

Hybrid market offering in the medical technology sector and the role of network configuration: An exploratory assessment of dynamics in developed and emerging markets

Authors:

Huda Khan (Business School, University of Aberdeen, UK)

Ahmad Arslan (Oulu Business School, University of Oulu, Finland),

Lauri Haapanen (Oulu Business School, University of Oulu, Finland)

Peter Rodgers (Southampton Business School, University of Southampton, UK)

Shlomo Y. Tarba (Birmingham Business School, University of Birmingham, UK)

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Hybrid market offering in the medical technology sector and the role of network configuration: An exploratory assessment in both developed and emerging markets

Abstract

Purpose: Applying both the dynamic capability and configuration theoretical perspectives, the paper showcases the role of network configuration and dynamics of hybrid offerings in both developed and emerging markets by high-tech firms.

Design/methodology/approach: The current paper uses an exploratory qualitative research methodology based on in-depth case studies of three Finnish high-tech firms operating in the medical technology industry globally.

Findings: Our findings showed that dynamic capabilities such as sensing and customer engagement along with internal coordination and adaptation capabilities are critical to the success of hybrid market offerings. Moreover, dynamic capabilities were found to be influential in those emerging and advanced international markets where case firms were less familiar with market dynamics. Moreover, the configuration of these capabilities within functional units and coordination of marketing and R&D activities can be effective for creating hybrid offerings in international markets. Ultimately, we found that to be the case even though target market selection for hybrid offerings were influenced by the level of convergence and fragmentation of the market.

Originality/value: Applying configuration theory, it is one of the first studies to specifically analyze the differences in organizational network configuration changes in relation to hybrid market offerings in both developed economies and emerging economies. The findings contribute to hybrid market offering literature by pointing out that not only internal capabilities are important for enacting hybrid offerings, but the role of ecosystems and knowledge centers are also extremely important to develop hybrid offerings. Our paper also highlights the criticality of under-studied dynamic capabilities such as market sensing and customer engagement in the context of hybrid offerings in international markets. This showcases the wider role of ecosystems in enabling technology firms to develop hybrid offerings.

Keywords: Developed Markets, Emerging Markets, High-tech firms, Hybrid market offering; Medical Technology; Network Configuration.

Paper Type: Research Paper

1. Introduction

Servitization is the process of “moving from the old and outdated focus on goods or services to integrated ‘bundle’ or systems with services in the lead role” (Vandermerwe and Rada 1988). Hybrid offerings that combine both goods and services have been found to significantly improve firms’ profits (e.g., Ulaga and Reinartz 2011) as well as positively improve their competitiveness (e.g., Pertusa-Ortega *et al.*, 2009; Sonar *et al.*, 2020). In an increasingly competitive market environment, hybrid market offerings are increasingly becoming a visible aspect of strategies of many manufacturers (e.g., Patel *et al.*, 2019). To date, scholars have referred to different strategies being used by manufacturers in their hybrid market offerings, ranging from offering service as part of manufactured goods (e.g., Patel *et al.*, 2019) to outsourcing service to a third party (e.g., Thomas, 2017) to offering customers flexibility in choosing which service aspects they wish to use for that specific manufactured good (e.g., Cenamor *et al.*, 2017). Extant literature has also linked hybrid market offerings to an increasingly visible research stream of servitization (e.g., Rabetino *et al.*, 2018; (Raddats *et al.*, 2022, Gebauer *et al.*, 2021).

The importance of organizational networks is well-established within the extant literature concerning firm’ strategies as well as in their internationalization into new markets (e.g., Jansson, 2007). Scholars focusing on network dynamics have been increasingly stressing the importance of network configurations as they tend to differ from market to market (e.g., Kiss and Danis, 2008; Leppaaho *et al.*, 2018) and in some cases, from one specific industrial customer to another (e.g., Pittaway *et al.*, 2004). At the same time, prior research indicates the importance of network intensity in relation to hybrid market offerings and servitization (e.g., Symeonidou *et al.*, 2017; Ziaee Bigdali *et al.*, 2018). Despite rising scholarly attention in hybrid market offerings, a recent thematic review in servitization literature has called for work in a network perspective of hybrid offerings as it has gained little attention in the literature (Raddats *et al.*, 2019).

Meanwhile, technology manufacturers are implementing digital methods to enhance their front and back end operations for successful hybrid offerings, for example, including online monitoring or tracking devices in their products (Porter and Heppelmann, 2014). These offerings create opportunities for servitization offerings. Previously, scholars have stressed the importance of the industrial sector while analyzing hybrid market offerings (e.g., Schaarschmidt *et al.*, 2018) as the dynamics differ from technologically intensive products, for example, a power plant or an engineering equipment to automobiles. Technologies are offering opportunities as well as creating new challenges for firms, e.g., new business operating models (Paiola and Gebauer, 2020). While the manufacturing sector is widely researched in servitization literature (Schmenner, 2009), understanding the network

configuration required for high-tech manufacturing firms' hybrid offering in the context of internationalization literature has remained an under-explored area. This is an important context given that internationalization of servitized manufacturers is often more complicated than non-servitized manufacturers (Shleha *et al.*, 2022), which exacerbates the challenges of network configuration for high-tech firms. Applying configuration theory (Meyer *et al.*, 1993), the first objective of this study is to present an answer to the first research question: *What are the key changes required in the organizational network configurations when traditional manufacturing organizations transit towards hybrid market offerings, and the focus on service provision becomes important?* It is one of the first studies to specifically analyze the differences in organizational network configuration changes in relation to hybrid market offerings in developed economies vs. emerging economies. By doing so, it makes clear contributions to multiple literature streams. The findings contribute to network theory by demonstrating the vital role that networks and alliances played in hybrid offerings. Our study elucidates the notion that networks and alliances play a crucial role in hybrid offerings.

Manufacturers must learn how to grow revenue through hybrid offerings by developing key capabilities (Ulaga and Reinartz, 2011). Drawing upon servitization literature, it is argued that co-creation of value within networks involves combining and creating unique capabilities for hybrid offerings (Gebauer *et al.*, 2013). The multiple case studies in the context of servitization finds that it is critical for manufacturers to develop compatible capabilities with network agents (Story *et al.*, 2017). Hence, applying dynamic capability theory (Teece *et al.*, 1997) in combination with configuration theory, the second objective of this study is to answer this research question: *Which dynamic capabilities are critical for hybrid offerings of high-tech manufacturing firms in emerging and advanced markets?* Accordingly, we contribute to the hybrid offering literature by pointing out that not only internal capabilities are important for enacting hybrid offerings, but also that the role of ecosystems and knowledge centers are extremely important to develop hybrid offerings. We also point out under-studied dynamic capabilities such as market sensing and customer engagement in the context of hybrid offerings in international markets. This showcases the wider role of ecosystems in enabling technology firms to develop hybrid offerings.

