IDENTIFYING FACTORS THAT INFLUENCE INTENTION TO ADOPT QR CODE AMONG FIRMS IN THAILAND

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ABSTRACT

The main objective of this research is to identify the factors influencing the intention to adopt QR Codes among firms in Thailand. Many firms are currently adopting the innovation that could effectively interact with customers. QR code is a vitally necessary tool for any firms for communication with their customers. Firms need to understand what factors they should consider before implementing QR code to avoid resistance from their employees.

In this research, the technology, organization and environment (TOE) framework was selected to analyze three aspects that influence the intention to adopt QR code. Over 400 sets of questionnaires were distributed to a corporate employee to evaluate the proposed model. The results show that environmental context were the highest influential rate. For individual factors, we found that mimetic pressure, complexity and organization compatibility are the most significant that could influence the intention to adopt QR code.

KEY WORDS: FIRMS IN THAILAND / THE INTENTION TO ADOPT QR CODE / ADVERTISEMENT / QR CODE

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การวิเคราะห์ปัจจัยที่ส่งผลต่อการตัดสินใจเลือกใช้ QR code ของบริษัทในประเทศไทย
IDENTIFYING FACTORS THAT INFLURENCE INTENTION TO ADOPT QR CODE AMONG FIRMS IN THAILAND

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บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์หลักเพื่อวิเคราะห์ปัจจัยที่ส่งผลต่อการตัดสินใจเลือกใช้ QR code ของบริษัทในประเทศไทย ในปัจจุบันมีหลายบริษัทที่นำเทคโนโลยีมาใช้ในการสร้างสัมพันธ์อย่างมีประสิทธิภาพกับลูกค้า QR code เป็นเครื่องมือที่มีความจำเป็นอย่างยิ่งสำหรับทุกๆ บริษัทที่จะใช้ในการสื่อสารกับลูกค้า บริษัทจึงมีความจำเป็นที่จะต้องเข้าใจถึงปัจจัยต่างๆ ที่จะต้องนำมาพิจารณาก่อนที่จะนำเอา QR code มาใช้เพื่อหลีกเลี่ยงแรงต่อต้านจากพนักงาน

ในการวิจัยชุดนี้ได้มีการนำเอาขอบข่าย ด้านเทคโนโลยี องค์กร และสิ่งแวดล้อม (Technology, Organization and Environment (TOE) Frame Work) มาเพื่อใช้สำหรับวิเคราะห์ ทั้งสามแง่มุม แบบสอบถามมากกว่า 400 ชุด ได้มีกาแจกจ่ายไปยังพนักงานในบริษัทต่างๆ เพื่อประเมินผลของโมเดลที่ใช้ ผลจากการวิเคราะห์แสดงให้เห็นว่าขอบข่ายด้านสิ่งแวดล้อมส่งผลมากที่สุด สำหรับปัจจัยเดี่ยวพบว่า แรงกดดันในการลอกเลียนแบบ ความซับซ้อน และ ความสอดคล้องกับองค์กรคือตัวแปรสำคัญที่สามารถส่งผลกระทบต่อการตัดสินใจเลือกใช้ QR code

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CHAPTER I
INTRODUCTION

As the number of internet users has increased over the years, most people, especially the new generation of Thais, consume the news, advertisements and social activity on the internet. Many firms rely heavily on internet advertisement, and QR codes are found to be one of the reliable tools to connect their products with customers.

The QR code originates from a Japanese company, Denso Wave, a subsidiary of Toyota, which invented this technology in 1994.The company invented the QR code based on barcodes, which have a limit capacity to contain information. Barcodes can hold only 20 alphanumeric items of information, which cannot effectively respond to the demand of users. The user needs a code that can hold greater amounts of information and respond faster to the reading device.

QR stands for quick response, which expresses the idea that the code responds faster, store more information and can be read by more devices.

Denso Wave has patented their QR code, but did not restrict use by other users. They allow the public to use the code at no cost, which has led to the codes being widely used by companies not only in Japan, but also in many countries around the world.

In 2002, the launch of mobile phones with QR reading facilities made further waves in marketing trends in Japan. It can take people straight to a website or obtain a discount coupon by just scanning the code. A URL is not necessary to enter the website.

Now the QR code has been adopted by most firms and used in many ways such as issuing name cards, electronic tickets for various modes of transport including flight tickets.

QR codes can be seen anywhere such as in magazines, price tags, websites, name cards, print Ads, campaign signs, etc. The most popular device that connects the QR code to the consumer is the smart mobile phone. By pointing a smart phone's built-in

camera at the code, it will read the product information, video advertisement, picture, price and location to buy the product and display it on the mobile phone.

It is necessary for any firm to use QR codes for their advertisements or marketing campaigns. For example, a firm can promote their product by directing customers to the website, where additional information is provided such as product details or sales coupons, as well as links to product commercials.

Most people in Thailand use smart phones, which presents a great opportunity for firms to promote their products almost anywhere with less cost and time consumption. To increase the visibility of a product, QR code is useful as they contain product information, pictures and prices. The consumer can use their smart phone to scan the code and access the product details at any time. A QR code can be sent from one device to another when a consumer wants to suggest the product to their friend.

1.1 Scope of Research

The rate of internet use has continued to grow every year. Business owners have start to develop their own websites and offer online purchase services to respond to the demand of customers who would like to obtain product details and purchase online. Adopting a QR code can be very helpful for firms to allow their customer easier access to the product information. However, there are many factors that could affect the adoption decision. This study will collect information from 400 respondents to determine the most important factors that firms should consider when adopting QR codes.

1.2 Problem Statement

Many businesses in every industry attempt to determine ways to effectively engage with consumers. They need to find tools that allow consumers to quickly and accurately see and understand their product. Most of the time, businesses will interact with consumer via advertising channels such as magazines, newspapers, radio, television, billboards or leaflets. However, these channels cost a certain amount of money which

mid-size or small-size business cannot afford, and for most forms of advertisement, it is difficult to measure the number of consumers who have seen the advertisement.

The adoption of QR codes increases product awareness and provides an additional way to engage with consumers. The QR code is not only free, but also allows firms to know how many consumers have accessed their advertisement, and it might also increase value for the business.

However, to implement QR codes, we need to be able to identify the rate of user acceptance. Adopting QR code may result in increased product awareness, but it will be difficult to use if the operator is resistant to the technology. Therefore, it is important to study the factors that could affect the adoption decision.

1.3 Research Objectives

The objectives of the research are as follows;

1. To identify which variables of the TOE framework are the most influential in the adoption of QR codes.

2. To provide guidelines and suggestions to firms to increase the level of adoption

3. To compare the intention of adopt QR codes by the year of establishment, capital and IT spending of the firm.

This research was expected to provide practical information to owners or managers of firms on effective ways to implement QR codes, which could result in better sales and service performance and generate benefits for the business.

1.4 Significance of the Study

The QR code is a tool to empower businesses to engage with consumers. Since a QR code can be read by a smartphone, it can be displayed in many places such as posters, billboards, leaflets, websites and magazines. The QR code is a way for consumers to access product information easily and save it in the phone's memory so the information can be viewed at any time. QR codes are not only a way to increase engagement, but also reduce the cost of advertising. Even though we understand the

benefits of QR code, we also need to understand the factors that can contribute to the adoption decision. There are some researches that have indicated the level of significance. As such, it is necessary to conduct research on factors that could affect the adoption decision. This research will be useful to firms that are considering the use of QR codes in their advertising.

1.5 Expected Outcome from the Research

1. To identify the factors that could influence the decision to adopt QR codes.
2. To identify the level of influence of each factor in the decision to adopt QR codes
3. Firm can implement the findings from this research in their adoption plans

CHAPTER II
LITERATURE REVIEW

This research analyzes the degree of influence of each factor on the intention to adopt QR code using the Technological-Organizational-Environmental (TOE) framework of Tornatzky and Fleischer. Each context will include three factors. (1) Technological context (Technological Competence, Relative Advantage, Complexity) (2) Organizational context (Top Management Support, Organizational Compatibility, Organization Readiness) (3) Environmental context (Competition, Normative Pressure, Mimetic Pressure)

2.1 Toe Framework

The TOE framework is a theory that explains the three different contexts of a firm that influence the intention to adopt an innovation. Tornatzky and Fleischer (1990) are credited as the first to develop the TOE framework to study the relationship between each context with regard to the adoption of innovation.

Tornatzky and Fleischer (1990) believed that the intention to adopt a new technology in a firm was influenced by three contexts – Technological-Organizational-Environmental. Therefore they developed the TOE framework to evaluate the influence of each context on a firm's adoption decision. (Wan Nur Syahida Wan Ismail[1], Azwadi Ali[2], July 2013)

The TOE framework identifies three aspects, the technological, organizational, and environmental contexts, which influence the process of technology implementation. The technological context describes the firm's existing technologies as well as the available new technologies for a firm to implement and refers to both technological equipment and the development processes. The organizational context describes the firm's characteristics and resources including top management support, organizational compatibility, organizational readiness and other factors relevant to technology adoption. The environmental context describes the environmental characteristics in which an

organization conducts its business, such as industry structure and the degree of competition. These three contexts influence an organization's decision to adopt an innovation, which ultimately influences organizational performance. (Boni Pudjianto*, Hangjung Zo**, Andrew P. Ciganek***, Jae Jeung Rho****, March 2011)

There are several models that have been implemented in many innovation acceptance studies such as TAM, DOI and TOE. The reason that we apply the TOE framework in our study is because TOE is more comprehensive compared to the others as it includes all of the important aspects (Technological, Organizational and Environmental) that we should consider when adopting a new innovation. In contrast, DOI theory mainly focuses on the individual and organizational level (Katz et al., 1963; Roger, 1995). It does not include the environmental context, which can affect the adoption decision. The disadvantage of TAM compare to TOE is it only emphasis on the technological context (Jiang, & Chen, 2010). Many researchers mentioned that TAM needed to add additional variables to the model to become a stronger model (Jen-Her Wu, Shu-Ching Wang, 2005)

2.2 Hypothesis Development

This section describes the hypothesis development based on the research model**.**

2.3 Technological Context

The technological context describes the IT innovation characteristics that do not yet exist in the business but may have a positive effect on the business's performance when adopting it (Thong, 1999: Chau and Tam, 1997). The main focus of the technological context is how an organization's adoption process can be influenced by the characteristics of the technology (Chau & Tam, 1997)

This research focuses on three elements which are technological competence, relative advantage and complexity. These elements have been selected from the Diffusion of Innovation (DOI) theory by Roger (1983) and the TOE framework theory of Tornatzky &

Fleischer (1990*)* in order to explain the factors that can influence the adoption of QR code technology.

2.3.1 Technology Competence

The TOE framework's technology context refers to technologies that are both internally and externally relevant to the firm. The intention to adopt technological innovations is determined by what exists and whether the innovations will fit with the existing technological landscape (L. G. Tornatzky and M. Fleischer, 1990.)

A firm that is able to gain a competitive advantage over other firms in the industry tends to make more profit and grows faster than its competitors (Frank T. Rothaermel., chapter7**)**

It is also claimed that a combination of technological and marketing capabilities and competencies can create such a competitive advantage (Chang, 1996; Dutta et al., 1999; Song et al.,2005). A firm with strong technological competencies is more likely to develop or implement an innovation that offer new benefits and creates value for customers (McEvily et al.,2004). A firm with strong marketing competencies is able to identify customer needs to develop a new innovation or marketing activities that provide unique value to customers (Day, 1994; Vorhies, 1998)

Much research has demonstrated that technological competence is necessary to leverage the firm's competitive advantage. Firms can acquire many benefits from the adoption of QR code technology. This viewpoint leads to the following hypothesis:

H1: Technological competence is positively related to the intention to adopt QR code.

2.3.2 Relative Advantage

The degree of relative advantage is generally expressed as the degree of perceived benefits that the innovation may provide to the organization, and thus, relative advantage and perceived benefits are commonly used interchangeably in many IT adoption literatures (Henderson et al., 1995; Yoon, 2009)

The QR code is a vital tool to reduce the cost of advertising while it also enhances the provision of product details to the consumer, so a firm can take advantage of the technology to solve the problem of high cost (Premkumar, Ramamurthy, & Nilakanta,

1994). Instead of using a lot of space for words to inform and convey the product details, a QR code can be used to shortcut all of that. Another advantage of using QR codes over conventional advertising (leaflets or brochures) is that statistics are accessible. It is possible to know how many people have viewed the product website or information. The benefit that is received from this relative advantage can affect the adoption decision, which leads to the following hypothesis;

H2: Relative advantage is positively related to the intention to adopt QR code.

