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Determining the effectiveness of the Delphi method for quantifying the drivers of demand for health and social care

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He Yang 25392859

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Abstract

This paper focuses on research of the Delphi method used in the Centre for Workforce Intelligence (CfWI). In the CfWI, the Delphi method is applied to quantify the uncertainties for the future workforce demand and supply modelling in health and social care. The objective of this research is to review and assess the strengths and weaknesses of the Delphi method as applied to recent CfWI projects, and to make recommendations for improving this method. The Strategic Options Development and Analysis (SODA) method is used in this research which contains three main steps. The first step is to conduct independent interviews with several staffs relevant to the Delphi procedure in the CfWI, from which lots of information about the specific application of the Delphi method in the CfWI can be obtained. The second step is to summarize the concepts got in interviews. A cognitive map can be achieved combing the summary of interviews, literatures, and the reports of the CfWI projects. The final step is to improve the cognitive map by interviewing some key staffs again. From the cognitive map, some problems existing in the current CfWI projects are founded, such as high attrition rate, time consuming, technical limitations, and so on. The relationships among different problems can be identified by analysing the relations of each concept in the cognitive map. In order to solve the problems effectively, the CfWI proposes an improvement plan using workshop Delphi instead of the web-based Delphi. In addition, the author puts forward a video workshop Delphi approach based on the workshop Delphi method.

Keywords: Delphi method; Cognitive mapping; SODA; Robust workforce planning; Workshop Delphi

Executive Summary

Background

The health and social care system is complicated, which includes lots of organizations and professions. The system is full of uncertainties so that it is challenging to plan the right workforce for the future. A new approach to improve the process of health and social care workforce planning is developed by the Centre for Workforce Intelligence (CfWI) which is the national authority on planning workforce of health and social care. The method is called robust workforce planning which is made up of four stages. The first stage is the horizon scanning which mainly considers what the health and social care may look like in the future, meanwhile identifying the uncertain driving forces and potential issues. The second stage is the scenario generation in which a set of plausible scenarios are created to capture the uncertainties. The third stage uses the system dynamics modelling to calculate the future workforce demand and supply in health and social care system. The final stage called policy analysis tests the policies against different scenarios, and the most robust policy will be selected. In the whole framework, the outputs of each stage feed into the next. The Delphi method is used in the second stage. The purpose of this method is to help determine the factors that are intrinsically unknowable, which then lead to the quantified scenarios.

The current Delphi method in the CfWI is web-based. In the first round of the Delphi procedure, the selected panellists are provided with the scenarios generated in horizon scanning and the questions about the future workforce demand and supply. They need to complete the questionnaire within the stipulated time and give their rationales using SurveyMonkey which is an online survey tool. Then the organizers will

summarize the results and give the feedback to the participants to make the second round judgments. After two or three rounds, the median value of the participants' quantitative judgments will be chosen as the final quantitative data feeding into the demand and supply modelling.

The robust workforce planning approach as well as the Delphi method has been used in several CfWI projects recently. The objective of this research is to find the strengths and weaknesses of the Delphi method applied to these projects. And most of all, it is going to identify the problems in the Delphi procedure and make some reasonable recommendations to improve this method.

Methodology

In order to show the contents relevant to the Delphi method, cognitive mapping is chosen, which is a technique using the graph to represent the personal views of different individuals on the same issue. More precisely, the Strategic Options Development and Analysis (SODA) is the real research method, which using individual interviews to achieve a cognitive map. To be specific, eight staffs related to the Delphi procedure in the CfWI are interviewed, during which they provide as much information as possible about the Delphi method, especially the problems they met. After that, the concepts of the interviews combined with projects' reports and the relevant literature are summarized to a cognitive map. The map is improved by the second round interviews with some key staffs. The final cognitive map consists of several concepts of the problems in the current Delphi method, which is shown as follows:

(Figure 1 Cognitive map of issues in the CfWI's Delphi procedure)

Key Findings

The high attrition rate of the participants over rounds is the major issue occurring in the Delphi procedure since this concept is pointed to by several other concepts. According to the cognitive map, the reasons causing the high attrition rate are time consuming, lack of constraints on the participants, the experts being not confident, low credibility of the

Delphi method, and the low quality of the expert panel.

Time consuming is a problem for both the organizers and the participants. For the organizers, because the SurveyMonkey is not convenient to use, it cost them much more time in formatting the questionnaires. Moreover, the organizers need to spend lots of time finding more participants in case of the high attrition rate. For the participants, the technical limitation of the SurveyMonkey also leads them spend much time to complete their questionnaires. Furthermore, inaccurate scenarios and questions, some speculative questions, and the professional prediction requirement cause the difficulties of the prediction, which cost the participants more time to give their judgments.

The problem that the participants are not confident enough stems from two aspects. One of them is that the participants always misunderstand the questions, and the other one is still that the prediction is too difficult. The reasons why the experts misunderstand the questions are that the technical limitation of the SurveyMonkey causes the unreasonable design of the questionnaires and the questions themselves are not rigorous enough.

The lack of constraints on the participants as a result of that the CfWI does not make any contract with the participants about the Delphi procedure. The loose cooperation mode only contains some verbal agreements or confirmation emails.

The low credibility of the Delphi method refers to the questions about this method by the participants, which are reflected in three aspects. The first one is that the prediction is so difficult that the Delphi method cannot make sense. The second one is the low credibility of the consensus which

is caused by the speculative questions, the experts misunderstanding the questions, and the unprofessional panellists. The final aspect is that only two rounds in the Delphi process as a result of the time limit cannot convince the experts.

The low quality of the expert panel means that the panellists are not professional enough. The professional predictions and the requirement of more participants lead to the difficulties for the organizers to get the most appropriate participants.

Obviously, there are several problems existing in the current Delphi procedure in the CfWI. No matter the problems are for the organizers or for the participants, there should be some solutions to deal with them.

Recommendations

The CfWI has its own improvement plan which uses the workshop Delphi method instead of the web-based Delphi approach. It allows experts to communicate with the organizers during the whole Delphi process and discuss with other experts between any two rounds. Apparently, this method can save time because the Delphi procedure can be done in one day. It can also reduce the attrition rate and be easier to reach general consensus. However, this approach has some disadvantages. Especially, it is not strictly anonymous due to the face-to-face discussion among the experts. In addition, it is difficult to unify the experts' time to make them participate in the workshop in the same day.

Based on the workshop Delphi method, a video workshop Delphi approach is designed by the author. The difference between these two methods is that the video workshop is implemented using video and

audio communication. In addition, it needs a particular software which can collect and summarize the real-time judgments given by the participants automatically. This improvement can guarantee the anonymity, but there is no doubt that the technical support needs more funding budget.

Limitations and Further Work

The research method still has space for improvements. The interviewees can be selected more comprehensively, and the number of the participants and the organizers of the Delphi procedure can be balanced. Furthermore, a workshop can be tried to increase the efficiency of improving the cognitive map. Apart from this, some problems identified in this research need to be further solved. How to determine the number of panellists and the proportion of different experts in the panel need a solution. In addition, there need to be another study to provide more understandable and more reasonable scenarios and questions about the future workforce in health and social care for the participants of the Delphi procedure.

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Contents

1. Introduction

This paper is based on a cooperative project between the University of Southampton and the Centre for Workforce Intelligence (CfWI), which aims to evaluate the effectiveness of the Delphi method in quantifying the drivers of future workforce demand and supply of health and social care by research of the internal workforce planning projects using the Delphi method in the CfWI. The objective of this project is to identify the strengths and weaknesses of the Delphi method applied to the relevant projects in the CfWI as well as make recommendations to improve this method. The Delphi method is a structured approach depending on an expert panel to make predictions, which uses iterative questionnaires and feedback over rounds (Dalkey and Helmer, 1963; Brown, 1968; Linstone and Turoff, 1975). The CfWI is the national authority on planning workforce of health and social care. It developed a supply and demand model in health and social care and the Delphi method is used for the quantification of the driving factors. In order to achieve the objective of the project, cognitive mapping is chosen as the research method. Or more precisely, the specific approach is Strategic Options Development and Analysis (SODA) which is a more complete method to solve a problem with the cognitive map as the carrier.

This paper will start with the introduction of the background of the entire project, including the robust workforce planning approach, and the reason why this project need to be implemented. Then a comprehensive literature review of the Delphi method will be presented in the next chapter, which contains each aspect about this approach. More importantly than all of that, the applications of the Delphi method in a variety of fields and comparisons with other methods will also be described. After that, the methodology chapter will introduce how the

SODA and cognitive mapping are used for the research within CfWI. In the following chapter, the findings of research will be presented and analysed. Next, recommendations from literature, an internal improvement plan in the CfWI, and an improvement program proposed by the author will be stated and evaluated separately. Finally, there is going to be a further work section as well as a conclusion of the whole article.

2. Background

2.1 About the CfWI

The CfWI is a government commissioned agency specializing in workforce planning for the NHS. As an independent agency, it is committed to workforce planning, as well as providing effective recommendations to the health and social care system. The mission of the organization is to become the main source for health and social care workforce intelligence. The planners, clinicians and commissioners in health and social care system can benefit from the CfWI obtaining essential information to supply better health and social care services. In addition, the CfWI uses the robust workforce planning approach to establish long-term workforce planning across the whole health and social care system by means of research and analysis (http://www.cfwi.org.uk).

