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- Empowering Organizations for the Digital Era: Unlocking the Potential of ICT Utilization and Organizational Learning -

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Elizabeth Solberg

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Enjoy the read.

Abstract

The purpose of this study has been to provide a comprehensive investigation into the relationship between ICT and OP by considering multiple aspects of ICT utilization and organizational learning, innovative capabilities, and operational excellence as mediators. By examining the post-COVID-19 context and focusing on the finance-, technology-, and professional services industries in Norway, this research aims to offer managers and business leaders an updated understanding of how to optimize ICT utilization and enhance OP within a technologically advanced business environment. Data was gathered through a questionnaire-based survey that was sent out to executives and managers in 1007 Norwegian organizations. The total of 312 responses was completed and included in the analysis.

A PLS-SEM analysis was conducted in order to investigate the relationship between the study's variables. Our findings reveal that the relationship between ICT utilization and organizational performance is mediated by organizational learning. The relationship between organizational learning and organizational performance was further mediated by innovative capabilities and operational excellence. Furthermore, ICT knowhow, information sharing, and ICT collaboration emerged as crucial aspects of ICT utilization for driving both organizational learning and organizational performance. While this study contributes to the literature and offers valuable implications for managers, it is important to acknowledge limitations, including the subjective nature of performance measurements and the use of measures that have not been previously validated.

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1.0 Introduction

1.1 Case significance

Information-and communication technology (ICT) is an important factor in today's business environment as it has become an increasingly integrated part of how organizations work. According to a survey conducted by McKinsey, the COVID-19 pandemic has had a significant impact on the increasing adoption of ICT across industries (LaBerge, 2020). The same survey found a shift in executives' view of technology, from looking at it as a means for increasing cost efficiency, to viewing it as a critical component of business with high strategic importance which can lead to an increase in organizational performance (OP) and ultimately a competitive advantage.

The relationship between ICT and OP has received a great deal of attention throughout the years, and the literature suggests that ICT has an indirect positive effect on OP (Akram et al., 2018; Kuusisto, 2017; Real et al., 2006; Jean, 2007). The most common explanation for this effect is that ICT leads to operational excellence (OX) and improved innovative capabilities, which has its output in OP. Most of the reviewed literature on the subject takes a resource-based view of the firm and tries to explain the relationship between ICT and OP as being mediated by other capabilities. While earlier studies identified organizational learning (OL) as an important mediator (Tippins & Sohi, 2003; Real et al., 2006), more recent studies have focused on knowledge management capabilities (Akram et al., 2018), knowledge sharing (Deng et al., 2022), and absorptive capacity (Cuevas-Vargas, 2002) as mediators. However, both knowledge management capabilities, knowledge sharing, and absorptive capacity could arguably be seen as highly related to OL.

Previous literature on the relationship between ICT and OP has also operationalized and measured ICT in numerous different ways, leading to a focus on several different aspects of ICT e.g. ICT capital investment (Brynjolfsson, 1993), ICT competency (Tippins & Sohi, 2003; Akram et al., 2018), ICT Infrastructure (Bhatt & Grover, 2005; Real et al. 2006; Akram et al., 2018) and

ICT adoption (Yunis et al., 2017; Cuevas-Vargas et al., 2022). Together with a diverse focus on different mediators, it makes for a difficult interpretation and guidance as to how managers and business leaders can optimize their ICT utilization in order to increase OP. We therefore argue that it becomes necessary to conduct new studies which examine the effects of the different aspects of ICT and integrate multiple mediators to provide managers and business leaders alike with much clearer implications.

The purpose of this study will be to take a more comprehensive approach to investigating the relationship between ICT and OP in order to provide managers with clearer implications. This paper will be based on both the RBV framework, and the 4I framework for OL, where the latter is proposed as the main mechanism for how ICT affects OP through the pathways of innovative capabilities and OX. This study will also focus on ICT utilization, which will be seen as a higher order construct (HOC) consisting of ICT knowhow, ICT communication, ICT collaboration, ICT information sharing, and ICT information acquisition. By considering multiple aspects of ICT and including multiple mediators, we aim to provide managers and business leaders with a more complete understanding of how ICT affects OP, and how they can optimize ICT utilization in order to increase OP.

One crucial aspect of our study is the investigation of the ICT – OP relationship post COVID-19. As Previously mentioned, the global pandemic sped up the adoption of ICT as well as altered executives' views of ICT as an integral part of business (LaBerge et al., 2020). Examining the relationship of ICT – OP in this context will help managers and business leaders to get an up-to-date understanding of the unique dynamics and opportunities that have emerged during these times of disruption.

Furthermore, our study focuses specifically on the finance-, technology-, and professional services industries. These industries can be seen as knowledge intensive industries characterized by a high level of knowledge creation, sharing, and utilization, making them particularly susceptible for the effects of ICT (Aslesen & Isaksen, 2007). The following study has been conducted in Norway, which is ranked as one of the leading nations in terms of technological

development and ICT use (United Nations, 2023). By conducting our research in this context, we can leverage the expertise and experiences of organizations operating in an advanced ICT ecosystem. The latter contributes to valuable insight into the intricacies of the ICT – OP relationship within a highly developed technological landscape, giving a broader understanding of this relationship across different contexts. Additionally, this could also help extend the life cycle of our study, as the findings likely will remain relevant in less technologically developed countries.

By addressing the aforementioned research gaps and objectives, this study aims to contribute to the theoretical understanding and practical implications surrounding the relationship between ICT utilization and OP. The findings will have the potential to guide strategic decision-making and assist managers in optimizing ICT utilization to enhance overall OP in knowledge-intensive industries.

1.2 Defining key concepts

1.1.1 Information-and Communication Technology

ICT relates to the technological tools and resources used in organizations to facilitate effective communication, response, coordination, storage, and protection of vital information (Bennet & Tomblin, 2006). As there is an extensive literature on the subject of ICT and the digitalization of businesses, there is no lack of definitions. Blurton (1999) defines ICT as the "diverse set of technological tools and resources used to communicate and to create, disseminate, store and manage information" (p. 46). Real et al. (2006) tries to provide a more specific definition and defines ICT infrastructure as "the shared IT capabilities that enable flow of knowledge in an organization to be supported" (p. 508). For the purpose of our study, we define ICT as the digital tools and systems used to enhance communication, coordination, and storage, distribution and utilization of knowledge and knowhow in businesses. This includes systems and applications like Google Workspace, Microsoft 365, Bitrix24, Business Intelligence tools, video conference tools, chat platforms, and databases.

Based on the information gathered through the review of literature we have identified information sharing (Deng et al., 2022), information acquisition (Real et al., 2006), communication (Deng et al., 2022; Jean, 2007), and collaboration (Real et al., 2006) as important functions of ICT. Previous literature has also focused on ICT competency or ICT knowhow (Siddiqui et al., 2019). As the purpose of this study is to provide clearer implications for how organizations can utilize ICT, this study will look at ICT utilization which we define as the organization's ability to use ICT for different functions. These functions include information sharing, information acquisition, communication, and collaborations. It will in addition include organizations ICT knowhow or competency as this would arguably influence their ability to use ICT efficiently for these functions.

1.1.2 Organizational Learning

As the case with ICT, OL suffers the same lack of consensus regarding its definition, especially when OL is seen in relation to its related and overlapping concepts such as knowledge management, knowledge sharing, and absorptive capacity.

In order to define OL, multiple studies have been reviewed. Fiol & Lyles (1985) defined OL as the capability that facilitates the improvement of actions through the application of knowledge and understanding. More recent studies have adopted and built on these initial definitions. Pérez-Lopez et al. (2005) defined OL as the process of acquiring, interpreting, distributing, and storing knowledge in the organization. Based on a dynamic model which integrated organizational learning and knowledge creation, Real et al. (2006) examined how OL contributed to the development of technology distinctive competencies. They defined OL as "a dynamic process of knowledge creation generated at the heart of the organization via its individuals and groups, directed at the generation and development of distinctive competencies that enable the organization to improve its performance and results" (p. 506). Vera et al. (2012) conceptualized OL as a process, consisting of single-, double- and deutero- learning, seeing it as a descriptive stream. The research defined OL as "the process of change in individual and shared thought and action, which is affected by and embedded in the institutions of the organization" (p. 154). Relating OL to how knowledge changes or flows through the different organizational levels.

Considering the purpose of this study, we define OL as the mechanism that leads to the development and alteration of an organization's capabilities (Vera et al., 2012), and that enables the organization to improve its performance and action (Fiol & Lyles, 1985; Real et al., 2006). This definition will also include the processes of acquiring, interpreting, distributing, and storing knowledge as suggested by Pérez-Lopez et al. (2005). As for measuring OL, the application of the Strategic Learning Assessment Map (SLAM) will be used as it is based on Crossan et al.'s (1999) 4I framework. The framework consists of a dynamic process of intuiting, interpreting, integrating, and institutionalizing, where feed-forward and feed-back contributes to organizational, group and individual learning. The 4I framework will be further discussed in the next chapter (2.2), as part of the theoretical framework.

1.1.3 Innovative capabilities

An organization's ability to recognize, assimilate, and create new knowledge, concepts and ideas is connected to the organization's innovative capabilities (Cuevas-Vargas et al., 2022; Siddique et al., 2019). A common understanding within the literature is that innovative capabilities are proactive responses on a dynamic market where organizations seek to alter their internal or external environments in order to sustain or obtain a competitive advantage (Cuevas-Vargas et al., 2022). It can be argued that these proactive responses act as dynamic capabilities (specific strategic and organizational processes that create value for firms within dynamic markets) as they relate to firm-specific capabilities that provide sources of competitive advantage (Eisenhardt & Martin, 2000).

Organizational capacities connected to responsiveness, flexibility, and allocation of organizational assets are all indications of innovative capabilities. Yoo et al. (2010) presented the notion that in order for organizations to stay competitive, innovation must be leveraged in response to changes in the environment, and defined innovation as "the production or adoption of novel and useful systems, processes, products, or services" (p. 333). For the sake of this paper, the definition used for innovative capabilities is the organization's ability to produce and implement new novel and useful systems, processes, products, and services in order to stay competitive (Yoo et al., 2010).

1.1.4 Operational Excellence

If organizations are to stay competitive, being able to attain and use new and existing knowledge becomes imperative. Being able to put new initiatives into practice by using different programs or methodologies, thereby resulting in effective and productive levels of operations, is a sign of OX (Yunis et al., 2017). Through the use of processes such as Six Sigma (LSS) and lean thinking, organizations are able to experiment and apply it to emerging problems creating the possibility of being inferior to competitors (Bogodistov & Moormann, 2019). These processes can be seen as the organization's operational capabilities as they are implemented and routinized within the organization. For the sake of this paper, OX has been defined as the organization's ability to dynamically deliver high efficiency operations, through continuous improvement to new and reviewed methods in order to enhance the productivity and competitiveness of the organization.

1.1.5 Organizational Performance

Organizational performance (OP) or business performance are surprisingly difficult to define. Previous literature has defined performance as the extent to which an organization achieves its financial and non-financial objectives (Vera et al., 2012). Attaining organizational goals is a crucial aspect of performance, which can include reaching quarterly numbers, increasing market share, or contributing to reducing the organization's CO2 footprint (Pérez Lopez et al., 2005). Meeting established standards and goals implies that the organization is able to fulfill its obligations, and OP helps achieve those goals (Daft, 2015). The literature also differs on the measures of absolute performance (Real et al., 2006) and measuring performance in relation to competitors (Akram et al., 2018). Furthermore, the RBV framework sees OP as a competitive advantage and therefore suggests that OP is something that is relative to competitors (Barney, 1991). Based on this and the aforementioned literature, we define OP as the organization's ability to achieve organizational goals, both financial and non-financial, in relation to the competitive circumstances.

2.0 Theoretical framework

2.1 The Resource-Based View of the firm

Our research encompasses how organizations are able to achieve and sustain a competitive advantage through better understanding how ICT and OL affects OP. Therefore, using a framework which focuses on how the resources and capabilities of the organization contribute to organizational success, i.e., the resource-based view (RBV) becomes a preference. As the RBV draws a focus to how organizations can leverage their resources in order to build unique value (Akram et al., 2018).

Barney (1991) argued that in order to understand whether or not an organization's resources could sustain competitive advantage, there were some criteria that needed to be fulfilled. If the resource were found to be valuable, rare, imperfectly imitable, and without substitution, the resource could be defined as having a competitive advantage. The framework further implies that the organization "cannot expect to obtain sustained competitive advantages when strategic resources are evenly distributed across all competing firms and highly mobile" (Barney, 1991, p. 103). This implies that heterogeneity and immobility play a crucial role in sustaining any competitive advantage the organization might have.

Several researchers have discussed how an organization's ICT resources and capabilities can be leveraged in light of RBV, e.g., Bharadwaj (2000). The study provided a detailed argument for how the organization's IT capabilities could be used in order to gain a sustainable competitive advantage. His study saw the organization's ICT capability as comprising three distinctive areas. First, an organization's ICT capability comprises its tangible assets, specifically ICT infrastructure. Second, the technological skill set of its employees poses as the organization's human capital. Third, the intangible assets, which encompasses the organizations knowledge, customer orientation and its synergies, which are enabled through ICT. As the organization manages to leverage the use of its ICT capabilities, thorough e.g., having managers with distinctive ICT competencies, enabling the creation of flexible ICT infrastructure, decreasing costs, and increasing financial performance could then lead to competitive advantage. Based on this, it is clear that it is the organization's ability to take advantage and

leverage their competencies which leads to competitive advantage, not merely the investing in a new certification or buying a new computer program.

