FOSQNET: A PROTOTYPE FOOD QUALITY AND SAFETY MANAGEMENT SYSTEM FOR CHINA

TANGYAO ZHANG

Submitted in partial fulfilment of the requirements of the degree of

MASTER OF BIOTECHNOLOGY

(With research component: SCIE90016 Biotechnology Research Project)

Melbourne Graduate School of Science

UNIVERSITY OF MELBOURNE

Melbourne, Australia

15 November 2014

Supervisor:

Dr. David Tribe
Declaration

TANGYAO ZHANG

This is to certify that

(i) the thesis comprises only my original work towards the Masters,

(ii) due acknowledgement has been made in the text to all other material used,

(iii) the thesis is less than 10000 words.

(iv) this thesis will elucidate and discuss Chinese topics, which are only on People's Republic of China and NOT including distinct Chinese regions: Hong Kong, Macau, and Taiwan.

Acknowledgement

I have eternal gratitude to Dr. David Tribe, my supervisor, for his inestimable help and valuable instruction, for his insightful lectures, which inspire me to compose this thesis. I am greatly indebted to Dr. David for his allowing me to have access to his resources pertinent to this thesis. I really treasure our friendship.

I have gratitude to Yichen Jin, Yixin Hou, and Linchuan Huo, who provided assistance during the project development. I do appreciate advices from Dr. Matthew Digby, my course coordinator and Simon Cave, the manager of Graduate Coursework and Academic Programs. I can not conduct this project without their advices. I also thank those who help me in course of the Master of Biotechnology and whose names I can’t list here one by one.
Abstract

China has achieved remarkable successes since 1978. However, China is facing some serious issues. Food quality and safety is one of them. The status of food quality and safety is complicated and difficult to supervise. Lack of transparency have led to loss of consumer confidences. The Chinese government has taken actions to improve the food quality and safety as well as restore the consumer confidences. These initiatives are working, but are far from being satisfactory.

This thesis reviews the situation and introduced a possible solution: the FosqNet. This is a novel food quality and safety management system focusing on risk communication. The FosqNet has a hybrid peer-to-peer electronic network communication architecture. This architecture provides a secured, transparent and high efficient communication channel. The FosqNet App is the main interface of FosqNet which is a user-friendly and private smartphone application. The concept of FosqNet is independence, neutrality and openness. It could benefit all users who can be ordinary people or professionals. This thesis also suggests that the net neutrality principles are important considerations for the development of FosqNet.
# Table of Contents

Declaration .......................................................................................................................... I
Acknowledgement ............................................................................................................... I
Abstract ............................................................................................................................. II
Table of Contents ............................................................................................................... III
List of Figures ..................................................................................................................... IV
List of Tables ..................................................................................................................... V
Chapter 1: Introductory Chapter ..................................................................................... 1
Chapter 2: Objectives and Approaches ........................................................................... 12
Chapter 3: Network Architecture .................................................................................... 17
Chapter 4: Users ............................................................................................................... 24
Chapter 5: Development ................................................................................................. 33
Chapter 6: Risks ............................................................................................................... 36
Chapter 7: Discussion ...................................................................................................... 39
Chapter 8: Concluding Chapter ...................................................................................... 43
Bibliography ..................................................................................................................... 44
List of Figures

Figure 1.1 A news article from the People's Daily, 13th Aug 1958 ........................................... 2
Figure 1.2 Food-borne outbreaks in 2013 ................................................................................. 4
Figure 1.3 Fake eggs .................................................................................................................. 5
Figure 1.4 Gutter oil .................................................................................................................. 5
Figure 1.5 Soy sauce made from human hair ............................................................................. 6
Figure 1.6 The Chinese food quality and safety management system ..................................... 7
Figure 1.7 The structure of RASFF ......................................................................................... 11
Figure 2.1 Eight Quality Management Principles included in the ISO9000 businesses system. .................................................................................................................................. 15
Figure 3.1 A peer to peer structure for FosqNet .................................................................. 17
Figure 3.2 The information transmission process of the FosqNet ........................................ 19
Figure 3.3 Network Topological Graph .................................................................................... 20
Figure 3.4 Network working procedure: the initial step ......................................................... 21
Figure 3.5 Network working procedure: information transmission ......................................... 21
Figure 3.6 Network working procedure: information distribution .......................................... 22
Figure 3.7 Network working procedure: the final step ............................................................ 22
Figure 4.1 The real-name registration procedure. ................................................................. 26
Figure 4.2 Core Server Administration ................................................................................ 29
Figure 4.3 Demonstration of FosqNet App graphic user interface ........................................ 31
Figure 5.1 Four phases of the development .......................................................................... 33
Figure 7.1 The importance of net neutrality .......................................................................... 41
List of Tables

Table 1.1 Food-borne outbreaks in 2008 ................................................................. 3
Table 1.2 Food safety incidents in China................................................................. 4
Table 1.3 Financial statistics of Inner Mongolia YILI Industrial Group Co. .......... 6
Table 1.4 Reorganisation Plan .............................................................................. 8
Table 1.5 Differences between two regulations on gene technology ................. 9
Table 1.6 Contaminants standards in GB 2762-2012 and Standard 1.4.1 .......... 10
Table 1.7 Comparison between GB19301-2010 and GB/T 6914-1986 ............... 10
Table 2.1 Approaches .......................................................................................... 13
Table 3.1 Users of FosqNet .................................................................................. 18
Table 3.2 Physical Elements ............................................................................... 19
Table 4.1 User Levels .......................................................................................... 27
Table 5.1 The budget plan of FosqNet ................................................................. 34
Table 5.2 Required Resources ............................................................................. 35
Chapter 1: Introductory Chapter

1.1 GENERAL BACKGROUND

About 2000 years ago, ancient Chinese historians acknowledged that food is the paramount necessity of the people (Ban, 1938). Food is necessary like air and water, and ancient Chinese strategists believed that food supply was the most important resource for a country, granaries were always the primary targets of military operations and defence of food supply could be determining factor of a country’s fate (Besio and Tung, 2007). Indeed, food related issues have been critical for China since the ancient age. Among them, food quality and safety, food security are the higher priorities than other issues for China to deal with (Vasant and Zhangyue, 2014). The reason of this situation is the population of China and the natural resources are not balanced, the natural resources including farming land, fresh water and biological resources are not sufficient for producing enough high quality food for everyone living in China (Datamonitor, 2004). The population of China is 1.83 billion and it will reach 1.4 billion in 5 years (Chen and Powell, 2012). Therefore, Chinese government takes food related issues as a priorities.

Between 1959 and 1961, there was a significant unnatural decrease of Chinese population and the cause was major political failures included food safety and security policies. In 1958, the Chinese government introduced the Great Leap Forward policy as the guiding ideology of the society. This policy of ultra-left productivism aimed at high industrial and agricultural productivity which was intended to let China ‘fly’ in becoming a communist society. However, the Chinese government at that time did not consider some basic scientific principles, and set a number of impossible food production targets to accomplish. As the result, farmers had to destroy the natural environment to approach these targets and faked the food production statistical results to cope with government checks (Figure 1). The unbalanced and unscientific farming lead to widespread crop failure and directly caused the Great Chinese Famine between 1959 and 1961. The statistics of Great Chinese Famine are unclear, Dikötter (2010) state that at least 45 million people died during the famine. The similar scenario is happening in
North Korea, since the North Korean government never discussed the consequences of such a agricultural productivism campaign (Howard-Hassmann, 2012). In order to avoid this kind of tragic scenario, the Chinese government have invested heavily to improve the primary industry include the food industry as well as science, technology, education, international relation after 1978 (Zheng, 2014). With the great economic development, Chinese food industry is No.1 (US$ 454 billion in 2007) in the world (FAO, 2014) and the Chinese people will hopefully not have to worry about famine again. However, since 1978 food quality and safety issues are becoming more and more serious.