2.3.3 Complexity

Complexity describes "the degree to which an innovation is perceived as relatively difficult to understand and use" (E.M. Rogers, 2003.) Generally, complexity is widely recognized as a key barrier to implement new technology, such as QR codes (Thong, 1999). In many recent studies, complexity has been proved to have a major impact on the adoption decision (Huy et al.,2012; Lin & Chen, 2012; Wang et al., 2010).

There are many ways that firms can use QR codes to create value, not only to provide product information, but also to allow consumers to purchase products online with their smart mobile phone, rewarding consumers with discount or special offers when they scan QR codes and creating a sense of loyalty. However, using QR codes requires proper technical knowledge. Firms that are not familiar with innovation may find difficulty in implementing new technology. Being user-friendly is a key factor in increasing the adoption rate (Parisot, 1995; Sahin, 2006). Many researchers perceived complexity as the barrier that prevents innovation in firms if they lack the technical skill to use it (Rui, 2007; Loe et al., 2011; Premkumar et al., 1994; Lin, 2008). For this reason, an innovation may be considered as complex by firms that lack knowledge and skill (Rui, 2007).This leads to the following hypothesis;

H3: Complexity is negatively related to the intention to adopt QR code.

2.4 Organizational Context

The organizational context refers to the characteristics and resources of the organization (Tan & Felix, 2010). It looks at the structure and processes of an organization that restrict the adoption and implementation of innovations (Chau & Tam, 1997).

Previous research has proposed many factors that are vital to the adoption of technology. In this research we have selected three factors “Organization readiness”, “Top Management Support” and “Perceived Benefits” that could influence the intention to adopt QR codes.

2.4.1 Top Management Support

Top management support refers to the level of support extended by the higher management in the adoption of technological innovations for business use (Grover, 1993) Many researches have revealed that top management plays a critical role in organizational innovation adoption (Basu et al., 2002; Bradfort and Florin, 2003; Cerpa&Verner, 1998; Grandon&Pearson, 2004; Matta&Moberg, 2006; Quaddus&Xu, 2005; Steinbart&Nath, 1992; Zhang et al., 2005).

Previous studies on IT innovation adoption based on the TOE framework have also suggested that top management support has a positive relationship with the organizational decision to adopt an innovation (Lederer and Mendelow, 1998; Lertwongsatien and Wongpinunwatana, 2003; Nelson and Shaw, 2003; Premkumar and Ramamurthy, 1995). It can also minimize the organization’s resistanceto the innovation as management can provide a long-term strategic vision, support and a commitment to creating a positive environment for the innovation (Quinn, 1985) Moreover, management’s level of IT sophistication is also significant because the more IT system experience they ,have, the more they will invest in innovation (Hayes and Abernathy, 1980)

Implementing the use of QR code may require human, technical and financial resources which are judged by top management decisions to support the innovation. Therefore, it is greatly expected that businesses with strong management support are more likely to adopt the QR code than businesses with less management support.

This lead to the following hypothesis;

H4: Top Management Support is positively related to the intention to adopt QR code

2.4.2 Organizational Compatibility

Compatibility reflects the extent of innovation that is perceived to be consistent with the existing operating practices, past experience, and the needs of potential adopters (E.M. Rogers, 2003). Compatibility permits innovation to be interpreted in more familiar contexts (Rogers, 1995)

Much research has found that compatibility is positively related to the rate of innovation adoption (Tornatzky and Klein 1982). Innovation adoption can play a significant role in changes in the working practices of businesses, and resistance to change may be experienced, which is a normal organizational reaction (Premkumar and Roberts 1999)

When a firm perceives QR code to be compatible with their existing policy and beliefs, they are more likely to implement it. For example, the low cost of implementing QR code and reducing the operating cost by using QR code as part of a business strategy that is compatible with the business structure, can influence the adoption rate.

This lead to the following hypothesis;

H5: Organizational compatibility is positively related to the intention to adopt QR code.

2.4.3 Organizational Readiness

Organization readiness is defined by Iacovou et al. (1995) as the availability of the required organizational resources necessary for the adoption. In many studies, organizational readiness primarily concerns the technological and financial resources of the organization (Gemino et al., 2006; Chau & Hui, 2001; Grandon & Pearson, 2004; Iacovou et al., 1995; Chewlos et al., 2001; Nelson & Shaw, 2003; Mackay et al., 2004; Yoon, 2009). Businesses may not feel comfortable to adopt QR codes if they lack these resources.

Financial readiness refers to the financial resources of the organization available for installation, further development, and ongoing expenses during usage (Iacovou, 1995).

Technological readiness refers to the degree of sophistication of IT use and management in an organization (Chewlos et al., 2001; Iacovou et al., 1995)

Many studies found that technological and financial readiness significantly influence the adoption of innovation by an organization. For example, Mehrtens et al. (2001) found that an organization's decision to adopt the use of the internet was positively influenced by financial and technological readiness. Mackay et al. (2004) also found that technical and financial readiness has a positive influence on an organization's decision to establish a website.

This lead to the following hypothesis;

H6: Organization Readiness is positively related to the intention to adopt QR code.

2.5 Environmental Context

The environmental context is the area in which the firm does business (Tornatzky and Fleischer, 1990) or in other words concerns the surroundings of the organization, looking at how external influences affect the motivations or barriers to adopt an innovation (Teo et al., 2004)

2.5.1 Competition

Competition refers to the degree that the organization is affected by competitors within the market (Zhu, 2003b)

It has long been recognized that competition can put pressure on organizations to adopt innovation (Thong, 1999: Zhu et al., 2003; Yoon, 2009). Previous study has indicated that competition is an important factor that influences organizations to adopt a new innovation in order to remain competitive (Lacovou et al., 1995)

In highly competitive markets, IT innovation adoption is necessary to maintain and achieve competitive advantage (Yoon, 2009). In order for the organization to maintain their competitive advantage, the adoption of innovation is an important factor that needs to be considered. QR code is a tool that can help businesses to keep up with other players in the high competitive market.

Organizations intend to adopt technology if they perceive that competitors that have adopted the technology have benefited or succeeded from using it (Wan Nur Syahida Wan Ismail, Azwadi Ali, 2013). Those who choose not be follow the trend,

risk being left behind and may be in a disadvantaged position compared to their competitors (Chong&Ooi, 2008; Chong&Chan, 2012; Ghobakhloo et al., 2011b)

This lead to the following hypothesis;

H7: Competition is positively related to the intention to adopt QR code.

2.5.2 Normative Pressure

Normative pressure is pressure to achieve a standard of professionalism and to adopt technologies that are considered up-to-date and are used by other firms in the same industry.

There are many previous studies that indicated that normative pressure is a major drive for technology adoption. For example, according to DiMaggio and Powell (1983 and 1991) normative pressure can encourage a firm to adopt the technology that others have already adopted. A firm will adopt the particular business practice when they perceive that it is an appropriate thing to do (Scott, 2003; Chiravuri and Ambrose, 2002). As per social contagion literature, firms that are directly or indirectly associated with other firms that have adopted the technological innovations are more likely to learn about that innovation and its benefits and losses, and should be convinced to act similarly (Burt, 1982).

Firm will face normative pressure to adopt an innovation when they learn about its benefits and value from numerous channels such as media, trade partners, customers, suppliers and trade organizations (DiMaggio and Powell, 1983; Spell and Blum, 2005; Burt, 1982; Chiravuri and Ambrose, 2002)

This lead to the following hypothesis;

H8: Normative Pressure is positively related to the intention to adopt QR code.

2.5.3 Mimetic Pressure

Mimetic pressures are those that push a firm to imitate actions of other firms in the industry that are considered to be similar (DiMaggio&Powell, 1983).

Mimetic pressure can result from a firm's response to any uncertainty. They will face uncertainty when top management or business owners are not sure how to achieve a desired goal or objective. When facing this uncertainty, a firm will observe

what others have done to achieve the same goal and imitate their strategy if it is successful and Benefit. A firm can face mimetic pressure when the number of firms that take the same action in its industry is increasing. (Haveman, 1993)

Imitation can reduce the uncertainty regarding actions, and top management believes that they should follow the same action in order to reduce the fear of losing competitive advantage (An empirical investigation of factors affecting organizational adoption of virtual worlds; Tom Yoon, 2009) Imitating the behavior of other organizations not only allows firms to achieve the same benefits, but can also reduce research and experimentation costs (Cyert and March, 1963; Levitt and March, 1988), as well as the risk of uncertainty (Liberman and Montgomery, 1988)

Many researchers found that mimetic pressure is a major driver in IT adoption. For example, Khalifa and Davison (2006), mentioned that when a firm perceives that its competitors who have adopted new innovation have greatly benefited or succeeded, the firm is willing to adopt the same innovation in order to compete with others. Teo et al. (2003) found that a firm's intention to adopt an innovation such as financial electronic data interchange (FEDI) is also positively influenced by mimetic pressures from its competitors. QR codes were first designed for the automotive industry in Japan. After the successful use of QR code to enhance competitive advantage; many firms in related industries also started to adopt the use of QR code in order to compete with others in the industry.

This lead to the following hypothesis;

H9: Mimetic Pressure is positively related to the intention to adopt QR code.

2.6 Firm Attributes

Year of establishment; to adopt a new innovation, the year of firm establishment can play a major role as firms that are more established tend to have a higher rate of adoption than younger firm. Freeman, Caroll, and Hannan (2003) mentioned that the older firm tends to have a higher technology adoption rate than a younger one because the experience of managing a business usually comes with age, which has a significant effect on the adoption of technology.

Firm's Capital; limitations of capital can act as a barrier that prevents a firm from adopting an innovation. Lawrence (2002) stated that the limitation of resources can restrict a firm's ability to adopt an innovation.

Ratio of IT spending; the spending on IT is also critical to the firm as a firm that lacks computer access, software, hardware or IT knowledge tends to have la ow adoption rate Cloete et al. (2002), Kapurubandara & Lawson (2006),

This leads to the following hypothesis;

H10: the firm's intention to adopt QR code differs with regard to the firm's establishment, capital and ratio of IT spending.

CHAPTER III
CONCEPTUAL MODEL AND HYPOTHESIS

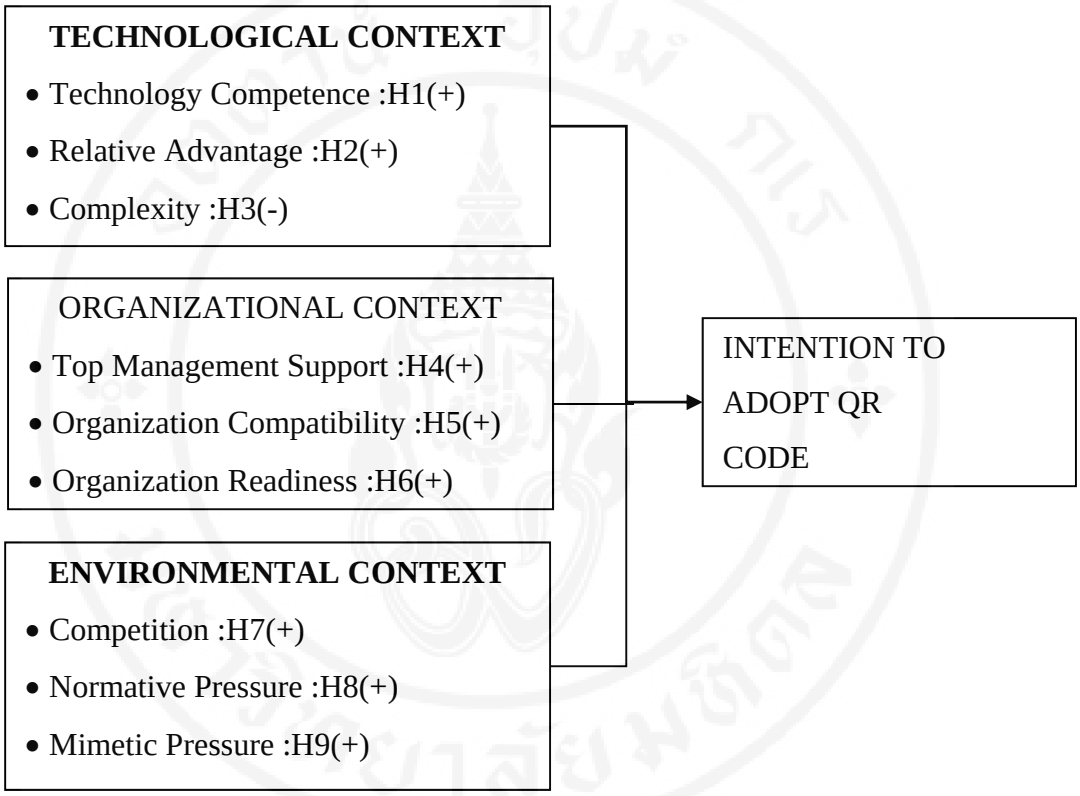

Figure 3.1 TOE Framework

The above model was developed base on a review of previous literature on technology, organization and environmental.

