CHAPTER 7

Summary & Conclusion

7.1 Introduction

The first Japan Delphi survey indicates that average realisation rate of technology foresight is about 28%. By this result, the question of predictability of future remains unresolved. This, however, does not deter technology foresight from re-flourishing in recent years. More and more countries have started their national technology foresight programme, and Malaysia is one among them.

The re-emergence of technology foresight amid the uncertainty of foresight accuracy is a cause for concern. How can policy planners and decision-makers adopt foresight programme and plan according to its uncertain results? What necessary changes, both at conceptual and practical level, are needed to provide a sound justification to technology foresight if foresight accuracy cannot be guaranteed? This research is partly inspired by these concerns. These issues are very relevant to Malaysia, as the country has also started its own National Technology Mapping Programme.
7.2 General conclusions

In order to gain a better understanding of technology foresight, this research has studied both the epistemological and methodological aspects of technology foresight. On the epistemological level it has surveyed the very concept of technology foresight. The research found out that foresight knowledge is basically an uncertain knowledge, as illustrated by its average realisation rate of 28%. As the uncertainty of foresight result has raised the question of whether technology foresight is a scientific endeavour, the research has also looked into the notion of scientific knowledge and scientific method and its weaknesses. It has also compared the different nature between social and physical science research, and the dissimilar purposes of research that each serves.

With the purpose of ascertaining the nature and origin of uncertainty that beset foresight result, the research has also dwelled into the sources of foresight knowledge by looking at the methodology by which foresight knowledge is attained. The Delphi method, as one of the most frequently used method, is studied for the purpose of illustration. Towards the end of the research, further efforts are being made to look at the forces of technological innovation, which is also the sources where future knowledge about technology is being extracted. With an understanding of the limitation and purpose of foresight knowledge, the task of technology foresight is defined. The following sections will outline the major observations that this research has been able to make.
a. Importance of foresight

Certain researchers are sceptical about the reliability of foresight results. This is due to the nature of foresight research itself, which deals with inconclusive future knowledge. However, three points are established which support the importance and plausibility of foresight research.

First, planning of technology is inevitable. This is due to the recognition of the fact that technology is important to social and economic development, and harnessing technological development is expensive. As a result, the issue of prioritising areas of technological development arises. And technology foresight can rightly cater to this need.

Second, foresight research brings many spin-off benefits. The accuracy of foresight result is not the sole criterion to judge the success of a foresight exercise. Matters such as communications and co-operation among experts of various fields are equally important. This is especially true with the recognition of the importance of inter-disciplinary exchange of opinions. The process of consensus building in foresight research also helps to raise the commitment among members towards the effort of technological development.
Third, foresight research is not mere guessing but a systematic research. Though the degree of uncertainty remains high (average realisation rate is about 28%), foresight research represent one of the most systematic effort which is possible. The uncertainty should not be blamed on the foresight itself, but should be recognised as the nature of future occurrences.

b. “Foresight” means uncertainty

The issue of accuracy of prediction has been partially resolved in foresight research. Summarising experiences of past forecasting efforts, researchers have come to conclude that the quest for certainty over the past few decades had made little advancement. As such, the current strategy in foresight research is to recognise the uncertain nature of future. Foresight will not focus on a single possible future, but its result must include various possible futures as illustrated by the concept of *la prospective* by Mitchell Godet.

This change of philosophy underlying foresight research has great implications. First, it realigns our attention from concentrating solely on foresight accuracy to other spin-offs of foresight. Second, it marks a departure of debate from issue of accuracy to issue of how to best depict possibilities. Third, it highlights the limitation of our knowledge about future. Fourth, this makes foresight an activity to prepare us for uncertainty instead of capturing the one truth about future.
The solution to the uncertainty of future knowledge is not to abandon the effort of technology foresight, but rather to adjust our perception about future knowledge. Researchers have to admit that with our current ability, uncertainty cannot be eliminated but can be handled. One of the ways to get out of this problem of uncertainty is to allow, in our foresight, several possible futures, and give leeway for this uncertainty in our planning and policy. The point is not to remove uncertainty, but to prepare for uncertainty.

c. Foresight is a process, not an end product

Following the understanding that “foresight means uncertainty”, researchers have come to accept that foresight is a process rather than an end product. As an end product, we only concern with the final outcome, that is, the foresight results. However, as a process, researchers appreciate fully every stage of the foresight activity, from the planning stage to the implementation stage.

This is yet another example showing how our perception about future knowledge affects our way of conducting foresight research. If we think that we can ascertain future knowledge, then our approach of research will place more emphasis on the accuracy of the foresight. Otherwise, we will pay more attention on finding out several possible futures, and stress the importance of foresight as a “process”.

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d. The purpose of foresight knowledge

In an effort to analyse whether future knowledge can be counted as scientific knowledge, it is found that future knowledge is not scientific knowledge as according to the principle of "falsification" proposed by Popper. This is due to the "non-falsifiability" of future knowledge. We have no empirical means of testing future knowledge as future knowledge is yet to materialised. However, that does not render future knowledge purposeless.

The purpose of future knowledge is not to explain – the vocation of physical sciences – but to present several pictures of possible future for decision making. Physical sciences cares about the truth of nature. Future knowledge, however, does not share this destiny. The purpose of foresight is for planning. It seeks to look for several possible futures. As a result, whether a foresight represent ultimate truth is not important. What is important is to identify a few plausible futures for present decision making.

e. Foresight methodology

While quantitative foresight methodologies such as correlation analysis and trend extrapolation are still actively been used, they are usually used concurrently with other kinds of "subjective" methods which involve personal judgements. In fact, the discontinuous and uncertain nature of historical development begs us to place more
attention to these subjective methods. One of the subjective methods, Delphi, is in fact being widely used in OECD countries.