International business scholars are gaining interest in servitization research due to evolving technology dynamics in international markets (Rammal *et al.*, 2022). While servitization literature is growing, however, the research on hybrid offering to date has not presented side-by-side findings for emerging and developed markets. Hence, this study presents important contributions given that emerging markets entail different business dynamics and environmental characteristics than developed markets (Falahat *et al.*, 2018, Xing *et al.*, 2017). Our research addresses the gaps using the

findings of in-depth qualitative research undertaken with three Finnish case firms operating in the technology-intensive sector. Finland is chosen as it is a small, open economy with substantial international focus (Ojala, 2009), which makes it a relevant context.

The rest of the paper is organized as follows. The next section presents a literature review followed by empirical research design and methodological details. In the subsequent section, study findings are presented. The paper concludes with a presentation of key theoretical and managerial implications, limitations and directions for future research.

2. LITERATURE REVIEW

2.1 Hybrid market offerings

Hybrid offerings are defined as an innovative blend of goods and services (Venkatesh, Berry *et al.* 2009). Scholarship suggests that it is a process of “moving from the old and outdated focus on goods or services to integrated ‘bundle’ or systems with services in the lead role” (Vandermerwe and Rada 1988). Specifically, these offerings are defined as a composition of one or more products or services such that it generates more customer-value compared to individual products or services sold (Venkatesh, Berry *et al.* 2009). Facing stagnant revenue, manufacturing firms have now been shifting their focus from good-dominant to hybrid offering to enhance value creation, market positioning and growth. This phenomenon is known as ‘servitization’ in literature, whereby firms’ majority proportion of manufacturing industries have been bundling their tangible goods with services.

The practical importance of servitization and scholarly interest has led the growth of research in hybrid offerings (Lexutt, 2020). In the context of manufacturing product, servitization-focused firms are required to create value propositions through service (Kohtamäki *et al.*, 2020b). Scholars have indicated that through hybrid offering, firms can create mutual value for themselves and for their customers (e.g., Ulaga and Reinartz, 2011).

European market for servitization was 4.5 billion euro in 2016, and it is expected to grow to 33 billion euro by 2025 (Probst *et al.*, 2016). This implies significant revenue generation potential for manufacturing firms offering hybrid products and services rather than stand-alone tangible products. As a consequence, there has also been increased scholarly attention on hybrid offerings in understanding value for both customers and firms. For example, a study found that the efficacy of hybrid offerings becomes noticeable when it reaches at least 20-30% of a total firm’s sale (Fang *et al.*, 2008). In understanding the value of customer-focused vs. supplier-focused approaches, scholars

find that suppliers perceive such offerings as a customized approach while customers perceive these as relational approach (Tuli *et al.*, 2007). Studies have also examined distinctive capabilities of manufacturing firms in order to create successful servitization (e.g., Ulaga and Reinartz 2011). Despite the emerging interest in the current body of literature in understanding how hybrid market offerings generate value for customers and firms, there has been a considerable gap in understanding how such offerings change network configuration and dynamics for effective business, and key capabilities required for service delivery in advanced vs. emerging markets' context (e.g., Boojihawon *et al.*, 2021).

Servitization literature classifies into different clusters including structure and strategy of firms, motivation and performance, resource development and capabilities, and service development and delivery (Raddats *et al.*, 2019). However, there has been paucity of servitization research in hybrid eco-systems that requires change in network configuration and dynamic capabilities required for hybrid offerings (Khanra *et al.*, 2021), especially in the context of technology-based firms (e.g., Paschou *et al.*, 2020). The role of network and dynamic capabilities such as anticipating market changes has been identified as a key gap to be considered for extending servitization literature (Baines *et al.*, 2017). The topic is worthwhile to examine in the technology firms, given the emergence of new technologies such as artificial intelligence which can transform the business eco-system and nature of service delivery (Ardolino *et al.*, 2018). For instance, General Electric (Evans and Annunziata, 2012) and Kone (Ardolino *et al.*, 2018) have demonstrated how hybrid service can be delivered digitalized to enhance business efficiency. General Electric also showcased the development of necessary capabilities (e.g., anticipating, analyzing *et al.*) in developing remote monitoring hybrid services (Paschou *et al.*, 2020). Accordingly in the context of this study - technology firms, it is critical to determine the key capabilities and the role of network and its configuration for successful hybrid offerings.

2.2 Firms' capabilities in hybrid offerings

Manufacturing firms can seek growth by integrating services with product offerings. This requires firms to leverage resources in developing distinct capabilities (e.g., Matthyssens and Vandenbempt, 2010). From the resource-based view (RBV) perspective, unmatched or unique resources such as well-directed product distribution channels, trained field agents, product manufacturing principles can be exploited for designing and selling hybrid offerings (Ulaga and Reinartz 2011). The deployment of firm resources in the development of key capabilities for

innovative market offerings is a dynamic process (e.g., Fang *et al.*, 2008). Extending this, scholars assert that ambidexterity or co-existence of dynamic and operational capabilities are required in hybrid offerings (Kowalkowski *et al.*, 2015). This helps a firm to maintain its existing products, while simultaneously offering services.

Applying dynamic capability theory (Teece *et al.*, 1997), scholars also assert that innovation-related dynamic capabilities are required for digital servitization and environmental contingencies pushes the firms towards digital servitization (Coreynen *et al.*, 2020; Liu *et al.*, 2021). It is also argued that service-centric dynamic capabilities can be developed through networks (e.g., Reim *et al.*, 2019). However, effectiveness of capabilities for hybrid offerings may be contingent upon degree of servitization (e.g., Khanra *et al.*, 2021). A recent study finds that servitization changes technology-focus to customer-focus capabilities' development, positioning from upstream to downstream manufacturing, and focus on service efficiency (e.g., Huikkola *et al.*, 2020). There has been limited studies that examines the role of servitization in an international marketing context, and the trend of dynamic capabilities research has recently been touted in this regard (Keskin *et al.*, 2021). For example, a study on mergers and acquisitions and servitization of manufacturing firms (from emerging markets to advanced markets) finds that absorptive capacity is required for service development (e.g., Xing *et al.*, 2017). Firms operating in international markets are required to pay attention to their offerings as it affects their international business. Hence, international market strategies of manufacturing firms are deployed by hybrid offering, requiring product-service customization (Ulaga and Reinartz, 2011), which may be even more challenging in the context of technology-based manufacturing firms. In this regard, agility – a meta dynamic capability of sensing and responding in international markets may be required (Li *et al.*, 2018). Despite the importance of dynamic capabilities in international marketing literature (Khan, 2020, Khan and Khan, 2021), scholarly work on key dynamic capabilities for technology manufacturing firms' hybrid offerings in both emerging and advanced international market is lacking. Emerging market dynamics differ from advanced markets (Falahat *et al.*, 2018, Xing *et al.*, 2017), hence it is plausible that different capabilities may be required for effective hybrid offerings across the markets.