Figure 1.1 A news article from the People's Daily, 13th Aug 1958

The article suggested that the yield of early rice was approximately 277020 kg/hectare. Normally, yield of early rice is approximately 5000 kg/hectare (Wei and Tao Yang, 2005).

1.2 STATUS OF FOOD QUALITY AND SAFETY IN CHINA

Generally, the status of the Chinese food supply system is complicated and difficult to supervise. In the near term, China is not likely impacted by a major food security issue. In this context, the Chinese people are paying more attention on food quality and safety because food quality and safety has a vital bearing on the people's livelihood. However, food quality and safety had become chaotic in China since a major melamine milk contamination incident in 2008 and is still unsatisfactory. Nearly 53000 infants were hospitalised during this incident (McDonald, 2008). Two criminals who provided melamine to dairy farmers were executed in 2009 (LaFraniere, 2009).
The overall picture of food quality and safety in China is difficult to describe due to lack of reliable statistics. For example, the statistics of food-borne outbreaks in 2008 are summarised in Table 1.

<table>
<thead>
<tr>
<th>Information Source</th>
<th>Title</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Health</td>
<td>Food-borne outbreaks 2008</td>
<td>431 clusters, 13095 patients</td>
</tr>
<tr>
<td>Journal article</td>
<td></td>
<td>433 clusters, 13013 patients</td>
</tr>
<tr>
<td>General news sources</td>
<td>2008 Chinese milk scandal</td>
<td>53000+ infant patients</td>
</tr>
</tbody>
</table>

Table 1 shows that different information sources have different description of food-borne outbreaks in 2008. According to Ministry of Health, there were 431 outbreaks in China (MOH, 2009) but others suggested the number was 433, with patient numbers totalling near 13000 (Xin et al., 2010). Moreover, other sources show there were more than 53000 children being hospitalised in 2008 Chinese melamine milk scandal alone (McDonald, 2008), the number in this one incident is approximately 4 times than all the Ministry of Health reported outbreaks.

Since 2013, the Ministry of Health was replaced by National Health and Family Planning Commission (NHFPC). The latest statistics from the NHFPC indicated that 152 food-borne outbreaks were reported, accompanied by 5559 patients and 109 deaths in 2013. However, 22% of outbreaks were of unknown causes (Figure 2), which means Chinese government was officially unclear to these outbreaks (NHFPC, 2014). In 2010, Australian government agencies reported 154 outbreaks of food-borne and suspected food-borne illness. These outbreaks affected 2,146 people, of whom 157 were hospitalised and 15 died (OzFoodNet, 2012). Comparing the number of food-borne outbreak cases in China and Australia, and given the 60-fold larger Chinese population (CIA, 2013), the statistics indicate very inefficient detection and recording of food-borne outbreaks in China.
In China, food safety incidents are often associated with criminal activities, such as the melamine milk scandal. This is an important reason that the country-wide food safety status is complicated and difficult to supervise. Table 2 lists major food safety incidents in the last 5 years and highlights (red italic) incidents which were involved with criminal activities. Figure 1.3-1.5 show examples of safety incidents.

### Table 1.2 Food safety incidents in China

<table>
<thead>
<tr>
<th>Incident Description</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tainted Chinese dumplings</td>
<td>Microbial pathogens</td>
</tr>
<tr>
<td>Contaminated powdered ginger</td>
<td>Chemical</td>
</tr>
<tr>
<td>Contaminated baby formula</td>
<td>Toxic animal/plant</td>
</tr>
<tr>
<td>Contaminated egg products</td>
<td>Unknown</td>
</tr>
<tr>
<td>Plastic tapioca pearls</td>
<td></td>
</tr>
<tr>
<td>Pesticide in mantou</td>
<td></td>
</tr>
<tr>
<td>Goat urine duck meat</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde blood pudding</td>
<td></td>
</tr>
<tr>
<td>Gutter oil</td>
<td></td>
</tr>
<tr>
<td>Dyed Green beans</td>
<td></td>
</tr>
<tr>
<td>Contaminated strawberries</td>
<td></td>
</tr>
<tr>
<td>Pork Meat Scandal</td>
<td></td>
</tr>
<tr>
<td>Lamb Meat Scandal</td>
<td></td>
</tr>
<tr>
<td>Recycled Out-of-date food</td>
<td></td>
</tr>
<tr>
<td>Beef Meat Scandal</td>
<td></td>
</tr>
<tr>
<td>Cat Meat Scandal</td>
<td></td>
</tr>
<tr>
<td>Gutter oil scandal</td>
<td></td>
</tr>
<tr>
<td>Expired meat sold to global brands</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.2 Food-borne outbreaks in 2013**
Figure 1.3 Fake eggs
Artificial fake eggs, which looked like real eggs but made up of gypsum powder and inorganic gel, were sold in supermarkets in China (Salucop, 2013). The technology of artificial eggs was originally applied for making egg models for exhibition or education purposes, and the cost of fake eggs is significantly lower than real eggs.

Figure 1.4 Gutter oil
Used cooking oil was recycled and collected from wasted food, leftovers from the restaurant, wasted materials from manufacturers (Qin, 2010). These oils are always stored in some dirty tanks even in gutters, that is the origin of the name ‘gutter oil’. Gutter oil are often used for making students’ food in schools and universities as well as restaurants even some luxurious restaurants.
Figure 1.5 Soy sauce made from human hair

China Central Television reported that some soy sauce manufacturers used human hair and other human wastes as materials of soy sauce on Jan 4th 2004 (Fitzpatrick, 2004).

Among those food safety incidents, the most serious in terms of scope and health impact is the melamine milk incident in 2008. This incident completely destroyed consumer confidence in domestic dairy products and profoundly impacted the dairy industry in China. Table 1.3 shows the key financial statistics of YILI Industrial Group, one of the leading Chinese dairy companies and not directly involved into melamine milk incident. This company reported that melamine was detected in their raw milk. Unlike Sanlu’s lethal infant formula, the content of melamine in YILI’s product was not in disease-causing levels. Nevertheless, company faced financial impact that the damage in 2008 is twice than net profit in 2009 (Wang, 2010a).

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Revenue (million US$)</th>
<th>Return on Assets (%)</th>
<th>Net Profit (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>3122.53</td>
<td>-0.77</td>
<td>17.16</td>
</tr>
<tr>
<td>2008</td>
<td>3493.32</td>
<td>-48.26</td>
<td>-315.43</td>
</tr>
<tr>
<td>2009</td>
<td>3923.00</td>
<td>20.78</td>
<td>130.95</td>
</tr>
</tbody>
</table>
1.3 THE FOOD QUALITY AND SAFETY MANAGEMENT SYSTEM IN CHINA

In this system, 6 ministries are involved in the management of the entire food chain. In addition, this system is a national system, each province has a quasi-independent management system. Therefore, the governmental supervision of food safety is complicated and difficult to operate, especially in cross-province cases (Guo, 2011).