2.2 Robust Workforce Planning

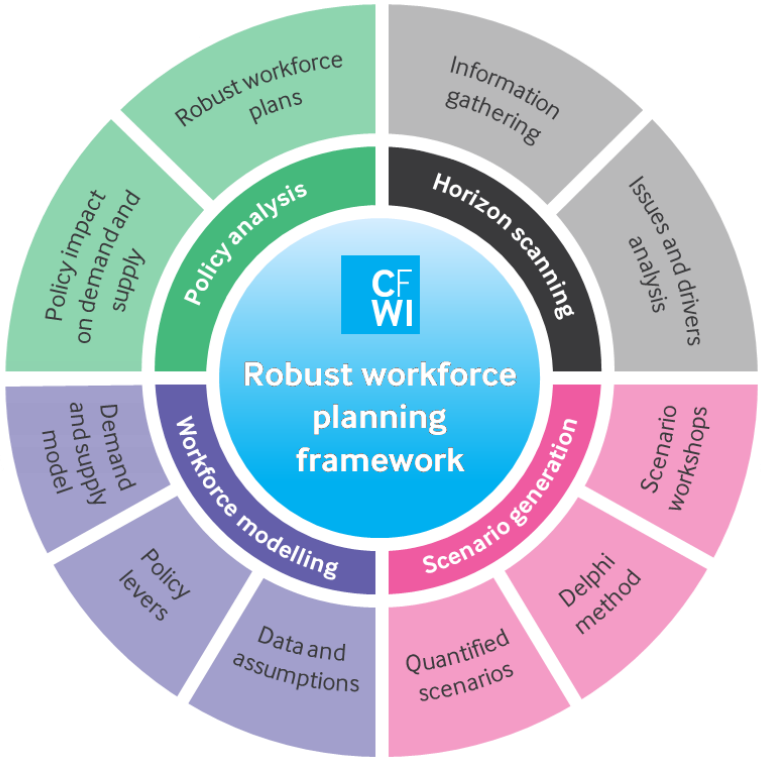
2.2.1 Demand and Supply of Future Workforce

The CfWI developed the ‘robust workforce planning’ approach with the aim to plan health and social care workforce effectively. Taylor (2005)

described that ‘the right people with the right competence are in the right jobs at the right time’ is the most ideal situation that workforce planning attempts to create ultimately. However, it is challenging to make an effective health and social care workforce planning as a result of the complex requirements of the professions and the services. In fact, the relevant staff training needs a very long time. The non-medical workforce training can take a minimum of between 3-5 years (when counting from the start of the university), whereas for the medical profession, it can take over 10 years (when counting from Medical school). There are many different stages in the whole training process, but some necessary activities may delay the normal time needed sometimes. So the supply of the workforce becomes difficult to forecast due to these variations of the training process, such as research delay and unexpected leave. Meanwhile, in the long training period, the demand for employees subject to a number of factors are not static. For instance, some new technologies used may replace labour-intensive work. Influenced by the uncertainties in health and social care, establishing a reasonable model is very difficult, and the model built in this case will be very complex.

The workforce demand and supply is also greatly influenced by the policies, since the government may always change them so that the workforce planning need to change as well. Although sometimes the policies have to be changed according to specific issues, they do make the future workforce unpredictable. To make matters worse, demand and need are different. In other words, the people who have demand for health and social care may not really need it, while the people to whom the services need to be delivered do not demand care. The practitioners themselves have to judge whether the workforces can meet the demand or not. If the demand is not satisfied, they also need to determine the number of lacking or redundant staffs. In addition, the overall adequate

supply does not mean that the demand can be met in every place because of the uneven distribution of population. Obviously, irrational workforce planning of health and social care can result in serious consequences. Firstly, people's lives cannot be guaranteed if there is no enough supply for the demand. Secondly, if the supply exceeds the demand, the waste of professionals and money cannot be avoided.



(Figure 2 CfWI's robust workforce planning framework)

Source: http://www.cfwi.org.uk

The robust workforce planning approach consists of four stages which can be performed simultaneously (The framework of this approach is shown in Figure 2). Nevertheless, the results of each step will be applied to the next step, thus they have a very close relationship generally. The main purpose of the first stage 'horizon scanning' is to identify the uncertain drivers for health and social care workforce planning. Then the second stage 'scenario generation' creates possible future scenarios

according to the output of the first stage. After that, the third stage ‘workforce modelling’ quantifies the supply and demand of the workforce for each scenario. The final stage ‘policy analysis’ is to determine which policy can adapt to the uncertain futures best. The whole framework is built based on a number of key issues.

2.2.2 Characters

A significant character of the robust workforce planning approach is that the stakeholders participate in the whole process, including the creation of future scenarios and the development of targeted policies. It should be particularly noted that it is not necessary to implement every step of the framework. That is to say that there are some steps that can be skipped, but the premise is that the results which these steps should have produced are already known. For example, if the uncertain factors in the futures can be obtained directly, the horizon scanning can be not considered. As another example, the scenario generation can be omitted if the future scenario has been created. However, the quantified factors which can be used to the demand and supply model are necessary in order to meet the modelling needs. Hence, it must be guaranteed that the first two stages can provide the necessary information anyway.

2.2.3 Horizon Scanning

Horizon scanning is applied to explore the possible future trends, look for drivers, and search for the issues which may affect workforce demand. The categories of the driving forces contain six areas: technology, economy, environment, politics, social and ethics (TEEPSE), all of which have influence on the unknown future. Horizon scanning can be used in all areas related to health and social care.

2.2.4 Scenarios Generation

Scenarios describe a range of plausible futures which serve to bind the possible supply and demand of staff. They are created mainly based on those drivers which have large impact and high uncertainty. The futures which may occur due to those drivers are the ones that need to be planned for since their impact can have significant consequences to delivering health care. Workforce planning has to pay attention to these factors. The scenario generation consists of three parts: scenario workshops, Delphi method, and quantified scenarios.

Scenario workshop is a way to generate scenarios. The specific implementation of this method is to get a wide variety of stakeholders together for a one-day workshop. The participants need to know the issues and drivers summed up at the horizon scanning at first. Then they will make some necessary changes and additions. The final scenarios will be presented as stories, which focus on those uncertainties influencing the future workforce demand and supply. These stories should contain enough information to allow people make a judgment about the parameters in different scenarios. The Delphi method is to let the experts return quantitative results of the uncertain parameters according to provided scenarios over multiple rounds. The quantified scenarios just need an analysis of the response in the Delphi method, as well as determining the best estimate which is prepared for the next modelling step.

2.2.5 Workforce Modelling

There are three sections in the workforce modelling stage, which are data and assumptions, policy levers, and demand and supply model. The data

and assumption part need to make it clear of all the inputs for the workforce model. The inputs include the known facts, assumptions, controllable variables and uncertain variables. The policy levers are those variables controlled by decision makers to keep the balance between demand and supply. In the final section, the demand and supply model is built to calculate the workforce demand and supply.

2.2.6 Policy Analysis

The policy analysis stage aims to make an analysis of policies and give the findings. There are two parts of this stage which are policy impact on demand and supply, and robust workforce plans. In the first part, the workforce model runs against each of the scenarios at first, and then runs for each of the policies in turn. The second part will decide which policy is the most robust after considering a wide range of factors.

2.3 Rationale of the Project

As stated previously, the supply and demand modelling plays a very important role in workforce planning. However, a major difficulty of the model is how to get quantified drivers. It is challenging that the model requires data input which contains parameters that are intrinsically uncertain. Actually, the data is almost impossible to collect in reality. Although the qualitative methods have been used to identify the effect on the model, these uncertain parameters which may vary by scenarios require a consensus judgment. Therefore, the Delphi method is used to do the quantification work, the output of which will be provided to the supply and demand model to complete the rest of processes. The robust workforce planning approach as well as the Delphi method has been widely used in various CfWI projects. The purpose of this paper is to find

the strengths and weaknesses of the Delphi method applied to these projects. However, the main thing here is to identify the problems in the Delphi procedure and make some corresponding improvement suggestions.

3. Literature Review

In order to do an in-depth review of the Delphi method, the published literature which are relevant to this method have been identified as many as possible. It should be noted that those papers which are not published will not be included in the scope of references. Even if those papers contain some useful information, the main factor which leads them not to be considered is that they have not been through the peer review process as the published journal articles or book chapters. It is undeniable that the contents of those unpublished papers should have been included in the published formats if they are remarkable enough. Apart from this, for the purpose of finding the relevant literature, a large number of keywords associated with Delphi (e.g. Delphi characteristic, Delphi issues, Delphi applications etc.) have been used to search on the Google Scholar, PubMed, and TDNet which is the journal catalogue of the library in the University of Southampton. In addition, some relevant books are borrowed from the library of the University of Southampton.

Since it was developed at the RAND Corporation in 1948, the Delphi method has been reviewed over and over again, but a literature review referring to Hill and Fowles (1975), Linstone and Turoff (1975), Lock (1987), Parente and Anderson-Parente, (1987), Stewart (1987) and Rowe et. Al (1991) will still be presented in this paper. In general, this literature review will be mainly divided into two parts. The first part is a relatively complete summary of the Delphi method by reviewing a variety

of literature, which includes its definition, classification, characteristics, the implementation process, and the advantages and disadvantages. These contents obtained from literature can be regarded as the basis of the Delphi method, and they also provide theoretical support and comparison criteria to the following research of the Delphi method's application in the CfWI, which will be very helpful to understand the method itself and identify the existing problems. The other part will focus on how the Delphi method is applied in other studies, which includes the analysis of the specific application as well as comparisons with other methods. These contents will be beneficial for the transverse analysis of the Delphi method's application in the CfWI.

3.1 General Review of the Delphi method

3.1.1 Definition

The Delphi method is a kind of subjective and intuitive method of forecasting in operations research. According to Woudenberg (1991), the name of Delphi can even be traced back to the Delphic oracle, however, which only makes little sense understand the modern Delphi method. Actually, the Delphi method was developed in the 1950's by the RAND Corporation, Santa Monica, California. At that time, a project of RAND Corporation was sponsored by the U.S. Air Force, and aimed to estimate the required number of atomic bombs in order to reduce munitions output. In particular, the opinions of the experts who mainly referred to Soviet strategic planners were applied to make the quantification.

