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Outsourcing Strategies of Established Firms and Sustainable Competitiveness: Medical Device Firms

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Abstract: Successful outsourcing strategy is a key enabler of sustainable competitiveness of established firms engaged in technology-intensive business. This study proposes a research framework of a successful outsourcing process composed of resources, dynamic capabilities and created values, from a review of relevant literature and in-depth case study of four leading medical device firms. The research results specify four outsourcing types according to the characteristics of outsourced resources, and their alignment with resources owned by the outsourcer. Each type of outsourcing is positively affected by the outsourcer's dynamic capabilities, namely sensing, integrating capability, absorptive capability and technology transfer capability. In addition, the significance of the outsourcee's size according to each outsourcing type is also found. As a result of successful outsourcing experience, the outsourcer can reap the benefits of enhanced dynamic capabilities, i.e., market-oriented innovation, strategic flexibility, agility and increased efficiency, thereby creating a virtuous cycle of sustainable competitiveness in a volatile environment.

Keywords: outsourcing strategy; sustainable competitiveness; established firms; dynamic capabilities; medical device industry

1. Introduction

As modern firms are confronted with higher levels of complexity and uncertainty, it is significant for the firms to adjust their capabilities to cope with environmental change for sustainable competitive advantages [1]. In such unpredictable business environments, in order to enhance their competitiveness, many established firms continuously utilize external resources, as well as internal capabilities [2]. Outsourcing has been a typical strategy that takes advantage of the more advanced or lower-priced resources with greater efficiency, and thereby brings strategic advantages to the outsourcing firms [3–5]. Outsourcing strategies lead the firms to have a broad network of the best competencies linked by outsourcing contracts, from which necessary functions such as raw materials, components and systems can be outsourced. Through the networked organizations, the outsourcing firms can transform themselves into more flexible and agile organizational structures [6,7]. For these reasons, an increasing number of firms have adopted outsourcing strategies, seeking enhanced efficiency and competitiveness, and a topic of strategic outsourcing is increasingly widespread among modern organizations, thereby attracting great interest from organizational scholars, as well as firm management [3,6,8–10]. According to Transaction Cost Economics (TCE), the costs associated with economic exchange play a leading role in the outsourcing decision, and the transactions are made through the governance form requesting minimum costs [11,12]. From the perspective of TCE, corporate management decides outsourcing to minimize transaction costs, in the case that outsourcing can be more cost effective than in-house development [13,14]. As it is increasingly difficult for firms to keep the boundaries of their core competences stable for long, the purposes of outsourcing have evolved from cost efficiency, e.g.,

in offshore manufacturing, to more strategic issues, such as flexibility, innovation, and sustainability, by reducing risk in a volatile environment [7,12,15]. Some studies support that a resource and competence-based perspective should complement TCE to analyze outsourcing activities, because a firm's inherent capability and strategic orientation, as well as cost efficiency, affect outsourcing decisions; and thus TCE alone is insufficient to explain the dynamics of governance in the outsourcing process [12,16,17].

Resource-Based View (RBV), which is another popular approach to outsourcing phenomena, focuses on the idiosyncratic resource owned by each firm as an effective factor to motivate outsourcing. The resource-based perspective of outsourcing posits that a firm can extend its boundary by building bridges to outsourcing partners, enabling access to immediately available technologies, while TCE considers a firm's boundary to be where they relinquish control over resources [13,18]. Outsourcing is considered as a strategic opportunity that can complement resources that are difficult to develop internally, and thereby generates synergies beyond combined value [3,17,19,20]. As a dynamic issue of outsourcing governance that changes over time beyond a static and restricted realm gains more attention along with changes in market needs, successful outsourcing practice between the outsourcer and outsourcing partner, i.e., the outsourcee, demands the outsourcer's dynamic capabilities, such as the sensing of valuable external resources, absorption of foreign resources, and integration of acquired resources with internal capacities [12,21,22]. The Dynamic Capability View (DCV) that is evolved from the traditional RBV, complementing its static nature, emphasizes the dynamic process of linking external resources or stimuli with internal capacities, and therefore is an important explanation of how corporate resources or capabilities affect outsourcing decisions, and how outsourcing practices of technology-intensive firms lead to long-term success [5,17,21,23]. According to DCV, a successful outsourcing experience creates positive value for the organization with enhanced dynamic capabilities, e.g., increased flexibility, agility, efficiency and innovativeness, which in turn leads to sustainable competitiveness of the firm [5,12]. Nevertheless, few studies have focused on the established firm's dynamic capabilities in connection with successful outsourcing practice and sustainable competitiveness, and in addition, how a firm's inherent resource or capability affect outsourcing strategy according to the characteristics of resources and the firm size.

This study first suggests a research framework of successful outsourcing practice of established firms, comprised of resources, dynamic capabilities, and created values, which is based on a review of existing literature relevant to the topic of DCV and outsourcing. In sequence, a case study of the leading, established firms in the medical device business, which is technology-intensive and highly dependent on outsourcing, concretizes the proposed framework, by specifying outsourcing types characterized by a firm's retained resources and capabilities. In addition, the interrelationship between the outsourcing type and the outsourcee's size has been investigated. Although outsourcing is a strategically important field in the medical device industry that requires convergence with various ICT technologies, there is still a lack of relevant academic research. For an in-depth case study, content analysis for the relevant media articles from 2010 to 2018 has been conducted, in order to analyze detailed outsourcing events of four leading established firms in the industry: Medtronic (headquartered in Minnesota, United States), Johnson & Johnson (in New Jersey, United States), GE Healthcare (in Illinois, United States), and Royal Philips (in Netherlands). This study contributes to existing research in the field of outsourcing by providing a link between a firm's outsourcing strategy and its sustainable competitiveness from the view of the outsourcer's dynamic capabilities coping with the environmental change. A DCV-based research framework interprets the dynamic process of outsourcing resources and capabilities between the outsourcer and the outsourcee, and further investigates the role of successful outsourcing on the sustainable competitiveness of the established firms in technology-intensive industry. Moreover, the in-depth case study of multiple established firms nourishes our understanding of different outsourcing types in technology-intensive firms, which are classified by the characteristics of outsourced resource, and its alignment with resources owned by the outsourcer. The outsourcer's dynamic capabilities for

successful outsourcing, consequent benefits, and significance of the outsourcee's size according to each outsourcing type are also provided.

The remainder of this paper is organized as follows. Section 2 provides a theoretical background, while Section 3 describes the research method of this study. Section 4 develops the research framework from a review of relevant literature, while Section 5 analyzes the details of the case study, discussing the research results. Finally, Section 6 provides theoretical and managerial implications of the study and concludes with the suggested future work.

2. Theoretical Background

2.1. Traditional Approaches to Outsourcing

The term “outsourcing” comes from the American terminology “outside resourcing”, which means to get resources from the outside [24]. It is defined as an agreement in which a firm contracts-out a part of its internal process to another firm [25]. Outsourcing also refers to the reliance on external sources for manufacturing components and other value-adding activities [26]. It has been referred to as “disintegration of production”, “one subtype of distributed work”, or “vertical fragmentations” [27–29]. Traditionally, scholars considered outsourcing as “make or buy” decisions on intermediate goods to the use of temporary external services, or the process of entrusting non-core activities from internal manufacturing to an external firm specialized in particular operation [30,31]. Recently, the strategic importance of outsourcing, such as generating innovation or sustaining competitiveness, is gaining popularity [8,32].

Although the outsourcing concept has been proposed in various contexts, the theoretical foundation for explaining motivation of outsourcing and building a successful outsourcing relationship is mainly based on two streams, the economic perspective of TCE, and the capability sourcing perspective of RBV [33]. TCE, originally suggested by Williamson (1975) and built on the prior study of Coase (1937), has emerged as a predominant theory, explaining outsourcing activities via an interdisciplinary approach that combines economics with organizational theory and contract law [7,13,34]. The approach provides a definite guideline of when the firm will perform transaction in-house, and when it will turn to the external market [13,34,35]. TCE is concerned with uncertainty factors in deciding appropriate governance mechanisms that include competitive pricing and the necessity of specialized investments [36,37]. Cost reduction can be achieved through variable structural mechanisms, including the rearrangement of bureaucratic organization [12]. TCE posits that managerial choice between different governance structures, such as vertical integration or disintegration, i.e., contracting out, should be made to minimize the sum of transaction and production costs [5,13,14,34]. The basic premise of the perspective is that if the transaction costs of contracting out to the outsourcee outweigh the production cost advantages, firm managements should choose in-house production, rather than outsourcing [37,38].

Since a strategy focused on the cost reduction or efficiency is a part of complicated outsourcing phenomena, and therefore does not guarantee the long-term success or sustainable competitiveness of an organization; outsourcing is considered as a repetitive strategic decision on which business processes are to be developed by suppliers with superior resources or capabilities, aiming at the pursuit of sustainable competitive advantage [39,40]. Many technology-intensive firms acquire and integrate resources by means of strategic alliances with other firms, rather than by extending corporate boundaries [3,41]. In this respect, resource and capability-based theories can interpret outsourcing strategy and related organizational behaviors in a more proper way [19].

RBV, which considers a firm's valuable, rare, costly to imitate, and non-substitutable resources as a basis of its competitiveness, is another powerful theoretical approach to explain outsourcing relations [2,5]. Unlike traditional economic assumptions of TCE, RBV scholars propose that resources distributed across firms are heterogeneous and imperfectly mobile [2,34]. RBV argues that differences in a firm's resource endowment can result in differences in performance, assuming resource heterogeneity and immobility [2,42]. Penrose (2009) noted that a firm can be defined as a collection of productive resources, not merely an administrative unit [43]. As each firm has different resource assortments, it

searches for valuable and complementary resources to access those that it does not own [44]. RBV posits that through outsourcing activities, firms can maximize their value by building successful relationships with partners, exploring new markets, and gaining strategic market access, not merely minimizing costs [17,45]. This approach provides key issues in the outsourcing strategies, such as which types of resources can lead to high profits, which resources should be internally developed, and which resources should be acquired from external providers [46,47].

