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Weng, W. H. (2020). Internet of things utilization in marketing for competitive advantage: an organizational capability perspective. In *Proceedings of The 20th International Conference on Electronic Business* (pp. 200-209). ICEB'20, Hong Kong SAR, China, December 5-8.

Internet of Things Utilization in Marketing for Competitive Advantage: An Organizational Capability Perspective

(Full Paper)

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ABSTRACT

Innovative developments in the Internet of Things (IoT) have invoked tremendous attention from both academics and industries. Studies suggest that IoT not only serves as an innovative tool for enterprise operations but also triggers impacts on business performance. As researchers increasingly raise interest about IoT and its applications in marketing and competitive strategy, this study examines its direct and indirect managerial effects by investigating the link between IoT, marketing, and competitive strategy performance. From the organizational capability perspective, this study constructed a research framework in which marketing intelligence capability mediates the effect of IoT capability on business strategy performance. This research conducted an empirical survey and analyzed the data to test the hypotheses in the research framework. The results confirmed the partial mediating effect of marketing intelligence capability in the link between IoT capability and business strategy performance. The paper then discussed the test results and elaborated on the managerial implications.

Keywords: Internet of Things, marketing intelligence, competitive strategy, organizational capability.

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INTRODUCTION

Recent development of the extensive global pandemic has caused business environments to change rapidly and enormously. To respond effectively to the changing internal situations and external environments, a firm must interact closely with changes through its distinctive capabilities to form a highly robust organization. Pursuing a robust organization makes a firm's organizational capabilities especially critical, because organizational capabilities are the source of competitive advantage (Barney, 1995; Day, 1994, 2011; Grant, 1991, 1996; Teece, Pisano, & Shuen, 1997).

Many organizations consider the evolution of the Internet of Things (IoT) as "the next big thing" of information technology (Borgia, 2014; Miorandi *et al.*, 2012). Firm managers expect the development of various IoT related technologies to affect enterprises' managerial paradigm and business strategy. IoT attracted attention as a possible source of strategic advantage for firms (Porter & Heppelmann, 2014). It may provide business opportunities for companies, and may even change the future market (Iansiti & Lakhani, 2014). Therefore, aligning with the development of IoT has become critical for the formulation and execution of a firm's business strategy. The perceived capability of IoT implies that firms make strategic decisions more efficiently. By employing IoT, firms should be able to recognize new business opportunities, identify possible threats, and maintain competitiveness. However, studies of the relationship between IoT and business capability are rare in the literature so far. To fill this gap, this study intends to investigate the link between IoT and business capability.

Moreover, a firm is a value chain with various value activities (Porter, 1985). Among these value activities, marketing plays a crucial role in shaping the overall business strategy of a firm (Day & Wensley, 1983; Dobni & Luffman, 2003). However, during abnormal time such as a disastrous pandemic, business operations of firms are severely restricted because of quarantine measures and traffic blocking. As a critical business function, marketing is also under serious restraint. Furthermore, in a firm's marketing operations, marketing intelligence is the foundation of overall marketing activities, because marketing decisions rely on the capability of acquiring and interpreting accurate marketing intelligence (Trainor, Krush, & Agnihotri, 2013). As IoT enabled products and services have the potential of transforming marketing paradigm (Bulearca & Tamarjan, 2010; Porter & Heppelmann, 2014; Zancul *et al.*, 2016), the objective of this research is to investigate the linkages among IoT, marketing intelligence and sustainable competitive advantage under uncertain situations. The paper begins with a review of the relevant literature about the relationships between the Internet of Things, marketing intelligence, and business strategy. Then it proposes a model that links these three variables. Following that, the paper describes the procedure that tests the model using a sample of Taiwanese companies with global operations. Finally, the paper presents the findings along with managerial implications and recommendations for future work.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Internet of Things and Organizational Capability

Several researchers have elaborated on the technological features of the Internet of Things (Agarwal & Brem, 2015; Atzori, Iera, & Morabito, 2010; Borgia, 2014; Bradley *et al.*, 2015; Gubbi *et al.*, 2013; Krotov, 2017; Miorandi *et al.*, 2012; Porter & Heppelmann, 2015). These features are classified and summarized as follows.