Generally, the procedure of the technique can be described as that the most reliable consensus of opinion of a group of experts was obtained by

a series of intensive questionnaires interspersed with controlled opinion feedback (Dalkey and Helmer, 1963). Therefore, as a strongly structured group communication process, the Delphi method allows the unsure and incomplete knowledge which is judged by the experts (Häder and Häder, 1995). Particularly, the positive properties of the expert panel such as the abundant knowledge reserve and the creative power are intended to be allowed, while the negative attributes caused by social, personal and political conflicts are to be avoided.

It is generally accepted that the statistical and model-based approaches play an important role in the forecasting area. However, the Delphi method does not intend to replace their position, and the human judgment appears not as good as them. In fact, some judgment and forecasting situations where it is not possible to use the pure model-based statistical approaches need the existence of the Delphi method. In other words, the models which lack of data result in the necessity of the artificial prediction. The main purpose of the Delphi method is to offer a structured method to collect data under the circumstances that the alternative is an entirely subjective approach (Broomfield and Humphries, 2001).

3.1.2 Classifications

Indeed, there are a few different types of the Delphi methods which have been identified. Gupta and Clarke (1996) stated that the practitioners are always eager to modify Delphi. Although some modifications are not useful and even destroy the quality and reliability of the method, several modifications take effect to some extent. The Modified Delphi (McKenna, 1994), the Policy Delphi (Crisp et al., 1997) and the Real-time Delphi (Beretta, 1996) were reported to exist, but Zolingern and Klaassen (2003)

introduced three categories which are more widespread. The first one is the Classical Delphi, which is the most widely used when Delphi is needed. Another one is the Policy Delphi. It aims to get policy alternatives using a structured public dialogue not to acquire a stable professional response. In this situation, the Delphi method can be used to develop policy and promote participation since it can obtain really diverse opinions from the experts. Selective anonymity, iteration, controlled feedback, polarized group response, and the structured conflict are regarded as the characteristics of this method. Here, the selective anonymity means that the participants can have a meeting together, but give their responses separately. The third type of Delphi method is Decision Delphi. This category of Delphi can be useful for decision making on social developments. A group of experts create the reality, which must be better than the reality provided by only a small number of decision-makers. Furthermore, the participants of Delphi are the decision-makers who are relevant to the problem. The selection criteria for the participants are based on their position in their professional field so that consensus can be achieved by structure thinking. A significant feature of the Decision Delphi is that the names of experts are known to every participant from the beginning, but the questionnaires are finished by themselves anonymously.

3.1.3 Characteristics

Based on Dalkey (1967), Linstone and Turoff (1975), Goodman (1987), Hasson et al. (2000) and Snyder-Halpern (2002), there are four features of Delphi method generally, which are anonymity, iteration, controlled feedback, and statistical group response. Anonymity is achieved by using questionnaires or other formal communication approaches, such as network communication, which can reduce the influence of the people

who have high authority. Indeed, some pressures which come from several dominant individuals or the majority of people can be remitted since the participants have the chance to make judgments or state their opinions independently. This means that under ideal situations, each participant is allowed to consider the questions only on the basis of their knowledge and experience in the professional field. Moreover, the experts who are invited to participate in the Delphi process will get opportunities to change their mind owing to the iteration of the questionnaire for several rounds and summary of the results between any two rounds, which is a good way to reduce the inappropriate judgments. Furthermore, there is always some simple statistical summary of the results of the previous round appearing on the feedback. Occasionally, the participants can receive some extra information such as the rationales of peers if some of them have made a totally unreasonable judgment. At the end of the process, the opinions of individuals may still be widely spread, so using the statistical definition of the group response can promote to obtain an accurate result. More importantly, the statistical group response can confirm that the final response can contain the opinion of every one of the group. No matter which way the Delphi method is applied in, these characteristics are essential for the method itself.

3.1.4 Implementation Process

Wechsler (1978) summarized the process of a standard Delphi method as follows: 'It is a survey which is steered by a monitor group, comprises several rounds of a group of experts, who are anonymous among each other and for whose subjective-intuitive prognoses a consensus is aimed at. After each survey round, a standard feedback about the statistical group judgment calculated from median and quartiles of single prognoses

is given and if possible, the arguments and counterarguments of the extreme answers are fed back...'.

Specifically, Martino (1983) gave the description of the whole process. The first round of the Delphi procedure is unstructured which gives the group members free space to determine scope, and give the detailed description of those important issues in their eyes. The organizers of Delphi then gather these respective points of view and summarize into a set of information which was used to make a structured questionnaire. A quantitative measure may be formed under the help of the judgment and ideas of the participants of the Delphi procedure. After each subsequent round, the controller of the Delphi procedure analysed and summarized the questionnaire feedback using statistical method. The statistical result and the individuals' explanation for each judgment will be provided to the group members as a reference to do judgment for the next round. So in the third round, the participants do not have to estimate by themselves. Their previous ideas may be overthrown according to the offered feedback. Besides, the panellists may need to explain their estimates if they are beyond the range between the upper quartiles and lower quartiles. It is necessary for the participants to prove that their assessments are based on valid analysis, although they are different from the majority of results. In addition, the median of the final round can represent the real result of the whole Delphi procedure. The process will not come to end unless at this stage that the experts' responses present a relatively stable result.

In the views of Linstone (1978) and Martino (1983), there is a fact that the ideal Delphi procedure is not always constant since there are really some changes of the procedure. Generally, for the sake of simplifying the procedure considering both the organizers and the participants of Delphi,

the first round became structured. Normally, the Delphi procedure lasted no more than three rounds as the participants will not be reluctant to change their opinion after that. Nonetheless, the number of iterations is regarded as a variable. Beyond that, the questions designed for the expert become succinct. The experts in the group only need to make judgment for one statistic instead of forecasting a set of value or explaining their extraordinary opinions in detail. In particular, the laboratory studies intend to apply these simplified Delphi procedures which make a contribution to achieving essential consequences for the research output accordingly.

3.1.5 Analysis of results

Achieving a general consensus among experts is the main target of studies using the Delphi method. Whether a consensus is great or not depends on the size of the variance of the summarized result after each round. It should be acknowledged that the smaller the variance is, the more accurate the consensus is. Even though some results were not analysed, it is typical for the majority of the Delphi studies that the variance decreased as the number of rounds increase until the end of the Delphi procedure, as a result, the situation that no consensus to be achieved rarely occur in practical Delphi procedure. Although whether the reductive variance means that a more consistent consensus has been achieved remains controversial, the Delphi method has been regarded as an effective forecast approach to minimize the influence of other experts for each participant. Meanwhile, the growing consensus reflects that the opinions of the expert panel tend to be more concentrated. Based on Sackman (1975), Bardecki (1984) and Stewart (1987), different people have different interpretations of this issue. In the eyes of supporters, a consensus is demonstrated by the reduced variance. In contrast, those

opponents argue that this consensus is only superficial. In reality, the reduction of variance stem from some other factors, so it cannot illustrate that common opinions have been acknowledged by the experts. Distinctly, if the experts just make a change close to a median value following the general trend and they do not really accept the elaboration of other experts, this phenomenon will still affect the quality of Delphi procedure more or less.

3.1.6 Advantages

The ultimate goal of the Delphi method is to achieve consensus. This consensus means making judgment in a structural method (Lai et. al., 2002) and reaching a unanimous opinion generally (Thompson, 1995). The ability of achieving consensus can be seen as an advantage of the Delphi method since the consensus is always achieved in a field which is full of uncertainties and lack of practical basis (Delbecq et al., 1975; Dawson and Barker, 1995; Murphy et al. 1998). Sometimes, it is disturbed by a number of circumstances to achieve a real consensus in a group. For example, the low-status members yield to the participants in high status with the point of view (Gupta and Clarke, 1996); it is possible that the panellists make judgments forced by a few small groups or incited by some high-profile pundits (Fein et al., 1997; van Zolingen and Klaassen, 2003). With all that going on, one of the most significant advantages of Delphi method is anonymity. It allows the participants to freely express their views without the influence of others, as well as not taking other panellists' prejudices into account. Consequently, there is no doubt that the result given on the premise of anonymity is real (Goodman, 1987; Snyder-Halpern, 2002). It was also noted by Gupta and Clarke (1996) that these judgments under the condition of anonymity are substantially based on the experts' professional knowledge and practical experience,

but by no means a random conclusion drawn after measuring a variety of external factors.

Another obvious advantage of Delphi method is reflected in the use of questionnaires, which can refer to different variables and characteristics at the same time (Gupta and Clarke, 1996). It can also allow those experts who are located in different regions give their own ideas (Jones et al., 1992; Rogers and Lopez, 2002). Linstone and Turoff (1975) put forward a key point that the participants will not feel too much time pressure, and they can easily think giving their most reasonable response. Apparently, using questionnaires is beneficial for the Delphi method to enhance the quality of itself. In addition, it is noted by Pill (1971) and Stokes (1997) that the feedback offered by the organizer is useful for the participants as it can provide more information and inspire more inspiration. Based on Murphy et al. (1998), the most valuable resource of Delphi method is the knowledge and experience of the panellists, which is directly reflected in the quality of the results.

3.1.7 Disadvantages

On the contrary, some disadvantages of Delphi method have been identified. It is stated by Sackman (1975) that some panelists may not be able to ensure their own sense of responsibility for their responses, because anonymity seems to be a form of protection for them, and there is no possibility of challenging their views. Moreover, Rennie (1981) and Powell (2003) stated that the final result is just a neutral viewpoint between real good ideas and some biased judgment, so it can be regarded as the most moderate result. There is also a comment about the Delphi method that it is an expensive research methodology due to large consumption of time and workforce (Williams and Webb, 1994; Jairath

and Weinstein, 1994; Fitzsimmons, 2001). Even though Lindeman (1975), Jones et al. (1992), Everett (1993) and Powell (2003) hold the opposite view, this weakness appears in some practices sometimes, so it requires improvement to enhance efficiency.