2.2. *Dynamic Capability View of Outsourcing*

Despite the importance of RBV in the field of outsourcing and strategic management research, the approach has been criticized for its static nature, especially in a volatile market, and its failure to clarify how resources are transferred and lead to sustainable competitive advantage [33,42,48,49]. It is necessary for firm managements to keep reconfiguring the boundaries of the core competencies to maximize value creation along with environmental change [7]. Hence, scholars have focused on dynamic capabilities as the forefront of a sustainable competitive advantage of a firm, along with the increase in the complexity and dynamism of the business environments. Whereas RBV focuses on the resource itself, DCV considers the processes of achieving new resource configurations in an integrated and coordinated way [50,51]. Dynamic capabilities transform operational-level capacities to enhanced value-creating routine and thus is critical to long-term survival of an organization [51,52]. Dynamic capabilities are conceptualized as a learned and stable pattern of collective activity, through which an organization systematically generates and reconfigures its operational-level routines to attain increased efficiency and flexibility [53]. A unique combination of resources through coordinated processes generates hard-to-imitate outcomes, which provide sustainable competitive advantage for the firm [50]. Thus, a firm's long-term success highly depends upon the firm's ability to develop dynamic capabilities [54–56].

In a technology-intensive industry, the development of dynamic capabilities is particularly crucial in outsourcing strategy, because it is related to knowledge management routines such as learning, sharing, integration, and reconfiguration between the outsourcer and the outsourcee, which in return results in sustainable value addition to the outsourcing process [12,23,57]. Combining current capacities with new resources or technologies acquired by interactions with other firms is a core activity in the innovation process [21]. From outsourcing, a firm can access a broader range of advanced and specialized technology available to the organization that can provide a more competitive resource base. Hence, dynamic capabilities allow the firm to increase the capacity to create, extend, or modify its resource base, thereby creating future value [17].

The dynamic capability construct in the outsourcing process is a significant factor affecting the successful outsourcing partnership, and as a result, explaining successful outsourcing performance [5]. The dynamic capabilities of the participants transform the network into a strategic net, and the potential complementarities of resources owned by the outsourcer and the outsourcee can turn into a higher outsourcing performance [58]. The created value from outsourcing practices can also be increased through a trust-based relationship and the willingness to learn from each other [12,59].

3. Research Method

Based on the arguments in the previous section, this study uses DCV as the underlying research framework that outlines the successful outsourcing process of established firms and its contribution to sustainability. Firstly, to construct the framework, we reviewed abstracts of literature that are collected by keyword or subject search (including “outsourcing” or “dynamic capabilities”) in the database of SCOPUS and the Web of Science, and in addition, by snowball sampling from the reference list of each document. Secondly, we selected 43 research documents from abstract review which study outsourcing phenomena of firms from the perspective of dynamic capabilities or knowledge-based capabilities. Key concepts of outsourcing activities from the perspective of dynamic capabilities are derived by investigating the selected documents, which constitute our research framework.

We validated and concretized the constructed research framework by multiple case analysis of medical device firms. A qualitative case study provides abundant insight into a long-term complicated phenomenon that is difficult to be clearly understood [60,61]. Therefore, an in-depth case study design is fitted to investigate outsourcing capabilities, strategies, and created values of multiple firms that have been interacting for many years. The cases are closely analyzed through content analysis for published media sources on the basis of the established research framework. Content analysis is a research methodology that can be used to make relevant and valid inferences from context [62]. Mass media, such as corporate websites, newspapers, and industrial magazines, were selected as major sources of this study, since they provide rich amounts of news and official interviews relevant to major outsourcing events and strategic activities of firms for the period of interest. Therefore, secondary sources over a specific period are suited for qualitative research [46,63]. Content analysis procedure starts from inducing the original intention from content and developing a quantitative interpretation [52]. After establishing the research outline, the analysis develops category schemes for research, and validates them. We abstracted key phrases from each of the collected texts and classified them into proper categories that are developed in the stage of conceptual study. The developed categories can be adjusted or created according to the case study results. We performed the process of qualitative coding for the articles via Weft QDA, a qualitative data analysis software package, as is briefly illustrated in Figure 1. Figure 2 outlines our research procedure, where the initial framework based on literature review and the case study results complement each other to build final research framework.

To investigate the case of firms that have been successful in value creation for years, we selected four established medical device firms, i.e., the outsourcers, that are ranked in the top 4 by annual sales in 2017 (Figure 3). Since these four firms also maintain the top four medical device firms during that period (Figure 4), we claim that these four established firms are truly good examples of sustainable medical device firms in the last 10 years. Outsourcing activities of the four selected firms provide us with useful evidence that lead to their sustainable performances. A total of 45 outsourcing partners that performed outsourcing business with these top four medical device firms, including three duplicated firms, were investigated throughout the case analysis. We collected useful content published in the period (2010–2018) from diverse media sources including medical, economic, IT magazines and websites of the firms. To maintain objectivity, we reviewed each outsourcing event from multiple sources that are accessible online.

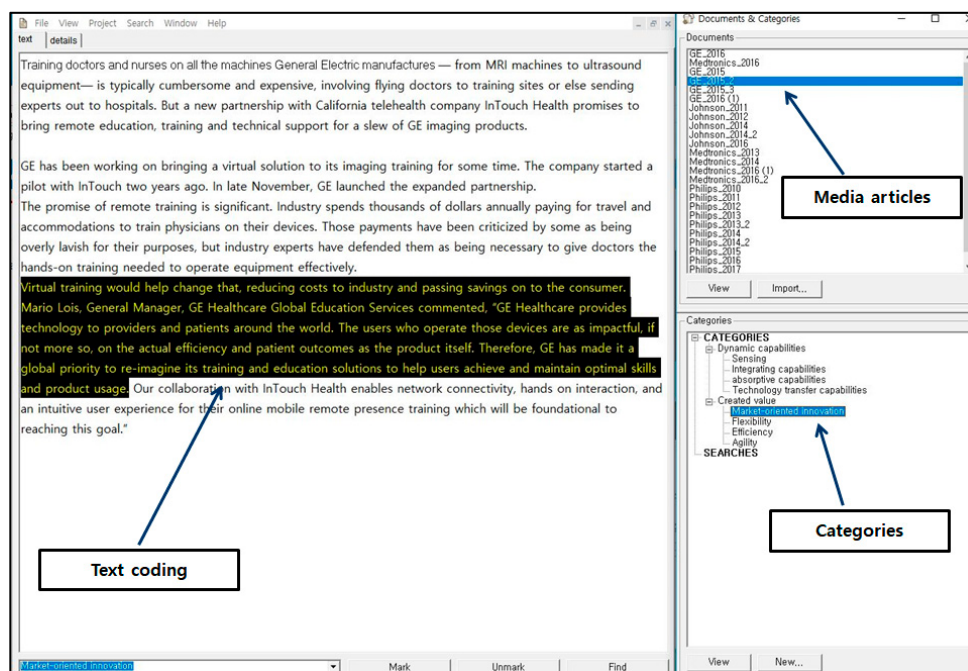


Figure 1. Qualitative coding procedure in content analysis (using Weft QDA).

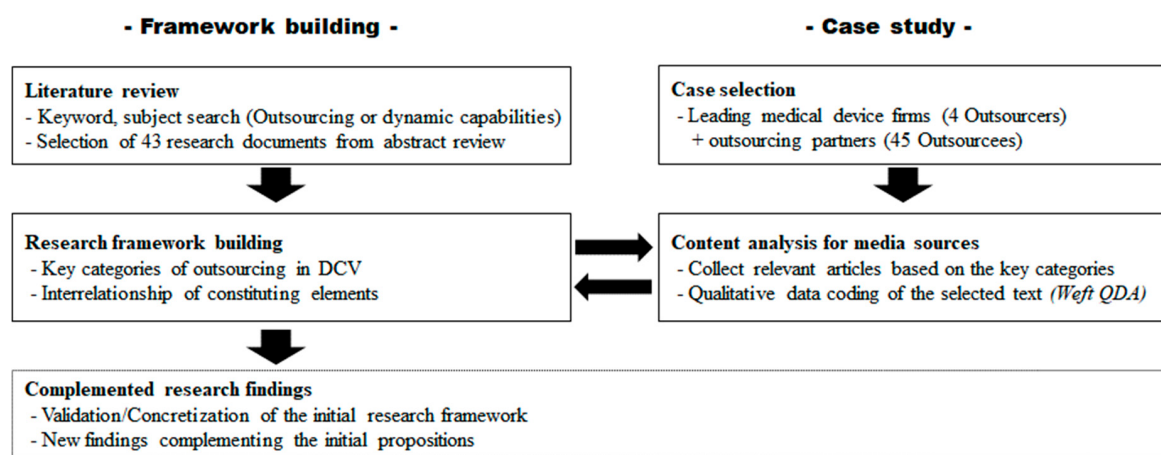
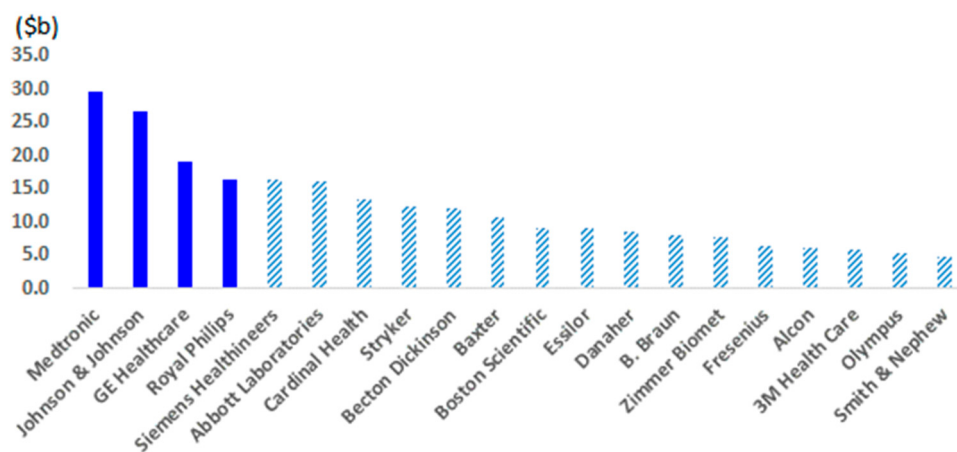
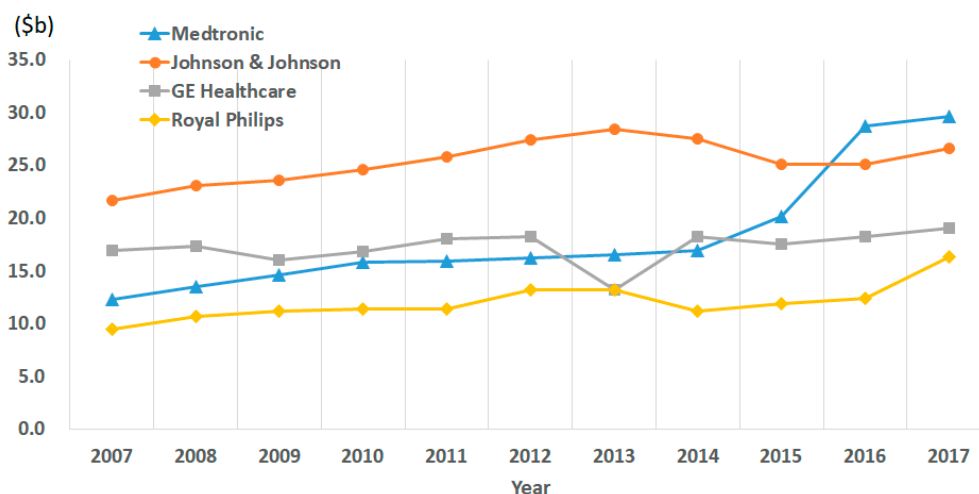