2.3 Network configuration in hybrid offerings

While manufacturing firms can effectively employ emergent technologies, human resources, suppliers, and customer relationship management processes for hybrid offerings (e.g., Baines 2014), the entailed challenge is underlied by rejuvenating the focus on value-creation and value-delivery processes (Rabetino *et al.*, 2017). Firms that offer hybrid offerings are not only restrained to selling but also delivery. This compels firms to imitate service delivery practices without discounting the

financial objectives (e.g., Cusumano *et al.*, 2015). Hence, it is critical to understand customers' perceptions and needs, usage, delivery of offering (e.g., Smith *et al.*, 2014). Servitization practices require the manufacturing firms to rely on their networks to offer services (e.g., Story *et al.*, 2017). First, firms must switch from a transactional to a relational view in co-creating value for customers. Second, they must be customer-driven and agile in-service creation and delivery (e.g., Tuli *et al.*, 2007, Sjödin *et al.*, 2016).

The importance of network configuration is well-established for product development (Lasagni 2012). Limited research has been conducted in the context of hybrid offerings. For example, scholars have examined the effects of network effectiveness of a subsidiary or subsidiary-headquarter relationship (e.g., Andersson *et al.*, 2002) and local network embeddedness in buyer-supplier relationship (e.g., Liu *et al.*, 2019). According to configuration theory (Meyer *et al.*, 1993), advanced service offering is a complex multi-dimensional phenomenon that tends to cluster into archetypes or patterns of causal conditions (e.g., capabilities). The theory postulates that the same causal factors can cause different results depending upon their arrangements. The theory allows for a combination of different attributes leading to successful or unsuccessful outcomes (Ragin, 2009). Multiple combinations (of, e.g., capabilities) are relevant for hybrid offerings, as there can be numerous ways through which servitization can be implemented successfully (Lexutt, 2020). Hybrid offerings involve re-configuration of resources, capabilities and organizational routines (Kowalkowski *et al.*, 2017). Under this view, it is argued that different capabilities can be configured for successful servitization (e.g., Sjödin *et al.*, 2016).

Applying the dual perspective of configuration and dynamic capabilities theories, we explore critical factors in hybrid offerings in the context of international markets. This is also because in servitization literature, it is argued that co-creation of value within networks involves combining and creating unique capabilities for hybrid offerings (Gebauer *et al.*, 2013). The multiple case studies in the context of servitization finds that it is critical for manufacturers to develop compatible capabilities with network agents (Story *et al.*, 2017). Accordingly, we also apply dynamic capability theory (Teece *et al.*, 1997) in combination with configuration theory (Meyer *et al.*, 1993) to explore the successful ways through which hybrid offerings can be offered. This is important given that prior scholarly work has shown that different approaches cast a different impact on outcomes of servitization. For example, hybrid offerings improve product performance (Raddats *et al.*, 2015). One contrary notion to this, service-oriented strategies, i.e, service-supporting products and clients have no direct impact on performance, however product strategy configured with corporate culture and

structure and client strategy configured with corporate culture and human resources positively influence performance (Yan *et al.*, 2019).

Hybrid offering development extends beyond the initial stage whereby multinational corporations rely upon organization structure to support servitization (Bustinza *et al.*, 2017) to network configuration, whereby a business eco-system is dependent upon value-creation through network production systems (Kohtamäki *et al.*, 2019). While these processes are contingent upon international networks, whereby network players focus on identifying the best market positioning (e.g., Parida *et al.*, 2019), however, these also bring challenges pertinent to internationalizing business hybrid offerings, including choice of partners and market positioning. For example, in selecting partners, knowledge-based service is critical for developing global and local business eco-systems (e.g., Lafuente *et al.*, 2017, Liu *et al.*, 2019).

International marketing and business literature has widely examined the international expansion of manufacturing firms (Hitt *et al.*, 1997) but to a lesser extent, their hybrid offerings (Kowalkowski *et al.*, 2015) despite services underlie different internationalization strategies than products (e.g., Li *et al.*, 2019). A firm with hybrid offerings may not be able to maintain consistent service and customization capabilities across foreign markets (e.g., Bustinza *et al.*, 2017, Liu, 2017) and the required capabilities and outcomes may differ for developed and emerging markets (Bustinza *et al.*, 2020). Other challenges relate to product development in international markets (Dubiel *et al.*, 2018) and product adaptation (e.g., Ulaga and Reinartz 2011, Porter and Heppelmann 2014). Such challenges call for research attention to understand network capabilities and configurations in international markets. Overall, very limited studies conducted on servitization of international firms e.g., (Knight and Liesch, 2016, Rammal *et al.*, 2022). Hence, our study fills this important gap in the international business literature.

3. CONTEXT AND RESEARCH METHODOLOGY

Context remains a critical issue within business and management studies (Meyer & Peng, 2016). Indeed, as Liu and Vrontis (2017) argue, it is essential that scholars, business managers and public policymakers take into account the underlying importance of the ‘context’ of sociocultural, economic, political and institutional differences. We focus on Finland as empirical context as 53% of manufacturing firms have been servitized in some way here, i.e., hybrid offerings are a visible part of their business (Rajala *et al.*, 2019). Against this background, medical technology is one of the pioneering industries that have moved from tangible goods towards combinations of products and

services and hence, the medical high-tech industry provides us with a good perspective from which to examine hybrid offerings.

For our empirical analysis, we selected three Finnish high-tech firms that belong to the medical technology industry and operate both at developed and emerging markets. Two of the firms, Bittium and Optomed, are listed in the Nasdaq OMX Helsinki. These three case firms effectively represent Finnish high-tech medical industry and we thus, can assume that the data from the respective key informants provide us with rich evidence (Yin, 1994). In selecting our case firms, we used the convenience sampling method. In general, the non-probability sampling method is relatively often used in research (Etikan *et al.*, 2016), and most management studies use convenience samples (Cuervo-Cazurra *et al.*, 2016). First, we chose our case firms so that they develop, manufacture, and sell their own medical solutions. In fact, even though there is a relatively large cluster of medical technology field firms in Finland, many of the Finnish medical high-tech firms are doing subcontracting to their foreign principals. Second, we wanted our case firms to differ in terms of their share of services, or in other words, in a different stage of progress of providing their services. All of our case firms' growth, from product-oriented to networked firms offering both products and services has taken different paths and these firms have been following quite diverse strategies. In selecting cases that reflect very different types (Eisenhardt, 1989), we are able to study and compare our case firms' changes to their organizational network configurations. Third, we focused on such medical technology field firms in which we had a good insight into these firms' business, and we had existing contacts with these firms' top management. In qualitative research, it is imperative to conduct in-depth and rigorous enquiry to get an understanding of the meanings in a broad sense (Acharya, Singh, Pereira & Singh, 2018). This said, we argue that our personal relationships with case firms' top management over a long period of time come with mutual trust, which in turn, promotes openness in discussions and encourages the interviewees to provide rich data.