Another important aspect to the RBV framework is the organization's second-order capabilities, dynamic capabilities, and operational capabilities. OL becomes an important component within RBV as can be defined as the organization's ability to acquire, create, and apply knowledge in order to enhance its capabilities and adapt to changing environments. In order to fully grasp how OL acts as an organizational capability Winter (2003), presented the organizational capability hierarchy which includes zero-level-, dynamic-, and second-order capabilities. Zero-level capabilities are the fundamental capabilities within the organization, generating income, these are seen as operational capabilities and the current way operations are performed (Vera et al., 2012). Zero-level- or operational capabilities could thus be seen in relation to OX. Dynamic capabilities are associated with long-term commitments in product development, representing a differentiation of operational capabilities of the first order (Vera et al., 2012). Dynamic capabilities could thus be seen in relation to innovative capabilities. Second-order capabilities contribute to the complexity of capabilities, differentiate dynamic capabilities of the first order and operational capabilities of the second order. Learning becomes an important second-order capability within this framework, where research has indicated that organizational focus on building capabilities from unique competencies can contribute to increased long-term performance (Bhatt & Grover, 2005).

2.2 The 4I framework of Organizational Learning

While the RBV emphasizes the strategic value of OL, and how ICT could be a facilitator for OL, it does not provide insight into the organizational learning process and mechanism. This is a crucial element for managers and business leaders in order to understand how they could utilize ICT for improving OL, as well as for improving OP. The 4I framework can be seen as complementary to RBV as it provides such insight.

Crossan et al. (1999) presented the 4I framework, which defines organizational learning as a principal method of strategic renewal and a means of ensuring company success. Organizational learning is suggested to occur at three levels: individual, group, and organizational. These levels are further thought to be linked through four processes: intuiting, interpreting, integrating, and

institutionalizing. *Intuiting* involves acquiring tacit knowledge at the individual level, which is then made explicit through *Interpretation* and communication with the group. The knowledge is *Integrated* as the group coordinates actions based on shared understanding. Finally, rational actions can be *Institutionalized* within the organizational structures, routines, systems, and strategies. As ICT utilization is shown to enhance communication and coordination (Deng et al., 2022; Jean, 2007), information sharing (Yunis et al., 2018) and information storage (Kuusisto, 2017), it would likely have a positive effect on these OL processes.

Furthermore, the 4I framework depicts that the presented processes interact and influence each other through feed-forward and feed-back mechanisms. Where feed-forward is recognized as deriving from the individual to the organization, and feed-back deriving from the organization to the individual (Crossan et al., 1999). ICT utilization can facilitate feed-forward and feed-back processes by improving information dissemination through e.g., easily accessible databases such as cloud storage and SharePoint. This is further related to innovation and OX as (1) new innovative ideas, products or work methods can be fed-forward and institutionalized and (2) then be fed backwards and materialized as OX. As such, organizational learning is seen as a second-order capability, building on feed-forward and feed-back flows, relying on both resources and capabilities within the different levels of the organization, from zero-level and first-level order.

2.3 Literature review and introduction to research model

2.3.1 The relationship between ICT Utilization and OP

Early studies on the relationship between ICT and Organizational performance focused on the relationship between ICT capital investment and organizational productivity. The results were mixed but indicated that there wasn't a direct relationship between ICT and increased productivity (Brynjolfsson, 1993). Researchers have since discussed whether or not there is a direct relationship between ICT and Organizational Performance. Using the RBV framework, it has been argued that ICT in itself is a commodity and that it therefore cannot lead to increased organizational performance. Instead, it is suggested that ICT could act as an enabler for complimenting resources or capabilities and thus have an indirect positive effect on performance (Carr, 2003).

According to Tippins & Sohi (2003), organizational learning plays a crucial role in determining the outcomes of ICT, which is defined as the process by which new knowledge or insights are developed by the organization. Their study refers to information technology as a resource that facilitates the effective collection and utilization of information. Using RBV as a theoretical framework, they hypothesized that OL mediates the relationship between ICT competency (the organizations' knowledge and abilities related to ICT) and firm performance. The ICT competency measure draws on ICT operations, ICT objects and ICT knowledge, which draws resemblance to how our measure of ICT is built. Among the samples from their studies, were 524 executives from electronic, industrial & commercial machinery, transportation, measuring & analyzing, and transportation equipment manufacturers. According to the results of the study, it is indicated that the partial mediation model reveals greater variance between ICT and organizational performance than the direct effect. The direct effect also becomes non-significant in the partial mediation model, indicating that OL fully mediates the relationship between ICT and organizational performance.

In a study conducted by Real et al. (2006), the authors attempted to assess how ICT, defined as the infrastructure with shared capabilities that enable the flow of knowledge within an organization through technological resources (hardware and software), contributes to learning and development. The authors define learning as "a dynamic process of knowledge creation generated at the heart of the organization via its individuals and groups, directed at the generation and development of distinctive competencies that enable the organization to improve its performance and results" (p. 506). The researchers conducted their research using a multi-sectoral sample, sending questionnaires to 492 Spanish companies within the manufacturing industry e.g., food and drinks, machinery, and mechanical equipment, which resulted in 140 responses that were eligible for analysis. Their results indicates that there isn't a direct relationship between ICT and OP, but that the relationship is mediated through OL and technologically distinctive capabilities. The authors further argue that ICT infrastructure contributed to the increase of organizational memory within the organization through the ability to store, access, and revise information.

As part of a literature review conducted by Jean (2007), RBV was also shown to be useful for the analysis of ICT in a business-to-business context. By reviewing the literature, the study aims to understand how ICT is used by

multinational enterprises and their suppliers, where ICT is seen as supporting business to business coordination and information sharing. This paper presents a framework suggesting that ICT can affect OP through intermediary processes. According to their conceptual framework, supply chain activities can gain competitive advantage through the integration of ICT, and specifically electronic integration, which can contribute to a sustainable competitive advantage. According to the research, ICT can contribute to the improvement of business processes and information quality, which in turn can increase partnership equality. This indicates that small businesses with ICT and electronic integration will be able to have a positive impact on larger companies. As with a growing agreement within the literature, the findings in the review concur that ICT, in conjunction with supportive measures, can have an impact on OP via mediated effects "by coordination, control and opportunism processes (Jean, 2007, p. 316), however, implementing them without complementary organizational capabilities, such as managerial assistance, could as the study states, result in deterioration.

A more recent literature review on the effects of digitalization on organizations was conducted by Kuusito (2017). Several main effects were identified, including organizational agility, structure, learning, digital innovation, and business ecosystems. Due to the strong focus on OL and digitalization in our study, these also become the primary areas of investigation when reviewing the material found. Among the main focuses of the review is the use of digital assets to improve the performance of organizations and the impact these technologies have had on the way business is conducted today. It has been shown that digitalization facilitates and enhances the analysis of knowledge, allowing organizational memory and managerial tools to be easily accessed. Moreover, the review argues that the use of different platforms and access to organizational memory have caused innovation processes to change, with new ideas and modifications being implemented using existing methods. As a result of the review, the managerial implications of digitalization are highlighted. This adheres to implications of digital ICT, where OL and innovative capabilities can be carefully managed in order to be able to compete in the dynamic market.

A study by Yunis et al. (2018) examined the impact of ICT and innovation on organizational performance, seeking to understand why and how a proper implementation of ICT can contribute to reducing the number of project failures. Referring to the definition used by Blurton (1999), it also contributes to provide a

definition of ICT adoption, as “willingness to take the new innovation related to computer and internet” (p. 344). The study uses two theoretical frameworks, focusing on the dynamic capabilities view, and the theory of innovation translation. The study used a sample of managers and employees on a middle and senior level where the employee’s possessed competence in ICT. 374 usable surveys were gathered for analysis. From the analysis the paper found that innovative use of ICT resources could in fact generate better OP, where ICT adoption with proper appliance and the dissemination of innovation lead to growth and sustainable competitive advantage, therefore confirming their hypothesis that innovation mediates the relationship between ICT and OP.

Accordingly, Akram et al. (2018) investigated how ICT could determine OP and sustainable competitive advantage through the use of the resource-based view and its extension, the knowledge-based view of the firm, on knowledge management. A combination of ICT infrastructure (hardware, software, networks, and storage) and ICT competence was used in the study. As opposed to ICT infrastructure, competence refers to the employee's expertise and skills in information technology. 365 middle and senior managers from ICT and non-ICT manufacturing services were surveyed in Pakistan for the study. Based on their analysis, they found that incorporating knowledge management capabilities contributed to mediating the relationship between ICT and OP. However, this was only a partial mediation as the direct effect of ICT on OP remained significant. The authors therefore suggest that other complementary resources also mediate the relationship between ICT and OP.

A recent study by Deng et al. (2022) found that digital technologies can facilitate knowledge sharing and decision-making within organizations by facilitating coordination and communication between employees. In the study, the importance of technology in channeling and disseminating knowledge is acknowledged, and COVID-19 is identified as a contributing factor to the acceleration of the growing use of e.g., Microsoft Teams and big data. For the purpose of measuring the use of technology among Australian employees, several of their communicative measures with the use of technology have been adopted by us in our study. The online survey that was sent, generated 237 responses, but only 199 were considered eligible for analysis. Their research provides new and vital insight into how technology allows managers to have better access to organizational knowledge, which enables them to make better decisions and

improves their decision-making capability. Considering that the study contains both new and up-to-date information on information-and communication technology, it provides important perspectives as to how the pandemic and the accelerating use of and integration of technology and how this may enhance knowledge and its accessibility.

Additionally, Cuevas-Vargas et al. published a study in 2022 that examined how ICT adoption contributed to increased OP through innovation and the organization's absorptive capacity (that is, its ability to absorb external knowledge and convert it into tangible assets). According to their analysis of 145 Colombian companies in the service and industrial sectors, there was a positive correlation between OP and innovation. The study concludes that adopting ICT, it is possible to absorb information more easily and thus create new knowledge. As a result, a positive environment is created for the exploitation of organizational knowledge, which fosters the development of innovative capabilities. This study asserts that the absorptive capacity of organizations serves as a mediator between ICT adoption and innovation. This is relevant to our study as absorptive capacity can be seen as highly related and somewhat overlapping with OL, and thus indicates OL as a mediator.

The majority of the articles reviewed have relied upon the RBV framework, discussing the possibility of ICT being the source of competitive advantage depending on if it can be seen as a firm specific, rare, imitable, and valuable resource (Teece et al., 1997). The literature leans towards the notion that ICT is not directly affecting OP (Jean, 2007). As ICT has been deemed by some as a mere commodity (Carr, 2003), it becomes evident that the proper enabling of ICT could contribute to fundamental changes in business processes and structures, facilitating efficient processes of collaboration (Alavi & Leidner, 2001; Dedrick et al., 2003), enhanced communication and knowledge sharing (Deng et al. 2022) enhanced knowledge management capabilities (Akram et al. 2018).

Relating to how OL could affect ICT and OP, previous research has identified OL as both a dynamic capability and second-order capability, being able to generate organizational competitive advantage (Real et al., 2006; Vera et al., 2012), based on the organization’s ability to renew its competence in order to keep up with technological advancement (Teece et al., 1997). These findings are further supported by Crossan et al. (1999), who describes OL as a dynamic process, inhabiting a feed-forward and feed-backwards ability, which enables the

possibility to reach a substantial network, taking advantage of the OL. The feed-forward and feed-back mechanisms contribute to the understanding that there are positive correlations between ICT and OL. As it increases communication, enabling a more accurate level of sharing insights and dialog (Alavi & Leidner, 2001), tapping into organizational memory could therefore increase the learning capacity. Thus, creating a cycle of learning which affects the degree of how new technology is adopted and used (Robey et al., 2000). Contributions to this understanding are further supported by Kuusisto (2017) who argue that the major impact of digitalization on organizations seems to be the way it makes information more readily available. The availability contributes to knowledge transfers occurring at various levels to where it is best served (Alavi & Leidner, 2001, from individuals to teams or teams to individuals, also becoming institutionalized (Crossan et al., 1999) by being embedded into routines and systems creating OL (Vera et al., 2012).

Based on the aforementioned studies and information, we hypothesize the following:

H1: There is not a direct relationship between ICT Utilization and OP.
H2: The relationship between ICT and OP is mediated by OL.

2.3.2 Innovation and operational excellence as mediators

As presented earlier in the introduction of the RBV framework, OL could be seen as a second-order capability, and it is therefore suggested that it influences OP through its effect on dynamic and operational capabilities (Vera et al., 2012). It has been further suggested that both innovative capabilities and OX could be seen as dynamic- and operational capabilities and the effects of OL on OP should thus be mediated through these capabilities.

The study by Real et al (2006), suggests that innovation and learning are closely related as companies innovate through continuous learning, thereby creating new technological knowledge. Adhering to the work of Crossan et al.'s (1999) framework, from intuiting where new insights are gained by an expert or entrepreneur, then fed forward through interpretation and integration before being institutionalized within the organization. A continuous process of acquiring new technological innovations, implementing, and utilizing them can increase the organization's competitive advantage and operational performance. Accordingly,

organizations can leverage innovative technological knowledge that has been stored in organizational learning through effective processes. New innovative capabilities contribute to and provide dynamic capabilities to OL and vice versa, as well as contributing to OX through feedback mechanisms.

