Advance Journal of Food Science and Technology 10(12): 899-907, 2016
DOI: 10.19026/ajfst.10.2284
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: April 2, 2015 Accepted: April 22, 2015 Published: April 25, 2016

Research Article

The Antecedents and Outcomes of the Internet of Things Use in Food Firms: The Moderating Role of Firm Size

Xiuhe Yu, Fanbo Meng, Yuanyuandang, Xiaoyang Zhang, Yuqiang Feng
School of Management, Harbin Institute of Technology, Harbin, China

Abstract: This study examines the antecedents and outcomes of the use of Internet of Things (IoT) in firms and the moderating role of firm size. Drawing on institutional theory, Corporate Social Responsibility (CSR) and IoT use in firms, we propose a model that is empirically tested by survey data from 352 enabled food firms in Heilongjiang provice. The results show that institutional theory factors and corporate social responsibility determine firms' IoT use behavior. The results further indicate that IoT use positively infuences firms' quality and operational performance. The moderating effect of firm size on the relationship between IoT use and operational performance is negative, indicating that IoT can play a more positive role on opertation management in small firms. These findings contribute to the literature on IoT in food safety and are the basis for recommendations for advancing IoT.

Keywords: Corporate social responsibility, food safety, institutional theory, performance, the internet of things

INTRODUCTION

As a Chinese old saying says, "As food comes first to humans, so does safety to food." The importance of food safety cannot be ignored. Although food safety is playing an increasingly indispensable role in modern life, severe food safety accidents have occurred frequently in recent years. For example, "Sudan I" was found in ingredients of KFC chicken wings and chicken burgers in 2005 by the Shanghai quality inspection department (Qiao *et al*., 2012); "Sanlu" melamine milk powder caused thousands of babies to suffer from a series of diseases such as urinary tract stones and malnutrition in 2008 (Veil and Yang, 2012). In 2001, foot-and-mouth disease broke out in the United Kingdom and Ireland, a crisis that lasted for eleven months and that gave rise to a large reduction of European meat markets and a dramatic loss of breeders (Thompson *et al*., 2002). In 2006, the world famous British chocolate maker, Cadbury food, produced chocolate using seriously polluted water, resulting in 42 people being poisoned. These events point to the importance of food safety management, a value that is highly supported by the public.

From the beginning of the 21st century, the Internet of Things (IoT) has attracted numerous in-depth technical studies and applications (Chen *et al*., 2008; Welbourne *et al*., 2009; Kortuem *et al*., 2010) in the international context. Information Communication Technology (ICT), including the Internet of Things plays indispensable significant role in the process of food safety management (Regattieri *et al*., 2007). Applying IoT technology in food safety process management could track events from top to bottom and vice versa and achieve the whole process management of information (Yuan, 2011). This would contribute to improved capacity and efficiency of food traceability and recall, thus effectively eliminating food safety hazards and food safety risks and resulting in improved food safety.

With the development and application of Information Technology (IT), applied IT in the food industry has become a worldwide hot topic (Hill and Scudder, 2002; Xu, 2011). Numerous enterprises have begun to use IT to monitor and manage the production process, especially after greater efficiency and other advantages of IT have been reported by many scholars (Melville *et al*., 2004). Although some companies have made good use of IT in their supervision of food production; nevertheless, there are still many large-scale enterprises unwilling to use IT in their supervision of safety in food production.

While some enterprises have enhanced their business performance greatly after use of IoT, the efficiency and productivity of others have declined after use (Bharadwaj, 2000). In order to understand the causes and effects of these phenomena, this study examines the extent and reasons of IoT usage in food enterprises and the effects of IT use on enterprises' performance.

There is no unified view on how environmental and institutional factors affect technology use in a company (Zhang and Dhaliwal, 2009). A food company is different from general companies facing pressure from competitors and supply partners because a food

Corresponding Author: Fanbo Meng, School of Management, Harbin Institute of Technology, Harbin, China

company faces coercive pressure related to food safety and public health issues (Batie, 1997). Thus, institutional theory is suitable for this phenomenon (DiMaggio, 1988). However, corporate social responsibility in Food Company is closely linked with food safety practices (Kong, 2012).

This study uses institutional theory and corporate social responsibility as the antecedents of firm IoT use behavior. For the effects of IoT usage, we use operation performance and quality performance to measure the impacts, as operation and quality management play a direct role of IoT in food industry. To investigate whether the IoT has different impacts on different kinds of firms, this study also tests the moderating role between IoT use and impacts.