Basically, six ministries are involved in national food safety management (Figure 1.6); they are the Ministry of Health (MOH), the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), the State Administration For Industry & Commerce (SAIC), the Ministry of Agriculture (MOA), the Ministry of Commerce (MOFCOM), the State Food and Drug Administration (SFDA). Each of them have different authorities which govern every phases of the food chain. This means their regulatory power are overlapping and redundant. In addition, there is a Food Safety Committee which is not a physical governmental body but has the highest political power above all ministries. In order to reduce redundancy and overlap, Chinese government have implemented a major shift plan inside the national government. The plan named Reorganisation Plan which reduce the 6 authorities into 4 (Wang, 2013). However, the authorities of 6 ministries still exist and effect. The continuing ministerial power is illustrated by the Heinz infant cereal recall in China (Abdulla, 2014). The main operated authority in this case was Industry & Commerce Bureau of Hangzhou, which is a subordinate body of SAIC (Burkitt and Liyan, 2014). The CFDA as well as NHFPC did not play any role in this case.
1.4 FOOD SAFETY LEGISLATION AND STANDARDS

The Chinese food safety legislation started in 1980s. The first law was the Food Hygiene Law 1983 which is no longer valid and was replaced by Food Safety Law 2009. The core of the food safety legislation is Food Safety Law 2009 and the National People's Congress is currently reviewing the Draft of Food Safety Law 2013 (Chen, 2014). Food Safety Law 2009 regulates following activities in China: all activities in the food chain (including but not limited to manufacture, distribution, catering), dealing with food additives, dealing with food related devices and equipment, use of food related products, and food safety management. The nature of Food Safety Law 2009 is an overall framework for all food related activities, and operational details are addressed in other legislative documents such as the GB Food Standards. Comparing the Food Safety Law 2009 to Australia New Zealand Food Standards Code, the Food Safety Law is easier to understand and the Food Standards Code is more detailed. For example, both the Food Safety Law and Food Standards Code regulate gene technology in food industry. Australia and New Zealand Standard 1.5.2 has a complete list of approved food produced using gene technology, and China Food Safety Law 2013 has only one sentence (Item 131) mentioning gene technology (Table 1.5). Obviously, Item 131 is easy to understand because it only highlights the regulator body.
In addition, there are other laws regulate the food quality and safety such as Agricultural Production Safety Law 2006 and Product Quality Law 2000. The Agricultural Production Safety Law focuses on safety of farming, fishing, stock raising and forestry. The Product Quality Law is generally regulating manufacture of all products including industrial products such as cars, electronic products like computers as well as food and feed. Therefore, the Food Safety Law, Agricultural Production Safety Law and Product Quality Law are presenting overlaps on legislation. Moreover, there are some conflicts between different regulations, such as the responsible authorities. According to the Product Quality Law, the major authority which is governing product quality is State Administration For Industry & Commerce. The Food Safety Law prescribes food safety authority body is State Food and Drug Administration. Since the concept of ‘product’ includes food, the food safety regulator body is in conflict according to these laws.

Food standards in China are regulated by several laws and regulators. All standards in China are classified into 4 levels: national standards, industrial standards, local standards and enterprise standards. Food Safety Law prescribes that food safety standards are national compulsory standards and established by health department of the State Council which is now NHFPC. The establishment of standards is regulated by Standardisation Administration of China under the Standardisation Law 1988. Technically, the some Chinese food safety standards is close to standards in developed countries such as the Australia New Zealand Food Standards Code. The following table

| Standard 1.5.2 regulates gene technology in food. | One item (Item 131) mentioned gene technology. |
| Simplified outline of this Standard: | Original full translated text of Item 131: |
| Division 1 of this Standard sets out the permission and conditions for the sale and use of foods produced using gene technology. | Dairy products, genetically modified food, swine slaughter, alcohol, and salt are regulated by Food Safety Law. Where it is otherwise provided in laws, administrative regulations or the provisions of the State Council, such provisions shall apply. |
| Division 2 of this Standard specifies the labelling and other information requirements for foods produced using gene technology. | |
| List of permitted Foods produced using gene technology | |
provides a example comparison between Chinese food safety standard GB 2762-2012 and Food Standard 1.4.1.

### Table 1.6 Contaminants standards in GB 2762-2012 and Standard 1.4.1

<table>
<thead>
<tr>
<th>Metal contaminant (mg/kg)</th>
<th>GB 2762-2012</th>
<th>Standard 1.4.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium in rice</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Lead in cereals</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Mercury in fish</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

There is one problem that affects the impartiality of national standards in China: some standards are initially established by enterprises. For instance, the standard of raw milk GB19301-2010 were drafted by dairy experts in YILI Industrial Group (Chen, 2011). The following table compares current standard GB19301-2010 and the old version GB/T 6914-1986. The standard of key requirement such as the minimum protein is decreased in current standard of raw milk, which could significantly decrease the costs of dairy companies (Wu and Zhu, 2014).

### Table 1.7 Comparison between GB19301-2010 and GB/T 6914-1986

<table>
<thead>
<tr>
<th>Requirements</th>
<th>GB19301-2010</th>
<th>GB/T 6914-1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum protein (g/100g)</td>
<td>2.8</td>
<td>2.95</td>
</tr>
<tr>
<td>Physical density</td>
<td>1.027</td>
<td>1.0280</td>
</tr>
<tr>
<td>Limited TBC (CFU/ml)</td>
<td>2×10^6</td>
<td>0.5×10^6</td>
</tr>
</tbody>
</table>

### 1.5 FOOD QUALITY AND SAFETY NETWORK

The Ministry of Health declared that a food quality and safety network was under construction after the melamine milk incident (Wang and Zhao, 2010), but any information of the network is not released and the Ministry itself was dismissed in March 2013. Thus, reform and improvement of a food quality and safety warning network is still a high priority for both the Chinese government and the food industry.

Currently there are several major food quality and safety networks, these include the International Food Safety Authorities Network (INFOSAN) run by WHO and FAO, Global Environment Monitoring System (GEMS/Food) run by United Nations
Environment Programme and Rapid Alert System for Food and Feed (RASFF) run by European Commission (Yan Shao-qing, 2007). The RASFF could be a productive model example for establishing Chinese food quality and safety network. The RASFF is an exchange information tool on risk measures related to food and animal feed safety control (Leuschner et al., 2013). Since 2002, RASFF has provided food safety information to all members in the network and is functioning well (Figure 1.7).

Figure 1.7 The structure of RASFF
The RASFF Assessment and Transmission are foundation this system. Image source: Leuschner et al., 2013.
Chapter 2: Objectives and Approaches

2.1 OBJECTIVES

As mentioned in the Chapter 1, it is believed that the status of food quality and safety in China is complicated and difficult to manage. There are still lots of problems to solve, which drove the current project’s initial planning. The overall objective of this project is finding out the root causes of the Chinese food safety situation and to develop a possible solution which adapts to China's actual conditions. As a joint theme initially involving four investigators, this overall objective was separated into four individual sub-objectives for individual projects, which were Recent Changes in the Chinese Food Chain and Food Safety Regulatory Institutions, Comparative Analysis of Chinese Food Risk Communication and those of Developed Countries, Risk Communication in Chinese Food Quality and Safety Management and Real Time Food Safety and Quality Warning Network. This thesis will elucidate and discuss the FosqNet, which is a prototype food quality and safety management network for China. The name FosqNet is from the project name Real Time Food Safety and Quality Warning Network.

The objective of the proposed Real Time Food Quality and Safety Warning Network project is developing a food quality and safety communication network which can provide real time food quality and safety information to users of the network. The network is designed for Chinese food quality safety management and it can provide a world wide communication channel. For example, an Australian dairy provider might find that milk might be contaminated by pathogenic bacteria, and customers from China can get this information immediately. According to the project objective, the FosqNet is proposed to have following features as the detailed objectives for this prototype network:

- A secure, transparent and high-efficient risk communication channel.
- A user-friendly interface for both ordinary consumers and professional users.
- Strict and well defined instructions for users and administrators.
The issues that FosqNet proposed to solve is risk communication challenges in Chinese food quality and safety management. For example, the risk communication failure in 2008 melamine milk incident, which was an important reason a crisis of consumer confidence (Assmann, 2013). Therefore, the voice of consumers opinion would be a critical element of this network which also aims for rebuild the consumer confidences with Chinese food quality and safety. This is a novel concept, in that none of exist food quality and safety networks reviewed allows consumers to be directly involved in the management system.