As suggested by Yunis et al.'s (2017) findings, innovation and corporate entrepreneurship are the driving forces behind the transformation of ICT resources and organizational processes, with intuiting described as tacit knowledge becoming explicit, contributing to the improvement of organizational resources and performance. Moreover, the study argues that early adaptation can enhance ICT through organizational entrepreneurship, thereby contributing to the organization's competitive advantage. The authors also stress the importance of ICT and innovation when it comes to organizational strategies and operational excellence.

Podrug et al. (2017) studied how individuals, organizations, and technology (ICT) influence knowledge-sharing processes. Study relevance lies in the fact that it addresses the importance of innovation in relation to ICT as a source of efficiency. Based on 400 questionnaires, 196 usable responses were obtained from ICT companies in the study. According to the study, innovation contributes to the discovery of new opportunities and predicts future trends, making connections with the aforementioned studies, where being early with innovative ideas contributes to gaining a competitive advantage, just as early adoption of ICT tools does. It is suggested that these innovative insights contribute to the reduction of transaction costs and coordination costs within the organization as they are implemented. According to the results, employee willingness to donate and collect knowledge was positively influenced by the use of information-and communications technology, thereby enhancing the organizational ability to innovate.

The previously introduced study by Cuevas-Vargas et al. (2022) showed results which indicated that ICT activities and open innovation, defined as the "combination of the internal mechanism of a company that starts from internal and external ideas creating value in business models" (p. 11) showed significant and positive signs as the technological aspect provided an environment where employees could exploit organizational knowledge. It was determined, however, that facilitation of the use of internal and external knowledge for innovation processes was also necessary, in relation to Akram et al. (2018).

According to Bogistov & Moormann (2019), operational excellence (OX) contributes to the ability of an organization to adapt to new knowledge, regulations, and customer demands. According to them, in order for an organization to achieve operational excellence, its OX needs to be activated regularly. Additionally, OX is viewed as a high-level organizational routine, where a repetitive execution is necessary in order to become a capability. A focus on resources rather than capabilities is often at the root of the failure of OX initiatives and programs (Lean, Agile, Six Sigma). The authors contend that by incorporating OX into an organization's capabilities, communication, decision-making, and implementation will be enhanced. As a result, both operational and strategic performance could increase.

In relation to OX, Akram et al. (2018) suggested that the organization is capable of attaining a competitive advantage and increasing operational effectiveness through utilizing its internal knowledge. However due to a lack of competence and infrastructure in handling and operating information technology capabilities, an exploitation of its internally held knowledge is hindered. This study focuses on knowledge management capabilities and relates inefficiencies in the organization's method of deploying knowledge management strategies to inadequate utilization of internal knowledge. Moreover, they suggest that organizations should tap into both their internal and external environments for the purpose of enhancing their innovative capabilities.

An exploratory study of the organizational impact of knowledge management was conducted by Zack et al. (2009). The study included 88 participants from Canada, the United States, and Australia. According to this study, highly focused knowledge management practices are associated with OX. This is relevant to our study as it provides an indication that OL also might lead to OX.

Through feed-forward and feed-back learning flows, the 4I framework suggests that OL is positively related to innovation and OX (Crossan et al., 1999). The literature review conducted by Kuusisto (2017) identifies OL and digital tools as facilitators of innovation and process efficiency, in particular by facilitating the creation of new knowledge and the sharing and implementation of best practices within an organization. In addition, Akram et al., (2018), Zack et al., (2009), and Cuevas-Vargas et al., (2022) point out that the effective use of existing knowledge depends on both the organization's infrastructure and its ability to provide support

and management. Organizations that are capable of doing this can leverage acquired technological innovations, as Real et al. (2016) have demonstrated through effective processes for assessing organizational memory and OL. Organizations should regularly utilize internal competence and knowledge to incorporate OX into their capabilities as OX is seen as a high-level organizational routine. This could, in conjunction with adequate infrastructure and management, enhance operational and strategic performance by facilitating the incorporation of OX into the organization's capabilities (Bogistov & Moormann, 2019).

The ability of an organization to effectively exploit its existing knowledge as well as new innovative insights and capabilities will increasingly manifest itself within the organization (Real et al., 2016). As a consequence, organizations will be better equipped to incorporate and translate insights through the 4I process, where tacit knowledge or entrepreneurial insights are adopted and used by the organization, increasing the OX level of organizations, as suggested by Yunis et al., (2017). Drawing on this, Podrug et al. (2017) also suggest early adoption of innovative ideas which could increase the effectiveness of the organization in terms of coordination and transaction, gaining a competitive advantage as they are able to utilize their advantage more astutely and fortuitously than their competition (Eisenhardt & Martin, 2000). The use of external information will enable new methods and insights to be introduced, which can then be implemented within the organization through the 4I process. Leveraging the use of the organization's resources, where the possibility of creating and building unique value can increase the organization's competitive advantage (Akram et al., 2018). Based on the aforementioned literature review, we propose the following hypotheses:

H3: The relationship between OL and OP is further mediated by Innovation and OX

As the literature review demonstrates, previous studies have examined many different aspects of ICT when investigating its relationship to organizational performance. These include among others ICT capital investment (Brynjolfsson, 1993), ICT capabilities (Bharadwaj, 2000), ICT competency (Tippins & Sohi, 2003; Akram et al., 2018), ICT use (Deng et al., 2022; Yunis et al., 2018), ICT knowhow (Siddique et al., 2019), and ICT infrastructure (Real et al., 2006; Akram

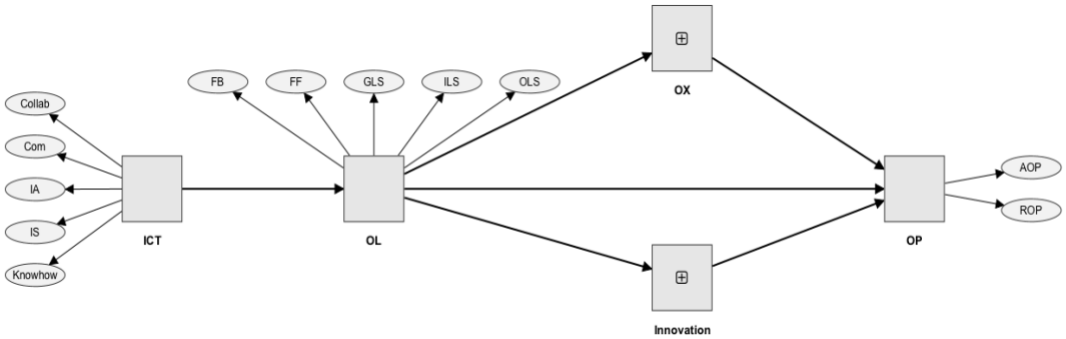
et al., 2018). As presented, previous studies have used different measures and conceptualizations for measuring the effects of ICT on organizational performance. As one of the main objectives with this study is to provide managers with clearer implications for how they can optimize ICT utilization for OP, this study will also investigate the following research questions.

Research question: Which aspects of ICT Utilization are most important for OL and OP?

Based upon the hypotheses and research questions presented, we propose the following research model to be tested (Figure 1).

Figure 1.

Research model.



3.0 Method

3.1 Data collection and procedure

The purpose of this study has been to provide a comprehensive investigation into the relationship between ICT and OP by considering multiple aspects of ICT utilization and organizational learning, innovative capabilities, and operational excellence as mediators. Additionally, this study aims to examine these relationships in today's post-pandemic business environment, focusing on finance-, technology-, and professional services industries. To do this, a cross-sectional design and quantitative analysis at the organizational level were employed. Data was collected through a survey distributed primarily to executives, partners, and middle managers in Norwegian businesses from February until the end of April 2023. Apollo.io, a B2B prospecting tool was utilized to identify companies and retrieve contact information, including email addresses, of the aforementioned personnel.

The search criteria used to identify companies included location (Norway), employee number (10-10,000+), and industry (accounting, banking, consultancy, capital markets, financial services, human resource management, law, and information technology services). The selection of individuals who possessed a comprehensive understanding of their company's business operations was crucial in obtaining the necessary insights for the study. Therefore, a focus was placed on managerial roles, particularly executives, as their perspectives were expected to contribute to more valid and reliable response, as opposed to entry-level employees who may have had limited insights into the organization's operations.

Applying the aforementioned criteria, a total of 2375 people in 1007 companies were contacted via email. Among them, 655 responses were received from 467 companies. Out of the recorded responses, 284 (43.4%) had completed less than 50% of the survey, 27 (4.1%) had completed between 50-99% of the survey, and 344 (52.5%) had completed the entire survey.

3.2. Data cleaning and Sample

Prior to analysis, Hair et. al. (2017) recommends screening the data for missing data and straight lining as this could lead to bias in the results. Based upon this the 284 responses that had completed less than 50% of the survey were excluded. An independent t-test was then conducted to investigate if there were any differences in the responses given by those who completed 50-99% of the survey and those who completed 100% of the survey. No significant differences were found ($p > .05$). Since the data lacked normality a Mann-Whitney U test was also conducted to confirm that there weren't any differences. The results from this test were also non-significant ($p > .05$) and the 27 responses that had finished 50-99% of the survey were excluded from our sample in order to minimize missing data. We also chose to exclude responses from entry level employees assuming that their lack of experience within the organization contributes to a lack of knowledge needed in order to be able to properly answer the questionnaire. Next the population standard deviation (SD) was used to examine the remaining 344 responses for straight lining, where respondents who had answered all the questions the same were excluded. All responses that showed SD values below 0.5 were visually inspected as this indicates low response variability. As a result, 10 responses were excluded from the analysis based on straight lining.

Lastly, as a result of our data collection method we received multiple responses from the same companies (further referred to as duplicate responses). Out of the remaining 322 responses 20 were duplicate responses. This poses a challenge as this study is conducted on the organizational level and each response should represent one unique company. To deal with this, all duplicate responses were visually inspected and compared to the other response from the same company. There were no big discrepancies between the duplicate responses and the duplicate responses were thus aggregated into a mean response for the corresponding company. As a result of this process the final sample consists of 312 Norwegian companies (descriptive variables presented in table 1).

Table 1.

Descriptive variables for sample (N = 312)

Descriptive variables	Number of firms	Percentage
1. Industries		
Professional services	130	41.7%
Finance	68	21.8%
Technology	60	19.2%
Other	54	17.3%
2. Organization size		
Micro-enterprise	7	2.2%
Small enterprise	117	37.5%
Medium sized enterprise	104	33.3%
Large sized enterprise	84	26.9%
3. Organization stage		
Start-up	7	2.2%
Scale-up	101	32.4%
Established	204	65.4%
4. Position level of respondent		
Experienced/intermediate staff	34	10.9%
First-level management	15	4.8%
Middel-management	66	21.2%
Executive-level	192	61.5%
Other	5	1.6%

3.3 Measures

3.3.1 ICT utilization

Findings from the literature indicate that there are a number of different measures that have been used to measure ICT. The measurement items used in the article by Yunis et al. (2018) focused on the individual perspective, drawing on previous studies in which the measures had been validated. According to Cuevas-Vargas et al. (2022), four reflective measures were used to measure the adoption

of ICT: ICT infrastructure, strategic alignment, organizational structure, and individual learning. The article did not contain any measurement items.

The organization's ICT infrastructure was measured by Real et al. (2006), among others. Within the conceptualized construct of ICT, a number of items were used where questions were posed from the perspective of the employee, both on an individual and organizational level. The research article contained all the items. Additionally, Deng et al. (2022) presented research items in their study where the importance of knowledge sharing contributed to a better understanding of ICTs impact on coordination and communication. Siddiqui et al. (2019) presented evidence of the importance of ICT knowhow when implementing and utilizing specific ICT tools and resources. These measures were not included in the article.

Despite the fact that the measures used by the studies mentioned above contribute in some way to our study, we still believe that a more comprehensive measure with an organizational focus on ICT is necessary. Consequently, we have developed a higher-order measure of ICT use based on five lower-order constructs (LOC's): communication, collaboration, information sharing, information acquisition, and ICT knowhow. These lower-order constructs have been identified in the above-mentioned studies (see Cuevas-Vargas et al., 2022; Deng et al., 2022; Real et al., 2006; Siddiqui et al., 2019; Yunis et al., 2018). The constructs are measured and assessed on a 7-point Likert scale ranging from 1= strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree.

The *ICT communication* construct measures the extent to which organizations use information-and communication technologies for communication, including both external communication with clients and internal communication between team members and colleagues. This construct is measured by three items (see appendix 1). These are mainly based on items (CM1, CM2, and CM3) from Deng et al. (2022), where the use of email, instant messaging and social network technology contributed to improved communication.

The *ICT collaboration* construct assesses the extent to which organizations use ICT for collaborative purposes. We have adapted Real et al. (2006)'s ICT scale, which includes items (IT4 & IT5), to measure this construct. With minor modifications, these items were used (see appendix 1). As we were unable to

identify a specific measure of ICT as a collaborative tool, we based our third measure on the literature we found on ICT. ICT is identified as a tool that can be used to increase the effectiveness of storing, responding, and managing organizational information (Bennett & Tomblin, 2006; Blurton, 1999). Considering the aforementioned reasoning, item Coll_1 is formulated to address how the employee perceives the organization's use of ICT as a tool for collaboration (see appendix 1).

The use of ICT in order to share information within the organization relates to how the organization is leveraging ICT in order to share relevant knowledge and insights both internally and externally, and across geographical locations and organizational levels. In order to measure the degree of *information sharing*, the following items were drawn from Deng et al. (2022) where information and knowhow are exchanged through the use of ICT. We applied the items in Deng et al's study (KS1 & KS3) to our study with some minor revisions (see appendix 1).

