

Chapter 4 Research Methodology

4.1 Introduction

This chapter clarifies key concepts and justifies to be used, discusses how data is to be collected and analysed, and describes and justified the case study selected in this research. Two research instruments were employed to collect primary data – the structured research questionnaire and narrative case study. The questionnaire was designed mainly to elicit cross sectional data on the innovation activities among the innovative small and medium-sized wooden furniture manufacturers. On the other hand, the narrative case study was to identify the dynamics of innovation in a wooden furniture cluster in the country based on the three building blocks advanced in SIS framework. The presentation of this chapter is in three parts. The first part discusses the fundamental issues and concepts pertaining to analysis and measurement of innovation activities. The second part describes the survey administration procedures, and the third part of this chapter describes the procedures for narrative case study, which takes place in Muar District, Johor State, Malaysia. The primary objective of these exercises was to obtain quantitative and qualitative primary data and information that could explain the trends of technological innovation in Malaysia’s wooden furniture industry.

4.2 Issues and Concepts of Innovation Analysis and Measurement

While our understanding of the nature of technological innovation has greatly increased over the decades, the measurement of innovation activities remains rudimentary. One of the reasons for this is that technological innovation is a continuous process with enterprises constantly making changes to products and services, and it is more difficult to measure a dynamic process than a static activity (OECD, 2005). Moreover, as discussed in Chapter 2, innovative performance involves a complex set of interrelated variables, which fluctuate with the cultural and philosophical differences among departments and companies (Thamhain, 1996).

According to Alan Greenspan, an American economist and the former chairman of the United States Federal Reserve Board, it has always been difficult, if not impossible, for policymakers to understand how innovation is affecting current economic conditions. Thus we must design improved measures of innovation since it is crucial with sense that measuring innovation is central to understanding the economy as it evolves and responds to growing world competition. Indeed, improvements to our measurements of innovation will help to ensure continued economic growth, and at the same time avoid harmful policies and the enactment of facilitative policies (U.S. Department of Commerce, 2008).

For Smith (2005), the main problem of measuring innovating enterprises is that innovation is the creation of something qualitatively new, via processes of learning and knowledge building. Technological innovation involves multidimensional novelty in aspects of learning or knowledge organization that are difficult to measure or intrinsically non-measurable. Arguably, technological innovation is a process, not an event. The process is not sequential or linear but one involving interaction and feedback in knowledge creation (Kline & Rosenberg, 1986). The term “innovation” itself is subjective in the sense that different people have different definitions for it. In addition, measuring a continuous process is always much more challenging than measuring an event or product. This is because in measuring an on-going process, we need to tolerate a qualitative indicator which is subjective and non-codifiable.

In a nutshell, technological innovation measurement at the firm level should not be static and therefore needs to be tolerant of qualitative and subjective measures due to its nature, particularly its dynamics and interactive. Analysis and measurement of technological innovation should be an iterative process that needs to be treated like a “project” and more like an ongoing “dialogue.” Learning and improvement are to be gained from each stage of the process (U.S. Department of Commerce, 2008). Drawn upon these remarks, two research instruments, namely structured survey questionnaire and narrative case study, have been used to elicit primary data and information from the Malaysia’s wooden furniture sector. A detailed account of both these instruments is provided in the following parts of this chapter.

4.3 Self-administered structured questionnaire

This section presents the questionnaire design, survey administration procedures, survey responses and data collection of this study. A brief profile of technological innovating active responses derived from the survey is presented at the end of this section.

4.3.1 Questionnaire Design

As mentioned in Chapter 2, one of the striking facts about SIS is that innovation at the firm level can be analysed based on three building blocks' framework: (a) knowledge, technological domain and sectoral boundaries, (b) actors, relationships and networks, and (c) institutions. Table 4:1 summarise the three building blocks of SIS and some of the indicators for the analysis and measurement of technological innovating activities for each block. The proposed indicators here follow the Oslo Manual as closely as possible in order to reach international comparability.

