LAPIN AMK
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EXPLORING THE CONCEPT OF QR CODE AND THE BENEFITS OF USING QR CODE FOR COMPANIES

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Abstract of thesis

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This research work concentrates on the concept of QR Code and the benefits of using QR Code for companies. The first objective of this research work is to study the general information of QR Code in order to guide people to understand the QR Code in detail. The second objective of this research work is to explore and analyze the essential and feasible technologies of QR Code for the sake of clearing the technologies of QR code. Additionally, this research work through QR Code best practices to explore and analyze the benefits of using QR Code for companies and provide a set of accommodation in this thesis.

The research derived from the aim to increase the understanding of people and companies in terms of the benefits of QR Code. This research focuses on the theoretical framework relevant to the QR Code studying. This QR Code studying involves the fundamentals of QR Code and the technologies of QR Code. Moreover, this research emphasizes the capacities of the service of QR Code in application of WeChat. Besides, this research explores and analyzes the service, deployment and implementation of QR Code in WeChat application to gain the benefits of using QR Code for companies.

Exploratory research and descriptive research are the main research methods used in this thesis. Because of all the concept and essential information of QR Code explores and describe according to the literature, which contains the books relevant to the QR Code, the resources from Google and Internet.

On the basis of the background study of QR Code, characteristics of QR Code and technologies QR Code investigation are illustrated in the thesis work. Benefits for using QR Code for companies are studied in this thesis simultaneously. A set of recommendations are generated for companies using QR Code at the end of this thesis work.

Keywords: QR Code, WeChat, benefits

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1. INTRODUCTION

Initially, the background and motivation for this research work are presented. Besides, the objectives and research questions are discussed. Furthermore, the structure of QR Code is used to introduce the thesis structure.

1.1Background and motivation

Today, Smart-phone plays a significant role in people's daily lives. According to previous research, it is found that the mobile activated space maintains steady growth. In 2012, the range of mobile activated space is 8,448 activated pages, until 2013, the range of mobile activated space increases to 13,088 activated pages. (Nellymoser 2013.)

There are a lot of activities in mobile space, such as social networking and shopping, therefore, the identification and payment methods are created. What kind of thing can be replacing as an identity to visit a virtual store by their smart-phone If consumers shopping online. Quick Response Code (hereinafter QR Code) as a new identity is used in the world, it looks like a small box which includes a random series of black and white pixels. Even though QR Code is a tiny symbol, a website address, specifications of particular products or personal information can be included in this symbol. In addition, the surprising news is that various information accesses can be done through smart-phones. (Speed & Nykamp & Heiser & Anderson & Nampalli 2013, 17-18.)

QR Code is becoming popular and extensive adoption in international. Especially in Japan and Korea, people who are using QR Code scanning to visit Internet accounts for 96%. The QR Code is often used on newspapers, magazines, journals, websites, advertisement, and advertisement board to store websites' addresses, content information and miscellaneous data. For instance, QR Code is used in advertisements

to guide people to visit their websites in business world. (Jin & Du 2014, 910-911.) Additionally, QR Code becomes an official tools is utilized in governments and companies (Speed & Nykamp & Heiser & Anderson & Nampalli 2013, 18). In 2011, the Royal Dutch Mint announced QR Code embedded into the official coin that QR Code would direct a user to a website about the Royal Mint's centennial. The world's largest QR Code is created by Hacherspace and painted on the top of their company's building in Charlotte, North Carolina in 2010 (MCNC, cited by Speed & Nykamp & Heiser & Anderson & Nampalli 2013, 18.) In China, QR Code is used on the train tickets on the corner of the right bottom and the names of passengers and relevant personal information are also included in this QR Code (TCHINASIA 2011, cited by Speed & Nykamp & Heiser & Anderson & Nampalli 2013, 18).

In compliance with the description of the QR Code illustrates the wide usage of the QR Code in different fields. Yet, the majority of companies are still confused about the concept of QR Code even though they follow the market trend while using QR Code. This research concentrates on the concept of QR Code and attempts to understand the characteristics of QR Code. On the basis of the underlying technologies of QR Code, combinations of essential knowledge of QR Code explore and analyze the benefits of using QR Code for companies. To sum up, this research emphasizes on describing the concept of QR Code for the sake of offering decision guidelines for company managers when they are implementing the platform of QR Code.

1.2 Objectives

The first objective of this thesis work is to study the concept of QR Code in detail, which involves the development history and the definition of QR Code. Furthermore, the characteristics of QR Code are introduced, and through different types QR Code the features of different QR Code are analyzed. In addition, the underlying and feasible technologies of QR Code will be explored and analyzed in the thesis. The analysis involves the symbol of QR Code, encoding and decoding procedures of QR

Code. Moreover, regarding the QR Code generator and QR Code reader process implementation are demonstrated in this research. To achieve the objective, various resources are used to support this thesis.

The second objective of the thesis work aims to find out the benefits of using QR Code within companies and give reasonable recommendations on companies QR Code usage. In order to achieve this objective, this research is to explore the application of QR Code in WeChat and the characteristics of QR Code. Moreover, examples are used to explore and explain the benefits of using QR Code.

1.3 Structure of the thesis

This thesis has seven chapters. Research topics, research questions and methodology are discussed in the second chapter. The third chapter focuses the concept of QR Code and the types of QR Code, as well as the characteristics of QR. The fourth chapter describes and discusses the underlying technologies of QR Code. The best practice of QR Code subjects are provided in the fifth chapter. The benefits of using QR Code for companies are described in the sixth chapter. Recommendations and summaries are discussed in conclusion chapter.

2. RESEARCH TOPIC, QUESTIONS AND METHODOLOGY

This research work describes the fundamental of QR Code and provides various types of QR Code to represent the concept of QR Code in detail. This research involves the development history of QR Code and the background of QR Code, and explains the reason why QR Code becomes increasingly popular around the world. The research also explores the characteristics of QR Code of different types of QR Codes. Furthermore the research through the figures to display the features of QR Code in vivid.

In addition, the research explores the technologies of QR Code, such as the symbols of QR Code, which includes the version of QR Code and the size of its symbol. What is more, the research explores the functions of different squares which included QR Code. Additionally, the study focuses on encoding and decoding procedures of QR Code, and provides guidebook for generating QR Code and information about categories of QR Code generator. Besides, the process of QR Code reading instructions and different kinds of readers are exhibited in this thesis.

The outcome of the research is a set of recommendations generated for companies who are using QR Code. On the basis of the background and characteristics study of QR Code, QR Code technologies investigation and best practices of QR Code, the benefits of using QR Code within companies are studied in this thesis.

2.1 Research questions

In accordance with the two objectives of the study, the following research questions are formulated.

1. What is QR Code? What are the essential technologies of QR Code?

This question explores the concept of QR Code, and it enables readers to know the fundamentals of QR Code and understand why QR Code is popular in different fields. In recent years, QR Code is increasingly and widely used in various fields. However, QR Code is still new for most companies and individuals therefore more knowledge relevant to QR Code should be acquired by people. Thereby, one dimensional barcode would be compared with QR Code in this thesis in order to illustrate the characteristics of QR Code. Hence, this research question is able to achieve the underlying technologies of QR Code exploration.

2. What are the benefits of using QR Code for companies?

This research question focuses on understanding and recognizing the benefits of using QR Code for companies in intensive ways. A successful enterprise sample will be explored and analyzed in this thesis. After the exploring and analyzing, this research can help more companies to know QR Code deeply.

2.2 Research methodology

Descriptive and exploratory research methods are used in the light of literature analysis. In this thesis, exploratory research is nature because QR Code is widespread used in the world and the function of QR Code is evolving rapidly at present. Apart from that, the concept of QR Code and the technologies of QR Code are often updating. According to Sontakki (2010, 68) “Exploratory research is very often the first step in research process. This also called as informal research or investigation. This is a preliminary phase and is absolutely essential in order to get a proper definition of the problem on hand. And increasing the analyst’s familiarity with the problem and clarifying the concepts.” The research introduces the fundamentals of QR Code and the technologies of QR Code in appliance with the literature that is the

reason why exploratory research approach is selected. Sontakki (2010, 68) also points out that “An exploratory research focuses on discovery of ideas and generally based on secondary data, and gathering information about the practical problems for carrying out research on particular conjectural statements.” Therefore, the exploratory research approach used in this thesis that in order to explore and analyze the benefits of using QR Code for companies.

Except for exploratory research, the descriptive research method should be used in this thesis. The descriptive research describes existing phenomena that is used to identify and gain data for the characteristics of a special problem or pertinent issues, the results might be used to notice another research (Baban 2009, 23-24). In this thesis work, the main objective of descriptive research is to describes the characteristics of the topic studied and answers to the questions which involves how, what, who (Sachdeva 2009, 15). In this research, the descriptive research is used to describe the concept of the QR Code, such as the background of QR Code, the definition of QR Code, types of QR Code. In addition, the technologies of QR Code describe in this thesis as well. And the QR Code worked in WeChat also describes in this thesis.

3 QR CODE

The essential information of QR Code is explored in this chapter by searching the existing definition of QR Code and the characteristics of QR Code. Furthermore, types of QR Code is described and discussed in this chapter as well.

3.1 Fundamentals of QR Code

A QR Code is a two-dimensional barcode that means that it is scanned in two directions that is vertical as well as horizontal. QR Code enables stores more data than one dimensional barcode that illustrates the QR Code requires a more sophisticated reader. (Winter 2010, 18.) QR Code is defined by the ISO/IEC 18004 industrial standard. Nevertheless, QR Code is created and protected by the Japanese company Denso Wave in 1994. The main objective of QR Code development is encoding and reading easily for user. (Beker 2011, 131.) Denso Wave announced QR Code is released to the world in 1994 whereas Denso Wave retains the patent right of the QR Code. In accordance with the intent of developers, from the beginning of QR Code development, it could be used by as many people as possible. Under this circumstance, QR Code can grow into “public code” used by individuals and enterprises without cost and do not worry about the potential problem. QR is the abbreviation of quick response, the aim of the QR is expressing the development notion of QR code, which means emphasizing on the high-speed reading. (Denso Wave 2014a.)

