FINAL REPORT

FURNITURE INDUSTRY SECTOR

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EXECUTIVE SUMMARY

This report starts with an overview of the global furniture industry in which the world furniture trade was seen to be increasing for the past decade. It highlighted that Vietnam had surpassed Malaysia in the world ranking of furniture exporters in 2009 and has continued rising to fifth place in 2014. Subsequently, the impact of Emerging Science, Engineering and Technology Foresight output on the Malaysian furniture industry was examined. In particular it is expected that emerging new species of wood tree for furniture use, marketing through internet, internet of things in the furniture, less waste produced in furniture manufacturing and automated manufacturing system will have a significant impact on the furniture industry. Economy and finance, social and culture, and geopolitics in 2050 will also shape the direction of the furniture industry., Malaysia's economy and finance by then will catch up with current advanced nation such as Japan where our 2030 per capita income should match or surpass the Japanese 2010 per capita income. Current spending patterns on household furniture are set to hold if not increase. In terms of social and culture, Malaysia will become a knowledgeable society as well as a community centred society where inter district travel will become significantly less. Thus working from home will become universal such that the home furniture shall have to be suitable designed the design of furniture will also be influenced by the rising ageing population, smaller living space, and higher sustainability awareness. Furniture manufacturing practices may also be affected by changes in geopolitics and the higher education level of the general population.

The general scenario and the inherent problem faced by the Malaysian furniture industry was then presented. The strength of the Malaysian furniture industry has always relied on wood furniture. As the world becomes more environmental conscious, natural forest timber furniture, faces stringent scrutinizing to maintain the sustainability of forest. Even with the existence of planted forest timber however, it only caters for the export market. In terms of furniture production, Malaysian furniture industry is still a labour intensive industry dependent on general workers. Automation among the furniture manufacturer is relatively small and not yet fully implemented. However, the awareness of automation technology is considerably high among the furniture manufacturers. In term of business, Malaysian furniture is recognized as medium-quality furniture. Malaysian Pride is the highlight of quality furniture made in Malaysia

with 16 companies recognized with the Malaysian Pride brand. Some manufacturers have move towards marketing through the internet for the domestic market. In terms of furniture designers, although Malaysian furniture design can be very artistic, some of the designs can be difficult to be manufacture. Designers are also influenced by western design and have not been able to innovate designs with strong differentiation which will give then a competitive edge in the international market. The Malaysian furniture industry is also facing a severe lack of local youth participation which has led to mass foreign general workers employment. This is where the problem starts as new regulations implemented by the Malaysian government limit the number of foreign workers.

Government policies are also having a great impact on the furniture industry. Several issues regarding governing policies, including but not limited to, inefficient allocation of resources due to duplicate efforts, suboptimal policy design, inefficiency in public-private sectors collaboration and international concern over deforestation, felling logging or from forest conversion for agriculture crop planting were identified. In the wake of the Paris Agreement for Climate Change, the environment sector as well as energy sector will drive the furniture industry towards mandatory sustainability practices.

As Malaysia strived to be a developed nation, other industries may affect the furniture industry directly or indirectly. The agriculture sector can contributes to the furniture industry in terms of more resilient timber product from timber plantation. Plastics and composite sectors may contribute to the sustainable materials from which quality furniture can be made of. The advancement of electrical and electronics sectors will see more furniture being embedded with electronics. The health s and transportation sectors are potential niche areas for the furniture industry.

As Malaysia will become a developed nation by 2020, issues on talent development for Malaysian furniture industry were also discussed. In the academic stream, programs are available for designers, production engineers, or material researchers. However, these programmes are general in nature rather than furniture specific programmes. In technical and vocational (TVET) stream, the teaching is focused to groom the talent in acquiring the necessary skill-set to make furniture from general woodworking, wood-machining, wood crafting.

Several strategies are proposed to drive the Malaysian furniture industry to a higher level. The main idea behind the proposed strategies revolves around the transformation of the furniture industry manufacturing practices namely sustainable raw materials, encouraging automation in manufacturing practices, branding, exploring new marketing strategies, starting new ODM companies, fostering public-private partnership, enhancing R&D, holistic, sustainable, streamlined, governance and reduction of bureaucracy. A roadmap was proposed to drive the industry through achievable goals from 2016 to 2050 to become globally competitive. The roadmap is divided into short-term, medium term and long term goals. The roadmap focuses on the manufacturer, educational institution, as well as the government as the main stakeholders. Finally some recommendations are made to be implemented towards a technological driven Malaysian furniture industry in 2050.

CHAPTER ONE

OVERVIEW OF INDUSTRY SECTOR VIS-À-VIS SCIENCE AND TECHNOLOGY FORESIGHT OUTPUTS

1.1 POTENTIAL WORLD FURNITURE SHIFT AND MALAYSIA READINESS

In 2050, the world population is expected to be 9.6 billion, an increase of 38%, from 6.9 billion in 2010. Geographically, 54% of the world's population lives in urban areas, a proportion that is expected to increase to 66% by 2050 (United Nations, 2013). In addition, the group of people above 15 years old is expected to increase significantly whilst children younger than 15 years old is projected to increase by only 10%, a consequence of falling birth rates (Figure 1.1). A healthy lifestyle and also better health care will also see an increase in the elderly population. The ubiquity of information as a result of increasing bandwidth and reach of the internet has also significantly affect lifestyle.

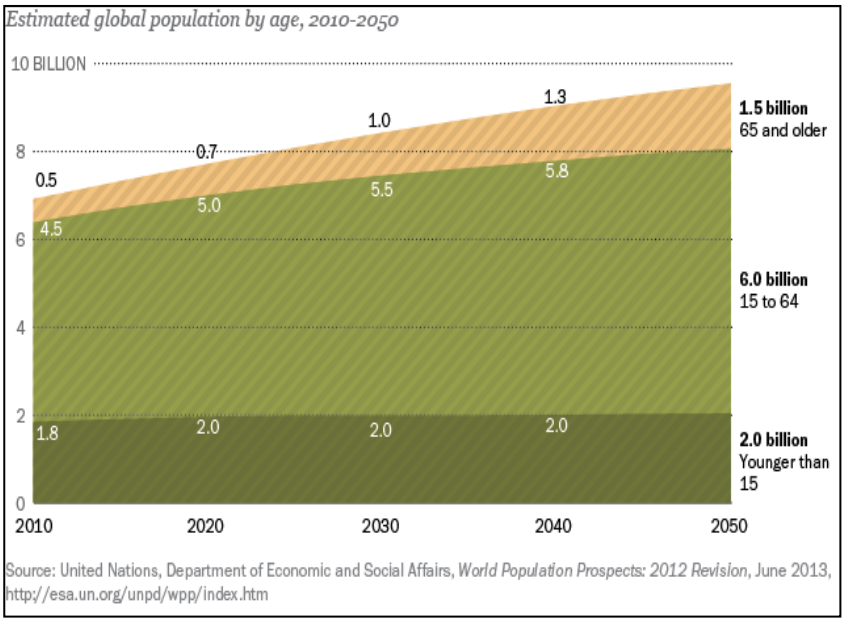


Figure 1.1: Estimated world population in 2050 according to group of age (Kochhar, 2014)

These demographic and technological changes will have a significant impact on the lifestyle by the year 2050. The increasing population will create greater demand for vertical and smaller space living. This will have an impact on furniture materials and design. The greater younger population are more IT savvy which will mean spending more time in the home but yet having a wider circle of network through social media. The increasing number of the elderly population will be a burden on the health system which can be alleviated by home care and health monitoring. Thus the home furniture in the 2050 may emerge to be:

a) Excessive multipurpose furniture
b) Intelligent robotics furniture
c) Furniture with shape shifting materials
d) Virtual reality community in designing furniture

At the national level, the Malaysian furniture industry had grown dramatically from the early 90's to the turn of the century, owing to the transformation of the industry's from traditional based operation to a technological driven industry. However starting from 2004, the industry seems to be saturated as the export revenue remains stagnant at 7 to 8 billion per year for 10 consecutive years with an average annual growth at 3.98% (MFPC, 2013). There is a need to also explore the market for furniture in transportation, aviation, marine, and aerospace which has been a very niche market that the Malaysian furniture industry may have overlooked.

There is also a lack of information on the state of the furniture industry in East Malaysia. There are about 2,965 furniture plants in Malaysia, with 2,630 in Peninsular Malaysia, 120 in Sabah and 215 in Sarawak. Most of the larger sawmills, veneer and plywood mills are located in Sabah and Sarawak. Mills in Sabah and Sarawak utilise tropical wood species for the production of sawn timber, veneer, plywood and other veneered panel products. The numerous number of furniture plants located in East Malaysia is due to the major production of timber products.

1.2 PROBLEM STATEMENT

The shift towards vertical and smaller space living will affect the material and design of furniture in the future. It has to be light, multifunctional and compact. It will likely

incorporate electrical/electronic features tailored towards a certain age group such as internet social media, entertainment, healthcare device and etc. This phenomenon itself defines a new concept of future furniture. Therefore, there is a need for the local furniture industry to gear towards these dynamic changes of the future human lifestyle.

1.3 OBJECTIVE OF THE STUDY

In this study, the main objective is to determine the current state of the Science, Technology, and Innovation (STI) in the Malaysian furniture industry. The more specific objectives of this study are:

a) Benchmarking the STI application in the Malaysian furniture industry with top furniture industries around the world.

b) Determine the potential areas and benefits of STI application in the Malaysian furniture industry.

c) Propose a national policy on implementation of STI that is capable of transforming the Malaysian furniture industry for the rising challenges of the human lifestyle in 2050.

1.4 IDENTIFYING FOCUS AREA

This study has been categorized into four focus areas namely furniture design, furniture manufacturing, marketing, and sustainability.

1.4.1 Furniture Design

The product is given more significant value for the market and successful, if the product developers can fulfil, and integrate the user needs into a new intended product. It is suggested that focus should be placed on furniture designer and user who are the main stakeholders in determining the success of a product.

1.4.1.1 Gaps in Furniture Design

Design should focus on things like material exploration, new end-use applications, issues of sustainability and the user experience as well as the implementation of STI. STI is important in furniture design due to the fact that future furniture may shift to wearable, intelligent robotics, and multipurpose furniture.

1.4.2 Furniture Manufacturing

Machining process is the key area for high quality product as it is the value adding operation in furniture production. Therefore, investment on production machinery is essential to the industrial player in order to meet the required product quality. There is a need by the industrial players to work together with research institutions to develop woodworking technology. In addition, the Malaysian furniture industry should explore the use of other materials like metal, plastic and composites in their furniture.

1.4.2.1 Gaps in Furniture Manufacturing

Innovation from an industrial perspective can be classified into two, namely the "innovation of the product" as well as the "innovation of the process". However, the Malaysian furniture manufacturing practices are more focused on product innovation rather than process innovation. The furniture industry should work with public institutions with R&D facilities to develop new technology (STI) and process innovation. In term of product innovation, additional materials such as metal, plastic, and composite could be utilised by the furniture industry to developed new products with less usage of wood.

1.4.3 Marketing

The focus areas of this section include traditional markets, raw material, Original Equipment Manufacturing (OEM) versus Original Design Manufacturing (ODM) and Original Brand Manufacturing (OBM), local designers, and cottage producers.

1.4.3.1 Gaps in Marketing

Association between industry players and government link must be very powerful to create a good marketing benefit. However, industry attitude towards change and technology is quite negative as it will require commitment and investment. Therefore, more STI promotions are needed to persuade the industry player to employ STI in their businesses.

The Malaysian furniture designs are often inspired by Italian furniture design since it is considered to be the most influential design in the global furniture trend. The Malaysia furniture industry needs to establish its own design and branding. This will also allow the growth and expansion of ideas from local talents.

As information through the internet will become ubiquitous in 2050, the furniture industry must explore new marketing strategies. Currently Malaysian furniture manufacturer is ill-equipped to market their products through the internet as most of the furniture is big and bulky and Malaysian courier services cannot cater for furniture postage and handling.

1.4.4 Sustainability

It is inevitable that the regulatory and policy pressures of environmentally sustainable furniture are important issues. Efforts need to be taken quickly to improve the state of readiness for Malaysian Furniture industry to be environmentally sustainable by engaging STI. This compliance will gain acceptance to new market as well as improving reputation in Malaysia current market.

1.4.4.1 Gaps in Sustainability

There are few areas that should be improved the environmentally sustainability of Malaysian furniture industry in term of gaps as listed below:

a) Sustainable Production Process
b) Sustainable Supply chain
c) Sustainable Product Design
d) Sustainable Business Model

1.5 AN OVERVIEW OF THE GLOBAL FURNITURE INDUSTRY

In 2014, the world furniture trade was USD 134 billion as presented in Table 1.1 (CSIL, 2015). This amount corresponds to 1.09% of the World Trade of Manufacturer. This value had increased at a steady rate of 4% since 2009.

China is the leading furniture exporting country since 2005 overtaking Italy. Previously, Italy was a major furniture exporter with Germany. Germany and Italy had been competing against each other in furniture export value since 2009. China has risen rapidly compared to Germany, Italy, Poland, Vietnam, and United States as depicted in figure 1.2. Table 1.2 categorizes 70 most important countries into High Income Countries and Middle and Low Income Countries. Seven of the highest High Income Countries and four of the highest Middle and Low Income Countries contribute the most to furniture production and export.

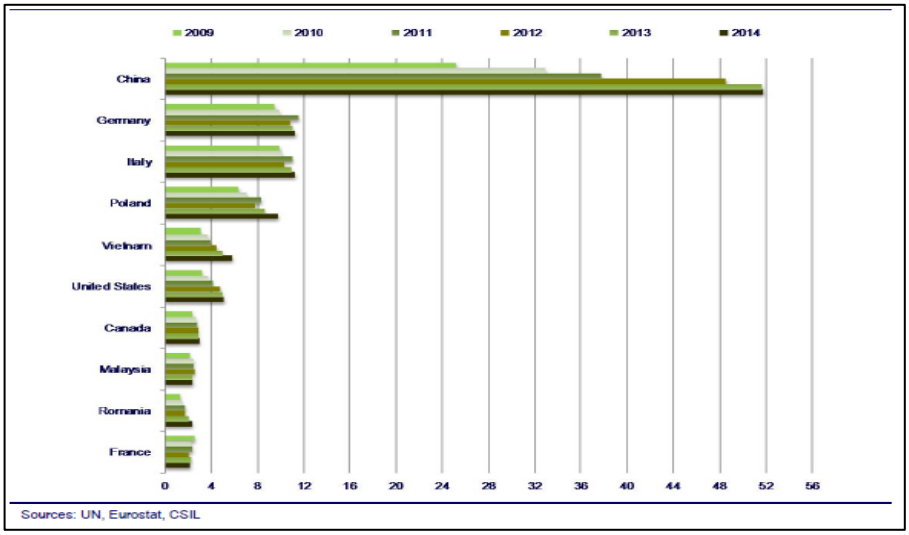


Figure 1.2: The Main Furniture Exporting Countries from 2009 – 2014 in USD Billion Currency. (CSIL, 2015)

Table 1.1: World Trade of Manufactures and World Trade of Furniture (in USD Currency) (CSIL, 2015)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*	2015*
World Trade of Manufac-tures	7378	8333	9521	10420	8320	9949	11430	11434	12041	12389	11572
World Trade of Furniture	84	93	109	117	94	106	117	122	128	134	134

*Projected

Table 1.2: Market Shares of the Major Exporting Countries by Percentage. (CSIL, 2015)

	Production		Exports	
	2005	**2014**	**2005**	**2014**
By High Income Countries / Middle and Low Income Countries				
High Income Countries				
Major Industrial Countries				
Canada	3.5	1.9	5.4	2.1
France	3.2	1.9	3.0	1.6
Germany	6.5	4.8	9.1	7.9
Italy	8.2	4.2	12.7	7.9
Japan	4.5	2.2	0.6	0.5
United Kingdom	3.5	2.1	1.6	0.9
United States	21.7	10.0	3.6	3.6
Subtotal G7	**50.9**	**27.0**	**36.1**	**24.4**
Other High Income Countries	21.3	15.2	30.4	23.0
Total High Income Countries	**72.2**	**42.1**	**66.5**	**47.5**
Middle And Low Income Countries				
Major Furniture Exporting Middle and Low Income Countries				
China	14.6	45.0	16.6	36.2
Vietnam	0.7	1.5	2.2	4.1
Malaysia	0.9	0.8	2.4	1.7
Turkey	1.3	1.3	0.7	1.5
Other Middle and Low Income Countries	10.2	9.3	11.5	9.1
Total Middle and Low Income Countries	**27.8**	**57.9**	**33.5**	**52.5**
World (70 Countries)	**100.0**	**100.0**	**100.0**	**100.0**
By Geographical Region				
EU (28) of which:	**37.0**	**23.2**	**55.8**	**41.2**
Old EU Members (15)	30.9	17.6	41.0	27.0
New EU Members (13)	5.3	5.0	13.6	13.5
Norway, Switzerland, And Iceland	0.8	0.5	1.2	0.7
Central-East Europe Outside The EU And Russia	**2.6**	**2.6**	**1.4**	**2.5**
Asia And Pacific Of Which:	**30.1**	**57.7**	**29.4**	**47.5**
China	14.6	45.0	16.6	36.2
Japan	4.5	2.2	0.6	0.5
Other Asia And Pacific	11.0	10.6	12.2	10.8
Middle East And Africa	**2.0**	**1.7**	**1.3**	**1.0**
North America Of Which:	**26.2**	**12.4**	**10.7**	**7.2**
United States	21.7	10.0	3.6	3.6
Canada	3.5	1.9	5.4	2.1
Mexico	1.1	0.5	1.7	1.5
South America	**2.2**	**2.4**	**1.5**	**0.5**
World Total (70 Countries)	**100.0**	**100.0**	**100.0**	**100.0**

It is worth mentioning that, both production and export value of High Income Countries had been decreasing from the year 2005 to 2014. There was a significant increase in the emerging countries noticeably China. However, the share of High Income Countries had decreased by 20 per cent whereas China's export has increased from 16.6% to 36.2%. Vietnam, which was lower than Malaysia in the world furniture export value before 2009, had surpassed Malaysia gradually and had become the fifth major furniture exporting country in 2014 overcoming the United States.

The world furniture consumption had resumed growth after the slump in 2009 due to the recession. The furniture consumption is forecasted to grow by 3.6% in real terms worldwide, with limited growth in South America and Europe and a continuing fast expansion (above 5%) in Asia (CSIL, 2015). Figure 1.3 depicts the world map of the worldwide furniture consumption growth. The colour-coded world map is ranked by size of furniture market. Consumption in countries like China and India are increasing at 6% and most countries in Asia are increasing in consumption as well.

1.6 FURNITURE INDUSTRY IN HIGH INCOME COUNTRIES

As shown in figure 1.2, the top five major furniture exporting countries are China, Germany, Italy, Poland, and Vietnam. Two of the countries categorized in High Income Countries are in the European Union Region (EU).

Furniture industry in European region has moved towards educating the consumers' awareness in decision making when buying furniture by promoting the quality of their products to consumers. Table 1.3 shows the key features of several measures that are being used for promoting quality of furniture product.

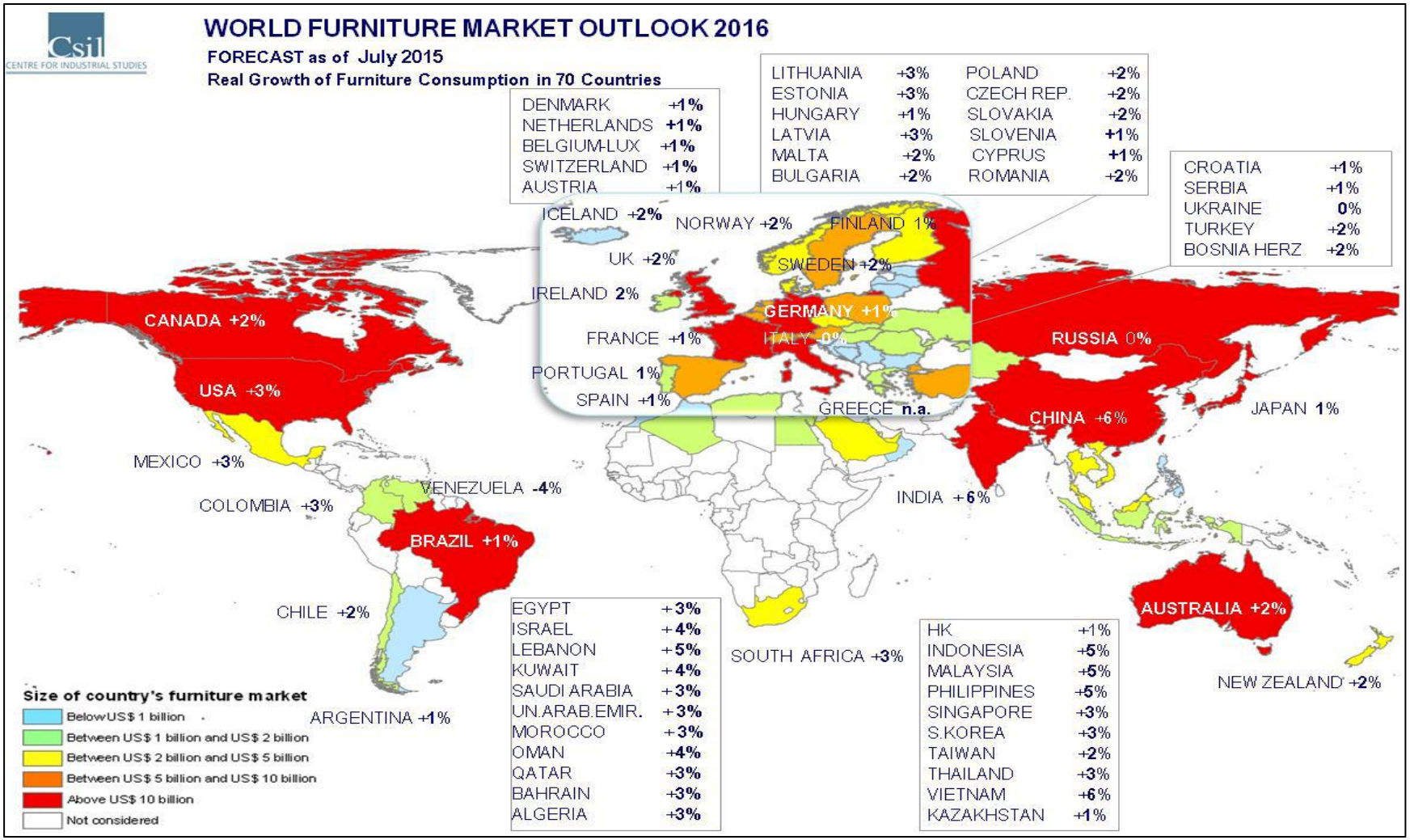


Figure 1.3: The Forecast of Furniture Consumption Real Growth among 70 Countries as in 2015. (CSIL, 2015)

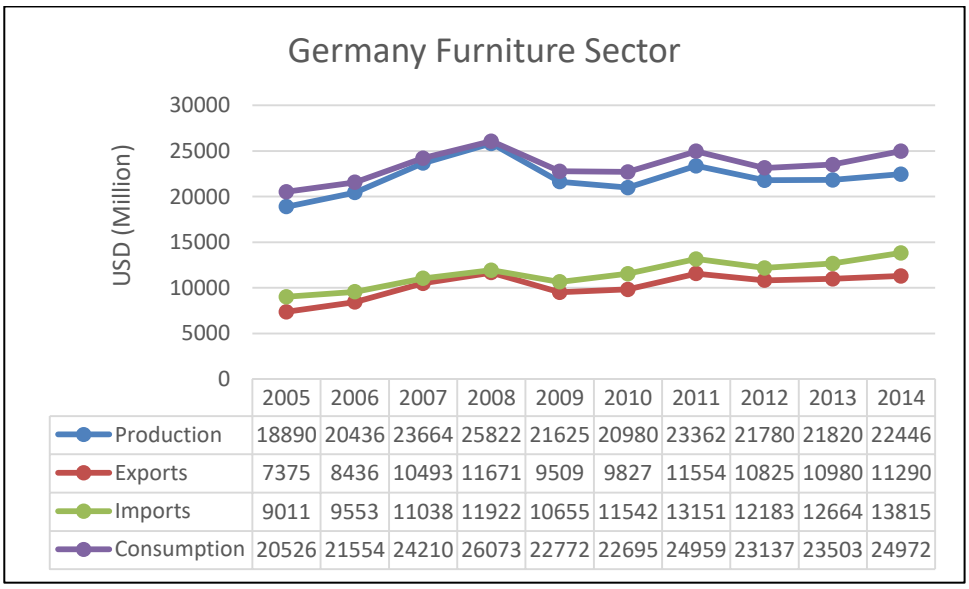
Table 1.3: Measures for Promoting the Quality of Furniture Products (Centre for European Policy Studies, 2014)

Measure	Country	Scope of The Information Provided	Product Range Involved	Method of Information Provided	Uptake (Number of Companies / Number of Products)
MANDATORY SCHEMES					
Decree on Trade in Furniture Products	France	General	All furniture	Card and label	Mandatory
Decree on Certain Leather Products and Certain Similar Products	France	Leather	Furniture covered in leather or split leather	Label	Mandatory
Industrial Research and Standards (Fire Safety / Domestic Furniture) Order	Ireland	Flammability	Upholstered furniture	Label	Mandatory
Product Sheet	Italy	General	Wood furniture	Card and label	Mandatory
The Furniture and Furnishing (Fire / Safety) Regulations	UK	Flammability	Upholstered furniture	Label	Mandatory
VOLUNTARY SCHEMES					
Austria Quality Seal	Austria	General	All furniture	Label	19 / n.a.
Onorm A 1650 Tested	Austria	Safety	Seating and tables for general school education	Card and label	1 / 14
Czech Quality - Furniture	Czech Republic	General	All furniture	Card and label	13 / 3537
German Furniture Quality Association – The Golden M	Germany	General	All furniture	Card and label	80 / n.a.