Figure 2. Outline of research procedure.

Figure 3. Top 20 medical device firms by order of annual sales (in 2017). Source: Medical Product Outsourcing Magazine (<https://www.mpo-mag.com/>).Figure 4. Annual sales of the top-4 medical device firms over 10 years. Source: Medical Product Outsourcing Magazine (<https://www.mpo-mag.com/>).

4. Research Framework

The dynamic capabilities of outsourcing firms are vital elements of a successful outsourcing process, and resultantly create values that are critical to their sustainable competitiveness in a volatile

market. In this respect, resources of outsourcer-oursourcee (i.e., antecedents), the outsourcer's dynamic capabilities necessary for outsourcing (i.e., process), and created value from the outsourcing activities (i.e., outcomes) comprise our research framework. We derive key elements and propositions constituting the framework by reviewing research documents that we collected by a keyword search (outsourcing & dynamic capabilities) in SCOPUS and the Web of Science.

4.1. Resources: Antecedents

According to RBV, a firm's superiority in specific resources explains the different performances among firms in the same industry, and thereby can be an important source of sustainable competitiveness [64–66]. Resources of both the outsourcer and the sourcee are basic determinants of outsourcing strategy, whose potential complementarities turn into greater outsourcing performance by the organizational capabilities of firms [59]. Firms are motivated to outsource when they are in need of resources, or when they possess valuable resources to share [19]. Some studies suggest that firms with a higher level of internal resources are more capable of exploiting external resources [67,68].

For strategic purposes, the outsourcers increasingly focus on outsourcing various forms of resources, including physical resources, human resources, R&D knowledge, tacit know-how, and managerial systems [17,69]. Non-core resources that do not belong to the outsourcer's core competence, clear definition of which is necessary before the outsourcing decision, can be outsourced, in order to cut cost, or increase efficiency by better focusing on core technology [13,70]. Some studies suggest that firms should not outsource core competencies or related strategies to outsourcing partners, in line with the RBV or core competence theory [20,71,72]. Thus, the alliance structure between the outsourcer and the sourcee can be affected by the characteristics of resources, e.g., core, or non-core characteristics, and alignment of the outsourcing resources, for example, supplementary (i.e., reinforcing resource base supplemented by similar resources) or complementary (i.e., expanding resource base complemented with dissimilar resources) [3,19]. We hereby posit the following research propositions:

Proposition 1. *Characteristics of resources owned by the outsourcer and the sourcee, and their alignment affect outsourcing strategy.*

4.2. Dynamic Capabilities: Process

The outsourcer's dynamic capability to recognize the value of external resource or knowledge is a prerequisite in the process for successful outsourcing [73]. Environmental sensing capability is a capability that can be used to detect an opportunity or threat by exploring new technology and knowledge, thereby taking the appropriate measure for the particular situation [74–77]. This sort of cognitive flexibility is more critical as environmental uncertainty increases [46,78]. In short, the outsourcer needs a capability of sensing opportunities that recognizes customer's needs, as well as industrial technology trend, and searches for external resources to complement the current resource base of the firm.

In addition, the lack of internal firm resources can be compensated by focused learning from the appropriate sourcee, if otherwise, it can never achieve on its own [79]. The outsourcer's absorptive capability to acquire and assimilate new recognized external resources for the purpose of applying it to commercialized ends is another driving force for a successful outsourcing relationship [73,77]. Innovation through adoption, i.e., the ability to draw ideas or knowledge from elsewhere, and build on them to meet the demand for changes in the start-up stage, becomes a powerful dynamic capability for a firm's sustainable growth [22,57]. Absorbing external technology from diverse sources to help maximize the benefits of a firm can nourish the development of operating routines and can enhance dynamic capabilities [53]. Absorptive capabilities have positive relationship with outsourcing partnership performance, in that the more both parties are willing to learn from each other, the higher the outsourcing performance [59]. Therefore, the following propositions are formulated:

Proposition 2a. *The outsourcer's sensing capability contributes to a successful outsourcing process.*

Proposition 2b. *The outsourcer's absorptive capability contributes to a successful outsourcing process.*

Dynamic capabilities enhance knowledge management practices of integrating absorbed foreign resources with internal capacities along the value chain system to create maximum values [23,80]. Integrated technology within a firm through interaction with the other organizations and the environment will contribute to launching the timely-developed products quickly to grasp the changes in business opportunities [22]. In large firms, system integrating capabilities to bundle diverse development fields, e.g., hardware, software, design, and manufacturing, in order to propose new solutions to market, are in the spotlight of management [68,81]. Thus, integrating capabilities to positively interact among the different fields of resources by transforming them into comprehensive sets of organizational skills that can create value in line with environmental changes are requisite dynamic capabilities for outsourcing [82].

Likewise, outsourcing value can be created through transferring technology that is internally accumulated or acquired from elsewhere [57]. According to market conditions or for strategic purposes, the outsourcer should be willing to share their knowledge with external vendors [79]. Dispersion of innovation activities through the value chains from outsourcer to key suppliers, i.e., outsourcee, can lead to opportunity seizing, such as exploring new markets, and timely launching of new products. In return, the outsourcee makes advances in innovation capability as a result of the outsourcing process [83]. Also, a firm's governance development to assist the technology flow, while protecting its core competences or intellectual properties from misappropriation, constitute important dynamic capabilities in many industrial sectors [77]. The following propositions emerge from the above arguments:

Proposition 2c. *The outsourcer's integrating capability contributes to a successful outsourcing process.*

Proposition 2d. *The outsourcer's technology transfer capability contributes to a successful outsourcing process.*

4.3. Value Creation: Outcomes

According to DCV, the routine of absorbing and sharing valuable resources among business partners improves an organization's strategic flexibility to changes in market or customer needs [50]. Flexibility is referred to as the organization's capability to meet an increasing variety of customer needs and spreads risks by diversifying business models or pioneering niche markets, which therefore is a core success factor in a volatile environment [1,84]. The advantage of managing properties that are owned by other independent suppliers is that the buyer can increase its flexibility, switching orders between suppliers as the market environment changes [85–87]. Many established firms adopt a simultaneous twin process of vertical integration and disintegration (or outsourcing) through the product life cycle, in order to maintain strategic flexibility [81]. The existing resource base of the firms can be reconfigured, e.g., acquired, changed, or discarded, to adapt them to the changing situation as a result of outsourcing activities [88]. Increased flexibilities of the firms help them spread risk by diversifying their business model and market in the modern volatile market. We posit the following proposition:

Proposition 3a. *The firm's outsourcing activities help increase its strategic flexibility, diversifying its business model.*

Many firms choose to outsource their non-core activities to reduce cost and increase efficiency [6]. As in the transaction cost perspective, the outsourcer can minimize the cost of product development and production by converting fixed costs into variable ones, reducing operating costs, reducing employees, eliminating unprofitable projects, and avoiding new infrastructure investments [89,90]. When a firm outsources non-core resources (e.g., maintenance, repair, or transportation), cost reduction is a primary

benefit from outsourcing, rather than capability enhancement [33,89]. For example, the outsourcer can reduce production cost by offshore production in a low wage country [5].