- Ubiquitous sensing

This is the mechanism that the “things” or devices in IoT perceive the surrounding physical environment, detect and record the changes in the environment, and respond to the changes. Ubiquitous sensing is enabled by wireless sensor network (WSN) technologies (Borgia, 2014; Bradley *et al.*, 2015; Gubbi *et al.*, 2013).

- Pervasive connectivity
  IoT contains multiple layers of communication networking infrastructure to provide the pervasive communications between people and people, people and things, and things and things, to form a smart environment (Atzori *et al.*, 2010; Gubbi *et al.*, 2013; Weng & Lin, 2015).
- Embedded computing
  IoT devices contain embedded hardware and software to work intelligently within the environment. The embedded hardware includes processor chips, data storage units, and power units. The embedded software includes embedded operating systems, mobile apps, and middleware. In particular, IoT devices can be embedded further in other devices (Gubbi *et al.*, 2013; Krotov, 2017; Weng & Lin, 2014b).
- Real-time analytics
  IoT monitored and detected information is invisibly embedded in the environment around users, results in the generation of big data in real-time, which is distributed, stored, processed, presented, and interpreted in a seamless, efficient, and easily understandable form (Gubbi *et al.*, 2013; Krotov, 2017; Weng & Lin, 2014c).
- Cloud support
  IoT systems deploy cloud services to assist the processing and storage of IoT analytics, and provide IoT users ubiquitous access to supporting services initiated by IoT devices around the smart environment (Atzori *et al.*, 2010; Bradley *et al.*, 2015; Gubbi *et al.*, 2013; Weng & Lin, 2014a).
- Intelligent user interface
  Visualizing, touching, and listening are critical for an IoT application as these functions allow the IoT users to be aware of the IoT environment. 3D viewing and printing technologies, personal mobile assistants, wearable devices, and augmented-reality systems provide a novel interface for users to interact with the smart environment (Bradley *et al.*, 2015; Gubbi *et al.*, 2013; Weng & Lin, 2014d).
- Interconnected smart products
  IoT enables the evolution of various products such as smart home appliances, robots, drones, crewless cars, automated factory machines and business equipment, and many other innovative devices (Krotov, 2017; Miorandi *et al.*, 2012; Porter & Heppelmann, 2015; Weng & Lin, 2014b, 2015).
- Cyber-physical convergence
  The convergence of computer network, telecom network, and IoT triggers further convergence of cyberspace and physical space, and results in various smart spaces, such as smart home, smart office, smart factory, smart laboratory, smart store, smart marketplace, smart hospital, smart museum and smart city (Agarwal & Brem, 2015; Bradley *et al.*, 2015; Gubbi *et al.*, 2013; Miorandi *et al.*, 2012).

In the information technology capability context, IoT capability refers to the firms’ ability to integrate resources and skills arising from IoT to align with the firms’ strategic directions (Bharadwaj, 2000; Grant, 1996). IoT capability enables an organization to exploit and incorporate the above IoT technological features for business value. By using IoT, firms can identify new business opportunities and potential threats, and maintain competitiveness, thus establishing the IoT capability to be a source of competitive advantage (Yu, Nguyen, & Chen, 2016). A firm with IoT capability is competent in developing or deploying IoT core components for business applications, making or using IoT connected products for business benefits, and implementing IoT enabled environments for business value (Porter & Heppelmann, 2014, 2015).

Internet of Things and Sustainable Competitive Advantage

From the strategic management perspective, cost leadership and differentiation are two essential approaches to competitive advantage and basic choices of business strategy (Porter, 1980; Porter & Millar, 1985). Furthermore, researchers have argued that cost leadership and differentiation are not mutually exclusive, but rather are compatible approaches to dealing with external situations, and a combination of strategies could lead to success in various circumstances (Hill, 1988; Li & Li, 2008; Murray, 1988). In the IoT context, whether a firm wants to achieve cost advantage, differentiation advantage, or a combination of both through its IoT capability is a strategic intent, which causes the firm to formulate and implement IoT facilitated cost leadership strategy, differentiation strategy, or a combination of both types of strategy.