3.1 Research Design

The unit of analysis for this research is people who work in a firm in Thailand. A sample of 400 respondents will be used for the analysis based on the Yamane formula. The data collection for this study will be through questionnaire surveys that are developed based on the literature. The data will be analyzed using the Multiple Indicators and Multiple Causes (MIMIC model) to test the hypotheses

3.2 Population, Sample size and Research Methodology

The number of respondent that we are going to collect the data is based on number of company limited/ public company limited in 2012 as small size of firm may lack of financial and IT capability to adopt the innovation (Welsh&White, 1981) which can consequently lead to the high barrier of IT adoption (Ein-Dor&Segev, 1978)

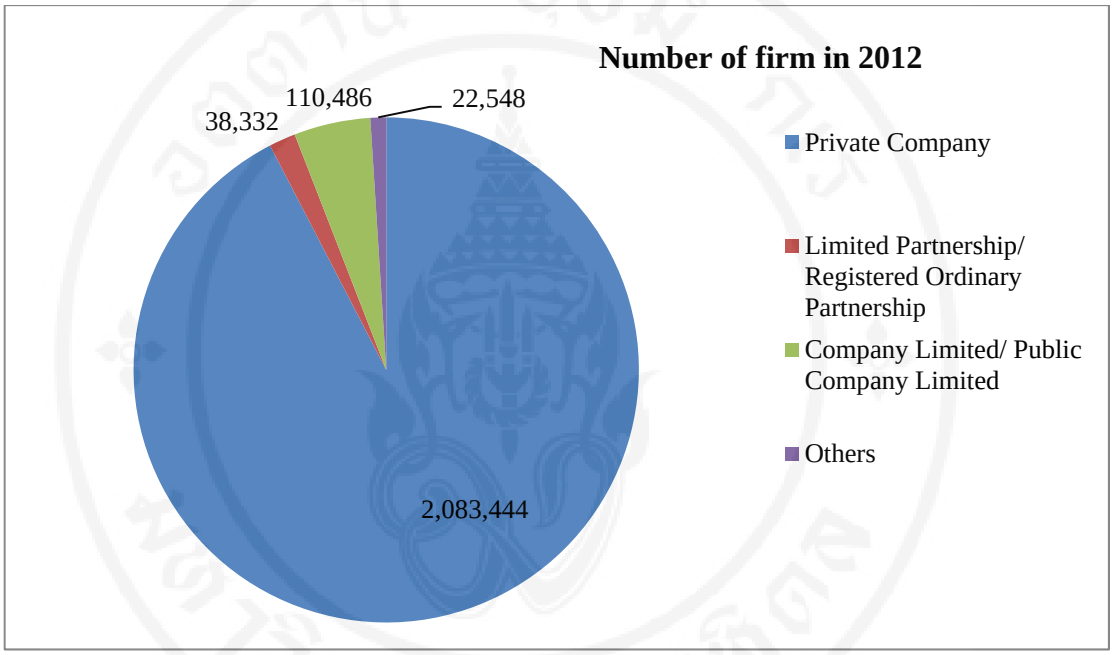

Figure 3.2 Number of firm in Thailand year 2012

Source: Department of Business Development, Ministry of Commerce

Compiled by: Statistical Forecasting Bureau, National Statistical Office

3.3 Sample Size

This research used the Yamane formula (Yamane, 1967) to calculate the sample size at the 95% confident level

$$n = \frac{N}{1+Ne^2}$$

n = The sample size

N = The population size

E = The acceptable sampling error

*95% confidence level and p = 0.5 are assumed

The sample size can be calculated according to the formula as follow:

$$n = \frac{110{,}486}{1+110{,}486 * 0.0025}$$

3.4 Research Methodology

The questionnaire was developed based on the examples from prior literature. It consists of 3 parts:

Part1: personal information about the business owner, decision maker or person who works for the firm.

Part2: a questionnaire with 35 Items to investigate the relationship between the TOE model, which consists of the technological context, the organizational context, the environmental context and the decision to adopt QR code. The questionnaires were distributed to 400 respondents who have experience about IT systems and QR code in Thailand. For all independent variables in this research, the format was based on a 5-point Likert scale to let the respondents indicate the most appropriate answer. Likert scales were originally developed by Rensis Likert, a sociologist at the University of Michigan from 1946-1970 and originally published in “A technique for the Measurement of Attitudes” (Likert, 1932). In survey research, 5-point and 7-point Likert scales are the most commonly used. In this study, a 5-point Likert scale is adopted for two reasons. First, to keep the respondent focused on the questionnaire and answer with more honestly; it also prevents them from choosing their answer randomly, which could affect the reliability of the data. Second, many research papers on technology adoption have applied 5-point scales in their study (e.g., Alqahtani, and Fosso Wamba, 2012; Suhaiza Zailani, Noornina Dahlan, Yusof Hamdani Jallaludin, 2009).

Part3: 3 questions to determine the intention to adopt QR code.

418 copies of the questionnaire were distributed to respondents who work in a firm. The response rate was 95.69%, which means there are 18 copies that are not complete. The results were prepared for analysis.

CHAPTER IV
SURVEY RESULTS

This chapter presents the results of the analysis of the factors that influences the intention to adopt QR code for firms in Thailand. The researcher has separated the study into three parts as follows;

1. Symbols that are used in data analysis
2. Variables
3. Results of data analysis

4.1 Symbols That Used in Data Analysis

Adoption:	Intent to adopt QR code
Y1:	Intention
Y2:	Replacement
Y3:	Beneficial
TC:	Technology Competence
RA:	Relative Advantage
Cpx:	Complexity
TMS:	Top Management Support
OC:	Organization Compatibility
OR:	Organization Readiness
Cpt:	Competition
NP:	Normative Pressure
MP:	Mimetic Pressure
S.D.	Standard Deviation
C.V.	Coefficient of variation
S.K.	Skewness
K.U.	Kurtosis

Sig.	Significant (p-value)
x^2	Chi-square
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index
CFI	Comparative Fit Index
RMR	Root Mean Squared Residual
SRMR	Standardized Root Mean Squared Residual
RMSEA	Root Mean Square Error of Approximation
*	Significantly at the 0.05 level
**	Significantly at the 0.01 level

4.2 Variables

1. The independent variable is the observation variable, which consists of 9 variables considered to be factors that influence the intention to adopt QR code for firms in Thailand. According to Tornatzky and Fleischer (1990), the variables are Relative Advantage (RA), Complexity (Cpx), Top Management Support (TMS), Organization Compatibility (OC), Organizational Readiness (OR), Competition (Cpt), Normative Pressure (NP) and Mimetic pressure (MP)

2. The dependent variable is the interest in QR code adoption, which is a latent variable. There are three observation variables that estimate the interest of QR code adoption, which are Intention (Y1), Replacement (Y2) and Benefit (Y3)

4.3 Results of Data Analysis

To present the result of data analysis, researcher has separated the analysis into 5 sections.

Section 1. The analysis of firm's attributes.

Section 2. The analysis of factors that influence intention to adopt QR code among firms in Thailand.

Section 3. Firm attribute analysis.

Section 4. Correlation Coefficient analysis.

Section 5. Conformity Factor Analysis.

Section 6. The analysis of factors that influence intention to adopt QR code using MIMIC models (Multiple Indicators and multiple causes) and ANOVA according to below hypothesis;

H1: Technological competence is positively related to the intention to adopt QR code.

H2: Relative advantage is positively related to the intention to adopt QR code.

H3: Complexity is negatively related to the intention to adopt QR code.

H4: Top Management Support is positively related to the intention to adopt QR code

H5: Organizational compatibility is positively related to the intention to adopt QR code.

H6: Organization Readiness is positively related to the intention to adopt QR code.

H7: Competition is positively related to the intention to adopt QR code.

H8: Normative Pressure is positively related to the intention to adopt QR code.

H9: Mimetic Pressure is positively related to the intention to adopt QR code.

H10: The firm's intention to adopt QR code differs with regard to the firm's establishment, capital and ratio of IT spending.

4.3.1 The statistic of firm attributes.

The statistic of firm attributes are presented in table 4.1

Table 4.1 Statistic of firm attributes

(n = 400)

Statistic of firm attributes		n	Percent
Year	Before 1900	12	3.00
	1900-1930	33	8.25
	1931-1960	89	22.25
	1961-1990	105	26.25
	After 1991	161	40.25
Total		**400**	**100.00**

Table 4.1 Statistic of firm attributes (cont.)

(n = 400)

Statistic of firm attributes		n	Percent
Number of employee	Below 50	196	49.00
	50-100	132	33.00
	101-150	40	10.00
	151-200	20	5.00
	More than 201	12	3.00
	Total	**400**	**100.00**
Last year Annual Sales	Below 50 Millions	181	45.25
	50 Millions- 100 Millions	71	17.75
	101 Millions- 150 Millions	84	21.00
	151 Millions- 200 Millions	31	7.75
	More than 201 Millions	33	8.25
	Total	**400**	**100.00**
Position	President, Managing Director, CEO	68	17.0
	IT Management	10	2.5
	Financial Management	3	0.8
	Business Operation Management	12	3.0
	Executive Staff	307	76.8
	Total	**400**	**100.0**
Capital in Organization	Less than 20 Millions	197	49.3
	21 Millions- 40 Millions	68	17.0
	41 Millions- 60Millions	73	18.3
	61 Millions- 80 Millions	25	6.3
	More than 81 Millions	37	9.3
	Total	**400**	**100.0**
Ratio of IT spending	0%-5%	215	53.75
	6%-10%	147	36.75
	11%-15%	38	9.50
	Total	**400**	**100.00**

Table 4.1 Statistic of firm attributes (cont.)

(n = 400)

Statistic of firm attributes		n	Percent
Ratio of Advertising spending	0%-5%	183	45.8
	6%-10%	161	40.3
	11%-15%	38	9.5
	16%-20%	18	4.5
	Total	**400**	**100.0**
QR Code Familiar	I have good Acknowledge about QR code	55	13.75
	I have some knowledge of QR code	281	70.25
	I have only heard about it	58	14.50
	I have not familiar with it	6	1.50
	Total	**400**	**100.00**
Experience of using QR code	Yes	383	95.75
	No	17	4.25
	Total	**400**	**100.00**
Year of Using QR code	0-1	332	83.00
	2	65	16.25
	More than 3	3	0.75
	Total	**400**	**100.00**

Table 4.1 displays the number and percentage of sample group and describes the demographic factors that associated with the sample group which are year, number of employee, last year annual sales, position, capital in organization, ratio of IT spending, ratio of advertising spending, QR code familiar, experience of using QR code and year of using QR code.

Year: 161 businesses or 40.25% firms where the sample group members were employed had been established after 1991; 105 businesses or 26.25%, were established between 1961 and1990; 89 businesses or 22.25%, were established between 1931and 1960; 33 businesses or 8.25% were established between 1900 and 1930, and 12 businesses or 3.00% were established before 1900

Number of employees: The results show that 192 businesses (49.00%) where the sample group were employed had fewer than 50 employees 132 (33.00%) businesses had between 50 and 100 employees; 40 businesses (10.00%) had between 101 and 50 employees; 20 businesses (5.00%) had between 151 and 200 employees and 12 businesses (3.00%) had more than 201 employees.

Last year annual sales: The results shown that 181 businesses (45.25%) had total annual sales of below 50 million baht ; 84 businesses (21.00%) had total annual sales of between 101 million baht and 150 million baht; 71 businesses (17.75%) had total annual sales of between 50 million baht and 100 million baht; 33 businesses (8.25%) had total annual sales of more than 201 million baht and 31 businesses (7.75%) had total annual sales of between 151 million baht and 200 million baht.

Position: The results show that the sample group includes: 307 executive staff or 76.75%, 68 Presidents, Managing Directors, CEOs or 17%; 12 Business Operations Management staff or 3%) 10 IT management or 2.50%, and 3 Financial Management staff or 0.75%.