In addition to cost efficiency in the non-core activities, a firm's core activities of R & D become more efficient by outsourcing activities that are less related to their core competences. The outsourcer can invest more time and money in the area of strategic importance by hiving off non-core operations [91]. Outsourcers also have benefits from their partners by sharing the costs of R & D and new product launch in the global marketplace [92]. We thus propose as follows:

Proposition 3b. *The firm's outsourcing activities increase its cost efficiency in core activities, as well as non-core activities.*

Increased efficiency in the firm's outsourcing activities helps improve its agility. Agility can be referred to as a dynamic capability to respond quickly to customers' changing demands by making timely decisions and shortening production cycles [93]. The time-to-market launch of a firm's new products ahead of its competitors by reducing the R & D cycle is an important source of its competitive advantage [94,95]. Such a time-to-market capability becomes especially important in the market of short product life cycles [95]. Outsourcers will have benefits of enhanced time-to-market capability from successful outsourcing strategy. For example, an outsourcer could benefit its agility from reduced development time through R & D collaboration with the outsourcee, or from absorbing state-of-the-art technology that is already developed by the technology-provider [58,89]. The outsourcer can spare time to develop new products by focused learning from appropriate partners, rather than taking the risk of experimenting with new technology and developing all requisites in-house [79]. By outsourcing experience, the firms may be able to rapidly seize emergent opportunities, uninhibited by bureaucratic structures and organizational inertia [85]. Thus, we make another proposition, as follows:

Proposition 3c. *The firm's outsourcing activities improve its agility to promptly grab emergent opportunities.*

One of the core activities for the firm's growth is innovation, a central part of which involves acquiring valuable technology through outsourcing [7,96]. Ultimate value created by the firm's successful outsourcing process lies in the market-oriented innovation that puts a firm in a sustainable leadership position [8]. The firm can better achieve innovation in new product development, whether incremental or radical, through the outsourcing process of learning, integrating, and sharing cutting-edge technologies [86,95]. They can keep their own capacities up-to-date by managing and coordinating a network of best capabilities through outsourcing [6]. The more an outsourcer's organization is open to the external partners that can be potential sources of innovation, the easier such innovations can be brought [73]. As successful outsourcing is based on the constant identification of market needs, created value from the outsourcing experience includes market-oriented innovation that can attract consumers, and thereby dominate the market. We therefore derive our final proposition as follows:

Proposition 3d. *The firm's outsourcing activities help achieve market-oriented innovation.*

4.4. Framework Building

From the arguments and propositions described in the previous section, we propose a research framework as in Figure 5, which interprets the elements of a successful outsourcing process. Resources of the outsourcer and the outsourcee, whether core or non-core characteristics, are basic elements that motivate the outsourcing process. The outsourcer's dynamic capabilities to sense good partners along with technology trend or market needs, to acquire necessary resources (or technologies) and integrating them with internal capacities, and to transfer its own resources to the appropriate outsourcee for the purpose of maximizing benefits, form the basis of a successful outsourcing process. Through the successful outsourcing experience, the outsourcer can create greater value for consumers and

enhance its dynamic capabilities, in the form of improved strategic flexibility, agility in market response, increased efficiency, and market-oriented innovation. Moreover, an outsourcer can take advantage of international networks that are expanded through outsourcing experiences, which can become a bridge to a broader network of foreign partners [85,97]. Such outcomes of successful outsourcing process create a virtuous cycle of sustainable competitiveness through accumulated capabilities.

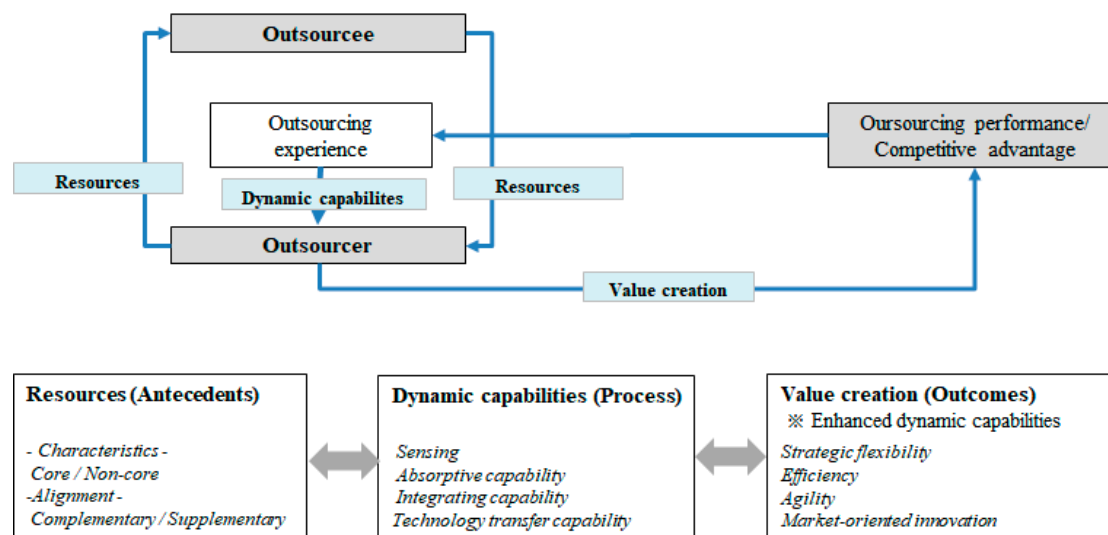


Figure 5. Research framework of outsourcing process: virtuous cycle of sustainability.

5. Case Analysis

5.1. Case Description

In the medical device industry, which is technology-intensive and rapidly growing, the competition among firms has recently become intense and diversified. New entrants to the industry are gaining competitiveness by effective ways, such as outsourcing necessary resources, or acquiring businesses. The reason for the high growth of the medical device market is analyzed from various viewpoints, such as population aging, and the growth of emerging countries. According to World Health Organization's report, medical supply and expenses for the elderly population are likely to be a great burden on society, because cardiovascular, cerebrovascular, or respiratory diseases that mainly affect them are increasing [98]. In addition, expansion of the middle class and rising GDP in China, India, Latin America and other emerging countries also drive demand for medical devices and services [99]. Nevertheless, the number of medical professionals and facilities currently available is not sufficient, and that is why there is a rising demand for advanced medical devices that are capable of early diagnosis and minimally invasive treatment, and IT convergence products for home care and self-care.

Established firms in the medical device industry are using outsourcing strategies in a variety of business activities, such as R & D, manufacturing, service, and licensing. The outsourcing market in the medical device industry is expected to grow by an average of 10.5% annually by 2025 [100]. Although outsourcing is a major activity in the medical device industry and is highly significant from the perspective of corporate strategy, there is still a lack of relevant academic research. Our case study includes the top four established firms successful in the medical device business—Medtronic, Johnson & Johnson (J & J), Royal Philips, and GE Healthcare—for detailed investigation of the interrelationship among their resources, capabilities, strategies, and created values in the outsourcing activities from 2010 to 2018.

5.2. Research Results

5.2.1. Evidence from the Case: Resources and Outsourcing Types

As a result of the content analysis for the four leading, established firms (i.e., outsourcers) in the medical device industry, we go into detail of the research framework in Figure 5. Firstly, we found four distinctive types of outsourcing events according to the characteristics of outsourced resources, i.e., core or non-core, and their alignment with resources owned by the outsourcer, i.e., supplementary or complementary. In the outsourcing events of type I and II, the firms outsourced core resources for the purpose of supplementing or complementing their current capabilities, respectively. While in type I outsourcing, mutually complementary resources of the outsourcer and the outsourcee were combined, and expanded the existing resource bases, in type II outsourcing, the outsourcer acquired resources that could reinforce its capabilities by supplementing its resource base. In type III, the firm outsourced its non-core activities, such as production and payroll service, which as a result, supplemented their core activities. In type IV, the outsourcer transferred a core part of its resource base to the outsourcing partner, for the purpose of taking advantage of the outsourcee's local network and expanding the marketplace. Figure 6 indicates the four types of outsourcing, along with the characteristics and alignment of the outsourcing resources.

Several items of evidence from the case according to each outsourcing type are described as follows. The Appendix A briefly summarizes the main outsourcing events with key phrases from the articles, media sources and classified outsourcing types.

Characteristics of outsourced resource	Core	Type II (Core $\leftarrow$ <u>Core</u>)	Type I (Core + <u>Core</u>)
	Non-core	Type III (Core $\leftarrow$ <u>Non-core</u>)	Type IV (Core + <u>Non-core</u>)
		Supplementary	Complementary
Resource alignment			

Figure 6. Four outsourcing types according to the resource characteristics and alignment.

- Type I: Outsourcer (Core resource) + Outsourcee (Core resource)

Collaboration in technology with a variety of partners has been the most common type of outsourcing in the technology-intensive firms engaged in the medical device business. The outsourcer develops diverse innovative products that are well adapted to the changing market, by integrating appropriate external technologies with internal competence, thereby creating synergy. In this type of outsourcing, core resources of both the outsourcer and outsourcee, which are dissimilar and mutually complementary, are involved in outsourcing activities. Many events summarized in the Appendix A (ID: M1–M6, P1–P10, G1–G8, J1–J4) support that the four established firms have combined their strengths with appropriate partners to expand their capabilities and diversify business models, several items of the evidence of which are described below.

Medtronic has integrated its sophisticated medical technologies with another core technologies such as Fitbit's automatic activity tracking technology, which provides insights into how exercise affects glucose levels for more effective diabetes care management (ID: M1), and IBM's artificial intelligence unit, which enabled the diabetes devices of Medtronic to predict whether a diabetic person will have

low glucose (ID: M2). Medtronic also took advantage of its market-leadership in diabetes management in collaboration with Qualcomm Life's expertise to create more affordable, easier-to-use Continuous Glucose Monitoring (CGM) systems that can provide near real-time and retrospective glucose data (ID: M4). Medtronic's range of future solutions, jointly developed with Samsung Electronics, could improve the way people with diabetes live, by remotely viewing diabetes data and ultimately integrating mobile devices into diabetes management systems (ID: M5).

In the case of Philips, a partnership with Amazon connected millions of devices to the Internet of Things (IoT) using Amazon Web Services (AWS) (ID: P1). Philips also made a strategic alliance with Salesforce.com, leveraging Philips' leadership in medical technology and Salesforce.com's leading position in enterprise cloud computing by delivering a cloud-based healthcare platform (ID: P3). For the purpose of a long-term collaboration with partners, Philips secured certified compatibility between its products and the outsourced systems (ID: P8).