Measure	Country	Scope of The Information Provided	Product Range Involved	Method of Information Provided	Uptake (Number of Companies / Number of Products)
Simbolo Calidad	Spain	General	All furniture	Label	133 / n.a.
Mobelfakta	Sweden	General	All furniture	Label	31 / 330
Austrian Eco-Label	Austria	Environmental sustainability	All furniture	Label	15 / 46
Nordies Ecolabelling (Svanen)	Denmark, Finland, Iceland, Norway, & Sweden	Environmental sustainability	All furniture	Label	25 / 233
ECO-LABELS					
NF Environment	France	Environmental sustainability	All furniture	Label	51 / 482
EU Ecolabel for Wooden Furniture	EU	Environmental sustainability	Furniture made of at least 90% w/w solid wood or wood-based materials	Label	2 / 39
EU Ecolabel for Bed Matresses	EU	Environmental sustainability	Bed matresses, materials filling the bed matresses, Wooden bed base	Label	4 / 18
The Blue Angel-Environmental Label Jury	German	Environmental sustainability	All furniture	Label	46 / 125
Milieukeur Certification Scheme for Furniture	The Netherlands	Environmental sustainability	Home, kitchens, beds, bedsteads and cradles, bathroom furniture	Card and / or label	2 / 2
EU Eco-Label for Bed Matresses (National Implementation)	Romania	Environmental sustainability	Bed matresses	Label	/ 0

1.6.1 Germany Furniture Industry

In the last decades, Germany and Italy have the largest furniture industry in Europe and are among the largest exporters of furniture in the world market. Both countries are characterized by sustained growth rates of real exports. A study made by Florio, Peracchi, & Sckokai (1998) found that both furniture production and furniture retailing of Germany are far more concentrated than in Italy. Of late, Germany have been specializing in kitchen and office furniture. Many of the recent functional innovations and ergonomic improvements have emerged from Germany manufacturers. 'Made in Germany' is an excellent sales pitch for high-technology kitchen brands (ITTO–ITC, 2004). Figure 1.4 shows the trend of Germany production, exports, imports, and consumption since 2005 to 2014.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	18890	20436	23664	25822	21625	20980	23362	21780	21820	22446
Exports	7375	8436	10493	11671	9509	9827	11554	10825	10980	11290
Imports	9011	9553	11038	11922	10655	11542	13151	12183	12664	13815
Consumption	20526	21554	24210	26073	22772	22695	24959	23137	23503	24972

Figure 1.4: The Progress of Germany Furniture Sector since 2005. (CSIL, 2015)

The country had shifted its traditional furniture a while ago into modern furniture industry. The modern furniture industry has benefited the Germany foreign trade significantly. The high labour costs had always been a burden for the industry. However, this was solved with the development of technology in the furniture industry. Figure 1.5 shows that Germany's export was not much affected with a decreased of only EUR 0.3 billion although the number of German furniture companies had decreased by 0.5% in 2013 as shown in figure 1.6.

The slight drop in 2013 resulted partially from the hitches in the traditional European markets where exports value to France, Austria, Netherlands and Switzerland were shrunk (IHB, 2014). That scenario somewhat impeded the German furniture exports.

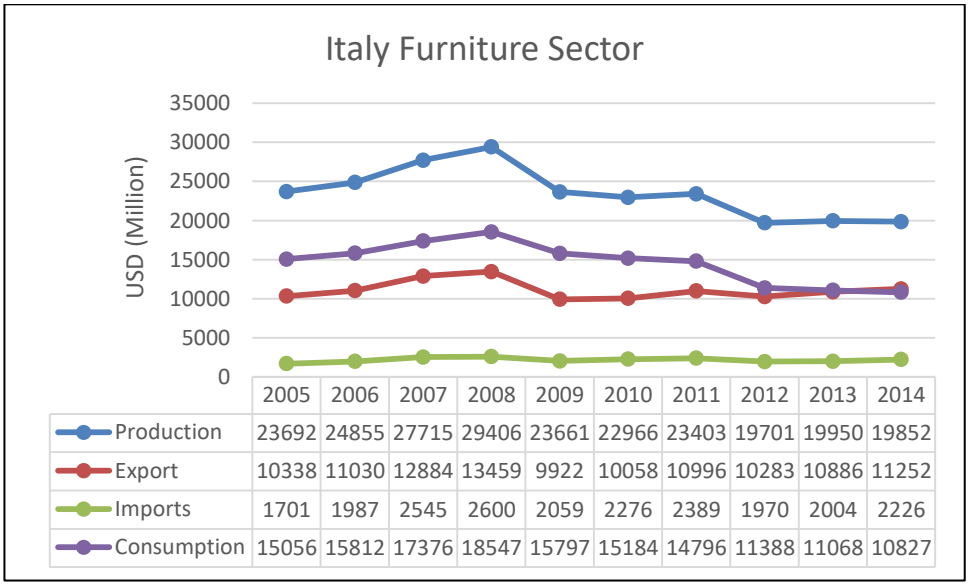
Figure 1.5: Export and Import Value of Germany Furniture Foreign Trade from 1995 to 2013. (HDH, 2014)

Figure 1.6: Number of Companies in German Furniture Industry from 2005 to 2013. (HDH, 2014)

Germany had strengthen the supporting attributes to achieve technological furniture industry. The Germany furniture ecosystem of furniture making is comprehensive, from focusing on technological early education in furniture manufacturing to the abundance of various furniture accessories and spare parts. These are among the important elements in order to sustain the furniture industry.

1.6.2 Italian Furniture Industry

Italy led the furniture industry since 1979. However starting from 2005, it was no longer the world's leading exporter of furniture (Lojacono, 2013) as it was surpassed by China. Despite that, Italy without doubt has very good furniture branding and design. In contrast with Germany, the furniture industry in Italy is concentrated more on bedroom and living room furniture (Florio et al., 1998). Figure 1.7 showing the trend of Italy furniture sector's production, export, imports, and consumption. In 2014, there is a moderate decline in furniture production but still the export value had increased by 3%.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	23692	24855	27715	29406	23661	22966	23403	19701	19950	19852
Export	10338	11030	12884	13459	9922	10058	10996	10283	10886	11252
Imports	1701	1987	2545	2600	2059	2276	2389	1970	2004	2226
Consumption	15056	15812	17376	18547	15797	15184	14796	11388	11068	10827

Figure 1.7: The Progress of Italy Furniture Sector since 2005. (CSIL, 2015)

The worldwide furniture industry are captivated by European innovation and design. Most furniture manufacturers are eager to produce look-a-like European furniture in particular Italian furniture. Italian furniture has been a trendsetter for most

furniture industry around the world. Italy has been organizing an international furniture fair called The Salone Internazionale del Mobile (International Milan Furniture Fair) annually that takes place in Rho, Milan, Italy. Furniture manufacturers have taken the opportunity to visit the biggest world furniture fair to get ideas of the newest trend in Italian furniture.

Italian furniture manufacturers use highly advanced technology due to the close cooperation with machine manufacturers and the small average size of Italian furniture plants. In addition, Italian furniture industries also outsource furniture parts. Many furniture companies outsource all components and assemble semi-finished parts.

The most common outsourced parts are cut-to-size overlaid panels (often drilled and sometimes grooved), cabinet doors, tops, furniture mouldings, carcasses and drawers. A rough estimate of the size of this market indicates that Italy's furniture companies buy as 'components' about one-fourth of their requirements for materials (ITTO–ITC, 2004).

There is a significant rise of labour costs aligned with raw material shortage in Italy. Therefore, Italy has invested in the Poland furniture industry to produce furniture products for the country with the design provided by Italy. This is a great opportunity for the developing country to grow in the industry. Moreover, Poland has abundance of raw materials and cheaper labour cost.

1.7 FURNITURE INDUSTRY IN MIDDLE AND LOW INCOME COUNTRIES

China, Poland, and Vietnam are the highest three furniture exporters in the world. Figure 1.8 shows the gap has been narrowed to 53% between Middle and Low Income Countries and the High Income Countries.

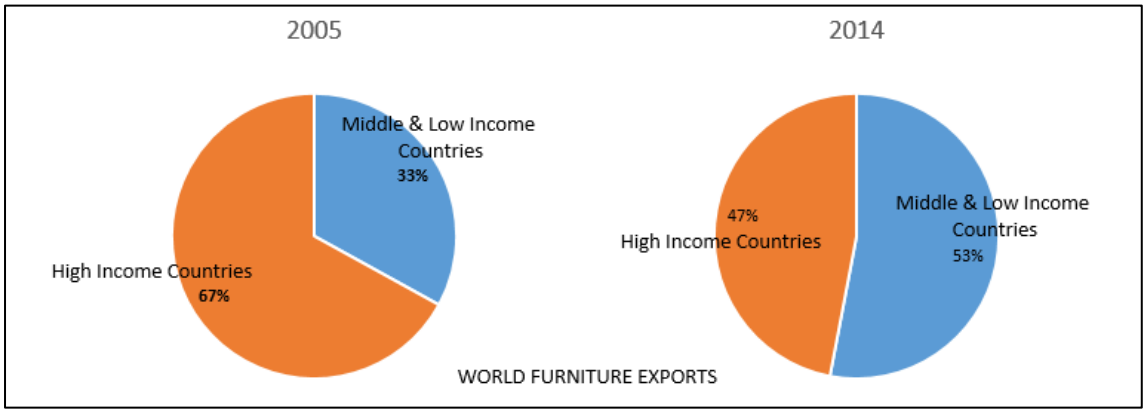


Figure 1.8: Breakdown between High Income and Middle and Low Income Countries for Furniture Exports in 2005 and 2014. (CSIL, 2015)

1.7.1 China Furniture Industry

China has now become the world's largest furniture production base and exporter due to the rapid economic growth that has increase the nation's living standard and buying power in the recent 30 years. Figure 1.9 shows that furniture production has increased close to 400% in the last 9 years. The furniture industry in China is mostly concentrated in the Pearl River Delta where furniture manufacturers generate the highest production output and possess the strongest integrated support capability. This is followed by Fujian, Zhejiang, Jiangsu, Shandong and Shanghai, which are advance in product quality and operations management. Meanwhile, the furniture industry in Yangtze River Delta is developing fast with the highest average growth rate in the country (HKTDC, 2015).

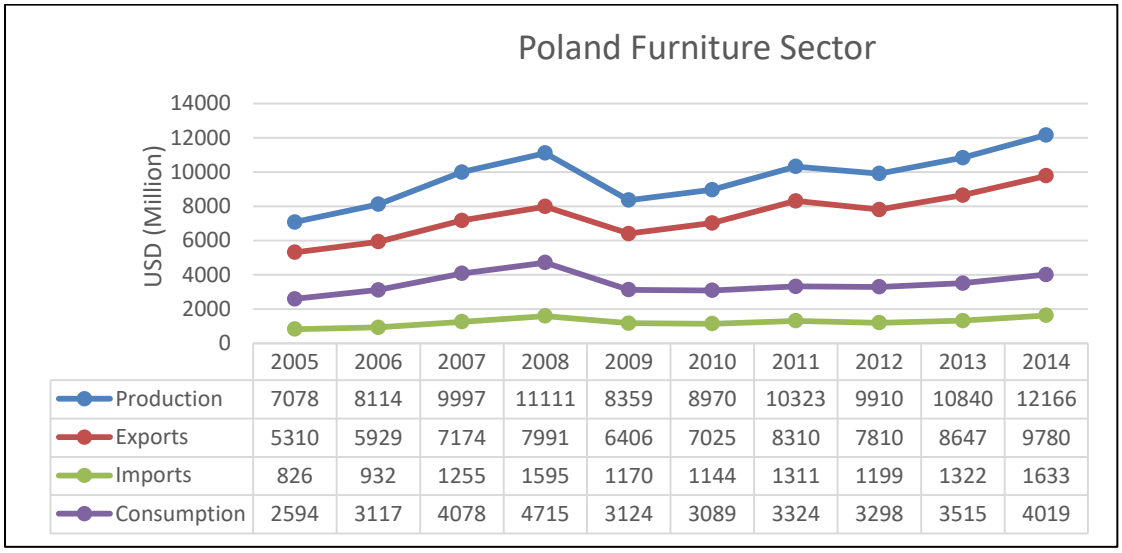
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	42500	53750	71484	92185	108753	128516	156272	180666	200523	212156
Exports	13451	17059	22030	26807	25221	32896	37803	48591	51583	51751
Imports	479	596	882	1006	1093	1507	1885	1936	2136	2382
Consumption	29528	37287	50337	66384	84625	97126	120354	134011	151076	162786

Figure 1.9: The Impressive Progress of China Furniture Sector since 2005. (CSIL, 2015)

According to ITALIA (2012), more than 80% of China's furniture export is Original Equipment Manufacturing (OEM). However the Chinese manufacturers are moving towards higher value-added production and spending more on design and branding instead of focusing purely on price competition. This is especially to serve the export market as well as mid-high domestic market. There are a variety of raw materials used for furniture making such as wood, rattan, plastic, and metal. In 2011, the metal furniture has been dominating furniture production with 363.44 million pieces compared to 247.74 million pieces of wooden furniture production. This shows that the Chinese furniture industry is gradually moving towards the sustainability of Chinese forestry by diversifying the material used in production.

1.7.2 Polish Furniture Industry

The furniture industry in Poland has contributed significantly towards the country‘s economy. It is among the major European exporters and a major exporter in the global market too. Figure 1.10 depicts the trend of Polish furniture sector. As a country that has abundant wood resources, the country is capable of becoming an important wood furniture manufacturer. Poland easily has access to the latest woodworking technology as it is geographically situated next to Germany. 90% of the furniture production is being exported (Sawa, 2013). However most of the furniture manufacturers are OEMs. The local brand furniture is not well known as most furniture is sold under a foreign brand. Some of Poland well-known brands are Kler, Forte, Paged, Klose, Nowy Styl or Ludwik Styl. Main furniture players such as Italy and Germany are likely to invest in the Polish Furniture Industry due to the abundance of wood resources.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	7078	8114	9997	11111	8359	8970	10323	9910	10840	12166
Exports	5310	5929	7174	7991	6406	7025	8310	7810	8647	9780
Imports	826	932	1255	1595	1170	1144	1311	1199	1322	1633
Consumption	2594	3117	4078	4715	3124	3089	3324	3298	3515	4019

Figure 1.10: The Progress of Poland Furniture Sector since 2005. (CSIL, 2015)

1.7.3 Vietnam Furniture Industry

Similarly to China, Vietnam has also steadily climbed to be a main furniture exporter in the world. Vietnam has plenty of forest reserve giving it an advantage in furniture production. The industry aims to be an exporter as well as an OEM player. As depicted in figure 1.11, the production and export value rose correspondingly whereas the furniture consumption has increased gradually.

The Vietnam Trade Promotion Agency (2013) promotes the furniture industry by offering the following:

a) Plentiful labour readily adaptable and lower cost than that of neighbour countries;
b) Excellent handicraft skills and a wide range of handicraft materials giving it a basis of product decorativeness and differentiation;
c) An attractive environment for Foreign Direct Investment (FDI) by furniture companies because of plentiful low cost labour and relatively stable environment both socially and fiscally;
d) The government of Vietnam facilitates incentives for sustainable development of the furniture industry;
e) The Vietnamese worker is flexible and has a striving work ethic that makes the development of a business an exciting and rewarding activity for those entrepreneurs able to invest in enterprise;

f) Vietnam has a growing name as a good destination for investment in furniture production, capable of competing with China with much less exposure to risk;

g) By recently joining the World Trade Organization (WTO), Vietnam has an adequately predictable regulatory environment;

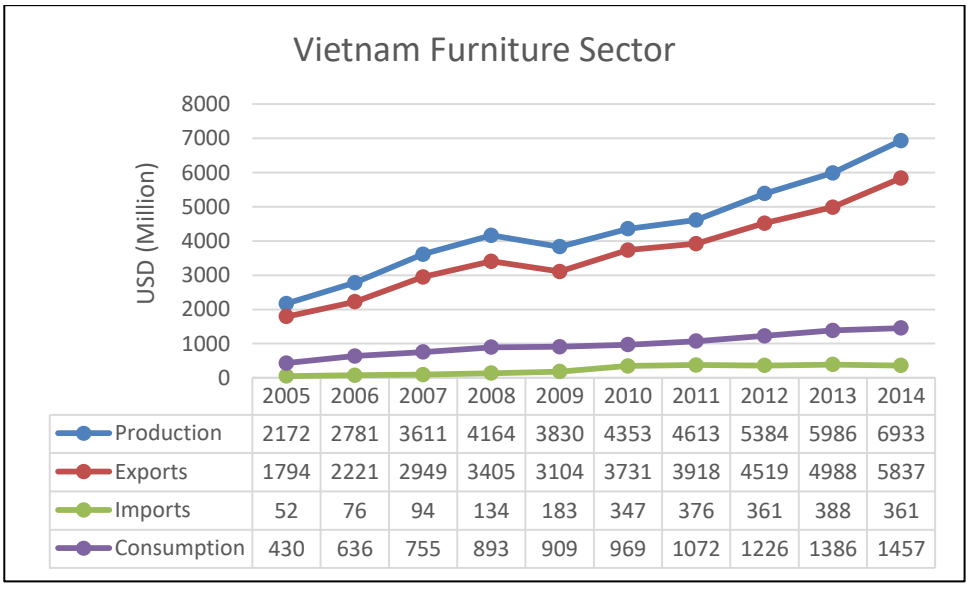
h) Vietnam is the focus of much international development aid and is developing the capacity to effectively absorb the aid;

i) There is a working export-oriented infrastructure in Vietnam successfully minimizing red tape on both necessary import inputs and exported products;

j) With furniture manufacture still a sunrise industry in Southeast Asia, ample space exists in the market place for quality producers supplying well-designed furniture to controlled quality and on time;

k) Vietnam has a long history of stability from the 10th century through to the latter half of the 19th century during which arts and crafts flourished leaving behind a legacy that can now be drawn upon for design and decoration. This was further tempered by the French period which enhanced the already developed arts; and

l) Being a relative newcomer to the market, there is still time for Vietnam to develop a presence in the market through design, quality and business culture.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	2172	2781	3611	4164	3830	4353	4613	5384	5986	6933
Exports	1794	2221	2949	3405	3104	3731	3918	4519	4988	5837
Imports	52	76	94	134	183	347	376	361	388	361
Consumption	430	636	755	893	909	969	1072	1226	1386	1457

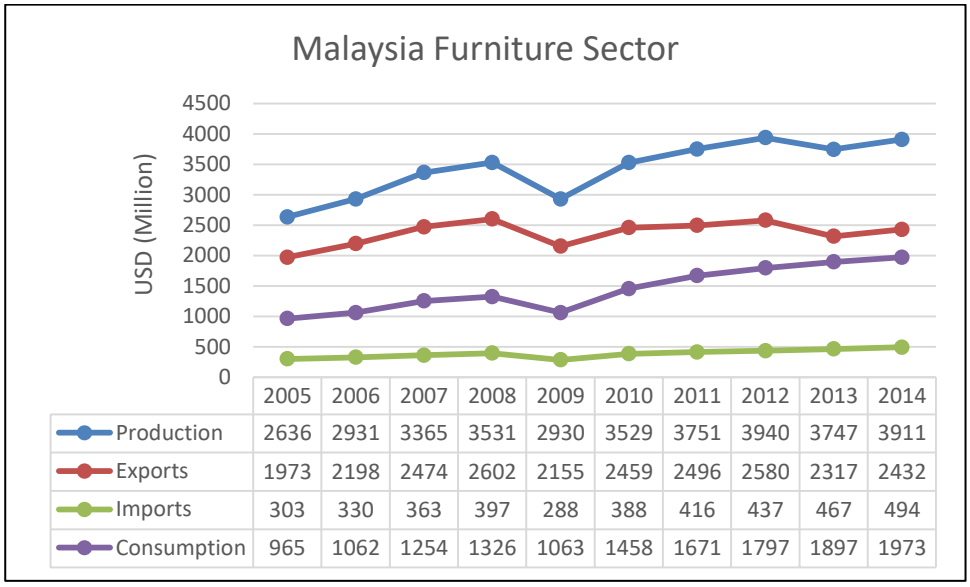
Figure 1.11: The Progress of Vietnam Furniture Sector since 2005. (CSIL, 2015)

1.8 FURNITURE INDUSTRY IN MALAYSIA

The Malaysian Furniture industry is very vibrant and it has obtained its longevity all on its own from a cottage industry into a full-fledged RM 8 Billion (approximately USD 2.4 billion) exporting industry annually. The industry generally started in Muar, Johor and has since flourished into an exporting giant within the Malaysian economic sectors. The industry is also flourishing in Sungai Buloh, Selangor and in Penang. The industry started as early as in the 1980's and has been ranked the number 8 producing country and known as the most reputable producers for manufacturing efficiency. Figure 1.12 showing the progress of the furniture industry in Malaysia. There is a moderate decrease of production and export in 2013 but the industry rose back in 2014.

Almost 30% of Malaysian furniture export was to the United States of America in the year 2013 and 2014 which are valued at RM 2.1 billion and RM 2.3 billion respectively. It is estimated that the world's furniture production was USD 456 billion in the year 2013 and the market share has been increasing from 10 to 15% yearly. The market is huge and the Malaysian furniture industry should take advantage of this.

Malaysian furniture industry has been operating predominantly on an Original Equipment Manufacturer (OEM) model centred on rubberwood furniture. This is because the initial investors in Malaysia were Taiwanese companies, who adopted the OEM model to provide visibility of volume to justify the investment required. Due to the successful model of OEM, the industry has grown tremendously and Malaysian furniture is in great demand.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production	2636	2931	3365	3531	2930	3529	3751	3940	3747	3911
Exports	1973	2198	2474	2602	2155	2459	2496	2580	2317	2432
Imports	303	330	363	397	288	388	416	437	467	494
Consumption	965	1062	1254	1326	1063	1458	1671	1797	1897	1973

Figure 1.12: The Progress of Malaysian Furniture Sector since 2005. (CSIL, 2015)

There have been only a few of the OEM manufacturers who are moving towards an Original Design Manufacturer (ODM) model. Feedback from these manufacturers showed that the additional profit margin obtained through ODM is small compared to the investment made even though the retail prices are high. The retail price is high due to the retailer absorbing transportion cost and volume risk. Furthermore, lack of the right design talent had led to past efforts to move to ODM with a low success rate of approximately 20%. This was due to the lack of understanding of market consumer preferences. The prevalence of sub- contractors in this industry has also made it prone to copying, even with patented products. Malaysian law allows for 5 modifications of an existing design. However the Muar Furniture association indicated that at least 50% of its members of nearly 500 are moving towards Original Design Manufacturing.

Malaysian Furniture industry cannot stay as OEM producers as the rising cost of labour and shortage raw materials are affecting the total cost of production compared to Vietnam whose labour cost and raw materials are more accessible to their manufacturing needs.

