Chapter 1 Introduction

1.1 Introduction

The innovation systems approach has recently received considerable attention with many adopting it as a conceptual framework to undertake innovation studies at the sectoral level, for example, Kautonen (1996), Freel (2003), Beerepoot (2004a, 2004b), Oltra & Jean (2009), Dolata (2009), Yam, Lo, Tang & Lau (2010), and Parrilli, Aranguren & Larrea (2010). Advancement in technological innovation, in this context, is generally described as the results of the accumulation of idiosyncratic competencies amongst the key innovation actors through a series of path-dependent processes. Likewise, technological innovation is also sector-specific and the formulation of Science, Technology and Innovation (STI) related policies and strategic thrusts have to be tailor-made to suit the specific needs of the sector as well as the country (Köhler, 2008; Malerba, 2002; Pavitt, 1984). However, many of such sectoral studies have been undertaken in the developed world and largely focused on high-tech sectors. There has been a bias in policy towards science-based innovation and high-tech industries, while the low and medium-low-tech (LMT) sectors have received less explicit political attention and support by the policymakers (European Commission, 2006; Hirsch-Kreinsen, 2008a, 2008b). Based on the foregoing, this study seeks to explore the specific trends of technological innovation in a LMT industry in a developing country, Malaysia. In order to achieve this goal, empirical evidence for the study was derived from the case study of Malaysia's wooden furniture industry. This industry warrants an in-depth analysis as it is among the very few full-fledged home-grown industries that

has successfully penetrated the global market (MFPC, 2009). The uniqueness of Malaysia's wooden furniture is that its success is drawn mainly by the collective efforts of the industry practitioners, without much government support.

The main objective of this introductory chapter is to provide a comprehensive overview of the rationale, motivation, significance and context of this study. It begins with the background and problem statement, research objectives, research questions, research design and strategy, and significance of the study. The key terminologies used in the study are defined and the outline of the thesis is described at the end of the chapter.

1.2 Background and Problem Statement

The study of technological innovation management at the sectoral-level is undeniably a focal point of both academic and industrial interest. Technological innovation in this context, whether product or process oriented, is one of the prime drivers of a firm's competitiveness (Carlsson, 1997; Dodgson, 2000; OECD, 2010; Thamhain, 1996). Firms are able to leverage technological innovation in order to achieve high performance, incorporate new features and achieve lower costs so as to add value to their products while competing more effectively in the market (Boly, Morel, Renaud, & Guidat, 2000; Freeman, 1982). In developing this perspective, Ettlie (2000) asserted that addressing the issue of technological change in the workplace is a critical because of three primary reasons, namely (a) technology-driven change is everywhere and always present; (b) competitors use technology as part of their strategies to achieve success; and (c) value-capture from new technology is challenging and never guaranteed.

Complexity and inter-disciplinarity are the key characteristics that underpin the discourse surrounding technological innovation (Betz, 2003; Janszen, 2000; Mowery, 1995). Technology in this context can be embodied in people, materials, cognitive and physical processes, plants, equipment and tools (Hall, 1994). As the process of technological innovation does not consist of a single or isolated event, Dodgson (2000) strongly contends that its management has to encompass both specific and general areas. The management of Research and Development (R&D), new product development, operation and production, the commercialisation process, technological collaboration and technological strategy are examples of specific area management, while the management of complexity, risks, knowledge, creativity and learning are examples of general area management. A similar argument can be drawn from the studies by Kline & Rosenberg (1986), Petterson (1996), Janszen (2000) and Chiesa (2007).

The features of technological innovation as mentioned above are fully addressed in the framework of innovation systems. Innovation systems are systemic views of the innovation process that explicitly recognise the potentially complex interdependencies and possibilities for multiple kinds of interactions between the various elements of the innovation process (Edquist & Hommen, 1999). Although the literature on innovation systems is extensive, the concept is by and large defined at different levels for different purposes of analysis. Among them, the sectoral innovation systems (SIS) framework is one of the most influential. SIS is rooted on the hypothesis that innovation differs greatly across sectors in terms of characteristics, sources, the actors involved, the boundaries of the process, and the organisation of innovative activities (Malerba, 2002, 2004, 2005). Firms, together with other heterogeneous actors, are linked together by

market and non-market relationships. All of these actors, characterised by their specific beliefs, expectations, goals, competences, and organisation, are the key players that are continuously engage in the process of the generation, adoption and use of new technologies and knowledge (Nelson & Winter, 1982).