GE Healthcare also established its cloud system that integrates powerful IT solutions of large-sized system integrators and leading-edge independent software vendors across a range of care areas (ID: G5, G6).

J & J integrated its core capabilities with experts in 3D-printing technology in order to develop 3D printed products in the areas of orthopedics, eye health, and consumer health. For example, 3D printed surgical devices increase the predictability and efficiency of surgery, and pharmaceutical researchers can recognize how the drug compounds will react in a real human body by measuring the toxicity levels of compounds on 3D printed kidney cells or liver cells (ID: J1–J3).

- Type II: Outsourcer (Core resource) → Outsourcee (Core resource)

When the firm plans to catch up with cutting edge technology of the industry to fulfill customer needs promptly, it particularly needs external partners with advanced technologies to fill the technology gap. In this type of outsourcing, the outsourcer acquires the necessary external resources and sometimes the relevant organization or company. The firm would also make a cross license agreement with the technology provider to use the necessary intellectual property, in the case that mutual interest is met. The outsourced resources, which are core resources of the outsourcee in this type, are supplementary to resources owned by the outsourcer, thereby enhancing the core competence of the outsourcer. Part of the events in Appendix A (ID: M7, P11–P14, G9–G11) correspond to this type.

Philips could strengthen its innovation pipeline of catheter-based therapy devices by acquiring CardioProlific, because CardioProlific's technologies are supplementary to Philips' portfolio of image-guided therapy devices. The acquisition of CardioProlific underpins Philips' strategy to develop new solutions for clinicians to guide and confirm the adequate therapy for cardiac and peripheral vascular disease (ID: P11). In addition, Philips has signed an agreement to acquire EPD Solutions, an innovator in image-guided procedures for heart rhythm disorders, which supplements Philips' portfolio of interventional imaging systems, smart catheters, planning and navigation software, and services. As a result of the acquisition, Philips could introduce new solutions in the fast-growing EUR 2+ billion market for the image-guided treatment of cardiac arrhythmias (ID: P12). Philips also acquired Remote Diagnostic Technologies (RDT), a leading innovator of advanced solutions for the pre-hospital market, providing cardiac therapy and data management, for the purpose of enhancing Philips' Therapeutic Care business and strengthening its leading position in the EUR 1.4 billion resuscitation and emergency care market (ID: P14).

In the case of GE Healthcare, the firm reinforced its capability to provide a variety of ultrasound disinfection solutions to customers by outsourcing CS Medical's products, which provides healthcare professionals the tools to properly reprocess the delicate ultrasound probe, thereby minimizing healthcare-acquired infections (ID: G9). GE Healthcare also outsourced SonoSim's solution that offers training from the basics to hands-on simulations of real-world, pathologic cases from actual patients. GE Healthcare invested \$13 million to help build a modernized healthcare system in Kenya by building

the GE Healthcare Skills and Training Institute, for the purpose of training healthcare professionals in the use of the up-to-date technology (ID: G11).

- Type III: Outsourcer (Core resource) ← Outsourcee (Non-core resource)

The management may decide to outsource if the sum of production and transaction cost is less than the internal production cost. This strategy, where the firm outsources a non-core part of its operation, for example, offshoring to a low-wage country, is the most common strategy used in the traditional manufacturing firms for the purpose of minimizing overall cost. Although not many outsourcing events of medical device firms belong to this type, several events in Appendix A (ID: M8, G12, J5, J6) could be classified to this type.

For the purpose of R & D efficiency and cost reduction, Medtronic outsourced transactional and repetitive jobs that do not require high-level knowledge of Medtronic. For example, the firm hired the well-known outsourcing and IT services firm Cognizant, whose department provided customer service and phone-answering functions for Medtronic (ID: M8).

GE Healthcare also outsourced the non-core process of training doctors and nurses on all the machines General Electric manufactures, from MRI machines to ultrasound equipment. Such operation is typically cumbersome and expensive, involving flying doctors to training sites, or else sending experts out to hospitals. However, a new partnership with InTouch Health helped to bring remote education, training and technical support for a bunch of GE imaging products (ID: G12)

J & J has signed an exclusive original equipment manufacturer (OEM) agreement with Nova Biomedical to provide its point-of-care blood glucose testing systems to hospital customers in China. By outsourcing non-core process to the emerging market, J & J could serve the changing needs of a fast-growing market with increased efficiency (ID: J5). Besides, J&J could save time in reconciling payroll issues, and focus more on its core activities, by partnering with PayrollServe, a specialized firm in payroll matters (ID: J6).

- Type IV: Outsourcer (Core resource) + Outsourcee (Non-core resource)

Another type of outsourcing classified from the case analysis occurs when the outsourcer plans to expand the business by exploring new markets. In this type, the outsourcer transfers resources to the outsourcee that typically belongs to a developing country with a relatively low level of industrial technology. For example, the outsourcer grants the local partner a license to develop the products, or shares the relevant know-how with the firm, whereas the local partner can acquire core technology from the outsourcer, thereby enhancing its own competence. Such outsourcing can be supported by the local government, because the collaboration may bring a positive ripple effect to the entire national industry. Even though the outsourcer does not receive an immediate return from the transaction, it could gain access to a new niche market, and from a long-term perspective, take the initiative in the industrial ecology by securing more and more distribution networks. Part of the events in Appendix A (ID: M9, P15–P18) exemplify this type of outsourcing.

As an emerging market strategy, Philips has established a unique cooperation format with Russian firms of leading industrial networks in the local market. The firm partnered with Electron, a leading Russian medical equipment manufacturer, supporting the modernization of the healthcare system at technology and even strategy levels, by bringing in Philips' global expertise to serve the needs of the Russian healthcare system (ID: P15). Philips also cooperated with MEDSI, a leading provider of patient-centered quality care in Russia, taking advantage of the healthcare facilities of MEDSI. This new partnership provides MEDSI with guaranteed affordable access to the Philips' latest healthcare equipment, technology, and international expertise in hospital management, beyond the traditional supply of equipment (ID: P16). In addition, with the signing of a ten-year strategic partnership agreement with the Expert Group of Companies, Russia's leading networks of healthcare centers and clinics, Philips provided its clinical expertise, consulting services, and technology planning for multidisciplinary medical centers (ID: P17).

In the case of Medtronic, the firm has developed an innovative partnership with the National Institute of Hospital Administration, an influential think tank under China's National Health, to carry out research projects focusing on building an integrated care system for patients with diabetes. This partnership shows an effort to collaborate with an important organization to access data necessary to understand the clinical and economic value of therapies, and how they can best be utilized in a patient population. In this joint endeavor, Medtronic shared with the Chinese government the extensive experience it has accumulated through dealing with a similar mechanism in other countries around the world (ID: M9).

5.2.2. Dynamic Capabilities and Value Creation

The case study results also explain details of other elements of the proposed research framework: dynamic capabilities and value creation. The four leading, established firms showed different dynamic capabilities in the events of different outsourcing types. In all types of outsourcing, the sensing capability of understanding market demands and continuously exploring an appropriate partner with superior or cheaper resources play a key role in the successful outsourcing process. For example, Omar Ishrak, chief executive officer of Medtronic, recognized market needs and realized where to focus, by saying, "Diabetes is unfortunately rising in prevalence around the world, driving up system costs and, ... we believe there is tremendous opportunity to better align care across the diabetes care continuum through new technologies and patient care management strategies" (ID: M6).

Specifically, the outsourcer that plans type I outsourcing requires integrating capability to combine different kinds of resources based on mutual trust and cooperation among the outsourcing partners [10,54]. When GE Healthcare collaborated with Zenith Technologies, it announced that the two companies integrated process control systems, and other supporting technologies with GE Healthcare's start-to-finish technologies for the biopharmaceutical manufacturing industry (ID: G4). As a result, the outsourcer could create market-oriented innovation. "Using the Arterys System together with cloud computation, the diagnoses can be made in a non-invasive MR imaging procedure that is quick, accessible and easy for both the patient and the radiologist," said Fabien Beckers, Arterys CEO, in a statement in 2016 (ID: G1). Also, the partnership offered more choices to customers by diversifying the solutions. GE Healthcare announced that it will bring IT solutions for clinicians across a range of care areas, by collaborating with two large systems integrators and seven leading-edge software vendors (ID: G5). In some cases, type I outsourcing brings benefits of lower total costs, as announced by Jim Davis, GE Healthcare's management, in 2011. "Research in this area aims to bring benefits of lower total costs, ... and makes this an attractive opportunity for collaboration" (ID: G8).

In type II outsourcing, the outsourcer needs absorptive capability to acquire, learn, and share external knowledge within the organization. Through the outsourcer's absorptive capability, the absorbed external resources can form a knowledge evolution cycle of promoting the outsourcer's core competence and exploring more advanced technologies. In particular, established firms need a culture of openness to successfully acquire external knowledge, while overcoming organizational inertia, and accepting unfamiliar changes. As a result of this outsourcing, the outsourcer can create diverse market-oriented value by reinforcing its resource base with outsourced up-to-date technologies in a shorter period of time than developing entire technologies internally. Strategic flexibility can be increased by diversifying products from utilizing multiple outsourcing partners, and thereby spreading risk in a volatile environment. Several announcements from the management show evidence of the value created by the outsourcing, such as the following statements: "... this agreement reinforces GE's ongoing pledge to provide a variety of ultrasound disinfection solutions to help our customers improve patient outcomes" (ID: G9), "Medtronic acquired the OsteoCool technology and ... the OsteoCool System expands our Pain Therapies portfolio" (ID: M7).