Experiences showed that the accuracy rate of foresight research is about 28%, and if partial realisation is taken into consideration, the rate can be as high as 64%. This neither shows us that future is predetermined (thus predictable); nor does it proves that future is not predictable. Over the years, researchers have come to recognise that there are a few categories of future facts, some are genuinely or relatively unpredictable and others are relatively predictable.

A foresight method should try to capture the category of relatively predictable facts. As for those relatively unpredictable facts, researchers have adopted a pragmatic approach whereby several possible futures are delineated for considerations. This relies heavily on expert opinions. Basically, they are two arguments for the usage of expert opinion. First, experts have a huge reservoir of "background information" which they acquire through their vast involvement at one profession. Second, experts are able to relate various strings of information and derive in-depth insight from them. This, however, does not mean that experts can always provide better estimation.
f. The task of technology foresight

As the realisation rate of technology foresight is only 28%, consequently, to provide accurate prediction is not the conviction of a foresight researcher. Foresight researchers acknowledge the uncertain nature of future knowledge. As a result, their task is not to eliminate uncertainty, but to prepare decision-makers for uncertainty. In the field of foresight research, this is called "strategic uncertainty". To prepare decision-makers for uncertainty means to present several possible futures in foresight analysis. This will minimise the chance of being caught in surprise. Some researchers call this a "surprise free" foresight.

Apart from that, technology foresight also serves other purposes. The process of technology foresight provides chances for scientists, policy makers, entrepreneurs and experts from various fields to communicate, generate consensus and strengthen their commitment towards harnessing technological development. These functions are equally important if not more important than foresight result in providing justifications for doing foresight research.

g. The forces of foresight resurgence

From the analysis, the resurgence of foresight activities is made easy when the issue of foresight accuracy has been "bypassed". Bypassing is not eliminating. The issue of uncertainty in foresight results remains, but is mitigated. Bypassing is
achieved by presenting multiple futures in foresight analysis. This helps to reduce the risk of inaccurate foresight. Apart from that, the process of globalisation also helps to propagate foresight activities where foresight information and experiences can be shared more easily at regional level. This couple with other benefits of technology foresight, as mentioned in Section 3.4, has given foresight a second life in recent years.

7.3 Suggestions

Technology foresight is an ongoing programme. As one of the pioneer in this field, Japan has been doing it for the past 30 years in a 5 yearly interval. In 1997, Malaysia had also joined the rank by launching its National Technology Mapping Programme (NTMP). Though designated a national programme, the NTMP is rather small in its scale. It involves only two industrial sectors, namely telecommunication and pharmaceutical. From the finding of this research, the following suggestions may help to maximise the benefits of NTMP.

First, as a national programme, the NTMP should be done at a higher level. Instead of doing it at sectoral level, the NTMP should cover most of the social and economy sectors in this country; using more general categories as the unit of analysis such as “industry and resources” and “food and agricultural” categories used by Japan (as discussed in Section 3.5, Chapter 3). Once the overall S&T development path of the country is charted, the lower level exercise should be left to stake holders like
private firms or relevant government agencies. Only by doing the foresight at a higher level and involving more sectors, can the nation’s human resource potential be fully exposed.

Second, the NTMP results should be widely disseminated. As we have seen in Chapter 2 (Section 2.5(b)), the post-foresight stage actually involves dissemination of foresight result. In other countries, the foresight results are widely made available to relevant S&T stakeholders for their further participation and action. The current NTMP, probably due to its commitment at firm level or other reasons, is not making its foresight findings public. Again, as a national project, the commitment of NTMP should go beyond firm level.

Third, a combination of judgmental/analytical and normative/extrapolative methods should be employed in foresight research if historical data are available. This is in line with the concept of *la prospective* which sees future as partially free and partially predetermined. The data used in analytical method will help to clarify the past and present conditions and the judgmental method will help to estimate future possibilities based partly on these past and present data. On the other hand, the normative method will take into account the future needs of people while the explorative method will look into the currently available resources.
Fourth, to focus the foresight in short to medium terms, that is between 5 – 30 years. As uncertainty of foresight results is high, it is less useful to look into a period of more than 30 years as the longer the time span, the lower the foresight accuracy is. The cognitive power of man in perceiving the future is also limited to certain time span. Some researchers suggest that a period of 10-15 years as the limit of our ability to conceive a reasonable picture about future.

Fifth, Malaysia should seek to co-operate with ASEAN countries in doing foresight research, as what is being done by OECD. This does not necessarily mean that the a few countries doing one foresight programme. This may not be feasible since each country may have its own problems that are unique to the country in one way or another. However, these countries may still share their foresight experiences and exchange personnel. If the stage of development of two countries is close, comparative foresight study may be carried out as has been done by Japan and German.

7.4 Suggestion for further research

This research has basically clarified some fundamental issues of technology foresight, especially those related to the concept, method and knowledge of foresight. On the epistemological aspect, foresight researchers have come to acknowledge the uncertain nature of foresight knowledge, as exemplified by the concept of la prospective. On the methodological aspect, the above ontological switch has impacted
the foresight methodology where a strategy is adopted to present several possible futures, instead of one, in foresight analysis.

Basically, the research has achieved what it sets out to fulfil, especially on the epistemological and methodological study of technology foresight. Further research can be carried out at both abstract and empirical level. At the abstract level, the interaction between man and future images and the consequences of this interaction can be further analysed. The delineation of boundary between relatively predictable & unpredictable future facts is also another area where efforts can be channelled. At the empirical level, case studies can be done to scrutinise the effectiveness of foresight activities. This can range from the investigation on foresight methods to the implementation of foresight activities. This is useful to highlight the foresight experiences of different environment settings and this may throw new light into the concept of foresight itself.