Today, QR Code obtains central commercial popularity thanks to mobile technology. In 2001, the penetration ratio of mobile devices is 15.6%, until 2010, the penetration ratio of mobile devices increases to 74.9% globally. (Narang & Jain, & Roy 2012, cited by Cata & Patel & Sakaguchi 2013.) QR Code can be read by almost all mobile phones in Japan. South Korea is similar to Japan, Europe is catching up, and the United State is comparatively new to the game. Thanks to the iphone, Google’s Android operation system, and Windows Mobile phone, and Nokia’s phones all

provide Internet access and camera, because they have the ability to scan and decode QR Code. (Winter 2010, 20.) The QR Code serves as a bridge which links the virtual and real world to digital domain is altering the method of marketing. Additionally, the QR Code also offers an opportunity to Interact with consumers and attract consumer with their brand. Previous research and investigation statistics brand needs an appropriate implementation of marketing campaign to create consumers' awareness via QR Code. There are two cases of QR Code implementations are applied to demonstrates two frameworks. One of the frameworks is the marketing strategies in accordance with the layer of product or service involvement. Another one is the marketing communication system used. (Cata & Patel & Sakaguchi 2013, 1.)

At present, QR Code is becoming an increasingly standard way when communicating with potential customers via print media in most countries. QR Code is being located on e.g. stickers, booths, business cards and advertisement vehicle. When an audience of tradeshow walks past a booth and the QR Code catches audience attention. And the audience use self smart-phone to scanning the QR Code, the QR Code will automatically link to the company's webpage. The audience will clear the detail information of the company. (Weir 2010, 12-13.) The reason why use QR Code is that QR Code is new and unique. In addition, QR Code can immediately connect people to virtual environment of information and entertainment. In addition, convenient and fast features of QR Code also attract people to use it. Besides, QR Code can send information to the mobile phone instantly, whatever someone's location. (Winter 2010, 19.)

3.2 QR Code characteristics

The characteristics of QR Code are described below to understand the different QR Code features.

3.2.1 High capacity encoding of data

A barcode is one-dimensional, which means that scanners use only horizontal direction to scan the barcode. No matter what the height of barcode is. Since barcode is one-dimensional, the storage of information capacity is limited and the barcode can store less than 20 characters. (Winter 2010, 17-18.) A QR Code possesses a high capacity of storing information (Shao &Sun & Hui 2013, 59). While a traditional barcode is able to store highest of approximately 20 digits, a QR Code enables to store several of information that is hundred times than the capacity of traditional barcode stores information. The QR Code is capable of storing various types of data, e.g. numeric and alphabetic characters, kanji, kana, hiragana, symbols, binary, and control codes. Additionally, QR Code can store maximum 7,089 characters in one symbol. (Denso Wave 2014b.) Figure 1 demonstrates that the QR Code can be stored encoding numeric and alphabetic characters (Denso Wave 2014b).

Figure 1. An example of the QR Code encodes numeric and alphabetic characters (Denso Wave 2014b)

Figure 1 displays that the different alphabetic characters and numerics are encoded in a QR Code. Although the size of symbol is small, it can be stored amount of information.

3.2.2 Small printout size

Compared with the one dimensional barcode, a QR Code can be hold information

both horizontal and vertical direction. When the number of data is same, the space of QR Code information storage only accounts for 25% space of the one dimensional barcode information storage. (Denso Wave 2014b.)

3.2.3 Kanji and kana capability

QR Code transfers the information into an image for the sake of saving the space. Due to QR Code designed in Japan that is the reason why QR Code is suitable to kanji and kana setting. QR Code encoding focuses on the Japanese industrial standards level1 and level 2 of kanji character set. In terms of kanji encode one kana or kanji character is efficiently encoded in 13 bit. Compared with other two dimensional code, QR Code can be stored more than 20% data. (Denso Wave 2014b.) Figure 2 displays the kinds of kanji convert to QR Code.

Figure 2. Kanji and Kana convert to QR Code (Denso Wave 2014b)

Figure 2 reveals that the various kanji and kana can be transferred into data and they are stored in QR code symbol.

3.2.4 Capacity of restoring and error correction

The capacity of QR Code relies on the several factors, which contain the version of QR Code, the size of the version, the level of error correction and the categories of encoded data both impact the ability (Khalil & Mantoro 2012, 24). The significant

parts of QR Code are data part and error correction code-words. Data part combines to several of segments which use different encoding and each part has its unique mode in using. Moreover, the segment of data code-words and part of error correction code-words are easy to identify except decoding QR Code when version and error correction level are given. Besides, the length of the information part is not base on the real length of the data. The length of the information is filled up with padding patterns to the whole length. (Khalil & Mantoro 2012, 30.)

QR Code has the error correction capability, therefore, QR Code can be stored the code-words maximum 30% when the image is dirty and damaged (Denso Wave 2014).When the image of QR Code is contaminated, the error detecting can focus on the place of correct information. Data can be recovered even though a part of the code is dirty and damaged in general situation. Nevertheless, in some situation of the image is dirty and damaged, data may not be restored. (Shao & Sun & Hui 2013, 59.) Figure 3 illustrates that the Dirt and Damage of QR Code (Denso Wave 2014b).

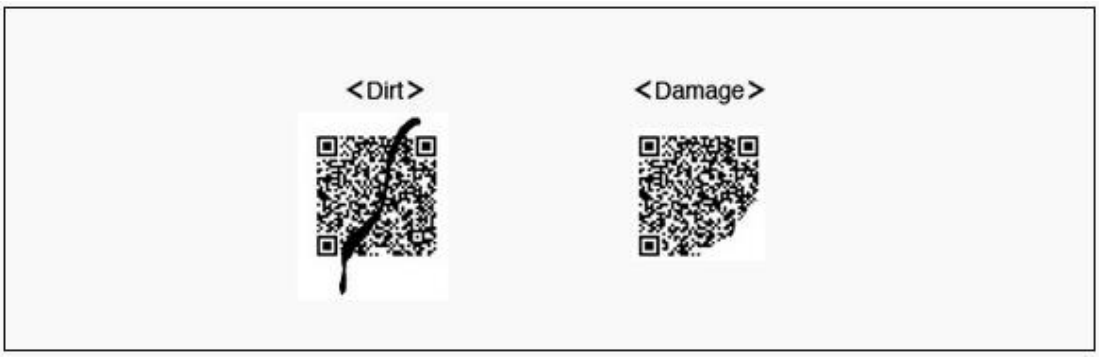

Figure 3. Dirt and damage of QR Code (Denso Wave 2014b)

Figure 3 shows that the situation of the QR Code is dirty or damaged. The QR Code can be corrected bases on these situations of dirty QR Code and damaged QR Code.

As mentioned earlier, QR Code has a mechanism of complicated error correction and restoration. Data can be easily restored even if a segment of the code due to whatever reason lead to the code unreadable. There are four different levels of error detection

that can be chosen for the incomplete QR Code corrected. In addition, the elements of considering an error correction level selection contain the size of QR Code, the performing situation, the real-estate it will have and the degree to what kind of environment can be controlled. The four levels of Reed-Solomon error correction of QR Code refers to L, M, Q and H in increasing order of capacity as follow. (Greaney 2011, 146.)

1. Level L is approximately 7% or less error enables corrected.
2. Level M is approximately 15% or less error enables corrected.
3. Level Q is approximately 25% or less error enables corrected.
4. Level H is approximately 30% or less error enables corrected.

In accordance with the level of error correction, the capacity of Level L is the weakness one, the capacity of level H is the stronger one.

3.2.5 Readable from any direction in 360 degrees

QR Code has a characteristic that it can be read in 360 degree direction. Nonetheless, the traditional one dimensional barcode recognizes the information only plus-minus ten degrees which is relatively smaller than QR Code. (Shao & Sun & Hui 2013, 59.) QR Code not only can be read in 360 degree direction, but QR Code also can be read in high speed. The secret of QR Code reading direction in 360 degrees is that position the detection patterns located at the three corners of the symbol can locate the QR Code. Therefore, QR Code can read quickly and circumvent the effects of background interference. (Denso Wave 2014b.)

3.2.6 Structured appending Feature

QR Code is capable of classifying a variety of data areas. On the contrary, a lot of

information is stored in various QR Code symbols can compose a QR Code symbol. One data symbol allows dividing into maximum 16 symbols that is providing convenience to print. (Denso Wave 2014b.) Figure 4 reveals that the structured appending features of QR Code (Denso Wave 2014b).

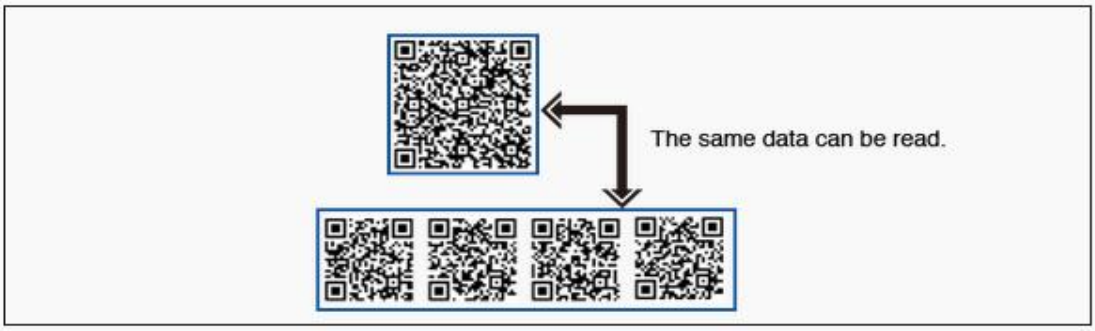

Figure 4. Structured appending of QR Code (Denso Wave 2014b)

Figure 4 shows that A QR Code can be divided into more than one QR Code, and all the QR Code also can be stored in one QR Code.

3.3 Types of QR Code

Different types of QR Code are displayed in this section. Table 1 displays five types of QR Code (Denso Wave 2014d).