Cost leadership strategy requires organizational capabilities to achieve operational efficiency, including time efficiency, cost efficiency, and flexibility. The problem is that employees have spare time and imperfect accuracy, and therefore, they are not very accurate at capturing information about things in the physical world. The IoT sensor technology enables connected devices to sense, observe, and understand the physical world – without the limitations of human entered data (Haddara & Elragal, 2015). Furthermore, enterprises will be flexible enough to respond to production changes swiftly with IoT capability. The functions of IoT-enabled smart factory can integrate technologies of many disciplines. IoT capability helps an enterprise to make extensive use of artificial intelligence, simulation, automation, robotics, sensors, data collection systems, and networks towards advanced engineering and precision machining. These systems make possible the establishment of efficient, collaborative, and sustainable industrial production to achieve sustainable cost advantage (Benias & Markopoulos, 2017).

Differentiation strategy requires organizational capabilities to achieve product or service uniqueness for higher customer premiums. Firms realize products or services differentiation through innovation or customization. IoT capability provides higher accuracy on analyzing and identifying distinctive customer preferences through hidden analytics of interconnected products. Sensor-based information collected through IoT embedded products covers actions of customer purchase and use, and can be analyzed to obtain a much more precise and complete picture of the customer's characteristics and preferences (Ng *et al.*, 2015). Smart laboratories can provide test fields for innovative products and services before delivery to customers. Customer feedbacks are collected and transmitted in real-time through various sensor networks and supportive cloud services for further refinement of innovation or customization. Thus IoT capability could expand opportunities for product or service differentiation, moving competition away from cost alone. This effect is particularly crucial under uncertainty. Therefore, this study proposes the following two hypotheses:

H1a. IoT capability is positively associated with cost performance under uncertainty.
H1b. IoT capability is positively associated with differentiation performance under uncertainty.

Internet of Things and Marketing Intelligence

Effective marketing requires adequate information for planning and allocating resources to different markets, products, territories, and marketing tools (Kotler, 1977). Marketing intelligence is systematically collected and extracted information for making marketing decisions. Marketing intelligence is a critical component for the overall marketing activities of a firm. Acquisition and effective use of marketing intelligence are vital in shaping the firm’s sustainable competitive advantage (Jaworski & Kohli, 1993; Kohli & Jaworski, 1990). Marketing intelligence capability concerns a firm's ability to learn about customers, competitors, channel members, and the broader market environment in which it operates (Day, 1994; Morgan, Slotegraaf, & Vorhies, 2009).

IoT capability can enhance marketing intelligence capability because IoT capability enables a firm with a better ability to sense and collect information from customers and competitors (Yu *et al.*, 2016). IoT capability indicates the ability to merge the digital world with the world of things. It involves the ability of convergence of the manufacturing systems with the power of cloud computing, big data analytics, pervasive sensing, and internet connectivity (Agarwal & Brem, 2015). For a firm with IoT capability, large scale real-time customer surveys can be conducted with the assistance of sensing and recognition technology. Augmented reality enhanced user interface allows users to view and test products and services using their smartphones, tablets, or 3D viewing glasses. The big data from IoT connected products provide a clear picture of product use, showing the features customers prefer. By comparing usage patterns, firms can identify more precise market segmentation information (Porter & Heppelmann, 2015). Firms can then apply this knowledge to generate more valuable intelligence and develop more sophisticated pricing strategies that better match price and value at the market segment.

IoT capability also facilitates collaborations between firms and business partners. Information sharing in the IoT can occur among people, among people and things, and among things. Firms with IoT capability are more convenient to form virtual alliances or virtual groups with partners. These partners could be customers, suppliers, intermediaries, governments, and competitors, all of which are important in the IoT context (Yu *et al.*, 2016). Sensing a predefined incident is often the beginning for information sharing. Information sharing can enhance situational awareness and support collaboration (Lee & Lee, 2015). This cycle of sensing, sharing, and collaboration is the essence of marketing intelligence. As such, IoT capability can enhance a firm’s marketing intelligence acquisition efforts, representing the extent to which they can generate and disseminate marketing intelligence, and which may lead to novel interpretations and recombination of prompt responses to marketing situations. Thus with IoT capability, a firm can transform marketing intelligence capability and enhance marketing results. In summary, we propose the following hypotheses:

H2. IoT capability is positively associated with marketing intelligence capability.