As published by Rowe and Wright (1999), a study suggested that dropouts between rounds are more likely to be the group members who hold extreme opinions rather than those whose judgment is close to the median value. This phenomenon further illustrates that the result of the Delphi method is not convincing enough. Certainly, it would be better if there were researches on whether all the participants who have completed the whole Delphi process could really be responsible for their judgments.

3.2 Applications of the Delphi method

3.2.1 Premise of application

The Delphi method has been in use for about sixty years and the situations it has been involved are well introduced. According to Linstone and Turoff (1975), Goodman (1987), as well as Gupta and Clarke (1996), particular situations need to be considered as follows: Firstly, a problem for which the precise analytical approaches are not appropriate can only permit the application of subjective judgments; Secondly, the experts associated with the problem come from a variety of fields and work organizations, which makes their communications less effectively. In addition, the group meeting cannot be organized owing to the limitation of time and money.

3.2.2 Applications in other areas

Since the Delphi method was developed in 1950s in the USA, its application has not been limited in the original military field. Based on Linstone and Turoff (1975), people pay more attention to Delphi because its applications extend from nonprofit organizations to government, even to academic. It has not only been applied to predict scientific and technological trends, but also used to make decisions and policies. Based on extensive literature, Delphi has a wide range of applications in a variety of fields. For instance, cases did occur in the areas of education (Olshfski and Joseph, 1991), transportation (Saito and Sinha, 1991), information systems (Neiderman et. al., 1991), marketing (Lunsford and Fussell, 1993) and health care (Hudak, et.al, 1993).

The Delphi method has been widely used in information systems research to identify and prioritize issues for making managerial decisions. On the one hand, the method is applied to forecasting and for issue identification. Especially in the early stages, the majority of Delphi was devoted to pure forecast, containing both short-range and long-range forecasts. After that, some studies demonstrated the validity and long-range accuracy of the Delphi technique.

Although Delphi was mainly used to generate a consensus in forecast studies, there are still some other studies which focus on the differences of opinion. They will produce some alternative scenarios. On the other hand, another application of the Delphi method is concept or framework development. This kind of study is composed of two steps typically, which are identification of concepts and classification development. In terms of the applications of the Delphi method in information systems research, there are lots of example studies of both of the two application area. For

instance, Hayne and Pollard (2000) aimed to find out the critical issues in Information System (IS) in the next five years recognized by Canadian IS managers and normal IS practitioners. In this study, IS personnel were chosen as the participants for the purpose of forecasting and issue identification. Moreover, Mulligan (2002) used Delphi method in order to develop a capability-based typology of information technologies used in financial services industry. The participants came from eleven different organizations.

3.2.3 Comparisons with other methods

There exists another method which is similar to Delphi, but has some improvements to get consensus. What is unique of it is that the group members will give their real thoughts personally after the Delphi procedure is finished, about whether to be in favour of the common conclusion, to stick to their judgment, or to agree to the views of other members of the group. Rohrbaugh (1979) reported that Delphi method did not draw more concentrated conclusions than other approaches by comparing the personal thoughts of the participants and the final group response. This finding once again Implies that some participants just pursue consistent with the majorities' points of view blindly but they did not really agree with the opinion of other individuals.

The result of the first round of Delphi procedure corresponds to that of a staticized group. Therefore, comparing the result of the final round with the first round result is equivalent to a comparison between the Delphi method and staticized group. Generally speaking, each study about Delphi method should involve comparing the results of each round, but some studies have overlooked this point. According to Best (1974), Larreche and Moinpour (1983), Erffmeyer and Lane (1984) and Rowe

and Wright (1996), the accuracy of the results of Delphi procedure goes up as the number of rounds increase, which also prove that Delphi method has high accuracy than staticized group.

Although extensive literature describe the accuracy of Delphi as above, some other articles which give different and even opposite views do exist. For instance, Fischer (1981) and Sniezek (1990) reported that the Delphi method and staticized groups have similar accuracy. The poor accuracy of Delphi method was clearly point out by Gustafson et al. (1973) and Boje and Murnighan (1982). The former claimed that the staticized groups reveal more accuracy than Delphi method, and the latter argue that the accuracy of the Delphi procedure declined as the number of rounds increase.

The Delphi method was originally designed to eliminate the impact of various external factors on the experts' judgments, so it is necessary to make a comparison between Delphi method and interactive method. Van de Ven and Delbecq (1974) and Larreche and Moinpour (1983) demonstrated that Delphi is more accurate than the interacting groups. There are also some other researchers holding the similar view, which are Riggs (1983) and Erffmeyer and Lane (1984). By contrast, Gustafson et al. (1973) found that the interacting groups show more accuracy. Additionally, the accuracy of both the two methods is demonstrated to be similar by Fischer (1981) and Sniezek (1990). Brockhoff (1975) did not have clear judgment about that, but he explained that the accuracy of the two approaches mainly depend on the specific type of study.

Apart from the staticized group and the interacting group, there are some other structured processes. One of them is the Nominal Group technique, which was compared with the Delphi method in several studies. In fact,

this approach has the similar procedure with the Delphi method, but its special is embodied in the discussion among rounds. Precisely, the fact that the panellists are allowed to discuss with each other before the next round start is a significant improvement of Delphi method. These two methods are applicable to different situations. The Delphi method comes into play when the experts have no chance to have a meeting face to face, whereas if a research is urgent, the Nominal Group technique is required. As to compare the accuracy of both the approaches, the relevant studies draw different conclusions. Those researchers who claimed that the Delphi method is more accurate are Erffmeyer and Lane (1984). In contrast, those researchers who are more optimistic about the accuracy of the Nominal Group technique are Gustafson et al. (1973) and Van de Ven and Delbecq (1974). Meanwhile, some studies suggest that the results of both the methods are not significantly different (Miner, 1979; Fischer, 1981; Boje and Murnighan, 1982).

3.2.4 Case Study

Fleuren, Wieffferink and Paulussen (2004) aimed to introduce innovations to health care, therefore determinants that may promote or dispute the introduction should be considered. In order to obtain information of determinants of innovations in health care organizations, a literature review and a Delphi study was carried out. From the literature review, the author identified the determinants which are supplied to a group of implementation experts to come to consensus using the Delphi method. Due to the young history of innovation studies in the field of health care, databases occurred in the recent ten years' articles were searched, which is a way to obtain relatively accurate data. Before Delphi process, forty-four implementation experts who will be contacted with the first two authors personally agreed to participate in the study. Not only were they

required to determine the quality of the determinant, but they were asked to present the reasons for their judgments as well as indicating the direction of influence of determines using open-ended questions. In addition, they also need to give their opinions on whether they had got enough description of the determinants. Only if the influence of a determinant and the reasons why they belong to its level were agreed by 75% of the experts, even though some experts said they did not know the how to answer, the consensus could be regarded adequate enough. The Delphi process ran three rounds of which the feedback was given to the participants anonymously before the next round. The feedback mainly presented the group answers on the percentage of each level which every determinant belong to, and a summary of the experts' explanations.

The statistics of the actual participation show that the amounts of the experts who completed each round are 40, 37 and 34 respectively. Of 44 experts totally, 33 experts participated in all three rounds and 5 experts responded to two rounds. For the experts who did not finish the study, they attributed that to time rush. Especially, one expert did not accept the Delphi method.

However, the results of both literature review and Delphi study in this article are matched, and fifty potentially relevant determinants of innovation processed were identified. This study also had some limitations caused by Delphi process. The experts including academics and practitioners who were chosen to participate in the Delphi study came from three different professional fields, as a result, their familiarity with the particular field might have influence on the results. Furthermore, whether the experts who quitted the study had the same opinion as other experts might affect the degree of agreement built.

4. Methodology

4.1 Cognitive mapping

In psychology, the cognitive map is a technical term used to describe people's mental concepts and the link among concepts which can be seen as a tool to understand their environment (Tolman, 1948). It is subsequently seen as a mental model for a particular problem. This model has been derived from the interaction between individuals and environment. The cognitive map will help people to understand the problems as well as make a reasonable response when similar issues occur. It can also change the internal information after screening them. The cognitive map includes a variety of relationships among concepts, such as similarity, cause and effect, including and sequence.

Generally, cognitive mapping is a technique which uses graph to represent the personal views of different individuals on the same issue (Eden and Ackermann, 2002). It usually need the organizer to ask the participants some question to elicit their concepts at first. Generally, this technique has to go through three steps: elicit concepts, refine concepts and identify the relation among different concepts. The feature of this technology is that it focuses on getting individuals' views, some of which need the organizers' question as a guide, on a particular issue. Cognitive map is a graph containing nodes and arrows essentially. The most of the cognitive maps are used to show the individual cognition, but there are less cognitive maps which refer to group cognition. However, combining the individual cognitive maps together to a collective cognitive map will be very complicated and time consuming.

4.2 SODA

The SODA method is used with consultants and their customers together to solve the complex problems which generally require a modelling approach to solve the qualitative and quantitative terms (Eden and Ackermann, 2002). Its purpose is to allow the consultants to combine the skill of promoting the process for a team to solve the problem effectively and the ability of building the model associated with the areas concerned by the customers. Indeed, both the model and analysis play an important role in reaching a consensus.