The innovation systems approach has led to a more integrated approach to the delivery of innovation-related policies (Lundvall & Borrás, 2005; OECD, 1997, 2005). As technological innovation and the development of capabilities are highly idiosyncratic at the sectoral level, there is a strong need to study sectoral-level innovation in order to provide policymakers with knowledge regarding the current needs and challenges of a particular sector. For instance, Goedhuys, Janz, & Mohnen (2008) assessment on the importance of total factor productivity of various sources of technological knowledge in low-tech industry (namely food and beverages, textiles, and garments and leather products) in five countries (Brazil, Ecuador, South Africa, Tanzania and Bangladesh) provide evidence that the sources of knowledge that raise productivity are highly industry-specific. Thus, the knowledge sources driving productivity performance are very different across sectors. Following these viewpoints, and by employing the SIS approach, this study has been designed to empirically explore the significant patterns and process of technological innovation at the sectoral level.

According to the European Commission (2006), efficient and sustainable policies to support innovativeness should be non-discriminatory and LMT industries should be acknowledged as important actors of a country's innovation infrastructure. Hirsch-Kreinsen (2008a, 2008b) finds that the vast majority of output and employment in modern economies is accounted for by both manufacturing and service LMT sectors,

and such sectors are significant users of the output from high-tech sectors. However, while the importance of knowledge is generally recognised for high- or medium-tech industries, it has long been neglected for low-tech industries (von Tunzelmann & Acha, 2005). Likewise, findings from the Policy and Innovation in Low-tech (PILOT) project funded by the European Commission (2006)[1] reveals that policymakers in the European Union as a whole and its member states are often advised to focus on high-tech manufacturing and high-tech services and not waste money, time and attention on pre-21st century businesses:

> Policy makers and scholars often contend that industrialised nations are currently undergoing a fundamental transformation into knowledge-based societies. The competence to generate and utilise new knowledge is seen as a decisive factor for both economic success and societal progress in this modern era. This argument is accompanied by a firm belief that in the current situation the improvement of research intensive high-tech industries is the key to increasing overall welfare. Correspondingly, so called low-tech sectors, mature and – compared to promising young branches such as biotech or nanotech – rather mundane industries are presented as being less important as agents for change in major industrialised countries. (p. 20)

It is apparent from the foregoing discussion that the low-tech sectors have received little attention from innovation policymakers and remain a rather unprivileged research topic. Literature has suggested that STI policies can be more effective when they are based on a more comprehensive understanding of the nature of LMT industries and the interrelationship between the LMT and high-tech industries, such as European

[1] The PILOT project comprised partners from nine European countries. The national research teams have conducted a series of case studies on non-research-intensive, so called low-tech companies in eleven countries, investigating their value chains and regional networks, and the policies that impact on these firms and on LMT sectors in general. The project began in December 2002 and completed in November 2005.

Commission (2006), Hirsch-Kreinsen (2008a, 2008b) and Mendonça (2009). Accordingly, this research is designed in such a way to address the main issues and challenges mentioned above. This empirical research presented in the subsequent chapters complements the literature review by providing alternative views on the issues from the perspective of a developing country, Malaysia.

The empirical data and observations for this study were taken from the wooden furniture industry in Malaysia. The process of exploring the trends of technological innovation in this industry is indeed a laborious task. This is because the success of the industry is the result of its own dynamics in integrating all the available resources and relevant supporting industries into its business environment. Both explicit and tacit knowledge, networking and cooperative spirit, trust and loyalty among the industry actors are the main factors that have contributed to the success of the industry. All these features are aligned with the framework of SIS.[2]

The wooden furniture industry is the major downstream activity in Malaysia's timber industry which contributed to 30.3 percent of the total export value of the timber industry in 2008. In year 2008, Malaysia is ranked as the tenth largest furniture exporter in the world, third in Asia and second among countries in the Association of Southeast Asian Nations (ASEAN) (MFPC, 2009; MPIC, 2009). As the sector has long been recognised for its quality in the world market, an interesting research question that merits attention is how this home grown industry which has always been categorised as low-tech, labour-intensive and tagged as "3D – dirty, dusty and dangerous" has been

[2] It is important to note that this scenario is also true for most industries, including high technology ones such as computers and information technology.

able to achieve such an impressive performance globally. The industry certainly has some valuable experiences to offer and share with other similar industries in Malaysia and abroad.