Marketing Intelligence and Sustainable Competitive Advantage

A business strategy includes mission and goal clarity, situation analysis, comprehensiveness of alternative evaluation, and strategy formation process (Slater, Olson, & Hult, 2006). A business strategy concerns the competitive positioning, market segmentation, and industry environment of a company (Porter, 1980). To survive, grow, and sustain, a firm needs to monitor its internal and external status for possible changes. Thus the formulation and execution of a business strategy rely heavily on the collection, extraction, analysis, interpretation, and prediction of internal and external status data of the company (Claver-Cortés, Pertusa-Ortega, & Molina-Azorín, 2012; McAfee & Brynjolfsson, 2012). Therefore, a firm’s marketing intelligence capability is critical in facilitating its business strategy formation. Business strategies of most companies are frequently a combination of their intended strategies and the emergent strategies (Mintzberg, 1985). Business leaders need to analyze the status information of emergence and to make strategy adjustments when appropriate (Mintzberg & Waters, 1985). For this purpose, marketing intelligence capability is also essential as the capability for the strategic decisions to be accurately updated and aligned with competition changes (Akter *et al.*, 2016; Janssen, van der Voort, & Wahyudi, 2017).

Marketing intelligence capability enables a firm to acquire and analyze the cost structures and distinctive features of products and services of peers in the marketplace. It helps the firm to determine which market segments are suitable for cost leadership, and which market segments are feasible for differentiation. Marketing intelligence about cost analytics of all levels needs to be collected and accurately analyzed for a firm to maintain a viable leading cost status. Marketing intelligence regarding customer preferences and distinctive features are required for a firm to determine the need to differentiate its products against the need to keep its cost structure under control in order to offer a unique product at a competitive price (Slater *et al.*, 2006; Xie *et al.*, 2016). In unusual events such as a serious epidemic, marketing intelligence capability is especially crucial for a firm to continue its marketing operation under uncertainty. Therefore, the author proposes the following two hypotheses:

H3a. Marketing intelligence capability is positively associated with cost performance under uncertainty.
H3b. Marketing intelligence capability is positively associated with differentiation performance under uncertainty.

Research Framework

Based on our proposed hypotheses, the research framework is illustrated in Figure 1.