Capital in organization: The results show that 197 businesses (49.25%) had authorized capital of less than 20 million; 73 businesses (18.25%) had authorized capital of between 41 million and 60million; 68 businesses (17.00%) had authorized capital of between 21 million and 40 million; 37 businesses (9.25%) had authorized capital of more than 81 million and 25 businesses (6.25%) had authorized capital of between 61 million and 80 million.

Ratio of IT spending: The results show that 215 businesses or 53.75% of the sample group worked for a firm that had a ratio of IT expense and annual sales of 0%-5%; 147 businesses or 36.75%) a ratio of IT expense and annual sales of 6%-10% and 38 businesses or 9.50% had a ratio of IT expense and annual sales of 11%-15%.

Ratio of advertising spending: The results show that 183 businesses or 45.75%, of the sample group worked in a business that had a ratio of advertising expense and annual sales of 0%-5%; 161 businesses or 40.25%), had a ratio between 6% and 10% ; 38 businesses or 9.50% had a ratio between 11% and 15% and 18 businesses or 4.50% had a ratio between 16% and 20%

QR code familiarity: The results show that there were 281 persons (70.25%) who had some knowledge of QR code, 58 persons (14.50%) had only heard about it,

55 persons (13.75%) had good knowledge about QR code and 6 persons (1.50%) were not familiar with it.

Experience of using QR code: The results show that there are 383 firms (95.75%) that had applied QR code in their operational process and 17 businesses (4.25%) that had never applied QR code.

Years of using QR code: The results show there were 332 persons (83.00%) that had been using QR code for between 0 and 1 year; 65 persons (16.25%) had been using QR code for 2 years and 3 persons (0.75%) had been using QR code for more than 3 years.

4.3.2 The analysis of factors that influence the intention to adopt QR code for firms in Thailand.

The data that were collected from participants were analyzed by using Means ($\bar{X}$), Standard Deviation (S.D.), Coefficient of Variation (C.V.), Skewness (S.K) and Kurtosis (K.U) to explain the results of variables from the survey which consist of Intention (Y1), Replacement (Y2), Benefit (Y3), Technological Competence(TC), Relative Advantage (RA), Complexity (Cpx), Top Management Support (TMS), Organizational Compatibility (OC), Organizational Readiness (OR), Competition (Cpt), Normative Pressure (NP) and Mimetic Pressure (MP)

Table 4.2 Variable Analysis

Variable	Name	$\bar{X}$	S.D.	C.V.	S.K.	K.U.	Level
Technology Competence	TC	2.81	0.46	0.16	1.24	1.84	Neutral
Relative Advantage	RA	2.59	0.45	0.17	-0.32	0.21	Disagree
Complexity	Cpx	2.72	0.39	0.14	0.32	1.72	Neutral
Top management support	TMS	2.74	0.43	0.16	-0.48	0.58	Neutral
Organizational Compatibility	OC	2.74	0.39	0.14	0.12	1.27	Neutral
Organizational Readiness	OR	2.79	0.48	0.17	0.38	1.76	Neutral
Competition	Cpt	2.77	0.46	0.17	0.17	1.75	Neutral

Table 4.2 Variable Analysis (cont.)

Variable	Name	$\bar{X}$	S.D.	C.V.	S.K.	K.U.	Level
Normative Pressure	NP	2.78	0.37	0.13	-0.31	0.90	Neutral
Mimetic Pressure	MP	2.76	0.31	0.11	0.19	1.86	Neutral

*Remark $\bar{X}$ = 4.21-5.00 = strongly agree, $\bar{X}$ = 3.41-4.20 = Agree, $\bar{X}$ =2.61-3.40= Neutral, $\bar{X}$ =1.81-2.60= Disagree, $\bar{X}$ =1.00-1.80= strongly disagree

The results in table 4.2 can be summarized as follows;

There are 8 variables that have $\bar{X}$ at a neutral level which are TC (2.81), OR (2.79), NP (2.78), Cpt (2.77), MP (2.76), TMS (2.74), OC (2.74), Cpx (2.72) and 4 variables that have $\bar{X}$ at a low level (Disagree) which are RA (2.59), Replacement (Y2) (2.54), Intention (Y1)(2.43), Benefit (Y3)(2.54)

The results for the standard deviation (S.D.) of the variables, show that the data are in the range between 0.31and 0.75. The standard deviation is the only indicator that shows the distribution of data.

The results Coefficient of Variation for the variables show values between 0.11and 0.31 and the variables with the highest values of C.V. were Intention (Y1) and Benefit (Y3) (C.V = 0.31). The variable that had the lowest value of S.D. was Mimetic Pressure (MP) (C.V = 0.11)

The results for Skewness (S.K.) and Kurtosis (K.U.) show that the variables had a Skewness value of between -0.48 and 1.24. Technological Competence (TC) had the highest value (S.K. = 1.24) and Top Management Support (TMS) had the lowest value (S.K. = -0.48)

For Kurtosis, the results show that the variables had a Kurtosis value of between -0.49 and 1.86. Mimetic Pressure (MP) had the highest value (K.U. = 1.86) and Intention (Y1) had the lowest value (K.U. = -0.49)

The values for Skewness and Kurtosis satisfied the valuation criteria (-2 to +2) (George & Mallery, 2010; Mardia, 1985)

4.3.3 Firm Attribute Analysis

In this section, the demographics of firm are analyzed using ANOVA to compare the differences in value of the variables that may be associated with the intention to adopt QR code, which consist of years of establishment, capital in the organization, the ratio of IT spending and the ratio of advertising spending. The details of the analysis are presented in the table below;

The analysis of firm attributes for years of establishment and the intention to adopt QR code.

Table 4.3 The analysis of $\bar{X}$ and S.D. (year of establishment and the intention to adopt QR code)

Intention to adopt QR code	**Year**	$\bar{X}$	**S.D.**
Intention to adopt QR code	Before 1900	2.17	0.61
	1900-1930	2.29	0.52
	1931-1960	2.51	0.56
	1961-1990	2.52	0.61
	After 1991	2.45	0.64

Table 4.4 The analysis of firm attributes (year of establishment and the intention to adopt QR code)

Intention to adopt QR code	**SS**	**df**	**MS**	**F**	**Sig.**
Between Groups	2.58	4.00	0.64	1.76	0.14
Within Groups	144.59	395.00	0.37		
Total	147.16	399.00			

One-way ANOVA was used to interpret the information from the survey. The results presented in table 4.4 indicate the statistical significance of the years of establishment and intention to adopt QR code, which are more than 0.05. This indicates that years of establishment has no effect on the intention to adopt QR code. (F=1.76, Sig. = 0.14)

The analysis of firm's attribute for capital in organization and the intention to adopt QR code.

Table 4.5 The analysis of $\bar{X}$ and S.D. (capital in organization and the intention to adopt QR code)

Capital in Organization	Year	$\bar{X}$	S.D.
Capital in Organization	Less than 20 Millions	2.48	0.64
	21 Millions – 40 Millions	2.55	0.58
	41 Millions – 60 Millions	2.30	0.57
	61 Millions – 80 Millions	2.36	0.44
	More than 81 Millions	2.59	0.61

Table 4.6 The analysis of firm's attributes (capital in organization and the intention to adopt QR code)

Capital in Organization	SS	df	MS	F	Sig.
Between Groups	3.28	4.00	0.82	2.25	0.06
Within Groups	143.89	395.00	0.36		
Total	147.16	399.00			

One-way ANOVA was used to interpret the information from the survey. The results presented in table 4.6 indicate the statistical significant of capital in organization and the intention to adopt QR code, which are more than 0.05. This indicates that capital in organization has no effect on the intention to adopt QR code. (F=2.25, Sig. = 0.06)

The analysis of firm's attribute for ratio of IT spending and the intention to adopt QR code.

Table 4.7 The analysis of $\bar{X}$ and S.D. (ratio of IT spending and the intention to adopt QR code)

Ratio of IT spending	Year	$\bar{X}$	S.D.
Ratio of IT spending	0%-5%	2.47	0.62
	6%-10%	2.45	0.61
	11%-15%	2.48	0.50

Table 4.8 The analysis of firm's attributes (ratio of IT spending and the intention to adopt QR code)

Ratio of IT spending		SS	df	MS	F	Sig.
Ratio of IT spending	Between Groups	0.05	2.00	0.03	0.07	0.93
	Within Groups	147.11	397.00	0.37		
	Total	147.16	399.00			

One-way ANOVA was used to interpret the information from the survey. The results presented in table 4.8 indicate the statistical significant of ratio of IT spending and the intention to adopt QR code, which are more than 0.05. This indicates that ratio of IT spending has no effect on the intention to adopt QR code. (F = 0.07, Sig. = 0.93)

4.3.4 The analysis of the Correlation Coefficient of the factors that influence the intention to adopt QR code for firms in Thailand.

In this section, Pearson's product Moment Correlation Coefficient will be employed to measure the correlation coefficient of the factors that influence the intention to adopt QR code for firms in Thailand. The results are summarize in the table below.

Table 4.9 Analysis of Correlation Coefficient of the variables

	Y1	Y2	Y3	TC	RA	Cpx	TMS	OC	OR	Cpt	NP	MP
Y1	1.00											
Y2	0.54**	1.00										
Y3	0.42**	0.58**	1.00									
TC	0.11*	0.08	0.09	1.00								
RA	0.05	0.04	0.05	0.35**	1.00							
Cpx	0.10*	0.04	0.11*	0.24**	0.38**	1.00						
TMS	0.09*	0.12**	0.14**	0.16**	0.19**	0.38**	1.00					
OC	0.11*	0.20**	0.20**	0.18**	0.10*	0.74**	0.46**	1.00				
OR	0.06	0.11*	0.16**	0.19**	0.09	0.55**	0.33**	0.38**	1.00			
Cpt	0.08	0.10*	0.18**	0.09*	0.09	0.31**	0.18**	0.21**	0.51**	1.00		
NP	0.05	0.02	0.10**	0.15**	0.15**	0.20**	0.43**	0.24**	0.26**	0.38**	1.00	
MP	0.24**	0.19**	0.24**	0.16**	0.10	0.53**	0.29**	0.59**	0.47**	0.34**	0.35**	1.00

Table 4.9 shows the correlation coefficient (r) of 12 variables. The quantity, r, called the linear correlation coefficient, measures the strength and direction of the linear relationship between two variables. There are 43 sets of correlation coefficients that have statistically significant values at 0.01 for positive correlation and there are 9 sets of correlation coefficients that have statistically significant values at 0.05 for positive correlation

When examining the correlation coefficient of all variables, it was found that the value of "r" was between 0.02 and 0.74. There are three strong relationships which are Organizational Compatibility (OC) and Complexity (Cpx) (r = 0.74), Mimetic Pressure (MP) and Organizational Compatibility (OC) (r = 0.58), Benefit (Y3) and Replacement (Y2) (r = 0.57).

The weak relationships are Normative Pressure (NP) and Replacement (Y2) (r = 0.02), Relative Advantage (RA) and Replacement (Y2) (r = 0.04), and Normative Pressure (NP) and Intention (Y1) (r = 0.05).

The analysis of the correlation coefficient of variables indicates that all variables affect the intention to adopt QR code for firms and it is appropriate for further analysis.

4.3.5 Confirmatory Factor Analysis (CFA)

This section will discuss Confirmatory Factor Analysis in the measurement model for 9 variables as follows: echnological Competence (TC), Relative Advantage (RA), Complexity (Cpx), Top management support (TMS), Organizational Compatibility (OC), Organizational Readiness (OR), Competition (Cpt), Normative Pressure (NP) and Mimetic Pressure (MP)

CFA will be employed to test the hypothesis that a relationship between variables and their underlying latent constructs exists by analyzing the Factor Loading or Beta (β), Standard Error (SE), T-test and R^2

The summary of CFA is described below;

1. Technological Competence (TC) consist of 3 observation variables and the results of the CFA analysis are shown in table 10 below;

Table 4.10 Technology Competence (TC) analysis

Observation variables	β	SE	t	R^2	α
The technology infrastructure of my organization is available to support QR code application (TC1)	0.69	(0.03)	11.94**	0.38	0.90
My organization decided to ensure that employees are familiar with QR code technology (TC2)	0.71	(0.03)	11.28**	0.49	0.90
My organization has a high level of QR code related knowledge (TC3)	0.74	(0.03)	11.28**	0.43	0.90

χ^2 = 0.02, df = 1, p = 0.90, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.10, we found that the value of R2 is between 0.38 and 0.49 and we also found that the model conformed with the empirical data by considering χ^2 = 0.02 df = 1 p = 0.90 χ2 /df = 0.02 GFI = 1.00 AGFI = 1.00 CFI = 1.00 RMR = 0.00 SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below

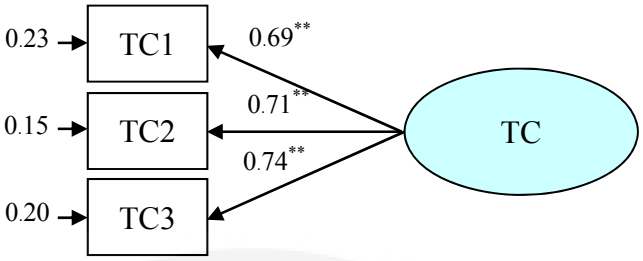

Figure 4.1 Technology Competence (β)

From the picture, we found that TC3 has the highest value of β = 0.74, TC2 has β = 0.71 and TC1 was β = 0.69.