Table 1. Types of QR code (Denso Wave 2014d)

QR Code Model 1and Model 2	Micro QR Code	iQR Code	SQRC	LogoQ
				
[Feature] Model 1 is the original QR Code. The largest version of this code is 14 (73 x 73 modules), which is capable of storing up to 1,167 numerals. Model 2 is an improvement on Model 1 with the largest version being 40 (177 x 177 modules), which is capable of storing up to 7,089 numerals. Today, the term QR Code usually refers to this type.	[Feature] Only one orientation detecting pattern is required for this code, making it possible to print it in a smaller space than before. This code can be viable even if the width of its margin is 2 module-worth (QR Code requires a margin of 4 module-worth at least around it). The largest version of this code is M4 (17 x 17 modules), which can store up to 35 numerals.	[Feature] Code that can be generated with either square modules or rectangular ones. Can be printed as a turned-over code, black-and-white inversion code or dot pattern code (direct part marking). The maximum version can theoretically be 61 (422 x 422 modules), which can store about 40,000 numerals	[Feature] QR Code that has a reading restricting function. Can be used to store private information or manage a company's internal information) Its appearance is no different from the regular QR Code.	[Feature] QR Code that can incorporate high-levels of design features such as illustrations, letters and logos. Since proprietary logic is used in generating this type of code, its readability is not compromised.

In agreement with the table 1, there are six types QR Code e.g. Model one, Model two, Micro QR Code, IQR Code, SQRC and LogoQ.

3.3.1 QR Code Model one and Model two

Model one is the primary QR Code and it enables encode 1,167 numerals and its highest version being 14. Model two is the edition of Model one promotion, thus Model two can be read smoothly even though it is distorted in some way. Model two can store more than 7,089 numerals with its maximum version being 40. (Denso Wave 2014c.)

3.3.2 Micro QR Code

A traditional QR Code has three finder patterns which are placed on the three corners of the QR Code image. Compared with the traditional QR Code, Micro QR Code has merely one finder pattern for positioning. On the other hand, a normal QR Code needs

no less than four-module wide margin within a symbol. Nevertheless, Micro QR Code only requires a two-module wide margin. Under this circumstance, Micro QR Code permits printing in areas smaller than QR Code.（Denso Wave 2014e.） Figure 5 illustrates difference QR Code and Micro QR Code (Denso Wave 2014e).

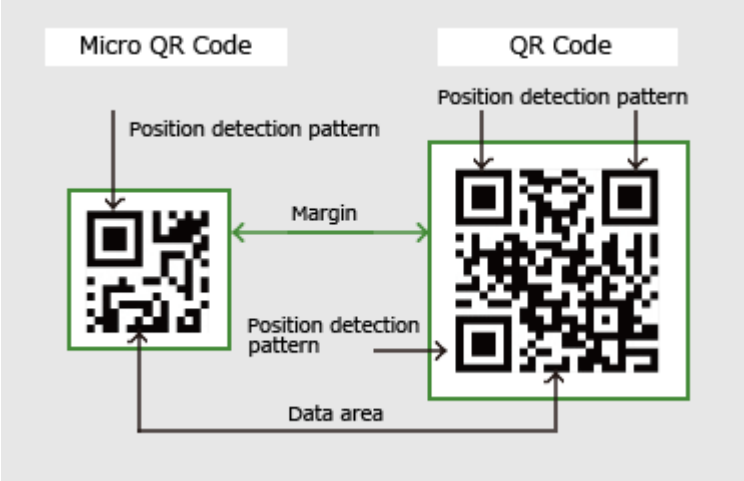

Figure 5. The symbol of Micro QR Code and QR Code (Denso Wave 2014e)

Figure 5 shows that the Micro QR Code feature and the QR Code feature in detail. In accordance figure 5, the Micro QR Code has a finder patterns, whereas QR Code has three finder patterns. Moreover, the Micro QR Code's wide margin is smaller than QR Code.

Furthermore, for the capacity of data storage and the size of code, the data can be stored by Micro QR Code in less than 35 numerals data. Micro QR Code not only enables to encode data more efficiently than the regular QR Code, but the size of Micro QR Code also does not need to be made much larger when the numbers of data stored rising. In addition, the standardization of Micro QR Code is made publicly available similarly to QR Code. (Denso Wave 2014e.)

3.3.3 IQR Code

IQR Code is a matrix-type two dimensional barcode and its position and size is read easily. Using IQR Code can be generated more extensive two dimensional barcode.

The new two dimensional barcode can be smaller than the normal QR Code and Micro QR Code. Moreover, the new two dimensional barcode also can be a large size two dimensional barcode. Furthermore, IQR Code is able to printout as a rectangular code, and IQR Code supports for turned-over code, black-and-white inversion code and dot pattern code. IQR Code permits a wide range of applications in several fields. Because IQR Code can be generated as rectangular modules, IQR Code enables replace the one dimensional barcode. IQR Code can maintain the code's readability while it printed on cylindrical products, even though square modules are difficult to print on cylindrical. (Denso Wave 2014f.) Figure 6 shows that the sample of code with rectangular modules (Denso Wave 2014f).

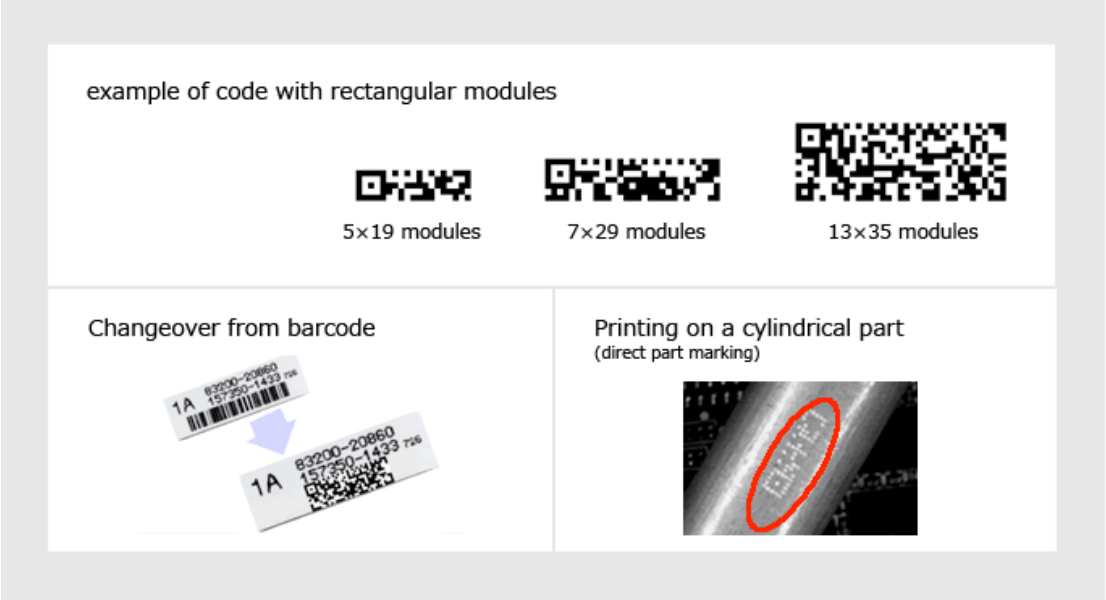

Figure 6. The rectangular modules of IQR Code (Denso Wave 2014f)

In agreement with figure 6, IQR Code has different size of version. Additionally, IQR Code can instead one dimensional code to printout on product.

IQR Code can store more information than the ordinary QR Code. If the size of symbol is same, compared with the ordinary QR Code, the IQR Code capacity of storing information increases to 80% regular QR Code. If the same amount is stored, an IQR Code can be made 30% smaller than the regular QR Code. (Denso Wave

2014f.) Figure 7 demonstrates the situation of same size and same amount within the regular QR Code and IQR Code (Denso Wave 2014f).

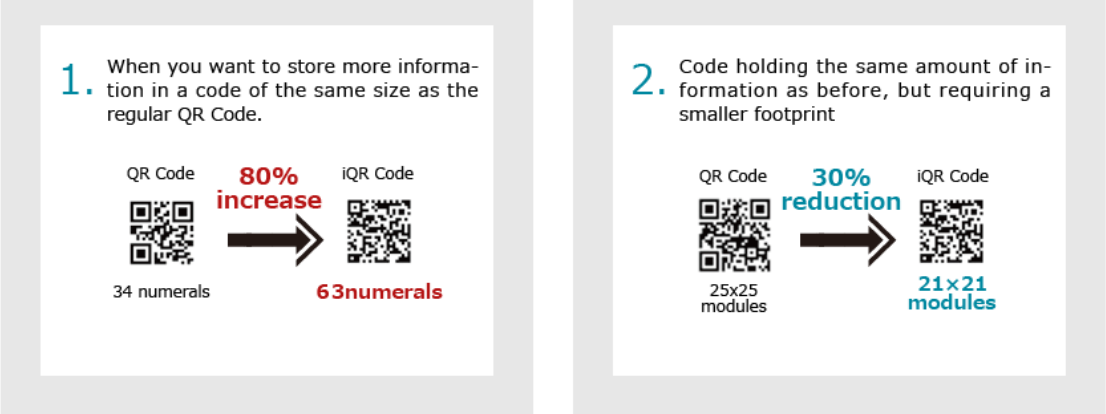

Figure 7. Comparison of regular QR Code and IQR Code (Denso Wave 2014f)

Figure 7 reveals that the size of IQR Code reduces when IQR Code has same amount data as traditional QR Code. Moreover, Figure 7 displays IQR Code possesses high data capacity. When the characters are all numerals, the highest version of QR Code can be stored 7,000 characters. By contrast, the number of characters that IQR Code can be hold in its biggest version is approximately 40,000. (Denso Wave 2014f.)

Besides, IQR Code has high restoration capability which is higher than traditional QR Code. The QR Code error correction highest level is recovered no more than 30% of error in a QR code. However, compared with the QR Code, the error correction level of IQR Code is improved to 50%. (Denso Wave 2014f.)

3.3.4 SQRC

SQRC is a particular QR Code and it is embedded into reading restricting function. The SQRC concentrates on private data storing and internal data of enterprise managing, nevertheless, this function does not ensure securing of coded data. The aspects and properties of SQRC are similar to the traditional QR Code. In addition, SQRC can be locking up of encode data, merely specific scanners can read it. Besides,

data for SQRC includes public segment and private segment, different layer of information can be stored in one SQRC. (Denso Wave 2014g.)