Table 4:1 Indicators for innovation analysis and measurement

SIS Elements	Indicators for measurement	
	<i>What to measure?</i>	<i>Variables</i>
Knowledge and technology generation and development	Components and coverage of innovation activities	Type of innovation activities and expenditure breakdown (e.g. R&D; acquisition of other external knowledge; acquisition of machinery, equipment & other capital goods; other preparations for product and process innovation ³⁵ ; market preparations; & training)
	Main developer of innovation	Mainly by the enterprise itself; in co-operation with other enterprises or institutions; or mainly by other enterprises
	Methods to protect innovation	Patents, registration of design, trademarks, copyrights, confidential agreement and trade secrecy
Linkages and networks	Sources for transfer of knowledge and technology	Internal (e.g. R&D, production); external (e.g. competitors, clients, consultants); public sector (e.g. universities, government); or general information (e.g. patent disclosures, exhibitions, trade unions)
	Source of funds	Own funds; related companies (e.g. subsidiary or associated companies); other non-financial enterprises; financial companies (e.g. bank loans, venture capital); government (e.g. loans, grants); international organizations; and other sources
Institutions and practices	Objectives, Obstacles and Outcomes of Innovation	Competition, demand and markets (e.g. replace products being phased out, increase range of goods and services, develop environment-friendly products, enter new markets, etc.); and product and delivery (e.g. improve quality of goods and services, improve flexibility of production or service provision, reduce unit labour costs, reduce consumption of materials and energy, reduce product design costs, etc.)
	Factors hampering innovation activities	Cost factors (e.g. excessive perceived risks, cost too high, lack of funds, etc.); knowledge factors (e.g. lack of qualified personnel, lack of information on technology, etc.); market factors (e.g. uncertain demand for innovative goods or service, etc.); and institutional factors (e.g. lack of infrastructure, weakness of property rights, legislation, regulations, taxation, etc.)

Source: compiled from OECD (1997, 2005)

³⁵ They include development activities that are either partially excluded as R&D (such as industrial design, engineering and set-up, and trial production) or fully excluded (such as patent and licence work, production start-up and testing), and development activities for product or process innovation that do not meet the novelty requirement for R&D (i.e. they are new to the firm but not new to the market).

This cross-sectional research attempts to explore the trends of technological innovation activities among the technologically innovation active SMEs in Malaysia's wooden furniture manufacturing sector during the period of 2006-2008. The unit of analysis is a technologically innovative SME. Both quantitative and qualitative indicators have been used in the questionnaire to elicit firm's level of technological innovating activities. Quantitative data is useful in providing the "*know-what*" of firm's innovating activities, such as innovation expenditure, impact of innovation (such as manpower use, material consumption, energy consumption and utilisation of fixed capital, etc.), and life cycle of innovation (i.e. time taken to reach the commercialisation phase, the expected cost recovery, and payback period). On the other hand, qualitative data explain the "*know why*" and "*know how*" of the firm's innovating activities.

The questionnaire used in the survey is given in Appendix 1. The questionnaire can be generally divided into two parts and it consists of 18 questions. The sample questionnaire used in the UK Innovation Survey and the Malaysian Innovation Survey were referred to and harmonised in the process of designing the questionnaire. The first part which consists of six open-ended questions attempts to elicit demographic information pertaining to the respondents. These six survey questions were on:

- a) The enterprise's main product
- b) When the enterprise was established
- c) Ownership structure of the enterprise
- d) Turnover in 2008 and percentage derived from exports
- e) Number of full-time employees

- f) Proportion of full-time employees educated to degree level or above in science and engineering

The second part of the questionnaire captures the technological innovative activities in the enterprise from the perspective of the involvement of product or/and process innovation, methods of protect innovation, sources of innovation expenditures, partners for innovation co-operation, objectives of innovation, sources of knowledge and technology, and factors hampering innovation. The measurement scale that will be employed for the second part is non-parametric, namely nominal and ordinal scale. A 4 point Likert scale was used to elicit respondents' technological innovation trends. Table 4:2 lists the survey questions, variables and attributes used in the questionnaire, which attempts to elicit primary data on the innovation trends of technologically active SMEs during the survey period of 2006-2008.