1.9 SUMMARY OF WORLD FURNITURE INDUSTRY

Observations of the top furniture manufacturing countries in the high income countries and medium low income countries reveals several important points:-

a) In the high income countries:
    i. Focus is on niche market such as office furniture and kitchen cabinet
    ii. Investment in advances technology machineries and manufacturing system to remain cost effective.
    iii. Investment in neighbouring countries with abundant human and material resources to reduce the production cost as well as reducing the product price.

b) In medium and low income countries:
    i. Diversifying the materials used for furniture such as using more metal than wood.
    ii. Focusing on well-designed furniture and producing high quality furniture.
    iii. Developing an environment which is more conducive with government support and less bureaucracy.

1.10 FURNITURE INDUSTRY INSIGHT OF SCIENCE AND TECHNOLOGY FORESIGHT

In 2015, a study on Emerging Sciences, Engineering and Technology (ESET 2015) was conducted by the Academy of Sciences Malaysia (ASM) (ASM, 2015). One of the objectives of the study is to forecast the possible scenarios of technological changes in specific sectors toward 2050 as well as to look at possible inter areas integration. In the study, five major areas are expected to give a significant technological impact on the world in 2050 which are:

a) Digital technology
b) Green technology
c) Biotechnology
d) Nanotechnology
e) Neurosciences and Neurotechnology

Malaysian is aspiring to become a world class player in digital technology. Several major areas have been identified to become drivers in digital technology namely artificial intelligence algorithm, internet of things, unified communication, content creation, and embedded computer. Malaysia foresees its main role in the development of new algorithm techniques, artificial intelligence communities through internet of things, sensor based communication technology, virtual content for lifelong learning and embedded chips and sensors at nano, pico and femto size. Interventions to advance the current digital technology can be executed through education and training including education facilities, collaboration of educational institution – government- industry, flagship projects under the name technology driver.

The definition of green technology often varies upon countries. Greenness can be measured qualitatively and quantitatively based on indicators such as greenhouse gas emissions, energy efficiency, recycling and waste management. Based on these indicators, the world green technology encompasses related sectors such as energy, transport, waste management, water, industrial, residential and commercial sectors. From these sectors, the possible scenarios of future technology develop towards 2050 is forecasted. The vital importance of the green technology drives from a few push factors such as population, resources, urbanization, energy, climate change, safety, rules and regulations. A major conclusion drawn from the ESET 2015 study is that Malaysia is too dependent on foreign technology, which is increasing the cost of the technology due to patent royalty. As a countermeasure, the government should strengthen the R&D strategy by local universities as well as policies to increase the public awareness and to support local green technology invention.

Towards 2050, Malaysia foresees three areas in Biotechnology in order to evolve into a bio-economy country. The three areas are Biotechology enhancement in agriculture, industrial, and health biotechnology. Table 1.4 shows the paradigm shifts that Malaysia aims to achieve.

Table 1.4: Paradigm Shifts of Malaysian Biotechnology. (ASM, 2015)

Agriculture Biotechnology	Industrial Biotechnology	Health Biotechnology
• From low value / high volume to high value / low volume; • From input-intensive (inputs," such as water and chemicals) to output intensive • From traditional to agroecology and climate – smart agriculture	• Move towards using renewable products and materials – away from petrochemicals • From synthetic to natural • Closed loop manufacturing	• From chemical-based to biotechnology-based drug development • Dual use – from therapy to enhancement (lifestyle drugs) • Acknowledgement that metabolic health is governed in part by microbial genomes (microbiome) that reside on us and in us. This opens up opportunities for new therapies and techniques for maintaining health

Nanotechnology is still considered as a new research area. Few issues concerning the standardization, regulations and safety due to most of the breakthrough are still classified as on-going research. However the trend of investing in this particular area is continuously increasing in line with the strong push factors in areas such as aerospace, defence, automotive, information technology, energy, medical, pharmaceuticals, chemical, advanced materials, agriculture and food. In order to venture into this advanced area, a huge effort is needed on human capacity development as well as coordination of resources to minimize the cost.

Neuroscience on the other hand is a scientific study of the human brain and nervous system. The adoption of neurotechnology in Malaysia has largely been focused in the healthcare sector, primarily on rehabilitation purposes only. Although the global standard set a high pace, Malaysia is still very much behind when it comes to neuro technology. Basically, there are clear gaps in the human capacity development, institutional capacity and non-specific funding opportunities for neuroscience to grow in future.

1.10.1 Toward Green Technology for Future Furniture Manufacturing

Growing public awareness and increasing government interest in the environment have induced many companies to adopt programmes aimed at improving the environmental performance of their operations. The implementation of green manufacturing will result in a series of changes and innovations of the manufacturing industry in the 21st century,

which include the changes of pursuing goals mainly on economic benefits to achieving a balance between economic, environmental and social benefits. Consequently there will be a change of the decision making attributes from the three (Time, Quality, Cost) to the five (Time, Quality, Cost, Environmental impact and Resource consumption) as shown in figure 1.13.

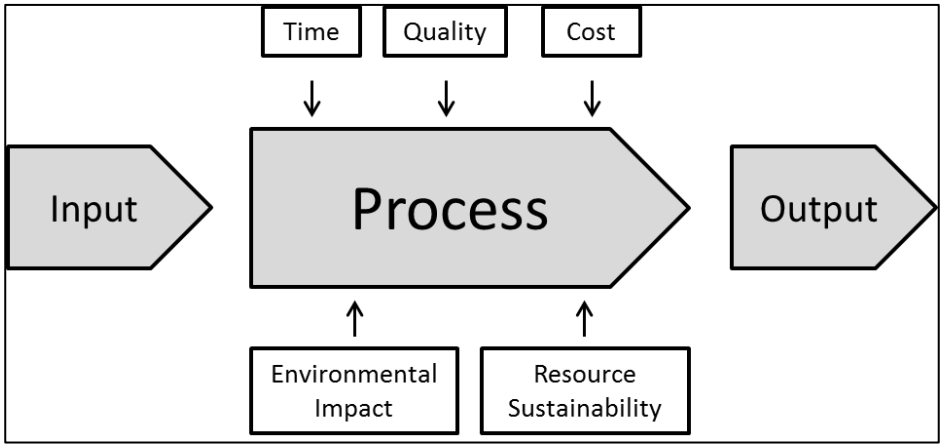


Figure 1.13: Decision making attributes for Green Manufacturing Process.

Making the same product using fewer resources and/or energy is a good strategy to make money. In other words, being efficient through preventing waste will improve both ecological and economic performance of the company. Thus management should acknowledge that the cost of green manufacturing initiatives will be paid by the money saved in a more efficient system which in turn will positively impact the return of investment (ROI). In manufacturing there are a lot of wastes that can be eliminated in the process as well as the product. Green manufacturing strategy to reduce wastes is outlined in figure 1.14.

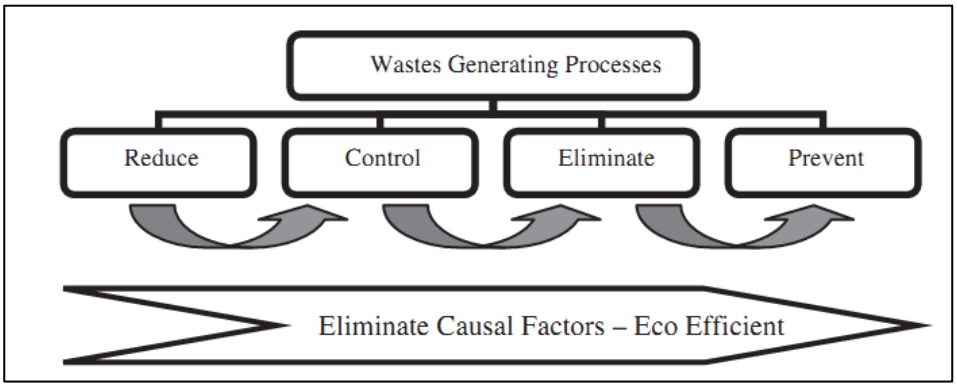


Figure 1.14: Green Manufacturing Strategies to Eliminate Waste.

1.10.2 Raw Materials

The furniture industry is currently facing problems such as low quality rubber-wood due to rubber tapping activities, long maturity time (7 years for *kelampayan*, 12 years for acacia, 20 years for rubber-wood), and illegal logging. Advanced biotechnology and genetic modification will spearhead a new breed of hardwood timber plant with less than 3 years maturity time (Furniture Workshops, 2015). This three years harvesting cycle will allow better plantation control in terms of land use or pest. This faster timber plant maturing time will make hardwood timber plantation much more attractive than current timber plantation in terms of return of investment (ROI). Faster ROI for timber plantation will shift logging activities toward timber plantation rather than natural forest.

On the other hand, non-wood based material will become ubiquitous with the advancement of 3D scanning and additive manufacturing technology. In future, furniture design can be downloaded through the internet and customized to suit individual customer. The furniture can then be 3D printed by the user or any additive manufacturing services company. Thus, it is imperative for Malaysian furniture companies to start investing in original design furniture.

1.10.3 Design

In terms of furniture design, the advancement of digital technology through ubiquitous internet of thing devices, virtual/physical studios, fully body stimulation and green technology through optimum energy consumption, carbon capture, and storage may become more significant. The furniture design of the future will be mass customised and respond quickly to changes in customer demands. This will require the use of technology such as virtual reality where customers will buy the experience of a living space rather than just individual furniture. Customers awareness of the environment in the future may be heightened requiring 100% sustainable material (sustainable wood, cork, flax, or hemp fibreboard) in the furniture. The advancement of nanotechnology especially in the electronics front may see future furniture design to be embedded with thousands of nano-sized sensors to monitor the user well-being and preferences.

In the future, furniture will be sold through the internet with the help of digital technology and additive manufacturing technology. Furniture manufacturers may transform themselves into living space designers selling living space experiences and limited to very high end furniture for high end customers only as the general population will be able to buy a furniture design and have the furniture made at an additive manufacturing services company.

1.10.4 Furniture Product

Moving towards 2050 there is likely to be changes in the trend of product ownership, moving away from the traditional purchasing ownership to manufacturer leasing in many products including furniture, as a means to improve product end of life produce responsibility, which is a sustainability regulatory trend in many markets such as the US and EU. This would likely see more leasing based business approaches such as Product Service System (PSS) being implemented in the furniture industry. Also there is a growing trend on using materials that have been recovered from used furniture as input materials for furniture or other products. Thus it would be critical for the furniture manufacturing supply chain to consider many of the necessary requirements to these new business approaches in their products and components such as the capability for refurbishing, remanufacturing and recycling. The furniture supply chain infrastructure and business systems are also required to be adaptive to these new approaches. Evidence from the workshops shows there are internal recycling practices for reducing cost and overcoming materials scarcity.

1.10.5 Business

The decision of buying is highly influenced by factors such as culture, social, psychological and personal factors, habits, values and preferences of consumers. These factors should be taken into account in the design of furniture. However, price policies and strategies, communication and distribution may yield significant influence.

With the vast growth of digital technologies such as internet, emerging new trends are seen in the furniture retail landscape, particularly among younger consumers, and opening up new channels distribution. Consumers can shop, order and arrange for

delivery of furniture online. They don't have to travel around town, visiting furniture showrooms and comparing options. The online furniture store is giving advantage to both consumers and furniture companies. While in a physical store, interactive consumer information kiosks are another application of information-processing technology. Store are self-standing structures that often include a computer and touch screen for capturing and displaying the 3 dimensional model of products and information as well as in some cases, processing orders.

1.10.6 Technology

Over the past decades digital and networked technologies have altered the way we live, work, access knowledge, meet and get to know each other. Advance technology have make us empowered, motivated and active, rather than mindless consumer of information and entertainment. The widespread use of robots, automation process, 3D printing and other technology has rendered obsolete many traditional human roles. Advanced 3D printers are available locally on site to manufacture everything from household furniture to personal transportation. It can even produce replacement parts for the building itself.

The technology of developed countries has always impressed the nation worldwide. For example, Germany's furniture industry produces the very best kitchen furniture. The innovative and ergonomic kitchen features such as soft close drawers, space optimising carousel units, and embedded with up to date technological application in the furniture. Besides, the technology used in furniture manufacturing in Germany was started 50 years ago by KOCH in gluing and dowel insertion technology. Lean manufacturing has been implemented significantly in Germany furniture manufacturing such as The HOMAG Group, KOCH, Hacker Kitchens and many more. Germany also produces high technological furniture machineries to be exported worldwide.

Research institutes also have started to design future furniture prototype since the past decades by performing foresight investigation. Active life, household occupants, age level per household, population behaviour, working behaviour, and safety are among the main features to be considered in furniture design. Futurologist expects home of the future to be integrated with high technology to ease daily activities.

For instance, Care Home of the Future is one of the projects of Living Tomorrow in Brussels showing prototypes of future furniture. The innovations of Living Tomorrow are vision of home living in 2030. Care Home of the Future is focused on environmental awareness and sustainability with specific topics such as:

a) Service and quality of care
b) Technology, communications and automation
c) Safety
d) Energy
e) Environment and garden
f) Food
g) Relaxation, health and wellness
h) Media, education and information
i) Arts & Leisure
j) Construction and architecture
k) Design and layout
l) Mobility

Tangible Media Group led by Professor Hiroshi Ishii in Massachusetts Institute of Technology Media Laboratory (MIT Media Lab) had the idea to transform still furniture into a dynamic machine driven by movements above the surface. Another development is TRANSFORM; a table that is embedded with sensor technology that has the capability to change its shape depending on the kinetic energy of a person (Brownlee, 2014). Figure 1.15 displays the "Amazing in Motion" concept by TRANSFORM.

On top of that, another shape shifting sofa in combination of surrounding air cleaning features were introduced by Agata Hoffa in Electrolux Design Lab 2013 competition (Hoffa, 2013). Electrolux Design Lab is a yearly competition to challenge undergraduates and graduate design students worldwide in innovating future household. The competition was established since 2003 and continuously receives innovative ideas. There were several incredible innovations related to furniture product throughout the competitions as listed below:

a) Self-assembling furniture using smart foam technology
b) Technological baby cot which optimising sleeping habit
c) Closet with self-cleaning facilities
d) Modular kitchen shelves with flexible modes of cooking, refrigeration, air conditioning, lighting, and environmental design.

e) Ergonomic secret drawer to encourage children to prepare own meal while educating them about ingredients, healthy diet, safety during cooking.

f) Kitchen cabinet for future classroom that highlights kitchen as the central element to teach and inspire children in healthy lifestyles. The kitchen cabinet comprise aquaponics system, cooking area, and interactive surface.

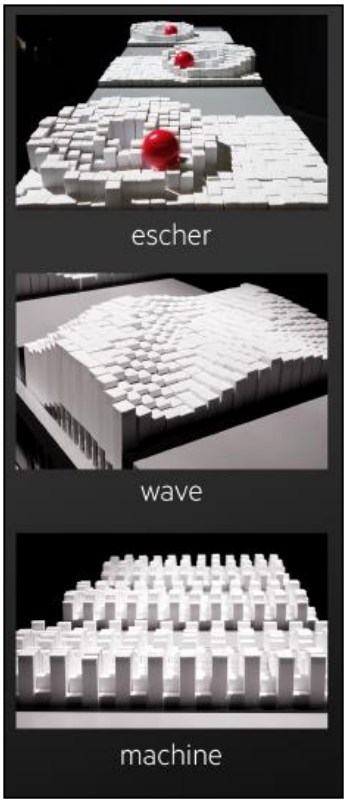


Figure 1.15: The Technological Dynamic Pins that Comprise Three Dynamic Shape Displays. (Ishii et al., 2014)

1.10.6.1 Digital Fabrication

There have been many explorations into digital fabrication in the world of furniture design prototyping in recent years; from 3D printing to laser cutting. Digital fabrication has the potential of overcoming all the issues in current manufacturing processes, allowing quick, interactive and seamlessly integrated manufacturing, while open platform software and hardware will allow new sharing and knowledge opportunities. Figure 1.16 shows a 3D printed table made by NOWLab Germany.

Figure 1.16: A 3D Printed Table Made by NOWLab Germany. (www.nowlab.de)

1.10.6.2 Smart Material

The increasing world population will increase the demand for furniture and other wood-based products, with the consequence of increasing amount of deforestation. In order to sustain the competitiveness in the world market, Malaysian furniture industry should work closely with suppliers of new materials and new technologies. There are a variety of new bio-composites as furniture material such as oil palm biomass, wood waste, coconut husks, banana stems, rice straw and many more. For example the Fraunhofer Research Institute for Wood Research has developed natural fibre plastic or wood plastic composite (WPC) with low flammability characteristic as an alternative to natural wood composites (Simone Peist, 2015). Figure 1.17 shows a chair made from oil palm biomass.

Figure 1.17: Chair Made from Oil Palm Biomass.
(http://oilpalmproducts.com/index_files/PalmFurniture.htm)

1.10.6.3 The Transition from OEM to ODM

The global demand for furniture is strong despite numerous economic downturns. Malaysia furniture industry continues to grow due to original design that adds aesthetic value and a good work ethic. However, this phenomenon will be temporary because others competitors such as China and Vietnam is moving forward and improving in this sector. The way forward is to shift away from the strategy of original equipment manufacturing (OEM) towards original design manufacturing (ODM) and ultimately to original brand manufacturing (OBM).

This is acknowledged by Ms. Patrizia Torelli, the Chief Executive Officer of Australian Furniture Association in her seminar entitled 'Australia: Brand, Design and Opportunities' during Export Furniture Exhibition (EFE 2016) in March 2016. In addition, designers should shift from designing a single furniture concept to designing furniture that adds to a pleasing experience in using a space.

Furniture can be made effectively if the designer has experience of the method and processing technique from design to finished product. This will result with a higher quality product in terms of design and meeting the order due date.

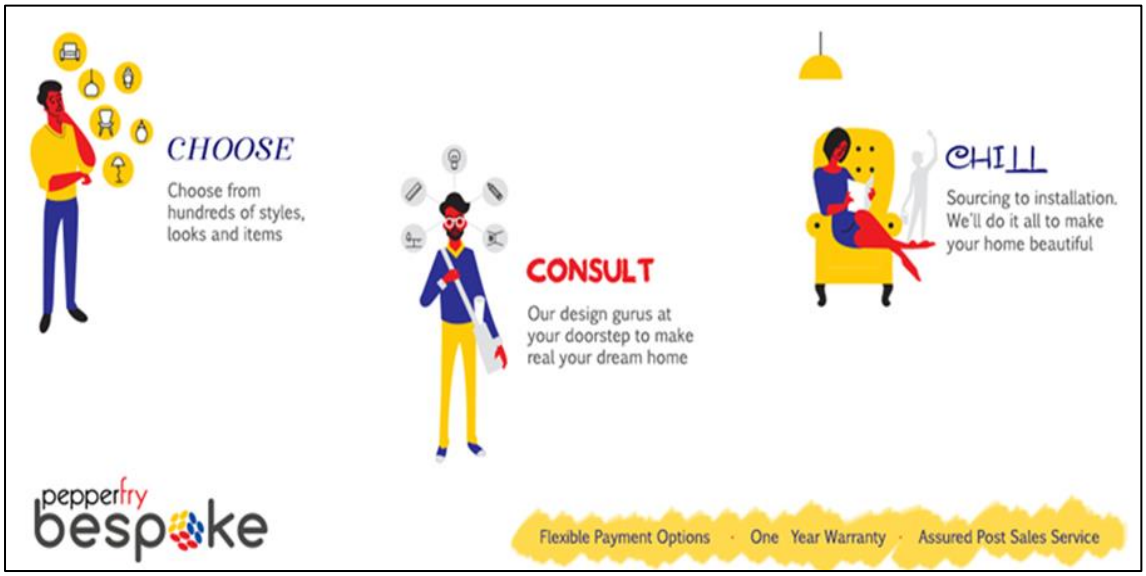


Figure 1.18: Pepperfry Bespoke that Offers Design Consultant for Space Customization. (http://www.pepperfry.com/bespoke-furniture.html)

Buying single furniture would no longer be relevant in the future. Instead, the consumer will buy the experience of designers. As designed furniture requires function and is driven by an objective, the finished product may be able to bring comfort, and gratification towards consumer.

Currently there are few stores that offer design of the living space. For example, Pepperfry.com in India offers design of the interior living space as illustrated in figure 1.18. This concept required an array of workers such as designers, consultants, craftsmanship, and business acumen.

1.10.7 Internet of Things (IoT)

The internet of the future will give rise to a new business model that allows enterprises to form business networks. The digital penetration has given rise to things and their interactions through the internet of people and the internet of things. Networking is expanding not only in person-to-person interaction, but also in person-to-machine and machine-to-machine interactions.

Since last year, Germany is pushing for Industry 4.0 (or Industrie 4.0) while a decade ago German Artificial Intelligence Research Centre (DFKID) had developed the internet of things (IoT) for manufacturing (Temperton, 2015). Industry 4.0 or the fourth industrial revolution in manufacturing is about a comprehensive strategy for automating

factories, embracing organizational structure, data, product development, logistics and human resources as described by George Frey, the President of Lignum Consulting Inc (Woodworking Network ALMANAC, 2015). The advent of IoT in the manufacturing industry will have a significant impact on the Germany furniture manufacturing industry and subsequently on the world furniture industry.

1.10.7.1 Smart Furniture

The human need for furniture has evolved from its basic function to a more advanced multifunctional function. In line with the vast growth of digital technology, electronics devices and sensors will change the function of the future furniture. New emerging trend in furniture design is the incorporation of electronics devices as added features on furniture. For example, built-in massage mechanism is embedded into sofa set, furniture with a capability of remembering personalize setting and position, embedded sensors in furniture for monitoring blood pressure, heart rate, breathing, weight, body temperature, sleep quality and other physiological indexes, (Figure 1.19), and embedded sensors for monitoring postural position chairs. These types of innovation will shape the growth of the industry with furniture that appeal to the digital generation. Such furniture is often integrated with electronics devices to improve the furniture function as well as adding value to the furniture features.

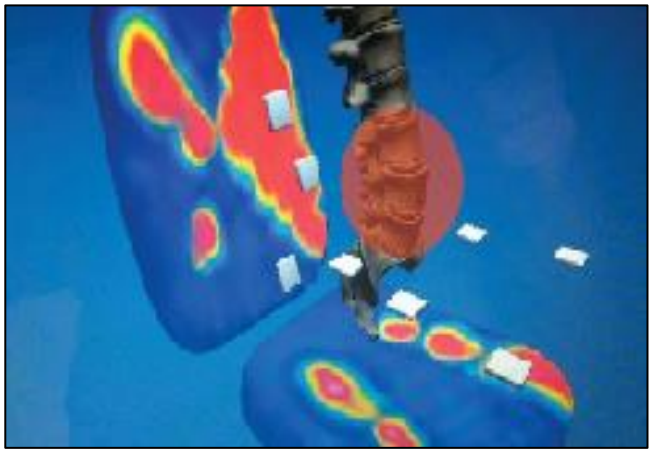


Figure 1.19: Spinal Posture Chair.
(http://www.smh.com.au/digital-life/digital-life-news/sore-back-this-australian-smart-office-chair-could-soon-fix-that-20150615-gho2hp.html)

1.10.7.2 Information and Communication Technology (ICT)

Based on current trend, ICT will play an important role in allowing consumers to give feedback through product review forums or social media groups. People all over the world are able to rate and give feedback to the manufacturer/designer regarding their product. Besides feedback, the system will present business opportunities gained from greater insight into user demand and co-create products with users. Users will find themselves more empowered by communicating their interests and expectations for future product development and improvement. Figure 1.20 shows possibility of remote monitoring for elderly through smart phones. Advancement of the ICT will allow data obtained by the smart furniture be made available to medical professionals to aid in the early detection of possible health issues.

Figure 1.20: Remote Monitoring Using Smart Phones.
(http://www.dailymail.co.uk/sciencetech/article-3068832/High-tech-sensors-help-kids-eye-aging-parents.html)

1.11 SUMMARY

In this chapter, we have presented an overview of the global furniture industry in which the world furniture trade was seen to be increasing for the past decade. This overview has also highlighted that Vietnam had surpassed Malaysia in the world ranking of furniture exporters in 2009 and has continued rising to fifth place in 2014. Observations of the furniture industry in two countries from high-income countries and three countries from middle- and low-income countries had revealed salient features for the Malaysian furniture industry to consider.