3.3.5 Logo Q

A new style of QR Code is LogoQ which combines a QR Code with a picture. LogoQ is designed for the sake of boosting the recognizable ability of vision. (Denso Wave 2014h.) Figure 8 reveals the sample of LogoQ. (Denso Wave 2014h.)

Figure 8. An example of LogoQ (Denso Wave 2014)

Figure 8 displays that colorful combination guides people easy to understand the code base on personal intuition. Because of LogoQ is used an exclusive logic in generating, it possesses design ability and readability. What is more, Since LogoQ has highly designable feature and it is different from the ordinary QR Code. (Denso Wave 2014h.)

4 QR CODE TECHNOLOGIES

The symbol of QR Code is described and explored in this chapter in order to guide people understand the QR Code structure clearly. As well as encoding and decoding procedure are analyzed in this chapter. Additionally, the guidebooks of implementation of QR Code generating process and reading process are listed in this section.

4.1 QR Code symbols

QR Code has forty sizes symbol e.g. version 1, version 2 and version40. When the version increases one, the side of version plus 4 modules, such as a side of version 1 is 21 modules, a side of version 2 is 25 modules and the side of version 40 is 177 modules. (ISO/IEC 2005, 9-13.) Figure 9 illustrates that the structure of versions 1 and version 2 (ISO/IEC 2005, 9-13).

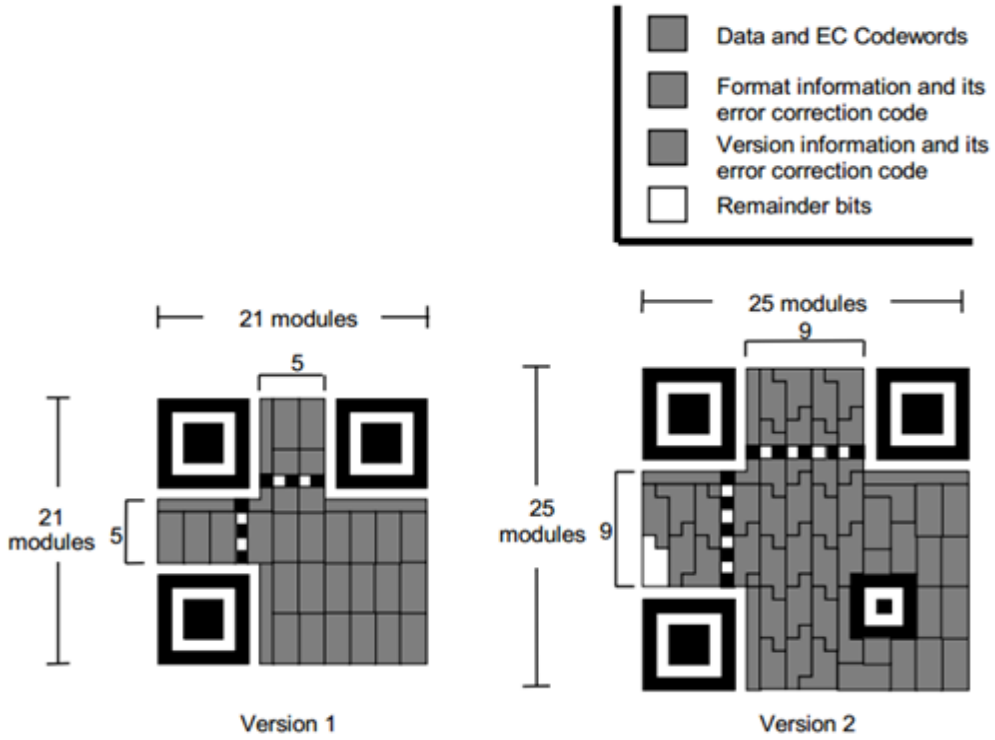

Figure 9. Version 1 and version 2 symbol (ISO/IEC 2005, 9)

In appliance with the Figure 9, the acreage of version 1 is 21 modules x 21 modules,

and the acreage of version 2 is 25 modules x 25 modules.

Figure 10 demonstrates that the structure of Versions 6 (ISO/IEC 2005, 9-13).

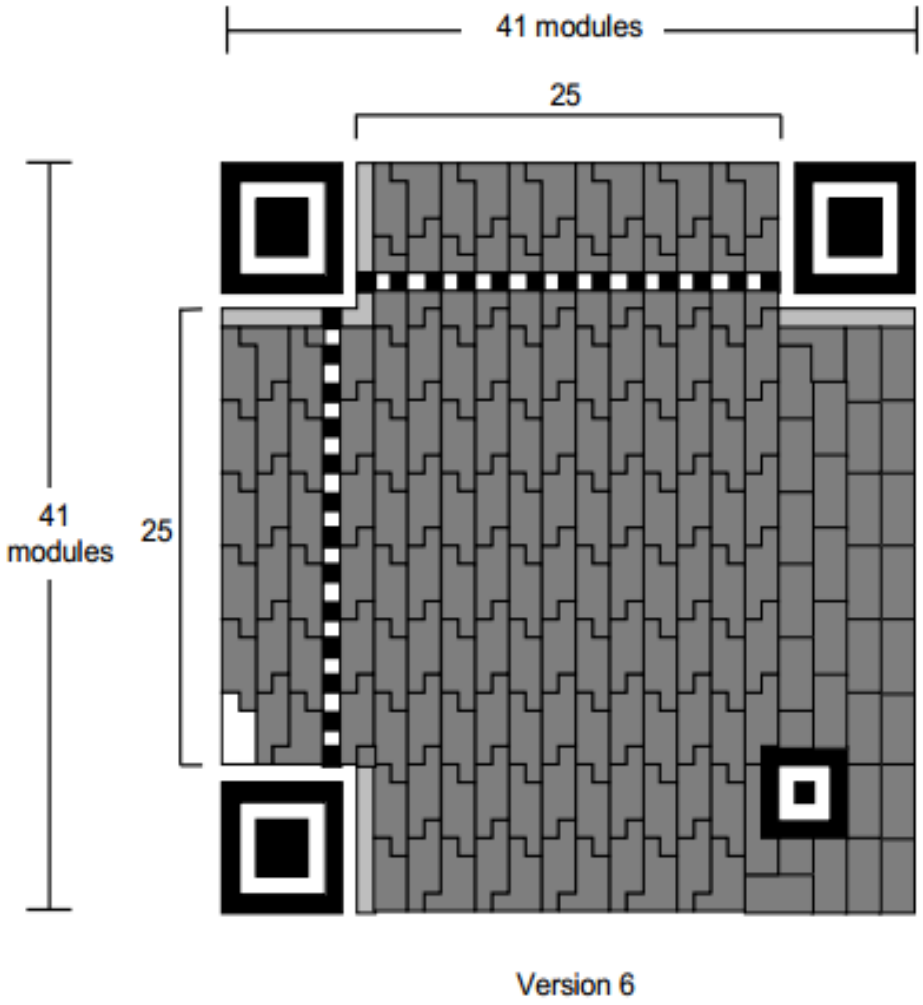

Figure 10. Version 6 symbol (ISO/IEC 2005, 10)

Figure 10 shows that the acreage of version 6 is 41 modules x 41 modules, and the distance between two finder patterns is 25 in version 6.

Figure 11 reveals that the structure of Versions 7 (ISO/IEC 2005, 9-13).

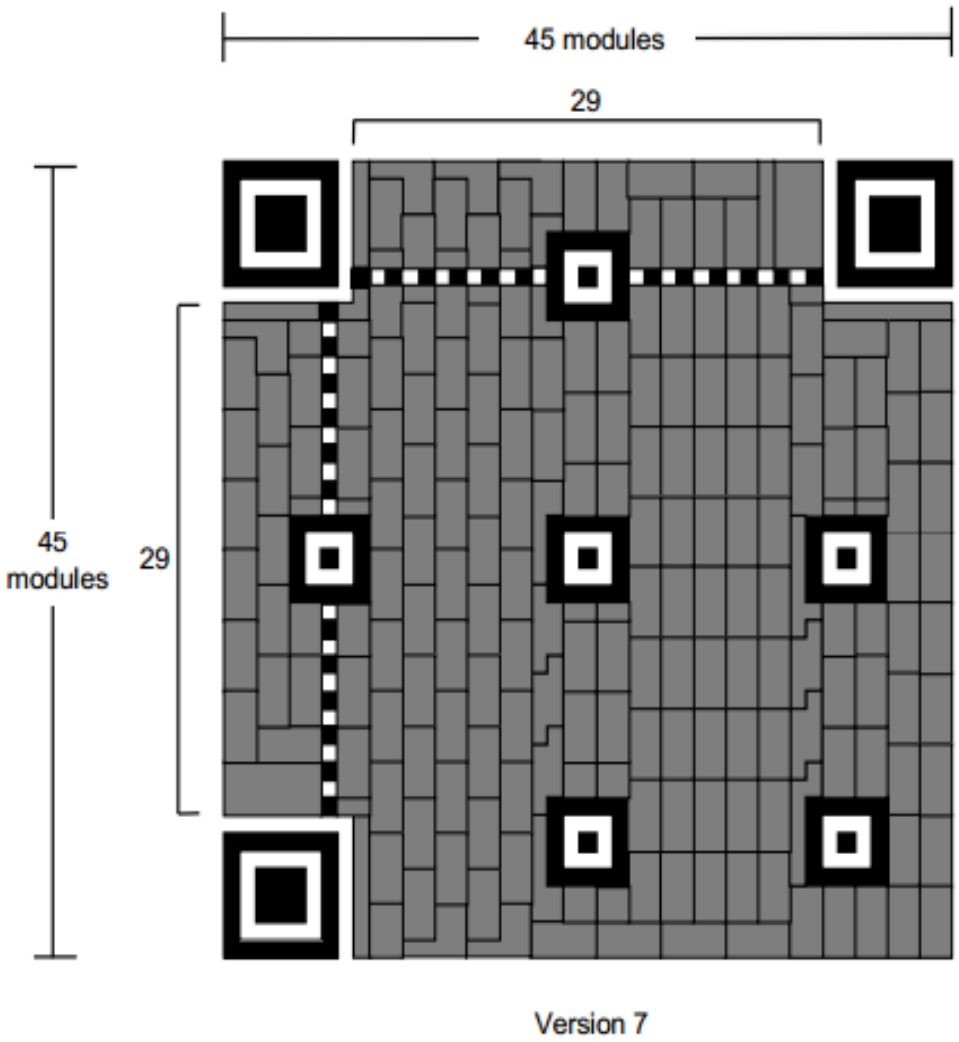

Figure 11. Version 7 symbol (ISO/IEC 2005, 11)

Figure 11 demonstrates that the acreage of version 7 is 45 modules x 45 modules, and the distance between two finder patterns is 29 in version 7.