2. Relative Advantage (RA) consists of 5 observation variables and the results of CFA analysis are shown in table 11 below;

Table 4.11 Relative Advantage (RA) analysis

Observation Variables	β	SE	t	R^2	α
Adopting QR code will allow better communication with our customers (RA1)	0.75	(0.04)	6.05**	0.16	0.90
Adopting QR code will increase the profitability of our organization (RA2)	0.67	(0.04)	9.66**	0.40	0.90
Adopting QR code will reduce costs (RA3)	0.69	(0.05)	10.47**	0.52	0.90
Adopting QR code will improve our web presence (RA4)	0.62	(0.05)	6.78**	0.24	0.90
QR code will improves data capacity (RA5)	0.78	(0.03)	8.81**	0.24	0.90

χ2 = 1.56, df = 2, p = 0.46, GFI = 1.00, AGFI = 0.99, CFI = 1.00, RMR = 0.00, SRMR = 0.00 RMSEA = 0.00

From table 4.11, we found that the value of R^2 was between 0.16-0.52 and we also found that the model conformed with empirical data by considering $\chi^2 = 1.56$ df = 2 p = 0.46 χ^2 /df = 0.78 GFI = 1.00 AGFI = 0.99 CFI = 1.00 RMR = 0.00 SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

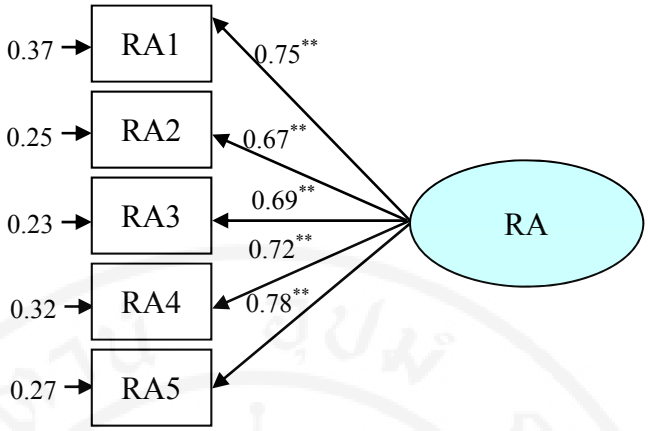

Figure 4.2 Relative Advantage (β)

From the picture, we found that RA5 had the highest value of β = 0.78, RA1 was β = 0.75, RA4 was β = 0.72 RA3 was β = 0.69 and RA3 was β = 0.67.

3. Complexity (Cpx) consists of 4 observation variables and the results of the CFA analysis are shown in table 12 below;

Table 4.12 Complexity (Cpx) analysis

Observation Variables	β	SE	t	R^2	α
The skills required to use QR code technology are too complex for employees (Cpx1)	0.73	(0.05)	5.05**	0.43	0.90
Integrating QR code technology in current work practices is very difficult (Cpx2)	0.65	(0.03)	3.78**	0.50	0.90
Integrating QR code technology with existing IT systems is very complex (Cpx3)	0.70	(0.04)	4.26**	0.80	0.90
The use of QR code is too complex for business operation (Cpx4)	0.78	(0.09)	6.42**	0.78	0.90

χ^2 = 1.28, df = 1, p = 0.26, GFI = 1.00, AGFI = 0.98, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.02

From table 4.12 we found that the value of R^2 was between 0.43-0.78 and we also found that model conformed with empirical data by considering χ^2 = 1.28 df = 1 p = 0.26 χ^2 /df = 1.28 GFI = 1.00 AGFI = 0.98 CFI = 1.00 RMR = 0.00 SRMR = 0.00

RMSEA = 0.02 with statistical significant = 0.01. We can construct β of each observation variable as shown below;

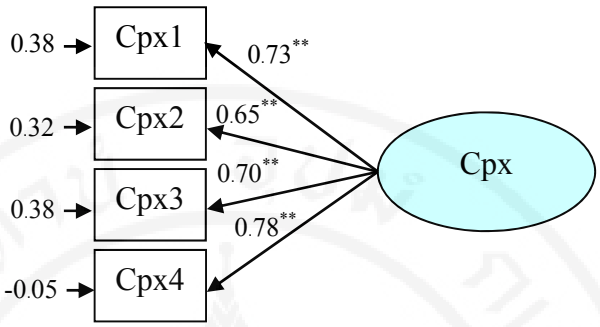

Figure 4.3 Complexity (β)

From the picture, we found that Cpx4 had the highest value of β = 0.78, Cpx1 was β = 0.71, Cpx3 was β = 0.70 and Cpx2 was β = 0.65.

4. Top Management Support (TMS) consists of 5 observation variables and the results of the CFA analysis are shown in table 13 below;

Table 4.13 Top Management Support (TMS) analysis

Observation Variables	β	SE	t	R^2	α
Top management has taken an active role in deciding the priority of QR code implementation in my organization (RA1)	0.66	(0.03)	6.40**	0.32	0.90
Top management is likely to consider the adoption of QR code as strategically importance (RA2)	0.68	(0.03)	10.04**	0.43	0.90
Top management in my organization has shown support for QR code adoption (RA3)	0.75	(0.04)	13.99**	0.89	0.90
Top management is aware of the benefits from QR code (RA4)	0.69	(0.03)	13.99**	0.36	0.90
Management in my organization actively seeks innovative ideas (RA5)	0.78	(0.04)	7.58**	0.27	0.90

χ^2 = 1.72, df = 2, p = 0.42, GFI = 1.00, AGFI = 0.99, CFI = 1.00, RMR = 0.00, SRMR = 0.01, RMSEA = 0.00

From table 4.13, we found that the value of R^2 was between 0.27 and 0.89 and we also found that the model conformed to empirical data by considering $\chi^2 = 1.72$ df = 2 p = 0.42 χ^2 /df = 0.86 GFI = 1.00 AGFI = 0.99 CFI = 1.00 RMR = 0.00 SRMR = 0.01 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

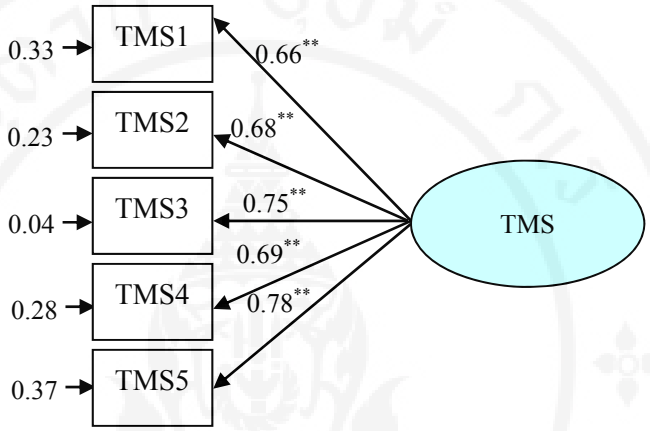

Figure 4.4 Top Management Support (β)

From the picture, we found that TMS5 had the highest value of β = 0.78, TMS3 was β = 0.75, TMS4 was β = 0.69, TMS2 was β = 0.68 and TMS1 was β = 0.66 respectively.

5. Organization Compatibility (OC) consists of 4 observation variables and the results of the CFA analysis are shown in table 14 below;

Table 4.14 Organization Compatibility (OC) analysis

Observation Variables	β	SE	t	R^2	α
QR code adoption is consistent with my organization's business strategy (OC1)	0.69	(0.09)	3.13**	0.19	0.90
The attitude towards QR code adoption in my organization is favorable (OC2)	0.73	(0.10)	3.31**	0.29	0.90

Table 4.14 Organization Compatibility (OC) analysis (cont.)

Observation Variables	β	SE	t	R^2	α
QR code adoption is compatible with my organization's information technology (IT) infrastructure (OC3)	0.71	(0.15)	3.31**	0.92	0.90
Our organization have to change current work processes to be compliant with QR code (OC4)	0.77	(0.04)	2.01**	0.22	0.90

$\chi^2 = 0.03$, df = 1, p = 0.87, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.14, we found that the value of R^2 was between 0.19 and 0.92 and we also found that the model conformed to empirical data by considering $\chi^2 = 0.03$ df = 1 p = 0.87 χ^2 /df = 0.03 GFI = 1.00 AGFI = 1.00 CFI = 1.00 RMR = 0.00 SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

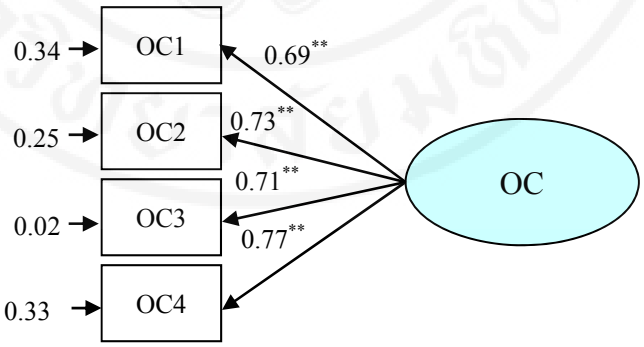

Figure 4.5 Organization Compatibility (β)

From the picture, we found that OC4 had the highest value of β = 0.77, OC2 was β = 0.73, OC3 was β = 0.71 and OC1 was β = 0.69.

6. Organizational Readiness (OR) consist of 3 observation variables and the results of the CFA analysis are shown in table 15 below;

Table 4.15 Organizational Readiness (OR) analysis

Observation Variables	β	SE	t	R^2	α
Employees are willing to participate in the QR code implementation (OR1)	0.67	(0.03)	11.14**	0.32	0.90
Employees have skills in using QR code relevant to their functions (OR2)	0.77	(0.03)	16.48**	0.76	0.90
My organization knows how QR code can be used to support operations (OR3)	0.72	(0.03)	13.94**	0.54	0.90

χ^2 = 0.00, df = 1, p = 0.96, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.15, we found that the value of R^2 was between 0.32 and 0.76 and we also found that the model conformed to empirical data by considering χ^2 = 0.00 df = 1 p = 0.96 χ^2 /df = 0.00 GFI = 1.00 AGFI = 1.00 CFI = 1.00 RMR = 0.00 SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

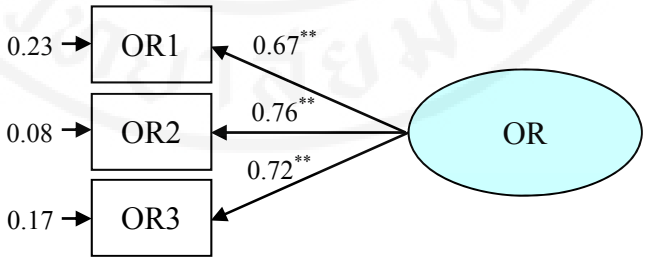

Figure 4.6 Organizational Readiness (β)

From the picture, we found that OR2 had the highest value of β = 0.76, OR3 was β = 0.72 and OR1 was β = 0.67.