Only the following several conditions are met, the consultants will generally consider using SODA to solve the problem. Firstly, as a modeller and facilitator, the consultant should be happy to make face to face contact with the members of the problem solving group. They should not just do some research about the problem by themselves passively, but they should take the initiative to design a workshop to solve the problem and manage the working group. Secondly, the consultants should look for an appropriate number of individual as clients instead of an organization roughly. Thirdly, the consultants may be good at using devious methods to deal with the problem. Although it seems like that there is no clear goal and ideas, they are able to find the useful conclusion from the chaos structure. In addition, based on Eden and Sims (1979), both the consultants and the clients expect that the consultants are able to take full advantage of their expertise to integrate a variety of opinions, to find the internal relations of them, and to promote to reach an agreement.

SODA is a very subjective method since each individual client has his own personal opinion about the issue. These complex personal views are

the core content of the entire method. The profession and experience will make the decision more credible. Obviously, this method pays more attention to individuals, which is affected by the 'Theory of Personal Constructs' (Kelly, 1955). The subject of this theory is cognitive theory. The theory argues that people know much more about the world, so people can use their concepts to solve the problem. Within SODA, cognitive mapping formed a structured theory using language. Cognitive mapping is used by the clients to explore the feature of the problem, which can be seen as a model of concepts.

4.3 Implementation of SODA

Pidd (2003) published that SODA has two forms. One need the individual cognitive map by interviewing different individual separately, and eventually they will be combined into a complete collective cognitive map. Another form does not require a separate cognitive map, and it generates a group cognitive map directly.

For this project, individual interview is the main approach to get the contents relevant to the Delphi method. Because of the constraints of the associated personnel's' time, the workshop has not been organized. In order to obtain information about the how the Delphi method was implemented in the CfWI and the problems encountered, the objective interviewees are identified as those CfWI staffs that have worked with the Delphi method. In the CfWI, several projects about GPs, psychiatrists, medical specialties, pharmacists and dentists have used the Delphi method. In each of these projects, one staff who is familiar with the Delphi procedure is chosen as the interviewee. A modeller is also interviewed since the demand and supply models need to use the data obtained from the Delphi process. Furthermore, a staff in the CfWI who have a better

understanding of all of the projects participates in the interview as well. There is another interviewee who works in the CfWI and also has participated in the Delphi procedure as a panellist. Thus, there are eight people who are interviewed in this project.

As envisaged at the beginning, a questionnaire can be designed for the potential interviewees to make the interviewer have a general understanding about the condition in which the Delphi method is applied. However, the questionnaire will contain some open-ended questions, such as a particular question that what problems have the staff met when they looked for the appropriate panellist to participate in the Delphi procedure. Obviously, this kind of question will make those who need to answer them get bored definitely although they may have lots of ideas to express. Moreover, it will cost a long period of time to get the response. In contrast, there are more real-time interactions between the interviewer and the interviewees in face to face interviews which are more efficient. In addition, being present at some relevant meetings as an observer and the regular communication with the project leader will contribute to the conduct of the entire project. These individual interviews usually last half an hour to one hour and a half, which mainly use the implementation steps of the Delphi method as clues. According to the understanding of the Delphi method and the information obtained from the literature review, the interviewer ask some questions to guide the interviewees to identify problems existing in the implementation process of the Delphi method. The interviewees can make use of divergent thinking ability focusing on any problem. All the contents of the interviews have been recorded. After the interviews, all the notes made during the visit, combined with the further information gained from the recording and the contents of the literature mentioned by the interviewees, will be summarized. The reason why not every interview is generated a cognitive map is that all the

summaries of the interviews are exactly similar. Therefore, what has been done in this project is that the relationship between different views comprehensively summarized after the first round is found and they are put together to construct the collective cognitive map. The views in the collective cognitive map will be supplemented based on the literature after that. In the second round interview, some key staffs are chosen to discuss on the cognitive map. They point out the points which are not appropriate, and suggest some improvement opinions. On the basis of the above steps, the final cognitive map is formed as shown in Figure 3.

4.4 Achieving the Cognitive Map

For the specific procedure of drawing the cognitive map, Pidd (2003) gave the explanation as follows. The target should be established as early as possible, which can guide the drawing process. Some appropriate supplements to the map should also be based on this goal. All the concepts which are related to the target should be represented even if some concepts are mutually contradictory. The arrow between a pair of concepts expresses the causal relationship, the concept at the tail of which causes the concept on the other end. Moreover, the arrow with negative signs indicates that the influence of the concept is negative. It would be best if the concepts are action oriented. Ideally, the cognitive map should eventually flow to the target which is at the top.

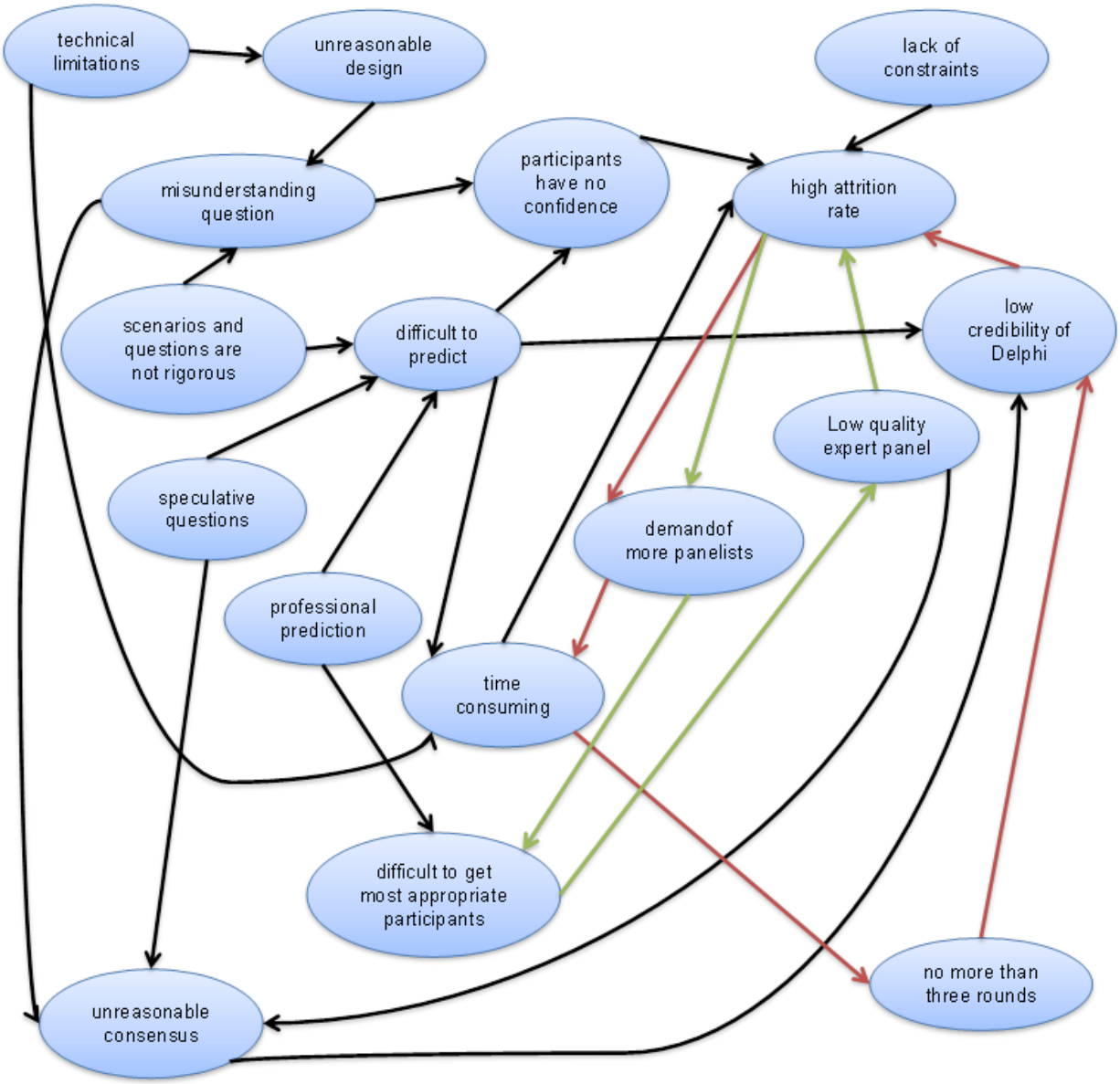
Because the advantages of the current Delphi method in the CfWI are similar to the literature review, they will not be presented in the cognitive map, and this project mainly focuses on the problems occurring in the implementation of the Delphi method. Since the complex relationship among concepts, it is not a good idea to put the target on one end. Considering the cognitive map is used to identify the problems existing in

the practical application of the Delphi method, spreading the problems in the map is reasonable, which will also be more helpful to find the real reason resulting in the problems. In order to make the statement easier to understand, the nodes in general cognitive maps are the brief statements which is refined from the interviewee's views. Theoretically, each node should have a description of two contrasting poles. In this project, only one pole occurs in the node. The most statements have no the other pole obviously, so there is no need to add its complexity deliberately. In addition, the nodes without output arrows are those which have the target description while the nodes with no input arrows represent those reasons. There is no negative sign of the arrows in the cognitive map because the relationships among concepts are positive, which is easier for understanding their logic relations.

As mentioned above, the general structure of the cognitive map is hierarchical. Basically, the target concept is on the top. However, this structure sometimes contains some circularity part, in which a series of the concepts follow back to the original concept after a loop. The circularity will exist in the cognitive map obtained in this project, but it cannot be regarded as an error. In operation research consultancy, this kind of structure is seen as a basic nature of the map. In fact, even as a part of the cyclic structure, some concepts can also be a part of the hierarchy. Moreover, this structure usually plays a significant role in solving problems.