The antecedents and consequences of this model, this study offers two main theoretical contributions to the IoT literature. First, although many studies have focused on the application of IoT and on the antecedents and consequences of IoT, this study specifically investigates the antecedents and consequences of IoT in the food industry. Second, to study the antecedents of IoT use in food firms from the perspectives of institutional theory and corporate social responsibility not only builds anintegrated perspective from a firm's pressure and intrinsic responsibility, but also investigates the antecedents and consequences of IoT at different levels of firm sizes, all of which will give a better understanding of firms'IoT related practices.

LITERATURE REVIEW

The Internet of Things (IoT): Although there are some similar features between the Internet of Things (IoT) and the Internet, the IoT is not a simple extension of the traditional MIS. The IoT is the third upsurge in the world information industry after the computer, Internet and mobile communication network (Sarma and Girão, 2009). More specifically, the IoT can combine the Internet and a variety of information sensing devices, such as Radio Frequency Identification (RFID) devices, infrared sensors, global positioning systems, laser scanners and other devices. It becomes a vast network that can connect many objects with the Internet (Strategy and Unit, 2005; González *et al*., 2008). This, for example, could result in a system quickly and automatically identifying, locating, tracking and monitoring objects.

The IoT, very suitable for the process management of food supply chain, can not only identify individual objects, but also effectively identify any contact point in the supply chain. Widespread use of the IoT in the food industry increases the possibility of improving the food traceability system (Regattieri *et al*., 2007). Technologies of information automatic collection and identification, such as barcode and RFID (Katz and Rice, 2009), can identify managerial objects in processes of food supply chain such as production, processing, storage, retail and so on. When food quality and safety problems occur, the IoT first accurately narrows down the range of food quality and safety problems and then can trace the source of the food quality and safety problems (Welbourne *et al*., 2009).

Institutional theory: The institutional theory proposed by DiMaggio and Powell (1983) illustrates that three external pressures can explain the phenomena of inter-organizational isomorphism and Mimetic behavior: mimetic pressure, coercive pressure and normative pressure. Mimetic pressure results in satisfying social expectation or organizational legitimacy instead of improving performance or gaining competitive advantages. Especially in uncertain external surroundings, the best decision designed by the organization is mimetic isomorphism (Mizruchi and Fein, 1999). Food firms who adopt the IoT cannot ignore the effects of mimetic pressures. Faced with a new technology, a firm cannot ensure its effects on economic performance, operational performance and adaptability of a new system. However, if industry leaders have already used the new technology, their success can be perceived by subordinates. As a result, they may intimate their leaders.

Coercive pressure, the second form of external pressure, arises from the formal regulations and policies from government and informal regulations from the industry and associations (Liang *et al*., 2007). For two reasons, the use of the IoT (traceability system) is extremely mandatory in the field of food safety. First, food safety problems have occurred frequently in recent years, leading the government and society to pay closer attention to these problems and publish regulations and guidelines. Second, since many major suppliers of food and agricultural food and distribution enterprises have a command of the IoT, relevant enterprises suffer pressure undoubtedly arising from the competitive environment, business partners, upper companies and companies upstream and downstream.

Normative pressure, the third form of external pressure, arises from industry professionalization that influences firms not only in holding common norms and values, but also in conducting similar practices (DiMaggio and Powell, 1983). On the basis of social contagion theory, a variety of firms and enterprises in upstream and downstream relations become aware of cost-effective and efficient technologies, which encourages observant enterprises to adopt the same technology (Burt, 1987). As a result, more and more firms will follow and share the regulations, which can strengthen the regulations (DiMaggio and Powell, 1983).

There are two reasons why institutional theory has been widely used in the field of information system management. First, information systems involve innovation, complexity and uncertainty. Second, information technology and information systems have become a necessary part in modern firms' operation; today, using information systems is considered to be a leading and innovative trend, especially when it improves a firm's reputation and fame (Wang, 2010).

The use of a new technology does not necessarily mean adoption. As is known, an organization may not always fully succeed in its innovation and may, for various reasons, even experience failure to adopt the new technology. Liang's research on the absorption stage of Enterprise Resource Planning (ERP) system indicates that institutional pressure can also enhance the assimilation within an organization after the implementation of complicated IT (Liang *et al*., 2007). Thus, this study uses institutional theory to investigate IoT use behavior in firms.

Corporate social responsibility: With the development of economics in society, firms can gain huge profits while also causing numerous social problems, such as employee safety and health issues; false advertising; product quality and safety issues; environmental pollution and ecological damage; and so on (Panayiotou *et al*., 2009). Faced with these serious problems, companies must bear some responsibility, for example, firms should not only make profit, but should also take social responsibility for employees, the environment and society. As a result, corporate social responsibility will emerge.

Corporate social responsibility is defined as a company's obligation to gain positive impacts and reduce negative impacts on society (Pride and Ferrell, 2000). The connotation of corporate social responsibility points to a complex and tortuous process. At present, the corporate social responsibility four-dimensional pyramid model is widely accepted, which includes economic responsibility, legal responsibility, moral responsibility and philanthropic responsibility (Carroll, 1991).