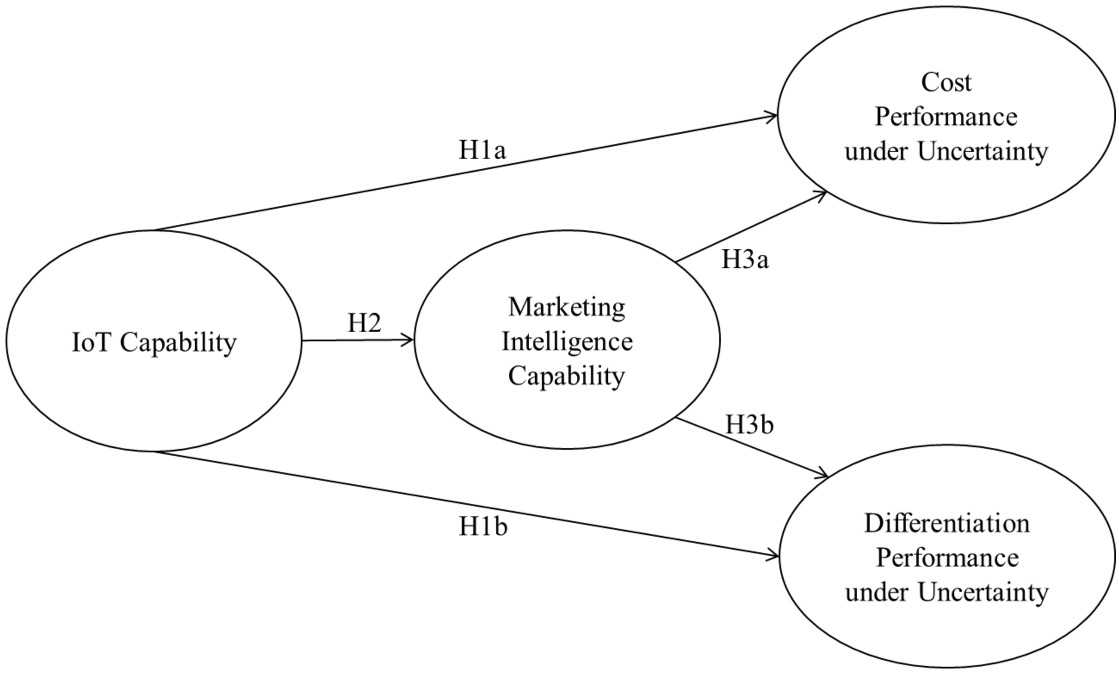

Figure 1: Research framework.

METHOD

Survey Instrument

The survey instrument uses questions derived from the literature on information technology capabilities, marketing capabilities, and Porter's typology of competitive strategies discussed previously. We operationalized the study variables by using multi-item reflective measures on a 7-point scale (1 – strongly disagree; 7 – strongly agree) (Jarvis, MacKenzie, & Podsakoff, 2003). Table 1 presents the construct and item description.

Table 1: Constructs and items used in the survey.

Construct	Items
IoT capability (IoT)	Following the definition of information technology capability by Bharadwaj (2000), a firm's IoT capability is measured here by its ability to develop or deploy IoT based resources, which include the tangible IoT resources, the intangible IoT resources, and the human IoT resources. The tangible IoT resources are tangible things such as IoT components, IoT connected products, and IoT enabled smart environments. The intangible IoT resources are assets such as knowledge, know-how, and synergy about IoT. The human IoT resources comprise technical and managerial IoT staffs. Thus we measure the core capability arising from IoT with three items according to the utilization of the three types of IoT based resources.
Marketing intelligence capability (MIC)	A firm's marketing intelligence capability concerns its competency in intelligence generation, intelligence dissemination, and responsiveness (Kohli & Jaworski, 1990; Kohli, Jaworski, & Kumar, 1993). Marketing intelligence capability is operationalized as the accessibility and utilization of resources and activities within a firm to collect and analyze market information and utilize it to develop effective marketing programs. The ability to effectively gather and disseminate customer and competitor information is critical for marketing intelligence capability (Kohli *et al.*, 1993; Narver & Slater, 1990). This four-item scale was from Vorhies, Morgan, and Autry (2009) and Trainor *et al.* (2013).

Cost performance under uncertainty (CSP)	The construct of cost performance under uncertainty was measured using four items that reflect the extent to which a firm performs a cost efficient strategy. The formation of a cost leadership strategy aims at achieving low manufacturing and distribution costs (Dess & Davis, 1984; Narver & Slater, 1990; Porter, 1980). The third item was the economic scale. A firm can usually lower costs through economies of scale or superior manufacturing processes (Porter, 1980, 1985). Finally, the formation of cost leadership often reflects a lower price of products or services (Dess & Davis, 1984; Robinson & Pearce, 1988).
Differentiation performance under uncertainty (DFP)	The construct of differentiation performance under uncertainty was measured using four items that reflect the extent to which a firm performs a differentiation strategy. Differentiation implies being unique or distinct from competitors by providing superior functionality or customized feature within products or services to customers (Porter, 1980; Wu, 2004). Extending Porter's business strategy framework, Miller (1988) discriminated differentiation strategy based on innovation from that based on intensive marketing (Miller, 1986, 1988). This distinction forms two items included in the construct.
Control Variables	Firm size, IT department size, and industry sector were used as control variables, as these variables have been noted in several studies to affect the deployment of information technologies (Liu *et al.*, 2010; Teo, Wei, & Benbasat, 2003).

Source: This study.

Sample and Data Collection

Enterprises operating in Taiwan were surveyed in order to test the hypotheses. A questionnaire designed following Table 1 above was implemented as the survey instrument. It was then pretested with 13 business executives and managers. The pretesting focused on instrument clarity, wording, and validity. Members of the pretesting sample were invited to comment on the questions and wording of the questionnaire. The comments of these respondents then provided a basis for revisions to the questionnaire to establish content validity.