To gain in-depth insight on the relationship between products and services in these three case firms, we applied an exploratory qualitative case study approach (Patton, 2002; Yin, 2009). Our Finnish high-technology medical context differs from earlier studies and for this reason, justifies an exploratory study to elaborate existing theoretical knowledge (Ketokivi & Choi, 2014). In using a qualitative research method, we are able to get a more holistic understanding of the role of ecosystems in hybrid offerings, and in doing so, gain a more general theoretical insight. To get an in-depth understanding (Bengtsson, 2016), we collected our primary data by using semi-structured, face-to-face interviews. As we show in Table 1, we conducted elite interviews with the case firms' top management; two of them were CEOs, one a CTO, one a VP, and one an SVP. The CEO of Optomed

is the founder the firm, the VP of Optomed is the founder of the acquired firm, Commit, which is currently responsible of Optomed's software design. When conducting the interviews, we used an interview guide, but we let the informants speak freely, and as a result, our winding discussions provided us with rich information on the issues that we did not cover in our thematic guide. All interviews were conducted in the Finnish language, we recorded and subsequently transcribed the interviews, and then translated them into the English language. Moreover, we used secondary sources as firms' annual reports, web pages, and newspaper articles to support and triangulate the primary data. Resulted triangulated data provided us with a trustworthy and holistic insight on the product-service relationship (Creswell & Miller, 2000; Eisenhardt, 1989). Table 1 summarizes the key aspects of our case firms.

Insert Table 1 here

3.1 Case firms' overview

Our first case firm, the Merivaara Group, is a Finnish firm focusing on intuitive healthcare technology and industrial design, with operating room solutions being the firm's key focus area. Merivaara was established in 1901. The owner founder died in 1938 and Finnish healthcare giant Instrumentarium acquired the firm. In 2003, General Electric acquired Instrumentarium, and at the same time, the Merivaara division was sold to its operating management. Two years ago, Merivaara sold its hospital bed business, which was quite traditional, low cost, iron tube-based products. Now the focus is entirely on the surgical room technology. Merivaara currently has three main product categories, operation tables, surgical lights, and operating room control systems.

The second case firm, Bittium, is an Oulu-based high technology firm providing products and services for the defense industry and medical technologies. The firm's medical technology business was initiated in 2016 when Bittium acquired Mega Elektroniikka, a domestic high technology firm focusing on bio signal measurement since 1983. Bittium's medical technology turnover is 18 million euros, the firm designs and manufactures products and services for remote cardiac monitoring. The solution consists of physical products and software for data transfer and analysis – algorithms and artificial intelligence.

Our third case firm, Optomed, is a Finnish, Oulu-based medical technology firm which designs, manufactures, and sells retinal imaging devices, both desktop and handheld fundus cameras. The firm was established in 2004 and has grown from a four-person R&D start-up to a global firm. In 2018, firm was recognized as one of the 1000 fastest-growing companies in Europe by the Financial Times. Optomed employs 115 persons, half of them work for the camera division and the

other half for the software solutions business. Today, Optomed Software is responsible for providing all the software and related services for the cameras.

In the data analysis, we use a qualitative content analysis method, in particular, the latent analysis method to interpret underlying meanings (Bengtsson, 2016). Our analysis followed three quite overlapping phases, immersion, reduction, and interpretation (Forman & Damschroder, 2007). To ensure reliability, at least two researchers were involved throughout all phases (Duriau, Reger & Pfarrer, 2007).

In the first phase, we listened through and transcribed our interviews in order to engage with the data and make sense of the whole. During the next phase, we reduced the data to the extent that we were able to identify emerging themes. Following the content analysis principles, we identified the most relevant key words and phrases in our data, and we re-organized our textual data under different thematic categories (Gaur & Kumar, 2018). In doing this, we were able to allocate data into such categories that we were able to address the main topics of our research. The final phase, iterations between themes, transcriptions, and our secondary data resulted in the final topics that we present in the Findings section. In Table 2, for the sake of credibility and trustworthiness, we present lots of versatile, occasionally quite lengthy quotations, and in doing so, we expose how we have proceeded from our data to conclusions (Creswell, 1994; Gibbert, Ruigrok & Wicki, 2008; Yin, 1994). We picked the most relevant key phrases and organized them according to emerging themes. This phase yielded seven thematic categories that are related to the need to add hybrid offerings, coordination between the R&D and the marketing function when developing hybrid offerings, the role of external actors, different markets, and emerging technologies. As we show in the Table 2, these categories fall under three main classes of dynamic capabilities.

Insert Figure 1 here

4. Findings

In this section, we outline the core findings which emerged from detailed analysis of the data generated during the research project. For ease of reading, we have structured these findings into subsections related to thematic categories. The first subsection, *Shift from hardware and software components to hybrid offerings* combines the two first categories that explain how customers' needs have impacted case firms development activities. The rest of the sections, *R&D – marketing cooperation*, *The role of networks, ecosystems, acquisitions and alliances for hybrid offerings*, *Global markets for hybrid offerings*, and *Future skills and capabilities for hybrid offerings*, follow the thematic categories in Table 2.

Insert table 2 here

4.1 The shift from hardware and software components to hybrid offerings

The findings indicate that all case firms have added hybrid offerings to their customers' product offerings by closely working with each customer and identifying their needs. Thus, proactive sensing and customer engagement capabilities are critical networking capabilities for hybrid offerings. Both Bittium and Optomed have relatively extensive experience in selling software services as an elementary part of their product offering. Both firms realized that in order to scale up their business, traditional device-based products needed a complementing software solution. As time passed, the software solutions have provided possibilities to include automatization, analysis, and artificial intelligence solutions. Moreover, Merivaara has recognized similar possibilities in its business and is slowly moving towards initiating software-based solutions in this offering. Merivaara has shifted its offering from hardware to a combination of hardware, software and related services. Merivaara's audio and video management systems enable video routing between sources and displays, inside or outside the operating room.

The role of software components has become more important in Optomed's fundus cameras. Optomed fundus cameras did not have relevant software services attached. Yet, remote services were included as patients could not always visit an eye doctor as, there are too few eye doctors to screen all diabetics. Today, the firm's fifth-generation fundus solution comes with a seamless link to the artificial intelligence servers and related algorithms. Similarly, Bittium designs and manufactures cardiac monitoring products including a small device, which is attached with a sticky tape to a person's chest. The patient's EKG is being monitored in real-time and if any anomaly is being found, then doctors can intervene. In doing this, Bittium's services make the data analysis easy for the doctors.

The findings suggest that our case firms were integrating product/service bundles with the increasing use and configuration of emerging technologies in order to create more value for their customers. However, this embedded software does not, per se, comprise a separate software service. Both Bittium and Optomed have been shifting their cardiac monitoring and fundus imaging solutions from a hardware-based product towards wireless, artificial intelligence-based holistic services. The role of the software service component has clearly become crucial for both firms' success. Our case firms all highlighted how software-based services are beginning to play a bigger role in their offering. Merivaara emphasized the importance of remote data handling, and similarly, in 2016, Bittium

acquired a Finnish firm which designs cardiac monitoring hardware. The reasons for introducing the SAAS solution was to gain repetitive, long-term income instead of selling single licenses.