Figure 12 displays that the structure of versions 14 (ISO/IEC 2005, 9-13).

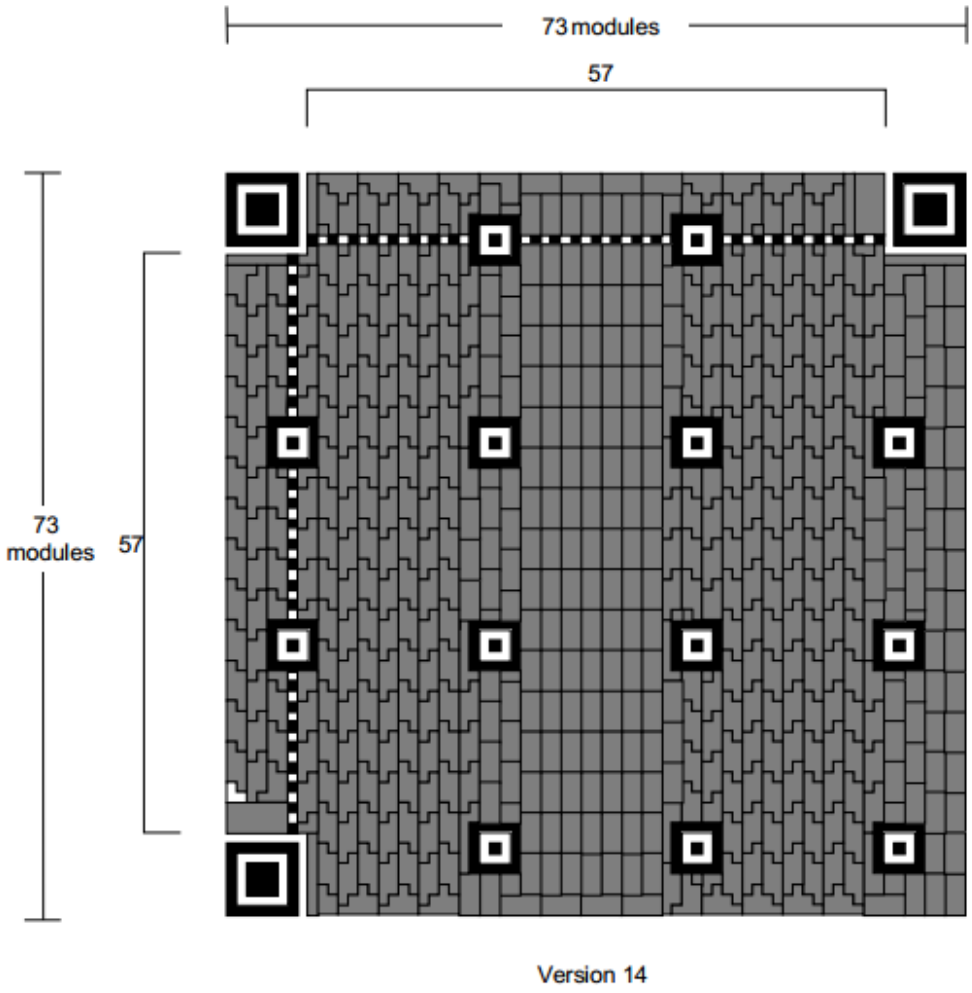

Figure 12. Version 14 symbol (ISO/IEC 2005, 12)

Figure 12 shows that the acreage of version 14 is 73 modules x 73 modules, and the distance between two finder patterns is 57 in version 14.

Figure 13 demonstrated the structure of Versions 21 (ISO/IEC 2005, 9-13).

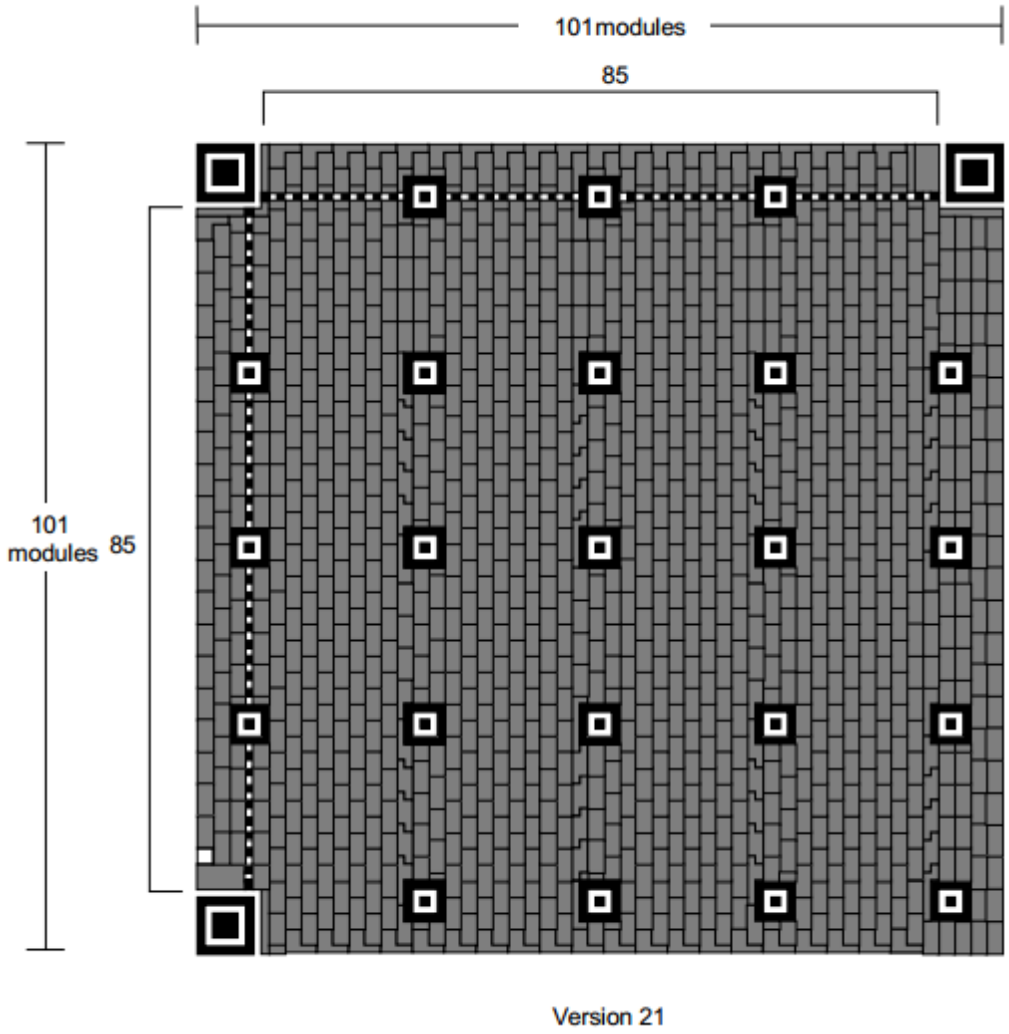

Figure 13. Version 21 symbol (ISO/IEC 2005, 13)

In accordance with figure 13, the acreage of version 21 is 101 modules x 101 modules, and the distance between two finder patterns is 85 in version 21.

Concerning the structure of QR Code, each QR Code symbol is constructed by square. The regular square consists of an encoding region and function patterns. The function patterns focus on the positioning and the encoding region concentrates on data encoding. (ISO/IEC 2005, 8.) Figure15 displays the structure of QR Code (ISO/IEC 2005, 8).

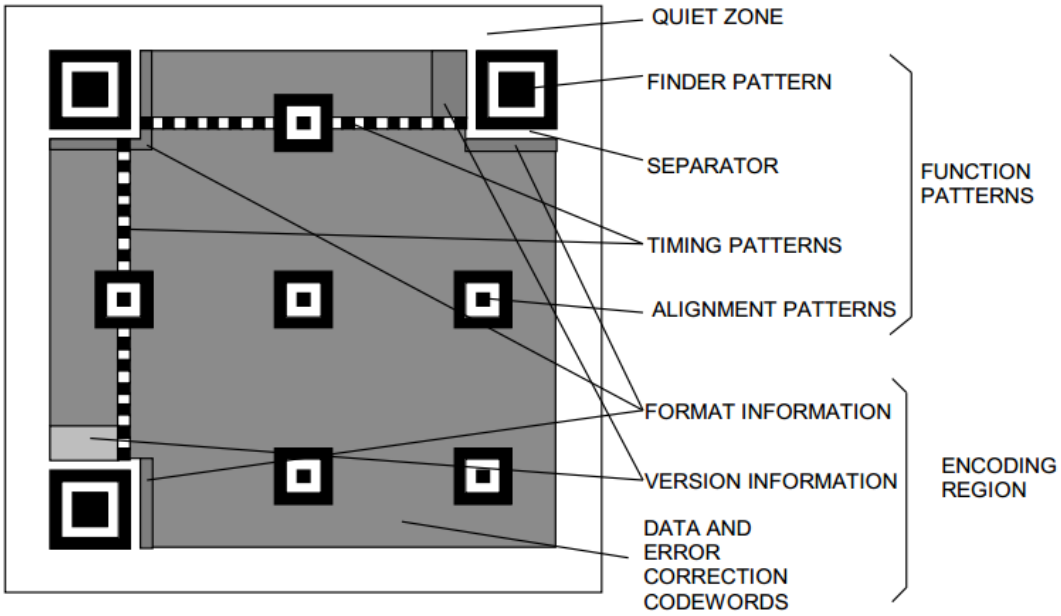

Figure 14. Structure of QR Code (ISO/IEC 2005, 8)

Figure 14 demonstrates the structure of QR Code, which is divided into two segments. In terms of function patterns which are composed by finder patterns, separators, timing patterns and alignment patterns. The Finder patterns are three common structures that are located in QR Code's three corners. Finder pattern is used for positioning the symbol, recognizing the symbol and deciding the correct orientation. Separators surround the finder pattern that can promote identification of the finder pattern. Timing patterns enable the decoder software to judge the side of module. Alignments patterns sustain decoder software in correcting for reducing the image distortion. Version one QR Code does not have alignment pattern. With the size of the version increasing, alignment pattern is added at the same time. For encoding region, format information appears in all sizes of version that used to store formatted data and select masking pattern. Data is transferred into a bit stream and stored in 8 bit parts in data section. And error correction codes are stored in error correction section. (Khalil & Mantoro 2012, 24.)