The wooden furniture sector is highly fragmented, and the predominance of the Small and Medium-sized Enterprises (SMEs) is very significant. However, despite constituting almost 85 percent of the total number of furniture establishments in the country, statistics reveal that SMEs only contribute 35 percent of the total industrial output. The remaining 65 percent is contributed by the large manufacturers (Ratnasingam & Wagner, 2009). In this regard, studies by Ismail Muhd Salleh & Latifah Rahim (1992), Moha Asri Abdullah (1999) and Mohd Ghazali Mohayidin & Shaari Abd Hamid (1988) shed some light on the issue of underperformance of Malaysia's SMEs. These studies reveal that, in general, the most commonly cited problem is the lack of competitive edge to face the challenges and opportunities in the global market, particularly their deficiency in technology. A situation which complicates the position of the SMEs in their quest for technological competitiveness is the fact that most of the local SMEs do not generate their own technology internally. This is due to factors such as the difficulty of obtaining financial support, the lack of technological, technical and managerial assistance, the lack of knowledge regarding international quality standards, etc. However, it is important to take note that as these studies were not carried out specifically on the wooden furniture industry in Malaysia, the validity of these claims need to be scrutinised. This study hopes to fill this gap in the literature by examining such claims from the perspective of a LMT industry.

As the furniture industry has been categorised as low-tech (OECD, 2007), one of the striking facts about the industry is its relatively low entry barriers compared to medium or high-tech industries, such as pharmaceuticals, electronics and electrical, machinery and equipment, etc. The low entry barrier is deemed to be beneficial to the local industry players, as participation in the industry is not limited to a particular or exclusive group of players. In fact, the whole value chain of the wooden furniture industry in Malaysia is made up of local enterprises. It is the only (or among the very few) industries in the country that is able to transform the raw materials into the final product, and subsequently to penetrate the global market. In spite of the obvious importance of this industry, its nature in terms of technological innovation has not yet been fully addressed in existing studies. Policymakers tend to assume that STI policies for high-tech industries can be transplanted into the wooden furniture industry. One of the examples of this is the action taken to reduce the industry's dependence on foreign workers by encouraging the full automation and computerisation of the production process. This has hampered the development of the industry as it overlooked the implications of technology in destroying the traditional bond between art and industry, eliminating skilled workmen and undermining the small shop system of manufacture[3].

1.3 Research Objectives and Questions

In general, this research is aimed at:

a) identifying the patterns of knowledge and technology capabilities development, linkages, and institutions among SMEs in Malaysia's wooden furniture industry;

[3] Issue pertaining to the implications of technology in "degrading" styles of furniture manufacture has been discussed extensively in Ettema (1981). Chapter 2 will provide some insight into this issue.

b) exploring and analysing the key problems and challenges with respect to the development of technological innovation capabilities among SMEs in Malaysia's wooden furniture industry;
c) examining the contribution of SMEs to the success of Malaysia's wooden furniture industry; and
d) proposing feasible STI-related policies for the development of the industry.

In order to achieve these objectives, several key research questions that need clarification are addressed throughout this study. Among them are:

a) What are the main characteristics of the innovators?
b) What is the status of knowledge and technology as well as its learning process in the industry?
c) What types of actors have contributed most to the success of the industry? How are they linked to each other?
d) What types of routines are commonly practiced by the industry?
e) What are the key factors that promote or hamper the technological innovation activities in the industry?
f) What is the role of the SMEs in the success of the industry?
g) What are the main issues pertaining to technological innovation activities in the industry?
h) What are the policies and strategic thrusts that should be put in place in order to foster the technological innovation capabilities of the industry?

1.4 Significance of the Study

Although Malaysia has long been recognised globally as one of the main furniture suppliers, its achievements in this sector have not generated much interest from both policymakers and researchers in the country. As it is categorised as a low-tech industry, it constantly gets less attention in national STI related policies and action plans in comparison to those high-tech and high-value industries such as information and communication technology (ICT), bio-technology, automotive, and aerospace.[4] The Malaysian Science and Technology Information Centre (MASTIC) has been conducting national surveys of innovation since 1994. However, the scope of the surveys has been broad as they have tried to incorporate all the manufacturing and services sectors. There has been no in-depth analysis of the technological innovation trends of the furniture industry in these surveys that have been undertaken to date.