Information acquisition refers to the degree organizations and its members use ICT for acquiring information from both inside and outside the organization. This measure is based upon Real et al.'s (2006) IT measures where the capability to acquire new information from internal and external sources relates to how the organization explores, finds, and adapts new technological competencies. The items (IT8, IT9, IT10, and IT11) were slightly modified and applied (see appendix 1).

Lastly, *ICT knowhow* relates to the organizations knowledge and competence to use and navigate ICT tools and systems. The knowhow measures the knowledge and capabilities of an organization with respect to utilizing ICT effectively. This construct consists of three items and is loosely based on Siddiqui et al.'s (2019) research and definition as "the literacy about the information communication tools in order to achieve the organizational goals and to achieve the competitive advantage over with the competitors'' (p. 476). Although the items that were used in this study are not attached to the article, this measure assesses a firm's knowledge and capability regarding ICT. The other measures primarily focus on the functional use of ICTs, while this measure assesses its in-house knowledge and capabilities regarding ICTs. The rationale for including this construct in the higher-order measure is based on the hypothesis that higher levels

of ICT knowhow indicate an organization's capacity to efficiently utilize ICT and integrate it more deeply into their processes and provide a competitive advantage.

In our study, all measures of ICT are measured reflectivity, meaning that each item represents a latent construct and is assessed according to the participant's response. Additionally, the higher-order constructs (HOC's) in our study are also measured reflectively, capturing the underlying dimensions of ICT utilization.

3.3.2 Organizational learning

This study measures OL using the Strategic Learning Assessment Map (SLAM) measurement developed by Crossan and Hulland (1997). Based on the 4I framework (Crossan et al, 1999), the measure views OL as a higher-order construct composed of five lower-order constructs derived from the 4I. The four constructs are interpreting, intuiting, integrating, and institutionalizing. The concept of "stocks" and "flows" is used by Bontis et al. (2002) to clarify how the different constructs interact within individuals, groups, and organizations. In this concept, learning is distinguished between learning at a given level and learning across levels, where stocks represent accumulated knowledge and skills, whereas flows represent the continuing learning process that occurs across the different organizational levels through feed-forward and feed-back. It is important to keep in mind that each learning stock does not exist in a static state, but instead has a dynamic learning flow within them.

As a measure of individual learning processes, the first LOC is *Individual Learning Stocks (ILS)*. Intuiting and interpreting are included in this category. The individual learning stock is defined as the "competence, capability, and motivation to undertake the required tasks" (Bontis et al., 2002, p. 443).

The second LOC is *Group Learning Stocks (GLS)*, which measures the learning at the group level, also known as the integrating process. Through dialog, the individual's interpreted insight is shared among members of the group, which is defined as "group dynamics and the development of shared understanding" (p. 443).

The Last learning stock is the *Organizational Learning Stocks (OLS)* which measure learning at the organizational level and the institutionalization process. Elevated to organizational level, it is an "alignment between non-human

storehouses of learning including systems, structure, strategy, procedures and culture, given the competitive environment" (p. 444).

Lastly, *feed-forward* and *feed-back* contribute to information flow through explorative and exploitative learning. Bontis et al. (2002) defines feed-forward elements as "whether and how individual learning feeds forwards into group learning and learning at the organizational level" and feed-back as "whether and how the learning that is embedded in the organization affects individual and group learning" (p. 445).

In the original SLAM measurement, 50 items were used to assess OL's impact on business performance (Bontis et al., 2002; Real et al., 2006). By implementing the original SLAM, the questionnaire developed for this study would have been a tiresome process to complete, and therefore its length had to be reduced. We therefore used the recently developed Short Form SLAM (SF-SLAM) measure which has been shown to maintain the psychometric properties of the original SLAM, and successfully retained the intended measurement focus of the original SLAM (Mainert et al., 2018). However, a key difference between the original SLAM and the SF-SLAM is that the latter focuses on individual employees. We have therefore replaced the items in the SF-SLAM with corresponding items from the original SLAM to measure OL at the organizational level. All of the LOC's were measured on a Likert scale with slight modification, from 1-7 where 1= strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree or disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree. All items used can be found in the appendix.

3.3.3 Organizational Performance

In light of the diversity of definitions and measurements of the OP construct, it can be argued that this construct encompasses a wide range of dimensions. According to Real et al. (2006), while some economists assert that OP can be measured through financial data, survey-based research with subjective measures provides a more comprehensive understanding of learning. Since the purpose of this study is to examine the relationship between OL and OP, the use of subjective measures may contribute to a better understanding of the benefits of OL.

A number of studies have been reviewed in order to determine appropriate measures for OP. Real et al. (2006) proposed a high-order measurement of OP,

which focuses primarily on measuring absolute performance without considering the organization's performance in relation to its competitors. On the other hand, Akram et al. (2018) utilized a higher-order model to measure an organization's performance in relation to its competitors. In order to measure for OP, a conceptualization that relates to the one made by Vera et al., (2012) and Daft (2015) is essential (see *2.1.5 Organizational Performance chapter*).

This study conceptualizes OP as a higher-order construct encompassing both absolute- and relative performance, incorporating elements from both Real et al.'s (2006) and Akram et al.'s (2018) studies. This study focuses exclusively on the organizational level, unlike Real et al.'s (2006) study that examined OP at multiple levels. Based on Real et al.'s (2006) LOC of OP, the absolute performance of the organization is represented. The items adopted (PERF7, PERF8, PERF9, and PERF10) were directly applied without any modifications (see appendix 2). In addition, Akram et al.'s (2018) measure of perceived OP is used to measure the organization's performance relative to its competitors (further referred to as relative organizational performance). In total, four items (POP1, POP2, POP3, POP5) were adopted and used without modification (see appendix 2). It is important to note that the subjective nature of the measure does impose certain limitations. However, this approach was chosen to capture the complexity of measuring OP in organizations. All items in this measure were rated on a 7-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree."

3.3.4 Innovative capabilities

To measure innovative capabilities, this study adopts four (IN1, IN2, IN4, and IN5) of the measures used by Yoo et al. (2011) (see appendix 3). In order to align the measure with the organizational perspective, slight modifications have been made to the items, as these focused on team specifications rather than accurately reflecting the specific context and focus of our study. A 7-point Likert scale was used on the innovative capabilities where 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree.

3.3.5 Operational excellence

To identify existing measurements of OX, a comprehensive literature search was conducted. However, only a few quantitative survey-based studies have explored this construct. Bogodistov and Moormann (2019) presented various options for operationalizing OX, including formative and reflective constructs. A validated quantitative measure was not presented in this study since it provided more of a conceptual framework than a set of measurement options. Due to a lack of suitable measures in the literature, this study developed a new measurement instrument. The measure consists of 5 items, which are assessed using a 5-point Likert scale. The specific items used in the measure can be found in the appendix 4. By creating this new measure, the study aims to provide a more comprehensive and targeted assessment of OX in the context of our research. A 5-point Likert scale was used where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree.

3.4 Statistical analysis

3.4.1 Data Screening

In order to check the normality of the data, a Mardia's test was conducted in *R.* The results from the test indicated that the data was highly skewed and the Mardia's test were significant ($p < .05$), thus the data lacks multivariate normality. This could also be seen in the descriptive statistics presented in table 2, where both skewness and kurtosis are above/below 1/-1 which indicates lack of normality (Hair et al., 2017). While PLS-SEM doesn’t make distributional assumptions and thus should be robust against non-normality, the bootstrapping procedure could lead to bias when the data is highly skewed. A Bias-corrected bootstrap procedure (BCa) was therefore used, as this is less prone to produce biased results when data is skewed (Hair et al., 2019a).

The mean replacement procedure for handling missing values was used. Missing values could be a source of bias even when using procedures to handle this like the mean replacement procedure. Hair et al. (2017) recommends that all indicators should have less than 5% missing values in order for using the mean replacement procedure without leading to bias. As described in the data cleaning and sample section, only respondents that had completed 100% of the survey were

included. However, 100% completed responses also include respondents who have skipped questions. The data was therefore inspected for missing values, and none of the indicators have more than 5% missing values.

The data was also examined post hoc for statistical power and heterogeneity to ensure the robustness of the results. The SmartPLS program provides indicators for statistical power and minimal sample size. The results suggest that the minimal sample size necessary to achieve a statistical power of 90% at a significance level of $p < .001$ was $N=306$. This suggests that the study has a sufficient sample for testing the proposed model, and that the results are robust (Hair et al., 2017).

Lastly, the analysis could be biased if unobserved heterogeneity is present and the data was examined for unobserved heterogeneity using FIMIX (Hair et al., 2018; Matthews et al., 2018). Two groups were identified through the FIMIX analysis where group 1 consisted of 274 respondents and group 2 consisted of 38 respondents. The group differences were examined through industry belongingness, organization size, organization stage, and position level of respondents and no consistent pattern was found that could explain these differences, thus indicating that unobserved heterogeneity was present. No actions were taken to correct this.

3.4.2 Estimation Method

This study has used the PLS approach to structural equation modeling (PLS-SEM) using SmartPLS 4 (version 4.0.9.3), as opposed to the more widely used covariance-based approach (CB-SEM). The fundamental difference between these two approaches is that CB-SEM is based upon a common factor model while the PLS-SEM is based upon a composite factor model. This is due to the nature of their statistical objectives where CB-SEM's objective is to minimize the difference between observed sample covariance matrix and the estimated covariance matrix. This makes CB-SEM more focused on model fit and theory testing. PLS-SEM's objective is to maximize the variance explained in the dependent variable and is thus more focused on prediction and providing practical implications rather than model fit (Matthews et al., 2018).

As a result of these differences CB-SEM is usually recommended for theory testing, while PLS-SEM is recommended for exploratory research, theory development, and when the focus is on providing managerial implications.

However, while CB-SEM is more strictly limited to confirmatory research, PLS-SEM is more flexible and can be used for both exploratory and confirmatory research (Hair et al., 2017). Simulation studies further suggest that both methods provide very similar results when the necessary distributional assumptions are met for CB-SEM (Hair et al., 2011). However, as PLS-SEM is a non-parametric test, it doesn't make any distributional assumptions and is therefore robust against non-normal data, and data that violates the assumptions made by CB-SEM (Hair et al., 2011; Hair et al., 2017; Hair et al., 2019a). Other benefits with PLS-SEM are that it has a greater statistical power than CB-SEM, meaning it performs better when sample size is small and when the model is complex, such as when estimating models involving higher-order constructs (Matthews et al., 2018; Hair et al., 2017; Hair et al., 2019a). These characteristics make PLS-SEM a promising alternative to CB-SEM, and research shows that PLS-SEM in many instances can serve as good proxies for CB-SEM. However, when prior theory is strong and further testing and confirmation is the objective, CB-SEM is often considered the more appropriate approach (Hair et al., 2011).

Whether or not one should use CB-SEM or PLS-SEM depends on multiple factors. Hair et al. (2017) and Hair et al. (2019a) recommends using PLS-SEM in the following situations: (1) when the analysis is concerned with testing theoretical frameworks from a prediction perspective, (2) when the research objective is to better understand increasing complexity by exploring theoretical extensions of established theories, (3) When the model is complex and includes many constructs, indicators and/or model relationships, (4) when sample size is small and/or the sample population is limited such as in B2B research, and (5) when distribution issues are a concern.

The nature of this study is both confirmatory and exploratory. A strong theoretical framework from both strategic management and organizational psychology is used to develop hypotheses for the study. As well as the theoretical hypothesis, this study also formulates an exploratory research question to gain a deeper understanding of the complex relationship between ICT and organization. To provide managers and business leaders with guidance as to how they can optimize their ICT utilization to leverage OP, this project aims to gain a deeper understanding of the various mechanisms underlying the relationship between ICT and OP. Additionally, the model tested contains a high number of indicators and higher-order constructs making it complex. Furthermore, the data used in this

study violates the assumption of multivariate normality of the CB-SEM. As the study is conducted at the organizational level and is limited to Norwegian companies in the fields of finance-, technology-, and professional services, the sample is relatively limited. Based upon this, and that one of the main aims of the study is to provide managerial implications, the PLS-SEM method was chosen as the preferred analysis method in this study based on the theory and reasoning presented.

3.4.3 Validation of measurement model and higher-order constructs

The validation of a PLS-SEM is conducted in two stages. First the measurement model is validated, and then the structural model is validated. A Confirmatory Composite Analysis (CCA) was conducted to validate and confirm the measurement model and higher-order constructs (HOC). A CCA can be seen as a non-parametric version of Confirmatory Factor Analysis (CFA) normally used in CB-SEM (Ciavolino et al., 2021).

HOC was assessed using the embedded two-stage approach. In the first stage, the measurement model for the LOC's were validated, and the latent variable scores for the lower-order constructs (LOC's) were saved. In the second stage, the latent variable scores for the LOC's were then used as indicators to measure the HOC's and validate the HOC measurement model (Becker et al., 2019). Both measurement models are evaluated according to the regular assessment used for PLS-SEM (Becker et al., 2019) which involves assessing the indicator loadings and their significance, indicator reliability, internal consistency reliability, convergent validity, and discriminant validity (Hair et al., 2011).

Indicator loadings are recommended to be larger than 0.708 as this means that the latent variable explains 50% or more of the variance in the indicator. This implies that the explained variance is larger than the variance caused by measurement error and that indicator reliability is acceptable. However, indicator loadings between 0.40 and 0.70 could also be acceptable (especially in exploratory situations) if the indicators are significant and the construct shows acceptable levels of reliability and validity as described below (Hair & Alamer, 2022). In order to get *p*-values for the indicator scores a BCa bootstrapping procedure was performed with 5000 iterations as recommended by Hair et al. (2019a).