Generally, the individual cognitive map drawn from a one-hour interview contains dozens of nodes, and there will be hundreds or even thousands of nodes in the collective cognitive map based on the different degree of difficulties and scales of the issues. In this project, the scale of the cognitive map is relatively small, which only has no more than one

hundred nodes. In general, it is difficult to construct a complete problem if the cognitive is too small, even though it is also helpful to understand the problem. However, in terms of that the Delphi method is just a small part of the whole research system for different projects, this scale of the cognitive map is enough to study the Delphi method. Furthermore, some small cognitive maps use more words' description instead of multiple-linked nodes, which makes the structure much clearer relatively avoiding too complex maps that are difficult to understand. No matter how the cognitive map is constructed, its purpose is to make it more amenable to be analysed. The cognitive map is mainly used as an approach to express the problem in the eyes of the interviewees. Its quality not only depends on the quality of the information provided by the interviewees, but also lies on the analysis ability of the interviewers. Cognitive map does not just transfer the description of the interviewees to the graphic representation, but also reflect their deep understanding of the problem.



(Figure 3 Cognitive map of issues in the CfWI's Delphi procedure)

5. Findings and Analysis

Daellenbach and McNickle (2005) have noted the analysis method of cognitive map. First of all, the cognitive map should be validated by the clients to ensure that all the contents in the map are accurate and no more concepts can be added. Secondly, the loop construction and the core concepts which are connected to other concepts with several arrows

should be focused on. In addition, the group concepts in which there are very close relationships with each other but little connection with other parts of the map are also important in the analysis. The emphasis on the cluster nodes has also been recommended by Eden and Ackermann (2002). According to the cognitive map, several problems existing in the current Delphi procedure are identified as follows.

5.1 High Attrition Rate

In the upper right of the map, “high attrition rate” as the tail of the arrows is connected with several concepts, which is the major issue occurring in the Delphi procedure. Here are some analyses about the attrition rate of the Delphi procedure in different projects of the CfWI, which can prove the fact that lots of participants do drop out during the Delphi process. In the Delphi procedure of the ‘CfWI in-depth review of the psychiatrist workforce’ project, there are 35 experts who participate in the first round, but only 29 participants complete this round and even only 21 panellists are left after the second round. The attrition rates of these two rounds are 17.14% and 27.58% respectively. It can be demonstrated that the attrition rate of the second round is much higher than that of the first round. In the Delphi procedure of the ‘CfWI future pharmacist workforce’ project, the number of participants who complete the second round and those who only complete the first round are 13 and 22 respectively. The attrition rate has reached 40.9% which is incredibly high. Moreover, although it is taken into account that only 13 panellists complete the first round, the attrition rate of the Delphi procedure in ‘GP in-depth review’ project is 23.07%. Anyway, the high attrition rate must draw the CfWI’s attention. According to the concepts which point to this problem, there are many reasons causing the high attrition rate, which are time consuming, lack of constraints on the participants, the participants having no confidence, the

low credibility of the Delphi method, and the low quality of the expert panel. In fact, as can be seen from the cognitive map, there are complex relationships among these concepts. In order to make the analysis more clear, each reason can be analysed separately, and their relations can also be explained incidentally.

5.2 Time Consuming

Time consuming is a problem for both the participants and the organizers, which is one of the main reasons why the participants drop out during the Delphi procedure. Ultimately, it is caused by the strong professional prediction requirements. Because the forecast of the future workforce in social and health care system involves lots of areas which need a rich professional knowledge, the existing knowledge of the panellists may not be able meet the requirement of the whole Delphi procedure. The participants need to put a great deal of time into reviewing many reference materials to prepare me for the study, not just judging by intuition. Each questionnaire is originally designed to let the participants spend one hour reading the scenarios and another one hour on the questions, but the whole process cost most of them much more than two hours according to their feedback, during which only understanding the scenarios needs more than one hour. Although the second round cost them less time under the help of the feedback, they also need to spend time reading the rationales of other experts. Moreover, it is difficult for the participants to focus on so hard works in such a long time, which bring a big trouble to the experts. Considering the busy work of the participants, the organizers have to leave more than one week for them in each round to allow them to have sufficient time to complete the questionnaire. Therefore, the entire Delphi process cycle will be very long, which make the participants may have not enough time to participate in each round.

The rule of the Delphi method is that only the participants who complete the first round are qualified to participate in the following rounds in turn, so there are always some experts who drop out over rounds.

For the organizers, time consuming also make them very troubled. Since worrying about that the high attrition rate leads to the insufficient participants to complete the Delphi procedure, the organizers will invite relatively more panellists at the beginning, which definitely cost much time. Furthermore, the preparation stage still need some time. Composing the questions with review and reiteration will take the organizers two to five days, and compiling the supporting information as well as writing up the scenarios and instructions will cost two days. Because the CfWI uses the web-based Delphi method, SurveyMonkey which is an online survey tool is chosen as the carrier of the implementation of the entire process, but the website itself has some technical limitations. Specifically, it is very complicated to upload the pre-designed questionnaire to the SurveyMonkey since formatting must be in accordance with its mode. So just uploading the questionnaire need at least one day. Moreover, collecting and summarize the response after each round will cost them three or four days. In addition, when waiting for the response from the participants, the organizers will always urge them to complete the questionnaire by phone calls or emails and have to deal with various issues of the participants constantly, which bring a large workload.

5.3 Participants Having no Confidence

The problem that participants are not confident enough stems from two aspects, one of which is that the prediction is too difficult and the other of which is that the participants always misunderstand the questions. As

mentioned above, some predictions are really difficult due to the high requirement of the professional knowledge of the participants. The experts would have preferred to focus on their own specialty, but it is hard enough to make predictions about one's own specialty without having to guess to the other subspecialty areas. Another reason causing the difficulty to make the predictions and to give arguments is the speculative prediction. There should have been a facility to 'not answer' about some questions rather than waste time having to fill in boxes where the views would not be informed by either personal experience or scenarios. In addition, the scenarios and the questions are not designed accurately, which also bring difficulties in forecasting. Some definitions are wrong in glossary and some scenarios lack of the baseline. Scenarios could have been better presented for ease of reference and it had better make the distinctions between scenarios clearer. Some questions are ambiguous and the supporting information cannot provide a great deal of help. Usually, the questions about the supply are much easier than those about the demand, so the participants always choose to answer the supply questions at first. In fact, there are a variety of difficulties in prediction. For instance, some questions were quite hard to answer since they had several questions packaged into one, such as a question of the ‘CfWI in-depth review of the psychiatrist workforce’ project on how much time a psychiatrist has to spend in 2033 to meet the psychiatric needs of the average member of the, which depends on the population needed, efficiency, technological change, workforce role and distribution, and available supports. Facing the enormous difficulties and all sorts of doubts, the participants cannot be confident about their judgments any more. So some participants give up several questions, and although some experts make judgments on some questions, they seem like pure speculation.

In addition, some designs of the questionnaires are not perfect and there are some inconveniences when answering questions due to the technical limitation of the SurveyMonkey. There are some graphic designs which can assist for making predictions. However, they are difficult to be done in SurveyMonkey, which makes the participants lack of enough visual information when answering the questions. Practically, the participants always need to answer the same questions for different scenarios, but they are not able to see their previous answers without scrolling back, which is not convenient to make judgments by comparisons. If the participants use a different computer or browser in the second round, they will need to manually re-enter their responses. SurveyMonkey does not save partial answers therefore the participants should ensure that they have completed a whole question before saving their answers, which cannot give the participants a flexible way to answer questions. All of these issues caused by technic and the scenario and questions themselves make the participants have various queries and bring them lots of inconvenience. The participants are generally not willing to always ask the organizers for help, so they may completely misunderstand the meaning of the questions.

Both the difficult predictions themselves and the misunderstanding of the scenarios or questions make the participants have no confidence with their judgments. Although most of them expect to look forward to some clue from the summarized result and the rationales of their peers, some participants choose to give up.

5.4 Lack of Constraints on the Participants

In order to organize an expert panel, the organizers need to invite lots of

participants. Some participants are purely voluntary, some have cooperation with the CfWI in some business, and there are also some experts who work part-time occasionally for the CfWI. Generally speaking, the CfWI does not make any contract with the participants about the Delphi procedure, and there is not even any constraint. Apparently, this loose cooperation mode that there are only verbal agreement or confirmation emails between the organizers and participants cannot guarantee that the participants will take the Delphi procedure seriously. If the participants answer the questions optionally or drop out because of their own business or the difficulty of the prediction, they will not get any loss, but in terms of the CfWI, it may mean the unreasonable consensus or the failure of the Delphi method.

5.5 Low Quality of the Expert Panel

A significant feedback loop marked by green arrows in the cognitive map shows that the low quality of the expert panel causes the attrition of the participants. Due to the existing high attrition rate, the organizers have to invite relatively more participants to make sure the panel has 15 to 35 panellists. Because there are a limited number of experts who are available in the same field and the professional predictions have a high requirement of the participants who need to come from different backgrounds, it is difficult to get the most appropriate stakeholders to participate in the Delphi procedure. So it may lead to the quality of the panel is not as high as expected. The low quality of the expert panel means that the panellists are more likely to drop out facing the difficulties, which make the attrition rate become higher. In contrast, if the attrition rate is not so high caused by other reasons, the organizers are able to find appropriate participants more easily. This high quality expert panel is more possible to stick to complete the whole Delphi procedure, which

make the attrition rate relatively normal.

5.6 Low Credibility of the Delphi Method

Although the participants should have known the Delphi method before they participate in it, some experts question this method during the Delphi procedure. Since some predictions are too difficult to make, some participants think this iterative expert prediction cannot really achieve the goal. Actually, due to the difficulty of the prediction, some speculative questions, misunderstand of the scenarios and questions, and the low quality of the expert panel may lead to unreasonable consensus, which will raise the suspicions of the participants who make efforts for this work and are confident with their judgments.