In type III outsourcing, a sensing capability of the decision maker to continuously relocate resources wherever they are needed to minimize time and cost in accordance with the changing market condition is a crucial element. Although this type of outsourcing is not directly relevant to long-term

value creation, the outsourcer can focus internal capacities on its core business area by outsourcing the non-core part of business to reduce time and cost, thereby increasing R & D efficiency. Several articles support the kind of values the outsourcing activities have created, as an official Medtronic spokesperson said, "... the job cuts will allow Medtronic to be more adaptive to fluctuations in market demands and maintaining service levels to our customers" (ID: M8). Also, Business Journal (2016) reported, "... industry spends thousands of dollars annually paying for travel and accommodations to train physicians on their devices ... collaboration with InTouch Health enables network connectivity, hands on interaction, and an intuitive user experience" (ID: G12). In addition, the outsourcer can speed up time to market by utilizing production facilities or market accessibility of the outsourcee, as Prnewswire (2014) reported, "the business has signed an OEM agreement with Nova Biomedical Corporation to market ... testing systems to hospital customers in China" (ID: J5).

Lastly, the outsourcer in type IV should be capable of sharing the core technology with the partner, whilst maintaining control over the relationship. Transferring parts of business processes or resources that are a core or complementary-to-core competence of the outsourcer could be risky, if the outsourcing partner spreads the acquired know-how to a third party and uses it to compete with the outsourcer. For this reason, the outsourcer should evaluate the detailed strategic value of the transferring resources, as well as the estimated benefits from the outsourcing, maintaining close contact with the partner. Evidence from Philips shows the expected benefits from this type of outsourcing. As an emerging market strategy, Philips explored the Russian healthcare market, utilizing the broad network of local Russian partners and infrastructure in the region, in return for supporting Russian healthcare industry by providing core resources to the local firm. Philips has improved the local healthcare system by developing products specialized in Russian under joint branding with the local partner. Ronald de Jong, CEO of Philips Healthcare said, "This unique partnership with Electron is a next step in executing on our emerging markets strategy for our healthcare sector, ... will support the modernization of the healthcare system at technology, economy and even strategy levels by bringing in Philips' global expertise to serve the real needs of the Russian healthcare system" (ID: P15). Such outsourcing strategy increased the firm's strategic flexibility, by expanding its business to local and global markets.

To summarize this section, Figure 7 illustrates the outsourcer's key dynamic capabilities that are required for successful outsourcing and created value according to the outsourcing types. Also, Table 1 briefly provides our research results supported by the case study, for each proposition suggested in Section 4.

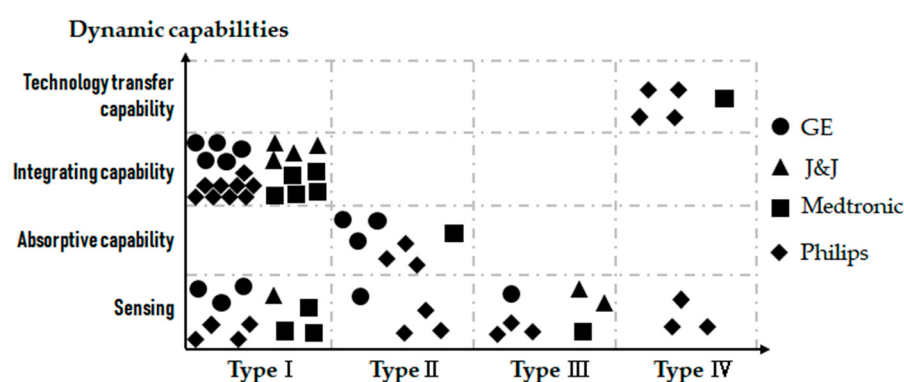


Figure 7. Cont.

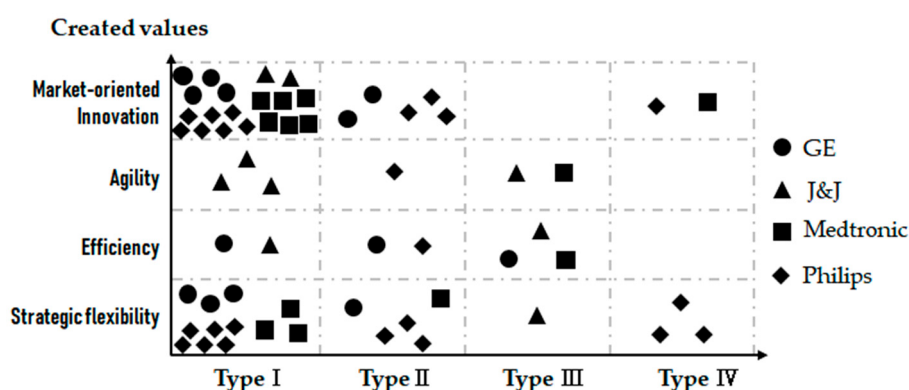


Figure 7. Outsourcer's dynamic capabilities and created value according to the outsourcing type.

Table 1. Research results for the suggested propositions.

Proposition	Research Results Supported by the Case Study
1	Characteristics of resources owned by the outsourcer and the outsourcee, and their alignment affect outsourcing strategy.
2a	The outsourcer's sensing capability positively affects "type I–IV" outsourcing.
2b	The outsourcer's absorptive capability positively affects "type II" outsourcing.
2c	The outsourcer's integrating capability positively affects "type I" outsourcing.
2d	The outsourcer's technology transfer capability positively affects "type IV" outsourcing.
3a	The firm's "type I, II, III, IV" outsourcing activities help increase its strategic flexibility, diversifying its business model.
3b	The firm's "type I, II, III" outsourcing activities increase its efficiency in core activities as well as non-core activities.
3c	The firm's "type I, II, III" outsourcing activities improve its agility to promptly grab emergent opportunities.
3d	The firm's "type I, II, IV" outsourcing activities help achieve market-oriented innovation.

5.2.3. Firm Sizes and Outsourcing Types

We further analyzed the frequency of the outsourcing events for each outsourcing type in different firms. From the content analysis of the four large established firms in medical device business, type I outsourcing, characterized by the integration of mutually complementary resources, appeared the most, while type III, i.e., events of outsourcing non-core activities, was the least as indicated in Figure 8. Compared to the capital-intensive industry where an outsourcer commonly benefits from economies of scale by outsourcing non-core operations to lower-cost foreign firms, our research case of technology-intensive firms shows much more outsourcing events related to technology or capability sourcing than cost reducing activities.

In addition, we investigated the significance of firm size by the outsourcing type. Large-sized enterprises (LEs) in the medical device industry are usually equipped with their own manufacturing facilities in addition to their inherent capabilities, while small and medium-sized enterprises (SMEs) utilize their strong points in technology or service in partnering with LEs. Since the outsourcers considered in this case study are LEs, the 45 outsourcees (including three duplicate firms) were classified as 18 SMEs and 27 LEs for further analysis. Although there are several different criteria of classifying LEs and SMEs, this study defined the firms with less than 500 employees as SMEs, according to the OECD's recommendation in 2005 [101–103].

Figure 9 indicates the frequency of outsourcing events for each outsourcing type by the outsourcee's size, i.e., "LEs vs. LEs", and "LEs vs. SMEs", because this study focuses on four large-sized outsourcers. The result shows that the outsourcing case in type I is not biased to either LEs or SMEs. The four

established firms partnered with the firms that own valuable, indispensable technologies, regardless of their size. In type II, the outsourcers partnered more with SMEs that are advanced in the required technologies in the form of technology or business acquisition at a reasonable cost, which accelerated business growth of the outsourcers. As a special case in type II, Philips made a deal with a large firm, Masimo, to resolve a patent dispute between them. As a result of a verdict in 2014, Philips paid \$466 million to use Masimo's patented technology that was indispensable for Philips to innovate and move forward.

We also found that the outsourcing events in type III and IV were biased to "LEs vs. LEs". In three cases of type III outsourcing, the outsourcers partnered with LEs that could provide manufacturing operation or payroll services promptly at a reduced cost, which makes the non-core part of business more efficient. In the other case of a partnership with a SME, InTouch, the outsourcee provided training solution to GE Healthcare, reducing time and cost remarkably. In the case of type IV, all five cases corresponding to the type were in the form of "LEs vs. LEs". In this type, the outsourcers could efficiently penetrate the emerging market through the influential local LEs, utilizing the broad networks and established regional facilities of the local firms. Table 2 briefly summarizes the outsourced resources in "LEs-LEs" and "LEs-SMEs", according to the outsourcing types.

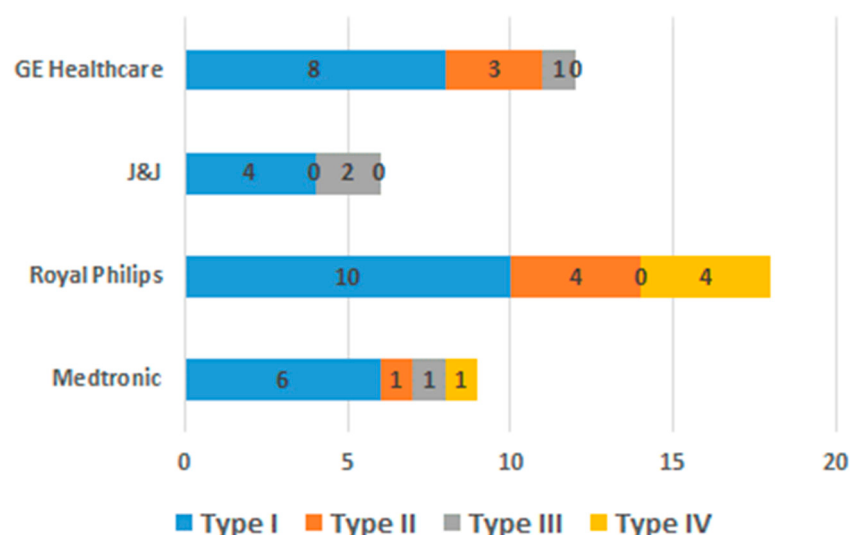


Figure 8. Frequency of outsourcing events by outsourcing types and different outsourcers.