The economic responsibility of a firm is profitability, meaning that all activities of an enterprise aim to make a profit. All other business responsibilities of an enterprise are based on economic responsibility. Legal responsibility means that enterprises have to abide by the laws that are an integration of the right and wrong in society. Enterprises have to abide by the economic targets but stay within the legal framework. Despite the economic responsibility and legal liability reflecting the ethical norms of fairness and justice, moral responsibility includes these members of banned activities and practices, even though they are not the part of the law. Philanthropic responsibility means the firm's response of society to promoting human welfare and goodwill (Carroll, 1991).

RESEARCH DESIGN

Based upon institutional theory, corporate social responsibility and IoT use in firms, this study proposes a model to explain why firms use IoT and the impact it has on their performance.

Figure 1 presents the model, the first part of which focuses on the antecedents of IoT use; the second focuses on the impact of IoT use on firms' operational and economic performance and the moderating role of firm size. Each of the antecedents of IoT use will be discussed in greater detail, after which we elaborate on the impact of IoT use on firm performance and the moderating role of firm size.

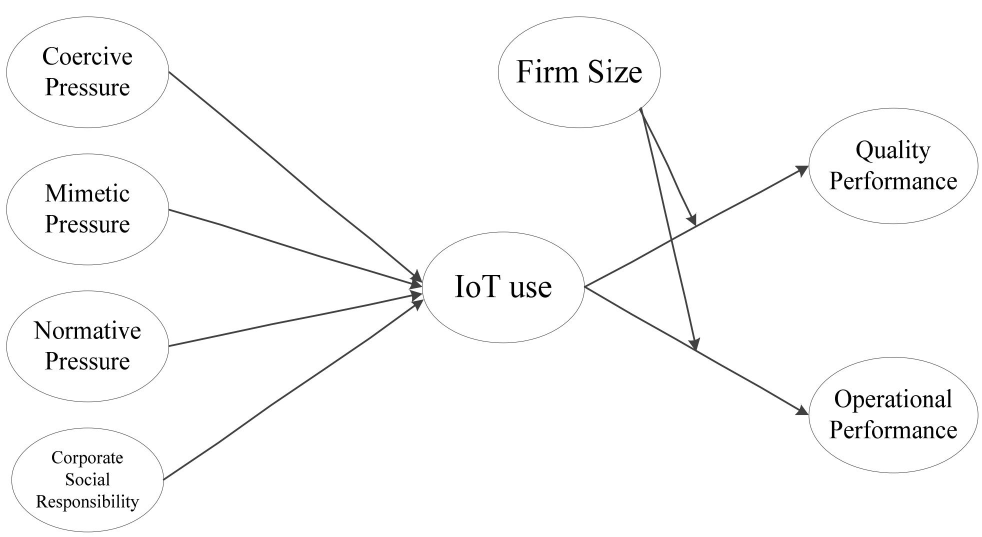

Fig. 1: Research model

Coercive pressure has a positive effect on the use of IoT: Coercive pressure means that enterprises when making decisions would inevitably be impeded by external pressure of other enterprises and social cultural expectations (Armstrong and Sambamurthy, 1999); or political regulations, industrial rules and consensus; or weighted consideration in market competition regime (DiMaggio and Powell, 1983; Kostova and Roth, 2002; Teo *et al*., 2003; Benders *et al*., 2006). Undoubtedly, this pressure would lead enterprises to the direction of convergence or the best solutions. In the food manufacturing industry, the pressure comes from strict governmental regulations on food safety, food quality standards of downstream enterprises and high expectations of superior quality food from ultimate consumers. All these pressures motivate enterprises to accept more standardized management systems and more advanced monitoring technology to relieve the pressure of revolution and development. The IoT mentioned in this study can be seen as a powerful monitoring technology that is helpful to enterprises' real-time traceability and whole monitoring process, including food purchase, production and processing, transportation, as well as sales and consumption. When enterprises face coercive pressures from the government, downstream enterprises and ultimate consumers, the enterprises will be more willing to adopt the IoT to achieve more comprehensive, dynamic food safety management, an indication of the positive effects of coercive pressure on the use of the IoT.

Mimetic pressure has a positive effect on the use of the IoT: Mimetic pressure refers to external uncertainties that lead enterprises to imitate behaviors of other organizations. Because of the lack of technical knowledge, unclear targets and uncertain environments, enterprises may choose to imitate other enterprises' behaviors in order to achieve success. In the food manufacturing industry, the IoT is still very new to most enterprises, where the required investment in the food safety traceability system is seen to be extremely huge. For many enterprises, investing in the IoT is perceived to be a high-risk behavior in which they would not dare to engage. However, if some enterprises attempt to use it and succeed, other enterprises may imitate the behavior of successful examples and eventually adopt the IoT. To conclude, enterprises in the same industry prefer imitating behaviors of successful enterprises who are using the IoT before risking their investment. This indicates positive effects of mimetic pressure on the IoT.