Subsequently, the impact of Emerging Science, Engineering and Technology Foresight output namely digital technology, biotechnology, neurotechnology, green technology and nanotechnology on the Malaysian furniture industry was examined with potential new species of wood tree for furniture use, marketing through internet, internet of things in the furniture, less waste produce in furniture manufacturing company and automated manufacturing system being adopted in furniture factory. It is concluded that the Malaysian furniture industry will be significantly affected in the following areas specifically furniture manufacturing practices, furniture raw materials, furniture design, furniture product, furniture business, furniture-making technology and the pervasiveness of Internet of Things.

In the next chapter, we will look at how the economy and finance, social and culture, and geopolitics in 2050 may affect the future of the Malaysian furniture industry.

CHAPTER TWO
OVERVIEW OF INDUSTRY SECTOR VIS-À-VIS FORESIGHT 2050

2.1 GENERAL BACKGROUND

The world in 2050 will be a world of contrasts and paradoxes. On the one hand, science and technology have continued to advance in response to emerging crises, challenges and opportunities. This scenario has created radical transformation in genetics, nanotechnology, biotechnology and related fields. These technologies would be disruptive and led to frightening, unpredictable and chaotic world than ever before. Humanity then would be at a crossroad in determining its future path for centuries to come.

Envisioning Malaysia 2050 focuses on other aspects that affect Malaysian as a nation. Apart from advancement of science and technology, economy and finance, social and culture, and geopolitics are the other focuses of Malaysia 2050 Project, beyond the 2020 vision of Malaysia. Figure 2.1 shows the overview of 'Envisioning Malaysia in 2050' Foresight Initiative Report.

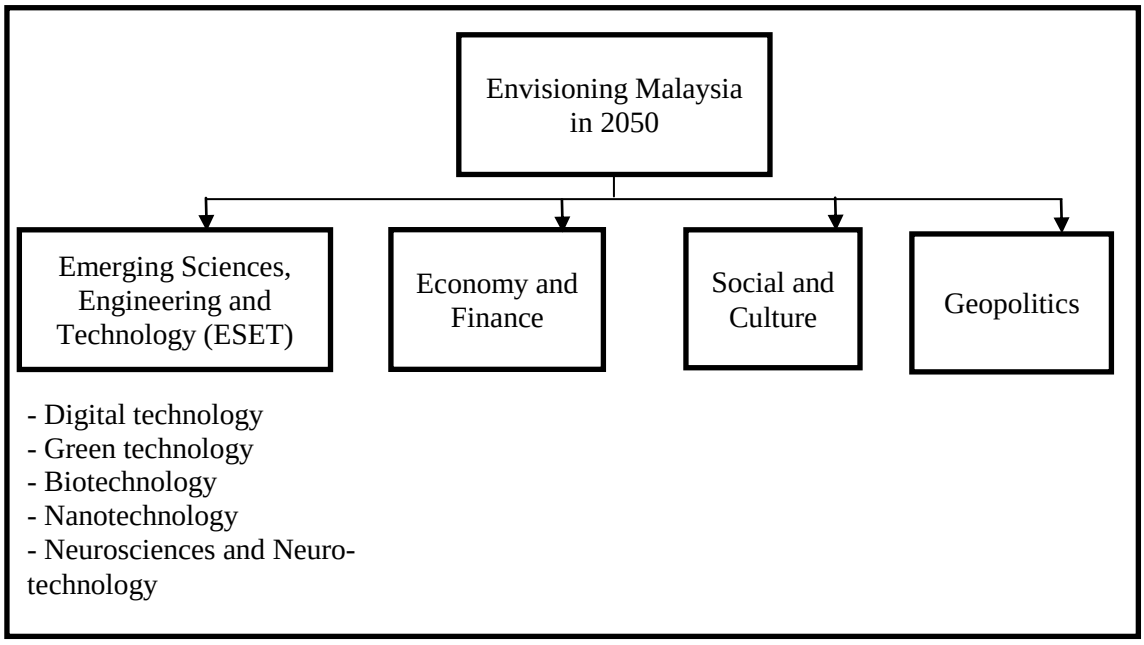


Figure 2.1: The Envisioning of Malaysia in 2050 Foresight Initiative. (ASM, 2015)

In terms of economy growth Malaysia has always been dependent on industrial, agriculture, and services sectors. Expanding these sectors will propel Malaysian economy to catch up with the Japanese economy in 2050. However, a massive catch up effort must be made over the period of 2020-2030 to be able to reach the Japanese 2010 per capita income in 2030. Several strategies were outlined by Foresight Malaysia 2050 Economy and Finance report. Among the strategies highlighted are quantitative build up in R&D expenditure, full time equivalent researchers, and scientific publication. This in turn will shift Malaysian growth from manufacturing based to knowledge based services as well as forming high value adding industries especially in high technology downstream industries. This catch up model requires in tandem a development of a financial system that would be able to efficiently mobilize national and world savings in order to fund the required investment for economic growth, investment and social expenditure to assure the prosperity, health and social well-being of Malaysian people. In 2050, Malaysian financial sectors should involve more financial instrument and financial technology, better financing for SMEs, better corporate finance, proliferation of innovative financial products, regulatory landscape in line of the growth of new technology, closing the urban rural gap.

Malaysia's social and culture mix has always celebrated its unity in diversity. In 2050, Malaysian aspires to adopt a knowledgeable society especially with the advancement of digital technology. Advancement of digital technology will shape the society and culture in Malaysia with more community centred development. This development means Malaysian in future will only socialize only in their own diverse small community as everything can be executed from home. Several major areas have been identified to become drivers in this type of society and culture namely education, ageing population, workplace related pathologies, social media, financial status, infrastructure, urbanization, politics and values. Malaysia, through foresighting exercises, are adopting strategies focusing toward building the society through accountable governance, elevating the citizen well-being, talent investment, flourishing sustainable, creative and green environment, and development of holistic care for Malaysian mental wellness.

Five megatrends for world geopolitics have been identified namely demographic and social patterns, shift in power, climate change and resource scarcity, technological innovation, and urbanization. However, Malaysia's unique challenges lie in its diversity,

both culturally and naturally. These challenges are a major hindrance toward a more equitable, united and environmentally sustainable state. Although diverse in ethnicity, common values do exists among the Malaysian ethnics. These values can be collectively called “Eastern Culture” or “Asian Values”. Externally, Malaysia also faces challenges to its common values. On one hand, the moderation of “Asian Values” can be seen as regressive or inflexible in adapting to new challenges in the view of Western Weltanschauung amid globalization. On the other hand, the strength of “Asian values” can be capitalized as a modern miracle in bringing peace and prosperity while maintaining relationships in a harmonious way in achieving a common goal. A right blend of values between absorbing the strength of Western values and preserving some of the traditional strengths of Asian values seems to be a moderate way of Malaysia. The following events have been identified as drivers that will influence Malaysia’s development trajectory as it moves through the forthcoming three decades:

a) *Environmental and Energy Security* - Malaysia secures strategic national resource such as energy, water and land to drive its economy against the escalation of sustainability challenges in the region.
b) *War and Peace* - Malaysia marches towards a prosperous and harmonious nation when war and conflicts turn obsolete.
c) *International Trade* - Fair and just international trade system work to the benefit of Malaysia.
d) *Nation State, Society, and Nationalism* - National and social integration initiatives are mainstreamed and accepted by all in Malaysia.
e) *Poverty and Development* - Malaysia is successful in addressing the growing inequality among the states and her peoples.
f) *Global Order and Multipolarity*- Malaysia appropriately positioned itself in the changing global order as an influential middle power.

A transformed Malaysian furniture industry where the industry utilizes advanced science and technology in their day to day operation from green manufacturing practices, raw material, furniture design, furniture products, to business can be achieved with the advancement of the several technologies of the future. The future technologies in biotechnology, digital technology, internet technology and green technology will

primarily influence the furniture making process into high profitable, sustainable and technology driven industry.

However, changes in national income and spending pattern, population, health system, urbanization, emerging technology, internet of things, world climate, and geopolitics in 2050 may also affect the demand of furniture product and design, requirement of raw materials, and the furniture business.

2.2 NATIONAL INCOMES AND SPENDING PATTERN

Year 2050 is chosen by many government sectors and private agencies as a new future benchmark to be looked forward in terms of technology, lifestyle, and economics. Foresighting 2050 is appropriate to indicate the longevity of nation and its attributes. At a macro level, Ward & Neumann (2012) in a HSBC report predicted many emerging countries would be expected to rise at a fast pace approaching 2050 as shown in figure 2.2. China, Mexico, Turkey, Russia, Argentina, Malaysia, Saudi Arabia, Poland, and Peru, for instance will be transformed from being low to middle countries to high-income countries.

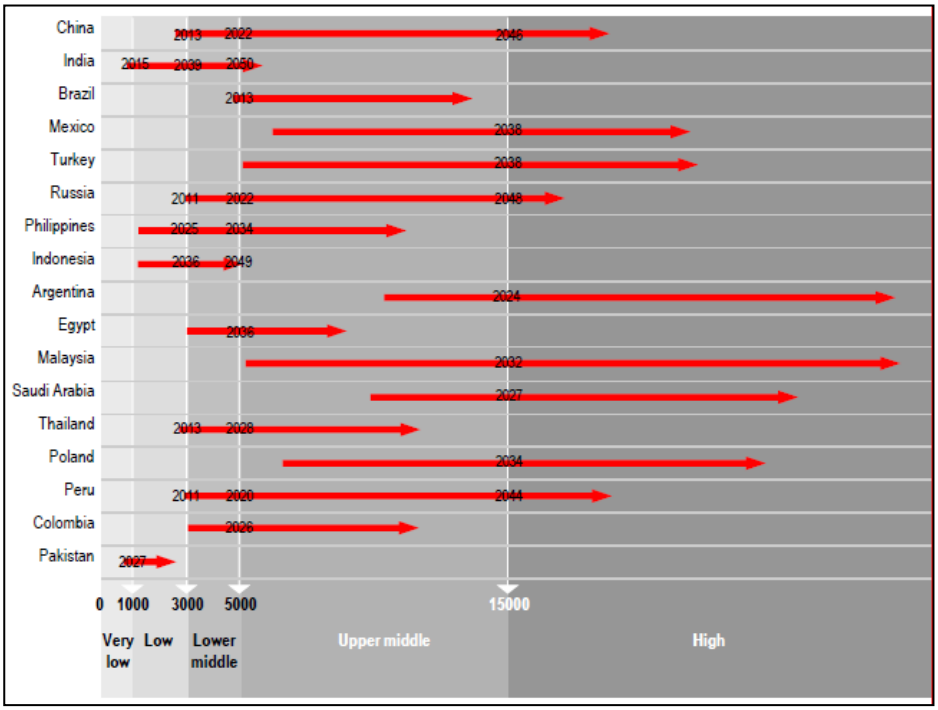


Figure 2.2: Expected Real Income Per Capita at a Constant USD currency in Year 2000. (Ward & Neumann, 2012)

This progressive economy scenario may change spending habit among the peoples in daily lives. The spending habits change is being weighed by using the information from the consumer surveys that are used to construct Consumer Price Index (CPI) baskets around the world. Ward & Neumann (2012) summarized that people spent on 15 major things in a month, for example:

a) food
b) non-alcoholic beverages
c) alcohol and tobacco
d) clothing and footwear
e) housing,
f) water
g) fuels
h) furnishing and household maintenance
i) health
j) transport
k) communication
l) recreation and culture
m) education
n) restaurants and hotels
o) any other miscellaneous things.

Table 2.1: The Percentage of the Peoples Spending Patterns in according to Income Level. (Ward & Neumann, 2012)

	INCOME LEVEL				
	Very Low	Low	Lower Middle	Upper Middle	High
	x < USD 1000	USD 1000 < x < 3000	USD 3000 < x < 5000	USD 5000 < x < 15000	x > USD 15000
Furnishings and Household Maintenance of which;	5.9%	4.8%	5.2%	5.5%	5.7%
Furniture and Furnishings	0.5%	1.2%	1.8%	1.6%	2.0%
Household Textiles	1.1%	0.2%	0.3%	0.5%	0.5%
Household Appliances	0.8%	1.2%	0.7%	1.0%	0.9%
Glassware, Tableware, and Utensils	0.8%	0.3%	0.2%	0.4%	0.5%
Tools and Equipment for Home	0.8%	0.3%	0.3%	0.2%	0.4%
Household Maintenance	1.8%	1.6%	2.0%	1.7%	1.4%

The HSBC report predicted that people would possibly spend around 4.8% to 5.9% of household total income for furnishing and household maintenance depending on the income level. Table 2.1 tabulates plots of the change in peoples spending

behaviour spesifically in furniture and household maintenance as income levels increase. The data collates CPI basket information for 50 countries and groups them according to income level in order to establish a ‘standard’ consumer spending for each income level

2.3 POPULATION

The population of the world will increase fast and consistently with limited unrecyclable natural sources. There has already been devastation of the environment in order to meet the needs of the increasing population. More people than ever before are choosing to live and work alone, whilst the number of children per couple has also declined.

2.3.1 Ageing Population

As depicted in figure 2.3, people aged 65 and above will account for about 11 % of the total global population (United Nations, 2013) by 2020. Each month, around 1.9 million people in the world will join the ranks of the over 65s. By 2050, the population is expected to rise close to 10 billion whilst the people aged above 65 years old will increase nearly to 2 billion.

Senior citizens no longer would be seen as burden to the nation. In fact, Japan is now facing a situation where there are more senior citizens than young people (Schlesinger and Martin, 2015). Even though automation is able to replace human workers however the elderly is encouraged to work to fill the void of labour shortage. Schlesinger and Martin (2015) suggested that senior citizens may do such unskilled tasks which do not require much movement.

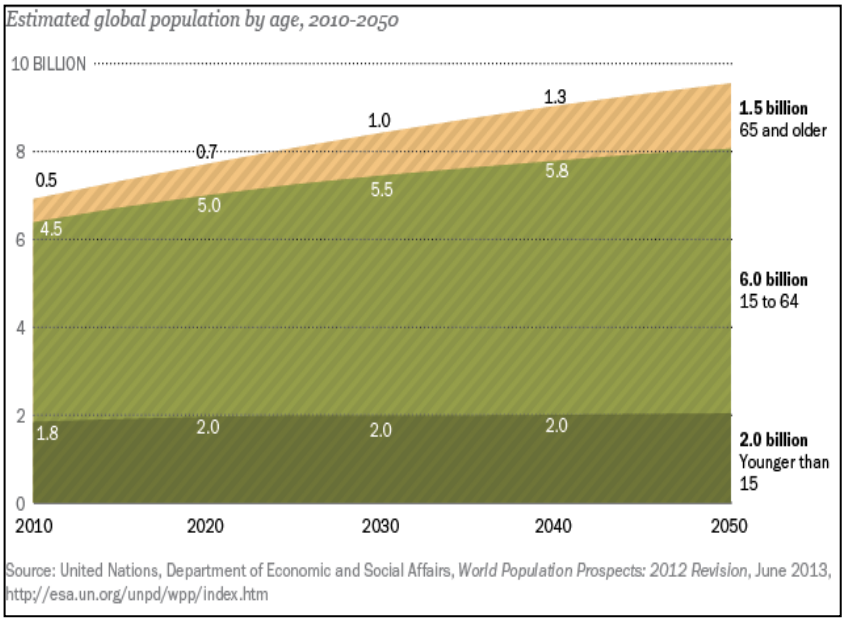


Figure 2.3 The Population Tabulation. (Kochhar, 2014)

These senior citizens may seek goods and services that will enable them to maintain independent and integrated lives. Meeting their needs will have an impact on all aspect of societal and economic well-being. Specialized products and services will be developed to enable people with high-dependency needs, especially for those with reduced mobility and severe illnesses, to live with dignity. There will be significant opportunities for inclusive design, for instance, solution to create a supportive environment of building products in example; furniture with IT features. Furniture will be smarter with the integration of computer-based applications and services. Specially designed online platform will allow older people to communicate, obtain health treatments, shop and manage their finances.

2.4 HEALTH SYSTEM

The rise of ageing population with longer life expectancy as mentioned in Section 2.21 shows that nations have world-class health support system facilities. For instance, more than half of Japanese men are still working at the age of 65 to 69 years old (Schlesinger and Martin, 2015). Some of their men are not in good health requiring robotic support system to be attached to the body to support their motion and movement (Figure 2.4). Even though the robotic support system currently is still at its experimental phase, however the scenario is expected to be widespread in the future.

Figure 2.4: Bendable Exoskeleton that Helps Older Worker to Carry Heavy Loads. (Schlesinger & Martin, 2015)

Figure 2.3 also predict the increasing rate of working age people (15 to 64 years old) up to 6 billion in 2050. It is known that the working environment can lead to a stressful condition resulting in some common illness. The increase in number of working age people results in more occupational and work-related diseases.

2.4.1 Occupational and Work-related Disease

A tense workplace may give rise to stress and depression which in turn may lead to dysfunctional behaviour, psychological problems, heart diseases, disorders in digestive

system, increased in blood pressure, and psychiatric disorders (Yusoff et al., 2016). The design of workplace furniture should have the capability of reducing stress apart from ergonomics and safety considerations.

Thus, designers no longer should focus on single furniture design but instead on the design of the whole office space to mimic home serenity. Figure 2.5 shows a typical office layout compared to an office with home serenity concept. Home serenity office concept may help to decrease non-work related stresses and depression in an office although in future, working from home may become a common practice. However, in some perspective, working from home is bad for morale, missing the esprit de corps of the office, and having no sense of purpose once separated from the corporate tribe.

Figure 2.5: Typical Office Layout (left) vs. Office with Home Serenity Concept (right). (https://en.wikipedia.org/wiki/Cubicle#/media/File:CubeSpace.jpg http://www.smh.com.au/good-weekend/homey-offices--the-workplaces-of-the-future-20141016-11752b.html)

2.5 URBANIZATION

The world is rapidly becoming urbanized with significant changes in our living standards, lifestyle, social behaviour and health. The United Nation (2014) predicted the world's population living in urban areas is expected to reach 66% by 2050. 90% of the increment is expected to be concentrated in Asia and Africa. Figure 2.6 projects that the majority of the world's population moving to the urban areas may rise up to 7 billion in 2050.

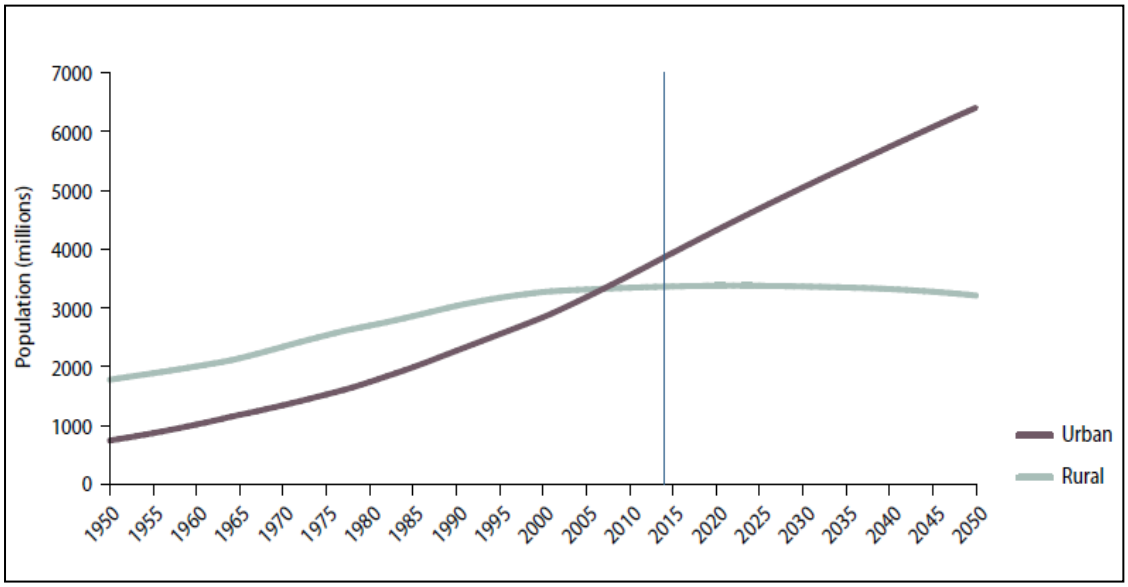


Figure 2.6: Urban and Rural Population of the World, 1950–2050 (United Nation, 2014)

Across the world, the effect of urbanization is making a huge impact on real estate and on retailer, developer and investor strategies. International retailers are likely to increase focus on the major city markets where there are greater opportunities.

2.5.1 Smaller Living Space

Nowadays, people tend to move to metropolises for greater employment opportunities and a more progressive lifestyle. This trend is causing cities to have relatively less available free space and also increases the price of property. People who live in large cities can only afford small apartment or condominium. This scenario provides a good opportunity for the development of transformable space saving furniture

2.5.1.1 Transformable Space Saving Furniture

Transformable space saving furniture is an innovative approach to furniture design that has a huge potential market in metropolises. The design of transformable space saving furniture can vary from traditional beds, tables and chairs. Transformable space saving furniture provides small properties with greater space and multiple functions. The MIT Media Lab research group has developed a new model of urban architecture by using the robotic furniture

approach. An all-in-one disentangled robotic furniture piece makes it possible to live comfortably in a tiny space by not only reconfiguring the space, but also by serving as a platform for technology integration and experience augmentation (Figure 2.7).

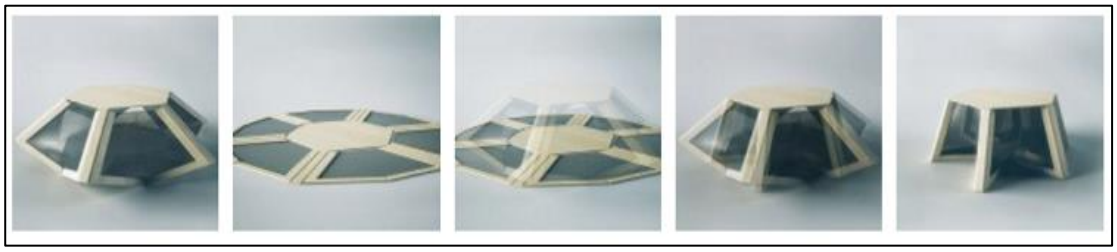


Figure 2.7: Self-Assembling Table (Grozdanic, 2015)

2.5.2 New Furniture in Lifestyle Changes and Eco-Design Trends

The increase in living cost and environmental factors have resulted in smaller, cheaper and more energy-efficient product. The concern for the environment is affecting furniture design. Furniture designs need to be more up to date with technology and environmental element concerns which include impact during production, products' operating life, and its recyclability.

2.5.2.1 Value-added Furniture

As the industry moves into higher value-added product, product developers should encourage creativity and provide foundations to enable manufacturers and designers to collaborate on producing furniture that is locally-made, innovative and well-designed. It should be able to have brand strength and be marketed effectively. The creation of value-added furniture is not about using high quality materials or state-of-the-art technologies, but rather it is about expressing a lifestyle in a creative and innovative manner. For example in the future living lab, Space 10 by Inter IKEA Systems B.V., they are exploring how design can be used to create a healthier, more sustainable future by enlisting the help of bright, innovative designers from around the world (Figure 2.8).

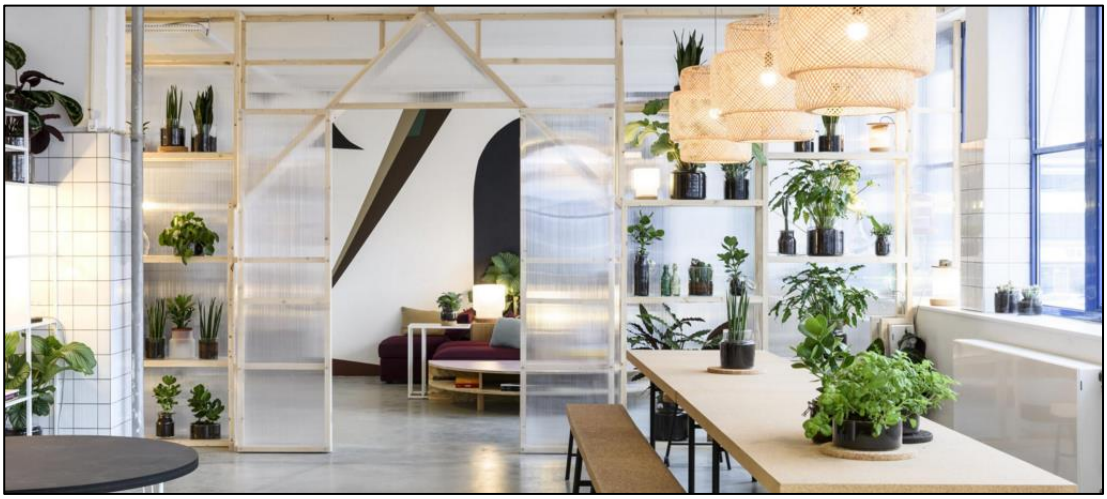


Figure 2.8: Space10 by Inter IKEA Systems B.V. (Inter IKEA Systems B.V., 2016)(ref)

2.6 CLIMATE CHANGE

2.6.1 Eco-System

In the second half of the 21 century, a soaring urban population will pose serious problems for the environment, health and infrastructure of many cities. In newly industrialized nations urban centres may become polluted, overcrowded and chronically inefficient. Environmental and resource degradation will become so obvious and huge. It will trigger a radical rethink of production and consumption by citizens. As such, many modern skyscrapers are now built complete with internalized creation of food, water and other resources.