A detailed analysis on Malaysia's wooden furniture industry would help to provide policymakers with the options and information they need in terms of policy formulation. Based on this premise, this study is expected to provide a comprehensive account of the current technological innovation capabilities in Malaysia's wooden furniture industry. As STI policies and strategic thrusts have to be closely related in addressing issues and problems faced by the various actors operating within a sector, such sectoral studies will certainly provide valuable empirical evidence for the formulation of sound sector-specific STI development policies.

[4] This trend can be gauged by comparing the number of Google Scholar's search results on the keywords of "Malaysia; innovation" by industries. Searches completed on June 24, 2010 indicate that there are 8,160 search results for the furniture industry. This is relatively low compared to information technology (124,000), electronics (42,700), automotive (19,600), and biotechnology (14,200).

Some accounts of technological innovation activities in Malaysia's furniture industry are available in the form of consultancy reports, government documents and magazine articles such as those by EPU (2002), JETRO (1999), MTC (1998a, 1998b), Norini, Rohana, Ahmad Fauzi & Mohd Parid (2009), Ratnasingam (2000, 2005), Tan (2000) and sectoral reports in Malaysia's Industrial Master Plans (IMPs). However, most of these studies centre on the demographic, productivity and managerial perspectives of the industry. Comprehensive studies that examine the innovation systems and the correlation among the key innovative variables in the industry are limited. Thus, another contribution of this study would be to provide observations and data that would eventually fill in the gap in the academic discourse on the technological innovation trends in the furniture industry as well as contribute to the body of knowledge on Malaysia's SMEs technological capabilities development. For future researchers, this study would provide baseline information on the current status of technological innovation trends in one of the Malaysia's low-tech and labour intensive industries.

In summary, this study advances knowledge in Malaysia's wooden furniture industry as follows:

a) employs the SIS approach that has yet to be utilised for a comprehensive study of technological trends in Malaysia's wooden furniture industry;
b) provides a comprehensive understanding of technological innovation trends in Malaysia's wooden furniture manufacturers, particularly among the SMEs;
c) make available a rigorous empirical study on the factors contributing to the success of Malaysia's wooden furniture industry, particularly the emergence of the Muar furniture cluster, which is the furniture capital of the country;

d) contributes toward empirical evidence of sectoral studies of technological innovation of LMT industries in developing countries; and
e) assists policymakers to formulate sound sector-specific STI related policies to induce technological capabilities development of the LMT industries.

1.5 Research Design and Strategy

The research design for this study is oriented towards policy rather than theoretical research. This is because the objective is to explore and describe the current patterns and trends of technological innovation activities in Malaysia's wooden furniture industry, and eventually provide the policymakers with the options and information they need for the formulation of STI related policies in strengthening the technological capabilities of the sector. Majchrzak (1984) defines policy research as:

> … the process of conducting research on, or analysis of, a fundamental social problem in order to provide policymakers with pragmatic, action-oriented recommendations for alleviating the problem. Stated in different ways, a policy research effort begins with a social problem, such as malnutrition, poverty, or inflation, evolves through a research process whereby alternative policy actions for alleviating the problems are developed, and communicates these alternatives to the policymakers. (p.12)

Policy research is characterised as multidimensional as it encompasses a diversity of factors, effects and causes in solving complex social problems. For Hakim (2000), the intended audience for policy research includes all relevant groups of policymakers,

decision-takers, public pressure groups, managers of organisations, and clients. Hence, the presentation of the results and key findings of policy research should be in 'plain language' eschewed of specialist jargon terminology. Given their broad canvas, a multi-research method has been employed to gather data. Two methods were used – a structured questionnaire survey and narrative case study of a furniture industry cluster. Data and results of the survey are mainly presented pictorially or graphically. A detailed account of the research methods and data presentation is provided in Chapter 4.