2.2 APPROACHES

In order to achieve the objectives of the project, several approaches were applied which can be classified into three groups: pre-developmental approaches, developmental approaches and post-developmental approaches (Table 2.1).

<table>
<thead>
<tr>
<th>Table 2.1 Approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-development</td>
</tr>
<tr>
<td>Literature Research</td>
</tr>
<tr>
<td>Online Information Analysis</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

In this project, the initial approach was literature research. Literature included academic articles, news, scripts of interviews, etc., which are written in English or Chinese. The major literature source in this project was University of Melbourne Library, which provides full access as well as online access to the latest literature in field of food science and interdisciplinary fields. In addition, accurate translation was necessary when conducting the literature research. Most of Chinese academic articles have an English title and abstract written by the author or editor, such as *The Status Quo of the Frame of Food Safety Forecasting & Pre-warning Information System Foreign & Domestic* (Yan Shao-qing, 2007). However, some of Chinese academic articles and most of non-academic articles were written in pure and plain Chinese. It was necessary to translate key parts of those articles into English precisely and accurately. Key parts included titles, abstracts, key words and conclusions. The necessity of translation is driven by the cultural and linguistic differences between English and Chinese. For example, the
meaning of the word “supermarket” in Chinese is including the meaning of supermarket and hypermarket (Mintel, 2014).

Internet information analysis was an important documentation approach in addition to academic literature research. Because the manpower and the budget of this project was limited, it was difficult to collect data from the field, such as how many supermarkets were involved with the fake eggs incident. Therefore, most of related data and statistics for this project were collected by an online search engine, such as Google. In order to make sure the information is reliable, the credibility of online search engine was also considered in this progress of the project (Lewandowski, 2012). Google was selected as the search engine for data collection and statistics in the project for following reasons: 1) Google is the most popular search engine (OneStat.com, 2003). 2) Google accepts multi-language working environment (China Business News, 2007). 3) The information from Google is not controlled by Chinese government since Google was blocked by the Golden Shield Project in 2010 (Hughes, 2010). 4) Domestic search engines in China, such as Baidu, were not considered to be reliable. As the largest internet services provider, Baidu accepted bribes form Sanlu and deleted all information related to the melamine milk between 11th August 2008 and 12th September 2008 (Lu, 2008).

The development approaches were referred to the standards of software and network design, such as requirements analysis, topological design, and user interface design (Watanabe and Ohmae, 1992, Blair-Early and Zender, 2008, Brace and Cheutet, 2012). Along with the standards of software and network design, another approach was development guideline. In this project, the guideline was Eight Quality Management Principles from ISO9000 (ISO, 2010).
Figure 2.1 Eight Quality Management Principles included in the ISO9000 businesses system.

The nature of this FosqNet is a quality and safety management system, therefore the development of FosqNet has to include following principles in order to meet the requirements of ISO 9000 (Hoyle, 2003), otherwise it can not be considered as a management tool in organisation which were certified to meet the ISO9000 series.

- Customer-Focus
- Leadership
- Involvement of People
- Process Approach
- System Approach
- Continual Improvement
- Factual Approach
- Mutually Beneficial Supplier Relationships
Risk analysis was a post-developmental and external approach, which was proposed to minimise the risks of the project itself during the current reported investigation as well as the risks to users when they interact via FosqNet. Indeed, an initial risk analysis was necessary during the project planning phase for the project. However, risks from FosqNet to users can only be identified when the general architecture of FosqNet is nearly completed. Therefore, overall risk analysis was classified as a post-developmental approach, since risks to users are more important than risks to the project itself.
Chapter 3: Network Architecture

This chapter will demonstrate the network architecture of FosqNet. The demonstration of network architecture will answer some key questions of the FosqNet:

- What type of network it is?
- What type of users take part in FosqNet?
- What kind of platform would FosqNet use?
- What is the structure of the FosqNet, and how does it work?

3.1 GENERAL NETWORK ARCHITECTURE

FosqNet is proposed to work as a hybrid peer-to-peer communication network. The key idea of a peer-to-peer network is sharing of information equally. Therefore, the FosqNet is designed so that all users in the network are in the same position with respect to information access. They have the same authority to access and provide information. The reason why a peer-to-peer network is important will be discussed in the Chapter 7.

There are 4 types of users in this network: academic users, such as researchers in universities or research institutes; food industry users, such as employees in a dairy company; users in the government and public agencies; consumer users (Figure 3.1 and Table 3.1). Users can use a smartphone application as the interface to access FosqNet.

![Figure 3.1 A peer to peer structure for FosqNet.](image-url)
Table 3.1 Users of FosqNet

<table>
<thead>
<tr>
<th></th>
<th>Academic users</th>
<th>Food industry users</th>
<th>Government users</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature</td>
<td>Organisational users</td>
<td>Organisational users</td>
<td>Organisational users</td>
<td>Individual users</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>Academic users have high capacity to conduct scientific risk assessment because of the research culture.</td>
<td>Food industry users have some capacity to conduct scientific risk assessment but it is difficult to assess their bias.</td>
<td>Government users have some capacity to conduct scientific risk assessment but the hardware and staff are limited by regulations.</td>
<td>Most of consumers do not have capacity to conduct scientific risk assessment. Their identification of food risks is restricted by their knowledge limited expertise.</td>
</tr>
<tr>
<td>Authority</td>
<td>Academic users have no authority to actively manage food safety.</td>
<td>Food industry users have limited authority to involve in food safety, such as drafting of the standards.</td>
<td>Government users have strong authority.</td>
<td>Consumers have relatively limited authority.</td>
</tr>
<tr>
<td>Information Access</td>
<td>Academic users are able to access the latest food safety information because of research infrastructure.</td>
<td>Food industry users are able to access the latest food safety information and industrial practices.</td>
<td>Government users have limited food safety information access due to communication issues.</td>
<td>Consumers have very limited information access.</td>
</tr>
<tr>
<td>Early Discovery</td>
<td>Academic users, especially epidemiologist and doctors can identify risks and food borne outbreaks in early stage.</td>
<td>Food industry users can discover food risks. However, they tend not to share the information in early stage.</td>
<td>Government users can identify risks from imported food in earlier stage, but difficult to identify risks from domestic markets.</td>
<td>Existing food incidents show that consumers can discover food borne outbreaks in early stage, including direct experience.</td>
</tr>
</tbody>
</table>

3.2 PHYSICAL STRUCTURE

As a network which contains both hardware and software, there are some physical elements in the network architecture of FosqNet. They are terminal devices of users, FosqNet distributed servers for information transmission, terminal display devices of administrators and a stand alone FosqNet core server (Table 3.2). Of course FosqNet requests internet access, and basic internet related equipments are also necessary, such as optic fibre or cable Ethernet, etc. This basic capital investment is already provided as a part of the service of internet service providers (ISP). Therefore, this project does not
venture into development of internet and only use the internet as platform for information transmission (Figure 3.2)

<table>
<thead>
<tr>
<th>Physical Elements</th>
<th>Details</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal physical devices of users</td>
<td>Devices can be any modern electric devices which have internet access.</td>
<td>Smart phones, laptops, tablet computer, PCs.</td>
</tr>
<tr>
<td>FosqNet distributed servers</td>
<td>Servers must have high spec and reliability.</td>
<td>Mac Pro, IBM X Server.</td>
</tr>
<tr>
<td>Terminal display devices of</td>
<td>Typically desktop computers or workstations with high security.</td>
<td>iMac with hardware firewall.</td>
</tr>
<tr>
<td>administrators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FosqNet Core Server</td>
<td>The core server has the highest spec and reliability, and no internet access.</td>
<td>A Mac Pro locked in a separated room without wired and wireless internet.</td>
</tr>
</tbody>
</table>

Figure 3.2 The information transmission process of the FosqNet.
3.3 NETWORK TOPOLOGICAL STRUCTURE

The following figure demonstrates the topological structure of FosqNet, which includes both peer-to-peer structure (distributed servers to distributed servers) and clients-server structure (the core server to distributed servers). In this topological structure, red paths are clients-server model and other paths are peer-to-peer model.