Environmental problems are mostly caused by people. It affects life existence negatively causing constructional harm that destroys the balance in ecosystem. Furniture designers may play an important role by searching new solutions for furniture design and manufacturing that is eco-friendly.

2.6.2 Sustainability Awareness

In many developed countries, the sustainability aspect of furniture is already an order winner, and certain green aspect a qualifier. Currently many furniture manufacturers in developed countries are paying special attention on the environmental aspect of product

design and manufacture in order to differentiate their products from competitors as well as to enter the emerging markets of green products (Gonzalez-Garcı´a et al., 2012).

In 2050, sustainability in furniture manufacturing would be strictly implemented. The factory must continuously improve in term of engaging renewable energy resources, minimising waste, and being eco-friendly. The Fraunhofer Institute for Wood Research – Wilhelm-Klauditz-Institut (WKI) and the Fraunhofer Institute for Silicate Research have investigated methods to reduce formaldehyde emission that is being used in chipboard panel production (Glasner and Ott, 2013). In the years to come, higher priority will be put on health and safety of furniture factory workers and consumers.

2.7 GEOPOLITICS

Since the 1960s the four Asian Tigers namely South Korea, Taiwan, Hong Kong and Singapore have achieved sustained and rapid growth and high levels of equal income distribution in their economy. These nations were seen as new political powers in Asia with enormous new markets for investors. BRICS whose members consist of Brazil, Russia, India, China and South Africa are experiencing fast growing economy in this era. There is a sharp rise in their global competitiveness and the prosperity of their populations and an equally sharp rise in their geopolitical status.

A survey conducted by Post-Crisis World Institute (2013) had summarized 14 attributes to measure the geopolitical leadership among countries as presented in figure 2.9. Based on the survey of visions towards 2050, 303 experts from 63 countries had concluded that enhancement of technology and education systems are the most important attributes to gain geopolitical strength. Therefore it is worth mentioning that these two attributes are essential in improving the manufacturing sector in a country including furniture industry.

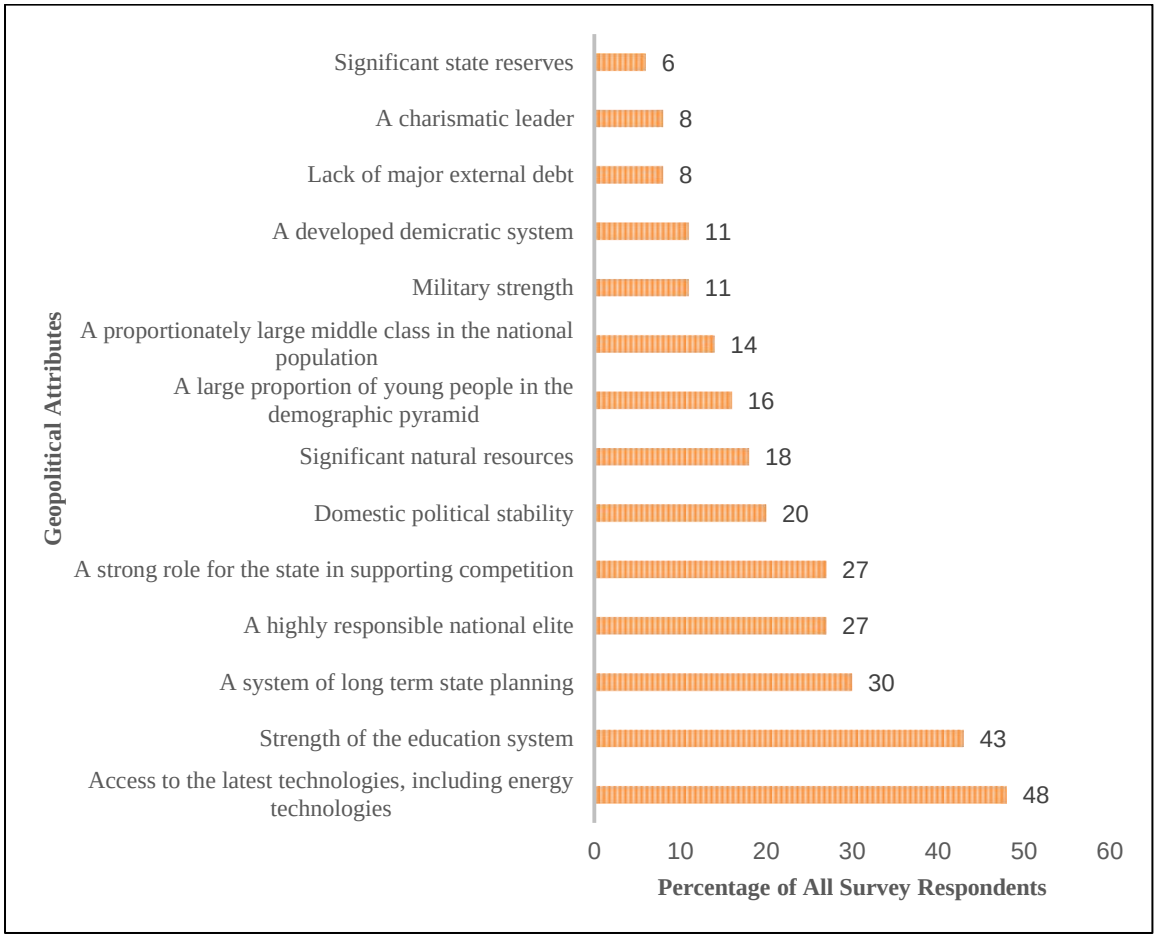


Figure 2.9: Competitive Advantages of States in the Period of Transition 2013 – 2050.

(Post-Crisis World Institute, 2013)

Malaysia, have implemented six free trade agreements (FTA) through ASEAN, seven bilateral FTAs as of December 2015, and signed the Trans-Pacific Partnership Agreement in February 2016. These agreements will allow Malaysian products to be marketed to more than 20 countries with little bureaucracy. These trade agreements give the opportunity for Malaysia's furniture industry to foster synergic cooperation with five of the top ten countries in world furniture export namely China (ASEAN-FTA), Vietnam (ASEAN, TPPA), United States (TPPA), Mexico (TPPA), and Canada (TPPA).

Malaysia, with these free trade agreements, can leverage on aesthetics furniture designs in favour of Chinese highly specialized wood working machineries and Vietnamese reforestation management. In fact, a symbiotic cooperation should be a better choice rather than rivalry between Malaysia and Vietnam due to the close location and similarity of culture. For example, Germany is sourcing their furniture

wood supply from their neighbouring countries. Between 2007 and 2011, Germany's intra-EU imports of solid timber products increased 26% to 25.1 million m^3 (RWE), mainly due to rising log imports, particularly from the Czech Republic, Poland and France. In contrast, imports from outside the EU fell 9% to 7.7 million m^3.

2.8 K-SOCIETY

The core design of education delivery will be based on "a global, immersive, ambient networked computing environment built through the continued proliferation of smart sensors, cameras, software, database, and massive data centre in a world-spanning information fabric known as the Internet of Things (IOT)".

Sustainability will be embedded into educational content. This will help to encourage a change in the way people understand their social, technological, ecological and political environments. In higher education, people will be trained with skills to manage technological breakthroughs and global issues.

2.8.1 Emphasis in Education System

Furniture design is a holistic and interdisciplinary field of study. It is social science that belongs to the humanities, an applied art that draws upon many design disciplines, and is dependent upon a working knowledge of materials and fabrication techniques. Design education needs to review the curriculum and foreseeing new instruments or method in order to strengthen the tie among design education and furniture manufacturers. In the modern society and increasing technological complexities, up-to-date design is now seen as a multi-disciplinary activity, which includes professions such as designer, engineer, marketer, scientist and others.

For example, in China, one can study to at least a bachelor degree in every aspect of furniture making processes. Among the courses offered by Chinese universities which are related to the furniture industry are:

a) Forest Management (Beijing Forestry University),
b) Chemical Processing of Forest Products (Beijing Forestry University),

c) Machine Design, Manufacturing and Automation (Beijing Forestry University),
d) Wood Science and Engineering (Beijing Forestry University),
e) Furniture Design and Manufacturing (Shunde Polytechnics),
f) Carving Art and Furniture Design(Shunde Polytechnics),
g) Packaging Engineering (Beijing Forestry University).

A detailed report on education system is discussed in Chapter Six.

2.9 SUMMARY

In this chapter, we have presented on how the economy and finance, social and culture, and geopolitics in 2050 may affect the future furniture industry. In terms of social and culture, Malaysia will become a knowledgeable society as well as a community centred society where inter district travel will become significantly less. In term of geopolitics, Malaysia will become a more equitable, united and environmentally sustainable state.

This chapter also highlighted on furniture design and function adaption to a rise in the aging population percentage with a better health care system, smaller living space, and higher sustainability awareness. The furniture manufacturing practices may also be affected due to changes in geopolitics and higher education level of the general population.

In the next chapter, we will look in detail at the general scenario of the Malaysian furniture industry in 2050 from stakeholders' engagement activities.

CHAPTER THREE
NATIONAL TECHNOLOGY AND INDUSTRY 2050 BUSINESS OUTLOOK

3.1 GENERAL BACKGROUND

The furniture industry has made a significant contribution to the Malaysian economy. The industry had grown dramatically from early 90's to the turn of the century, owing to the transformation of the industries from traditional based operation to a technological driven industry. However starting from 2004, the industry seems to be saturated as the export revenue remains stagnant at 7.0 to 8.5 billion per year for 10 consecutive years with an average annual growth at 3.98% (MFPC, 2015). Other than that, the Malaysian furniture industry is greatly dependent on wood based furniture which contribute to almost 80 % of the total export figure compared to other materials. Rubberwood has also become the flagship of Malaysian furniture (MFPC, 2013). Malaysian Furniture Exports have the highest exports value in the last 10 years (Figure 3.1).

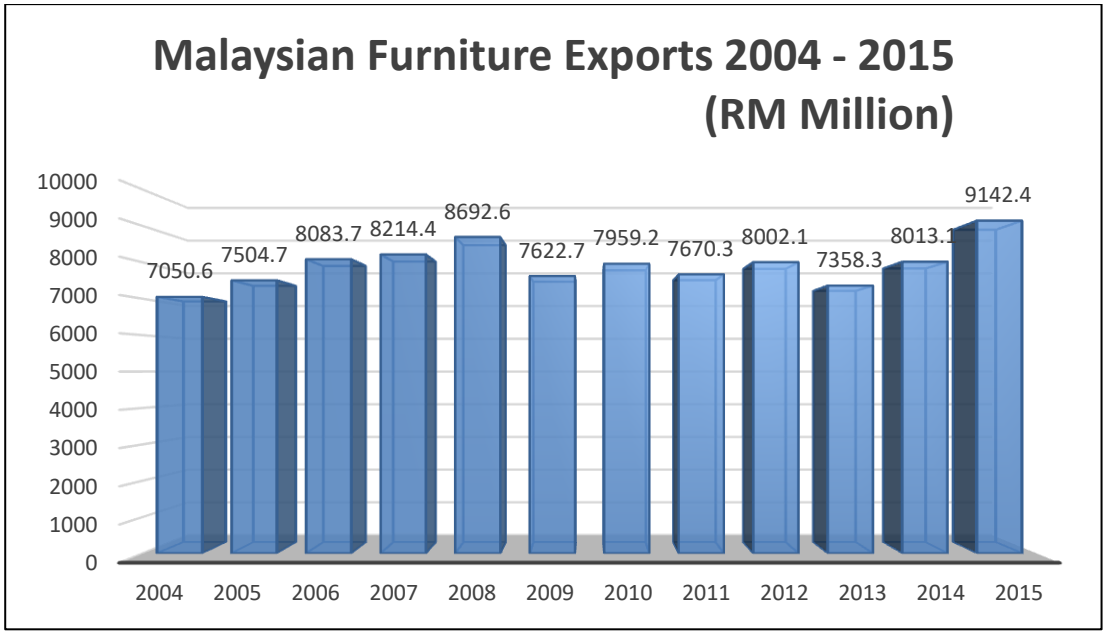


Figure 3.1: Malaysian Furniture Exports from 2004 until 2015. (MFPC)

The export performance to Europe has not been satisfactory in recent years. A recent market research by Malaysian Timber Council (MTC) revealed that Malaysia

market share has been shrinking by 45% over the past six years (Ho et al., 2015) due to the failure of innovating and redesigning furniture products to suit United Kingdom's changing requirements, consumer taste, and distribution trends.

As mentioned in Section 1.4, the largest importer of Malaysian furniture product is the United States but it is important to note that Malaysian furniture only fulfils 2% of its demand. There are a few contributing factors on the inability of Malaysian furniture manufacturers to produce more orders in particular due to shortage of raw materials and labour. This chapter discusses the problems encountered by most Malaysian manufacturers that prevent them from being competitive at a global level.

3.2 MATERIAL

3.2.1 Dependency on Natural / Planted Wood

The Malaysian wood furniture industry is a mature and dynamic sector and is well established in the international market. Over 80% of the wooden furniture products are made from rubber-wood so much so that rubber-wood has become the Malaysian furniture flagship. For volume utilization of mass production, a steady supply of cheap timber is the key to a sustainable business. In the next few years, it has to be emphasized that the wood furniture industry will be facing with problems of attaining adequate resources or shortage of raw material due to lack of replanting as well as replacement of rubber plantation with palm oil plantation.

According to Ethos & Company (2015), Malaysia's position in the global market is mainly that of a supplier rather than a consumer of timber products. Malaysia is blessed with highly valuable tropical hardwood timber in its natural forest such as Balau, Chengal, Meranti, Nyatoh, Resak, Belian, Giam, and Merbau. Malaysia is ranked as the highest exporters of log globally at a value of USD 197 / m^3 in 2014. In the meantime, rubberwood is also being planted as a resource apart from the hardwood timber species that are being harvested. These logs are processed into sawn timber, veneer, plywood, medium-density fibreboard (MDF), and particle board.

Peninsular Malaysia has banned log export therefore log export is mostly from Sabah and Sarawak. The report by Ethos & Company concluded that at least 71% of Malaysia's timber resources were being exported as primary products with proportions

as listed in Table 3.1. Another 29% are divided into timber used in construction and furniture making.

Table 3.1: Proportion of Malaysian Timber Export. (Ethos & Company, 2015)

Percentage	Primary Products
16	Logs from both natural and planted forest
17	Sawn timber
30	Veneer and plywood
8	MDF and particle board
TOTAL: 71% of Timber to Export	

Exporting upstream and midstream resources has been Malaysia's prominent income in the past years. The practice has a negative impact on the furniture industry. This issue was raised in all the furniture workshops in the central, northern, southern, east coast region, and Sabah, and Sarawak. Malaysia could gain more by exporting higher value-added timber products rather than timber logs.

The industry is facing problem in terms of raw materials as the usage of rubberwood, acacia and local species such as merbau is very high. The industry still needs to import from Africa, Australia and Brazil to name a few. Balau Merah, Cengal, Resak, and Giam are also among the species which are scarce. Furthermore, these species need more than 100 years to mature. There are plentiful timber resources in Sabah and Sarawak which come from their natural rainforest or planted forest. Acacia is a timber species that is planted heavily in Sarawak. However, most of the resources are being exported leaving less quality timber for the local furniture manufacturers.

Timber plant owners prefer to export logs rather than selling to local furniture manufacturers due to the price, term and conditions being attractive for exporter (Sabah Furniture Workshop, 2015). Most Acacia plantation in Sarawak is owned by foreign companies who export the harvested log back to their home countries (Sarawak Furniture Workshop, 2015).

The Ministry of Plantation Industries and Commodities (MPIC) has urged for forest plantation programs to be developed aggressively in Malaysia. As a result, the Forest Plantation Development Programme was established by the Malaysian Timber Industry Board (MTIB) which gives soft loans, auditing plantation process, technical

supports and training to land owners. However, land owners and foreign investor had benefited from the government's plantation program and the log export income leaving local furniture manufacturers with insufficient supply of timber.

The Forest Plantation Development Programme selected nine species for their program namely Rubberwood (*Hevea / Timber Latex Clone*), Acacia Spp. (*Mangium / Hybrid*), Teak (*Tectona Grandis*), Sentang (*Azadirachta Excelsa*), Khaya (*Khaya Ivorensis / Khaya Senegalensis*), Kelampayan / Laran (*Neolamarckia Cadamba*), Batai (*Paraserianthes Falcataria*), Binuang (*Octomeles Sumatrana*), and five selected commercial bamboo species. These plants need time to mature and further research is required to accelerate maturity.

The introduction of the three Industrial Master Plans (1986 - 2020) had spiked the growth of the rubber forest plantations. The plant needs a 15 years cycle to mature. At the moment, the plantation program for rubber is either for its latex or wood. The rubber tree is unable to satisfy both purposes. The difficulty is to maximise the use of the rubber tree due to the damage on the plant during the rubber tapping process (Terengganu Furniture Workshop, 2015). If this problem could be overcome, the land owner may enjoy the double advantages of latex and rubberwood harvest. The time for rubberwood to mature can also be reduced.

Some manufacturers are still doing what they do best, but some of them are already focusing on niche market based on their strength and working closely with new raw materials available such as oil palm trunk (OPT) and also bamboo. The difficulty with these new materials is that they are not widey used due to limited resources. On the other hand, OPT has low demand in the furniture sector due to its dark color that restricts manufacturers ability to vary the colour of finished furniture products. A well known furniture company which is using OPT is Smart Victory Sdn Bhd in Ulu Tiram, Johor.

Feedback from a furniture manufacturer association indicated that Malaysian furniture manufacturers are reluctant to use fibre glass, plastic, and composite due to the high cost of moulding which increases with variation in design. In addition, wood furniture is perceived as Malaysia's strength. Moreover, the return profit is uncertain due to unfamiliarity with the material. However a niche area like laboratory furniture has great potential. The market for laboratory furniture worldwide in 2014 is 6.4 billion USD. This is expected to increase to 8.94 billion in 2022. More than 50% of laboratory

uses metal and plastics. Companies like Servco Resources Sdn. Bhd. exports 40% of its laboratory furniture products.

3.2.2 Sawmill's Deficiency in Knowledge and Technology

Some of Malaysia's sawmills have the best practice in timber grading and proper curing technique. However, there are many more local sawmills who still refuse to upgrade their facilities to the required standard in order to achieve fast production and good quality processed timber. The machineries and technologies of kiln drying for instance need to be imported at the moment. Therefore, most sawmills are reluctant to invest in such technologies due to the high cost.

Moreover, most furniture manufacturers prefer to import raw materials due to the lack of quality and quantity of local supply. This weakens the local sawmills initiative to upgrade their factory as there are less market opportunity available.

In general, the timber is graded according to its type (such as hardwood, mid-hardwood, mid-light hardwood, softwood, and premium standard) and the quality of processed timber. In an interview with a manufacturer, it is purported that local sawmills are unable to categorize processed timber into preferred species. The manufacturer prefers to use only a certain species of mid-light hardwood category. However the local sawmills cannot provide the right species according to their needs. This is due to lack of furniture making knowledge in local sawmills because export logged timber are the main concern of their business.

3.2.3 Lack of Certified Sustainable Timber

The Malaysian Timber Certification Council (MTCC) has specific rules and regulation in timber grading hence it is a disadvantage for sawmills to have abundant supply of raw materials. Sustainable policies on the export of logs and finished furniture product to European and North America countries are rigidly implemented thus limiting the market access of timber products. Most manufacturers in the furniture workshops (figure 3.2) testified that they have to order legal timber from foreign countries in order to produce furniture with legal timber to be exported to Europe and North America. Unlike Europe and North America, furniture export to other developed countries does

not need timber certification but the revenue is not as high as furniture export to European countries.

Figure 3.2: Mr Sunny Ter the Managing Director of Tawei Furniture Sdn Bhd Shared His Thoughts of the Furniture Industry.

3.3 MASS PRODUCTION

3.3.1 Limited Use of Innovative Technology in Furniture Development

According to Henning et al. (2013), the industrial revolution started at the end of the 18th century when the steam machine was invented leading to the technology of mechanical production plants. In the 20th century, the revolution evolved into Industry 2.0 when mass production was introduced in Cincinnati Slaughter houses. By this time, the technology has shifted to the use of electrically-powered and division of labour. Automation of manufacturing using electronics and IT were evident in industrial revolution 3.0 (Industry 3.0) from the 1970s. The latest revolution is Industry 4.0 where autonomous machines and virtual environment are envisaged to dominate manufacturing. Figure 3.3 shows the four stages of industrial revolution.

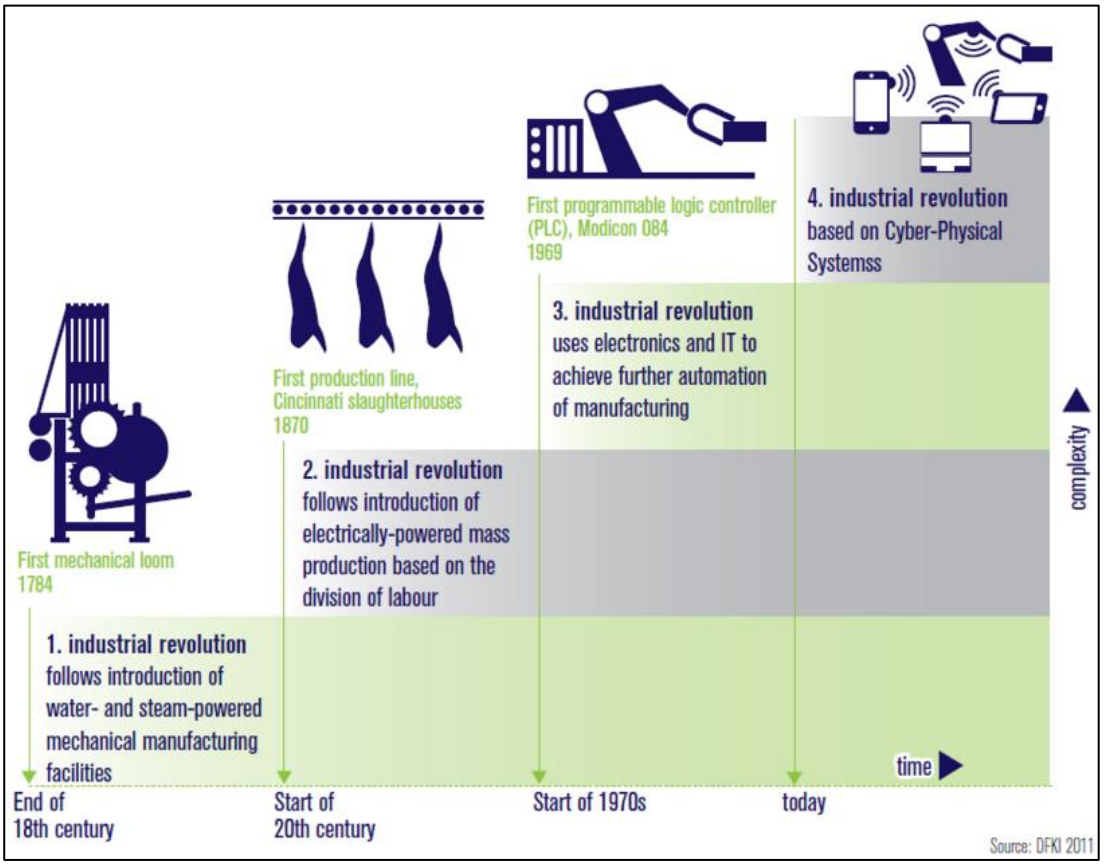


Figure 3.3: The Industrial Revolution.