Internal consistency reliability refers to the degree the measure is influenced by random error and noise. Hair et al. (2019a) suggests that one should use Jöreskog's (1971) composite reliability measure (ρ_c) as Cronbach's alpha (α) is too restrictive. However, in a more recent study Hair & Alamer (2022) it is suggested to use Cronbach's alpha in conjunction with ρ_c to evaluate reliability. It is recommended that both Cronbach's alpha and ρ_c is above 0.70 (Hair et al., 2019a; Hair & Alamer, 2022).

Convergent validity refers to the degree of shared variance explained among the construct's indicators. A commonly used measure for this is Average Variance Explained (AVE) which gives us information about the average variance explained by the construct for the indicators. It is recommended that AVE is larger than 0.50, meaning that the construct explains at least 50% of the variance in the indicators (Hair et al., 2019a).

Discriminant validity tells us whether the indicators share more variance with each other than with the latent construct. This is especially important in the context of higher-order models as LOC's should not be too similar. If LOC's lack discriminant validity one should assess whether or not a higher-order model exists or not (Becker et al., 2019). The Fornell-Larcker measure has previously been a popular method for assessing discriminant validity, however, multiple recent studies suggest that this measure is not well suited for detecting discriminant validity in PLS-SEM (Hair et al., 2019a; Hair et al., 2019b). Instead, Hair et al. (2019a) recommends using the HTMT measure for discriminant validity and suggests that HTMT should not be higher than 0.90.

3.4.4 Validation of structural model

As opposed to CB-SEM, PLS-SEM doesn't provide chi-square based goodness of fit measures. Alternative goodness of fit measures is available, however, it is recommended to be cautious when considering these as they haven't been thoroughly assessed yet (Hair et al., 2019a).

PLS-SEM is however not relying on model fit in the same manner CB-SEM does. Some researchers mistakenly conclude that this makes PLS-SEM inappropriate for theory testing and confirmation (Hair et. al., 2019a). However, the term "fit" has different meanings for PLS-SEM and CB-SEM. In CB-SEM the fit statistic is derived from the discrepancy between the empirical and the model implied covariance matrix. In PLS-SEM model fit means that there is discrepancy

between the observed (manifested variables/indicators) or approximated (latent variables) values of dependent variables, and the values predicted by the model in question (Hair et al., 2017). Based upon this, it is suggested to evaluate PLS-Model fit on the basis of the following (Hair et al., 2017; Hair et al., 2019a; Hair & Alamer, 2022):

(1) *Examine the model for collinearity*. This can be done by examining variable inflation sores (VIF) where VIF values should ideally be below 3, however values between 4 to 5 are seen as acceptable.

(2) *Evaluate the size and significance for the path coefficients.* PLS-SEM uses standardized beta coefficients, and a bootstrapping procedure is necessary in order to get p-values. Hair & Alamer (2022) suggests that standardized coefficients between 0-0.10 are weak, 0.11-0.30 are modest, 0.30-0.50 are moderate, and > 0.50 are strong. In this study we have used a BCa bootstrapping procedure of 10 000 subsamples since our data lacks normality. This is in accordance with the recommendations provided in the literature (Hair et al., 2019a; Becker et. al., 2022).

(3) *Evaluate the model's in-sample predictive power*. This refers to the R^2 value of the endogenous constructs and is often also called the models explanatory power since it shows how much of the variance the model can explain in the sample. There isn't any strict rule of thumb for what an acceptable R^2 value is, as this depends on the research model and research discipline. However, a general guide is that a R^2 between .25, .50, and .75, respectively could be seen as weak, moderate, and substantial (Hair et al., 2019a).

(4) *Evaluate the models out-of-sample predictive power.* This refers to the model's ability to predict data outside the sample and relates to the model's external validity. This is done by performing a hold-out procedure such as the one in PLSpredict (Hair et al., 2019a; Hair & Alamer, 2018). To evaluate out-of-sample predictive power through PLSpredict, it is recommended to first examine the $Q^2predict$ values of the predictors of key endogenous constructs. If the $Q^2predict$ values are above 0.00, the

model outperforms the most naïve benchmark which is the indicator means (Hair et al., 2019a). Next the RMSE of the PLS-SEM model is compared to the naïve linear model (LM) produced by the PLSpredict algorithm. The model shows low predictive power when the PLS-SEM shows higher prediction errors in RMSE than the naïve LM benchmark for the majority of indicators, medium predictive power when the PLS-SEM shows higher prediction errors in RMSE than the minority of indicators, and high predictive power when the PLS-SEM shows lower prediction errors in RMSE for all indicators (Hair et al., 2019a). As this model contains HOC's and has used the embedded two-stage approach for estimating the HOC measurement model, it is recommended to use the Stage 1 model when conducting the PLSpredict procedure (Becker et al., 2019).

3.4.5 Mediation effects and relative importance of different aspects of ICT

The PLS-SEM model was also used for testing the hypothesized mediated relationships. The advantage of using PLS-SEM for this is that the bootstrap used to obtain *p*-values makes no distributional assumptions. The mediated relationships are also tested simultaneously as opposed to separately, which reduces bias. Additionally, PLS-SEM has greater statistical power than alternative methods, which reduces the necessary sample size for testing multiple mediation effects (Matthews et al., 2018). The mediation effects in this study were tested by first evaluating the indirect relationship between the variables, and then the direct relationship as described by Matthews et al. (2018).

To investigate the importance of the different aspects of ICT utilization two Importance Performance Map Analysis (IPMA) was conducted. The first analysis focused on OP to identify which of the constructs and lower-order constructs has the greatest importance for predicting OP. The second IPMA analysis was conducted with a focus on OL in order to see which of the different aspects of ICT utilization had the greatest importance for predicting OL. This was done in order to provide a more in depth understanding of the effects of ICT utilization on OL, as OL were identified as the most important construct for predicting OP.

4.0 Results

4.1 Descriptive statistics

Table 2 shows descriptive statistics for the variables ICT, OL, Innovation, OX, OP, and its LOC's. The descriptive statistic suggests that the Norwegian organizations in our sample on average report that they agree to all the questions regarding ICT utilization, indicating that ICT utilization is strong in Norwegian organizations within the selected industries. This is in accordance with what the United Nations Innovation and technological development report from 2023 suggests as Norway is ranked 3rd on ICT use (United Nations, 2023). Out of all the LOC's for ICT utilization, communication shows the lowest standard deviation and the highest average score, lying in between "agree" and "strongly agree", indicating that ICT is commonly used for communication in the sampled organization, and that there is less variation in this LOC than in the other ICT LOC's. The data for all the ICT LOC's as well as the HOC shows skewness levels below -1 and kurtosis above 1, indicating that the data is not normally distributed (Hair et al. 2017).

The average OL score in our sample is right between "somewhat agree" and "agree", and the standard deviation indicates some variation in the answers. The highest average score for the LOC's was for ILS which was right above "agree". ILS also had the lowest standard deviation amongst OL LOC's. This indicates that the sampled organizations agree that they have a strong individual learning stock and that there is less variation in responses with regards to ILS than the other LOC's. The largest standard deviation amongst OLs LOC's was for information sharing, indicating that this is the LOC where there is the most variation in responses in our sample. Both the LOC's and HOC OL shows Skewness and/or Kurtosis above/below -1/1, indicating that the data is not normally distributed (Hair et al. 2017).

The average score for OP was also between "somewhat agree" and "agree", however, interestingly there is a fairly large difference between the AOP and ROP mean scores where the average for AOP is at "agree" where ROP average scores are around "somewhat agree". The AOP data also shows skewness below -1 and kurtosis above 1 indicating that the data is not normally distributed, while the skewness and kurtosis for ROP is closer to zero indicating that the data

is normally distributed. There is also a larger standard deviation for ROP than AOP, indicating a larger variation in responses for ROP than AOP.

Table 2.

Descriptive statistics for the study's variables

Variables	M	SD	Skewness	Kurtosis
ICT	6.18	0.64	-1.37	2.99
Communication	6.62	0.55	-1.57	4.68
Collaboration	6.37	0.71	-1.76	2.29
Knowhow	5.67	0.90	-1.06	1.63
Information sharing	6.17	1.00	-1.71	3.57
Information Acquisition	5.82	0.91	-1.00	2.13
Organizational learning	5.66	0.72	-1.14	2.65
ILS	6.02	0.66	-1.06	2.34
GLS	5.58	0.81	-0.83	2.03
OLS	5.77	0.91	-1.37	2.73
FF	5.34	0.99	-0.94	1.44
FB	5.50	0.836	-1.26	3.13
Innovative capabilities	5.34	0.94	-0.71	0.82
Operational Excellence	3.91	0.63	-0.92	1.71
Organizational Performance	5.59	0.72	-0.95	2.22
ROP	4.98	0.97	-0.39	0.29
AOP	6.03	0.69	-1.21	3.57

Note. ILS = Individual Learning Stocks, GLS = Group Learning Stocks, OLS = Organizational Learning Stocks, FF = Feed-forward, FB = Feed-backward, ROP = Relative Organizational Performance, AOP = Absolute Organizational Performance

4.2 Measurement model and HOC

To validate the higher-order constructs used in this study CCA and the embedded two-stage approach was used in order to confirm both the LOC's and the HOC's. The results for stage 1 are presented in table 3, 4 and 5.

Indicator loadings and convergent validity. The results showed that 44 out of 47 indicators had loadings greater than .708. The three indicators that showed loadings below 0.708 were FB_5 (.675), ROP_2 (.705), and ROP_4 (.695). All of these are significant ($p < .05$), and above .40. All latent variables also showed acceptable AVE (> .50). Indicating that the latent variables had acceptable convergent validity. Based upon this, none of the items was excluded.

Internal consistency reliability was evaluated based upon Cronbach's alpha (α) and ρ_c. All LOC's showed acceptable internal consistency reliability ($\alpha < .70$, $\rho\_c < .70$). Lastly, *discriminant validity* was evaluated based upon HTMT. All of the LOC's showed acceptable levels of discriminant validity (HTMT > .90).

Table 3.

Stage 1: Evaluation of LOC's for ICT (Factor loadings, convergent validity, and reliability)

Variables	Loading	AVE	ρ_c	α
Communication		0.676	0.862	0.757
Com_1	0.792*			
Com_2	0.902*			
Com_3	0.767*			
Collaboration		0.694	0.872	0.779
Coll_1	0.867*			
Coll_2	0.802*			
Coll_3	0.829*			
Knowhow		0.710	0.880	0.796
Kh_1	0.843*			
Kh_3	0.856*			
Kh_4	0.829*			
Information Sharing		0.857	0.923	0.833
IS_1	0.926*			
IS_2	0.926*			
Information Acquisition		0.705	0.878	0.792
IA_1	0.860*			
IA_2	0.863*			
IA_3	0.795*			

*Note. *p< .001*

Table 4.
Stage 1: Evaluation of LOC's for OL (Factor loadings, convergent validity, and reliability)

Variables	Loading	AVE	ρ_c	α
ILS		0.637	0.897	0.856
ILS_1	0.760*			
ILS_2	0.784*			
ILS_3	0.845*			
ILS_4	0.867*			
ILS_5	0.725*			
GLS		0.663	0.908	0.873
GLS_1	0.774*			
GLS_2	0.813*			
GLS_3	0.829*			
GLS_4	0.827*			
GLS_5	0.826*			
OLS		0.682	0.914	0.882
OLS_1	0.853*			
OLS_2	0.873*			
OLS_3	0.869*			
OLS_4	0.749*			
OLS_5	0.778*			
Feed-forward		0.710	0.924	0.897
FF_1	0.790*			
FF_2	0.786*			
FF_3	0.879*			
FF_4	0.903*			
FF_5	0.848*			
Feed-back		0.554	0.861	0.799
FB_1	0.778*			
FB_2	0.780*			
FB_3	0.732*			
FB_4	0.751*			

Variables	Loading	AVE	ρ_c	α
FB_5	0.675*			

*Note. *p< .001*

Table 5.
Stage 1: Evaluation of LOC's for OP (Factor loadings, convergent validity, and reliability)

Variables	Loading	AVE	ρ_c	α
Absolute organizational performance		0.640	0.877	0.812
AOP_1	0.852*			
AOP_2	0.752*			
AOP_3	0.787*			
AOP_4	0.806*			
Relative organizational performance		0.545	0.856	0.788
ROP_1	0.866*			
ROP_2	0.685*			
ROP_3	0.731*			
ROP_4	0.695*			

*Note. *p< .001*

In the second step of the embedded two-stage approach the latent variable scores for the LOC's are used as indicators for the HOC. All indicator loadings were acceptable, both for the HOC constructs and the ordinary constructs (innovation and operational excellence). Internal consistency reliability, measured by Cronbach's Alpha (α) and ρ_c was above the recommended value of 0.700 for all constructs. Discriminant validity and convergent validity was measured through HTMT and AVE respectively. Both the HTMT and AVE were within the recommended limits (HTMT < 1.00, AVE > 0.50) for all constructs. The results suggest that our measurement model is valid and are presented in table 6 and 7 below.