A sample of 1,000 firms was randomly selected from the top 5,000 list of the largest companies in Taiwan published by a Taiwanese market research organization. Most of the companies on the list are public listed corporations with international operations. On the questionnaire we asked for top MIS managers or CIO level to answer our survey questions. The survey, which took three months to complete, was initially conducted by postal mail and e-mail, and then followed up with telephone calls and in-person visits. A total of 233 responses were received, of which 30 were unusable and eliminated. The remaining 203 responses were used in this study, for a response rate of 20.3%.

The mean differences between responding and non-responding firms were compared along with firm attributes using t-tests, and all statistics were non-significant ($p > 0.5$). Furthermore, the responses were classified into two groups to examine whether there was any response bias. The responses received during the first two months were classified as early returns, and those received during the last months as of late returns. The two groups were then compared for any significant difference in responses using the chi-square test of independence. No significant difference was found between these two groups, supporting that response bias is not an issue in this study (Armstron & Overton, 1977).

RESULTS

Reliability and Validity

To test the hypothesized research model, partial least square - path modeling (PLS-PM) was performed (Ringle, Wende, & Will, 2005). Table 2 reports the quality indicators of the PLS-PM model.

Table 2: Constructs reliability and validity.

Variable	AVE	Composite Reliability	R^2	VIF
IoT	0.719	0.884		1.159
MIC	0.738	0.918	0.113	1.172
CSP	0.695	0.901	0.463	
DFP	0.690	0.899	0.471	

Source: This study.

The AVE (average variance extracted) values of the four variables are all above 0.50, indicating the acceptable explanation powers of the four latent variables towards their measuring items (Hair *et al.*, 2016). The composite reliability are all above 0.7. The values of R2 of the three endogenous latent variables show medium predictability. The VIF (variance inflation factor) values of IoT and MIC are both less than 5.0, indicating low collinearity between the two variables (Hair *et al.*, 2016).

Table 3 summarizes the correlations among different factors. We also assessed discriminant validity based on the construct correlation that Campbell and Fiske (1959) proposed. The values in the diagonal are the square root of AVE (average variance extracted), which should exceed the inter-construct correlations for adequate discriminant validity. The tests indicated acceptable results concerning discriminant validity.

Table 3: Construct correlation.

Construct	1	2	3	4	5	6	7
1. IoT	**0.848**						
2. MIC	0.336	**0.859**					
3. CSP	0.368	0.659	**0.834**				
4. DFP	0.371	0.668	0.621	**0.831**			
5. Firm Size	0.112	0.021	0.063	0.036	1.000		
6. IT Size	0.063	-0.067	0.017	-0.026	0.400	1.000	
7. Industry	0.041	-0.121	-0.034	-0.043	-0.083	-0.242	1.000

Source: This study.

Tests of Hypotheses

The computation result of the model using partial least square algorithm is shown in Figure 2. All of the hypotheses in the research model are tested significant, providing sufficient support to the hypotheses.