7. Competition (Cpt) consists of 3 observation variables and the results of the CFA analysis are shown in table 4.16 below;

Table 4.16 Competition (Cpt) analysis

Observation Variables	β	SE	t	R^2	α
Our customers can switch to another company for similar service/products without much difficulty (Cpt1)	0.68	(0.03)	3.27**	0.25	0.90
The rivalry among companies in our industry is very intense (Cpt2)	0.84	(0.09)	4.18**	0.37	0.90
Firm will lose customers to competitors if they do not adopt QR code technology (Cpt3)	0.67	(0.10)	4.08**	0.27	0.90

χ^2 = 0.00, df = 1, p = 0.95, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.16, we found that the value of R^2 was between 0.25 and 0.37 and we also found that the model conformed to empirical data by considering χ^2 = 0.00 df = 1 p = 0.95 χ2 /df = 0.00 GFI = 1.00 AGFI = 1.00 CFI = 1.00 RMR = 0.00 SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

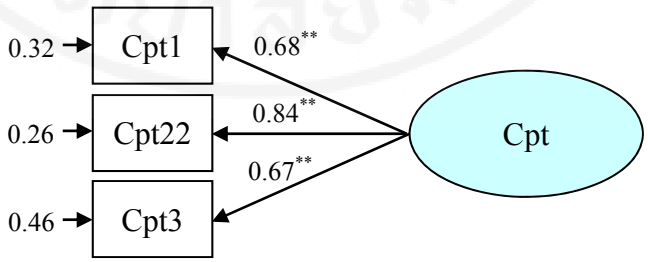

Figure 4.7 Competition (β)

From the picture, we found that Cpt2 had the highest value of β = 0.84, Cpt1 was β = 0.68 and Cpt3 was β = 0.67.

8. Normative Pressure (NP) consists of 3 observation variables and the results of the CFA analysis are shown in table 17 below;

Table 4.17 Normative Pressure (NP) analysis

Observation Variables	β	SE	t	R^2	α
Many of our suppliers are currently adopting QR code (NP1)	0.78	(0.04)	5.33**	0.61	0.90
Many of our suppliers will be adopting QR code (NP2)	0.67	(0.05)	4.23**	0.35	0.90
We often receive information regarding QR code from sources outside our organization (NP3)	0.70	(0.06)	2.60**	0.29	0.90

$\chi^2 = 0.00$, df = 1, p = 0.98, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.17, we found that the value of R^2 was between 0.29 and 0.61 and we also found that the model conformed to empirical data by considering $\chi^2 = 0.00$ df = 1, p = 0.98, χ^2 /df = 0.00, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below;

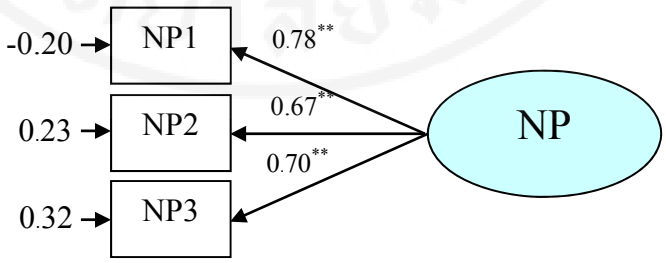

Figure 4.8 Normative Pressure (β)

From the picture, we found that NP1 had the highest value of β = 0.78, NP3 was β = 0.70 and NP2 was β = 0.67.

9. Mimetic Pressure (MP) consists of 5 observation variables and the results of the CFA analysis are shown in table 18 below;

Table 4.18 Mimetic Pressure (MP) analysis

Observation Variables	β	SE	t	R^2	α
Many of our competitors are currently adopting QR code (MP1)	0.75	(0.09)	5.82**	0.80	0.90
Many of our competitors will be adopting QR code in the near future (MP2)	0.68	(0.06)	5.46**	0.35	0.90
Our competitors that have adopted QR code are benefiting greatly (MP3)	0.73	(0.03)	2.59**	0.42	0.90
Our competitors that have adopted QR code are perceived favourably by others in our industry (MP4)	0.69	(0.03)	1.98*	0.29	0.90
Our competitors that have adopted QR code are perceived favorably by their customers (MP5)	0.72	(0.03)	2.89**	0.33	0.90

χ^2 = 0.58, df = 3, p = 0.90, GFI = 1.00, AGFI = 0.99, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.18, we found that the value of R^2 was between 0.29 and 0.80 and we also found that the model conformed to empirical data by considering χ^2 = 0.58 df = 3, p = 0.90, χ^2 /df = 0.19, GFI = 1.00, AGFI = 0.99, CFI = 1.00, RMR = 0.00, SRMR = 0.00 RMSEA = 0.00 with statistical significance = 0.01 and 0.05We can construct β of each observation variable as shown below;

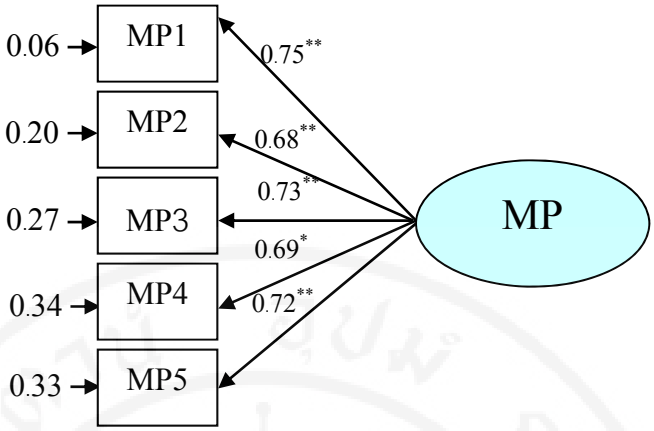

Figure 4.9 Mimetic Pressure (β)

From the picture, we found that MP1 had the highest value of β = 0.75, MP3 was β = 0.73, MP5 was β = 0.72, MP4 was β = 0.69 and MP2 was β = 0.68.

10. Intention to adopt QR code (Adoption) consists of 3 observation variables and the results of the CFA analysis are shown in table 19 below;

Table 4.19 Intention to adopt QR code (Adoption) analysis

Observation Variables	β	SE	t	R^2	α
Most firms would intend to adopt QR code technology (Y1)	0.67	-	-	0.39	0.90
In your opinion, QR code can replace the barcode and other type of advertisement as the primary means of conducting commerce? (Y2)	0.78	(0.06)	10.58**	0.75	0.90
Adopting QR code for my organization is going to be of benefit? (Y3)	0.71	(0.05)	10.39**	0.43	0.90

χ^2 = 0.02, df = 1, p = 0.89, GFI = 1.00, AGFI = 1.00, CFI = 1.00, RMR = 0.00, SRMR = 0.00, RMSEA = 0.00

From table 4.19, we found that the value of R^2 was between 0.39 and 0.75 and we also found that the model conformed with empirical data by considering χ^2 = 0.02 df = 1 p = 0.89 χ2 /df = 0.02 GFI = 1.00 AGFI = 1.00 CFI = 1.00 RMR = 0.00 SRMR =

0.00 RMSEA = 0.00 with statistical significance = 0.01. We can construct β of each observation variable as shown below

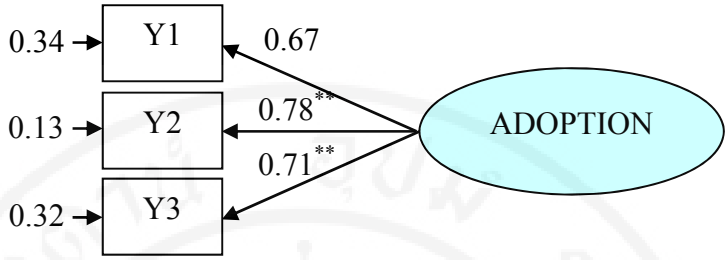

Figure 4.10 Intention to adopt QR code (β)

From the picture, we found that Y2 had the highest value of β = 0.78, Y3 was β = 0.71 and YI was β = 0.67.

4.3.6 The analysis of factors that influence the intention to adopt QR code for firms in Thailand with the MMIC model (Multiple Indicators and Multiple Causes)

The analysis of factors that influence the intention to adopt QR code for firms in Thailand with the MMIC model (Multiple Indicators and Multiple Causes) consists of the following variables;

The Independent Variables such as Observation Variables that effect the decision to adopt QR code are Technological Competence (TC), Relative Advantage (RA), Complexity (Cpx), Top Management Support (TMS), Organizational Compatibility (OC), Organizational readiness (OR), Competition (Cpt), Normative Pressure (NP) and Mimetic Pressure (MP)

The Dependent Variable refers to the intention to adopt QR code, which is the latent variable and includes 3 observation variables to determine the intention to adopt QR code, which are Intention (Y1), Replacement (Y2) and Benefit (Y3).

The analysis of factors that influence the decision to adopt QR code for firms in Thailand with the MMIC model (Multiple Indicators and Multiple Causes) considers the consistency between research model and empirical data.

Table 4.20 Analysis of Correlation Coefficient of the variables in MIMIC model and factor that influence intention to adopt QR code among firm in Thailand

	Adoption	TC	RA	Cpx	TMS	OC	OR	Cpt	NP	MP
Adoption	1.00									
TC	0.10**	1.00								
RA	0.04**	0.35**	1.00							
Cpx	0.14**	0.24**	0.38**	1.00						
TMS	0.17**	0.16**	0.19**	0.38**	1.00					
OC	0.25**	0.18**	0.10**	0.74**	0.46**	1.00				
OR	0.17**	0.19**	0.09**	0.55**	0.33**	0.38**	1.00			
Cpt	0.19**	0.09*	0.09	0.31**	0.18**	0.21**	0.51**	1.00		
NP	0.09**	0.15**	0.15**	0.20**	0.43**	0.24**	0.26**	0.38**	1.00	
MP	0.30**	0.16**	0.10	0.53**	0.29**	0.59**	0.47**	0.34**	0.35**	1.00

* $p < 0.05$

** $p < 0.0$

In table 4.20, the correlation coefficients of the variables in the MIMIC model and the factors that influence intention to adopt QR code for firms in Thailand are presented. The results show that the correlation coefficient that has statistically significance at 0.01 with positive correlations in every set are 45 sets.

The values of the correlation coefficient of all variables were between 0.04 and 0.74. There were 3 sets that had strong positive relationships which are; Organizational Compatibility (OC) and Complexity (Cpx) (r = 0.74), Mimetic Pressure (MP) and Organizational Compatibility (OC) (r = 0.59), Competition (Cpt) and Organizational Readiness (OR) (r = 0.55) respectively.

There are 6 sets that has weak relationships which are; Relative Advantage (RA) and Adoption (r = 0.04), Competition (Cpt) and Technological Competence (TC) (r = 0.08), Normative Pressure (NP) and Adoption (r = 0.09), Organizational Compatibility (OR) and Relative Advantage (RA) (r = 0.09), Competition and Relative Advantage (RA) (r = 0.09), and Mimetic Pressure (MP) and Relative Advantage (RA) (r = 0.09).

Table 4.21

Table 4.21 The analysis of MIMIC model to the factors that influence intention to adopt QR code among firm in Thailand

Variable	Name	β	SE	t	α	AVE	CR
Technology Competence	TC	0.11	(0.13)	2.87**	0.90	0.51	0.98
Relative Advantage	RA	0.15	(0.15)	2.01*	0.90	0.52	0.98
Complexity	Cpx	-0.73	(0.30)	2.41*	0.89	0.51	0.97
Top management support	TMS	0.19	(0.16)	2.15*	0.90	0.51	0.99
Organizational Compatibility	OC	0.65	(0.27)	2.43*	0.90	0.53	0.96
Organizational Readiness	OR	0.07	(0.16)	2.43*	0.90	0.51	0.98
Competition	Cpt	0.30	(0.15)	2.02*	0.90	0.54	0.96
Normative Pressure	NP	0.30	(0.18)	2.65**	0.90	0.52	0.97
Mimetic Pressure	MP	0.77	(0.26)	2.97**	0.90	0.51	0.98
R^2			0.14				

$\chi^2 = 14.87$, df = 15, p-value = 0.46, GFI = 0.99, AGFI = 0.97, CFI = 1.00, RMR = 0.00, SRMR = 0.01, RMSEA = 0.00

To assess the model fit, the above values should fall under criteria as shown in table 4.22;

4.4 Models Fit Criterion

Table 4.22 Models Fit Criterion

Criterion	Value	Recommended Value
χ2/ degree of freedom	0.99	≤ 3.00
Goodness of fit (GFI)	0.99	≥ 0.90
Adjusted GFI(AGFI)	0.97	≥ 0.80
Comparative Fit Index (CFI)	1.00	≥ 0.95
Standard RMR (SRMR)	0.01	≤ 0.08
Root Mean Square Error of Approximation (RMSEA)	0.00	≤ 0.05

The above table shows the common model-fit criteria that are used to assess the overall goodness of fit.