Table 6.
Stage 2: Factor loadings, convergent validity, and reliability for HOC measurement model

Constructs and indicators	Loading	AVE	ρ_c	α
ICT		0.648	0.901	0.863
Communication	0.689*			
Collaboration	0.872*			
Knowhow	0.850*			
Information sharing	0.837*			
Information acquisition	0.763*			
OL		0.730	0.931	0.907
ILS	0.787*			
GLS	0.854*			
OLS	0.877*			
FF	0.872*			
FB	0.878*			
OP		0.793	0.885	0.745
ROP	0.861*			
AOP	0.917*			
Innovation		0.624	0.868	0.810
Cap_1	0.712*			
Cap_2	0.700*			
Cap_3	0.865*			
Cap_4	0.867*			
Operational excellence		0.573	0.841	0.752
OX_1	0.789*			
OX_2	0.809*			
OX_3	0.615*			
OX_4	0.797*			

Note. $*p < .001$

Table 7.
Stage 2: Discriminant validity (HTMT)

Variables	1	2	3	4	5
1. ICT	-				
2. Innovation	0.574	-			
3. OL	0.676	0.625	-		
4. OP	0.368	0.645	0.658	-	
5. OX	0.367	0.564	0.702	0.647	-

4.3 Structural model

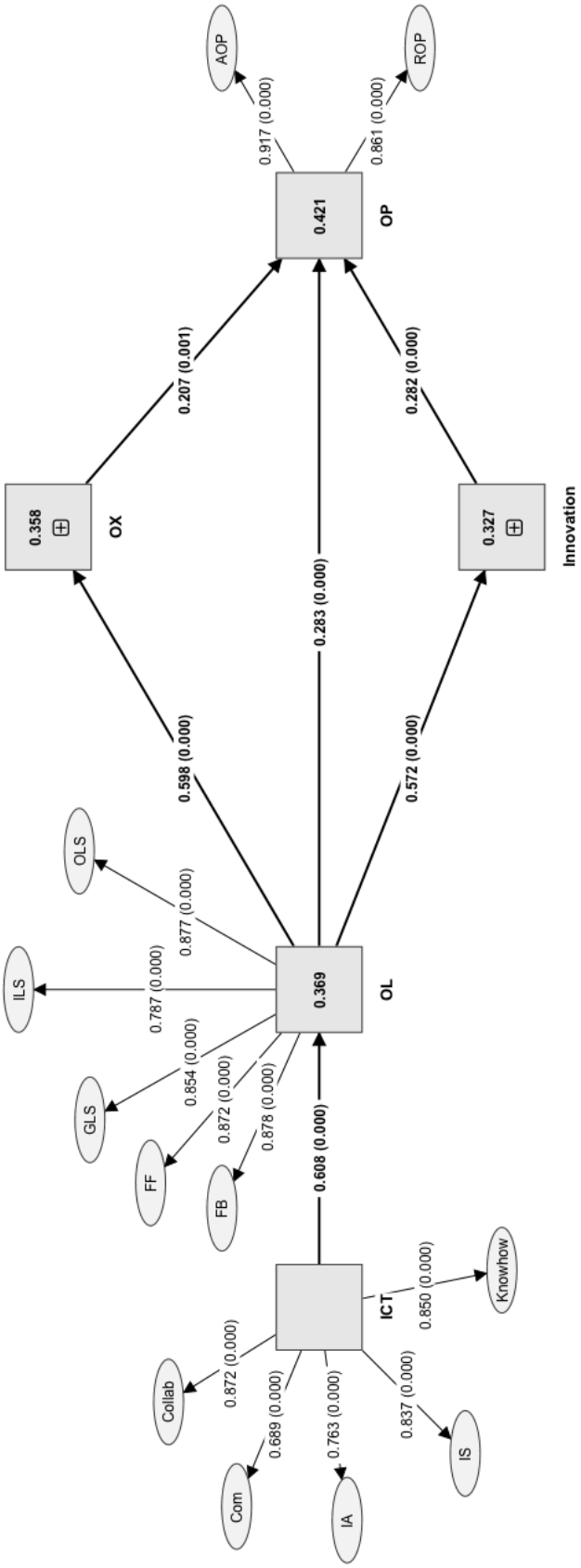
To explore the relationship between the constructs and test the hypotheses, a PLS-SEM analysis was performed. SmartPLS 4 (version 4.0.9.3) was used to estimate the model. As mentioned earlier, missing values were dealt with through mean replacement, and a BCa bootstrap with 10 000 subsamples was used in order to reduce bias in the model from skewness and to obtain p-values. All VIF values were inspected revealing that all values were below 3 as recommended and that there are no problems with collinearity (Hair et al., 2017).

The results revealed that all path coefficients between the latent constructs were significant ($p < .05$) and are presented in figure 2 below. ICT shows a strong positive effect on OL ($\beta = .608$, SD = .05, $p < .001$) which again has a modest positive direct effect on OP ($\beta = .283$, SD = .06, $p < .001$). The results also suggest that OL has a strong positive effect on Innovation ($\beta = .572$, SD = .05, $p < .001$) and a moderate positive effect on OX ($\beta = .598$, SD = .05, $p < .001$). Both Innovation ($\beta = .282$, SD = .06, $p < .001$) and OX ($\beta = .207$, SD = .06, $p = .001$) were further shown to have modest positive effects on OP.

The model's explanatory power is reflected in the R^2 values. The results (presented in figure 2) shows that the model explains 42.1% of OP ($R^2 = .421$), 36.9% of OL ($R^2 = .369$), 32.7% of Innovation ($R^2 = .327$), and 35.8 % of OX ($R^2 = .358$). Based upon Hair et. al. (2018) rule of thumb, these effects would be seen as modest - moderate.

Figure 2.

PLS-SEM Structural model



Note. p-values in parentheses. Path coefficients are standardized. R^2-values are presented in the constructs box.

To evaluate the models out-of-sample predictive power, a PLSpredict analysis was performed in SmartPLS, using OL and OP as the key endogenous constructs. As the model from stage 2 uses the LOC latent variable scores as indicators, the stage 1 model was used in the PLSpredict procedure as recommended by Becker et al. (2019). The $Q^2predict$ values were first examined and the results suggest that all indicators for OL and OP outperforms the most naïve benchmark, the indicator means from the analysis sample (Q^2-values for indicators > 0.00) (Hair et al., 2019a). Further the models were compared with linear regression models used in PLSpredict. The results are presented in table 8 and show that the minority of indicators in the PLS-SEM has higher prediction errors than the LM, indicating that the model has medium out-of-sample predictive power (Hair et al., 2019).

Table 8.
Results from PLSpredict analysis

Constructs and indicators	***Q²-predict***	**PLS-SEM RMSE**	**LM RMSE**
OL			
ILS_1	0.191	0.672	0.693
ILS_2	0.183	0.677	0.715
ILS_3	0.158	0.748	0.760
ILS_4	0.244	0.720	0.753
ILS_5	0.225	0.951	0.954
GLS_1	0.095	0.831	0.854
GLS_2	0.132	**0.995**	0.981
GLS_3	0.140	0.971	0.983
GLS_4	0.114	0.951	0.979
GLS_5	0.181	0.908	0.930
OLS_1	0.170	1.046	1.053
OLS_2	0.114	1.139	1.151
OLS_3	0..161	1.010	1.031
OLS_4	0.171	0.934	0.960
OLS_5	0.143	0.975	1.014
FF_1	0.185	**1.100**	1.091
FF_2	0.098	1.240	1.250

Constructs and indicators	Q^2-*predict*	PLS-SEM RMSE	LM RMSE
FF_3	0.191	**1.124**	1.109
FF_4	0.217	0.997	1.024
FF_5	0.189	0.952	0.975
FB_1	0.167	0.783	0.801
FB_2	0.172	1.033	1.059
FB_3	0.157	1.062	1.120
FB_4	0.156	1.193	1.240
FB_5	0.127	1.360	1.379
OP			
AOP_1	0.082	0.785	0.811
AOP_2	0.057	0.716	0.737
AOP_3	0.071	**1.008**	1.007
AOP_4	0.048	0.891	0.916
ROP_1	0.041	1.094	1.126
ROP_2	0.004	1.562	1.609
ROP_3	0.027	1.312	1.320
ROP_4	0.037	1.336	1.339

Note. Items where LM outperforms PLS-SEM model highlighted in bold.

4.4 Mediation effects and importance of constructs

Multiple PLS-SEM analysis was performed in order to test the mediation effects proposed in H2 and H3 (results presented in table 9).

The results indicate support for our hypotheses as no significant direct effect was found between ICT and OP (β = -.078, $p > .05$) when OL were present as a mediator (H1), the relationship between ICT utilization and OP was fully mediated by OL (total effect= .345, $p < .001$) (H2), and the relationship between OL and OP was further partially mediated by innovative capabilities (indirect effect = .162, $p < .001$) and OX (indirect effect = .098, $p < .01$) (H3). H4 proposed that the relationship between OL and OP be mediated by Innovation and OX. The results further suggest that ICT has an indirect effect on Innovation (β = .349, $p < .001$), and OX (β = .364, $p < .001$).

Table 9.
Direct and indirect effects.

Relationships	Indirect effect	Direct effect	Total effect	Mediation type
ICT -> OP	.345**	-.078	.345**	full mediation
OL -> OP	.286**	.282**	.568**	partial mediation
OL -> Inn -> OP	.162**			
OL -> OX -> OP	.098*			
ICT -> Inn	.349**			
ICT -> OX	.364**			

Note. * p = .01, ** p <.001

In addition to our hypotheses, this study aims to answer the following research question: *which aspects of ICT Utilization are most important for OL and OP?* To further investigate this research question, two Importance Performance Map Analysis (IPMA) was performed (results presented in table 10). The first analysis focused on OP as the endogenous construct and suggest that knowhow has the greatest importance (β = .107), followed by Information sharing (β = .088), Collaboration (β = .086), and Information Acquisition (β = .079). Communication showed the lowest importance for predicting OP (β = .066). The second analysis focused on OL as the endogenous construct and show a similar ranking of the importance as the results suggest that knowhow has the greatest importance (β = .188), followed by Information sharing (β = .156), Collaboration (β = .151), and Information Acquisition (β = .138). Communication showed the lowest importance for predicting OL (β = .116).

Additionally, the first IPMA analysis revealed that OL is the most important construct for explaining OP (β = .568), followed by ICT (β = .345), and Innovation (β = .328). Operational excellence had the least importance for explaining OP (β = .207).

Table 10.

Results from IPMA analysis for OP and OL (N = 312)

Constructs	Importance OP (total effect)	Importance OL (total effect)
ICT	*.345*	*.608*
Communication	.066	.116
Collaboration	.086	.151
Knowhow	**.107**	**.188**
Information Sharing	.088	.156
Information Acquisition	.079	.138
OL	*.568*	-
ILS	.132	-
GLS	.116	-
OLS	**.144**	-
FF	.132	-
FB	.141	-
Innovation	*.282*	-
Operational Excellence	*.207*	-

Note. HOC in italic. LOC's with greatest importance in bold

5.0 Discussion

The purpose of this study was to investigate the relationship between ICT utilization and OP, and how OL, innovative capabilities and operational excellence acts as mediators for this relationship, in a knowledge intensive business environment. Our analysis was conducted on 312 Norwegian organizations operating in the finance-, technology-, and professional services industries. Our hypothesis was that there wasn't a direct relationship between ICT utilization and OP (H1), that OL mediated the relationship between ICT and OP (H2), and that Innovation and Operational excellence mediated the relationship between OL and OP (H3). The results from our analysis show support for all of our hypotheses. These will be discussed further in the following section, along with our research question.

5.1 ICT, OL, and OP

The results from our study show that there isn't a direct relationship between ICT utilization and organizational learning (H1). The resource-based view framework suggests that this is because ICT is a commodity, and therefore, doesn't satisfy the criteria for being a strategic resource (Carr, 2003). This is however probably more true today than previously, as the adoption and use of ICT increased tremendously during the covid-19 pandemic (LaBerge et al., 2020). The results from our study therefore indicates that simply utilizing ICT won't lead to organizational performance, as it needs to be accompanied by complementing resources (Akram et al., 2018; Barney, 1991; Yunis et al., 2017). Our results further indicate that organizational learning could be a complimenting resource/capability, as it fully mediates the relationship between ICT utilization and organizational performance (H2). This would be in line with what has been suggested in the context of the RBV framework previously discussed (Barney, 1991; Carr, 2003). However, the 4I framework provides further explanation for the relationship between ICT utilization and OL. One way ICT utilization can improve organizational learning is through enabling institutionalization by providing systems and structures for knowledge to be stored. ICT utilization can further make sure this knowledge is easily accessible and shared with all organizational members, and thus enabling the feedback learning flow as well. Another way ICT utilization can increase organizational learning is by enhancing communication, coordination, and information sharing (Deng et al. 2022) which again could improve feed forward learning flow and the interpreting and integrating processes.

Our findings are also in line with what previous research has found, however there are some differences in terms of the strength of the relationship between variables and the explanatory power. Studies by Tippins & Sohi (2003) examined the relationship between ICT competency, OL, and OP within manufacturing industries. They found no direct effect between ICT competency and OP when OL was included as a mediator. However, they found a much weaker effect between ICT competency and OP ($\beta = .166$), and OL and OP ($\beta = .371$) than the effects between ICT utilization and OP (total effect = .345) and OL and OP (total effect = .568) found in this study. One possible explanation for this could be due to the differences in estimation methods. While Tippins & Sohi

(2003) used the ESRL approach to SEM, this study used PLS-SEM which is more focused on maximizing the regression coefficients and variance explained (Hair et al., 2017). Another possible explanation for this could be due to the operationalization of ICT. While Tippins & Sohi (2003) only focuses on ICT competency, the measure used in our study includes other aspects such as ICT utilization for knowledge sharing, knowledge acquisition, collaboration, and communication.