(Translated from http://www.leanbi.ch/blog/analytic-3-0-und-industry-4-0-sollen-heiraten-dann-wird-analytic-industry-4-0-zum-neuen-star/)

In furniture manufacturing in Malaysia, the application of advanced technology is still not yet fully implemented. Production of furniture using advanced technology not only contributes to high quality furniture, but also can reduce the material waste, production cost, lowering the number of foreign workers and limiting its impact on the environment. Adoption of the state-of-art computer numerical control (CNC) machines, computer aided design (CAD) system, 3D printer, 3D pen and etc. will bring enormous benefits particularly for the industry to respond quickly to customer demands and mass customization.

Based on a survey conducted in this study (Appendix D), it was found that only around 60% companies use some sort of automation in the production. However 78% companies are willing to invest in automation. This study shows that the main limitation to implement automation is high capital investment and high maintenance cost, followed by incompatibility of the technologies (reducing flexibility) and low technological literacy of the workers. The full results can be found in appendixes D.

3.3.2 Advanced Production Technology

There are many local furniture manufacturers who are reluctant to spend or invest on Research and Development (R&D) in furniture design and production process. The survey showed that most companies preferred to do R&D internally or have no R&D at all mostly due to limited funding and expertise. Only about 7 per cent of the companies are engaged with research institutions or universities. It is found from an interview with one of the manufacturers that more than 95% of the machines used by the industry are imported and local fabrication of machines is only in the finishing system. Most of the machines are imported from countries such as China, Taiwan, Germany and Italy. However it was noted that the Muar Furniture association estimated that smaller companies in Muar had invested Rm1-2 million ringgit annually on machine upgrades whilst bigger companies have invested approximately RM20 million ringgit annually. Figure 3.4 shows a worker operating a CNC panel saw machine.

Figure 3.4: A worker operating an automated machine (photo taken at Ramaco Bena Sdn. Bhd).

3.3.3 Sustainable Manufacturing Practices

In interviews with both manufacturers and governmental agencies in the workshop sessions across the regions, it was found that most companies are struggling to comply with basic environmental regulations outlined by the Department of Environment. Many small and illegal companies are having problems complying with basic requirements such as measuring air emissions. It was only found only that 25% companies which participated in the survey employed environmental consultant to help companies comply with environmental standards. However the data shows none of companies comply with ISO14000 standards. Looking into the sustainable manufacturing practices, most companies implement green initiative during the design stage, followed by the manufacturing process. Less effort was put into looking at the end of the product's life.

Nevertheless, the companies surveyed acknowledged that sustainable manufacturing will give a positive impact on economic and operational outcomes. Top three limitations to implement sustainable manufacturing strategies in participated companies are:

a) Difficult to change manufacturing process.
b) High cost to implement sustainable manufacturing strategies.
c) Lack of knowhow.

3.4 BUSINESS

3.4.1 Prestigious Image Branding

Branding is becoming much more important, however brand building is still lacking in the industry. The nature of the industry in Malaysia is that designs are replicated by competitors which has discouraged manufacturers to invest in design and branding. Malaysian brands should be recognized worldwide or in the domestic market. For example; Made in Malaysia is designed by Malaysian.

In spite of this, the Malaysian Furniture Promotion Council (MFPC) has taken the initiative to focus on the designing and branding aspects of Malaysian furniture. As a result, Malaysia Pride has been created to strengthen the qualities of Malaysian

furniture production. MFPC guideline several relevant criteria to be achieved by a local furniture company before authorizing Malaysia Pride brand. To date, there are 18 furniture companies which enjoy the benefits of Malaysia Pride recipient namely:

1. ORISS Sdn. Bhd.
2. Inart Furniture Sdn. Bhd.
3. Deep Furniture Sdn. Bhd.
4. SJY Furniture (M) Sdn. Bhd.
5. S. K. Furniture Sdn. Bhd.
6. Simewood Product Sdn. Bhd.
7. Omega Sofa (M) Sdn. Bhd.
8. Hin Lim Furniture Manufacturer Sdn. Bhd.
9. Marcoco Furniture Industries Sdn. Bhd.
10. IB Sofa Sdn.Bhd.
11. Tawei Furniture Sdn. Bhd.
12. Zone Furniture Sdn. Bhd.
13. Dynamic Furniture Industries (M) Sdn. Bhd.
14. Jukraf Furniture Sdn. Bhd.
15. Fiori (Malaysia) Sdn. Bhd.
16. Kian Contract Sdn.Bhd
17. Hup Chong Furniture Sdn. Bhd.
18. Puncak Bumi Sdn. Bhd.

3.4.2 E-Commerce

With the advancement of internet technologies the concept of online marketing has now been spiralling almost at a break-neck speed. With the growth of Internet as a global medium, this allows buyers and sellers to click from one country to another in seconds resulting in online marketing becoming increasingly important in all types of businesses. Table 3.2 lists a few online stores and their selling characteristics.

Table 3.2: Examples of Furniture Online Store.

No	Company Name	Characteristic
1.	Westwing (Germany) www.westwing.de	The website also includes an online magazine, decoration and furnishing tips to inspire the consumers
2.	XXXL (Germany) www.xxxlshop.de	The website offers attractive discount and vouchers
3.	ARREDACLICK (Italy) www.arredaclick.com	The website includes a library of 3D projects that had been done for their customers to inspire potential customers. The company also can recommend 3D design for a specific space according to customer need and request.
4.	UMA (Vietnam) www.uma.vn	The websites offers online magazine catalogues to inspire consumers.

No	Company Name	Characteristic
5.	DAKO FURNITURE (United Kingdom) www.dakohome.co.uk	The company offers free delivery to specific areas with a minimum purchase price. Instalment of furniture payment without interest also applicable
6.	HARVEY NORMAN (Australia) www.harveynorman.com.my	An Australian company in Malaysia that provides furniture and bedding products, electrical, and computers.
7.	LAZADA (Malaysia) www.lazada.com.my	The Lazada Malaysia under the Lazada Group e-commerce that sell wide range of products including beauty care, electronics, fashion, and furniture. Products on the website can be delivered anywhere within Malaysia.
8.	IKEA (Sweden) www.ikea.com.my	A Swedish company in Malaysia that has an established business concept and support sustainable growth. The company provides delivery service, product installation and assembly, payment instalment, return policy and planning tools for customer to make their own design.
9.	Delima Home (Malaysia) www.delimahome.com.my	This is a local company that provide online selling. The product range from bathroom, bedroom, home and office, kitchen and dining, and living furniture.

3.4.3 A Dynamic Balance between Economy, Society, and Environment

Demographic shifts, environmental awareness, urbanization, and new urban lifestyle will have a significant impact on the furniture industry. The furniture industry faces many challenges which require it to change and be innovative in order to remain competitive. Global trends influenced by environmental and social sustainability on top of economic sustainability of the company will need to be considered to differentiate the product of the company as indicated by the Muar Furniture Associations (Figure 3.5), buyers from the United States and Europe pay particular attention to social and environmental issues of the manufacturers, even auditing them.

Figure 3.5: Meeting with Muar Furniture Association.

3.4.4 Lack of Business Competitiveness

Malaysia has lost to Vietnam in terms of business competitiveness where Vietnam has successfully increase its total export value and jump to the 4th spot of the world furniture exporter. This fast growing country is having all the business advantages such as abundant source of raw materials especially timber, very low labour cost, good political stability and geographically less natural disaster such earth quake and volcanos.

3.5 HUMAN CAPITAL – EDUCATION, TRAINING AND RESEARCH CENTRE

3.5.1 Lack of Skilled and knowledgeable Designers

The Malaysian industry is characterized by a unique proficiency in design and product development. Most of them have established close connections with international suppliers, following the highest technical standards. Many companies are looking for

good designers to deliver innovation, to establish and build brands, and to improve production systems and sales. The most significant problem, relating directly to designer discipline, is the fact that all local furniture companies do not produce their own original design.

The designer's lack of active involvement in the design process and decision making have led to the downgrading of the designers' ability in problem solving and they do not have much opportunity to get involved in using their knowledge of sustainability in design. The designer does not participate in the final decision making because of the practice of copying design is common.

3.5.2 Monotonous Design and Unsustainable Trend

Most manufacturers have continuously looking towards western designs for product ideas and have not been able to innovate design with strong differentiation which will give then a competitive edge in the international market. Recently, many new industries player, e.g., China, Vietnam and Thailand have become stronger competitors for Malaysia because of their lower manufacturing cost and original design as well as their aesthetics and good work ethics of their labour force. To stay ahead in the market, design is an essential factor that can increase the value of furniture. A good design should combine the capabilities of a balanced approach in terms of commercial design, culture, environment, economy, idealism, and humanitarian concerns.

3.6 GOVERNANCE (STANDARD, POLICY AND REGULATION)

3.6.1 Lack of Environmental Practices Awareness

Compliance with the requirements of both legislative and voluntary performance standards has become a critical issue. The Malaysia industry is facing stringent and compelling regulations in the EU, USA and other countries. There are also many different voluntary and mandatory environmental performance labels that need to be fulfilled in different countries. For example; European Union (Flower), Germany (Blue Angel), Japan (Eco Mark), United States (Green Seal) and etc (figure 3.6 – figure 3.9). The environmental performance criteria specifically address:

a) The use of materials produced in a more sustainable way.
b) A reduction of the use of hazardous substance and of emissions of polluting substance.
c) The production of a durable product.

Figure 3.6: EU Eco Label Mark.

Figure 3.7: Germany Blue Angel Mark.

Figure 3.8: Japan Eco Mark Label.

Figure 3.9: US Green Seal label.

3.6.2 Skilled Workers

There is a lack of local youngsters walking in the industry due the strong stigma of lack of safety, unhealthy factory conditions and the low salary scale in the industry. In order to fulfil the vacuum, manufacturers hire foreign workers. This is where the problem starts as new regulations implemented by the Malaysian government limit the working duration up to a maximum of 5 years only. The industry has becomes a skill development centre where foreign workers enter as low skilled workers and leave as highly skilled workers after 5 years. Consequently, the industry needs to keep training a new batch of foreign workers every 5 years.

During an interview with a furniture association, it is revealed that government's new policy in limiting the supply of foreign workers is burdening the furniture industry. The orders cannot be fulfilled due to lack of labour to operate the machines (Figure 3.10). This is a constraint to manufacturers because export-based furniture has to meet order deadline even though the factory is facing ground issue such as machineries breakdown and runaway foreign workers. The shipment has to be shipped on time or else the manufacturers have to pay penalty. MTIB also affirmed that Malaysian manufacturers had turned down approximately a total of RM 68 million orders during MIFF and EFE Exhibition (Draft Final Report Feedback Workshop, 2016). This is because local manufacturers are unsure of fulfilling the orders on time due to limited labour.

Figure 3.10: Abandon Machineries without Worker due to Labour Shortage.
(photo taken at Deep Furniture Sdn. Bhd)

The government on the contrary is expecting local manufacturers to perform Good Manufacturing Practices (GMP) before allowing the manufacturers to have enough foreign work supply. Therefore, the industry is implementing lean management such as 5S and conveyor system as shown in figure 3.11.

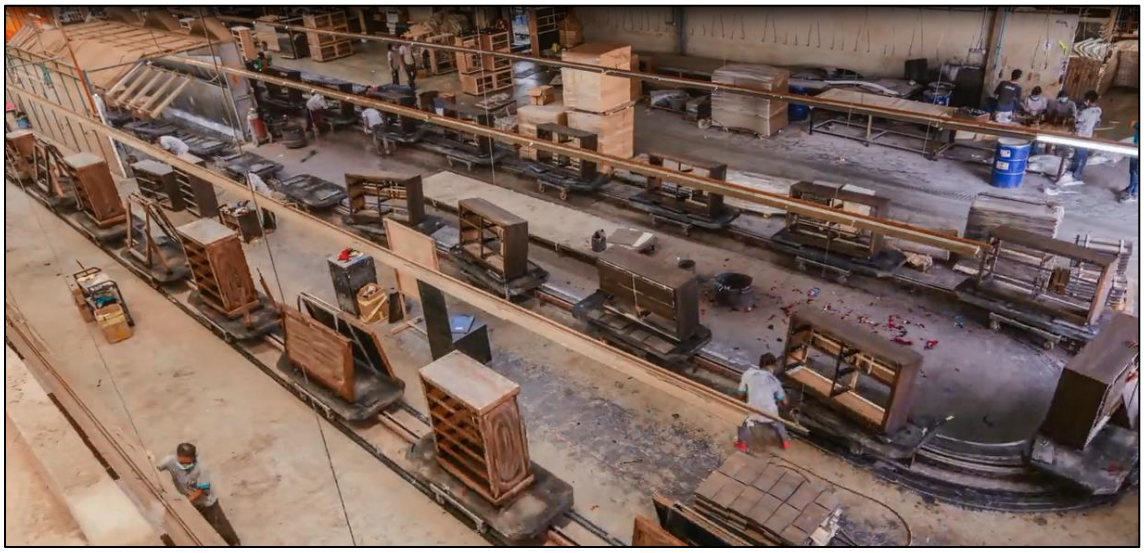


Figure 3.11: Conveyor System at AX Furniture, Muar, Johor.

The Malaysian furniture manufacturers also highlighted a problem regarding shortage of specialist for machine maintenance and repair work. This problem has led to longer machine downtime, difficulties in spare parts procurement as well as increasing machine maintenance cost. Currently when a machine breakdown, especially machines from Europe or United States origin, manufacturers have to engage foreign machine specialist from overseas. In a short term, the Malaysian furniture industry requires well-trained machine specialists who are capable of maintaining and repairing machineries.

3.7 SUMMARY

In this chapter, we have presented the general scenario and inherent problems faced by the Malaysian furniture industry. In term of raw materials, the industry is heavily dependent on wood product from natural forest timber or planted forest timber. As the world becomes more environmental conscious, natural forest timber is facing stringent scrutinising to maintain the sustainability of the forest. Planted forest timber however, is cultivated in small plantations and usually only catering for the export market. Rubber-

wood from rubber plantations may produce low quality wood as a result of rubber tapping activities.

In terms of furniture production, Malaysian furniture industry is still a labour intensive industry highly dependent on general workers. Automation technology among the furniture manufacturer is relatively small and not yet fully implemented. However, the awareness of automation technology is considerably high among the furniture manufacturers.

In terms of business, Malaysian furniture is recognized as medium quality furniture manufacturer. Malaysian furniture is perceived as higher quality than the furniture made in China or Vietnam, however it is still behind Italian or German furniture. Malaysian Pride is the highlight of quality furniture made in Malaysia with 16 companies recognized with the Malaysian Pride brand. Some manufacturers have shifted toward marketing through the internet for capturing domestic market.

In term of furniture designers, although the furniture design can be very artistic, some of the design can be difficult to manufacture. Some designers are also influenced by western design and have not been able to produce innovative design with strong differentiation which will give then a competitive edge in the international market.

In term of general workers, the industry is facing a severe lack of local youth participation which has led to mass foreign general workers employment. This is where the problem starts as new regulations implemented by the Malaysian government limits the number of foreign workers.

CHAPTER FOUR
GOVERNANCE

4.1 GENERAL BACKGROUND

Malaysia, as a country that has affirmed the sustainable development policies of the World Commission for Environment and Development (WCED) in 1987, has to face the challenge of implementing sustainability. The National Green Technology Policy (NGTP2009) has been developed by the government to encourage manufacturers to improve environmental problems (Savita et al, 2012). Green practices are also among the seven thrusts outlined in the National Timber Industry Policy as a policy direction in marketing and promotion (Commodities, 2009). The policy of the Furniture industry with respect to sustainability are among key issues that is and will continue to strongly influence the growth of the furniture industry. As of 12th December 2015 Malaysia is fully commited to achieve the guidelines outlined by the Paris Agreement for Climate Change. This agreement will come into effect in 2020, empowering all countries to prevent average global temperatures from rising. Malaysia had submitted its Intended Nationally Determined Contributions (INDC) to UNFCCC, committing to reduce greenhouse gas emission by 45% by 2030 (Bernama, 2015). Looking at this latest development, the Malaysian Furniture industry has no choice but to actively implement sustainable manufacturing practices..

4.2 CURRENT INTERNATIONAL POLICY

Generally the current international policies can be categorized into two distinct categories namely rules and regulation regarding furniture raw material, furniture product and testing

4.2.1 Furniture Raw Material

At the international level, greater pressure is exerted to the furniture manufacturer to introduce environmentally sustainable manufacturing. As the main furniture material is

wood, which is closely related to deforestation and illegal logging issues, the policy and regulatory drivers often coincide with forest management policy. Thus, certified woods are preferred in the international market although the certification are often voluntary and often differ between markets where it is more stringent in the United States and the European Union countries but less in Asian and African countries.

Among the primary internationally accepted certification body that helps the furniture industry manage the issues surrounding environmental sustainability are:

a) Sustainable Furnishing Council (SFC) which provides clarification and resources on furniture that is green, eco-friendly, environmentally safe and sustainable.
b) Forest Stewardship Council (FSC) which aims to help reduce the environmental impact of harvesting wood including furniture made from wood. The main aim is to promote the use of planted wood rather than old forest wood. The council provides certification that guarantees that the wood is from a certified well-managed forest. The two key elements of the certification are:
    i) The forest of origin has to be independently certified to verify that it is being managed in accordance with the requirements of an accredited forest management standard and
    ii) The 'chain of custody' system which provides independent certification of its unbroken path from the forest to the consumer including all stages of manufacturing, transportation and distribution.

    Demand for certified products has grown dramatically in the past few years to the extent that, for many organizations, the ability to prove that timber has been derived from a well-managed source is now a key factor in the specification of timber and paper products (TRADA, 2007). The demand for FSC certification is likely to grow not only as more retailers from leading countries like UK, US, Germany and the Scandinavia demands for it but also due to more emphasis among suppliers to insist that their supply chain meet this demand (Morris and Dune, 2004).
c) PEFC Chain of Custody certification (CoC) is an essential part of the Programme for the Endorsement of Forest Certification schemes (PEFC). It is a global system for certification and labelling of responsibly produced timber. Its

main purpose is to control the flow of certified products throughout the supply chain.

Apart from these certifications there are specific policies and regulatory drivers from individual geopolitical markets. The EU commission has widened the application of Producer Responsibility to include furniture manufacturer with the introduction of furniture category into the EU Eco-labelling (CREM, 2002). This could be translated into the inevitable introduction of more regulation in the near future that would need furniture manufacturers to be more accountable for the products that they produce. The EU has also introduced specific policy towards the entry of and use of illegal timber products through Forest Law Enforcement, Governance and Trade (FLEGT). The FLEGT Action Plan proposes measures to increase the capacity of developing and emerging market countries to control illegal logging, while reducing trade in illegal timber products between these countries and the EU (FLEGT, 2003).

4.2.2 Furniture Product and Testing

Furniture product is subjected to several regulations concerning product safety, which includes but is not limited to, safety design, product flammability, product toxicity (paint chemical, formaldehyde), packaging and labelling. In case of the United States the following laws, among others, had been enacted to regulate furniture product:

a) Consumer Product Safety Act (CPSA) Title 15, United States Code, Chapter 47, Sections 2059-2089.
b) Flammable Fabrics Act (FFA) Title 15, United States Code, Chapter 25, Sections 1191-1204.
c) 16 CFR 1303, Lead in Paint on Certain Furniture Articles (Children's Furniture).
d) 16 CFR 1219, Safety Standard for Full-Size Baby Cribs (Eff. June 28, 2011).
e) 16 CFR 1220, Safety Standard for Non-Full-Size Baby Cribs (Eff. June 28, 2011).
f) 16 CFR 1632, Standard for the Flammability of Mattresses and Mattress Pads.
g) 16 CFR 1633, Standard for the Flammability (Open Flame) of Mattress Sets

h) Title VI (Limiting Formaldehyde Emissions) Toxic Substances Control Act (TSCA)].
i) 19 CFR 134, Country of Origin Marking.
j) Textile Fibre Products Identification Act 16 CFR 303, Rules And Regulations under The Textile Fibre Products Identification Act.
k) Food, Conservation & Energy Act of 2008, Public Law No: 110-234, Section 8204, Preventing Illegal Logging Practices.
l) Food, Conservation, and Energy Act of 2008, Public Law 110–246, Sec. 8204. Prevention of illegal logging practices.

In order to comply with the laws, the American Society of the International Association for Testing and Materials (ASTM) has provided standards for manufacturers to follow. Some of the standards are mandatory for all furniture exported to the United States. The following are some of the standards govern by ASTM which is relevant to furniture product and testing.

a) F404 - 10 Standard Consumer Safety Specification for High Chairs.
b) F1169-11 Standard Consumer Safety Specification for Full-Size Baby Cribs.
c) F1427-07 Standard Consumer Safety Specification for Bunk Beds.
d) F1561-03(2008) Standard Performance Requirements for Plastic Chairs for Outdoor Use.
e) F1821-11a Standard Consumer Safety Specification for Toddler Beds.
f) F1838- 98(2008) Standard Performance Requirements for Child's Plastic Chairs for Outdoor Use.
g) F1858- 98(2008) Standard Performance Requirements for Multi-positional Plastic Chairs with Adjustable Backs or Reclining Mechanisms for Outdoor Use.
h) F1988- 99(2008) Standard Performance Requirements for Plastic Chaise Lounges, With or Without Moving Arms, With Adjustable Backs, for Outdoor Use.
i) F2057-09b Standard Safety Specification for Chests, Door Chests, and Dressers.

j) F2194-10 Standard Consumer Safety Specification for Bassinets and Cradles.
k) F2388-09 Standard Consumer Safety Specification for Baby Changing Tables for Domestic Use.

Another agency in the United States, Business and Industrial Furniture Manufacturing Association (BIFMA) working together with American National Standards Institute (ANSI) have developed standards for furniture manufacturers to comply voluntarily. Among the standards are:

a) ANSI/BIFMA X5.1 Office Seating.
b) ANSI/BIFMA X5.3 Vertical Files.
c) ANSI/BIFMA X5.4 Lounge and Public Seating.
d) ANSI/BIFMA X5.5 Desk Products.
e) ANSI/BIFMA X5.6 Panel Systems.
f) ANSI/BIFMA X6.1 Educational Seating.
g) ANSI/BIFMA M7.1 Standard Test Method for Determining VOC Emissions.
h) ANSI/BIFMA X7.1 Standard for Formaldehyde and TVOC Emissions.
i) ANSI/BIFMA e3 Furniture Sustainability Standard.
j) BIFMA HCF 8.1 - Healthcare Furniture Design - Guidelines for Cleanability.
k) BIFMA G1 Ergonomics Guideline for Furniture.
l) BIFMA Colour - 2005 Colour Measurement.
m) BIFMA PCR for Storage: UNCPC 3812.
n) BIFMA PD-1-2011 Mechanical Test Standards-Compiled Definitions.
o) BIFMA Quality v9.3 (24May04).

4.3 CURRENT MALAYSIAN POLICY

Malaysia is a signatory of the Trans PacificPartnership Agreement (TPPA). When the agreement takes effect in 2018, Malaysian furniture industries can look forward to

a) Lower trade barriers of processed wood products.

In 2014, almost half of Malaysia's exports of wood-related products were to the TPPA countries with Japan and the US being the biggest export partner in terms of wood-related product as shown in figure 4.1. Currently, Malaysian wood related exporter have to pay tariffs up to 36% to the US for all wood related product and up to 9% to Japan for about 5% of wood related product. Malaysia is also importing about 24% of its wood related product from TPPA countries. Thus, a saving of RM3.2 billion in term of import duties can be expected as TPPA comes into effect (PwC-MITI).

b) Cheaper import of logs could alleviate domestic supply shortages.

Malaysian furniture industry acknowledges the supply shortage of wood-related product particularly sawn logs and sawn timber especially in Sabah and Sarawak. Between 2007 and 2013, domestic log production had declined from 22 million m^3 to 14.3 million m^3 amid shortfalls in replanting and poor land utilisation (PwC-MITI). As TPPA becoming into effect, Malaysian furniture industry will gained access to cheaper wood and wood-related products from TPPA countries.