The χ^2 / degree of freedom is 0.99, GFI (Goodness of Fit Index) is 0.99, AGFI (Adjusted Goodness of Fit Index) is 0.97, CFI (Comparative Fit Index) is 1.00, which comply with the criteria that CFI ≥ 0.95 is recognized as indicative of good fit (HU and Bentler, 1999) RMR (Root Mean Squared Residual) is 0.00, SRMR (Standardized Root Mean Squared Residual) is 0.01, which comply to the criteria that a value as high as 0.8 is acceptable(HU and Bentler, 1999) and RMSEA (Root Mean Squared error of Approximation). is 0.00. According to Kline, 1999 and (Lance CE, Butts MM, Michels LC. 2006 Apr 1; 9(2):202–20.) the value of Cronbach's alpha should be 0.70 or higher.

Therefore, it can be stated that the model fits the data well. The analysis of factors that influence the intention to adopt QR code for firms in Thailand is conducted. If we consider the observation variables which are the factors that could affect the decision to adopt QR code, we can predict the intention for usage from the coefficient determination (R^2) whose value is 0.14

The observation variable that affects the intention to adoptf QR code can be assessed from the factor loading (β) which shows that Mimetic pressure (MP) has the most positive effect on the intention to adopt QR code (β = 0.77) and the level of statistical significance = 0.01. The next variables are Organizational Compatibility (OC), Competition (Cpt), Normative pressure (NP), Top Management Support (TMS), Relative Advantage (RA), Technological Competence (TC) and Organizational Readiness (OR) where the β = 0.65, 0.30, 0.30, 0.19, 0.15, 0.11 and 0.07 respectively, and the level of statistical significance = 0.01 and 0.05 while Complexity (Cpx) is the factor that has a negative effect on the intention to adopt QR code (β= -0.73); the level of statistical significance = 0.05; the value of Average Variance Extract (AVE) was between 0.51and 0.54 and the value of Composite Reliability (CR) was between 0.96 and 0.99

The intention to adopt QR code (dependent variable), which is the latent variable, has 3 observation variables. We found that Benefit (Y3) has the most effect on the intention to adopt QR code (β = 0.59) and the level of statistical significance = 0.01. The next variables are Replacement (Y2) and Intention (Y1) where β = 0.52 and 0.40 respectively, and the level of statistical significance = 0.01. The Value of Average Variance Extract (AVE) = 0.52 and the value of Composite Reliability (CR) = 0.98

Moreover, we found that the model is consistent with the empirical data as follows;

Chi-square (χ^2) = 14.87, df = 15, statistical significance (p-value) = 0.46, χ^2 /df = 0.99, Goodness of Fit Index (GFI) = 0.99, Adjusted Goodness of Fit Index = 0.97, Comparative Fit Index (CFI) =1.00, Root Mean Squared Residual (RMR) = 0.00, Standardized Root Mean Squared Residual (SRMR) = 0.01, Root Mean Square Error of Approximation (RMSEA) = 0.00

From the above data, we can construct a model to show the relationship between factors that affect the decision to adopt QR code with the MIMIC model and the empirical data as shown below;

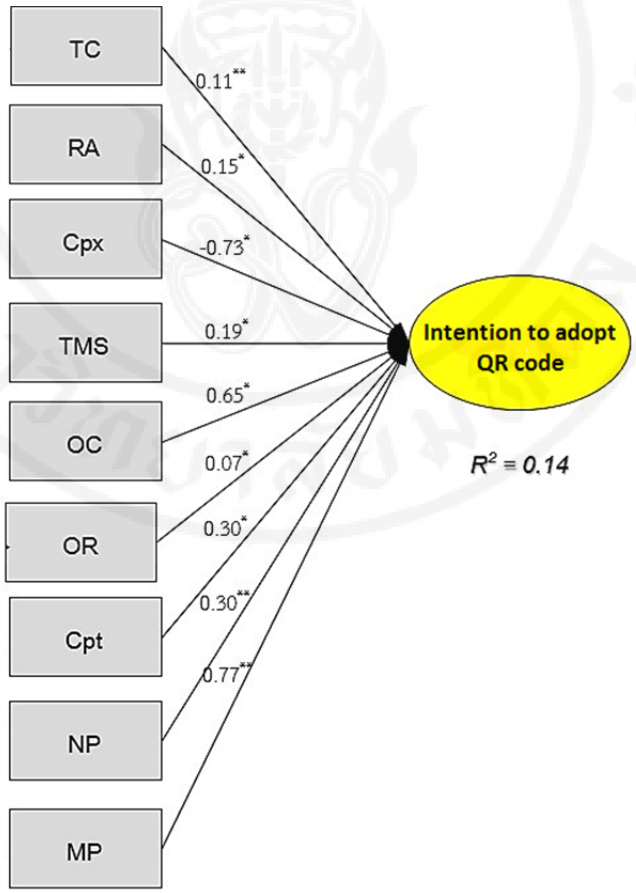

Figure 4.11 The relationship between factors in TOE framework and the intention to adopt QR code

4.5 The Result from the Analysis of Factor That Influence the Intention to Adopt QR Code Using MIMIC Model & ANOVA

H1; Technological competence is positively related to the intention to adopt QR code.

The results of factor loading analysis for Technology Competence has shown that it is positively correlated with the decision to adopt QR code (loading = 0.11) (statistical significant = 0.01). Therefore, the result is consistency with the research's hypothesis.

H2; Relative advantage is positively related to the intention to adopt QR code.

The results of factor loading analysis for Relative Advantage has shown that it is positively correlated with the decision to adopt QR code (loading = 0.15) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H3; Complexity is negatively related to the intention to adopt QR code.

The results of factor loading analysis for Complexity has shown that it is negatively correlated with the decision to adopt QR code (loading = -0.73) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H4; Top Management Support is positively related to the intention to adopt QR code

The results of factor loading analysis for Top Management Support has shown that it is positively correlated with the decision to adopt QR code (loading = 0.19) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H5; Organizational compatibility is positively related to the intention to adopt QR code.

The results of factor loading analysis for Organizational Compatibility has shown that it is positively correlated with the decision to adopt QR code (loading = 0.65) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H6; Organization Readiness is positively related to the intention to adopt QR code.

The results of factor loading analysis for Organizational Readiness has shown that it is positively correlated with the decision to adopt QR code (loading = 0.07) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H7; Competition is positively related to the intention to adopt QR code.

The results of factor loading analysis for Competition has shown that it is positively correlated with the decision to adopt QR code (loading = 0.77) (statistical significant = 0.05). Therefore, the result is consistency with the research's hypothesis.

H8; Normative Pressure is positively related to the intention to adopt QR code.

The results of factor loading analysis for Normative Pressure has shown that it is positively correlated with the decision to adopt QR code (loading = 0.30) (statistical significant = 0.01). Therefore, the result is consistency with the research's hypothesis.

H9; Mimetic Pressure is positively related to the intention to adopt QR code.

The results of factor loading analysis for Mimetic Pressure has shown that it is positively correlated with the decision to adopt QR code (loading = 0.77) (statistical significant = 0.01). Therefore, the result is consistency with the research's hypothesis

H10; The firm's intention to adopt QR code differs with regard to the firm's establishment, capital and ratio of IT spending.

The results indicated the statistical significant between year of establishment, capital, year of IT spending and intention to adopt QR code are more than 0.05 which can conclude that year of establishment, capital, year of IT spending did not affect the intention to adopt QR code.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion of the Study

To study the factors that influence the intention to adopt QR code for firms in Thailand, we developed a research model (TOE framework) to assess the degree of influence of 9 factors that can lead to the intention to adopt QR code. The empirical analysis provides several major findings as presented below.

Finding 1: The analysis of firm attributes indicates that the year of establishment, the capital in the organization, and the ratio of IT spending did not affect the intention to adopt QR code.

Finding 2: The Environmental context has the highest loading value compared to Technological context and Organizational context.

Finding 3: The individual factors that most influence the intention to adopt QR code are Mimetic Pressure, Complexity and Organization compatibility respectively.

Finding 4: The analysis results indicated that the levels of significance for the intention to adopt QR code are Mimetic Pressure, Complexity, Organizational Compatibility, Benefit, Replacement, Intention, Competition, Normative Pressure, Top management Support, Relative Advantage, Technological Competence, and Organizational Readiness, respectively.

5.2 Subject, Material and Procedures

The researcher collected data from 400 respondents who work for a firm and live in Thailand. Survey questionnaires were distributed to target respondents in several channels including face to face data collection, Email interaction and letters. The survey was conducted from June – August 2015. A survey questionnaire was used to analyze the relationships between variables and the decision to adopt QR code and consisted of 38 questions based on the TOE model. The SPSS program was then used

to analyze the raw data for descriptive statistics and the LISREL program was employed to analyze the consistency between the empirical data and the Goodness of Fit index.

Table 5.1 Summary of the Hypothesis Results

No	Hypothesis	Results
H1	Technology competence is positively related to the intention	Accepted
H2	Relative advantage is positively related to the intention to adopt QR code	Accepted
H3	Complexity is negatively related to the intention to adopt QR code	Accepted
H4	Top Management Support is positively related to the intention to adopt QR code	Accepted
H5	Organizational compatibility is positively related to the intention to adopt QR code	Accepted
H6	Organization Readiness is positively related to the intention	Accepted
H7	Competition is positively related to the intention to adopt QR code	Accepted
H8	Normative Pressure is positively related to the intention to adopt QR code	Accepted
H9	Mimetic Pressure is positively related to the intention to adopt QR code	Accepted
H10	The firm's intention to adopt QR code differs with regard to firm's establishment, capital and ratio of IT spending	Rejected

5.3 Major Finding

The research results indicated that all factors have positive relationships with the intention to adopt QR code except complexity and all variables were significantly related to the intention to adopt QR code at 0.01 and 0.05 levels of significance while the firm's establishment, capital and ratio of IT spending did not affect the intention.

5.3.1 Technology Competence

The results of factor loading demonstrate a value of β 0.11** which is consistent with our hypothesis (H1) that Technological Competence has a positive influence on the adoption of QR code. It is possible that firms will consider the adoption of QR code if they think that they can apply QR code with their existing technology. This positive relation was also supported in the study of the Process of technological innovation, L.G. Tornatzky and M. Fleischer, 1990)

5.3.2 Relative advantage

The results of factor loading demonstrate a value of β 0.15* which is consistent with our hypothesis (H2) that relative advantage will have positive influence on the adoption of QR code. QR code can reduce the cost of advertising as it does not require a lot of space on leaflets and brochures. The mobile phone user can simply scan the code instead of typing URLs to access information. The QR code provides instant data and information which people can access anywhere and anytime and can also increase the frequency of advertisement seen by people. Premkumar, Ramamurthy & Nilakanta, 1994 also found that iesconsider a technological innovation if the costs of adoption are outweighed by the benefits likely to be received.

5.3.3 Complexity

The results of factor loading demonstrate a value of β -0.73* which is consistent with our hypothesis (H3) that complexity has a negative influence on the adoption of QR code. If a firm finds the QR code too difficult to understand and to apply in the business, they will reject it. This hypothesis is also supported in a study of an integrated model of information system adoption in small businesses by Thong (1999), who found that complexity is a barrier for companies to implement technology.

5.3.4 Top management support

The results of factor loading demonstrate a value of β 0.19* which is consistent with our hypothesis (H4) that top management support has a positive influence on the adoption of QR code. Usually, when a firm implements an innovation in the operation process, not every member of staff will be open to or accept the idea and some may

resist learning about new technology. The management has to help them understand the benefits of innovation that can help the company to perform better. Top management plays a vital role in overcoming the resistance of those who resist the introduction of innovation (Mortara, Napp, Slacik,Minshall, 2009)

5.3.5 Organizational Compatibility

The results of factor loading demonstrate a value of β 0.65* which is consistent with our hypothesis (H5) that organizational compatibility has a positive influence on the adoption of QR code. The strong relationship suggests that the firm perceives that QR code is consistent with their existing procedures and it will be easy for them to accept the innovation. For example, if the firm is familiar with barcodes or related systems, there will be a great chance that they will implement the QR code into their business strategy plan. Rogers (1995) mentioned that the more innovation is consistent with existing technology and the organizational belief and value systems, the greater the chance of adoption.

5.3.6 Organizational Readiness

The results of factor loading demonstrate a value of β 0.07* which is consistent with our hypothesis (H6) that organizational readiness has a positive influence on the adoption of QR code. To implement an innovation generally requires employees to accept the change in the work process. If employees are not ready to change their work behaviors, implementing a new strategy is often impossible (Schneider, Brief, & Guzzo, 1996)

5.3.7 Competition

The results of factor loading demonstrate a value of β 0.30* which is consistent with our hypothesis (H7) that competition has a positive influence on the adoption of QR code. Most firms perceive that they need QR code as a marketing tool to compete with their competitors. Yoon (2009) mentioned that IT innovation is necessary to maintain and achieve competitive advantage. There are many firms that sell similar or substitute products at similar price. To win the competition, many firms use technology to help them promote their product and companies that are not able to access to the same technology tool, may lose their market share.