Normative pressure has a positive effect on the use of the IoT: Normative regulation originates from professionalization, which defines a profession's working conditions and methods in order to control professionalization and legitimacy (Teo *et al*., 2003; Mun and Davis, 2003). Normative pressure means that for one enterprise, similar positions and processes should maintain the same requirements and standards in the same industry. For example, in the food manufacturing industry, every enterprise should maintain the same level of food safety control and management. When the IoT is viewed as an indispensable factor in food safety control and management, enterprises will perceive that normative pressure can motivate them to use the IoT. This indicates positive effects of normative pressure on the IoT.

Based on the above analysis, the following hypotheses are proposed:

H1: Coercive pressure has a positive effect on the use of the Internet of Things.
H2: Mimetic pressure has a positive effect on the use of the Internet of Things.
H3: Normative pressure has a positive effect on the use of the Internet of Things.

Except for the effects of social system factors, both social ethics and enterprises' overall consideration of the whole society also influence enterprises' decision behaviors. These considerations could indicate corporate social responsibility.

Corporate social responsibility has a positive effect on the use of the IoT: Corporate Social Responsibility (CSR) is evident when an enterprise makes efforts for corporate overall interest and law instead of only making profit (Foster, 2008). These efforts include: eliminating animal testing and waste reuse, reducing pollution and using products to show social attributes and characters (Foster, 2008). In the food manufacturing industry, producing safe and reliable food is a specific behavior to show social attributes and characters. To conclude, corporate social responsibility could be achieved by manufacturing safe and reliable food. However, the IoT plays a necessary role in guaranteeing food safety. Therefore, corporate social responsibility has a positive effect on the use of the IoT. Based on the above analysis, the following hypotheses are proposed:

H4: Corporate social responsibility has a positive effect on the use of the IoT.

The impact of IoT use on firm performance: First, from the perspective of corporate performance metric, the potential profit of investing in IT is obvious (Nysveen *et al*., 2005), including quality performance (McAfee, 2002; Prajogo and Sohal, 2003) and profit of operational performance (Lichtenberg, 1995; Brynjolfsson and Hitt, 1996). Product quality is considered to be an important index for a manufacturing enterprise, directly affecting an enterprise's economic profit. Hence, enterprises usually pay close attention to it. In the food industry, product quality plays an indispensable role and is strictly monitored and controlled by the IoT: it ensures that every process meets the requirements and effectively improves the product quality during the whole process of food production. Based on the above, the IoT has a positive effect on quality performance.

Second, enterprises investing in information technology expect to gain profits of operational performance, such as reaction time, inventory, agility and on-time delivery (Lichtenberg, 1995; Brynjolfsson and Hitt, 1996), in comparison to output results and improving productivity. Thanks to the use of the IoT, food-manufacturing enterprises can also gain profits of operational performance. In conclusion, the use of the IoT has a positive impact on operational performance.

Based on the above analysis, the hypotheses are proposed as follows:

H5: The use of the Internet of Things has a positive impact on the quality of performance.
H6: The use of the Internet of Things has a positive impact on operational performance.

The moderating role of firm size: Firm size is an important factor in orgnizationalstructure and its influence on organizational performance has been widely studied (Gefen *et al*., 2000; Mun and Davis, 2003; Bentler and Chou, 1987). Firm size first increases the difficulty and complexity of a firm's staff management and then influences organizational performance. As employees are the end users of IoT, their use intention and proficiency will influence the impact of IoT directly. We propose that when employees have the same level of learning ability, it will positively affect their work motivation. Compared with large firms, small firms generally have fewer employees and are thus able to provide more detailed and personalize dtraining in the implementation of IoT. In post implementation, they can also buildmore powerful supervision mechanisms to ensure employees'effective use of IoT. Thus, we propose that firm size plays a negative moderating role in the effect of IoT use on performance.

H7: Firm size negatively moderates the positive relationship between IoT use and quality performance.
H8: Firm size negtively moderates the positive relationship between IoT use and operational performance.

METHODOLOGY

Data collection: To test our research model, a questionnaire was developed to collect data. Some of the items were adapted from previous studies and some were self-developed. The items of institutional theory factors (coercive pressure, mimetic pressure and normative pressure)were adapted from Liang *et al*. (2007). The items of corporate social responsibilitywere adapted from Lai *et al*. (2010). The items of IoT use were self-developed. The items of qualty performance were partly adapted from Hung *et al*. (2003) and operational performance partly from Samson and Terziovski (1999). The questionnaire was first developed in English and then translated into Chinese. See Appendix A for details of the questionnaire.