Table 4:2 Survey questions, variables and attributes for questionnaire

Survey Questions and Variables Label	Attributes Label
<p>a) During the period 2006-2008, did your enterprise introduce any technologically significant new or improved products?</p> <p>If 'YES', how were these products developed?</p> <ul style="list-style-type: none"> - Mainly by your enterprise or enterprise group - Your enterprise in co-operation with other enterprises or institutions - Mainly by other enterprises or institutions 	<p>Yes No</p>
<p>b) During the period 2006-2008, did your enterprise introduce any technologically significant new or improved process?</p> <p>If 'YES', how were these processes developed?</p> <ul style="list-style-type: none"> - Mainly by your enterprise or enterprise group - Your enterprise in co-operation with other enterprises or institutions - Mainly by other enterprises or institutions 	<p>Yes No</p>
<p>c) During the period of 2006-2008, did your company have any technological innovation projects that were:</p> <ul style="list-style-type: none"> - Abandoned - Not yet completed but on time - Not yet completed but seriously delayed - Not even started 	<p>Yes No</p>
<p>d) Please indicate the importance of each of the following methods to protect innovation developed by your enterprise:</p> <ul style="list-style-type: none"> - Patents - Registration of design - Trademarks - Copyrights - Confidentiality agreement and trade secrecy 	<p>Not Used Low Medium High</p>
<p>e) What were the sources of these innovations (product and / or process) expenditure?</p> <ul style="list-style-type: none"> - Own fund - Related companies (subsidiary or associated company) - Financial companies (bank loans, venture capital, etc) - Government (loans, grants, etc) - Supranational and international organizations - Other (non-financial) enterprises 	<p>Yes No</p>
<p>f) During the period of 2006-2008, did your enterprise engage in the following innovation activities?</p> <ul style="list-style-type: none"> - In-house R&D - Acquisition of external R&D - Purchase of external knowledge - Acquisition of machinery, equipment and software - All design functions - Market preparation - Training 	<p>Yes No</p>

g) If you ticked YES to in-house R&D, please indicate how your enterprise engaged in in-house R&D during the period 2006-2008?	<ul style="list-style-type: none"> - Continuously - Occasionally 	<p>Yes No</p>
h) Who were your partners for innovation co-operation? Also, please indicate the importance of your partners.	<u>External market and commercial:</u>	<p>Not Used Low Medium High</p>
	<ul style="list-style-type: none"> - Suppliers - Clients or customers - Competitors - Consultants - Commercial laboratories & private R&D institutes 	
	<u>Internal sources within the enterprise:</u>	
	<ul style="list-style-type: none"> - Other enterprises within your enterprise group 	
	<u>Public sector sources:</u>	
	<ul style="list-style-type: none"> - Universities or other higher education institutes - Government or public research organizations 	
i) What were the objectives of innovation for your enterprise during the period of 2006-2008?	<u>Competition, demand & markets:</u>	<p>Not Relevant Low Medium High</p>
	<ul style="list-style-type: none"> - Replace products being phased out - Increase range of goods & services - Develop environment-friendly products - Increase & maintain market share - Enter new markets 	
	<u>Product & delivery:</u>	
	<ul style="list-style-type: none"> - Improve quality of goods & services - Improve flexibility of production /services provision - Reduce costs (labour, operating, design) - Increase efficiency of delivery of goods & services - Achieve industry technical standards 	
	<u>Other:</u>	
	<ul style="list-style-type: none"> - Reduce environmental impacts / improve safety - Meet regulatory requirements - Improve working conditions 	
j) Please indicate the sources of knowledge and technology used in your technological innovation activities, and their importance.	<u>Internal:</u>	<p>Not Used Low Medium High</p>
	<ul style="list-style-type: none"> - Within the enterprise - Other enterprises within your enterprise group 	
	<u>External market & commercial:</u>	
	<ul style="list-style-type: none"> - Competitors - Other enterprises in the industry - Client or customers - Consultants - Suppliers of equipment, materials, components, etc. - Commercial laboratories 	

Education & research institutions:

- Universities and other higher education institutions
- Government or public research institutions (PRIs)
- Private non-profit research institutions

General information:

- Patent disclosures
- Professional conferences, meetings or journals
- Fairs and exhibitions
- Professional association, trade unions
- Informal contacts or networks
- Standards or standardisation agencies
- Public regulations (i.e. environment, security)

k) A range of factors may inhibit your ability to innovate. Please grade the importance of the following constraints during the period of 2000-2008.