4.2 Encoding procedure overview

The encoding procedure of QR Code plays an important role in QR Code study. “The QR Code has highly recognition rate and decryption the data in a short time” (Shao & Sun & Hui 2013, 60). In this section, the encoding procedure overview of QR Code is displayed in this thesis work. Step one is data analysis, which aims at analyzing the input data stream to recognize the plenty of characters for data encoded. The Extended Channel Interpretation feature is offered by QR Code format except for Micro QR Code format that is capable to encode different types of data. QR Code has variety of modes for transfer the characters into a symbol in efficiently. The modes includes numeric mode, alphanumeric mode, byte mode, kanji mode, extended channel interpretation mode, structured append mode and Fnc1 mode. Modes switch during transferring characters as needed in order to convert data into a binary string rapidly. If the user does not require specific symbol version, the smallest version can be the best choice which accommodate the data. (ISO/IEC 2005, 16) Table 2 provides completed information concerning symbol versions and capacities of QR Code (ISO/IEC 2005, 18).

Table 2. Codeword capacity of all versions of QR Code (ISO/IEC 2005, 18)

Version	No. of Modules/ side (A)	Function pattern modules (B)	Format and version information modules (C)	Data modules except (C) ($D=A^2-B-C$)	Data capacity [codewords][a] (E)	Remainder Bits
M1	11	70	15	36	5	0
M2	13	74	15	80	10	0
M3	15	78	15	132	17	0
M4	17	82	15	192	24	0
1	21	202	31	208	26	0
2	25	235	31	359	44	7
3	29	243	31	567	70	7
4	33	251	31	807	100	7
5	37	259	31	1 079	134	7
6	41	267	31	1 383	172	7
7	45	390	67	1 568	196	0
8	49	398	67	1 936	242	0
9	53	406	67	2 336	292	0
10	57	414	67	2 768	346	0
11	61	422	67	3 232	404	0
12	65	430	67	3 728	466	0
13	69	438	67	4 256	532	0
14	73	611	67	4 651	581	3
15	77	619	67	5 243	655	3
16	81	627	67	5 867	733	3
17	85	635	67	6 523	815	3
18	89	643	67	7 211	901	3
19	93	651	67	7 931	991	3
20	97	659	67	8 683	1 085	3
21	101	882	67	9 252	1 156	4
22	105	890	67	10 068	1 258	4
23	109	898	67	10 916	1 364	4
24	113	906	67	11 796	1 474	4
25	117	914	67	12 708	1 588	4
26	121	922	67	13 652	1 706	4
27	125	930	67	14 628	1 828	4
28	129	1 203	67	15 371	1 921	3
29	133	1 211	67	16 411	2 051	3
30	137	1 219	67	17 483	2 185	3
31	141	1 227	67	18 587	2 323	3
32	145	1 235	67	19 723	2 465	3
33	149	1 243	67	20 891	2 611	3
34	153	1 251	67	22 091	2 761	3
35	157	1 574	67	23 008	2 876	0
36	161	1 582	67	24 272	3 034	0
37	165	1 590	67	25 568	3 196	0
38	169	1 598	67	26 896	3 362	0
39	173	1 606	67	28 256	3 532	0
40	177	1 614	67	29 648	3 706	0

[a] All codewords are 8 bits in length, except in versions M1 and M3 where the final data codeword is 4 bits in length

Table 2 reveals that the different version has different modules which contain function patterns modules, format and version information modules, data modules. In addition, the capability of data is difference as well. However, in terms of the remainder bits, some part of versions are same, some is difference.

Step two is data encoding which aims at transferring input data. Data transformation through matching modes into a bit stream on the basis of the rules for the mode respectively and the bit stream sequence is composed of one or more modes. Step

three is error correction coding. In appliance with the version of image and the layer of error correction, dividing the data sequence into plenty of blocks for the sake of apply error correction coding. After the error correction code-words of every block are generated, the code-words are added at the end of the data sequence. Step four is arranging the data and error correction code-words from different block. Step five is placing codeword modules in the matrix with the finder patterns, separators, timing patterns, and alignment patterns. Step six is data masking. The data masking patterns in the encoding region of the symbol to optimize the dark and light module balance and minimize the wrong patterns appearance. Step seven is relevant to generate format information and version information and complete the symbol. (ISO/IEC 2005, 16-17).

4.3 Decoding procedure overview

Visual appearance of QR Code is different from the one dimensional barcode. The QR Code has nubby patterns, high speed, two dimensional graphic images and the QR Code can be read immediately by scanners and smart-phones which have QR reader application. (Lester 2014, 194.) As a result, the QR code decoding maybe relevant to the blocky patterns, in this section, the decoding procedure is introduced. Encoding procedure is opposite to the decoding steps which are reading a QR Code symbol to outputting data characters (ISO/IEC 2005, 59). Figure 15 shows a flow chart of the decode process of QR Code.

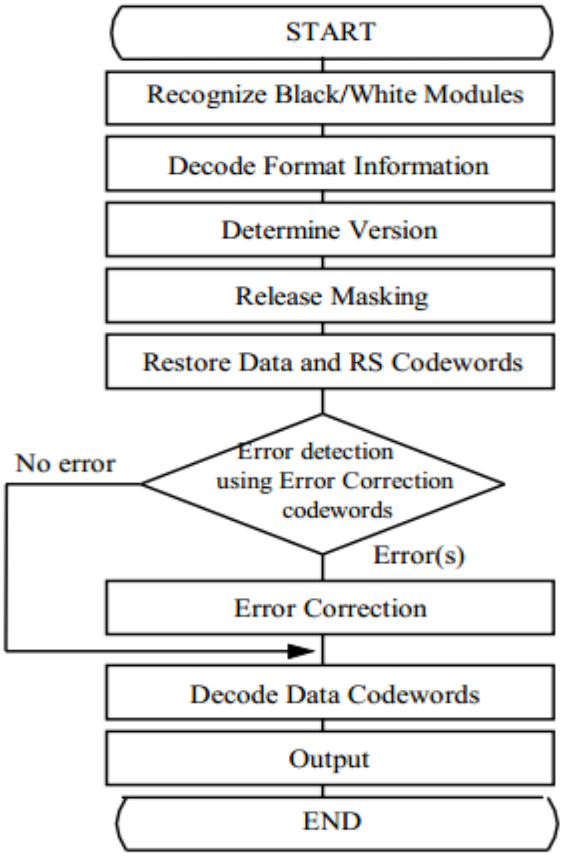

Figure 15. QR Code decoding process (ISO/IEC 2005, 60)

Figure 15 displays that the reader focus on positioning the image of QR Code when the reading process is starting. Additionally, reader recognizes the three finder patterns and identifies white and dark blocky. Second step is the format information is decoded. In this stage, the masking patterns are released and error correction is operated on the format information part. Symbol is in general guiding when successful, if not, the mirror image decoding of format information is attempted, the error correction is used for helping to decode. Third step is determining the version of QR Code. In this stage, version information is read and the version of the QR Code is verified. Afterwards, the data masking is released. The fifth and sixth step is reading the characters, detecting the error and restoring data. These steps utilize the error correction codeword to correct the error. The error will be amended when any error detected. The seventh step is classifying the data code-words into two parts in the light of the indicators of mode and indicator of character count. Finally, decode the

data character base on one or more mode and result in the original data. (ISO/IEC 2005, 59-60.)

4.4 QR Code implementation

In the section of the QR Code implementation, guidebook of QR Code generating and QR Code reading describes as follow.

4.4.1 Guide of generating QR Codes

Except for the QR Code encoding and decoding process, the QR Code generating process also significant for businesses. As Lester state “QR Code used for advertising, entertainment, and journalism purpose should be more complex than presently configured. They should not merely be used as links to a company’s homepage to help advertise and promote a product, service, or point-of -view or by journalists to simply point a user to a newspaper's website. They can also be thought of as examples of artistic expression.” (Lester 2014, 194.) However, the approach of generating QR Code is still strange for individuals or enterprises. Eslinger (2014, 24) points out that the QR Code is a bridge to link the digital and real world campaigns, because the QR Code is simply scanned by users’ mobile phone’s camera to gain the information online replace typing website addresses. There are various available QR Code generator websites free to use in both a commercial and personal setting (Dutson 2013, 5).This section illustrates the procedure of generating QR Codes, which classified six steps to describe. First of all, selecting a user-friendly QR Code generator website, websites can be picked up by individuals and enterprises in accordance with their personal preference or skill levels. Such as websites forms are easy to be understood, performed and completed. Numbers of generators provide the option of linking the QR Code to websites, phone numbers, text-messages or even picture messages. The websites refer to Kaywa, Zxing, Deliver QR Code Generator, QR stuff, Sparq Code,

QR Code Generator, Azon Media code Generator, Oline QR Lad, Beetagg Generator and Tagginn Generator. Secondly, ensuring the content that the user would like to put in user's QR Code. Carefully make a plan to list the sort of information that user wish to share with the users who are using QR Code. Thirdly, different websites display different categories when entering a website of QR Code generation, in agreement with the form requested to fill. Each of the previous mentioned liking automatically open up on the screen of smart-phone after the QR Code scanned by smart-phone. Therefore, the content of link relies on the types of information which creators prefer to share. If the type of information is about business contact, text messaging or a phone number can be a best approach. Due to the sharing information occur automatically after scanning QR Code, thus the QR Code should be tested. The reason of testing QR Code for the sake of making sure there are no errors with the code before the QR Code service provide for public. QR Code can be tested by smart-phone. When the previous entered content within the QR Code generator form appears on the screen of smart-phone that means the operation of generating QR Code is ready to use. After the QR Code is generated successfully, saving the QR Code image on your computer and backup it. This can avoid losing the QR Code image. When every step is completed, the QR Code can be public. (FreeQRCodes.org 2014.)