The questionnaire was sent out to 450 IoT enabled food firms in Heilongjiang provice, China, by telephone, email and visits. The respondents are middle and senior managersin firms and are fimilar with the firm's environment, pressures, IoT conditions and performance. After removing the incomplete cases, a total of 352 responces were collected.The descriptive statistics of the firms are shown in Table 1.

Measurement model: First,the measure model was tested by Smart PLS. Table 2 and 3 show the results. As seen in Table 3, the Composite Reliabilities (CR) are greater than 0.79 and the Average Variances Extracted (AVE) are greater than 0.66, higher than the expected cut-off values of 0.70 and 0.50, respectively (Fornell and Larcker, 1981), which suggests good construct reliability. As seen in Table 3, factor loadings are significant and higher than 0.75, indicating good convergent validity. Further, as is evident in Table 3, the square roots of AVEs are greater than the correlations. Therefore, the discriminate validity is acceptable.

Structual model: The structual model was also tested by Smart PLS. Figure 2 shows the results. Firm size is measured by employee number. The results show that Coecive Pressure (β = 0.260, t = 3.3733), Normative Pressure (β = 0.174, t = 2.394) and Corporate Social Responsibility significantly affect IoT use in firms, which supports H1, H3 and H4.IoTuse was found to significantly affect Quality Performance (β = 0.706, t = 17.38) and Operational Performance (β = 0.716, t = 17.036), which supports H5 and H6. The moderating

Table 1: Firm demographics

Employee	<10	10-50	50-100	100-200	200-300	>300
number	87	131	70	16	5	49
	24.7%	37.2%	19.9%	5.7%	1.4%	11.1%
Main	1	2-3	4-5	6-7	8-9	>10
products	19	62	47	39	18	166
	5.4%	17.6%	13.3%	11.1%	5.0%	47.2%
Kinds of	State owned	Joint firms	Foreign firms	Private firms	Others	
the firm	14	38	25	197	78	
	4.0%	10.8%	7.1%	56.0%	22.2%	

Table 2: Items and loadings

Construct	Item	Mean	Loading	t-Statistics
Coercive Pressure (CP)	CP1	4.53	0.767	3.710
	CP2	5.89	0.923	77.62
	CP3	5.66	0.896	43.06
Mimetic Pressure (MP)	MP1	6.26	0.802	12.58
	MP2	6.07	0.809	129.3
	MP3	5.94	0.716	76.83
Normative Pressure (NP)	NP1	5.04	0.718	29.27
	NP2	5.57	0.958	19.67
	NP3	5.65	0.946	11.95
Corporate Social	CSR1	5.77	0.768	21.03
Responsibility(CSR)	CSR2	6.07	0.840	28.80
	CSR3	6.13	0.838	46.62
IoT use (TU)	TU1	5.98	0.911	56.31
	TU3	6.16	0.909	65.53
	TU4	5.87	0.901	52.11
Quality	QP1	6.10	0.864	50.01
Performance(QP)	QP2	5.99	0.890	39.54
	QP3	6.31	0.856	46.23
	QP4	6.15	0.852	38.52
Operational	OP1	6.13	0.875	44.27
Performance (OP)	OP2	6.12	0.917	71.97
	OP3	6.14	0.907	77.28
	OP4	6.10	0.879	53.60

Table 3: Correlations and discriminant validity

	AVE	C.R.	Cronbach's α	CP	MP	NP	SR	TU	QP	OP
CP	0.597	0.798	0.689	0.773						
MP	0.776	0.911	0.863	0.660	0.8808					
NP	0.604	0.820	0.677	0.565	0.570	0.777				
SR	0.667	0.857	0.757	0.504	0.608	0.643	0.8152			
TU	0.823	0.933	0.892	0.510	0.353	0.522	0.582	0.907		
QP	0.750	0.923	0.889	0.461	0.439	0.510	0.651	0.671	0.865	
OP	0.801	0.941	0.917	0.435	0.424	0.559	0.647	0.691	0.880	0.895