![Network Topological Graph](image)

Figure 3.3 Network Topological Graph
3.4 NETWORK WORKING PROCEDURE

This section will demonstrate the working procedure of FosqNet. In this demonstration, the hypothetical scenario adopted is an event where some bottled UHT milk are contaminated by pathogenic bacteria, which is identified by some consumers. The consumers have FosqNet App (this app will be discussed in the next chapter) on their smartphone which they use as the interface with the FosqNet.

The initial step is identification of risk. First of all, a user identified that the some bottles of milk were contaminated by bacteria or chemicals since there were strange smells. Then this person launched the FosqNet App and wrote a short report as well as took photos of contaminated product (Figure 3.4). When the user launched the FosqNet App, an IPSec channel via internet was generated between user’s device and the nearest distributed server.

![Figure 3.4 Network working procedure: the initial step](image)

Next step is information transmission. The detailed transmission procedure is described in Figure 3.2. In this step, the short report was compressed into encrypted data packages. Then the data package were transmitted through firewall via IPSec protocol to a distributed server which is geographically nearest to the user (Figure 3.5).

![Figure 3.5 Network working procedure: information transmission](image)
Once the distributed server received the data packages, it automatically sent the data packages to all other distributed servers in FosqNet without decryption (Figure 3.6). This step is information distribution. In this step, administrator received the data packages and decrypted the data packages to review the short report. The administrator can backup the short report to the core server, by physically visiting the core server, because there is no internet connection.

**Figure 3.6 Network working procedure: information distribution**

After all distributed servers received the data packages, each distributed server sent the data packages to its users. In addition, the encrypted data packages had backups in every distributed server. The data packages were decrypted and presented as ‘Message’ on other users’ FosqNet App. This is the final step and all users in FosqNet can read the message about the contaminated product at this point in the sequence (Figure 3.7).

**Figure 3.7 Network working procedure: the final step**
In this scenario, the Message is a short report written by a consumer. This person did not conduct any standard risk assessment. Therefore, FosqNet App did not update the metadata of the Message and keep it blank. Because the metadata was blank, FosqNet App classified the Message as a potential risk. All users reviewed the message contaminated product, and acknowledged that there was a potential risk. If there is no follow up information related to this event after a period, FosqNet App will classify the Message as a cancelled risk.

Academic users, food industry users and government users can conduct risk assessments after all users received the Message. Risk assessments will follow the standards and guidelines, and the results can be shared to all users by starting from the initial step (Figure 3.4). For example, researchers can do a microscopy examination of the milk and deduce the type of bacteria. The researcher can write an assessment report with scientific evidence and use same event ID. Then the data packages will be sent to all users. The FosqNet App will check the event ID and contents. Since the event ID is same, the FosqNet App will update the metadata of the original Message as a low/medium/high risk depends on the scientific evidence. When some users shared messages which support some interpretation, and other users shared messages which are against this risk interpretation, administrators will contact other experts or members of Food Safety Committee to discuss the solution to the conflict. During this period administrators can manually update the metadata. This process is information indirect release pathway in the information transmission procedure (Figure 3.2).

In the working procedure, the data packages are encrypted and decrypted in users’ devices only. Data packages could be cracked by illegal access during the information transmission (Hughes, 2010). However, cracked data cannot be successfully decrypted (Dobbertin et al., 2005). Therefore, FosqNet is secure unless all user devices are hacked. The roles of administrators and core servers will be further discussed in the following chapter.
Chapter 4: Users

FosqNet relies on users. Unlike RASFF and INFOSAN, FosqNet allows all users, including ordinary consumers, to share information widely and transparently. This chapter will explain who can be users of FosqNet and how they use or manage the FosqNet.

4.1 OPENNESS

As a network open to all consumers, the network requires all users to have a certain level of food quality and safety knowledge to reliably characterise potential risks.

Generally, a certain level of food quality and safety knowledge means:

- The person is able to understand food labels. For example, Standards 1.5.2 requests all genetically modified food should be labeled (FSANZ, 2014). Consumers should have basic idea about the scientific term ‘genetically modified’.

- The person can identify food safety risks by basic accurate scientific knowledge. Food contaminated with fungi often presents changes of colour and smell (Foos, 2006). Consumers should know this phenomenon in order to identify risks.

- The person can access and use the internet to report food safety risks. Because FosqNet is internet based system, a person is not able to access FosqNet without basic internet skills.

According to Chinese Education Framework, people who have complete junior middle school education should be able to meet those requirements for FosqNet use since they have basic required knowledge and skills (Jinhao, 2011). Since the gross Chinese enrolment rate of high school was 82.5% for adults in 2010, it is clear that most of Chinese consumers meet the requirements of FosqNet. Therefore, FosqNet should be open for all internet users. This consideration also relates to the recent Net Neutrality statement by US President Obama, that an open internet is important and necessary (Obama, 2014). Nevertheless, FosqNet is not designed for Net Neutrality (as will be discussed in the Chapter 7), it meets the requirements of Net Neutrality which is proposed to benefit all users. Unlike internet as a public utility, FosqNet is food quality
and safety management system. It is proposed to be open to all users who follow the user policies.

4.2 USER POLICIES

In general, user policies contains following key policies:

- Honesty
- Real-Name Registration
- Privacy
- User Levels

The transmitted information in FosqNet is food quality and safety information which means vitalness to human welfare. Therefore, all FosqNet users must make sure that the information they shared in the network is ethical and honest. That means mistakes or misunderstanding is allowed, but perjury, bribery, academic misconduct and illegal information are strictly prohibited. A highly relevant illustration of this is the bribery of Baidu during the 2008 melamine milk incident. Baidu received money gifts from Sanlu cooperation and deleted all negative information about Sanlu, such as BBS posts, blog articles, microblogs, web search results and webpages. In FosqNet, users such as Baidu can not directly delete information from other users, because the network architecture is designed to protect all information from third party interference. However, a dishonest user could share fake information, such as purported scientific evidence which support that there was no melamine in the milk. This dishonest activity can confuse other users and even lead to large scale panic. An illustration of this is a dark public relations incident in 2010. Meng Niu, a leading dairy company, spent about $50000, hired 4 public relation experts and arranged for them write some negative articles with evidence against its major competitor: YILI. Because Chinese consumers had generally lost their confidence in food safety after the 2008 melamine milk incident, this serious public relations incident led consumers into panic (Wang, 2010b).

The real-name registration policy is an obligation for involvement in FosqNet to encourage all users to comply with ethical standards. Therefore, all users in the FosqNet should accept real-name registration in order to assure the information and metadata are not corrupted by dishonest activities. The real-name registration policy has its history in
China since 2012 (Fu et al., 2013). Currently, many major internet services like microblogs, and all telecommunication services require real-name registration (Marbridge, 2013). Some academics believe that real-name registration is censorship and a sign of autocracy (Fu et al., 2013). The FosqNet is not a political management system, so the real-name registration policy of FosqNet is different from the policy of Chinese government. The following figure summarises the procedure of FosqNet real-name registration.