Apart from this, there is an interesting feedback loop marked by red arrows which explains another question of the Delphi method. The high attrition rate of the participant leads to more participants be invited, which must cost much more time. As mentioned above, the cycle of each round of the Delphi procedure is long, which last about two weeks, but the whole project is usually finished no more than half a year. Considering the constraint of the overall project schedule and the organizers think the participants will seldom change their minds after the second round, the Delphi method is always designed to be implemented only two rounds. Two rounds are criticized not strict enough for these large prediction works, so this question results in the higher attrition. Conversely, if there is no so high attrition rate, the organizers do not need to invite more participants, which will save some time. Therefore, the Delphi procedure may be conducted one more round, which gives the participants more confidence of this method. There may be fewer experts to drop out during the process. Above all, the question of the Delphi method will lead to the

loss of the participants.

5.7 Comparisons with the Literature Review

Although the previous studies gave the Delphi procedure some flexibility, the typical Delphi method still has strict requirements for its implement. The questionnaires in the first round are usually non-structural with the purpose of receiving some open-ended responses. The participants are allowed to give the contents related to the topic, and then the quantitative results are obtained by analysing them. The questionnaires for the subsequent round are designed according to the information acquired from the first round, so the goal of the first round is to identify the issues will be involved in the subsequent round. In the CfWI, the form of the first round is different from that in traditional Delphi procedure. The questionnaire in the first round is structured, and the contents of the questionnaires remained the same regardless of how many rounds the Delphi procedure will be conducted. The processes of identifying those problems have not disappeared. They are actually reflected in the previous steps before the Delphi method is conducted. The scenario workshop allows the participants who are the stakeholders coming from different fields to study the driving factors obtained from the horizon scanning, and then represent their impact on the future workforce planning in the form of plausible stories. These scenarios include the uncertainties influencing the future workforce demand and supply. The questionnaire used in the Delphi procedure is based on the scenarios, thus these previous process play the same role as the first round of the traditional Delphi method roughly. In the literature, lots of changes occur in the form of the questionnaire in the first round. Bond and Bond (1982) used a semi-structured questionnaire in their study. Duffield (1993) made use of a structured questionnaire relied on the literature. The structured

questionnaire which is based on a simultaneous household survey is also designed by Oranga and Nordberg (1993). Although these changes are criticized by some professionals, for instance, Rowe et al. (1991) argued that the first round designed in advance is not rigorous, no disadvantage is found from the projects in the CfWI when the structured questionnaire is used in the first round. In addition, it makes the questionnaire more reasonable improving the efficiency of Delphi.

One of the main features of the Delphi method is that a group of experts are invited to do the forecast. The criteria of the number of panellists are not unified. Reid (1988) claimed that the number of experts should be between 10 and 1685 while Murphy et al. (1998) argued that the more experts the more reliable the consensus will be since there are more quantitative judgments. However, the majority of literature suggested that the panellist number should depend on the scale of the problem and the resources available. Unfortunately, there is no concrete evidence to prove the clear relationship between the accuracy of the consensus and the number of panellists. In the Delphi procedure in the CfWI, the ideal number of experts is generally between 15 and 35. Considering the attrition in the Delphi procedure, the expert number cannot be too small. The minimum number should be 10. If the panellist number is less than this lower limit before the end of the whole Delphi procedure, the consensus will not be reasonable enough. Meanwhile, the maximum number of panellists is 35 for the sake of the convenience of management as well as taking the difficult to find the right experts. Another reason for the upper limit number is that the results of each round in the Delphi procedure do not need complex statistical analysis. It is not necessary to invite too many experts if it just needs to acquire the median value. According to the experience of previous projects in the CfWI, the panellist number in this range is adequate, and the consensus based on

them is reasonable.

In fact, the quality of the expert panel should be considered more than the number of panellists in practice. Linstone and Turoff (1975) explained that the diverse expert panel can help to achieve a better consensus. Meanwhile, Jairath and Weinstein (1994) published that the participants must show their sufficient knowledge and experience related to the problem. Those expert panels with diverse experts who have different backgrounds and dedicate to different aspects of a problem are able to draw higher quality consensus than those homogeneous groups. The CfWI selects the participants using the same principles. For example, in a GP Delphi procedure, the participants contain the workforce planner for CCG, academics, and GPs et al..

6. Recommendations

According to the research of the practical application of the Delphi method in the CfWI projects, there are several problems existing in this approach, although it has played an important role in quantifying the uncertainties affecting the future workforce demand and supply in health and social care. Actually, literature, the CfWI's staffs, and the author have put forward a lot of corresponding measures to optimize the existing Delphi method.

6.1 Recommendations from Literature

It can be found by the study of the literature that the most problems occurring in Delphi's application in the CfWI also existed in the previous studies, so there are many researchers who have proposed a number of measures to deal with the issues. For the high attrition rate of the

participants in the Delphi procedure, some literature provided measures to improve the recruitment of the panellists and decrease their attrition rate. Frewer et al. (2011) and Goluchowicz and Blind (2011) recommended that a chain structure can be adopted when inviting the experts and an effective agreement should be reached. The chain structure means that the panellists will be found by themselves, which seems like snowballing so that participants have much closer connection, and there are also multiple constraints on their interaction. Therefore, it will not only enhance the quality of the expert panel, but also effectively improve the ratio of their completing the whole Delphi process. Based on Goluchowicz and Blind (2011), the selection of the panellist can depend on the published literature. Those authors who are likely to make contributions to solving the problem can be determined by reading the literature related to the problem. If the authors can participate in the Delphi procedure, it will certainly be beneficial to achieve consensus. Moreover, those who think that they themselves are professional enough in the field involved in the problem are more likely to stick to complete the entire Delphi procedure than those who are not confident about their professions. Thus, trying to know the degree of the experts' confidence of their capabilities in the relevant fields by interviews during the invitation can avoid inviting those experts who are suspicious of their professions, which can prevent them from dropping out during the Delphi process.

Increasing the heterogeneity of the expert panel is also believed as an improvement for the Delphi method by some researchers. Hussler et al. (2011) stated that the final result perhaps have more possibility if there are some relatively lay people. However, this so-called improvement is not recommended to be used in the CfWI projects. The judgments given by the lay people may just be consistent with the majority answers or become outliers finally due to the very professional requirements of

predictions. Apart from this, the information exchange between organizers and panellists should be strengthened according to some literature. For instance, Linde and Duin (2011) stated that the organizers should consider a face-to-face communication with those who always insist on the extreme judgments so that the deep-seated reasons can be identified and some necessary adjustments of the Delphi procedure can be made in time.

A few useful advices for the contents of the questionnaire are also provided by some other literature. According to Frewer et al. (2011), the questions must be simple enough, and they all had better be the closed questions. The questions should express the main idea using the most understandable English considering that not all the participants' native language is English. Furthermore, the rationale given by the participants after each round can be restated more precisely in the feedback so as to be more acceptable. Similarly, Parenté and Anderson-Parenté (2011) claimed that the wording of questions should be accurate, which will make the panellists' predictions meet the requirements more. There is more literature which made some other suggestions to improve the Delphi method. For example, Ecken et al. (2011) noted that the organizers can try to measure the attitudes of the experts when they make the predictions so that the optimistic or pessimistic bias is likely to be discovered.

6.2 Improvement Plan Proposed within the CfWI

6.2.1 Workshop Delphi

According to the experience using the Delphi method, an improvement plan of the Delphi procedure was proposed within the CfWI. A simple

generalization of this improvement is the use of the workshop instead of the Delphi procedure based on the SurveyMonkey. The specific implementation steps are as follows:

In the preparation phase, the organizers design the questionnaire depending on the scenarios as usual. After communicating with the selected potential participants, an appropriate day is determined considering both the progress planning of the project and the experts' schedule, on which to carry out the workshop. The workshop will be held in a conference room where all the participants and organizers get together. The identities of the participants are only known by the organizers, but they will be identified by their unique ID number in the workshop.

At the beginning of the workshop, the moderator will explain the whole Delphi process, the precautions, as well as the relevant backgrounds of the project, to the panellists. Then the first round will start with a detailed description of a scenario, during which the experts can ask the organizers any question if they are in doubt about the scenario, so that all the participants can be fully aware of the contents of the scenario. After that, the moderator will ask the questions designed in advance for this scenario. If the participants are confused with the meaning of the questions, they can also ask the organizers for help. After every participant make sure they have understood the questions, they can give their quantitative judgments or choose to give up using the wireless panel in their hands. The time to give answers is fixed, but it is enough for the experts to make judgments. Next, the moderator will ask the participants the same questions for different scenarios in turn according to the same mode. The workshop will be divided into several periods, each of which includes two scenarios. Between any two periods, the participants will

have the opportunity for a short break. Under normal circumstances, each project will have four scenarios so the panellists can have a longer rest after the questions are all finished in the first round. During the break, the organizers will summarize all the answers in the first round and make the simple statistic distribution of the results marking the median value.

Before the second round is conducted, the moderator will demonstrate the statistical results of the first round to the participants, and all the participants have chances to express their own views of the results freely or even argue with other experts on a particular issue. Then the second round of the Delphi procedure will continue. Because each scenario has been introduced in the first round and all the queries about the questionnaire have been solved as well, the second round will be carried out more quickly, which may only costs half the time of the first round. Since every expert has known the results of the last round and have understood the rationales via discussing, the participants only need to stick to their initial judgments or make appropriate changes when answering questions. After the second round, the organizers will spend some time to summarize the results once again. At this time, the consensus will be judged whether it is reasonable by the organizers and they will decide whether it is necessary to conduct one more round.