The data in bold diagonals refers to the square roots of AVE

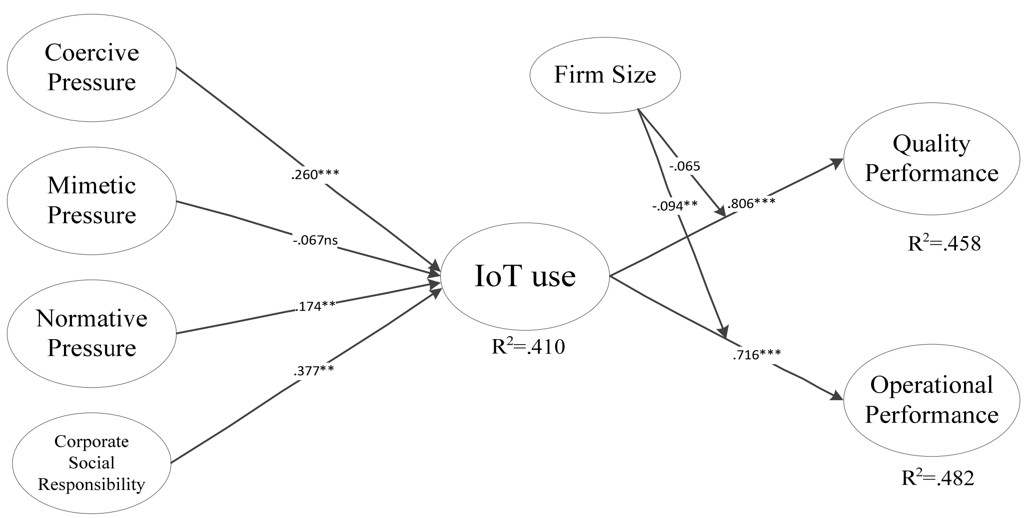

Fig. 2: Structural model results

role of firm size on the relationship between IoT use and Operational Performance is significant, which supports H8.

DISCUSSION

Key findings: IoT is widely used in the food industry. In order to understand the causes and impacts of IoT use behavior in the food industry, an integrated research model was built and then empirically tested by a survey. We now discuss the key findings in greater detail.

First, institutional theory factors and corporate social responsibility determinesfirms' IoT use behavior. Our study points out that the reasons why firms use IoT come not only from external pressure, but can also result from self responsibility. As the food industry is related to food safety, food firms may face more external pressure from the government and society, which will drive them to use new technology to safeguard food quality. The effect of Mimetic Pressure was not significant. A possible reason is that when Coercive Pressure and Normative Pressure aretoo strong in the food industry, the firm has no choice but to use IoT and then may not feel mimetic pressure.

Second, IoT use positively infuences a firm's quality and operational performance. IoT can enable better quality monitoring and increase better information transferin the firm, which will contribute to quality and operation management. Thus, we can conclude that IoT use in food firmscan increase food quality and operation management.

Finally, the moderating effect of firm size on the relationship between IoT use and operational performance is negative, indicating that in small firms the IoT can play a more positive role in operation management.

Implications:

Theoretical implications: This study enriches the research on IoT in the food industry in several ways. First, this study offers a comprehensive understanding of IoT use behavior in food firms. With the limited research in this area, most studiesinvestigate only the adoption intention of IoT from the technology perspective. This study advances existing research by integratingthe factors of IoT use behavior from external pressure and internalresponsibilty. Through this integration, scholars can gain a better understanding of how firms are driven by external and internal factors.

Second, this study reports the positive effects of IoT use on firm quality and operational performance and the negative moderating role of firm size. Apart from the many published arguments about the effects of Information Technology, this study shows IoT has positive effects on a firm's quality and operational performance. Moreover, the moderating role of firm size was found to be negative, shedding new light on the role of firm size.

Practical implications: This study has identified two main roles of IoT in the food industry that significantly indicate the value of IoT, an aspect is very important in solving the food safety problem. Further, to find out whether IoT has different impacts on various types of firms, this study gives a better understanding of a firm's IoT related practices and illustrates that how to develop the IoT system.

LIMITATIONS

Our findings should be interpreted in the light of the limitations of the study. Because the study was conducted in China, which has a collectivistic culture, applying the conclusions to other cultural societies should be further examined in future research.

CONCLUSION

To further the understanding of why firms use IoT and its impact on performance, we proposed a model based on institutional theory, corporate social responsibility and IoT use in firms. First, institutional theory factors and corporate social responsibility determined firms' IoT use behavior. Our study points out that the reasons why firms use IoT not only come from external pressure, but can also result from self responsibility. Second, we found that IoT use positively infuences a firm's quality and operational performance.

Finally, we identified the moderating effects of firm size on the relationship between IoT use and operational performance to be negative, indicating that in small firms the IoT can play a more positive role on operational management. These findings can contribute to the literature on IoT in food safety and provide recommendations for advancing the IoT.

ACKNOWLEDGMENT

This study was partially funded by NSFC 71471048, 71471049, 71101037, NCET-12-0146 and the Hong Kong Scholars Program2012-060.

Appendix A:

Coercive pressure: There is definite pressure from our government to meet food safety standards.

Our government takes an active role on food safety matters.
We cannot take food safety lightly as our government will hold us accountable.