**Figure 4.1 The real-name registration procedure.**

This procedure and the network architecture are designed to protect the user privacy. Technically, the identity of the information sharer is only known by the sharer his/herself. First, a new user fills and submits a registration sheet. When an administrator receive the registration sheet, he/she scan the registration sheet and saves the sheet in a physical archive. Then the administrator send the digital file from the scanner to the core server as a physical accession. The core server processes the digital file and generates a data package including encrypted User ID with the email address of the user. The administrator gets the data package and return the encrypted User ID to the user by email. Finally, the user exploits FosqNet App to decrypted the User ID and use this ID to share information. Administrators and other users can only see the User ID of the sharer but do not know that who owns the User ID. The only way to know who own a specific User ID is access to the core server by an authorised officer. From the above, the main role of FosqNet core server is to manage the real-name registration. The core server does not transmit data packages from users’ devices through the internet. This is the reason why core server is stand alone and locked in a secure room.
The FosqNet real-name registration procedure can make sure that

- all users who are proposed to share information have real-name registration, read-only users do not have to do that.
- the identities of users are kept private and secure,
- an authorised officer who has a court warrant or a search warrant can access real-name registration data when dishonest activities are identified.

There are 4 types of users of FosqNet, academic users, food industry users, government users and consumer users (Table 3.1 in the Chapter 3). All users have different level of authorities in FosqNet depends on their status. Table 4.1 lists details of user levels.

<table>
<thead>
<tr>
<th>Table 4.1 User Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Users</td>
</tr>
<tr>
<td>Level</td>
</tr>
<tr>
<td>Authorities</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

All users will have been classified after the successful real-name registration. Users without real-name registration are automatically classified as read-only users. Read-only users can read messages from other users and access online log.
4.3 ADMINISTRATION

The FosqNet is an independent and self-managed system due to the nature of the network architecture. Nevertheless, the system can work when all servers are down and only the core server is alive, and a team of administrators is necessary. The responsibilities of administrators are:

- Technical support. In order to maintain all servers and user interfaces are fully operational and functional, administrators should be able to provide technical support and fix technical issues.

- Real-name registration procedure. The registration documents are proposed to be processed by the administrators who are authorised to manage the core server and the archive.

- Administrators are registered as FosqNet users. They must follow the user policies and instructions.

- Core server administration (Figure 4.2). This is the most important part of administration, since the core server has backups of the entire FosqNet, data of real-name registration and other important information like data of administrators.

- Turn on the internet access for the core server in emergency situation, such as all servers are down.

- Keep system log for open access.
In this diagram, the red paths indicate physical access to the core server. In the Chapter 3, the topological graph shows a clients-server communication path. The path is a hybrid of administrators’ physical access and clients-server communication between administrators and all users. Therefore, the core server administration process can be considered as a clients-server communication path in the entire FosqNet as the topological graph described.

4.4 USER INTERFACE

In FosqNet, users can share information via different network user interfaces, such as webpages and smartphone applications. This project focused on the design of smartphone application interface (app). According to the latest statistics from Ministry of Industry and Information Technology, there are approximately 1.272 billion mobile phone users in China (MIIT, 2014), which means almost all Chinese people have their own mobile phone. Therefore, mobile apps would be the most popular method for people to communicate via FosqNet.
When people communicate with others via mobile phone, the typical methods are normal phone calls, video calls, messages, IM chats and social networking services (SNS). Among them, SNS is the most popular way that people share information to the public, such as Twitter and Weibo. In 2012, Twitter announced that it has 140 million active users (Wasserman, 2012) and Weibo also stated that 324 million Chinese people use it (Sina, 2012). Research shows that people are tent to share risk information via Twitter or Weibo (Mou, 2013). Both Twitter and Weibo provide application programming interfaces (API) and software development toolkits (SDK) for third party developers (Peri et al., 2012, Guo et al., 2012). Therefore, there are no technical barriers for Twitter and Weibo as the interface of FosqNet. However, Twitter and Weibo can not be used as user interface of FosqNet due to following reasons:

- All Twitter services were blocked by Chinese government since 2009. In fact, Chinese government also blocks Facebook and Google through the Golden Shield Project (Stan, 2009). Because the Golden Shield Project is not absolute blockage, access to Twitter is technically possible. But there is no necessity to increase the development difficulty.

- Twitter and Weibo are facing information credibility issues. Researches show that it is difficult to figure out the credibility of overall and individual tweets (Sikdar et al., 2013), and risk communication via Weibo is sometime not accurate (Mou, 2013).

- The security of private data in Weibo can be easily hacked. Twitter users do not have this problem because Twitter has no real-name registration policy. Weibo requires all users submit their identification documents but these documents could be accessed by hacking the Weibo server. For example, 70 million Weibo users’ private information were hacked in 6th January 2010 (Pan, 2010).

From the above, FosqNet would follow the trend for mobile phone communication and the FosqNet App is designed as Twitter-style risk communication mobile application with a secured network architecture. Figure 4.3 is a demonstration of a prototype FosqNet App.
As Figure 4.3 shows, FosqNet App has 5 basic pages. The first page is a login page (not included in the demo). It can provide users real-name or anonymity login option as well as the new user sign up. The upper left page in the demo is the main page, which lists all messages from other users and gives different colour coding to titles in order to
highlight different risk levels. When a user touches a messages, FosqNet App will show the details page (upper right in demo), and when user touches the ‘info’ button, it will show the further details page (lower in demo). Users can use new message page (not included in the demo) to create and share new risk information.
**Chapter 5: Development**

This chapter will explain the development of FosqNet in terms of development phases, project costs and necessary resources.

Basically, the development of the network involves following key points: the user interface, information transmission channel, kernel and database architecture, as well as security. The references and guidelines for development are ISO9000/22000, Food Safety Law and standard software design and engineering procedure as well as the University of Melbourne standard research project procedures. The phases of development can be separated into following phases (Figure 5.1):

<table>
<thead>
<tr>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q1</td>
</tr>
<tr>
<td>Q2</td>
<td>Q2</td>
</tr>
<tr>
<td>Q3</td>
<td>Q3</td>
</tr>
<tr>
<td>Q4</td>
<td>Q4</td>
</tr>
<tr>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td></td>
<td>Phase 3</td>
</tr>
<tr>
<td></td>
<td>Phase 4</td>
</tr>
</tbody>
</table>

**Figure 5.1 Four phases of the development.**

- **Phase 1**: Background research including scientific and legal knowledge. Identify the necessary resources for development. Currently, this phase was completed.

- **Phase 2**: Prototype architecture and design. In this phase, the architecture of the network, the guidelines for administration and the design and the programming of FosqNet App should be completed. Moreover, servers and server software should be prepared for the next phase. Currently, this phase is in progress.

- **Phase 3**: Beta test of FosqNet. The beta test will assess the capacities of servers and core server, the presence of unknown bugs in software and reliability of administration guidelines. It will also involve indentation of beta test users.
• Phase 4: Release candidate of FosqNet. Collect feedback and statistical data to improve the FosqNet and prepare a release candidate version through the Chinese government. This phase and phase 4 will start in 2015.

Currently, the identified project cost is zero, which is significantly different from a typical network development project. However, this does not mean that the project budget is zero. As a project working on a joint theme, the host faculty is Melbourne Graduate School of Science and the operational faculty is Melbourne School of Land and Environment (now Faculty of Veterinary and Agricultural Sciences).

According to the policies of Melbourne School of Land and Environment, funding is capped $1000 for projects. According to the project budget plan, the financial requirement of this project is at least $8500 for phase 1 and 2 (Table 5.1).