5.3.8 Normative Pressure

The results of factor loading demonstrate a value of β 0.30** which is consistent with our hypothesis (H8) that normative pressure has a positive influence on the adoption of QR code. It can be assumed that a firm is likely to adopt QR code if they perceiv that their competitors or other companies already used QR code in their operations. DiMaggio and Powell (1983 and 1991), refer to normative pressure as a factor that influences business to adopt innovations that others have already adopted. Chang and Cheung (2001) mentioned that normative pressure was significant fr the intention to use the internet at a workplace.

5.3.9 Mimetic Pressure

The results of factor loading demonstrate a value of β 0.77** which is consistent with our hypothesis (H9) that Mimetic pressure has a positive influence on the adoption of QR code. In this study, Mimetic Pressure appears to have the strongest positive correlation so it can be assumed that most firms prefer to learn from others that have already adopted QR code if it is seen to be a benefit before they decide to adopt it. DiMaggio & Powell (1983) mentioned that when the organizations perceive that there are sufficient numbers of organizations in a market that have adopted the innovation, they will copy that action without much investment in research and they can also reduce the risk of failure.

According to the findings of this study, before implementing QR code in the operation plan, firms should focus on mimetic pressure, complexity and organizational compatibility as the results from the analysis show that these factors have the most impact on the adoption decision. If a firm understands what they need to do, and whether QR code is suitable for them before adopting it, it can help them to minimal time & cost consumption in the adoption process.

5.4 Benefits of Major Finding

This study investigated the factors that have an effect on QR code adoption in order to yield comprehensive insights into these factors and the decision to adopt QR code.

The benefits of this study are to identify the relationships between the intention to adopt QR code and the factors in the TOE framework and to determine which context and which factors have the most influence on the adoption decision.

Table 5.2 The result of factor loading

TOE Framework	β
Technological Context	
Technology Competence	0.11
Relative Advantage	0.15
Complexity	-0.73
$\bar{X}$	0.33
Organizational Context	
Top management support	0.19
Organizational Compatibility	0.65
Organizational Readiness	0.07
$\bar{X}$	0.30
Environmental Context	
Competition	0.30
Normative Pressure	0.30
Mimetic Pressure	0.77
$\bar{X}$	0.46

From the results of factor loading in Table 5.24, in terms of context, the Environmental context has the highest value followed by the Technological context and the Organizational context which indicated that firms should pay more attention to this context. The results also support the importance of the TOE framework as other theories such as DOI and TAM do not include this context in the framework.

In terms of individual factors, Mimetic pressure, complexity and organizational compatibility are the drivers that are important to the firm. We can suggest that firms should provide information, knowledge and demonstrate how to use QR code to their employee as the complexity of an innovation can act as a barrier to the implementation

of it. If employees understand how to use QR code; it can reduce the level of resistance from employees. In addition, they should indicate the benefits of QR code that other companies have gained. When employees have a positive perception of QR code and know that it can benefit them in the future, it can motivate employees to accept the implementation plan. In terms of organizational factors, firms should also focus on their existing technology as it could influence the degree of acceptance for the adoption of QR code.

5.5 Contribution of Study

The study of factors that influence the intention to adopt QR code has widely contributed to firms in two ways. First, an analysis of the TOE framework helps firms to understand the motivations that significantly affect the adoption decision.

Second, this research is one of the first studies that has explored the relationship between factors that could influence the intention to adopt QR code. Firms can use the findings from this research to establish strategies with regard to priorities when adopting QR code.

5.6 Limitations and Future Research

As in most empirical studies, this research is limited in some ways. First, most of the data on this research were collected from respondents from different positions in the organizations so the results may vary as people from different positions may have different views of QR code. Future research should focus on other positions to compare the results.

Second, this research used a quantitative method to measure the factors that influence the decision to adopt QR code which may lack some significant information, some respondents may not answer the questions carefully and some may not understand the questions. A qualitative method, such as face to face interviews, may help the researcher to obtain broader information from respondents. The development of qualitative methods is also recommended for future research.

Third, in the firm, the rate of adoption of small and medium size of business could be different as medium sized businesses tend to have more resources to adopt new technology. Future research is needed to understand whether the differences between businesses of different size have any effect on the rate of adoption.

Lastly, this research only focused on 9 factors that could influence QR code adoption. We would encourage future researchers to investigate other factors and test them in different contexts.

REFERENCES

Boni P., Hangjung Z., Andrew P. C., and Jae J. R. 2011. Determinants of E-Government Assimilation in Indonesia: An Empirical Investigation Using a TOE framework, *Asia Pacific Journal of Information system*s, 21(1): 49-80.

Damon Gura, Kevin O'Shea, Arjuna Reddy and Micheline (Mich) Sabatte. 2011. *QR Codes*. Kellogg School of Management.

Frank T. R. (n.d.). *Competitive advantage in technology intensive industri*es. Retrieved from https://www.scheller.gatech.edu/directory/faculty/rothaermel/pubs/RothaermelCompetitiveAdvantageFinal.pdf.

Haveman, H. A. 1993. Follow the Leader: Mimetic Isomorphism and Entry into New Markets. *Administrative Science Quarterly*, 38: 593-627.

Jeff Baker. 2012. "The technology-organization-environment framework," in *Information Systems Theory*, Y.K. Dwivedi, M.R. Wade, and S.L. Schneberger, Eds., ed New York: Springer, pp 231-245.

Jen-Her Wu and Shu-Ching Wang (2005) what drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information & Management*, 42(5): 719-729.

Judy E. S. 2007. *An e-Transformation Study Using the Technology-Organization-Environmental Framework*. Retrieved from http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1004&context=bled2007.

Lance CE, Butts MM, Michels LC. 2006. The Sources of Four Commonly Reported Cutoff Criteria: What Did They Really Say? *Organizational Research Methods*, 9(2):202–20.

Lin, H. (2008). Empirically testing innovation charateristics and organizational learning capabilities in e-business implementation success. *Internet research*, 18(1): 60-78.

Louis G. T. Mitchell F. 1990. *Process of technological innovation*. Massachusetts/Toronto: Lexington Books.

Low, C., Chen, Y. & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems*, 111(7): 1006-1023.

Mortara, L., Napp, J. J., Slacik, I., and Minshall, T. 2009. *How to Implement Open Innovation: Lessons from studying large multinational companies.* Cambridge: Univ. Press.

Niina Heikkinen. 2012. *QR code as a channel tool: Value of the code in information sharing*. Retrieved from http://www.theseus.fi/bitstream/handle/10024/49739/Niina.Heikkinen.thesis.pdf?sequence=1.

Nuttaya, V. and Veera, B. 2016. *The determinants of social commerce system success for SMEs in Thailand*. Business Administration Division, Mahidol University International College.

Premkumar, G., Ramamurthy, K. and Nilakanta, S. (1994). Implementation of Electronic Data Interchange: An innovation diffusion perspective. *Journal of Management Information Systems*, 11(2), 157-186.

Rensis Likert. 1932. A *technique for the measurement of attitudes*. New York : The Science Press

Rogers, E.M. 2003. *Diffusion of innovations*. 5th ed. New York: Free Press.

Rui, G. (2007). *Information systems innovation adoption among organizations: A match-based framework and empirical studies*. Published PhD Thesis, National University of Singapore.

Schneider, B. and Guzzo, R. A. 1996. Creating a Climate and Culture for Sustainable Organizational Change. *Organizational Dynamics*, 24(4): 7-19.

Tom Yoon. 2009. *An empirical investigation of factors affecting organizational adoption of virtual wor*lds. Retrieved from https://fsu.digital.flvc.org/islandora/object/fsu:253879/datastream/PDF/view.

Veera, B. and Donyaprueth, K. (2013). *Acceptance of open source software amongst Thai users: an integrated model approach.* Retrieved from http://idv.sagepub.com/content/early/2013/01/04/0266666912465880.

Wan, N. S., Wan, I. and Azwadi A. 2013. Conceptual model for examining the factors that influence the likelihood of computerized accounting information system (CAIS) adoption among Malaysian SMES. *International Journal of Information Technology and Business Management*, 15(1): 122-151.

Welsh, J. A. and White, J. F. 1981. A small business is not a little big business. *Harvard Business Review*, 59(4): 18-32.

Yamane, Taro. 1967. *Statistic, an Introductory Analysis*. 2nd ed. New York: Harper and Row.

Zhu, K., Kraemer, K. L. and Xu, S. 2002. *A Cross-Country Study of Electronic Business Adoption Using the Technology-Organization-Environmental Framework*. University of California, Irvine.

APPENDIX

Questionnaire

Section 1: Personal Background

1: In what year was your organization founded?

Year ☐

2: Approximately how many employees does your organization have in total?

Number of Employees ☐

3: What were the approximate annual sales or revenue in the last financial year?

Million baths ☐

4: Please indicate what best describes your position.

- President, Managing Director, CEO
- IT management
- Financial Management
- Business Operation Management
- Executive staff
- Other (Please specify) ☐

5: Approximately, what is the capital in your organization?

☐ Million baths

6: Approximately, what is the annual IT spending of your organization as a percentage of total revenue (1-100%)?

☐ %

7: Approximately, what is the annual advertisement spending of your organization as a percentage of total revenue (1-100%)?

☐ %

8: Are you familiar with QR code (Quick Respond) and its uses?

☐ I know all about QR code

☐ I have good knowledge about QR code

☐ I have some knowledge of QR code

☐ I have only heard about it

☐ I have no idea/ not familiar with it

9: Do you have an experience of using QR code?

☐ Yes ☐ No

10: If yes, how many year have you been using the QR code?

[ ] Years

Section 2: Do you agree that the following competencies have influence to the firm to adopt the QR code?

Please indicate how much you agree or disagree with each of the following statements based on a scale ranging from “Strongly disagree” to “strongly agree”

Content	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
TECHNOLOGICAL CONTEXT **Technology Competence** The technology infrastructure of my organization is available for support QR code application					
My organization is decided to ensuring that employees are familiar with QR code technology					
My organization contains a high level of QR code related knowledge					
Relative Advantage Adopting QR code will allow better communication with our customers					
Adopting QR code will increase the profitability of our organization					

Content	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Adopting QR code will reduce costs (e.g., communication, advertising and marketing)					
Adopting QR code will improve our web presence					
QR code will improves data capacity					
Complexity The skills required to use QR code technology are too complex for employees					
Integrating QR code technology in current retail work practices is very difficult					
Integrating QR code technology with existing IT systems is very complex					
The use of QR code is too complex for business operation					
ORGANIZATIONAL CONTEXT **Top management support** Top management has taken an active role in deciding the priority of QR code implementation in my organization					
Top management is likely to consider the adoption of QR code as strategically importance					
Top management in my organization has shown support for QR code adoption					
Top management is aware of the benefits from QR code					
Management in my organization actively seeks innovative ideas					
Organizational Compatibility QR code adoption is consistent with my organization's business strategy					
The attitude towards QR code adoption in my organization is favourable					
QR code adoption is compatible with my organization's information technology (IT) infrastructure					

Content	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Our organization have to change current work processes to be compliant with QR code					
Organizational Readiness Employees are willing to participate in the QR code implementation					
Employees have skills in using QR code relevant to their functions					
My organization knows how QR code can be used to support operations					
ENVIRONMENTAL CONTEXT **Competition** Our customers can switch to another company for similar service/products without much difficulty					
The rivalry among companies in our industry is very intense					
SMEs will lose customers to competitors if they do not adopt QR code technology					
Normative Pressure Many of our suppliers are currently adopting QR code					
Many of our suppliers will be adopting QR code					
We often receive information regarding QR code from sources outside our organization					
Mimetic Pressure Many of our competitors are currently adopting QR code					
Many of our competitors will be adopting QR code in the near future					
Our competitors that have adopted QR code are benefiting greatly					
Our competitors that have adopted QR code are perceived favourably by others in our industry					
Our competitors that have adopted QR code are perceived favourably by their customers					

Content	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Intent to adopt QR code Most retailers would intend to adopt QR code technology					
In your opinion, QR code can replace the barcode and other type of advertisement as the primary means of conducting commerce?					
Adopting QR code for my organization going to be beneficial?					

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