4.2 R&D – marketing cooperation

All case firms emphasize the importance of cross-functional cooperation between the R&D and marketing functions. At Merivaara, the marketing function has a key role in providing R&D with input for new product features and new products. The firm has a clear process, in which the marketing function is responsible for sensing customers' needs and the the product manager is responsible for the product specifications and ultimate product development. In a similar vein, the role of product manager at Bittium is to understand the current and future customer needs, and based on this, deliver requirements for new product features and priorities to the firm's R&D. At Bittium, the relationship between R&D, marketing and business functions varies depending on the maturity of the offerings. R&D and marketing cooperate closely at the times when the firm is launching new products, but less so when offerings have reached more mature phases. At Optomed, marketing and R&D functions cooperate closely, yet the input for new offerings may come either from the R&D or the marketing. In such cases in which product innovations come from the R&D, the role of marketing is to ensure that new products and product features fit the customers' needs well. In some other cases, customers may reveal some unexpected needs that were not realized earlier. Regardless, product and service offerings are decided together with the firm's hardware segment, firm marketing, and management.

All three firms highlight the role of product management in designing new products, new product features, and services. Furthermore, both marketing and product development functions are screening and identifying possible future customer needs. Yet, in these firms' medical device business, it appears that R&D is cooperating closer with the end users and this close cooperation is quite important in recognizing their needs that can be further commercialized as new products and services.

4.3 Role of networks, ecosystems, acquisitions and alliances for hybrid offerings

All our case firms indicate loose partnerships with other firms and universities. Merivaara is a partner in an Inoroom alliance with two Finnish firms, Halton and Hermetel. Halton is one of the leaders in indoor air solutions for healthcare institutions and laboratories, Hermetel focuses on clean room and cooling technology. Hence, the Inoroom alliance is capable of providing holistic solutions for hospitals. Both Merivaara and Bittium cooperate with Finnish universities, especially with university hospitals, yet, all firms tend to have rather loose forms of or non-existent cooperation with their competitors.

Our interviewees suggested that they were increasingly utilizing networks and alliances for hybrid offerings. Merivaara has been buying its software and electronic design resources from third parties. As of today, the firm is moving towards setting up its own software design department. Bittium stresses the importance of component providers; a large share of Bittium's product manufacturing is done by their partners. In doing this, case firms are integrating entire chains/suites of services along with their products' offering. Given that valuable knowledge resources are spread across the networks, thus alliances and networks provide important mechanisms to develop capabilities in the service solution areas.

Two of our case firms made acquisitions to augment their exiting offerings. In 2016, Bittium acquired a Finnish firm, Mega Elekroniikka, which produces cardiac monitoring hardware. With this acquisition, Bittium's software-as-a-service (SAAS) solution for analyzing the cardiac activity was initiated. One year later, in 2017, Bittium established a joint venture, Coronaria Analyysipalvelut, which provides the remote analysis and diagnostic services for public healthcare in Finland and Sweden. Our interview with the SVP at Bittium indicated that, in some cases, the customers were relying on their own service ecosystems to use the firm's products. Similarly, other firms were also aggressively acquiring firms in order to provide hybrid offerings. This suggests that acquisitions and network partners offer important ways to create value and develop hybrid offerings. For example, in 2018, Optomed acquired a Finnish firm, Commit. Formerly known as Commit and currently known as Optomed Software, the company was founded in 1989 and has long traditions in developing workflow, resource, and quality management software solutions for radiological or surgical departments in the healthcare environment.

Whereas Bittium acquired a high technology cardiac monitoring firm, Optomed acquired a firm developing state-of-the-art software solutions. These acquisitions guaranteed that the two case firms have been able to ensure that their offerings consist of both hardware products and software services. The findings also indicate that some firms were exploiting emerging technologies in order to embed services with their products offerings. Our interviews with the top management of Merivaara indicated that the firm is in the middle of including intelligence in its product offerings, i.e., starting to utilize possibilities provided by software and artificial intelligence. So far, Merivaara has been subcontracting their software solutions from big software firms. Acquisition of these firms is hardly feasible, thus, Merivaara's future path seems to differ from Bittium and Optomed, as instead of depending on external partners, the firm is integrating and configuring emerging technologies for hybrid offerings.

4.4 Global markets for hybrid offerings

The findings indicate that hybrid offerings have a global appeal and all the case firms are targeting global markets through hybrid offerings. All three case firms sell their products in global markets, mainly in Europe and the USA. Yet, the firms have different focuses for target markets. Merivaara's customers are mainly hospitals building new operating room sections. On some occasions, hospitals may let the construction company do the purchasing, especially with regard to such furnishing that is permanently mounted onto the building. Despite Merivaara having had a strong foothold in Russian markets, the firm considers Nordic countries and the UK as their home markets. In global markets, Merivaara has approximately 80 distributors. The main markets for Bittium's cardiac monitoring solution are in the USA and Europe, to some extent also in Asia. Over the years, business in the USA has evolved from small service providers to a few large providers. For Bittium, whereas the USA has one customer which provides the firm with a remarkable turnover, in Europe, the firm has to sell some tens of units to thousands of customers. Thus, the market dynamism plays an important role. Hospitals do not need that many services, whereas treatment units need more supporting services. Optomed sells their products in more than 60 countries. Optomed cameras are sold through four global OEM customers and approximately 60 distributors in different countries, the largest being China and the USA. However, Optomed sells almost all of its software solutions directly.

Apparently, medical technology markets in Europe are more fragmented; whereas in the USA, markets are converging, fewer large operators are replacing numerous smaller distributors. Bittium is confident that European markets will be following a similar trend, and in doing this, they are willing to ensure that emerging service providers are using their technologies. In this respect, Bittium is investing in new, small service providers in Finland and in some European countries.

The findings also indicate that developing and emerging markets are becoming important target markets for hybrid offerings. All of the case firms are selling their products and solutions in Asian and African countries. For Merivaara, sales outside Europe are more arbitrary, and they occasionally do specific projects in African countries. Bittium is also selling its cardiac monitoring solutions in less developed parts of Asia and Africa; these markets are not presently highly significant but may prove to be especially prosperous in the future. In Africa, the firm delivers devices, yet fewer services. As African countries typically have fewer financial resources, these countries may benefit from the latest modern technology. For Optomed, the role of emerging markets is increasing. As doctors cannot always be reached, sales volumes of artificial intelligence-based solutions are rising to very high levels.