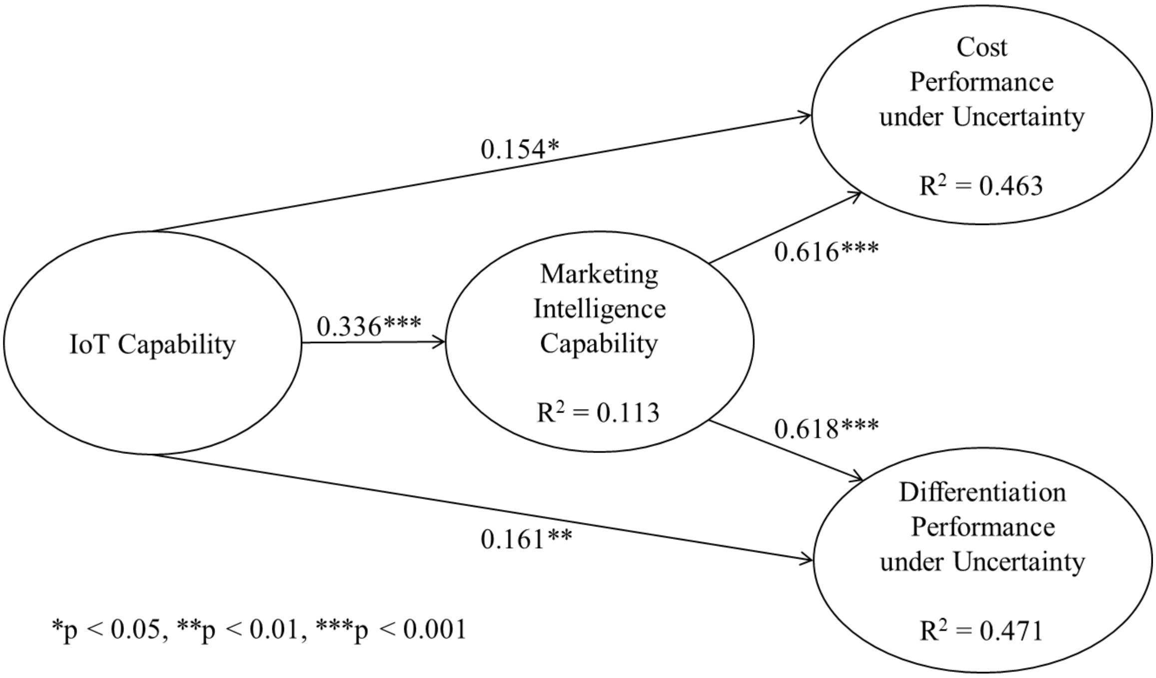

Figure 2: Results of research model.

Table 4 shows the significance test results of the path coefficients in the PLS model using bootstrapping. All of the path coefficients in the PLS model are tested significant.

Table 4: Significance tests of path coefficients.

Path	Path coefficient	t value	p value
IoT → CSP	0.154	2.508	0.013*
IoT → DFP	0.161	2.688	0.008**
IoT → MIC	0.336	4.519	0.000***
MIC → CSP	0.616	9.859	0.000***
MIC → DFP	0.618	9.373	0.000***

*p < 0.05, **p < 0.01, ***p < 0.001

Source: This study.

Table 5 shows the significance test results of the partial effects in the PLS model using bootstrapping.

Table 5: Significance tests of partial effects.

Path	Effect type	Effect	t value	p value	VAF
IoT → CSP	Total effect	0.361	4.767	0.000***	
IoT → DFP	Total effect	0.368	5.352	0.000***	
IoT → CSP	Effect without MIC	0.397	6.087	0.000***	
IoT → DFP	Effect without MIC	0.378	5.444	0.000***	
IoT → MIC → CSP	Indirect effect	0.207	4.453	0.000***	0.573
IoT → MIC → DFP	Indirect effect	0.207	4.411	0.000***	0.563

*p < 0.05, **p < 0.01, ***p < 0.001
Source: This study.

The VAF (variance accounted for) values for the two indirect effects in Table 5 are between 0.2 and 0.8, which verify the partial effects of MIC in the two links (Hair *et al.*, 2016; Preacher & Hayes, 2008).
The causal effects of paths in the model are summarized in Table 6.

Table 6: Causal effects of paths in the hypothesized model.

Hypothesis	Path	The causal effect from test results
H1a	IoT → CSP	Direct effect supported Partial mediation of MIC supported
H1b	IoT → DFP	Direct effect supported Partial mediation of MIC supported
H2	IoT → MIC	Direct effect supported
H3a	MIC → CSP	Direct effect supported
H3b	MIC → DFP	Direct effect supported

Source: This study.