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers with internet access</td>
<td>Since the project involves software development, high-spec computers are necessary.</td>
<td>$1500 ea</td>
</tr>
<tr>
<td>Software</td>
<td>Statistics, software development kit, prototype test and database management software.</td>
<td>$1090 total</td>
</tr>
<tr>
<td>Rooms for meeting, demonstration and presentation</td>
<td>According to University Handbook, regular meetings with supervisor(s) and presentation are compulsory.</td>
<td>Day rate: $300-$2200</td>
</tr>
<tr>
<td>Personnel</td>
<td>The project directly involves a supervisor and a graduate student. 3 graduate students indirectly involved.</td>
<td>at least $15 per person per hour</td>
</tr>
<tr>
<td>Travel</td>
<td>Travel to major cities in China, in order to interview food safety experts and ordinary consumers as well as collect field data.</td>
<td>$2000 once</td>
</tr>
<tr>
<td>Server</td>
<td>In the final phase of the project, at least one server computer necessary for the beta test via internet.</td>
<td>$5000</td>
</tr>
</tbody>
</table>

Currently, Melbourne Graduate School of Science does not have any funding plan to support FosqNet, and the Melbourne School of Land and Environment does not support FosqNet since it is hosted in other faculties. Therefore, the project was originally planned without any external financial support.
In order to successfully develop the FosqNet, certain software and hardware resources are necessary (Table 5.2).

<table>
<thead>
<tr>
<th>Software Resource</th>
<th>Hardware Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software development kits (SDK, such as Xcode) is required for developing the FosqNet App and the management tool for servers.</td>
<td>Servers for information transmission.</td>
</tr>
<tr>
<td>Statistics software is required for analysing the data from the background research as well as phase 3 beta test data.</td>
<td>Core server.</td>
</tr>
<tr>
<td>Debugging software which is different to the SDK is necessary for the phase 3 and 4.</td>
<td>Other hardware, such as devices for administrators and routers.</td>
</tr>
<tr>
<td>Fundamental software. For example, writing software.</td>
<td>Facilities for core server and its administrators: the room for core server and the office for administrators.</td>
</tr>
</tbody>
</table>
Chapter 6: Risks

This chapter will indicate identified risks, including risks that could cause project failure and risks could damage the interests of users, the government, and the food business.

6.1 RISKS TO THE FOSQNET

The development of the FosqNet is systemic and interdisciplinary engineering which involves food quality and safety, information technology, jurisprudence and politics, statistics, financial and resource management as well as project management. Each phase of the development has applied these principles from different disciplines. Therefore, developers and administrators are proposed to understand principles from these disciplines. If developers and administrators do not understand these principles and have insufficient skills, it will significantly risk the development and operation of the FosqNet. In order to decrease this risk, it is necessary to select qualified candidates for development and administration.

Insufficient financial support is also a risk to FosqNet, since there are no identified fundings for FosqNet phase 3 and 4. Currently, phase 2 is in progress and there is no need of financial support for this phase. Therefore, by the completion of phase 2, the prototype of entire FosqNet could be presented to the potential financial support providers to win funding for further development. Otherwise, the FosqNet and FosqNet App will be permanently limited to prototype.

6.2 RISKS TO USERS

There are two identified risks to users when they communicate via FosqNet. The first risk is invasion of privacy. When users submit their real-name registration documents to administrators, their private information can be seen by administrators. Therefore, it is possible that dishonest administrators could leak or sell this private information to a third party, such as selling user’s telephone number and address to a marketing company. Research indicate some cases that private information of SNS users can be hacked or sold for a illegal purpose (Conti et al., 2013). Therefore, administrators of
FosqNet should strictly follow the administration instruction as well as regulations including Tort Liability Law and Act on the Protection of Personal Information.

The second risk is false negative communication errors. In the melamine milk incident, some scientific evidence supported that there was no melamine in the milk, and this was a false negative error. Because there is no system can perfectly identify or predict mistakes or errors, it is possible that users can see contradictory information since all messages can be seen in the FosqNet. If users decide to believe false negative information or other users share further information which support a false negative error, they could expose themselves to food safety risks. In order to decrease the risk from the false negative error, administrators should seek advices from experts or even the Food Safety Committee to determine the truth when there is a potential false negative error. In addition, if multiple contradictory information events are identified, administrators should consider to suggesting to users to ignore potential false negative errors. False positive error does not expose users to real risks.

6.3 RISK TO FOOD BUSINESSES

When different users share different opinions and evidence on same event, there could be false positive errors or false negative errors or both. On one hand, a false negative error can potentially risk users. On the other hand, false positive errors could damage the interests of food businesses. When there is no food risk on a particular product but some users claim that they identified food risks, some consumers will probably stop purchasing the product which will damage the interests of the innocent food manufacturer and related food businesses such as retailers. The problems is when a false positive error occurs, no matter it is from a mistake or a illegal purpose, the damage to innocent businesses is difficult be to avoided. The insurance can be a possible solution to protect the interests of food businesses when false positive errors occur. Food companies can purchase insurance which cover the accidents by FosqNet false positive errors, and the insurance company should pay for the damage when false positive errors occur. However, when false positive errors were deliberate and illegal, insurance company should not pay for the damage and food business should report to department of public security of local government and request the compensation directly from the person who shared the false information.
6.4 RISK TO THE GOVERNMENT

The risk to the government also can be considered as a political risk. Currently, censorship of the Chinese government is a universal policy which regulates almost all intellectual activities in China, such as literary creation, art performance as well as speech on the internet (Lorentzen, 2014). A free, neutral and independent network will directly challenge this censorship policy. Therefore, once Chinese government accept FosqNet, it will become a potential political risk which could be exploited by activists against the censorship policy. Chinese government has the censorship policy for some reasons: the elimination of information that violated national regulations, and the avoidance of public panic when there are major public threats. Since this project is not working on political themes, it is difficult to objectively say whether the censorship of it is benefiting people. What is certain is that FosqNet is challenging the censorship policy and FosqNet is a risk from the government’s perspective.
Chapter 7: Discussion

In this chapter, I will discuss three topics related to the further development of the FosqNet: a case study of Wal-Mart recalled donkey meat in China, the Net Neutrality policy and further development of FosqNet.

7.1 A CASE STUDY OF WAL-MART IN CHINA

In the Chapter 1, I briefly reviewed the status of food safety in China and I concluded that the status is ‘complicated’. The meaning of this description can be elucidated by following case study which was widely reported by media.

The case started from a abnormal purchase. A household consumer, Mr. Wang, bought 1600 packs of Five Spice Donkey Meat from Jinan Wal-Mart on November 28th 2013. These products were ready-to-use vacuum packaged meats. Technically, there will be no biological contamination when the package is in good condition. However, Mr. Wang found that the taste and colour were abnormal, when he opened an intact package. He believed that there were food safety risks, then he sent some of these products for a risk assessment to Shandong Province Entry-Exit Inspection and Quarantine Bureau at City of Qingdao. Mr. Wang paid all charges during the assessment as well as the travel costs: Jinan is 300 miles away from Qingdao. The assessment was DNA sequencing examination and the result shown that the Five Spice Donkey Meat contained fox meat. On December 18th, Mr. Wang disclosed the DNA sequencing report to Jinan Times, which is the most popular local newspaper. Two weeks after the media report, Wal-Mart announced a major recall of donkey meat in China. With the completion of the recall, the case was closed. However, there are several questions still need answers. Why did Mr. Wang identify the differences between fox meat and donkey meat? No one noticed this issue before the case. Why did he purchase 1600 packs? This is sufficient meat for 5 years personal consumption. Why he need a DNA sequencing examination? DNA sequencing is not a necessary procedure of food safety management, and only a few government agencies have DNA sequencing facilities. Finally, Wal-Mart recalled donkey meat, but what about the manufacturer? According to the Food Safety Law, the main liability of recall is on manufacturer.
These questions indicate that the food quality and safety management is indeed complicated: there is on-one who asked the details of the manufacturer, there is no official statement from the local government, and the Food Safety Law had been ignored.