A third possible explanation for the differences in results between Tippins & Sohi (2003) study and this study could be due to the differences in focus on industries. While Tippins & Sohi (2003) focuses on manufacturing industries, this study focuses on the finance-, technology- and professional services industries. However, studies from Real et al. (2006) examined the relationship between ICT infrastructure, OL, and OP also in manufacturing industries and showed stronger relationship between ICT and OP (total effect = .660), ICT and OL (β= .695) and OL and OP (total effect = .801), than we found in our study. The study by Real et al. (2006) also shows greater explanatory power than our study as they explain 48.3% of the variance in OL and 71.6% of the variance in OP, compared to our study that explains 36.9% of the variance in OL and 42.1% of the variance in OP. This could indicate that the differences in industries doesn't explain the differences in the strength of the relationship between the variables.

This could be seen as somewhat surprising, as finance-, technology-, and professional services industries could be seen as more knowledge intensive than manufacturing, and thus ICT utilization and OL should have a greater importance for OP. However, the results from Real et al. (2006) indicate the opposite. One possible explanation for why our study explains less of the variance in OP than Real et al. (2006) could be due to the operationalizations used to measure OP. Real et al. (2006) measures OP as a result of individual performance, group performance, and organizational performance, and uses an absolute measure. This means that the measure they use does not provide any benchmarks for respondents to gauge their answer. This study has on the other hand operationalized OP as consisting of both absolute performance and relative performance, and only focused on the organizational level. The relative measure of OP asks respondents to rate their performance compared to competitors and thus provides respondents a benchmark to base their response on. As the descriptive statistic in table 1 shows, the average for the relative measure is much lower than the one for the

absolute measure. A possible explanation for why our study explains less of the variance in OP could thus be due to that OL explains a smaller portion of the variance for relative organizational performance than for absolute organizational performance, and that the focus on only organizational performance narrows our measure compared to Real et al. (2006).

However, Real et al. (2006) also explains more of the variance of OL than our study. This indicates that ICT had a greater importance for OL in Real et al. (2006) study than it has in this study. A possible explanation for this could again be due to the differences in how ICT is operationalized. However, given that the measure used in our study is a wider and more comprehensive measure, we should have been able to explain a larger variance in OL than Real et al. (2006). This is therefore not a highly plausible explanation. Another possible explanation could be due to the differences in industries. As the finance-, technology-, and professional services industries are arguably more dependent upon knowledge and OL (being seen as knowledge intensive industries), they could have developed other tools and practices that explains a greater portion of the variance in OL.

Real et al. (2006) results also suggest that ICT has a far greater total effect on OP (.660) than what our results suggest (.345). This could in large part be explained as a result of the difference in effect of OL, as both studies see OL as a mediator between ICT and OP. However, Real et al. (2006) also includes technological distinctive capabilities as a mediator, and some of the difference in total effect could therefore be attributed to this relationship. This could indicate that OL is the most important mediator as it has the strongest effect on OP, but that there also are other variables that mediates the relationship between ICT and OP.

5.2 Innovation and OX as mediators

The results from our analysis provide support for the mediating role of innovation and OX in the relationship between OL and OP (H3).

As means for the organization to be able to use innovative capabilities, the 4I framework attributes to the feed-forward learning flows. The feed-forward flow stimulates the generation of new and innovative ideas, solutions, and ways of working, where the feed-forward flow of knowledge facilitates the explicit transfer of individual knowledge to the organization. The use of these innovative

learning flows, in essence, describes how tacit knowledge becomes explicit through informal conversation or productive meetings (Mainert et al., 2018). The possibility to be able to draw on the feed-forward knowledge flows can facilitate organizational possibilities in being early adopters through entrepreneurial ideas and insights, creating important leverages that have an impact on organizational strategies (Yunis et al., 2017). In line with implementing newfound insight into organizational strategies, the acknowledgement of this insight having come from an individual or a team, would have positive effects on the employees as well, seeing their ideas come to life. Creating a habit of utilizing feed-forward knowledge flows also builds a greater understanding of the mechanisms that are needed in order to make use of these flows. This enables a much easier use of new opportunities that fits with organizational goals and could even contribute to predicting future market trends (Podrug et al., 2017). As a result of innovative processes, organizations have been able to access existing knowledge within digital platforms or databases more easily and more effectively, resulting in the development of new methods and ideas. This leads us to the feed-back mechanisms and OX.

Through feed-back flows, the organization can leverage what has already been learned and institutionalized within the organization, in order to effectively take advantage of established routines. The feed-back flow ensures that what has been institutionalized and applied to the organization, actually are being used, where best practices, work processes and other valuable knowledge has been attained over time. These learning mechanisms align with the concept of re-engineering, where a long-term exploitation of institutionalized learning can lead to increased profits and reduced losses, as proposed by Bogodistov & Moorman (2019). We recognize that in order to be able to apply internal knowledge and fully take advantage of the feed-back mechanisms found, it becomes important to establish an infrastructure and accessibility that enables effective and fast application. By doing this the organization can more easily perfect methods and knowledge, creating routines, and apply them with ease in new projects and strategies without being hindered (Akram et al., 2018). Scholars have referred to this capability as the ability to effectively exploit existing knowledge, where institutionalized knowledge is shared between individuals and the organization (Bontis et al., 2002). In contrasts to previous studies, our research investigated the effect of OX on OP. The results indicate that only a partial mediation effect was

found, as the variance between OL and OP remained significant even after introducing the mediator.

Several studies have contributed to the understanding of the relationship between innovative capabilities and how these are seen in relation to organizational excellence as new innovative insights and ideas contribute to new knowledge through feed-forward flows, ultimately leading to OX (Real et al., 2006). As the new information becomes institutionalized, feed-back flows contribute to the access of internal knowledge leading to a loop of information, where established knowledge is transferred back to the individual and or groups (Crossan et al., 1999). However, there can be some tension arising from the appliance of feed-forward and feed-back learning flows. As previous research refers to, what has already been learned by the organization can often be difficult to unlearn, thereby obstructing the appliance and use of new insight and knowledge. The need to find a balance between the utilization of these flows becomes important. Mainert et al. (2018) exemplifies feed-forward as being most dominant when the organization operates in a rapidly changing market and where the use of internally held knowledge and feed-back flows relates to a more stable environment. As one can argue that it becomes important for the organization to view itself as a dynamic entity where change is something that is constantly occurring, finding a balance is imperative.

Although previous studies have provided information and indication that the use of ICT contributes to OX, our literature review did not identify any research that specifically measured the mediating effects. This research however seeks to understand the mediating effects of these capabilities. Our IPMA analysis also provides us with insight as to which construct showed the most effect on OP, where innovation showed a greater total effect of .282 versus OX with a total effect of .207. According to RBV, second-order capabilities such as OL, can if properly utilized lead to the development of dynamic-, and operational capabilities, leading to improved OP. Our findings suggest that besides innovation and OX, other capabilities might also mediate the relation between OL and OP.

5.3 The importance of OL and ICT for predicting OP

In order to explore which of this study's variables are the most important predictors of OP and provide implications for which managers should focus on, an IPMA analysis was conducted. Our results suggest that OL is the most important

predictor of OP (total effect = .568) followed by ICT utilization (total effect = .345), innovation (total effect = .262), and OX (total effect = .207).

As the results suggest, OL seems to be almost three times as important as ICT utilization and innovation. This is perhaps not surprising as OL can be seen as a second order capability and thus is responsible for the development of dynamic- and operational capabilities (Vera et al., 2012). Another possible explanation for why OL is so important for OP could be that it is complex which makes it hard for competitors to imitate (Bharadwaj, 2000). It could also be suggested that capabilities such as OX and Innovation to some degree could be bought on the market (e.g., through consultancy services) which makes them easier to imitate or acquire. However, OL is much more complex and isn't necessarily something that could be bought. It has to be built from the ground up through institutionalizing the knowledge held within the individual organization members. Tools like ICT could help facilitate this process, but the results will only be as good as the input (which in this case would be the knowledge held by the individuals within the organization).

ICT utilization was found to be the second most important predictor of OP, only slightly more important than innovation. A plausible explanation for this could be that ICT enables OL which in turn enables innovation. In a previous study conducted by Akram et al. (2018) looked at the relationship between ICT capabilities, Knowledge management capabilities, and OP. Using an IPMA analysis they found ICT to be a more important predictor (total effect = .498) than found in our study (total effect = .345). A possible explanation for this could be due to the samples used and differences in technological development. While this study has focused on Norwegian firms in the finance-, technology-, and professional services industries, Akram et al. (2018) sample consisted of Pakistani firms within the manufacturing and service industries. According to the UNs Technology and Innovation report from 2023, Norway ranks as the thirteenth most technological developed country, and third in terms of ICT use, while Pakistan ranks as number 125 in terms of technological development and 149 in terms of ICT use (UN, 2023). A plausible explanation for these differences in results could therefore be that ICT use is less common and developed in Pakistan, which leads to fewer firms using ICT and having the necessary capabilities to use them efficiently, giving firms with ICT capabilities a greater competitive

advantage. While in Norway, the differences in ICT use and capabilities are much smaller, thus the effects of ICT use on OP are also smaller.

5.4 LOC's of ICT utilization importance for predicting OL an OP

In addition to testing the hypotheses discussed above, one of the main objectives with this study was to provide managers with clearer implications for how they can optimize ICT utilization for increasing OP. Based upon this a research question was formulated to investigate which aspects of ICT Utilization are most important for OL and OP.

As the results from our PLS-SEM model suggests that OL fully mediates the relationship between ICT utilization and OP, the LOC's of ICT utilization that are the most important for predicting OL should also be the ones that are the most important for predicting OP. An IPMA analysis was therefore conducted to see which LOC's of ICT utilization was the most important for OL. The results from the IPMA suggests that ICT knowhow (.188) is the most important predictor for OL followed by information sharing (.156), ICT collaboration (.151), information acquisition (.138), and lastly communication (.116). A second IPMA analysis was also conducted in order to verify this assumption and the results shows that the same importance ranking also applies for predicting OP. The following section will thus further discuss possible explanations for the importance of the different aspects of ICT utilization using the 4I framework as a basis.

ICT knowhow refers to the organization's knowledge, understanding and competence to use ICT in practice and was found to be the most important LOC of ICT utilization for predicting both OL and OP. The literature has suggested that the effect of ICT on OL is due to its ability to efficiently store and share information (Robey et al., 2000; Bharadwaj, 2000; Tippins & Sohi, 2003; Alavi & Leidner, 2004; Real et al., 2006; Pérez-Lopez & Alegre, 2012; Mao et al., 2016; Kuusisto, 2017), as well as enabling efficient communication (Robey et al. 2000; Bharadwaj, 2000). However, these functions of ICT are dependent upon that the organizational members have the ability to utilize these functions efficiently. If members of the organization aren't able to use ICT and understand how they can use it efficiently it would become difficult to see any positive effects from ICT utilization. If the members of the organization also have the knowledge,

understanding, and ability to find new and better ways of using ICT, this would also lead to a greater effect of ICT utilization. It is therefore not surprising that ICT knowhow is shown to be the most important LOC of ICT utilization, and indicates that managers should focus on developing employees' knowledge and understanding of ICT to see further gains in OP.

The second most important predictor of OL was found to be information sharing which refers to which degree ICT is used for sharing information, insights, and knowledge across the organization. This is with what many researchers have suggested to be the main explanation for the relationship between ICT and OL (see Robey et al., 2000; Bharadwaj, 2000; Tippins & Sohi, 2003; Alavi & Leidner, 2004; Real et al., 2006; Perez-Lopez & Alegre, 2012; Mao et al., 2016; Kuusisto, 2017). This could also be seen in relation to the 4I framework which emphasizes feed-back and feed-forward learning flows as fundamental elements of OL as it transforms individual knowledge into organizational knowledge and vice versa. Both of these knowledge flows are in essence information sharing and it is thus highly plausible that this is the most important aspect of ICT utilization besides knowhow.

The third most important LOC of ICT for predicting OL was ICT collaboration which refers to the extent organizations use ICT for collaborative purposes. This is something that we saw an increase in during the covid-19 pandemic as a consequence of the need for employees to work remotely (LaBerge et al., 2020) and haven't gotten much attention in the previous literature. However, previous studies have suggested that ICT can enhance coordination and communication (Jean, 2007; Deng et al., 2022), and it is reasonable to believe that this could also enhance collaborative processes. A plausible explanation for why ICT collaboration is ranked as the third most important LOC and only slightly less important than information sharing, could be that collaboration enables both the interpreting and integrating OL processes (Pérez-Lopez et al., 2005). It is essential for interpreting and integrating to make knowledge explicit and to create a shared understanding and this could also be seen as essential for efficient collaboration. As ICT could enhance communication and coordination this could facilitate this process, however, ICT also allows for visual presentation of knowledge and more efficient information sharing which also could help make knowledge explicit and to create a shared understanding.

Information acquisition was identified as the fourth most important factor for OL and refers to the degree organizational members use ICT to acquire information from both inside and outside the organization. This could be seen as somewhat overlapping with information sharing, however, information sharing is seen as distinct as it refers to how organizations use ICT to share / disseminate information. Few studies have focused on ICT utilization for information acquisition. An explanation for this could be that most of the previous studies were conducted in the early 2000's when the internet and ICT didn't provide the same access to information like it does today. Currently a vast amount of information is available through ICT tools, and this is likely to increase with the development and implementation of AI tools (Sweet et al., 2023). Information acquisition is mentioned in the 4I framework as an important aspect of OL, as the information existing within the organization must have its origins from somewhere outside the organization. Through feed-forward learning flow, new information from the individuals gets passed up in the organization and becomes institutionalized. A possible explanation for Information acquisitions relevance for OL is thus that it helps organizations increase the knowledge held by its individual members which over time gets institutionalized and embedded into the organization.