In summary, at present, the case study firms do not consider African and Asian markets to be core markets, but believe that their role will increase over time. Firms mention that in order to operate in unfamiliar market conditions, they are required to develop capabilities in order to identify market potential and ensure agility. Firms highlighted the importance of flexible and responsive capabilities, especially in the context of both advanced and emerging markets. Increasing sales of medical technology solutions is related to the subsequent services; in developing countries, the leap from traditional to wireless data transfer and the use of artificial intelligence are opening up possibilities for firms to scale up their businesses.

4.5 Future skills and capabilities for hybrid offerings

The three case firms are facing different needs in terms of future skills and capabilities. Merivaara will be focusing on usability and software design, the future role of software is becoming more prominent. The firm's customers have been asking about 5G and virtual reality possibilities, however, customers have not been able to express their specific needs pertaining to them. Bittium has its strength in data transfer and wireless technologies, the acquired firm Mega Elektroniikka had its core competencies in cardiological measurement. Technological development - as such - does not have any specific impact on Bittium's capabilities. However, artificial intelligence and machine learning, the fields in which Bittium is increasingly investing, do have an impact, even though the available resources are scarce. From a business perspective, international distribution and new partners will play a key role in scaling up the firm's business. Also Optomed's future needs and skills relate to artificial intelligence and especially its potential in healthcare, diagnostics, and data analysis. In addition, further understanding of clinical validation is becoming more important for the firm.

From above, it is obvious that the role of intelligent software-based services is increasing in the medical device field. Particularly, artificial intelligence and all such related services that make the diagnosis simpler, easier, and more trustworthy will become the elementary components of these firms' competitive advantage and agility in the international market.

Below, Figure 2 summarizes the key findings of the study. In response to both study questions of our study, we found that all three case firms have been able to identify customers' latent needs and for this reason, they are aiming to increase the role of services as a complementary part of their offerings. Bittium, which has been strong in designing software, acquired a hardware company and allied with a service provider. Optomed, initially a hardware developer, acquired a software company. With these acquisitions and alliances, both Bittium and Optomed transferred successfully and rapidly their businesses to hybrid offerings. The third case firm, Merivaara, has not engaged in acquisitions

but rather has been forced to rely on organic growth, and thus, has been remarkably slower in its progress in adding the missing parts of the hybrid offerings. All firms show strong sensing, customer engagement, coordination, and adaptation capabilities. However, the different outcomes among the three case firms highlight the key role of dynamic reconfiguration capabilities, managerial ability to shift from relying on third parties towards internalising the value-creating operations.

Insert Figure 2 here

Figure 2. The relationship between configuration capabilities and hybrid offerings

5. IMPLICATIONS

5.1 Theoretical implications

Our study findings offer several theoretical implications. The findings regarding products and service offerings suggest the importance of external dynamic capabilities such as sensing and customer engagement capabilities. Both marketing and product development functions should screen and identify both current and futuristic customers' needs. R&D should work closely with end users and be agile in recognising their needs that can be further commercialized as new products and services. Hence, the findings also imply that internal coordination and adaptation capabilities are no less critical. While previous studies have considered the role of dynamic capabilities in the context of servitization (such as exploration and exploitation) (Coreynen *et al.*, 2020), our findings extend the theoretical knowledge about critical networking-related internal and external dynamic capabilities required for hybrid offerings in the international market context. Moreover, extant literature regarding dynamic capabilities has hitherto focused primarily on the dynamism of the market (Teece *et al.*, 1997). Most international marketing studies have used external market-related factors to argue the importance of such capabilities for market performance (e.g., Khan, 2020). While others have argued that such capabilities are also influential in stable market conditions (Wilden & Gudergan, 2015), our findings imply that dynamic capabilities are clearly influential in those emerging and advanced international markets where firms are often less familiar with market dynamisms. Thus, these findings add to existing literature in the context of hybrid international offerings that dynamic capabilities are important in both types of markets (emerging and advanced), however, importantly, they are more influential when the market conditions are unknown.

Networking literature argues that absorption of acquired knowledge among different functional units can determine capability upgrading (e.g., Luo, 2000). Consistent with these findings

in existing literature, our findings imply that the configuration of capabilities within functional units and coordination of marketing and R&D activities can be effective for creating hybrid offerings in international markets. Our findings specifically imply the importance of initiation and adaptation of service-related solutions that must be embedded to be able to provide an innovative hybrid offering. This again aligns with extant scholarly work which suggests the development of a network organization that is fluid and flexible for international expansion (Luo, 2000). Our findings however further extend the knowledge by implying the importance of the configuration of value chains for connectedness with customers and value creation in international markets. Furthermore, the findings underline the wider importance of ecosystems and knowledge centers to be created in order to configure and disseminate knowledge across functional units and be able to create value offerings. One way to do this can be through adoption of emerging technologies and artificial intelligence as they may help firms develop futuristic capabilities to remain agile and competitive. Hence, these findings also extend the application of configuration theory in the context of hybrid offerings in international markets. We identify the configuration of key units that require coordination as well as identify key dynamic capabilities that are influential in creating hybrid offerings. To our knowledge, hitherto, there has been a paucity of scholarly work which has identified both internal and external dynamic capabilities and network configuration in the context of hybrid offerings. The importance of network configuration is well-established for product development (Lasagni, 2012), yet, to date, there only limited research has been conducted on the specific context of hybrid offerings. Hence, we extend the theoretical knowledge in this regard.

Finally, consistent with the configuration theory, our findings imply that capabilities needs to be configured as per the dynamics of the markets. Our findings extend the prior work in servitization literature by simultaneously applying configuration and dynamic capability theories to present side-by-side findings for both emerging as well as advanced market context. While servitization literature has been widely studied in the context of different sectors, the international business literature contributing to the servitization offering is limited (Rammal *et al.*, 2022), despite the evolving technology dynamics across international markets. Hence, our paper strengthens theoretical understanding of these aspects as well.

5.2 Practical implications

Along with theoretical implications, our findings also offer takeaways for the managerial and policy audience. For managers, our findings explicitly point to the need for the firms engaged in hybrid offerings to invest scarce resources to link R&D functions more closely with their end users. It is also critical for the managers of firms operating in the high-tech sector (like medical technology)

to ensure that their firms' capabilities need to be configured as per the dynamics of the target market. Hence, they cannot have a standardized formula for hybrid market offerings even though in some cases, the target markets may appear similar due to their location in either developed or emerging markets' particular context.

Also, our findings suggest that even though hybrid offerings have a global appeal, the target market selection depends upon the convergence and fragmentation of markets from the perspective of a specific firm. Hence, for firms operating in the medical technology sector, both developed and emerging markets are valuable for policy-makers, our findings demonstrate the need and rationale for investment of public funds into aiding the development of specific business ecosystems. Such investments of public funds can clearly lead to the development of concentrations of knowledge centers, which are critical for the success of hybrid offerings. Whilst investment in the short-term may seem large, the potential returns on investment in terms of developing a concentration of businesses employing highly-skilled employees are indeed large.

6. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

While our study offers valuable practical and theoretical contributions, there are also some limitations that can be addressed in future studies. This study's empirical research was undertaken only in a single geographical location, namely Finland, and as a result of the constraints of time, geography and resources, only several interviews were undertaken. Future studies could incorporate a similar study in different geographical locations. Furthermore, from a methodological perspective, the project could be widened to involve the integration of a mixed method approach (quantitative and qualitative), which could provide deeper insights and add empirical perspective to the findings. Moreover, from a contextual perspective, future studies could look into hybrid offerings for other strategic sectors. Whilst the empirical focus of this research study was three manufacturing firms, it would be interesting to explore how firms, operating in different sectors, for example, in services, engage with the opportunities for hybrid offerings. Indeed, the accessibility and connectivity which digitalization and technological advances have brought to the business world may mean that the findings in this paper may be generalizable into other sectors, which are worthy of further academic scrutiny. Moreover, it may also be useful to explore how hybrid offerings have prospered (or not) within different business ecosystems, investigating to what extent public funding can act as a strong driver for hybrid offering successes, as much as traditional market forces.

Theoretically, future studies applying dynamic capabilities could look into meta-capabilities such as marketing agility in enhancing the networking configuration for hybrid offerings. Studies

applying configuration theory could look into external contingency factors (e.g., market turbulence) and internal factors (e.g., resources and marketing skills) in international markets. Moreover, future academic research could also consider examining the ambidexterity of strategies and capabilities in this regard (Khan *et al.*, 2020).

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	Merivaara Group	Bittium	Optomed
Interviewee	Jyrki Nieminen CTO	Hannu Huttunen CEO Arto Pietilä, SVP	Seppo Kopsala CEO Markku Myllylä, VP
Founded	1901	1985	2004
Turnover	17 million €	78 million €	13 million €
Number of employees	68	684	115
		Nasdaq OMX Helsinki	Nasdaq OMX Helsinki

Table 1. Case firms and interviewees.

Topics	Thematic categories	Most relevant phrases, emerging themes
Sensing and customer engaging capabilities	Initiation and adaptation of combining hardware and software as holistic solutions	<p>“[The acquired firm] had good products that they had developed and improved for a long time. We recognized an opportunity to bring in additional product development, knowledge-based, and financial resources.” (Bittium SVP)</p> <p>“This device can record complete EKG data, even two weeks’ time, it can transfer the data real-time, for example, using a mobile phone to a cloud. We provide seamless offerings that outcompete competitors’ solutions.” (Bittium SVP)</p> <p>“You record and save the full cardiac activity. That is, a huge amount of data, too much, and then we step in with our algorithm to automatize the analysis, to recognize possible anomalies.” (Bittium CEO)</p> <p>“Tables are running with batteries. Batteries last from three to five years; this is the most important data to receive remotely. In the R&D, this is the area in which we have already been investing for a long time. It is high-end, it is global.” (Merivaara CTO)</p> <p>“The fact is that customers provide us with an idea and then we find out that no software solution exists for that need. How this can be possible, we have always thought that there are software solutions for all purposes.” (Optomed VP)</p> <p>“This combination is intriguing. It is difficult to sell just software, it is difficult to sell just hardware. Some solutions sell better in some places, less in some others, for example, artificial intelligence sells, or it does not sell – or cameras sell but buyers do not want complementary software solutions. Yet, to come up with something radically new, one would need to invent a completely new diagnostic method.” (Optomed VP)</p> <p>“Introduction of software has meant also increasing share of direct sales.” (Optomed CEO)</p>
	Adding services to support products, initiation of hybrid solutions	<p>“In the beginning, we sold cameras just to eye doctors who needed portable cameras. Next, we sold them to smaller eye clinics who did not have high enough patient volumes to invest in desktop fundus models. The spark for software came from the need to screen eye diseases in public healthcare, where patients cannot always visit an eye doctor, there are too few eye doctors to screen all diabetics. As a matter of fact, the public healthcare can do patients’ yearly screening only by using holistic fundus solutions. [...] For the past five years’ time, besides imaging, we have introduced software solutions for imaging, and now also artificial intelligence solutions that diagnose diseases from the fundus images. Our artificial intelligence solution can automatically recognize diabetes, retinopathy, and hence, the doctor needs not to browse all the images.” (Optomed CEO)</p> <p>“In many cases, they do not have a holistic solution for diagnosing eye diseases, workflow control, in some case they even lack patient registers. At the simplest, in our solution, a clinic buys our camera and a license to use our software, which we provide as a software-as-a-service. For bigger clinics, we do the installation at on-site. In the USA, our devices need to be integrated into most common US medical record systems and imaging archives. Customers can decide among our services which they select into their use.” (Optomed CEO)</p> <p>“Our solution is coming closer to consumer electronics and cloud services. Traditional hospital imaging equipment are typically being used by professionals, they are big, they sit on desks, hence, there is no need for cloud services. In a way, we have taken the mobile phone approach, in our cameras we have features similar to those of mobile phones.” (Optomed VP)</p>

		<p>“If you only have the electrocardiogram, studying a length of this diagram is really difficult and unproductive. Our pay per use service with our own software is quite new, though. [...] The more patients are treated at home, the more cost-efficient the treatment is. Remote treatment requires data transfer. The idea was to combine our profound knowledge on data transfer and data transfer security with their skills in measuring the human body.” (Bittium CEO)</p> <p>“If the customer is a hospital, they do not need that many services. Then again, if the customer is not a treatment unit, they potentially need more supporting services.” (Bittium CEO)</p>
Internal and external coordination and adaptation capabilities	R&D – marketing cooperation	<p>“In this regard [marketing], we have typically been quite self-sufficient, yet we have been taking new steps especially in branding and digital marketing. We have utilized this covid pandemic conditions in our promotion by having webinars and giving product demonstrations.” (Merivaara CTO)</p> <p>“The most important task of the product manager is to understand the current and future customer needs, and furthermore, how the competitive situation will evolve. With this knowledge, we can design the new product features and priorities. When products reach more mature phases, cooperation between R&D and marketing shifts towards a closer cooperation between business and marketing. [...] Our generic marketing takes place at the corporation level, that is, media, web pages, press releases, videos, etc., in other words, traditional marketing. However, product marketing takes place in the business, product managers who understand the business, define the new products” (Bittium CEO)</p> <p>“We are listening to our customers and trying to understand our customers’ needs, combine new technologies to best fit their needs.” (Bittium SVP)</p> <p>“When we started to design our products, we were not able to ask customers as there were no products available. Now, after five product generations, customers’ feedback is valuable, which features they would like to see being improved or added. Thus, the role of marketing and customers has increased, yet the development is still largely based on our own internal view on the needs.” (Optomed CEO)</p> <p>“No one invents anything in isolation in a dressing room, it would be nice to come up with disruptive technologies. Traditionally it has been software as the root of disruptive innovations, not only in healthcare. Are cloud services disruptive, to me, it is just semantics if the data is in a datacenter or if the data is located in a cloud.” (Optomed VP)</p> <p>“We are in a middle of a project designing an imaging workflow system for a Finnish university hospital eye clinic. The fact is that all over the world, doctors go through patients’ medical records to screen their glaucoma history. Customers had to tell us that there is no system for doing this. The point is not in the workflow system in which you see all the records with one click, but the point is that all five university hospitals and other possible healthcare units in Finland are now automatically uploading their image data into our cloud service, and now, all of the colleagues in any country can browse the graphs, how many of these patients you have had, how much you have prescribed this price level medicine, what has been the outcome ... oh, you have been using such expensive medicine, yet the results have not been as good. Benchmarking. Without the customer, how on earth could we have invented such a service by ourselves?” (Optomed VP)</p>
	Networks & ecosystems	<p>“We communicate on a weekly basis with the largest suppliers, we update forecasts and pass them on to manufacturing.” (Bittium SVP)</p> <p>“A good share of our product manufacturing is assigned to our partners. All product development and product manufacturing are being done entirely in Finland.” (Bittium CEO)</p>