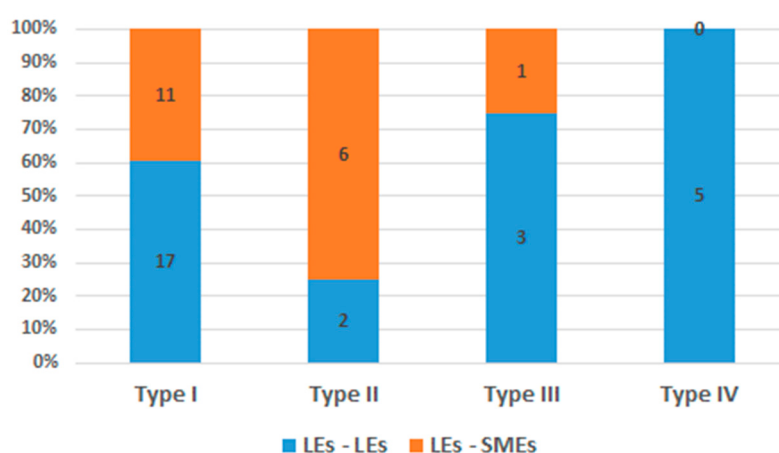


Figure 9. Frequency of outsourcing events by outsourcing types and the outsourcee's size.

Table 2. Outsourced resources in large-sized enterprises to large-sized enterprises (“LEs–LEs”) and large-sized enterprises to small and medium-sized enterprises (“LEs–SMEs”) according to the outsourcing types.

Type	LEs–LEs	LEs–SMEs
I	Valuable technologies complementary to the outsourcer’s core competence	
II	Superior technologies or services (Settlement of patent dispute)	Superior technologies or services
III	Manufacturing facilities, payroll service	Training solution
IV	Broad networks, facilities in local market	-

6. Implication and Future Research

6.1. Implication

This study focuses on the outsourcing activities of established firms as an essential process to sustain competitive advantage, particularly in a volatile, technology-intensive industry. The suggested research framework, including resources, dynamic capabilities, and resultant value creation, comprehensively interprets outsourcing phenomena from a long-term perspective, which are supported and concretized by the in-depth case study results. This study proposes that the four outsourcing types classified by the characteristics of outsourced resources, i.e., core or non-core, and its alignment with the existing resources of outsourcer, i.e., complementary or supplementary, require different dynamic capabilities of the outsourcer for successful outcomes. In addition, case study results support that successful outsourcing experience brings a variety of value, such as market-oriented innovation, strategic flexibility, agility, and efficiency, to the outsourcer, which in turn enhances the dynamic capabilities of the firm. According to previous studies on DCV, elements of dynamic capabilities are key enablers to sustain a firm’s competitive advantage in volatile environments [46,50,77,92]. We hereby claim that outsourcing activities of the leading firms have promoted development of the organizational dynamic capabilities, consequently leading to sustainable competitiveness. The research results also indicate the different frequency of outsourcing events according to outsourcing type and the outsourcee’s size. From the large-sized outsourcees, the outsourcers took advantage of the established facilities or broad networks, as well as complementary resources; while from the small and medium-sized outsourcees, they outsourced superior technologies or services. The proposed research framework based on DCV and supported by in-depth case study results can be utilized in the outsourcing and sustainability research in the diverse industrial fields.

Our study also provides several managerial implications for the decision-makers of established firms. Our study results suggest that top management must develop the organizational dynamic capabilities necessary for the selected outsourcing type, which were found to be significant for sustainable competitiveness of established firms. Sensing capability is a prerequisite for all types of outsourcing, as is shown in the case study results. Continuous customer-related surveying and participation in the regular technology exhibition of outsourcing partners help decision-makers strengthen their sensing skills and formulate a suitable outsourcing strategy. Absorptive and integrating capabilities are also critical dynamic capabilities for continued success through a successful outsourcing experience. Collaboration between the outsourcer and the outsourcee, which is based on mutual trust and communication, enhances the capability of integrating internal and external resources, and a culture of openness helps an organization overcome organizational inertia and absorb external technology more efficiently. In addition, technology transfer can be strategically important for exploring new markets, with utilizing the broad network of local partners and infrastructure in the region. When an outsourcer transfers its core resource to the outsourcee, as in the case of Type IV, the management should minimize the leakage of core competence by introducing contract clauses that clarify the restitution of core information at the end of the project.

We further propose that top management must accurately diagnose the strengths and weaknesses of the current organization, before deciding on a proper outsourcing strategy. The management needs to define which part of the business process forms core or non-core resource, and which resource should be outsourced. As a result, the management can decide which type of outsourcing can bring maximum value to the organization. In addition, top management must consider changing outsourcing strategy depending on situation, to sustain competitiveness in a dynamic environment. It could be necessary for the outsourcer to switch outsourcing partner, or shift from outsourcing to in-house development, and vice versa. However, as an excessive dependence on outsourcing partners can impair an outsourcer's capability to generate its own know-how optimized for a variety of situations, top management must always focus on enhancing the firm's own core competence from the accumulated experience of successful outsourcing.

6.2. Future Research Directions

We suggest future research directions that could not be covered by this study. Firstly, as this study focused on the capability and consequent benefits only from the perspective of the outsourcer, future research conducted from the perspective of the outsourcee could be helpful to better understand the interaction between the outsourcer and the outsourcee. Secondly, as this study investigated the single industry case, additional research on different technology-intensive industry, e.g., pharmaceutical or electronics industry, is suggested, to investigate the difference in outsourcing type or strategy according to industry. Finally, as the scope of this study could not cover individual outsourcing events and their consequences, negative effects of specific events could have been overlooked. We therefore suggest additional longitudinal study tracing specific outsourcing events for years, which interprets detailed causal relationships between each of the outsourcing events and the consequent performance. The suggested future research is expected to enrich the outcomes of this study and shed a light on the field of outsourcing and sustainability.

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Appendix A

This appendix summarizes part of the evidence described in empirical research findings.

• Case of Medtronic

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
M1	Fitbit	The partnership brings Medtronic's medical technology together with the automatic activity tracking of Fitbit, which provides insights into how exercise affects glucose levels for more effective diabetes care management. The collaboration between healthcare and technology is more important than ever, to simplify daily diabetes management.	Medtronic (2016)	I
M2	IBM	Medtronic and International Business Machines Co. (IBM)'s Watson Health unit outlined a tool to predict whether a diabetic person will have low glucose by integrating IBM's artificial intelligence and Medtronic's diabetes devices. Medtronic has been partnering with various technology companies to layer in more analytics.	ZDNET (2019)	I

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
M3	Nutrino	“By working with Nutrino, we will enhance our customers’ daily lives and will also help us collect insights to inform how we approach diabetes management in the future,” said the president of Global Diabetes Service and Solutions, Medtronic Diabetes.	<i>Nutrino (2016)</i>	I
M4	Qualcomm	Medtronic’s market-leadership in diabetes management could be leveraged with Qualcomm Life’s expertise to create more affordable, easier-to-use Continuous Glucose Monitoring (CGM) systems, including a new sensor and smaller design that can provide near real-time and retrospective glucose data.	<i>Medtronic (2016)</i>	I
M5	Samsung	Medtronic and Samsung Electronics are combining their strengths to develop a variety of future solutions that will improve the way people with diabetes lives, from remotely viewing diabetes data to integrating wearable and mobile devices into diabetes management systems.	<i>Medtronic (2015)</i>	I
M6	Sanofi	According to a joint statement of the companies, Sanofi’s extensive insulin portfolio and drug development expertise will be combined with Medtronic’s technology in continuous glucose monitoring. “Medtronic is committed to taking a broader approach, expanding beyond our core strength, to deliver superior clinical outcomes at an affordable price,” said the CEO of Medtronic.	<i>Medtronic (2014)</i>	I
M7	Baylis Medical	Medtronic acquired the OsteoCool technology and associated intellectual property from Baylis Medical, partnering with the company to further innovate the system. “The OsteoCool System of Baylis Medical expands our Pain Therapies portfolio,” said Julie Foster, general manager of the Pain Therapies business at Medtronic.	<i>Medtronic (2016)</i>	II
M8	Cognizant	The affected positions are lower and operational-level jobs that Medtronic called repetitive or transactional in nature, which do not require high-level knowledge of Medtronic. Medtronic is hiring the well-known IT services firm Cognizant, whose department will provide customer service and phone-answering functions for Medtronic.	<i>MDDI (2016)</i>	III
M9	Institute of Hospital	Chris Lee, the President of Medtronic Greater China said: “In this joint endeavor to help China prepare a nationwide Type 1 diabetes integrated pathway, we will share with the Chinese government the extensive experience we have accumulated through dealing with a similar mechanism in other countries around the world.”	<i>Medtronic (2013)</i>	IV

• Case of Philips

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
P1	Amazon	Philips and Amazon will connect millions of devices to the Internet of Things (IoT) using Amazon Web Services. The partnership is likely to extends the health data management connectivity and Philips’ HealthSuite digital platform technology.	<i>Medtronic (2015)</i>	I
P2	Banyan	Philips’ patient monitoring and handheld diagnostics technologies are united with Banyan Biomarkers’ strength in biomolecules. “The joint development agreement with Banyan Biomarkers will help Philips to expand into this fast-growing market and become a leader in the new market.”	<i>Philips (2017)</i>	I