Another important source that has contributed to the design of this study is the Oslo Manual[5] published by the Organisation for Economic Co-operation and Development (OECD). The Oslo Manual, which is currently the foremost international reference for collection and use of data on innovation activities in industries, asserts that although the trend of technological innovative activities can be identified through two different survey approaches, namely the "subject approach" and "object approach", the subject approach is more amenable to international standardisation. The subject approach survey starts from the innovative behaviour and activities of the firm as a whole, and the grounded idea is to explore the factors influencing the innovative behaviour of the firm (such as strategies, incentives and barriers to innovation) and the scope of various innovation activities, and above all to get some idea of the output and effects of innovation. On the other hand, the "object approach" involves the collection of data about specific innovation, which is usually the significant or main innovation of a firm (OECD, 1997, 2005). Drawn upon these suggestions, the "subject approach" will be employed in this study as the basis for collecting and interpreting data. It is also in line

[5] The main concept for innovation in Oslo Manual is actually concentrated on Joseph Schumpeter's works. The Oslo Manual was first published in 1992 by the OECD and the European Commission. The manual provides guidelines on data collection on technological innovation. It was published mainly in response to the need for a systematic and internationally standardised methodology for collecting data on innovation. Since its publication in 1992, the Oslo Manual was revised twice in 1997 and 2005.

with the objective of this research, which is to understand sectoral innovation activities over a period of time rather than examining specific "significant innovations" in the industry.

1.6 Definition of Terms

In order to ensure the results of this research are internationally comparable and can be used for future research, the definitions of important terms follow closely the ones determined by international organisations such as OECD and United Nations (UN). Listed below are the key terminologies used in this study.

a) *Innovation* – There are multiple definitions for the term "innovation". However, the one given by the Oslo Manual has been adopted throughout this study, because the procedures for data collection and interpretation on technological innovation activities are based on the standard guidelines suggested by the Oslo Manual. "Innovation" refers to a new or significantly improved product or process introduced to the market or introduced within a company. The term "product" is used to cover both goods and services.

   "Technological product and process (TPP)" innovation comprise technologically new products and processes implemented and significant technological improvements in products and processes. A TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve

a series of scientific, technological, organisational, financial and commercial activities. The minimum entry requirement for TPP is “new to the firm”. Hence, a “TPP innovating firm” is a firm that has implemented technologically new or significantly technologically improved products or processes during the period under review.

b) *R&D* – The Frascati Manual has defined R&D as one of the technological innovation activities which carried out at different phases of the innovation process. R&D may act not only as the original source of inventive ideas but also as a means of problem solving which can be called upon at any point up to implementation. To be more precise, R&D comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (OECD, 2002).

There are three categories of R&D activities, namely basic research, applied research and experimental development. As this study is about a LMT industry which is do little R&D, the term R&D in this study is mostly refers to experimental development related activities, that is, systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed (OECD, 2002).

c) *Innovation systems* – "Innovation Systems" is a systemic view of the innovation process that explicitly recognises the potentially complex interdependencies and possibilities for multiple kinds of interactions between the various elements of the innovation process (Edquist & Hommen, 1999). According to Edquist (1997), innovation systems can be defined as all important economic, social, political, organisational, and other factors that influence the development, distribution, and use of innovation.

The term "systems" in this concept, according to Nelson (1993), is a set of institutional actors that, together, play the major role of influencing performance. For Carlsson, Jacobsson, Holmén & Rickne (2002), systems are made up of components, relationships, and attributes. Components are the operating parts of the system and can be of a variety of types such as actors and organisations, physical or technological artefacts, and institutions in the form of legislative artefacts. Relationships are the link between components which involve market as well as non-market links. Attributes are the properties of the components and the relationships between them; they characterise the system. The dynamic properties of the system – robustness, flexibility, ability to generate change and respond to changes in the environment – are among its most important attributes.

d) *LMT industries* – The terms "LMT" is used according to the OECD (2007) classification. The classification of manufacturing industries based on technology into high-technology, medium-high-technology, medium low-technology and low-technology groups, after ranking the industries according to

their average 1991-99 against aggregate OECD R&D intensities. According to the OECD categories, the industrial sectors can be classified as follows:

- High-Tech industries: R&D/Turnover > 5%
- Medium-High-Tech industries: 5% > R&D/Turnover > 3%
- Medium-Low-Tech industries: 3% > R&D/Turnover > 0.9%
- Low-Tech industries: 0.9% > R&D/Turnover > 0%

The “medium-low-tech” and “low-tech” industries are non-research-intensive with R&D intensity below 3 precent. They are here referred to together as LMT. As shown in Table 1:1, examples of LMT industries are: building and repairing of ships and boats; rubber and plastics products; coke, refined petroleum products and nuclear fuel; other non-metallic mineral products; basic metals and fabricated metal products; manufacturing, n.e.c. and recycling; wood, pulp, paper, paper products, printing and publishing; food products, beverages and tobacco; and textiles, textile products, leather and footwear.