Normative pressure:

Our customers pressure us to do better on food safety
We have to meet standards for food safety as our customers are demanding us to do so
Our customers hold us accountable for food safety

Mimetic pressure:

We feel that we have to adopt food safety practices because everybody else does it.
We feel the pressure to adopt food safety practices as most of our peers have done so.
We feel that we have to adopt food safety practices as most of our rivals have done so.

Corporate social responsibility:

We adopt food safety practices to make us look good.
We adopt food safety practices to show the public that we care.
We adopt food safety practices to fulfill our social obligations.

IoT use:

We monitor the loading/unloading process of cargo to identify potential safety breaches
We exploit cargo tracking solutions
We use sophisticated technologies to detect if containers have been compromised

We use RFID or other similar technology for tracking purposes throughout our supply chain

Quality performance: In the last 3 years, we have experienced:

An improvement in supply chain food safety
A reduction/less potential for theft/loss
An improvement in food quality
A reduction in food contamination

Operational performance: In the last 3 years, we have experienced:

An improved capability to detect counterfeit food ingredients
An increase in our ability to deal with serious crises
Faster response to problems in the supply chain
An improved ability for early intervention

REFERENCES

Armstrong, C.P. and V. Sambamurthy, 1999. Information technology assimilation in firms: The influence of senior leadership and IT infrastructures. Inform. Syst. Res., 10(4): 304-327.

Batie, S.S., 1997. Environmental Issues, Policy and the Food Industry. In: Wallace, L.T. *et al*. (Eds.), Government and the Food Industry: Economic and Political Effects of Conflict and Co-Operation. Kluwer Academic Publishers, Springer, US, pp: 235-256.

Benders, J., R. Batenburg and H. van der Blonk, 2006. Sticking to standards: Technical and other isomorphic pressures in deploying ERP-systems. Inform. Manage., 43(2): 194-203.

Bentler, P.M. and C.P. Chou, 1987. Practical issues in structural modeling [J]. Sociological Method. Res., 16(1): 78-117.

Bharadwaj, A.S., 2000. A resource-based perspective on information technology capability and firm performance: An empirical investigation. MIS Quart., 24(1): 169-196.

Brynjolfsson, E. and L. Hitt, 1996. Paradox lost? Firm-level evidence on the returns to information systems spending. Manage. Sci., 42(4): 541-558.

Burt, R.S., 1987. Social contagion and innovation: Cohesion versus structural equivalence. Am. J. Sociol., 92(6): 1287-1335.

Carroll, A.B., 1991. The pyramid of corporate social responsibility: Toward the moral management of organizational stakeholders. Bus. Horizons, 34(4): 39-48.

Chen, R.S., C.C. Chen, K.C. Yeh, Y.C. Chen and C.W. Kuo, 2008. Using RFID technology in food produce traceability [J]. WSEAS T. Inform. Sci. Appl., 5(11): 1551-1560.

DiMaggio, P.J., 1988. Interest and Agency in Institutional Theory. In: Zucker, L.G. (Ed.), Institutional Patterns and Organizations: Culture and Environment. Ballinger, Cambridge, MA, 1: 3-22.

DiMaggio, P. and W.W. Powell, 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. Am. Sociol. Rev., 48(2): 147-160.

Fornell, C. and D.F. Larcker, 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Marketing Res., 18: 39-50.

Foster, S.T., 2008. Towards an understanding of supply chain quality management [J]. J. Oper. Manag., 26(4): 461-467.

Gefen, D., D. Straub and M.C. Boudreau, 2000. Structural equation modeling and regression: Guidelines for research practice [J]. Commun. Assoc. Inform. Syst., 4(7): 1-77.

González, G.R., M.M. Organero and C.D. Kloos, 2008. Early infrastructure of an internet of things in spaces for learning. Proceeding of 8th IEEE International Conference on Advanced Learning Technologies (ICALT'08).

Hill, C.A. and G.D. Scudder, 2002. The use of electronic data interchange for supply chain coordination in the food industry. J. Oper. Manag., 20(4): 375-387.

Hung, Y., M. Huang and K. Chen, 2003. Service quality evaluation by service quality performance matrix. Total Qual. Manag. Bus., 14(1): 79-89.

Katz, J.E. and R.E. Rice, 2009. Public views of mobile medical devices and services: A US national survey of consumer sentiments towards RFID healthcare technology. Int. J. Med. Inform., 78(2): 104-114.

Kong, D., 2012. Does corporate social responsibility matter in the food industry? Evidence from a nature experiment in China. Food Policy, 37(3): 323-334.

Kortuem, G., F. Kawsar, D. Fitton and V. Sundramoorthy, 2010. Smart objects as building blocks for the internet of things. IEEE Internet Comput., 14(1): 44-51.