6.2.2 Advantages of the Approach

This improvement program proposed by the CfWI has many obvious advantages, which indeed overcome lots of difficulties encountered in the web-based Delphi method. The cycle of the web-based Delphi method is very long, which will last about one month. However, the new program only needs one day to complete the whole Delphi process, while the preparation time before the workshop and the review time after the

workshop should also be taken into account. Generally speaking, this approach greatly reduces the cycle of the Delphi procedure, as well as accelerate the progress of the whole project, thus it saves plenty of human and material resources. Apart from this, this approach can mostly ensure that the participants will complete the whole process since the problems causing the high attrition rate has been overcome. The moderator describes the scenarios using speaking way combined with diagrams, thus it avoids the participants' aversion of reading the scenarios. Moreover, the participants' doubts about the scenarios or questions can be easily solved on the spot, so they only need to take one day off to attend the workshop, which helps them save much time. Besides, this approach fully embodies the characteristics of the Delphi method, especially anonymity. Both the ID number and the wireless panel can guarantee their absolute privacy when they give their own judgments while they also have opportunities to fully communicate with other experts. In addition, this approach can help the organizers to improve their work efficiency. They do not have to spend lots of time using SurveyMonkey to design the visual questionnaire, and they only need to present the questionnaire made by friendly office software on the screen, which unblock the technical limitation. The organizers can make more time to do other works because they do not need to always call or email the participants to complete the questionnaire and also have no necessary to deal with a variety of complicated questions from participants.

6.2.3 Disadvantages of the Approach

Although this improvement reflects its own advantages, there are also some problems with it. The main limitation of this approach is that it cannot guarantee a sufficient number of participants to participate in the workshop on the same day, that is to say, coordinating everyone's time is

a big issue. Even though some experts agreed to participate in the workshop, they may still miss it because of various reasons. After each round, although the participants have chances to discuss with others, they actually expose their points of view during the communication. Since there are a limited number of experts in the same field and some experts have long-term cooperation with the CfWI, it is likely that there are mutual understandings among experts. So when they make a discussion, some experts' judgments may be guided by authoritative persons, which contrary to the nature of the Delphi method more or less. Furthermore, the way to answer questions using the wireless panel need technical support and capital investment, and at least, the wireless panel should be able to reflect each answer on a computer terminal in real time. In addition, this theoretical method has not yet been proven, so the rationality of the process and the feasibility of the schedule require repeated verifications. If the whole process is not as smooth as imagination that the Delphi procedure is not completed in one day, the next step will get into trouble since each workshop needs an adequate preparation. It will be really difficult to organize another workshop in a short time inviting the same participants.

6.3 Improvement Program Designed by Author

6.3.1 Video Workshop Delphi

Based on the understanding of the specific implementations of the Delphi method in the CfWI, as well as the study of their internal improvement plan, another similar improvement program which is more refined is designed by the author. Generally speaking, it is a video workshop combined with computer technology. After the selection of the suitable participants, a specific day on which the most experts are available is

chosen to hold the workshop. The organizers had better sign a contract with the experts who decide to participate in the video workshop. The contract should be able to blind their attendances, for which the CfWI may need to pay reward. This program will be based on a video conference system, the basic requirement of which is that it should have the control side and the client side. The clients cannot join the workshop unless they got their unique accounts. The client can make a video and voice communication with the control terminal as well as make a video and text communication with other clients. The most important point is that the clients can send real-time answers to the control terminal. The control side needs a one-to-many video and voice communication. Not only need it to send the questionnaire in real time, but the responses of the participants can be automatically saved in tables and charts. On this basis, the flow of the video workshop is basically the same with the procedure of the workshop designed by the CfWI. There is one more point that it is necessary to mention the names of the participants in the final release of the project results if they agree. This kind of recognition of their contribution will motivate more participants to join in the Delphi procedure.

6.3.2 Advantages of the Method

Actually, in addition to the strengths of the workshop Delphi approach, this improvement reflects more advantages than the pure workshop. Because only the voice or text communication is available among experts, it avoids the possibility that the judgments are affected by others. Furthermore, because it is a web-based communication, the participants' selection scope can be extended. The participants can come from any place around the world and can also be in office or at home. The participants obtain the greatest degree of freedom which will help them

complete the Delphi process better. Considering the participants do not need to travel to attend the workshop and it only cost them one day or less, there may be more experts are willing to participate in this video workshop. In addition, because of the emphasis on the benefit distribution and the constraints of contracts, the experts will attend the video workshop as far as possible.

6.3.3 Disadvantages of the Method

In contrast, this method also has some limitations. The design of the software and the increasing spending are the problems that the CfWI has to face with. If a software company is entrusted to customize software which fully meets the requirements, the cost must be considered whether it is worthy. As a matter of fact, it will be worth designing this software if the cost is within the acceptable range and the Delphi method will be used frequently in the CfWI. But if the maintenance cost is also taken into account, this program must be determined by a comprehensive assessment. However, there are several alternative types of software and hardware in the market, which only lack of the function to automatically recovery the questionnaire and to made statistics of the answers although some software can handle the voting results. As a result, the organizers have to manually input the answers to a computer after the participants send the response, which can greatly reduce the cost and is more feasible. In addition, this approach needs the network communication, so it must be considered whether the network speed of the devices of the CfWI and every participant who may be distributed in any corner of the world can support this video workshop.

7. Conclusion and Further Work

7.1 Conclusion

To conclude, this paper generally describes the whole project applied in the CfWI with the aim to study the Delphi method. In the background chapter, the robust workforce planning approach is introduced in detail, which is the basis of this project. This article focuses on the strengths and weaknesses of the Delphi method which is a key step in the robust workforce planning framework. In the literature review section, a large amount of contents about the Delphi method are summarized from lots of literature, including the definition, characteristics, implementation process, classification as well as its advantages and disadvantages, which form an integral concept of the Delphi method. The review of the applications of the Delphi method shows that it plays an important role in the prediction aspect of education, transportation, information systems, marketing and health care. In order to study the practical application of the Delphi method in the CfWI in depth, SODA is used to get the cognitive map. The cognitive map is completed under the help of several one-to-one interviews with the staffs of the CfWI and it also refers to some reports of the projects. According to the analysis of the cognitive map, although the Delphi method makes a great contribution to quantifying the driving factors, there are still some problems to be solved in its implementation. The most obvious problem is the high attrition rate of the participants, which is directly caused by time consuming, lack of constraints on the participants, the participants having no confidence, low credibility of the Delphi method, and the low quality of the expert panel. Specifically, time consuming is caused by the technical limitation of the SurveyMonkey, the difficulties to make prediction, and demand of more panellists. The

reasons why the participants have no confidence are that some experts misunderstand the questions and the very difficult predictions. The low quality expert panel is affected by the difficulty to get the most appropriate participants. The questions about the Delphi method concentrate on whether it can really deal with the predictions of the workforce planning of health and social care.

In fact, the problems can be classified to the problems for the organizers and for the participants. The organizers face with the high attrition rate, time consuming, technical limitation, low credibility of the consensus, and the difficulty to identify the most appropriate participants. For the participants, except for time consuming, technical limitations, and low credibility of the Delphi method, they still encounter problems of misunderstanding the questions and the difficulties in making predictions. To solve these problems, the CfWI designs an improvement plan, which uses the workshop instead of the web-based Delphi. This approach shortens the cycle of the Delphi procedure and makes the participants understand the scenarios and questionnaires accurately in a more direct way, thus the attrition rate is reduced by this approach. Furthermore, it also increases the efficiency of the organizer. However, it produces some new shortages. The potential participants cannot be ensured to attend the workshop. In addition, anonymity may be violated due to the communication among the panellists. So this program is enhanced by the author who offers a video workshop program. This method guarantees anonymity and may attract more participants. Apparently, there are some limitations to this program. The measure to get the ideal technical support still needs a more detailed research. And whether the consequent cost increase is worthy or not needs to be assessed. It is necessary to try the detailed improvement gradually in the future projects in the CfWI. However, the whole improvement plan has to be tested in advance, which

cannot be used until it is mature enough to avoid the failure in practice.

7.2 Limitations

Although this project has been completed, there are some limitations about the research method. Firstly, the majority of the interviewees during the SODA process are the organizers of the Delphi method since the panellists are not available. The concepts related to the participants in the cognitive map mainly come from their comments in the Delphi process. There is no problem with the findings obtained in this way in essence. However, in order to get a more comprehensive and more rational cognitive map, the proportion of the number of the participants and the organizers had better be balanced. Secondly, the original cognitive map achieved from interviews and other materials should have been very detailed, but it is too complex. Thus, the map is simplified by summarizing the concepts, which makes it much clearer. Which kind of cognitive map will be better accepted, the detailed cognitive map or the simplified map with detailed prose descriptions, needs to be verified according to the feedback of readers. Thirdly, as stated above, there is no workshop which is organized for discussing the cognitive map as a result of the conflict of each potential participant's schedule. Although the validation interviews play a similar role as the workshop, in any case, the workshop can be tried if possible, after all, it can save time so as to increase the work efficiency.

7.3 Further Work

Indeed, some problems identified in the Delphi procedure need further solutions. The specific proportion of the number of different panellists is difficult to be determined by calculating or analysing, and there is also no reliable basis in the literature. Actually, the number and the proportion of

the participants is an issue worthy of further study. In terms of another problem that participants find it difficult to understand the scenarios or the questions clearly, the solution supplied by the workshop Delphi and the video Workshop Delphi just give the experts an opportunity to ask for help from the organizers, but the difficulties of the contents of the scenarios or the questions themselves are not reduced. To provide more understandable and more reasonable scenarios and questions about the future workforce planning of health and social care needs professional knowledge on each specific field. In order to solve this problem radically urging the participants make predictions much easily, a special study can be done by experts to optimize the core contents of the scenarios and questionnaires.

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I declare that this dissertation is my own work, and that where material is obtained from published or unpublished works, this has been fully acknowledged in the references.

Print Name:_____

Signature:_____

Date:_____