Cost factors:

- Excessive perceived economic risks
- Cost too high
- Lack of funds within the enterprise
- Lack of external financial resources

Knowledge factors:

- Innovation potential (R&D, design) insufficient
- Lack of qualified personnel
- Lack of information on technology
- Lack of information on markets
- Difficulty in finding co-operation partners
- Inflexibility within the enterprise
- Staff were burdened with production requirement

Not Used
Low
Medium
High

Market factors:

- Uncertain demand for innovative goods / services
- Market dominated by established enterprises

Institutional factors:

- Lack of infrastructure
- Weakness of property rights
- Legislation, regulations, standards, taxation

Other reasons for not innovating:

- No need for innovate due to earlier innovation
 - No need because of lack of demand for innovation
-

4.3.2 Survey Administration Procedures

Although it would be ideal to randomise the entire population of Malaysia's SMEs in the wooden furniture industry when selecting the sample, this sampling method was not able to be practised in this research. This is because to obtain a complete list of active SMEs in the industry in the country is next to impossible. Currently there is no centrally monitored statistics on the population of industry. Alternatively, the respondents were identified through the directories provided by two of the major furniture fairs in the country in, i.e. the MIFF and Export Furniture Exhibition Malaysia (EFE) for year 2009 and 2010. The directories were examined carefully to avoid replication and some of the non-manufacturing based enterprises were filtered out. In order to make sure that only SMEs are selected for the data analyses purposes, the respondents were required to provide information on the number of fulltime employees and the enterprise's annual sales turnover.

At the initial stage, a pilot test of the questionnaire was conducted on 10 SMEs. The piloting was aimed at identifying ambiguities, helping to clarify the wording of questions and permitting early detection of necessary additions or omissions. The real survey was carried out from February 2009 to April 2010. A total of 300 questionnaires were distributed to the potential respondents. Two methods were employed for the questionnaire distribution. The first was the mail questionnaire. Suggestions of Dillman's Total Design Method (Dillman, 2000) were applied in the implementation of the survey, which included pre-contact, cover letter, questionnaire, and return envelope. In order to provide a hassle-less reply system, the Business Reply Service (BRS) was obtained from POS Malaysia Berhad under the license number BRS4432 K.L. BRS is a

prepaid reply service provided by POS Malaysia Berhad, and respondents don't have to pay for the cost of postage to send back the questionnaire. A sample of the BRS envelop design used in the survey is appended in Appendix 2.

The second method was the on-site hand-delivered questionnaires during the furniture exhibitions in the country, i.e. the MIFF and EFE. In both methods, the managing directors or senior staff involved directly in the technological capabilities development of the enterprise was to serve as key-informants for the survey. As the survey was based on the concept of voluntary sample survey, the response rate is expected to be low. For instance, the response rate from Malaysian firms in the manufacturing sector during the National Survey of Innovation 2000-2001 was only 19 percent.

Data obtained was examined carefully to remove, for example, outliers and missing values, so as to improve data quality. Follow-ups with some of the responding enterprises were made to verify some of the 'suspicious' data. Statistical Package for the Social Sciences (SPSS) version 16.0 was used for the data analysis. Finally, the gathered data were tabulated accordingly and where necessary, presented pictorially or graphically using pie and bar charts.

4.3.3 Survey Responses and Data Cleaning

Responses were received from 97 firms from a total of 300 contacted, giving a respectable response rate of 32.3 percent. Of these, 70 enterprises indicated that they carried out technological innovation activities during the reference period of 2006-2008. This gives the incidence of innovation or percentage of innovating enterprises as 70.2 percent. The survey data were analysed using the SPSS version 16.0. Before performing the analysis, the data collected were entered into the SPSS data editor. This was followed by data screening to eliminate any error in data entry and outliers' data. In this regard, Normal Q-Q Plot provides an excellent summary of the distribution of the scale data obtained from the survey.

4.3.4 Profile of Technological Innovating Active Responses

Most of the technological innovating responses were majority Malaysian owned, with average sales of RM14.7 million and between 5 to 150 fulltime employees. As expected, most of the firms were focused on the export markets. These enterprises are characterised by a low percentage of fulltime employees educated to degree level of science and engineering. Most of the technologically innovation active enterprises have been engaged in both product and process innovation during the survey period. Overall, the number of enterprises that were active in product innovation is greater than those active in process innovation. A detailed account and discussions of the profile of technological innovation active respondents is provided in Chapter 5.