Table 1:1 OECD classification of manufacturing industries based on technology[a]

		1999				1991			
		R&D divided by production		R&D divided by value added		R&D divided by production		R&D divided by value added	
	ISIC Rev. 3	Aggregate Intensity[b]	Median intensity	Aggregate Intensity[b]	Median intensity	Aggregate Intensity[b]	Median intensity	Aggregate Intensity[b]	Median intensity
High-technology industries									
Aircraft and spacecraft	353	10.3	10.4	29.1	27.5	13.9	12.9	34.7	32.1
Pharmaceuticals	2423	10.5	10.1	22.3	25.8	9.4	8.7	20.6	19.7
Office, accounting and computing machinery	30	7.2	4.6	25.8	15.1	10.9	6.4	29.4	15.2
Radio, TV and communications equipment	32	7.4	7.6	17.9	22.4	7.9	8.2	17.0	21.5
Medical, precision and optical instruments	33	9.7	5.6	24.6	11.9	6.6	6.1	15.6	12.5
Medium-high-technology industries									
Electrical machinery and apparatus, n.e.c.	31	3.6	2.3	9.1	6.7	4.2	2.6	9.3	5.9
Motor vehicles, trailers and semi-trailers	34	3.5	2.8	13.3	11.7	3.7	3.0	14.3	11.9
Chemicals excluding pharmaceuticals	24 excl. 2423	2.9	2.2	8.3	7.1	3.4	2.8	9.8	8.0
Railroad equipment and transport equipment, n.e.c.	352 + 359	3.1	2.8	8.7	7.9	2.9	2.1	7.6	5.4
Machinery and equipment, n.e.c.	29	2.2	2.1	5.8	5.3	1.9	2.0	4.6	4.7
Medium-low-technology industries									
Building and repairing of ships and boats	351	1.0	1.0	3.1	2.9	0.9	0.9	2.8	2.6
Rubber and plastics products	25	1.0	1.1	2.7	3.0	1.0	0.6	2.6	1.5
Coke, refined petroleum products and nuclear fuel	23	0.4	0.3	1.9	2.7	1.2	0.7	5.4	3.8
Other non-metallic mineral products	26	0.8	0.6	1.9	1.3	1.0	0.6	2.4	1.5
Basic metals and fabricated metal products	27-28	0.6	0.5	1.6	1.4	0.7	0.6	2.0	1.6
Low-technology industries									
Manufacturing, n.e.c.; Recycling	36-37	0.5	0.5	1.3	1.2	0.5	0.4	1.2	0.9
Wood, pulp, paper, paper products, printing and publishing	20-22	0.4	0.1	1.0	0.3	0.3	0.1	0.8	0.3
Food products, beverages and tobacco	15-16	0.3	0.3	1.1	1.0	0.3	0.3	1.1	1.1
Textiles, textile products, leather and footwear	17-19	0.3	0.4	0.8	1.0	0.2	0.3	0.7	0.7
Total manufacturing	15-37	2.6	2.2	7.2	6.5	2.5	2.0	7.0	5.7

a. Based on data for 12 OECD countries: United States, Canada, Japan, Denmark, Finland, France, Germany, Ireland, Italy, Spain, Sweden, United Kingdom

b. Aggregate R&D intensities calculated after converting countries' R&D expenditures, value added and production using GDP PPPs

Source: OECD (2007)

d) *Wooden furniture manufacturing* – The process of "manufacturing" in the context of the furniture industry, according to Malaysia Standard Industrial Classification (MSIC) 2008[6] refers to standard methods of forming materials and assembling components, including cutting, moulding and laminating. MSIC recognises both aesthetic and functional qualities in the design of the article as important aspects of the production process. In sum, MSIC defines the activities of wooden furniture manufacturing as (Department of Statistics, 2008):

- manufacture of chairs and seats for office, workrooms, hotels, restaurants, public and domestic premises;
- manufacture of chairs and seats for theatres, cinemas and the like;
- manufacture of sofas, sofa bed and sofa sets;
- manufacture of garden chairs and seats;
- manufacture of special furniture for shops (e.g. counters, display cases, shelves, etc.);
- manufacture of office furniture;
- manufacture of kitchen furniture;
- manufacture of furniture for bedrooms, living rooms, garden, etc.;
- manufacture of cabinets for sewing machines, television, etc.;
- manufacture of laboratory benches, stools, and other laboratory seating, laboratory furniture (e.g. cabinets and tables);
- manufacture of furniture for churches, school, restaurants; finishing (e.g. upholstery of chairs and seats);

[6] MSIC 2008 is a classification of all Malaysia's economic activities which conform closely to the ISIC, Revision 4 published by the Department of Economic and Social Affairs of the United Nations in 2008.