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
P3	Salesforce	Royal Philips announced a strategic alliance with Salesforce.com to deliver a cloud-based healthcare platform, leveraging Philips' leadership in medical technology, and Salesforce.com's leading position in enterprise cloud computing. "Together with Salesforce, we have a tremendous opportunity to reshape the way healthcare is delivered and provide better access to data."	<i>Salesforce (2014)</i>	I
P4	Image Stream Medical	Philips signed an agreement with Image Stream Medical to further expand its solution to integrate its hybrid suite and interventional lab solutions with integrated video and live streaming technologies. Integrated solutions that enable physicians to optimally perform their tasks is necessary, as the trend towards image-guided minimally invasive therapies continues to grow.	<i>Philips (2014)</i>	I
P5	MIT	Philips announced it has teamed up with Massachusetts Institute of Technology (MIT) to research the use of Philips ultrasound technology and MIT physiological modeling as a less invasive way to measure intracranial pressure (ICP), to manage patients with brain injuries. "We were surprised by the breadth and richness of the competency at MIT and being extremely networked, they have a global vision," said van Houten, the global head of Philips Research.	<i>MedDevice (2015)</i>	I
P6	Pegasystems	Royal Philips, in collaboration with Pegasystems, enables care service providers to better personalize care and improve health outcomes. By connecting the Pega Care Management Application to the Philips HealthSuite Cloud platform, service providers can remotely manage care with connected health applications and provide immediate access to a patient's health status.	<i>Market-wired (2016)</i>	I
P7	Qualcomm	Philips' cloud-based platform integrating health data from a variety of devices joins Qualcomm Life's 2net Platform, providing HealthSuite users seamless access to connected medical devices, including medication dispensers, ventilators, and blood glucose meters.	<i>Fierce-Biotech (2016)</i>	I
P8	Hansen	Hansen Medical and Royal Philips secured certified compatibility between Philips' Allura interventional X-ray systems and Hansen Medical's Magellan Robotic System, as a milestone in their long-term collaboration. "We believe that robot-assisted interventional techniques have great potential."	<i>Philips (2013)</i>	I
P9	Trice Imaging	"Philips is committed to providing innovative solutions for global customers, and our partnership with Trice enhances our capability to provide world class ultrasound solutions," said Sean Gallimore, VP of Global Marketing of Ultrasound for Philips.	<i>Trice Imaging (2014)</i>	I
P10	Vidyo	The Philips-Vidyo platform will uniquely satisfy an increasing need for easier access to high-quality telehealth. We are excited to collaborate with Vidyo to leverage its cutting-edge telepresence technologies to enhance the scalability of our telehealth solutions. Philips is committed to working with industry leaders to better address healthcare needs by expanding telehealth services," said Mike Mancuso.	<i>Vidyo (2012)</i> <i>MobiHealthNews (2012)</i>	I
P11	CardioProlific	"The acquisition of CardioProlific will strengthen our innovation pipeline," said Bert van Meurs at Philips. As CardioProlific's technologies are supplementary to Philips' portfolio of image-guided therapy devices, the acquisition underpins Philips' plan to develop new solutions for clinicians to guide and confirm the appropriate therapy for cardiac and peripheral vascular disease.	<i>MedDevice (2017)</i>	II

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
P12	EPD solution	Philips has signed an agreement to acquire EPD Solutions, complementing Philips' portfolio of interventional imaging systems and services. The company introduced new solutions in fast-growing market for image-guided treatment of cardiac arrhythmias. "EPD's breakthrough innovation provides unique and detailed 3D anatomical information of the heart," said CEO of Royal Philips.	<i>Philips (2018)</i>	II

- Case of Philips (Cont'd)

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
P13	Masimo	The partnership includes joint marketing and sales programs in North America, Asia and Europe for Masimo's non-invasive sensor technologies in conjunction with Philips' patient monitoring and select therapy solutions.	<i>Philips (2016)</i>	II
P14	RDT	RDT's portfolio of comprehensive connected emergency care solutions complements Philips' Therapeutic Care business. RDT will also strengthen Philips' ability to drive digital transformation in healthcare and explore new markets.	<i>MedDevice (2016)</i>	II
P15	Electron	"This unique partnership with Electron is a next step in executing on our Emerging Markets strategy," Ronald de Jong, CEO for Philips Healthcare said. "Philips will support the modernization of the healthcare system at technology, and even strategy levels by bringing in Philips' global expertise to serve the needs of the Russian healthcare system."	<i>Euronext (2010)</i>	IV
P16	MEDSI	This new partnership provides MEDSI with guaranteed affordable access to the latest healthcare equipment, technology, and international expertise of Philips, beyond the traditional supply of equipment.	<i>Philips (2014)</i>	IV
P17	Expert Group	Royal Philips has signed a 10-year strategic partnership agreement with the Expert Group of Companies, one of Russia's leading network of healthcare centers and clinics. Philips will provide its deep clinical expertise, consulting services and technology planning.	<i>Philips (2014)</i>	IV
P18	ROSATOM	Philips said it plans to license its knowledge for the production and maintenance of medical devices to Rosatom, and it will provide training to Russian engineers. "Partnerships between global and local firms are key enablers to improve local healthcare systems," said Steve Rusckowski, CEO of Philips Healthcare.	<i>Euronext (2014)</i>	IV

- Case of Johnson & Johnson

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
J1	HP	Under the partnership, Johnson and Johnson (J & J) and Hewlett Packard (HP) will pool their scientific, clinical, material science and technological expertise, to develop products that can be manufactured quickly and customized to the needs of individual patients. Experts from both companies will work with long-term plans to make 3D-printed products in the areas of orthopedics.	<i>Medtronic (2016)</i>	I

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
J2	Carbon 3D	J & J has picked Carbon 3D to develop custom surgical devices. Unlike other technologies that may 3D print these devices in a matter of hours, Carbon 3D will be able to produce them in a matter of minutes.	<i>3dprinting-industry</i> (2016)	I
J3	Organovo	The companies will work together to evaluate the use of 3D bio-printed tissue in a drug discovery setting. By 3D printing tissues, pharmaceutical researchers can measure the toxicity levels of drug compounds on 3D printed liver cells, kidney cells, etc. This potentially reduces the need to test on animal subjects and can bring the drugs to market more quickly.	<i>3dprint</i> (2014)	I
J4	WellDoc	J & J's partnership with WellDoc, a startup developing mobile solutions for Type 2 diabetes patients, aims to integrate the mobile technology into LifeScan's glucose monitors.	<i>MedDevice</i> (2016)	I
J5	Nova Biomedical	The company announced today an exclusive agreement with Nova Biomedical to sell J & J's StatStrip, a blood glucose testing system, to hospitals in China for serving the fast-changing needs of emerging markets.	<i>Prnewswire</i> (2014)	III
J6	PayrollServe	PayrollServe was always knowledgeable and up-to-date about payroll matters, saving Johnson & Johnson Singapore time and energy.	<i>Payroll-Serve</i> (2016)	III

- Case of GE

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
G1	Arterys	GE Healthcare and Arterys have agreed to collaborate, incorporating Arterys' proprietary quantification and medical imaging technology with GE Healthcare's MR cardiac solutions. "Using the Arterys System together with cloud computation, the diagnoses can be made in a non-invasive MR imaging procedure that is quick, accessible and easy for both the patient and the radiologist."	<i>Fierce-Biotech</i> (2016)	I
G2	Getinge	General Electric (GE) Healthcare, in partnership with Swedish medical device firm Getinge Group, has launched a "highly flexible" angiography solution for hybrid operating room (OR) procedures. The solution combines GE's angiography system with Getinge Group Maquet brand's Magnus operating table system, which broadens the capabilities and services available in a hospital's Hybrid OR.	<i>MedDevice</i> (2016)	I
G3	Trice Imaging	A commercial partnership between GE Healthcare and Trice Imaging, Inc. will provide a new way for clinicians to connect with their patients. GE Healthcare's Ultrasound Women's Health product portfolio will be added by the new solution: cloud-based image sharing and diagnostic collaboration.	<i>MedDevice</i> (2016)	I
G4	Zenith Technologies	They will integrate process control systems and other supporting technologies with GE Healthcare's solutions for the biopharmaceutical manufacturing industry. "With Zenith Technologies' expertise in automation integration, we will be able to offer more choice to customers. This ushers in a new era of opportunity for both companies," said Brendan O'Regan, founder at Zenith Technologies.	<i>Zenith Technologies</i> (2016)	I

ID	Outsourcee	Summary of Events (Key Phrases from the Articles)	Source	Type
G5	Capgemini	GE Healthcare today announced two systems integrators and seven leading-edge software vendors are planning to move their innovative solutions to the new GE Health Cloud. They will bring IT solutions for clinicians across a range of care areas.	<i>MedDevice</i> (2016)	I
G6	Barco Healthcare	“The GE Health Cloud will host powerful analytical tools and services that turn mountains of data into actionable insights,” said CEO of GE Healthcare. “This is the future of healthcare: joining together to improve patient care and transform to value-based care.”	<i>MedDevice</i> (2016)	I
G7	Tata Consultancy	“The industry needs disruptive technology as it navigates rising clinical, operational and financial pressure. It’s a collaborative, healthcare-specific ecosystem that will solve healthcare’s greatest challenges,” said CEO of GE Healthcare IT.	<i>MedDevice</i> (2016)	I
G8	Mayo Clinic	“Research in this area aims to bring benefits of lower total costs, better image quality, and greater patient comfort. It’s an attractive opportunity for collaboration,” said Jim Davis, general manager of GE Healthcare’s MRI business.	<i>MedDevice</i> (2016)	I
G9	CS Medical	“This agreement demonstrates both companies’ continued commitment to minimizing Healthcare Acquired Infections. CS Medical provides healthcare professionals the solution to effectively reprocess the delicate ultrasound probe. GE’s ongoing pledge to provide a variety of ultrasound disinfection solutions to help our customers improve patient outcomes.”	<i>CS Medical</i> (2016)	II
G10	Masimo	“Masimo’s suite of noninvasive and continuous measurements will further enhance the point-of-care clinical intelligence benefits already offered in GE Healthcare’s patient monitors,” said Matthias Weber, General Manager at GE Healthcare.	<i>Masimo</i> (2012)	II
G11	SonoSim	“SonoSim’s solution offers training in everything from the basics of scanning to hands-on simulations of real-world, pathologic cases from actual patients.”	<i>Business-Wire</i> (2015)	II
G12	InTouch	Training doctors and nurses on all the machines General Electric manufactures is typically cumbersome and expensive, involving flying doctors to training sites or else sending experts out to hospitals. But a new partnership promises to bring remote education, training and technical support for a slew of GE imaging products.	<i>Business Journal</i> (2016)	III

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