4.4 Narrative Case study

This section describes the case study method used in this study. It begins with an introduction on the purposes of case study and some key research questions in this study. Some key sources of evidence of this study is presented at the end of this section.

4.4.1 Purposes of Case Study and Research Questions

A case study can provide a richly detailed ‘portrait’ of a particular phenomenon (Hakim, 2000). According to Yin (2003), the case study research method is:

... an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. (p. 23)

Yin (2003) has proposed three purposes of case study research – exploratory, descriptive and explanatory. The exploratory case study seeks to explore any phenomenon in the data which serves as a point of interest to the researchers. Second, descriptive case studies set out to describe the natural phenomena which occur within the data in question. Third, explanatory case studies examine the data closely both at a surface and deep level in order to explain the phenomena in the data. In the case of this research, all these three types of case study research were employed.

The subject for the case study is the Muar wooden furniture industry in Malaysia which is known as the furniture capital of Malaysia because it has more furniture factories than any other location in the country. The main objective of the case study was to study the process of technological innovation amongst wooden furniture manufacturers there, particularly in terms of linkages among the main actors of technological innovation in the industry. It deal mostly with the dynamics and changes over time in the industry which is not able to capture through the questionnaire. The research questions in the case study were framed in such a way to address the three purposes of the case study as mentioned above. Listed below are the key case study research questions:

a) *Exploratory*

- What is the state-of-the-art of technological innovation capabilities in Muar small and medium-sized wooden furniture industry?
- What are the actors that support the technological innovation process of those Muar wooden furniture manufacturers?

b) *Descriptive*

- How is the process of knowledge and technological development working in Muar wooden furniture industry? How is it beneficial to the small and medium-sized manufacturers?
- How are the linkages activities in Muar? How do they benefit the small and medium-sized manufacturers?

c) *Explanatory*

- How can the technological innovation capabilities of the manufacturers in Muar be upgraded?
- What can be done to the existing STI-related policies in order to strengthen the technological capabilities of these manufacturers in Muar?

4.4.2 Sources of Evidence

According to Yin (2003), there are six sources of evidence for case studies, namely documentations, archival records, interviews, direct observations, participation-observations, and physical artefacts. However, only documentation, interviews and direct observations were used for data collection. Table 4:3 provides the sources of evidence used in this case study.

After sufficient library research, intensive interview sessions were conducted with representatives of some of the main actors in the industry, such as the furniture enterprises, supporting industries, training institutions, local authorities, and furniture association. The intensive interviews were framed in such as a way to address Malerba's (2002) three building blocks of SIS. Also, the interviews were addressed major changes over time and the development in the industry. This complements the cross sectional data derived from the innovation survey in this research. Table 4:4 provides the brief profile of the some interviewees in this study. In addition, interviews were conducted with several anonymous interviewees in order to understand the nature of the Muar furniture industry.