7.2 NET NEUTRALITY

I have introduced FosqNet hybrid peer-to-peer architecture in the Chapter 3. According to an IEEE conference paper: *A Definition of Peer-to-Peer Networking for the Classification of Peer-to-Peer Architectures and Applications* (Schollmeier, 2001), definitions of peer to peer architecture is:

*Definition 1:* A distributed network architecture may be called a Peer-to-Peer network, if the participants share a part of their own resources. These shared resources are necessary to provide the Service and content offered by the network (e.g. file sharing or shared workspaces for collaboration). They are accessible by other peers directly, without passing intermediary entities. The participants of such a network are thus resource (Service and content) providers as well as resource (Service and content) requestors.

*Definition 2:* A distributed network architecture has to be classified as a pure Peer-to-Peer network, if it is firstly a Peer-to-Peer network according to Definition 1 and secondly if any single, arbitrary chosen Terminal Entity can be removed from the network without having the network suffering any loss of network service.

*Definition 3:* A distributed network architecture has to be classified as a hybrid Peer-to-Peer network, if it is firstly a Peer-to-Peer network according to Definition 1 and secondly a central entity is necessary to provide parts of the offered network services.

Nexus between FosqNet users needs distributed servers due to the necessity of IPSec. This security protocol is a client-server service, which means a higher performance server provides services to several lower performance users’ devices. According to the *Definition 1* and 2, the network topological structure of distributed servers is pure peer-to-peer architecture. Therefore, the overall FosqNet network architecture is close to the
Definition 3. The hybrid architecture can provide equal and transparent communication channels. This is related to the concept of net neutrality.

The key concept of net neutrality is about freedom. On 10th November 2014, US President Obama enumerated four principles in his net neutrality statement: no blocking, no throttling, increased transparency and no paid prioritisation (Obama, 2014). The President’s statement is targeting at unfair competition. In fact, it is an almost universal opinion that the internet should be considered as a public utility like water and electricity. No one should block other’s internet services or charge unfair payments (Figure 7.1). The concept of net neutrality shares same spirit with the concept of FosqNet: everyone should be free to share risk information. Of course, the four principles of net neutrality are also the guideline of the development of FosqNet. Users of FosqNet can share risk information equally and transparently. That is why FosqNet has a hybrid peer-to-peer architecture, because no one or organisation is able to entirely control a peer-to-peer network.

% change in Netflix download speed since Jan. 2013, by I.S.P.

![Graph showing changes in Netflix download speed](image)

**Figure 7.1 The importance of net neutrality**

In 2013, there was a negotiation between Comcast (an ISP) and Netflix (information provider). Comcast requested extra payments from Netflix, but Netflix disagreed with it. Then Comcast started to slow down or block the connection between users and Netflix. Finally, Netflix had to pay in order to recover the service (Ehrenfreund, 2014).
Net neutrality policy could potentially benefit both the Chinese government and consumers. However, the Chinese government and consumers are not attracted to net neutrality policy in an environment of censorship (Fu et al., 2013). FosqNet could be the first attempt to initiate net neutrality in China.

7.3 FURTHER DEVELOPMENT

The current development of FosqNet has four phases. There are three directions for possible further development after the phase 4.

The first direction is artificial intelligence. In the FosqNet, administrators have to manually update the metadata when they identify contradictory information. This will significantly increase the workload of administrators since they have to monitor the FosqNet 24/7. Thus, an artificial intelligence assistance program could significantly reduce the stress of administrators as well as the uncertainty.

Secondly, the FosqNet can be applied in international trade and in other industries. The concept of FosqNet including freedom, transparency, high-level security and reliability can not only be suitable for the Chinese food industry, but also available for other industries as well as other countries. The network architecture can be used for protecting private information in common internet services.

Finally, FosqNet can be considered as a research platform. The academics tried for years to figure out the root of Chinese food safety issues. Some of them reviewed the food supply chain (Hon-Ming et al., 2013) and others examined the political system (Peng, 2010), and commonly they have two reasons to explain the problems: a food industry perspective and the government perspective (Liu, 2012). However, their hard evidence was weak. For example, there was no statistics on food recalls in China, therefore the researches on food recalls would be difficult to indicate the real situation. The FosqNet can provide researchers real time data and statistics as well as an archive for historical cases. Nevertheless, data and statistics cannot be used to explain everything especially uncertainty (Savage, 2009), the FosqNet provides an extra option for researchers.
Chapter 8: Concluding Chapter

As the second large economic system in the world, China has achieved remarkable successes since 1978 and China is still facing some serious issues. Food quality and safety is one of them. These issues have been described as political challenge in China and the difficulties different perspectives (Liu, 2012). The status is complicated and difficult to supervise. Lack of transparency have led to loss of consumer confidence. Chinese government has some actions to improve the food quality and safety as well as restore the consumer confidences. These actions are working, but are far from a satisfactory end-point.

This thesis reviews the situation and introduced a possible solution: FosqNet. It is a novel food quality and safety management system and focused on risk communication. The FosqNet has a hybrid peer-to-peer network architecture. This architecture provides a secured, transparent and highly efficient communication channel. The FosqNet App is the main interface of FosqNet which is user-friendly and private. The concept of FosqNet is independence, neutrality and openness. It could benefit all users who are ordinary people or professionals. This thesis also lists risks and suggests the further development directions of the FosqNet as well as the net neutrality principles that underpin this initiative.

The ultimate purpose of this thesis is as a small step forward to help China improve food quality and safety. Currently, FosqNet is still in the development progress, but the concepts and implications even in the current form are able to unlock potential benefits.
Bibliography


EHRENFREUND, M. 2014. This hilarious graph of Netflix speeds shows the importance of net neutrality.

FAO 2014. FAOSTAT Country Profile.

FITZPATRICK, M. 2004. CHINA: China cracks down on soy sauce made from human hair. AROQ Limited.


HON-MING, L., REMAIS, J., MING-CHIU, F., LIQING, X. & SAI-MING SUN, S. 2013. Food supply and food safety issues in China. Correspondence address, Samuel Sai-Ming Sun, School of Life Sciences, Chinese University of Hong Kong, Shatin, Hong Kong Special Administrative Region, China. E-mail ssun@cuhk.edu.hk.


MARBRIDGE 2013. Beijing begins implementation of real-name network access registration. Information Gatekeepers, Inc.

MCDONALD, S. 2008. NEARLY 53,000 CHINESE CHILDREN SICK FROM MILK. NBCNEWS.


MOU, Y. 2013. Social media and risk communication: The role of social networking sites in food-safety communication. 74, ProQuest Information & Learning.


OBAMA, B. 2014. Statement by the President on Net Neutrality.


PAN, Y. 2010. 70 million Sina accounts were hacked [Online]. Available: http://zjnews.zjol.com.cn/05zjnews/system/2012/01/06/018126931.shtml.

PENG, L. 2010. Tracing and periodizing China's food safety regulation: A study on China's food safety regime change. Regulation & Governance, 4, 244-260.


Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
ZHANG, TANGYAO

Title:
FosqNet: a prototype food quality and safety management system for China

Date:
2014

Persistent Link:
http://hdl.handle.net/11343/45200

File Description:
Thesis main article