4.4.2 QR Code reader

QR Code is famous as a two dimensional barcode since QR Code stores data in both vertical and horizontal directions. The data which is stored in QR Code symbol can be a web address or other information, for instance, bank account or credit card information. QR Code reader application on smart-phone or other mobile devices is used for QR Code reading. (Vermaat & Sebok & Freund 2014, 305.) QR Code is read by dedicated QR Code reader, the free QR reader can be Downloadeded in personal devices, such as smart-phone. A lots of free reader applications are able to utilize to read QR Code e.g. Kaywa Reader, Qrafter, BeeTagg, QRReader, i-nigma, QRDroid,

and ATTScaner. The normal functionality of QR Code reader application is same, that is the reader scan QR Code, store access history. Moreover, some QR Code reader can be used to create QR Code. (Price 2013, 16.) When QR Code is scanned, choosing an application which enables to read QR Code. Concerning the steps of scanning the QR Codes, firstly, application software have to Downloaded and install in smart-phone or other device which has camera. The Second stage is selecting a QR Code and running the QR Code reader in smart-phone or other device. The third stage is pointing the device camera toward the QR Code and hold until the reader device read the image. At the end, if the QR Code is scanned, the result reveals automatically. (Vermaat & Sebok & Freund 2014, 305.)

5 QR CODE SOLUTIONS IN PRACTISE

QR Code is intensively used around the whole world. In this section, a few examples are illustrated below to explain how companies are using the QR Code in practice. (Sprague 2011).

1. Dick's Sporting put the QR Code on the JumboTron during a football game. Fans accessed to their website through taking the picture of QR Code. The fans gained discounts based on purchasing on the website.
2. QR Code is used on the packaging of McDonald's in Japan. Through scanning QR Code, consumers may know a review of total amount of calories, fat, and carbohydrates in this meal.
3. Few years ago, QR Code was placed in print advertisements, store placements, and mailers by Ralph Lauren. The QR Code leads consumers to access to their style guidebook, restrictive edition collections and video content of exclusively.
4. QR Codes prints on Indiana Jones and the Kingdom of the Crystal Skull movie posters, that giving users' access to movie's trailers. The user also received a discount of QR Code coupon for next purchase.
5. QR Codes prints on bottles by Pepsi that directed users to a landing page to read content.
6. QR Code is used to emphasize 'Favorite Places' in search consequences by Google.
7. Editoras Online publishes a book that only has QR Code. The QR Code is decodes the content about love and hate.
8. QR Code is used in one video advertisement by Audi. The giant QR Code is consisted of people holding black and white squares.
9. Lego creates advertisement of QR Code that using Lego blocks.
10. In a recent watch advertisement by Tissot, nowadays QR Code is used in luxury watch product field.

Another example is WeChat, which integrates the QR Code into the social

messaging application is demonstrated below.

5.1 WeChat

In spite of developing vast market of Internet and mobile device in China, over the past decade, Chinese market has been hugely restricted. Therefore, this kind of developing gives raises to most business, especially for limited domestic demand. As for dynamic Internet and mobile apartment in China, numerous companies are looking for their own new potential market abroad nowadays, e.g. Alibaba and Weibo. Alibaba is an online shopping service. These two companies both attempt to on list of New York Stock Exchange. These situation illustrate that many entrepreneur would like to enlarge Chinese market for technology, social network, and online shopping. As regards one Chinese entrepreneur, i.e. Tencent, who create a popular social message application WeChat. (South 2014.) WeChat is a typical OTT application of smart-phone which is developed by Tencent on 2011. It is equipped with voice-message, video-message, picture, text-message and group chats. WeChat allows users to send messages either by text or by voice, to share news, photos, videos, and web links with friend. At present, WeChat as an application of smart-phone is free to Downloaded and to use in China by connecting data traffic. In consequence of free for all users, WeChat results in amount of users accelerate increase. Until 2013, the number of WeChat users rise approximately twice than one year before. (Xu & Zhong & He 2014, 36.) As South state during the three years, the number of WeChat user arrives to 300 million. This amount of number may prove that WeChat has already occupied predominant social message service in the market of smart-phone to a certain extent. (South 2014.)

5.2 WeChat QR Code implementation

Concerning WeChat obtains success in Chinese social network, one selling point is

that Tencent promises the message from customer does not store on its server (South 2014). Another significant point is that WeChat combines QR Code with its social media marketing platform. Due to more detail content displays automatically when QR Code is scanned, QR Code helps individuals and enterprises to make their content can be read directly. Besides, QR Code offers a convenient way to visitor when they visit personal or enterprises' homepage which is available to read. Both two points illustrates quantities of WeChat user up to 100 million shortly. (BeQRious 2013.)

5.2.1 Personal QR Code

The function of QR Code which contains QR Code generator and reader has been embedded into WeChat. The reasons are that not only QR Code is a heart of social media service, but also QR Code is a special feature of WeChat. (BeQRious 2013.) In terms of the personal QR Code which is similar to username of WeChat. However, personal QR Code can be operated easily when users share their personal username to friends. In the light on the personal QR Code, peoples can scan their friends' personal QR Code to find out and add friends in a simple way. Each WeChat account generates personal QR Code automatically at the same time when applying. If this account is used by an enterprise, the personal QR Code becomes for an enterprise's QR Code. If the account is individually using, the personal QR Code becomes an individual QR Code. (Dad Asia 2012.)

WeChat enables scan QR Code in WeChat application. When a user uses smart-phone to browse a blog site and see a QR Code on the webpage, the user can save the QR Code as a picture in the smart-phone. Additionally, using the WeChat scanner to scan the QR Code, the blog is added into a user's personal blog list. If a user goes to somebody's personal page, the user can add the person as friend simply to scan this person's personal QR Code. When personal QR Code comes from celebrities, brand

and shows, people can scan the personal QR Code to follow the news of their favorite celebrities, brands and shows. (BeQRious 2012.)

5.2.2 Group chat QR Code

Mr. Dennis Hau who is the head of International Product Center, Tencent International Business Group (PR Newswire 2012) said “WeChat offers users innovative and fun ways to connect with the world. The concept of personal customized QR Codes has found huge popularity globally. QR Codes provide a unique identity to users along with a non intrusive form of connecting in the social media space. WeChat has become very popular in India within a short span of time and we will continue to offer new, exciting ways of engagement to our users.” For WeChat group chat, any organizations can set up group discussion for internal communicating. A group chats as a platform of internal public, each person belongs to this group has their unique identity inside for the sake of connect to others. If the Group chat is setting up by enterprise that means the staffs belong to this enterprise are allowing entering to this group. Moreover, this group chat offers a platform for those staffs for communicating, sharing the information, meeting online and making notification. Furthermore, the group chat is capable of becoming a public place for chatting and discussing with friends. Besides, the group chat is able to consumers make discussion and suggestion to manufactures. (Wu 2013, 243-244). The Figure 16 illustrates the steps of using QR Code to invite friends to a group of WeChat (WeChat 2014).

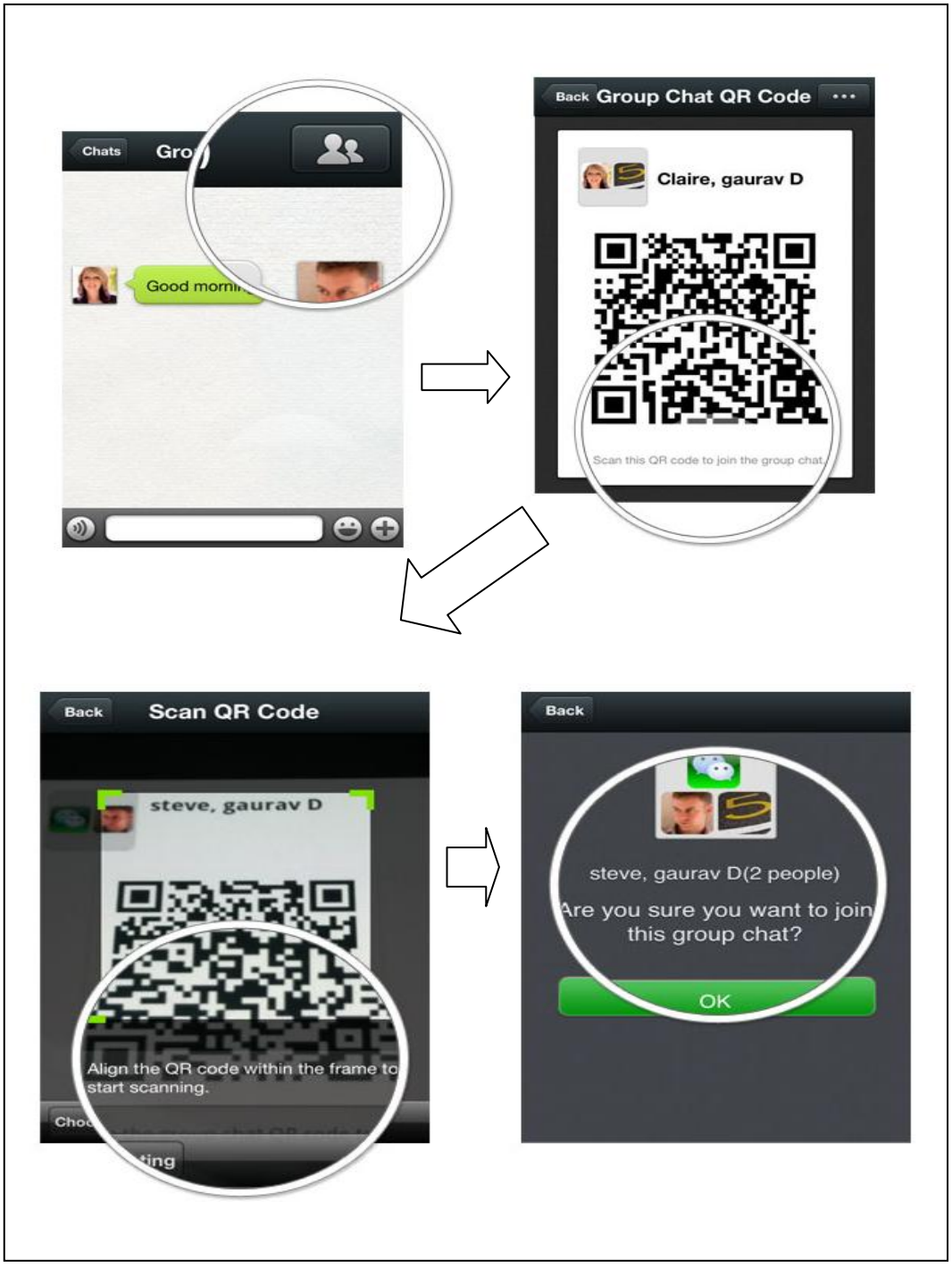

Figure 16. Steps of inviting friends join the WeChat group chat (WeChat 2014)