Lastly, communication was found to be the least important aspect of ICT utilization for predicting OL. While the 4I framework (Crossan et al., 1999) as well as previous research (see Bharadwaj, 2000; Robey et al., 2000) emphasizes the importance of communication for OL, it might become somewhat redundant compared to information sharing. However, information sharing is thought to relate to the formal knowledge sharing practices used in organizations while communication is thought to capture the more informal aspect of knowledge sharing. As communication through ICT often can be perceived as a more formal way of communicating, a possible explanation for why ICT communication is the least important factor could be that it does not facilitate the informal knowledge sharing, and sharing of tacit knowledge which often is associated with in person communication (Mainert et al., 2018). Another possible explanation for why ICT communication is the least important factor could also be that there is an information loss when communicating through ICT compared to in-person (for example facial expressions, tone of voice etc. isn't made explicit in chat etc.). Additionally, communicating through ICT could prove to be less effective

compared to face-to-face communication as it is easier to be interrupted, talked over etc. (Gregory, 2022) Thus it is possible that ICT enables efficient communication in terms of making it easier to get in touch with different people, but it might fail to realize the same value as in-person communication would have. This is however, something that needs to be further investigated in future research.

6.0 Implications

One of the main purposes of this study was to provide managers with clearer implications for how they can optimize ICT utilization in order to improve organizational performance. These implications along with the theoretical contribution of this study will be further discussed in this section.

First, the results from this study suggests that OL has the greatest importance for OP out of all the variables in this study. The results also suggest that OL leads to an increase in both innovative capabilities and operational excellence. This indicates that managers and business leaders should focus on how they can optimize ICT utilization for improving OL as this will lead to greater increases in OP as well as an increase in innovative capabilities and OX. This study found that ICT knowhow has the greatest importance for predicting OL, indicating that managers should focus on developing employees' understanding and abilities for using ICT. The second most important predictor of OL was information sharing which was closely followed by ICT collaboration. This further encourages managers to prioritize adopting ICT solutions that best facilitate both information sharing and collaboration. Information acquisition and communication was identified as the fourth and fifth most important predictor of OL, suggesting that this should be a lower priority (compared to the previously mentioned aspects of ICT) when designing and implementing ICT solutions.

Secondly, the results further suggest that ICT utilization has a greater importance for OP than innovative capabilities and OX. Additionally, ICT utilization has an indirect effect on both innovative capabilities and OX through OL, suggesting that ICT utilization also could lead to increases in innovative capabilities and OX. This suggests that managers should prioritize focusing on ICT utilization over innovative capabilities and OX.

In terms of theoretical implications, our study contributes to the literature in multiple ways. Firstly, by using both the 4I framework and the RBV framework, this study provides a more comprehensive understanding of how different aspects (LOC's) of ICT utilization affects OP through OL. The findings of this study also expand upon what previous studies have found by confirming the findings of Tippins & Sohi (2003) and Real et al. (2006) in industries outside the manufacturing industries. Additionally, this study confirms the role of OL as a mediator between ICT utilization and OP in post-pandemic times as well.

Secondly, this study found the relationship between OL and OP to be mediated by innovative capabilities and OX, and thus support the suggestions made from the 4I framework (Crossan et al., 1999). The study also adds to the literature by examining the role of OX in the relationship between ICT utilization and OP. While previous studies have suggested that ICT leads to performance through OX, none of the studies have actually tested this relationship. This study has therefore contributed by finding an indirect effect between ICT utilization and OX, which again is mediated by OL.

7.0 Limitations

It is important to acknowledge a number of limitations. First, this study has used a cross-sectional design, thus only providing a snapshot of the situation right now. As technology develops rapidly, this can mean that our findings do not necessarily apply in a few years' time. The design of this study is also not suited for establishing causality and the direction of the relationships in this study should therefore be interpreted cautiously.

Secondly, this study used a convenience sample which does not ensure that the sample is representative. The study was conducted on a sample consisting of Norwegian organizations operating within the finance-, technology-, and professional services industry. While the out-of-sample predictive power of our model was of medium strength, generalizability beyond the mentioned industries and outside Norway should be done cautiously. Future studies should try to confirm the findings of this study in different industries and contexts.

Thirdly, the measures used for ICT utilization and OX have not been validated previously. However, the ICT utilization measure was based upon previously validated measures, and both the ICT utilization measure and the OX

measure showed acceptable reliability and validity. Another limitation related to the measures used is they are all subjective measures. Most crucially, the OP measure is a measure of the respondents perceived organizational performance which might lead to biases or inaccurate answers. However, objective measures of organizational performance such as profitability, ROI, sales growth etc. could reveal sensitive information with competitive implications. This could make organizations more reluctant to participate in studies, and a subjective indirect measure of OP was chosen. Similar measures have been used previously in strategy research as well as in the context of investigating the relationship between ICT, OL, and OP (see Tippins & Sohi, 2003 and Real et al., 2006), and studies using objective measures should be conducted in order to solidify these findings.

Fourth, unobserved heterogeneity was found in our data, and this was not corrected for and could thus lead to biases in our results. The data was also not examined for linearity and endogeneity as suggested by Hair et al. (2019a), thus weakening the robustness of our findings.

8.0 Conclusion

The purpose of this study has been to investigate the relationship between ICT utilization and OP. This study has proposed OL as the main mediator explaining the relationship between ICT utilization and OP, and innovative capabilities and OX have been proposed to further mediate the relationship between OL and OP. The results from this study found OL to be the most important variable included in this study for predicting OP thus supporting the notion that OL could be the main mediator explaining the effects of ICT utilization on OP. The findings further support innovative capabilities and OX as mediating the relationship between OL and OP, however this was only a partial mediating. Future research should therefore further explore how OL could affect OP.

One of the main objectives of this study has been to provide clearer implications for managers for how they can optimize ICT utilization for increasing OP. The results from this study suggest that ICT utilization should be directed towards enabling OL. Our analysis identified ICT knowhow, information

sharing, and ICT collaboration as the most important aspects of ICT utilization for improving OL, suggesting that managers should focus on (1) developing employees understanding and ability to efficiently use ICT, (2) designing and implementing ICT solutions that facilitates effortless information sharing and (3) design and implement ICT solutions for collaborative purposes. Our results further suggest that OL and ICT utilization are more important for OP than innovative capabilities and OX. This suggests that managers should put a larger emphasis on increasing OL and ICT utilization, than on developing innovative capabilities and OX.

Lastly, our study contributes to the literature by expanding upon the findings from previous studies. Our findings demonstrate that the relationship between ICT, OL and OP found in manufacturing industries by Tippins & Sohi (2003) and Real et al. (2006) also applies in the finance-, technology-, and professional services industries in Norway in post-pandemic times. Our study also expands upon these findings by including innovative capabilities and OX as mediators between OL and OP.

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10. Appendix

Appendix 1.

Measurement for ICT and its indicators

Communication		*Scale*: 7-Point Likert
Our organization utilize Information and Communication technology (ICT) for		*Source: Own*
Com_1	Chatting / informal communication,	*Source: Own*
Com_2	Video meetings (internal eg. with team or colleagues)	*Source: Own*
Com_3	Video meetings (external, eg., with clients)	*Source: Own*
Collaboration		*Scale*: 7-Point Likert
To which degree are the following statements accurate for your organization?		
Coll_1	In our organization we rely on technology (ICT) as a tool for collaboration	*Source: Own*
Coll_2	Employees use technology (ICT) to collaborate with other persons inside the organization	Real et al. (2006)
Coll_3	Employees use technology (ICT) to collaborate with other persons outside the organization	Real et al. (2006)
Information Sharing		*Scale*: 7-Point Likert
To which degree are the following statements accurate for your organization?		
IS_1	In our organization we routinely share knowledge using technology (ICT)	Deng et al. (2022)
IS_2	In our organization we routinely share ideas openly using technology (ICT) (e.g., through chatting, video meetings, databases etc.)	Deng et al. (2022)
Information Acquisition		*Scale*: 7-Point Likert
To which degree are the following statements accurate for your organization?		
IA_1	Employees use technology (ICT) to search for new knowledge	Real et al. (2006)
IA_2	Employees use technology (ICT) to retrieve and use knowledge about its products and process	Real et al. (2006)

IA_3	Employees use technology (ICT) to retrieve and use knowledge about its markets and competition	Real et al. (2006)
Knowhow		*Scale:* 7-Point Likert
To which degree are the following statements true for your organization		*Source: Own*
Kh_1	In our organizations people are able to utilize the ICT systems optimally	*Source: Own*
Kh_2	The people in our organization can always ask someone for help with the ICT systems	*Source: Own*
Kh_3	The people in our organization regularly learn new ways of utilizing the organizations ICT systems	*Source: Own*

Appendix 2.

Measurement for OP and its indicators

Absolute organizational Performance		*Scale*: 7-Point Likert
To which degree are the following statements true for your organization?		
AOP_1	Our organization is successful	Real et al. (2006)
AOP_2	Our organization meets its clients' needs	Real et al. (2006)
AOP_3	Our organization's future performance is secure	Real et al. (2006)
AOP_4	Our organization is well-respected within the industry	Real et al. (2006)
Relative organizational Performance		*Scale* 7-Point Likert
To which degree are the following statements true for your organization		
ROP_1	Compared with the competitors, our company is more successful	Akram et al. (2018)
ROP_2	Compared with the competitors, our company has a higher market share	Akram et al. (2018)
ROP_3	Compared with the competitors, our company is growing faster	Akram et al. (2018)
ROP_4	Compared with the competitors, our company is more innovative	Akram et al. (2018)

Appendix 3.

Measurement for Innovation and its indicators

Capabilities		*Scale*: 7-Point Likert
Novel and useful systems, processes, products or services		
CAP_1	Are developed by our organization	Yoo et al. (2011)
CAP_2	Are produced by our organization	Yoo et al. (2011)
CAP_3	Are successfully implemented by our organization	Yoo et al. (2011)
CAP_4	Have become a stable and regular part of the organization	Yoo et al. (2011)

Appendix 4.

Measurement for OX and its indicators

OWN		*Scale*: 5-Point Likert
To which degree are the following statements true for your organizations		*Source: Own*
OX_1	In our organization we utilize best practices	*Source: Own*
OX_2	We have well designed and optimized processes	*Source: Own*
OX_3	We rarely make mistakes or errors in our deliveries	*Source: Own*
OX_4	We have high efficiency levels in operations	*Source: Own*

Appendix 5.

Measurement for SF-SLAM

Individual SF-SLAM		*Scale:* 7-Point Likert
To which degree do the following statements apply for your organization		
ILS_1	Individuals feel confident in their work	Mainert et al (2018)
ILS_2	Individuals feel a sense of pride in their work	Mainert et al (2018)
ILS_3	Individuals have a high level of energy at work	Mainert et al (2018)
ILS_4	Individuals are able to grow through their work	Mainert et al (2018)
ILS_5	Individuals are able to break out of traditional mindsets to see things in new and different ways	Mainert et al (2018)
Group SF-SLAM		*Scale:* 7-Point Likert
To which degree do the following statements apply for your organization		
GLS_1	In meetings, we seek to understand everyone's point of view	Mainert et al (2018)
GLS_2	We have effective conflict resolution when working in groups	Mainert et al (2018)
GLS_3	Groups have the right people involved in addressing issues in groups	Mainert et al (2018)
GLS_4	Different points of view are encouraged in our group work	Mainert et al (2018)
GLS_5	Groups are prepared to rethink group decisions when presented with new information	Mainert et al (2018)
Organizational SF-SLAM		*Scale:* 7-Point Likert

To which degree do the following statements apply for your organization		
OLS_1	The organizational structure supports our strategic direction	Mainert et al (2018)
OLS_2	The organizational structure allows us to work effectively	Mainert et al (2018)
OLS_3	Our operational procedures allow us to work efficiently	Mainert et al (2018)
OLS_4	We have a realistic yet challenging vision for the organization	Mainert et al (2018)
OLS_5	We have an organizational culture characterized by a high degree of trust	Mainert et al (2018)
Feed-forward SF-SLAM		*Scale:* *7-Point Likert*
To which degree do the following statements apply for your organization		
FF_1	Lessons learned by one group are actively shared with others	Mainert et al (2018)
FF_2	Individuals have input into the organization's strategy	Mainert et al (2018)
FF_3	Groups propose innovative solutions to organization wide issues	Mainert et al (2018)
FF_4	Recommendations by groups are adopted by the organization	Mainert et al (2018)
FF_5	Results of the group are used to improve products, services and processes	Mainert et al (2018)

Feed-back SF-SLAM		*Scale:* 7-Point Likert
To which degree do the following statements apply for your organization		
FB_1	Company goals are communicated throughout the organization	Mainert et al (2018)
FB_2	Company files and databases provide the necessary information to do our work	Mainert et al (2018)
FB_3	Training is readily available when it is needed to improve knowledge and skills	Mainert et al (2018)
FB_4	Cross-training, job rotation and special assignments are used to develop a more flexible workforce	Mainert et al (2018)
FB_5	Group decisions are supported by individuals	Mainert et al (2018)