Table 4:3 Sources of evidence of data collection for case studies

Sources of Evidence	Examples
Documentation	<p><u>News clipping:</u></p> <ul style="list-style-type: none"> - Ravi, N. & Azlan Abu Bakar. (2004, April 26). The jewel in Johor's furniture crown. <i>New Straits Times</i>, p. 15. - Thean, L. C. (1998, September 14). Muar - the furniture town of Malaysia. <i>The Star</i>, p. 18. <p><u>Magazines article:</u></p> <ul style="list-style-type: none"> - Habsah Marjuni. (2000, June). The 'Great Success' of Muar. <i>Investors Digest</i>, 18-19. <p><u>Government policy:</u></p> <ul style="list-style-type: none"> - JPBD. (2003). <i>Laporan Pemeriksaan Rancangan Struktur Negeri Johor 2001-2020</i>. Malaysia: Jabatan Perancangan Bandar dan Desa Negeri Johor. - JPBD. (2007). <i>Rancangan Struktur Negeri Johor – 2020</i>. Malaysia: Jabatan Perancangan Bandar dan Desa Negeri Johor. - MPM. (2002). <i>Rancangan Tempatan Daerah Muar 2002-2015 - Jilid 1</i>. Malaysia: Majlis Perbandaran Muar. <p><u>Industrial association directory:</u></p> <ul style="list-style-type: none"> - MFA. (2008). <i>MFA 25th Anniversary Special Edition: 25 Years of Glory 1982-2008</i>. Malaysia: Muar Furniture Association. <p><u>Thesis:</u></p> <ul style="list-style-type: none"> - Tee, L. H. (1995). <i>Faktor-faktor lokasi yang mempengaruhi pembangunan industri perabot kayu di kawasan Majlis Daerah Muar Selatan</i>. Unpublished Master's Dissertation, University of Malaya, Malaysia.
Interviews	<p>On-site or telephone interview sessions with representatives from:</p> <ul style="list-style-type: none"> - Small and medium-sized wooden furniture manufacturers - Large scale wooden furniture manufacturers - Pei Hwa High School, Sungai Mati, Muar - <i>Institut Latihan Perindustrian</i> Ledang - Muar Furniture Association - Muar Municipal Council - Furniture Testing Laboratory, FRIM - Wood Industry Skills Development Centre, Banting - Malaysian Furniture Promotion Council
Direct observations	<p>Site visits to Parit Bakar, Parit Jamil and Bukit Bakri, where the Muar wooden furniture manufacturers are concentrated.</p>

Table 4:4 Profile of the interviewees

Name	Profile
Bo Eng Chee	<ul style="list-style-type: none"> • President, Muar Furniture Association • President, Federation of Johor Furniture Manufacturers and Trades Association • Treasurer, Malaysia Furniture Entrepreneur Association • Managing Director, Digital Furniture Sdn. Bhd.
Desmond Tan Boon Hai	<ul style="list-style-type: none"> • Deputy President, Muar Furniture Association • Former President, Malaysia Furniture Entrepreneur Association • Executive Director, Muar Industries Sdn. Bhd.
Chua Lee Seng	<ul style="list-style-type: none"> • Executive Advisor, Muar Furniture Association • Former President, Muar Furniture Association • Chairman, Lii Hen Industries Bhd.
Au Leck Chai	<ul style="list-style-type: none"> • Chief Executive Officer, Malaysian Furniture Promotion Council
Mohd Arshad Saru	<ul style="list-style-type: none"> • Head, Furniture Testing Laboratory, FRIM
Mohd Saat Pawi	<ul style="list-style-type: none"> • Head, Community and Employment Support Service Unit, Industrial Training Institute Ledang
Muhammad Ali Tukiman	<ul style="list-style-type: none"> • Architect, Planning and Development Department, Muar Municipal Council
Rohaiza Abdul Kadir Jailani	<ul style="list-style-type: none"> • Assistant Director, Wood Industry Skill Development Centre Banting, Selangor
San Son Cheng	<ul style="list-style-type: none"> • Principal, Pei Hwa High School, Muar
Yong Kok Swee	<ul style="list-style-type: none"> • Committee Member, Education Affairs Committee, United Chinese School Committees' Association of Malaysia • Head, technical Education Board • Committee Member, Examination Board
Lee Lei Chen	<ul style="list-style-type: none"> • Head, Technical Education Department, United Chinese School Committees' Association of Malaysia
Tey Tong Kem	<ul style="list-style-type: none"> • Former Principal, Pei Hwa High School, Muar • Founder of the Furniture Vocational Programme, Pei Hwa High School, Muar • Consultant / industry practitioner
Lim Yee Chee	<ul style="list-style-type: none"> • Administrative Staff and former facilitator of Furniture Vocational Programme, Pei Hwa High School, Muar

4.5 Summary

As highlighted in this chapter, the research methods employed in this research are in line with the viewpoint that analysis and measurement of technological innovation should not be static and there needs to be comprehensive treatment of qualitative and subjective measures. In executing the research objectives, two research instruments were developed and used in order to obtain empirical evidence – the self-administrated structured questionnaire, and the narrative case study. The structured questionnaire is expected to deal with the cross sectional data while the case study is expected to deal with the dynamics and changes over time in the industry. Based on this conceptual framework and data collection procedures, the next two chapters provide the empirical evidence of this research.