for their customers and simultaneously develop operating models to address how the value can be delivered. In wood value chains, the first step towards a successful digital transformation requires the building of trust between value chain actors. Many respondents in the interviews noted that the attitudes and the unwillingness to change are the major challenges to overcome when the business is transformed. Currently, the very independent way of working was seen to cause chain inflexibility. In the same breath, however, many respondents emphasized the need for change and highlighted that one's success in the wood value chain impacts the overall success of the industry. This indicates that an attitudinal change is on its way, and the industry will renew as soon as it has enough information and means to do so.

In future studies, the focus should be on gaining a more profound understanding of the information needs of value chain actors. Moreover, there should be more research about how the industry could utilize digitalization in developing customer-oriented business strategies. As the industry already has many ideas about improving the internal efficiency (e.g., processes) of firms, there should be more attention to new offerings (e.g., products and services) and to new ways of doing business (e.g., business roles and ways of communication) – a core issue is the application of the knowledge-based economy in the wood products industry.

There was indication of data saturation as similar issues emerged in the interviews, particularly when discussing internal efficiency and external business opportunities. However, due to the small sample size and the restriction to a specific country, the findings of this study should be tested with larger samples and in broader geographic contexts; this would address the main limitations of the current study. The sample size was particularly small in wood supply, and the sample only represented large firms. This problem was slightly relieved by the fact that views on wood supply were also gained in the sawmill interviews. However, the findings of this study are not statistically generalizable, but should be regarded as indicative. An additional reason for this cautious view is that digitalization has not yet taken a leap within the value chain of wood products and construction industries, due to which the perceptions of the potential of digitalization may be constrained. In order to evaluate the potential more profoundly, interviews of professionals in pioneering industries could be one promising option.

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