		<p>“We have a similar arrangement [distributors’ own service ecosystems to use the firm’s products] in Switzerland. The USA is our biggest market, in the USA our customers have their own service offerings, we only need to deliver them our devices for monitoring.” (Bittium SVP)</p> <p>“We are investing in some new, small service providers in Finland and in some European countries.” (Bittium CEO)</p> <p>“Some of the resources are our own, some of the resources we buy outside. For example, we subcontract our electronic design. For doing this, we have a clear four-step process: customer needs, specifications, verification of specifications, and validation of the customer needs.” (Merivaara CTO)</p> <p>“We have not written a single line of our own software code, so far. Yet, we recruited one software specialist last year, this is the next step.” (Merivaara CTO)</p> <p>“Hospital may let the construction company to do the purchasing, especially with regard to such furnishing that are permanently mounted into the building, in our case, surgical lights. Hence, they [construction companies] are an additional sales channel.” (Merivaara CTO)</p> <p>“Historically, we have a strong foothold at Russian markets. When I started at Merivaara, one of our biggest markets were veterinarians in Russia and Armenia. Today, we sell our lights to top university hospitals. For example, HUS [Helsinki University hospital district] has our lights in their new hybrid operating rooms. Nordic countries, UK and Russia, those are our main markets. We have approximately 80 distributors.” (Merivaara CTO)</p> <p>“Cameras are sold through distributors, we approximately have 60 distributors in different countries, the largest being China and the USA. In the USA, we are now also selling our products directly. There are many big customers who buy first few cameras, then some tens of cameras, and in the end hundreds of cameras. Then we have four global OEM customers, who distribute our cameras under their own brands. However, we sell almost all of our software directly.” (Optomed CEO)</p> <p>“In China single devices are sold to many places, hence you need distribution channels. In addition, sales processes are long in China.” (Optomed CEO)</p> <p>“Together [with the university], we have carried out number of projects. This spring, we have had two designers to provide us with some new concepts, one engineer is finalizing his thesis.” (Merivaara CTO)</p> <p>“University hospitals in important for us, in Finland in particular, also into some extent in other countries, too.” (Bittium CEO)</p>
Reconfiguration capabilities	Global & emerging markets	<p>“Occasionally, we also have projects in African countries, in many cases as a part of development aid projects.” (Merivaara CTO)</p> <p>“We have one representative selling our solutions in Africa. There is always someone with cardiac disease [...] in African countries, we use local distributors.” (Bittium CEO)</p> <p>“In other African countries than South Africa, we have sold more devices, less services. These countries tend have fewer financial resources...yet African countries may catch up by moving straight to the latest modern technologies.” (Bittium SVP)</p>

		<p>“For Artificial Intelligence, Africa’s and India’s importance are increasing, in these countries, artificial intelligence is an advantage as doctors cannot always be reached, there are not enough doctors. There, volumes, number of images are incredibly high.” (Optomed VP)</p> <p>“In China, integration has a different nature, user interface logic is different. In China, we also have a couple of large customers to who we sell to directly. Yet, Southeast Asia is a sharply growing market.” (Optomed CEO)</p>
	Emergence of new technologies such as artificial intelligence	<p>“We are currently working with digital learning, which might in the future yield some services. We are just taking baby steps in this field.” (Merivaara CTO)</p> <p>“Usability is a new field. We clearly need people with background in healthcare. Software is the current focus area, we traditionally have carried all the mechanical engineering design in-house, we still do it, however, its role is less significant, intelligent, high-tech, and software is becoming more important, this a clearly our future direction. Some customers have been asking about virtual reality, and so on, however, customers are not able to tell what the real need is. The same applies to 5G.” (Merivaara CTO)</p> <p>“Artificial intelligence and machine learning, in these field the available resources are scarce, especially here in the Oulu region.” (Bittium SVP)</p> <p>“[...] to increase the accuracy of the algorithms. From the business perspective, the building of international distribution, finding, identification, and signing of new partners, and to carry out such tasks in a professional way, has a key role in scaling up our business. This is a field of know-how with a shortage of supply. In this regard, expanding of business is more straightforward in close markets compared to distant ones, Japan can be mentioned as an example.” (Bittium CEO)</p> <p>“We need to understand artificial intelligence and its potential in the healthcare, diagnostics, and data analysis. Also, understanding of clinical validation and tests, so far, we have delivered cameras, and we have proven these cameras are good, we are more and more proving that our holistic solution is cost-efficient in the country in question, hence, the value of such business development is emphasized.” (Optomed CEO)</p> <p>“It is strange that software developers are always needed, software design is the shovel job of modern times. Artificial intelligence ... there are plenty of artificial intelligence designers, there is even too many artificial intelligence firms. From the healthcare point of view, software is not that specific, any handy young person who can design code can jump into the field.” (Optomed VP)</p>

Table 2. Data analysis from key phrase to categories and topics.

Figure 1: Data analysis process

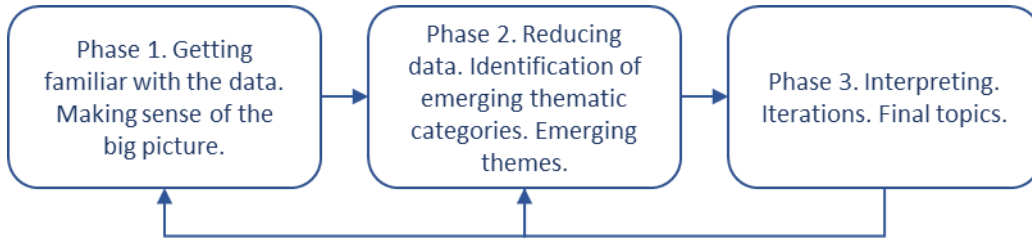


Figure 2: Relationship between configuration capabilities and hybrid offerings