DISCUSSION AND CONCLUSIONS

This study investigated the impact of a firm’s IoT capability on business strategy performance and tested the possible mediating role of marketing intelligence capability. By supporting the research hypotheses, this study can help business managers and strategy practitioners realize the links between organizational capabilities and business strategy performance.
First, the cultivation of organizational capabilities, in general, is expected to enhance an organization’s business strategies and further elevate its competitive advantage (Day, 1994; Grant, 1991; Ravichandran, Lertwongsatien, & Lertwongsatien, 2005). This study substantiates the positive correlation between a firm’s organizational capabilities and business strategy performance. In particular, our results support the positive correlations between two different organizational capabilities and the performance of two types of business strategies. The findings demonstrate that both IoT capability and marketing intelligence capability can have positive effects on the performance of both cost leadership strategy and differentiation strategy, which could further lead to competitive advantage (Porter, 1980, 1985). Therefore, the study serves to inform business managers that firms should do more than just invest in innovative technologies or marketing operations. They need to identify and build distinctive capabilities and put them in productive use. This study suggests that both IoT capability and marketing intelligence capability are worthy of attention in this regard. The findings that these capabilities may impact business strategy performance indicate that their influence on a firm are cross-functional and may transcend managerial hierarchy.

Second, this study identifies a mediator in the association between IoT and business strategy performance. While IoT capability influences business strategy performance positively, our findings also point out that the link between IoT capability and business strategy performance is partially mediated by marketing intelligence capability. Our study is unique in that it explores the link between IoT capability and marketing intelligence capability. The results reveal the mediating role of marketing intelligence capability on the relationship between IoT capability and business strategy performance. For the partial mediation effect, both of the links between IoT capability and marketing intelligence capability and between marketing intelligence capability and business strategy performance need to be significant, and the influence of IoT capability on business strategy performance is alleviated with the presence of marketing intelligence capability (Baron & Kenny, 1986). That is, in addition to the direct effect of IoT capability on business strategy performance, there is also an indirect effect through marketing intelligence capability. These two effects contribute to the total effect of IoT capability on business strategy performance. The extant literature seldom elaborates on what happens to the inside of a firm with the introduction of IoT. Most of the present research draws more attention to the analysis of how IoT could influence business performance. This study points out how IoT could influence the business strategy performance through the mediating role of marketing intelligence. Our findings support not only the marketing orientation concept of Jaworski and Kohli (1993), but also the hierarchy model of capabilities of Grant (1996). From the managerial implication perspective, the marketing department in a firm is skillful at sensing and understanding the outside environment. If a business strategy of a firm can fit into its surroundings, its performance is usually enhanced. Thus, a marketing department in a firm becomes critical for a firm to make its business strategies fit with its surroundings. Our findings suggest that IoT capability can facilitate the marketing department of a firm for the generation, dissemination, and analysis of marketing intelligence to shape the firm’s business strategy for competitive advantage.

In essence, IoT capability and its output, pervasive sensing and connectivity with embedded analytics, enable firms to deploy and operate in smart environments and thus could enhance the functional level operations with efficiency and flexibility to achieve cost leadership or differentiation, or a combination of both. It is also because of the cross-functional nature of pervasive sensing and connectivity with embedded analytics, IoT capability can have a positive influence on some other organizational capabilities, such as marketing intelligence capability. Marketing intelligence capability and its output, marketing intelligence, enable firms to anticipate and understand better the customer needs and the competitive situation, to deal with this information faster, and to develop products and services with lower cost or with differentiated features, which empower firms to sustain a competitive advantage. In conclusion, during the recent abnormal time of global epidemic while in-person and face-to-face contacts are restricted and marketing activities are limited, our results indicate that IoT utilization for marketing intelligence provides a possible capability toward sustainable competitive advantage.

Further research efforts that focus on accumulating more empirical evidence for assessing and validating empirical data are recommended to overcome the limitations of the present study. Such research is required to address how other emerging technologies are related to business strategies and functional operations. For example, wearable interface technology (Chan *et al.*, 2012; Chen *et al.*, 2015; Gruebler, Berenz, & Suzuki, 2012; Weng & Lin, 2014d) and augmented reality technology (Chung, Han, & Joun, 2015; Meža, Turk, & Dolenc, 2015; Petersen & Stricker, 2015) have received inadequate attention from strategic considerations and organizational capability theories. Moreover, special attention could be focused on data collected in various sub-industries or specific contexts over an extended period. The analysis of these data may enable conclusions to be drawn about more generalized relationships among business-level strategy, functional-level strategy, and technology-based organizational capability.

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