The figure 16 shows when a user opens a group dialog box, the top right corner has a button in the dialog box. The First step is clicking the button and the options are listing on the dialog. The second step is selecting the 'Group Chat QR Code' and a QR Code occurs in the dialog. The third step is clicking the button where at top right

corner and the options occur automatically. The group QR Code can share via email or the group QR Code can save in the operator's device and share later. Finally, other users are able to use WeChat reader of QR Code to scan the group QR Code of group and join this group chat. (WeChat 2014.)

5.2.3WeChat E-shop QR Code

Nowadays, WeChat turns into a popular social networking platform which enriches peoples' lifestyle. As mentioned before, WeChat supports for mobile texting, voicing and other functions. What is more, a major function is different from other social network application is that WeChat allows WeChat users set up their personal E-shop in WeChat for commercial activities. It is entirely commendable for a third party to publish a commercial on WeChat and the users who belong to third party can opt-in or opt-out. In WeChat E-shop, commodity can be uploaded on the webpage, and an E-shop has website and URL of itself. In addition, an E-shop also gains its own QR Code. All QR Code of E-shop and each item of QR Code can be posted at Moment, which is a place for sharing information in WeChat. The function of Moment is similar to Facebook user posts status and pictures on Facebook. Other WeChat users through scanning the QR Code of E-shop can access to the E-shop. This function provides an efficient mode when people visit a webpage without typing the URL. (Ding & Xu 2014, 338-339.)

5.2.4 WeChat public platform QR Code

WeChat public platform is a platform for marketing promotion, and this public platform cooperates with the organization, such as the celebrities, government, media and enterprises. The WeChat public platform is divided into two segments. One is for large enterprise, e.g. banks and the airline companies. Information can be sent to WeChat user who pays attention to the enterprise's WeChat public platform. Another

one is for some personal public platform or brand public platform. In personal public platform, information can be shared to WeChat user who focuses on this personal public platform. The information could be articles, pictures, approaches of cooking and newspapers. The same as personal public platform, such as the magazines, newspapers and discount information whatever is relevant to the brand can be posted in the brand public platform for their fans and consumers. A particular feature of WeChat public platform is that no matter enterprise or personal public platform, even brand public platform are able to integrate the special picture with QR Code to generate their personal QR Code. If the user of WeChat did not follow the public platform before, the WeChat user can scan the personal QR Code to add the public platform which the users prefer. The QR Code can be inserted in most places, e.g. the TV commercials, poster, and flyer. (Baidu Library 2014.)

6 BENEFITS OF USING QR CODE FOR COMPANIES

The benefits of using the QR Code are discussed here from the point of view of company user. Additionally, these section bases on the characteristics of QR Code analyze the benefits of using the QR Code for companies as well.

Today, QR Code strictly brings benefits to businesses and consumers, with an unequaled technological ability to promptly offer more content to consumers who focus on the company or brand (Brokaw 2012, 8). Attractive QR Code marketing is obvious. QR Codes are easy to create and implementing QR Code advertising is much cheaper than when a company develops its own smart-phone application (Patel 2012, cited by Brokaw 2012, 8).

There are many examples of the QR Code competition that succeeded in generating sales and increase revenue. One example is Taco Bell cooperates with MTV together to printout QR Codes on cups and boxes available at Taco Bell. With a fast scan of the QR Code located on the cup, clients are granted visit exclusive MTV music content. Content of the QR Code is changed every week, thus this concept is still new for consumers and stimulate repeat visits. In just 10 days, the activity has raised more than 100,000 scans and Taco Bell saw revenue growth of 5 %. (Tolliver-Walker 2012, cited by Brokaw 2012, 10.)

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Another example is a restaurant chain, Applebee's Neighborhood Grill and Bar (hereinafter Applebee) in the United States. The owner of Applebee began using QR Codes on the tabletops as a part of a campaign to improve the lunchtime service in June 2011, until to October 2011, as a result of the campaign, the lunch sale of Applebee increased to 9.8%, all by tabletop advertisement with a QR. (Johnson 2011, cited by Brokaw 2012, 10.)

According to Waters (2012, 14), the QR Code is not just for the average consumer of

for business-to-consumer or for business-to-consumer companies. Companies that sell business to business can also use them. One innovative business, CRT Industrial Equipment, Inc. is using the QR Code to service customers who are spending up to $100,000 on just one piece of equipment. (Waters 2012, 14.)

All above examples illustrate that using QR Code can bring more befits to companies, especially the income of companies. In addition, according to the characteristics description of the QR Code, QR Code has a lot of benefits for companies to use it. The significant one is that the QR Code has high capacity storage, and enterprises can utilize this feature in terms of market. Businesses can add the QR Code in an advertisement or poster or billboard with a short and attractive word to advertise their product. People are attracted and access to the link page via the QR Code to gain more information. That way reduces the time of advertisement and saves budget within product publicity. In addition, documents of companies can be generated the QR Code to store and the QR Code document help to save more space. Another useful feature is small printout size which means the QR Code can be printed on product and the QR Code merely occupies small size of whole product. Moreover, the QR Code does not affect the packaging of product and provides more information to the consumer when they scanned the QR Code. Hence, the QR Code promotes the product publicity in a convenient way. If products' QR Code have damage or dirt during the process of transportation, the products can easy to count via the QR Code. The reason is that the error correction capacity of the QR Code, and the readability from any direction in 360 degrees,

Furthermore, QR Code is free to use and there is no cost for all organizations and individuals all over the world. As a consequence, companies use the QR code is able to decrease the budget. In the light of the WeChat QR Code, personal QR Code can be regarded a company's QR Code which is used in a public platform. For internal companies, staff can communicate with each other in the internal public platform. Notification and information share are able to post in the internal public platform. If

the public platform is an external platform which focuses on the consumers or fans, brand can post the QR Code in daily life, other users through scanning brand's QR Code and read the content online. The content can be e.g. a magazine of the brand, newspaper, or discount information. Consequently, brand can communicate with the consumers in this public platform and get feedback from consumers. In addition, QR Code provides a convenient way during the information publish and information sharing that is a good way to promote brand-focused without largest advertising.

7 CONCLUSIONS

Based on this research of this thesis, the QR Code can be regarded as a considerable value for organizations. With the development of QR code, QR Code is widespreadly used in a number of fields, for instance in newspapers, magazines, public advertisements, business advertisements, food, drinks, restaurants, clothes stores, social network applications, enterprises, and government. Nevertheless, QR Code is relatively new for most companies. While QR Code is a competitive marketing tool today, it can also be regarded to provide commercial opportunities in different business areas in the future. As a result, the concept of QR Code was needed to be understood for individuals and organizations.

To summarize the findings of the research, QR Code is a two-dimensional barcode that can be scanned from vertical as well as horizontal angles. QR Code was created in 1994 by Wave Denso. QR Code is free of charge and there was no potential problem existed for both organizations and individuals. QR Code was used widely with the development of smart-phones. QR Code is divided into six types which refer to QR Code Model one, Model two, Micro QR Code, IQR Code, SQRC and LogoQ. Moreover, QR Code has a number of characteristics, which include high capacity encoding of data, kanji and kana capability, small printout size, error and correction capacity, readable form any direction in 360 degree and structure appending feature.

The technologies of QR Code were introduced in this thesis as well. QR Code contains forty versions of QR Code, and the structure of QR Code, which is divided into two segments. There are function patterns, which are composed of the finder pattern, separator, timing patterns and alignment pattern. Moreover, the function patterns focus on the positioning. Another part is encoding region, which involves format information, version information, data and error correction code-words. Besides, encoding and decoding procedure were also displayed in this thesis. Guidebooks of generating QR Code and reading QR Code were listed in this thesis for

guiding people to QR Code implementation as well.

Moreover, examples of how QR Code can be used by companies were provided in chapter five. As well as how QR Code was used in WeChat deployment was described in this thesis. In WeChat, the special feature relevant to QR Code is personal QR Code, which can be a business card of person or enterprise to provided more detail information to people than traditional business card. Additionally, WeChat provides public platform to organizations and individuals. The fans or consumers scan QR Code and the QR Code guides fans or consumers to visit a public platform of a brand, restaurants and government to browse more detailed information. Furthermore, WeChat offers an E-shop platform to people. People can establish personal E-store online for selling and other WeChat users through QR Code of E-shop can browse the E-shop for shopping.

In addition, on the basis of the characteristics description of QR Code in this research, the applications of QR Code in WeChat, the benefits of using QR Code for companies are exploring and analyzing. Apart from that, cases used in this thesis work demonstrate that QR Code can bring high profits for companies. Consequently, Companies can utilize QR Code in e.g. advertisements, picking of products and marketing campaign.

Further, this research illustrates six characteristics of QR Code, all of characteristics display QR Code is suit to adopt in business. Moreover, this thesis introduces the masking patterns, which focuses on the security of QR Code. Since the making patterns, QR Code offers a secure and steady environment to businesses. However, QR Code is still updating, therefore, further research possibilities explore the security of using QR Code for companies.

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