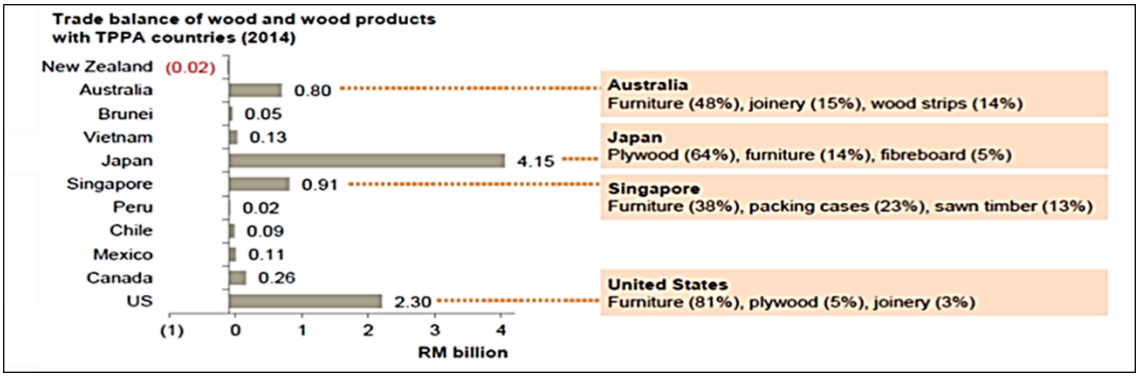


Figure 4.1: Trade Balance of Wood and Wood Product with TPPA Countries (PwC-MITI).

Participation in the TPPA would help defend Malaysia's export position. While lower priced Chinese and Vietnamese furniture pose significant competition, Malaysian furniture distinguishes itself through its original design as well as its good work ethics. The TPPA is expected to bring projected growth of 19.2% in furniture exports to US, Peru and Canada. Lower trade barriers would benefit Malaysian exporters. Lower

tariffs, particularly for plywood and furniture, is expected to increase exports, especially to Japan and US. Better ease of doing business and lower trade barriers provide opportunities for wood processing companies to invest abroad or move operations to another country.However, this would likely be limited to developing countries among the TPPA members, due to labour costs.

On the other hand, several challenges will become more apparent after TPPA takes effect. Among others are the dependency on foreign low skilled labour, inconsistencies and clear policy of raw material management by state government, and low availability of land for replanting of forests, the application process for lease of land requires a relatively long period of time.

Overall, the TPPA would bring positive impact to the wood and wood products sector, through increased market access and cheaper imports. There is potential negative impact from new labour laws, but this appears to be less of a concern relative to the shortage of raw material and other structural issues.

With the greater intensity of sustainable policies implemented in many countries that Malaysia exports its furniture products to, there is a need to take a closer look at current and future needs of sustainability focused governance of the furniture manufacturing industry. The following are some of the national policies governing the timber industry.

a) National Timber Industry Policy

Malaysian National Timber Industry is the guidelines concerning timber industry in Malaysia. This policy takes effect from 2009 to 2020. This policy have seven main thrusts namely industry structure,the supply of raw materials, innovation and technology, marketing and promotion, human capital development, funding and incentives, and bumiputera participation. This policy is targeting the ratio of primary to secondary processed wood products of 40 to 60.

b) Malaysian National Commodity Policy

Among the agenda for timber commodity is that the development of the timber industry will continue to be more competitive and sustainable as well

as strengthening cooperation in the industry value chain through the implementation of the nfollowing strategic cores:

i) Increase and diversify sources supply of raw materials.
ii) Strengthening innovation and technology through research, development and commercialization.
iii) Expanding market and branding.
iv) Facilitate the development of small and medium enterprises (SMEs).
v) Generating a potential source of new growth.
vi) Increase the participation of Bumiputera.
vii) Build and strengthen human capital.

c) National Forest Policy

The Policy makes provisions for managing Permanent Forest Estates, for maximising social, economic and environmental benefits, for implementing a planned programme of forest development, promoting efficient harvesting and utilization within the production forest, increasing the production of non-wood forest products and providing for the conservation of biological diversity. This policy was revised in 1994 to address requirements for Sustainable Forest Management (SFM) and include references to conservation of biological diversity, sustainability, and recognition of the role of local communities in forest development and of ecotourism. Sabah and Sarawak has their own govering policy concerning forest in Sabah and Sarawak.

d) Second National Physical Plan (NPP-2)

Malaysia has published a Second National Physical Plan (NPP-2), which is a long-term strategic framework shaping national spatial policy and measures for land use, biodiversity conservation and physical development until 2020 in Peninsular Malaysia. The Plan complements the Five Year Economic Development Plan as it provides the spatial dimension to the sectoral

distribution of national resources. The Plan aims to reduce greenhouse gas emissions by developing carbon sinks, ensuring a sustainable forest and water management policy, and establishing a Central Forest Spine to integrate and conserve forest resources and to control unsustainable agricultural expansion.

e) National Policy on Climate Change

Malaysia has a National Policy on Climate Change (2009), which intends to mainstream climate change mitigation and adaptation into overall development strategy. The National Policy on Climate Change also reinforces Malaysia's pledge to reduce emissions by 40% in 2020 compared to 2005 levels. This policy was further strengtened by Malaysian participation in the Paris Agreement on Climate Change.

From this highlighted policies, we noticed that there are several redundancy on the policies governing timber/furniture industry. This may lead to confusion, loop-holes, or unnecessary tension for the industry player.

4.3.1 Furniture Raw Material

Sustainability has long been a key concern in the governance of the national furniture Industry. This has been translated into many long running policies such as the National Forestry Policy (NFP) 1978 (revised 1992), National Forestry Act (NFA) 1984 (amended 1993), Environmental Quality Act 1974 (amended 1985) and Protection of Wildlife Act 1972 (amended in 1976 and 1988). These acts have provided a broad based policy that directly and in-directly influence the sustainability concerns of the local furniture manufacturing industry.

In a step for more accountability for sustainability of furniture manufacturing industry, the Malaysian government has entered into agreement the Forest Law Enforcement, Governance and Trade (FLEGT), Voluntary Partnership Agreement (VPA) with the European Union, in which the Malaysian government provides licenses as an assurance of the legal timber to be exported into EU markets. The licenses are

managed by the Timber Legality Assurance System (TLAS) agreed upon under the VPA in which the Malaysian Timber Industry Board is the authorized body (Wong, 2007). Malaysia commenced implementation of the Timber Legality Assurance Scheme (TLAS) designated as MYTLAS, purely as Malaysia's own initiative since 1 February 2013, to assure the legality of its timber and timber products exported to the EU. MYTLAS has also in place comprehensive control procedures to ensure the exclusion of unverified timber (MTC, 2014).

In Malaysia, through the Malaysian Timber Certification Scheme (MTCS), a voluntary scheme that provides independent assessment for forest management and chain of custody certificationto ensure the sustainable management of Malaysia's Permanent Reserved Forests (PRF). The Malaysian Timber Certification Council (MTCC) was set up as an independent organisation to develop and operate the Malaysian Timber Certification Scheme (MTCS) in October 1998. The MTCC started its operation in 2001 and currently is a leading timber certification scheme in the Southeast Asian region. In 2009 the MTCS becoming the first tropical timber certification scheme in the region to be endorsed by the Programme for the Endorsement of Forest Certification (PEFC) – an accreditation body of the largest forest area in the world (MTC, n.d.).

In meeting with the currently adopted and global policies on sustainability, several challenges to the national furniture industry were identified namely:

a) Lack of capability and infrastructure to process the chain of custody for certification.
b) Lack of sufficient investment in implementing sustainable design, process and certification.
c) Concerns of the lack of demand of sustainable furniture in domestic market.
d) Lack of awareness in some business towards potential opportunities and potential restrictions in complying with sustainability policies.
e) Insufficient domestic legislative push towards sustainability.

In the Third Industrial Malaysia Plan (IMP3), eight strategic thrust were formulated to support the wood based industry, namely:

a) Developing regional production and supply chain.

b) Promoting the efficient and effective management of forest resources and forest plantations.
c) Expanding market access through intensified marketing and the promotion of Malaysia's green image.
d) Developing and promoting the growth potential in:
    i. Utilization of lesser promoted species, non-wood fibres and wood waste materials.
    ii. Production of higher value-added wood products.
e) Expanding the production of own design and brand furniture.
f) Enhancing R&D and technology development.
g) Increasing the supply of highly skilled workforce.
h) Strengthening the institutional support and improving the delivery system related to the industry.

4.3.2 Furniture Product and Testing

In Malaysia, Malaysian Standard, developed together by Malaysian Timber Industry Board (MTIB), SIRIM Berhad, and Department of Standards Malaysia, Ministry of Sciences, Technology, and Innovation, governs the furniture product and testing procedures. However, complying with the standard for furniture is voluntary. The following are some of the Malaysian Standard relevant to the furniture industry:

a)	MS 1215:2012	Methods Of Test For Finishes On Wooden Furniture.
b)	MS 1276:Part 1:1992	Specification For Performance Requirements and Tests for Office Furniture Part 1: Desks and Tables.
c)	MS 1315:2014	Office Furniture - Storage Furniture.
d)	MS 1711: 2003	Furniture – Office Chair (Adjustable).
e)	MS 1764: 2004	Furniture – Seating: Part.
f)	MS 1765: 2004	Furniture – Tables.
g)	MS 1788:2005	Furniture – Educational Institutions –

		Specification for Student Chairs, Tables and Stools.
h)	MS 1789:2005	Furniture – Educational Institutions – Requirements for the Strength and Stability of Student Chairs, Tables and Stools.
i)	MS 1791:2005	Furniture - Office Furniture - Visitor Chairs.
j)	MS 1839:2005	Furniture - Office Tables.
k)	MS 471:2003	Glossary of Terms Relating to Timber and Wood-Based Panel Products: Part 3: Carpentry, Joinery and Furniture.
l)	MS 544: Part 4:	Section 4:2001Code Of Practice For Structural Use of Timber: Part 4: Timber Panel Products: Section 4: Oriented Strand Board (OSB).
m)	MS ISO 9241-5:2005	Ergonomic Requirements for Office Work with Visual Display Terminals (VDTS) – Part 5: Workstation Layout and Postural Requirements (ISO9241-5:1998, LDT).

Forest Research Institute Malaysia (FRIM) provided various testing services for wood-based products as shown in figure 4.2. The testing services labs are accredited by ISO 17025 and other recognized international body for wood-based industries.

List of FRIM Accredited Testing Services Labs:

a) Wood Preservative Analysis Lab (MAAK).
b) Paper Testing Lab (PTL).
c) Wood Composite Testing Lab (WCTL).
d) Fire Performance Testing Lab (FPL).
e) Wood Drying Lab (WDL).
f) Wood Finishing Lab (MKK).
g) Wood Lamination Lab (WLL).
h) Furniture Testing Lab (FTL).
i) Timber Engineering Lab (TEL).
j) Wood Mycology Lab (WML).

k) Natural Product Quality Control (NPQC).

Specifically the Furniture Testing Lab was established in 1989. The objective is to assist local furniture industry to make improvement on quality product in order to comply with the international market. This lab is the only furniture testing lab accredited by ISO/IEC 17025 and Furniture Industry Research Association (FIRA) in Malaysia which provides testing services based on Malaysian Standard (MS), British Standards (BS), European Norm (EN) and ISO.

Figure 4.2: Furniture Testing Lab at FRIM.
(http://www.sarawaktimber.gov.my/modules/web/pages.php?mod=download&sub=download_show&id=22)

4.3.3 Issues and Challenges of Malaysian Furniture Governance

The Malaysian furniture industry is facing several issues in term of governance. Among others:

a) Inefficient allocation of resources due to duplicate efforts.

b) Suboptimal policy design.
c) Inefficiency in public-private sectors collaboration.
d) International concern over deforestation, felling logging or from forest conversion for agriculture crop planting.

4.3.3.1 Inefficient Allocation of Resources due to Duplicate Efforts

There are multiple agencies that perform the same task. For example, furniture designer development programmes are being conducted by MFPC and MTIB through their Professional Designers Programme (PDP) and TANGGAM respectively. Four agencies are involved in disseminating the potential funding for any timber product promotion activities in export markets, (MFPC, MTC, MTIB, MATRADE) thus limiting the amount of funding available from each agencies. In another example, the negotiation to obtain FLEGT-VPA status to expedite export of Malaysian timber products to Europe, has stalled over the existence of dual certification systems within Malaysia such as MYTLAS in Peninsular Malaysia and Sabah, and TLAS in Sarawak.

4.3.3.2 Suboptimal Policy Design

Due to the existence of different bodies overseeing different segments of timber value chain, policymaking is optimal for each of these bodies but suboptimal when viewed as a whole. MTIB, for instance should develop the downstream timber industry but this means it does not have to be concerned with Malaysia's natural forests being optimally used for both timber and non-timber resources as its main concern would be to ensure downstream industry has sufficient supply.

Another example is the export of logs from Sabah and Sarawak which is optimal for logging companies within the states, but suboptimal at the national level as there exist downstream industry within Peninsular Malaysia with the capabilities to add value to these logs. From an interview in Muar, the manufacturers are critical of the government giving more incentives to foreign manufacturers compared to local manufacturers. This is to attract foreign manufacturers to invest in Malaysia.

4.3.3.3 Inefficiencies in Public-Private Sector Collaboration and Dialogue

In a workshop on furniture industry held in Muar, participants from the industry highlighted some degree of confusion over which government body they should be liaising to resolve different issues. For example, fire insurance, financing for mechanisation, obtaining land for forest plantations, and foreign labour quota.

4.3.3.4 International Concern over Deforestation, Felling Logging or From Forest Conversion for Agriculture Crop Planting

Major consumer's countries such as Europe and North America are implementing procurement policies for government projects that only allow use of only legal and/or sustainable timber. Therefore, the legality and sustainability of timber is increasingly being made a condition for market access. The adoption of certification is currently driven by market force, therefore our furniture exporters have to look for sustainable timber sources for their export market.

From the National perspective, it is critical to incorporate sustainability concerns into land use planning and forest plantation development planning as well as develop a reputation for stringently enforcing legality and sustainability standards to ensure easy marketability of Malaysia timber products. From the business point of view, the government should be more serious to assist in terms of raw materials shortage and policy that is not uniformed from each state such as Sabah and Sarawak.

As of December 2015, Malaysia has adopted the Paris Agreement. The Paris Agreement is an agreement within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) dealing with greenhouse gases emissions mitigation, adaptation and finance starting in the year 2020. The aim of the agreement is as follows:

a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels,

recognizing that this would significantly reduce the risks and impacts of climate change.

b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.

c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

Malaysia, as part of its contributions to achieve the Paris Agreement objectives, has outlined an Intended Nationally Determined Contribution (INDC) in accordance to United Nations Framework Convention on Climate Change (UNFCCC). Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This consist of 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building from developed countries. This intentions may affect Malaysian furniture industry in terms of industrial processes, waste, land use, land use change and forestry (LULUCF).

In the forestry sector, two major initiatives were launched, the Central Forest Spine (CFS) and Heart of Borneo (HOB) to ensure sustainable forest management and use of natural resources. As the furniture industry is dependent on wood as raw material, the industry may start to adopt chain of custody of wood product certification stringently by 2030 albeit at higher cost. This adoption may help Malaysia reduces illegal logging activities. Furthermore, certified wood may open a bigger market for Malaysian furniture through the TPP Agreement.

In term of industrial processes and waste, the Paris Agreement can be seen as an opportunity for Malaysian furniture manufacturer to optimize their manufacturing processes and manage their industrial waste. Although greenhouse gas emission in furniture manufacturing processes is minimal, effort must be made to optimize the manufacturing process in term of usage of energy, technology utilization and wastage reduction. The byproduct of furniture

manufacturing is the sawdust. The sawdust can be collected and reprocessed into other product such as briquettes, belt-winding cores, core plugs, etc (Figure 4.3). instead of dumping the sawdust as waste.

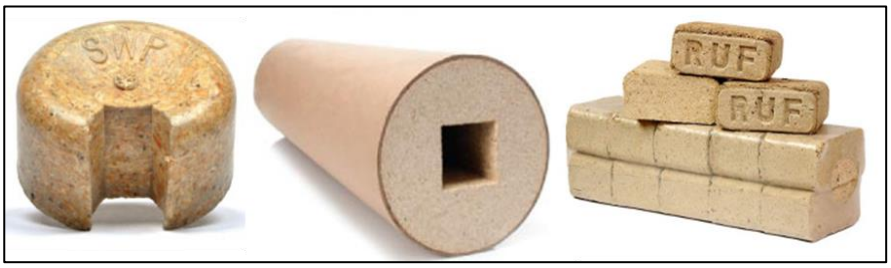


Figure 4. 3: Core Plug, Belt Core Winding and Briquettes. (Souhegan Wood, Malay Kumpulan Kayu)

4.3.3.5 Challenges in Sabah and Sarawak

The Sabah and Sarawak industry is facing an acute problem in terms of raw materials although their state is the main exporters for timber but they are not having the privileged to have it. The raw materials that are available is not of good quality as all the good quality timber is exported at a higher price.

In a workshop on the 13th August 2015 in Kuching, Sarawak (Figure 4.4), several participants from the industry and government agencies highlighted the issue on the cabotage policy where the exporters need to pay extra for the logistic as everything need to be sent through Port Klang in order to export their products to other countries. This means extra cost and time.

Figure 4.4: Discussion with the Furniture Industry in Sarawak.

The cabotage policy in Malaysia was introduced in 1980 to protect and help develop Malaysia's domestic capacity in trade and logistics. The policy requires that all ports comply regardless of whether or not it is under the purview of the state government or Maritime department. The policy stated that locally-manufactured goods between any two ports in the country can only be served by Malaysian-owned shipping companies. However, Malaysian shipping companies are not thriving and are favouring oil and gas products (tanker vessel) rather than containers shipping (Suffian, Rosline, & Abdul Karim, 2015). This has caused only a small segment of container shipping linking West Malaysia and East Malaysia. In turn this policy is driving the goods price in East Malaysia higher compared to the West Malaysia.

However, effective June 2009, the cabotage policy has been relaxed allowing foreign-registered vessels to import and export rice and corn, crude palm oil and cars freely to and from Sepanggar Port without requiring any domestic shipping license. But foreign vessels are still reluctant to unload goods in Sabah as the volume is small and that would incur various costs and valuable time. This partial liberisation of the cabotage policy is not yet conducive for Sabah manufacturers to increase volume of goods including furniture products.

4.4 FUTURE NEEDS IN GOVERNANCE

In order for the Malaysian Furniture Industry to be better prepared and equipped to tackle the concerns of current and future sustainable concerns several new policy measures is needed:

a) Sustainable Investment for Furniture Manufacturing.
b) Sustainable Education and Training.
c) Sustainable Furniture Market Awareness.
d) Sustainable furniture R&D.
e) Stronger and coordinated legislation.

4.4.1 Sustainable Investment for Furniture Manufacturing

In order to promote the industry towards sustainable practices, there is a need to support business with financial investment support such as through tax relief and initial grants. The initial cost of investing in sustainable practices such as building supply chain infrastructure, improving process and conducting certification are often high. Financial support policies in investments would benefit in motivating and reducing the burden of business towards implementing sustainable practices. Currently there are various financial incentives for timber plantation and manufacturing timber based as reported by MPIC (2009) in the National Timber Policy (2009-2020) report.

4.4.2 Sustainable Education and Training

There is a need to introduce or include sustainability practices in current and future training and education curriculum of furniture manufacturing industry related program. This would further increase the awareness and more important imparting necessarily knowledge to industry players in implementing sustainable manufacturing practices.

4.4.3 Sustainable Furniture Market Awareness

In order to push the green furniture in the domestic market there is a need for programs and initiatives to create awareness among the public. The market needs to be informed and introduced to green/eco labelling, PSS models etc. should be introduced in order to increase the demand of sustainable furniture.

4.4.4 Sustainable Furniture R&D

Sustainability practices often require research and development into new process, technology and material, which often requires high infrastructural and man power cost. As such it is imperative that R&D investment to be made available either through a Centre specific approach or providing specific grants to research or high learning institution.

4.4.5 Stronger and Coordinated Legislation

There is a need for a stronger legislative push moving from voluntary participation to punitive based legislation. There is also a need for a more coordinated legislation either through streamlining coordination among the different governing bodies or through a central single governing body.

4.3 SUMMARY

In this chapter we highlighted several government policies which will affect the furniture industry. By 2020, the Trans Pacific Partnership Agreement (TPPA) and the Paris Agreement on Climate Change (PACC) will have the biggest impact on Malaysian Industries. The TPPA will open new market for the furniture industry as well as possible new raw material sourced from the participating country. The PACC will push further the sustainable practices from forest management to Green House Gas reduction in manufacturing plant.

However, Malaysian furniture industry is facing several issues regarding governing policies, including but not limited to, inefficient allocation of resources due

to duplicate efforts, suboptimal policy design, inefficiency in public-private sectors collaboration and international concern over deforestation, felling logging or from forest conversion for agriculture crop planting.

Furthermore, the cabotage policy is believed to have contributed to East Malaysian industry to be under developed. Another acute problem faced by East Malaysian Furniture industry is the scarcity of raw material (wood product) even though Sabah and Sarawak are rich with timber wood. The timber harvested in Sabah and Sarawak is being exported to other countries rather than fulfiling the demand of the local furniture industry. Only the low quality timber are left for Sabah and Sarawak furniture industry.

CHAPTER FIVE
CROSS-REFERENCING

5.1 GENERAL BACKGROUND

In this chapter, the impact from Mega Science 1.0 to 3.0 on other sectors on the furniture industry is examined.

5.2 AGRICULTURE SECTOR (MEGA SCIENCE 1.0)

In Mega Science 1.0, the agriculture sector had identified several issues such as diminishing arable land due to population increase, rural-urban migration, aftermaths of Climate Change and nutrition, and the need to wisely use constrained resources. Several recommendations for the future of Malaysian agriculture include:

a) Molecular breeding (Figure 5.1), genome library sequencing, and barcode DNA Technology of important economic crops like oil palm, rubber, cacao, tubers, herbs, and commercial fruits. This technology could be developed to be as transgenic super crops. For instance, vegetable-oil super crop for oil palm, industrial / non-food super crop for rubber, and herbal-based transgenic super crop.
b) ICT-enabled technologies like satellite remote-sensing, satellite-based GIS, GNSS and RFID-tagged traceability system will be used to track the origin of food source, marketing and carbon audit.
c) Vertical farming technology with ICT-enabled features may create controlled-environment agriculture which is able to control humidity, temperature, light duration, timeliness of water availability. These technologies could be used on poultry rearing and aquaculture.
d) Adoption of automation and field robotics in overcoming labour shortage.
e) Development of technologies in composting and organic fertilizer development of using transgenic cover crops, crop rotation, and plant root system development. The efficiency of the nutrient and water uptake and

hence can be improved meanwhile reducing the over-reliance on inorganic, chemical fertilizers.

Figure 5.1: An Example of Molecular Breeding of Dandelion Plants into Rubber at the Fraunhofer Institute for Molecular Biology and Applied Ecology in Muenster, Germany.
(Burger, 2014)

In particular the molecular breeding of rubber tree will have a significant impact on the supply of raw material in furniture manufacturing. The feedback obtained from the workshops and survey had also revealed the problem of material shortage. Wood based furniture has been the primary material in furniture making. The implementation of stringent regulation on forest harvesting in Peninsular Malaysia has also worsen the dilemma. The current planted forest strategy also cannot accommodate the demand for timber.

Apart from rubber tree, other species can also be considered for molecular breeding such as Rattan, Acacia, Teak, Sentang, Khaya, Kelampayan, Batai, Binuang, and Bamboo. The technology of harvesting the planted forest also must be considered for cost effectiveness and sustainability.

5.3 PLASTIC AND COMPOSITE SECTOR (MEGA SCIENCE 3.0)

In order to reduce the dependency on wood, plastic and composite are potential alternative materials for furniture making. Many industries have adopted composite materials for their product due to its lightweight, high strength, high resistant towards chemicals and corrosion and elastic properties. These industries include aerospace, automotive, electrical and electronics, building & construction, and packaging. However composite materials would degrade over time especially with prolong exposure to UV sunlight. More R&D will need to be done to resolve this issue.

The Plastic and Composite sector have proposed a strategic approach of '5 Smarts' i.e. 'Smart Materials', vis-à-vis based on Plastics & Composites, produced by 'Smart Technologies for Smart Industries targeted for Smart Applications for Smart Communities'. The focus is on ensuring the availability of raw material, additives, and machinery for the local market to reduce the production price of plastic and composites product. This would be an added advantage for the furniture industry to diversify the raw materials used for furniture. Figure 5.2 shows an example of furniture from wood plastic composite.