Kostova, T. and K. Roth, 2002. Adoption of an organizational practice by subsidiaries of multinational corporations: Institutional and relational effects. Acad. Manage. J., 45(1): 215-233.

Lai, C.S., C.J. Chiu, C.F. Yang and D.C. Pai, 2010. The effects of corporate social responsibility on brand performance: The mediating effect of industrial brand equity and corporate reputation. J. Bus. Ethics, 95(3): 457-469.

Liang, H., N. Saraf, Q. Hu and Y. Xue, 2007. Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. MIS Quart., 31(1): 59-87.

Lichtenberg, F.R., 1995. The output contributions of computer equipment and personnel: A firm-level analysis. Econ. Innov. New Technol., 3(3-4): 201-218.

McAfee, A., 2002. The impact of enterprise information technology adoption on operational performance: An empirical investigation. Prod. Oper. Manag., 11(1): 33-53.

Melville, N., K. Kraemer and V. Gurbaxani, 2004. Review: Information technology and organizational performance: An integrative model of IT business value. MIS Quart., 28(2): 283-322.

Mizruchi, M.S. and L.C. Fein, 1999. The social construction of organizational knowledge: A study of the uses of coercive, mimetic and normative isomorphism. Admin. Sci. Quart., 44(4): 653-683.

Mun, Y.Y. and F.D. Davis, 2003. Developing and validating an observational learning model of computer software training and skill acquisition [J]. Inform. Syst. Res., 14(2): 146-169.

Nysveen, H., P.E. Pedersen and H. Thorbjørnsen, 2005. Intentions to use mobile services: Antecedents and cross-service comparisons. J. Acad. Market. Sci., 33(3): 330-346.

Panayiotou, N.A., K.G. Aravossis and P. Moschou, 2009. A new methodology approach for measuring corporate social responsibility performance. Water Air Soil Pollut. Focus, 9(1-2): 129-138.

Prajogo, D.I. and A.S. Sohal, 2003. The relationship between TQM practices, quality performance and innovation performance: An empirical examination. Int. J. Qual. Reliab. Manage., 20(8): 901-918.

Pride, W.M. and O.C. Ferrell, 2000. Marketing: Concepts and Strategies. Houghton Mifflin.

Qiao, G., T. Guo and K. Klein, 2012. Melamine and other food safety and health scares in China: Comparing households with and without young children. Food Control, 26(2): 378-386.

Regattieri, A., M. Gamberi and R. Manzini, 2007. Traceability of food products: General framework and experimental evidence. J. Food Eng., 81(2): 347-356.

Samson, D. and M. Terziovski, 1999. The relationship between total quality management practices and operational performance. J. Oper. Manag., 17(4): 393-409.

Sarma, A.C. and J. Girão, 2009. Identities in the future internet of things. Wireless Pers. Commun., 49(3): 353-363.

Strategy, ITU and P. Unit, 2005. ITU Internet Reports 2005: The internet of things. International Telecommunication Union (ITU), Geneva.

Teo, H.H., K.K. Wei and I. Benbasat, 2003. Predicting intention to adopt interorganizational linkages: An institutional perspective. MIS Quart., 27(1): 19-49.

Thompson, D., P. Muriel, D. Russell, P. Osborne, A. Bromley, M. Rowland, S. Creigh-Tyte and C. Brown, 2002. Economic costs of the foot and mouth disease outbreak in the United Kingdom in 2001. Rev. Sci. Tech. OIE, 21(3): 675-685.

Veil, S.R. and A. Yang, 2012. Sanlu's Milk Contamination Crisis: Organizational Communication in Conflicting Cultural, Economic, and Ethical Context. In: May, S. (Ed.), Case Studies in Organizational Communication: Ethical Perspectives and Practices: Ethical Perspectives and Practices. 2nd Edn., Sage Publications, Thousand Oaks, CA, pp: 111-118.

Wang, P., 2010. Chasing the hottest IT: Effects of information technology fashion on organizations. MIS Quart., 34(1): 63-85.

Welbourne, E., L. Battle, G. Cole, K. Gould, K. Rector, S. Raymer, M. Balazinska and G. Borriello, 2009. Building the internet of things using RFID: The RFID ecosystem experience. IEEE Internet Comput., 13(3): 48-55.

Xu, L.D., 2011. Information architecture for supply chain quality management. Int. J. Prod. Res., 49(1): 183-198.

Yuan, M., 2011. Analysis of food safety traceability system based on internet of things [J]. Internet Things Technol., 9.

Zhang, C. and J. Dhaliwal, 2009. An investigation of resource-based and institutional theoretic factors in technology adoption for operations and supply chain management. Int. J. Prod. Econ., 120(1): 252-269.