- finishing of furniture such as spraying, painting, french polishing and upholstering;
- manufacture of decorative restaurant carts (e.g. dessert cart, food wagon); and
- manufacture of wood partitions, free standing

However, manufacture of wooden furniture excludes:

- pillows, pouffes, cushions, quilts and eiderdowns;
- inflatable rubber mattresses;
- furniture of ceramics, concrete and stone;
- lighting fittings or lamps;
- blackboards;
- car seats, railway seats, aircraft seats;
- modular furniture attachment and installation, partition installation; and
- laboratory equipment furniture installation.

e) *SME* – Statistics revealed by Department of Statistics in 2009 shows that almost 95 percent of the furniture enterprises in Malaysia are classified as SMEs (Department of Statistics, 2009). Thus, we can generally say that the study of the Malaysian furniture industry is about SMEs. In Malaysia, the adoption of SME definition is based on two criteria – the number of fulltime employees, and annual sales turnover. The definition for SME in the manufacturing and manufacturing related services industries as approved by the Malaysia National

SME Development Council on June 9, 2005 is shown in Table 1:2. Based on this definition, SME is an enterprise with fulltime employees not exceeding 150 or annual sales turnover not exceeding RM25 million. SMEs can be further divided into three categories in terms of their size, namely micro, small and medium sized.

Table 1:2 Definition of SME in Malaysia's manufacturing and manufacturing related services industries

Definition		Fulltime employees	Annual sales turnover
General		Not exceeding 150	Not exceeding RM25 million
Specific	- Micro	Less than 5	Less than RM250, 000
	- Small	Between 5 & 50	Between RM250,000 & less than RM10 million
	- Medium	Between 51 & 150	Between RM10 million & RM25 million

Source: Central Bank of Malaysia (2005)

1.7 Organisation of Study

This thesis consists of seven chapters. Chapter 1 which serves as an introduction to this study, provides an overall view of the rationale, motivation and the context of this study. Chapter 2 builds the conceptual framework that underpins this study, which is drawn extensively from the perspective of SIS. The nature of technological innovation activities and their implications for management are addressed. The chapter also incorporates literature on the role of SMEs as a technological innovation actor.

Chapter 3 provides an overview of the global trends of the furniture industry in terms of its trade markets, value chain and sectoral patterns. Literature on previous spatial agglomeration and innovation systems studies of the industry are also presented. The chapter also incorporates literature on the technological profile of the Malaysian furniture industry. This is followed by Chapter 4, which explains the research methodology employed. It details the research tools and primary data collection processes employed in this study, namely the survey questionnaire and narrative case study.

The empirical evidence is presented in Chapters 5 and 6. Chapter 5 presents the data analysis and the results of the questionnaire survey, whereas Chapter 6 examines the pattern of technological innovation in the Muar furniture cluster in the state of Johor. Finally, Chapter 7 summarises the main findings from both the survey and case study methods in order to answer the research questions, including their policy implications. Limitations of the research and some suggestions for future research are also made.

1.8 Summary

This chapter provided an overview of the study including its background, rationale and significance. The presentation in this chapter detailed the importance of sectoral-level innovation studies its implications toward the sectoral-sensitive STI policies and strategic thrusts, particularly in the case of LMT industries. This is heavily based on the premise that different sectors have different needs and requirements, and their patterns and processes of innovation might also be different. Accordingly, STI-related policies

should not be made on the basis of "one size fits all" which views all sectors as one homogenous entity but, instead, must address the peculiarities of each sector.

The findings of this study is expected to fill a gap in the literature by addressing the patterns of technological innovation in LMT industries in developing countries with specific reference to Malaysia's wooden furniture industry. The empirical evidence in this study is derived from the survey respondents and the narrative case study of the Muar furniture cluster. By using the approach of innovation systems as a conceptual framework, this study explores the patterns of technological innovation in the selected case study from three perspectives, namely (a) knowledge and technology domain, (b) innovation actors and linkages, and (c) institutions. Detailed account on the conceptual framework of this study is provided in the next chapter.