Figure 5.2: Furniture from Wood Plastic Composite.
(http://brai.evilbreaks.com/stylish-composite-outdoor-furniture/outdoor-composite-furniture-kits/)

5.4 ELECTRICAL AND ELECTRONICS SECTOR (MEGA SCIENCE 2.0)

The Electrical and Electronics sector of Mega Science 2.0 are focusing on compound semiconductor, energy generation, transmission and distribution, solar as an efficient renewable energy, and cyber security. The recommendations of the sector include:

a) Taking part of wafer / substrate production (based on Sapphire) in Malaysia for the LED devices making. The local market share for LED industry also should be broadened and the whole value chain in the LED production should be supported.
b) Implementing energy efficiency usage and innovation for energy sources stability.
c) Moving up the value chain of Electrical and Electronics industry to produce higher value-added products. The R&D efforts should be undertaken in consumer electronics, electronic components, industrial electronics, and electrical.
d) Several enhancements in Malaysian energy generation, transmission and distribution through transition towards the hydrogen economy, distributed grid for Sabah and Sarawak, and introducing innovative renewable energy technology at rural villages.
e) Taking advantage of substantial socioeconomic benefits from solar energy industry. This can be done because Malaysia currently has specific policies on renewable energies, partnerships with advanced solar PV multinational corporations, deployment of small-scale solar PV and thermal applications, and establishment of solar energy R&D centres.

The furniture industry in Malaysia can benefit from the growth of the Electrical and electronics sector. Consumer electronics development is important to the era of smart home system. Furniture embedded with electronics technology such as sensors and home automation will give added advantage for furniture manufacturers in fulfilling future consumer’s lifestyle. An energy efficient furniture industry will help reduce the cost of furniture production. Using alternative energy as a source of will portray

Malaysian furniture companies as environmentally sustainable companies attracting environmental conscious consumers (Figure 5.3).

Figure 5.3: SOFT Rocker is a Solar-Powered Lounge Chair Created at MIT.
(http://www.gizmag.com/soft-rocker-chair-uses-solar-to-charge-gadgets/18748/)

5.5 ENVIRONMENT SECTOR (MEGA SCIENCE 2.0)

The biggest challenge to all scientists is how to utilize the fixed earth resources (especially water, land, forestsand minerals) to serve human needs without depriving the habitats of millions of other species and destroying the ecosystems. Existing technology must continuously be improved to be eco-friendly whilst the emerging one such as renewable energy, genomics, stem cells, nanotechnology, biotechnology and the ICT must conform to the new order of sustainability, ethical and moral obligations whilst contributing to the economic development of the nation. According to the Mega Science 2.0 Environment Sectoral Report, the environment refers to any of the following attributes; carbon and climate change and the management of water, energy, waste, land and forests.

As far as environment is concern, the future development of land and forests has to be integrated and synchronized with other changing external environments, vis-à-vis water, energy, waste, and carbon and climate. The need to ensure that forestry sector will continue to be the responsibility of both the federal and state governments is beyond

any doubt in order to bring about the socio-economic development to the states and nation at the highest quality of life of its people. Based on the report, the furniture industry is highly dependent on the supply of timber. A sustainable supply of timber would ensure the survivor of the furniture industry however this has to be balanced with the requirement of environmental and social sustainability. The impact of the manufacturing process of timber into furniture has to be reviewed to be more environmental friendly.

5.6 ENERGY SECTOR (MEGA SCIENCE 1.0)

Until now the government through its ministries and agencies has formulated more than 14 separate plans and policies that deal with sustainable development (SD), STI capacity building and the identification of energy-related opportunities and these plans and policies show minimal cross-reference to each other. Given the lack of integration of all these sincere but nonetheless uncoordinated efforts, the roadmap-development process requires a detailed review of every single one of these plans and policies. Even with all 14 national plan, Malaysian still rely on non-renewable energy such as natural gas, coal and distillate oil whereas the niche in renewable energy (RE) resources have a tremendous potential to provide sustained energy supplies for the future. The furniture industry can be the pioneer in developing reliable, efficient and affordable RE-based technology. For example waste from wood in production process can be used to generate energy.

5.7 HEALTH SECTOR (MEGA SCIENCE 1.0)

By 2050, Malaysia envisions to be a nation where its population enjoy the highest level of health and wellbeing. It will also have a health sector that is highly efficient and offers widely and easily accessible health care services of the highest quality and cost-effectiveness. Several enablers are in place to transform this vision into a tangible reality: a strong healthcare system; supportive policy and regulatory framework that centres around strengthening research and development capacity and human resources, enhancing investments, and fully exploiting locally available natural products; ongoing health and STI-related research and development initiatives for greater

health outcomes; political, social and economic stability; and good infrastructure in all sectors. Based on the sector recommendations, the impact on the furniture industry would be the furniture of the future which comes with embedded health monitoring function particularly for the ageing population. This could be a niche area that designers in the furniture industry should engage in order for Malaysian products to be more competitive.

5.8 TRANSPORTATION SECTOR (MEGA SCIENCE 2.0) AND AUTOMATIVE SECTOR (MEGA SCIENCE 3.0)

Due to economic growth and migration to urban areas in pursuit of better employment opportunities, private vehicle ownership and public transportation have increased in recent years. The emergence of the transportation industry including automotive industry offers the potential for furniture industry to seek opportunity in providing products for this sector such as seats. These seat assemblies can be a niche area for furniture industry to diversify. Based on available data, the demand of seat assemblies will continue to increase in line with the growth of the automotive sector as well as other transportation sectors such as rail.

5.9 CREATIVE SECTOR (MEGA SCIENCE 3.0)

The Creative Sector in Mega Science 3.0 focuses on 4 sub-sectors which are heritage, arts, media, and functional creations. As far as the furniture sector is concerned, the functional creations sub-sector has the most significant impact on the furniture industry. According to the Creative Sector, functional creations can be divided into two main categories namely design (e.g. architecture, interior design, urban design, fashion, jewellery, wearable technology) and services (e.g. Creative R&D, graphic design, advertising and branding). The design area such as architecture, interior design and urban design, has been quite clearly at the forefront of change. It is due to the global trend of design evolution particularly in transition from mass production to flexible and customised production (Castells, 2010). Therefore, functional creations could take a primary role as the agent of change of urban and interior design specifically in furniture design.

5.10 SUMMARY

In this chapter we have highlighted how other Mega Science sectors may affect the furniture industry. The agriculture sector will affect the furniture industry with potential species for a sustainable supply of timber. The Plastics and composite sector may provide new materials that will sustain the furniture industry. The advancement of electrical and electronics will see more furniture with embedded with electronics. In the wake of the Paris Agreement for Climate Change, the environmental as well as energy sectors will drive the furniture industry toward mandatory sustainability practices. The health sector impact is on health monitoring through embedded sensors in furniture whilst the transportation and automotive sectors will create new niche area of products for the furniture industry. Finally the functional creations subsector of the creative industry will give a major impact on furniture design.

CHAPTER SIX
ISSUES OF TALENT DEVELOPMENT / FUNDING

6.1 GENERAL BACKGROUND

The furniture industry is an established sector with a long history, substantial technological advancement and an established market. Because of its prominence, the performance of this sector can be considered as one of the driving force of Malaysian economic growth. Malaysian furniture industry has so far successfully struggled to remain competative worldwide. It is increasingly facing problems of quality and sustainability of its product. However, furniture manufacturing is currently confronted by a number of structural problems such as a lack of skilled workforce, low attractiveness for young workers, limited access to financal tools to boost research and innovation, limited use of innovative technologies, a not-fully harmonized internal market presenting too many barriers, shortage and rising prices of raw materials, and a non effective system of intellectual property rights protection.

A major issue faced by Malaysian furniture manufacturer is labour. Most manufacturers employ foreign workers with low qualifications from, among others, Bangladesh, Indonesia, and Myanmar for general works (panel sizing, sanding, joining, and painting). Although the cost of these workers are relative low, the initial cost (working visa, agent fee levy) for employing these foreign workers may be very expensive. General works in the furniture industry are very not appealing to Malaysian workers due to the low salary and dusty working condition.

One solution for the increasing cost of labour is factory automation. Factory automation can improve production efficiency thus less dependency on general workers. The Malaysian government offers various incentives to encourage automation, including a 200% capital allowance for up to RM4 million in qualifying capital investment, according to Eric Lee, the president of The Kuala Lumpur & Selangor Furniture Entrepreneur Association (Mahalingam, 2015).

However, automation requires higher educated workers who are trained in automated machine operation and maintenance. Although Malaysian Institution of Higher Learning as well as Malaysian Institution of Skill Training Centre produces thousands of engineers and technicians yearly, the furniture industry is not an attractive

industry compared to the Oil and Gas industry, Electric/Electronics Industry, or Automotive Industry. This scenario may stem from furniture industry being perceived as a low technology industry.

Furthermore, in high-end furniture making, master craftsman is needed to add detailing on personalized furniture. High end custom design furniture manufacturers have reported that skilled carpenters and woodworkers are no longer available in the market.

6.2 FURNITURE EDUCATION PROGRAM WORLD WIDE

Furniture manufacturing relies heavily on furniture design. The aesthetics of a furniture design is normally the first criteria to attract buyers. However, furniture design and manufacturing as a multidisciplinary subject is yet to be recognized. Good talent and knowledge of furniture design and manufacturing can be nutured by a good education system. Generally, a furniture design and manufacturing program is to develop knowledge and skills from the development of prototypes through to the manufacturing process. Table 6.1 shows a sample of university worldwide offering degree programs in furniture design and manufacturing.

Table 6.1: Worldwide General Professional Design Program for Degree and Above.

INSTITUTION	PROGRAM	REMARKS
School of Design Shunde Polytechnic, China	Furniture design and Manufacture / Furniture Manufacture Engineering	Furniture design is aim to cultivate professional personnel to meet the need of local economy and furniture industry development.
Sheffield Institute of Arts Sheffield Hallam University, United Kingdom	Product Design: Furniture	Furniture design based on design culture that considers all aspects of furniture and a philosophy that thrives on new idea, new ways of doing things and the exploration of creative possibilities.
School of Architecture & Design, University Of Tasmania, Australia	Furniture Design	Furniture design focus on design development and prototyping of design concepts all the way to production.
School of Design De Montfort University, United Kingdom	Furniture Design	Furniture design focuses on contemporary design for mass manufacture
National Centre For Excellence In Furniture Design And Technology Galway-Mayo Institute of Technology, Ireland	Furniture Design and Manufacture / Furniture and Wood Technology	Produces highly skilled graduates who combine their creative strengths with manufacturing technology in the design and making of innovative furniture product.
Florence Institute of Design International, Italy	Furniture Design	Furniture design is aim to develop knowledge and skills related to aspect of furniture production, from development and management of prototypes through the final manufacturing process.
Purdue University, United State	Furniture Design	Improvement and problem solving in design through technology application.
Auckland University Of Technology, New Zealand	Furniture Design	Innovation and strategic leadership development for design and marketplace.

6.3 LOCAL EDUCATION PROGRAM

6.3.1 Professional, Skill Based Program and Short Course

From table 6.2 and table 6.3, Malaysia has various institutions providing training in furniture related industry from certificate level, diploma level, first-degree level, and

even postgraduate research level. However, only Universiti Tun Hussein Onn Malaysia is offering furniture–oriented syllabus (under an executive program). Other furniture-oriented syllabus courses are offered up to diploma level by Technical Vocational Education and Training (TVET) centres such as Institut Kemahiran Mara, Kolej Kommuniti, Institut Latihan Perindustrian, Pusat Latihan Teknologi Tinggi, and Terengganu Timber Industry Training Centre (Figure 6.1).

Figure 6.1: Picture from Terengganu Timber Industry Training Centre.

Table 6.2: Local Professional Education Program in Malaysia.

INSTITUTION	PROGRAM	REMARKS
Faculty of Art And Design University Teknologi Mara (UiTM),	Industrial Design	Furniture based project
Faculty of Design And Architecture, Universiti Putra Malaysia (UPM),	Industrial Design	Furniture based project
Faculty of Applied And Creative Arts, University Malaysia Sarawak (UNIMAS),	Industrial Design	Furniture based project
Kulliyyah of Architecture And Environmental Design, Universiti Islam Antarabangsa Malaysia (UIAM),	Industrial Design	Furniture based project
School of The Arts, Universiti Sains Malaysia (USM)	Industrial Design	Furniture based project
Faculty of Mechanical Engineering, Universiti Technologi Malaysia (UTM),	Industrial Design	Furniture based project
Faculty of Creative Technology & Heritage, Universiti Malaysia Kelantan (UMK)	Industrial Design	Furniture based project
Faculty of Arts And Engineering Technology, Universiti Sultan Zainal Abidin (UNISZA),	Industrial Design	Furniture based project
School of Manufacturing Engineering, Universiti Malaysia Perlis (UNIMAP)	Product Design Engineering	Furniture based project
Center for Academic and Development, Universiti Tun Hussein Onn Malaysia (UTHM)	Furniture Design and Manufacturing Technology	Executive Program
KBU International College, KBU's School Of Design (KBU)	Product Design / Interior Design	Furniture based project
Malaysian Institute Of Art (MIA)	Industrial Design	Furniture based project
Kuala Lumpur Metropolitan University (KLMU)	Product Design	Furniture based project

Furniture making can be considered as hands-on training. Thus, it is not surprising that the TVET centres are the majority in offering courses directly related to furniture. Although these centres are currently only offering up to diploma level education, steps have been taken by the Malaysian government to make these TVET centres a favourite choice among Malaysian school leavers as an education path for tertiary study. The TVET centres have been empowered to offer higher degree levels including advanced diploma, bachelor degree as well as master's degree.

Table 6.3: Local Skill Based Education Program in Malaysia.

INSTITUTION / AGENCY	PROGRAM	REMARKS
Politeknik Johor Bahru (PJB)	Industrial Design	Furniture based project
Institute Kemahiran Tinggi Belia Negara (IKTBN), Dusun Tua, Selangor & Bachok, Kelantan	Furniture Design	Model making and manufacturing
Institut Kemahiran Mara (IKM)	Teknologi Reka Bentuk dan Pembuatan Perabot	Skill and making wood based furniture
Kolej Kommuniti Kuala Langat, Selangor	Reka Bentuk dan Pembuatan Perabot	Focusing on design and manufacturing
Institut Latihan Perindustrian (ILP-KSM)	Teknologi Reka Bentuk dan Pengeluaran Perabot	Skill and making wood based furniture
Pusat Latihan Teknologi Tinggi (ADTEC), Jerantut	Teknologi Reka Bentuk Produk Industri	Skill and making wood based furniture
Furniture Technology Center (FITEC)	Furniture Design	Entrepreneur and management
Kolej Kemahiran Tinggi Mara (KKTM),	Furniture Design	Skill and making wood based furniture
Wood Industry Skills Development Centre (WISDEC-MTIB)	Furniture Design and Making	Furniture making wood based
Terengganu Timber Industry Training Centre (Ttitc)	Certification SKM 1&2	Skill and making wood based furniture
Forest Research Institute Malaysia (Frim)	Certification SKM 2&3	Focusing on wood propriety / wood science
Sarawak Timber Industry Development Corporation (Stidc)	Certification SKM 2&3	Wood based furniture
Perbadanan Hal Ehwal Bekas Angkatan Tentera	Certification SKM 2&3	Wood based furniture
VTAR Institute	Furniture Technology Certification	Skill and making wood based furniture
Pusat Giat Mara	Furniture Technology Certification	Skill and making wood based furniture

Programs in furniture design mostly provide students the framework for their development as designers and makers. A comparison made between international furniture design education programmes and Malaysian furniture education design

programmes reveals that education in Malaysia is still bogged down with a rigid system in general. Furniture design programs are not yet specifically established in Malaysian education. Most design programs are focused on Industrial Design and product design.

Most of Malaysian education institutions are only offering general design or manufacturing courses with furniture project as part of their courses. This practice only prepare students for a wider range of job option thus does not help the furniture industry in terms of solving furniture-manufacturing problems, researching optimized methodology for furniture manufacturing or possible new materials for furniture .

However, a close relationship between industry and university is much to be desired in Malaysian education scenario. For example, MAS Woodworking Machinery & Equipment Co. Ltd from China works with local technical school to develop wood furniture program. Shunde Polytechnic has a campus within driving distance of Foshan furniture industry centre.

6.4 Related Program to Support Furniture Industry

The discipline of furniture design deals with the creation and evolution of objects, structures and systems at human scale that aim to improve the quality of live in the immediate living, working environment, while looking at sustainable and innovative use of diverse materials and processes. Table 6.4 list the related degrees that can support furniture industry offered by IPTAs. It shows that UiTM is offering a Bachelor of Science in Furniture and Wood Technology, UTHM is offering a Bachelor of Technology Management in Furniture Design and Manufacturing, and USM is offering a Master in Sustainable Development Practice.

Table 6.4: List of Related Degrees that can Support Furniture Industry Offered by IPTA.

	Universities	Degree Program	Research Centres
1	Universiti Malaya (UM)	• Bachelor of Mechanical Engineering (Materials) • Bachelor of Mechanical Engineering (Manufacturing) • Bachelor of Mechanical Engineering (Product Design) • Bachelor of Science in Biotechnology • Bachelor of Science in Ecology Biodiversity • Bachelor of Science in Environmental Management	• Centre of Advanced Manufacturing and Material Processing • Centre of Advanced Materials • Centre of Product Design and Manufacturing

	Universities	Degree Program	Research Centres
		• Master of Engineering (Safety, Health and Environment) • Master of Engineering (Manufacturing) • Master of Engineering (Material and Technology)	
2	Universiti Teknologi MARA (UITM)	• Bachelor of Science in Environmental Technology • Bachelor of Science in Material Technology • Bachelor of Science in Bio-composite • *Bachelor of Science in Furniture and wood Technology** • Bachelor of Engineering in Mechanical (Manufacturing) • Bachelor of Engineering in Chemistry and Environmental	
3	Universiti Sains Malaysia (USM)	• Bachelor of Engineering (Materials and Mineral resources) • Bachelor of Technology (Industrial *Technology)* • *Master in Sustainable Development Practice***	• Centre for Global Sustainable Studies (CGSS) • Science & Engineering Research Centre(SERC)
4	Universiti Kebangsaan Malaysia (UKM)	• Sarjana Muda Sains Sekitaran • Bachelor of Engineering (manufacturing) • Master of Engineering (Environmental)	• Institute for Environment & Development (LESTARI)
5	Universiti Putra Malaysia (UPM)	• Bachelor of Science in • Bachelor of Science in Wood Technology • Bachelor of Design (Industrial Design)	• Institute of Tropical Forestry and Forest Products • Institute of Advanced Technology
6	Universiti Islam Antarabangsa (UIAM)	• Bachelor Engineering in Manufacturing • Bachelor of Materials Engineering • Master of Science in Manufacturing • Master of Science in Materials Engineering	
7	Universiti Malaysia Sarawak (UNIMAS)	• Bachelor of Applied Arts (Design Technology) • Bachelor of Engineering (Mechanical & Manufacturing Engineering)	• The Institute of Design & Innovation (InDI)
8	Universiti Teknikal Malaysia Melaka (UTeM)	• Diploma of Manufacturing Engineering • Bachelor of Manufacturing Engineering (Manufacturing Process) Bachelor of Manufacturing Engineering (Robotic & Automation) • Bachelor of Manufacturing	

	Universities	Degree Program	Research Centres
		Engineering (Manufacturing Design) • Bachelor of Manufacturing Engineering (Engineering Materials) • Bachelor of Manufacturing Engineering (Manufacturing Management) • Bachelor of Manufacturing Engineering Technology (Process and Technology) • Bachelor of Manufacturing Engineering Technology (Product Design)	
9	Universiti Malaysia Perlis (UniMAP)	• Diploma in Manufacturing Engineering • Bachelor of Engineering (Manufacturing Engineering) • Bachelor of Engineering (Product Design Engineering) • Bachelor of Engineering (Material Engineering) • Bachelor of Engineering (Environmental Engineering) • Master of Science (Manufacturing Engineering) • Master of Science (Product Design Engineering) • Master of Science (Material Engineering) • Master of Science (Environmental Engineering)	
10	Universiti Malaysia Pahang (UMP)	• Bachelor of Manufacturing Engineering • Bachelor of Mechatronics Engineering • Bachelor of Engineering Technology (Manufacturing) with Honours • Bachelor of Engineering Technology (Energy & Environmental) • Bachelor of Engineering Technology (Energy & Environmental) • Master of Science (Advanced Material) • Master of Industrial Engineering	• Advanced Materials Group • Innovative Manufacturing, Mechatronics and Sports Laboratory.
11	Universiti Sultan Zainal Abidin (UniSZA)	• Bachelor of Technology in Industrial Design • Bachelor of Technology in Manufacturing Engineering (Product Design) • Diploma in Manufacturing Technology • Diploma in Industrial Design	

	Universities	Degree Program	Research Centres
12	Universiti Tun Hussein Onn Malaysia (UTHM)	• Bachelor of Technology Management (Furniture Design and Manufacturing) * Bachelor of Mechanical Engineering Technology (Manufacturing) • Master of Science in Manufacturing Engineering • Master of Science in Material Engineering	• Centre of Research for sustainable uses of natural resources (SUNR) • Advanced Manufacturing and Materials Centre(AMMC)

* Related degree in furniture technology
** Related degree in sustainability

6.4 TRAINING PROGRAM IN FURNITURE INDUSTRY

To sustain the Malaysian furniture industry, awareness of the environment should be raised. This could be done by fostering sustainable culture to Malaysian through embedding sustainable elements into school and university curriculum. The government estimated that the number of workers to be trained annually is 9800 up to year 2020.Table 6.5 shows existing training providers in timber industry as compiled by NATIP (MPIC, 2009). Table 6.6 show the number of trainees produced in the timber industry from 2000 to 2008 by specialized timber training institution.

Table 6.5: Number of Workers to be Trained Annually Up to 2020. (MPIC, 2009)

Sub-sector	Level of Employment	Estimated Composition of Labour Force in the Timber Industry (%)	Estimated Total No. of Workers	Estimated No. of Workers to be Trained/ Year – 5%
Sawmilling and Moulding	Managerial[1]	10	3,800	200
	Supervisory[2]	20	7,700	400
	Operations:			
	• Skilled[3]	30	11,500	600
	• Unskilled[4]	40	15,400	800
Subtotal			38,400	2,000
Furniture	Managerial[1]	10	6,800	350
	Supervisory[2]	15	10,200	500
	Operations:			
	• Skilled[3]	35	23,800	1,200
	• Unskilled[4]	40	27,200	1,400
Subtotal			68,000	3,450
Panel Products	Managerial[1]	10	7,100	400
	Supervisory[2]	50	35,700	1,800
	Operations:			
	• Skilled[3]	20	14,300	700
	• Unskilled[4]	20	14,300	700
Subtotal			71,400	3,600
Builders Joinery Carpentry (BJC)	Managerial[1]	10	1,500	80
	Supervisory[2]	20	3,000	150
	Operations:			
	• Skilled[3]	40	6,000	300
	• Unskilled[4]	30	4,500	230
Subtotal			15,000	760
Total			192,800	9,810

Notes:

1. Managerial level includes managers and assistant managers in production and administration;
2. Supervisory level includes supervisors, line leaders, superintendents, foreman/ technicians, designers;
3. Operations (skilled) level includes wood machinist, carpenters, saw-doctors, jig makers, prototype makers, finishers and grinders; and
4. Operations (unskilled) level includes general workers and clerks.

Table 6.6: Number of Trainees Produced in the Timber Industry, 2000 – 2008.

Institutions	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
	Number of Trainees									
Specialized Institutions										
1. Wood Industry Skills Development Centre (WISDEC)	625	460	867	542	509	790	687	984	909	6,373
2. Furniture Industry Technology Centre (FITEC)	n.a.	459	687	729	471	444	491	694	559	4,525
3. Forest Research Institute Malaysia (FRIM)	46	73	119	341	303	330	458	415	408	2,493
4. Terengganu Timber Industry Training Centre (TTITC)	65	80	92	94	262	135	110	311	189	1,338
5. Sarawak Timber Industry Development Corporation (STIDC)	130	131	13	74	132	176	148	152	82	1,038
Subtotal	866	1,203	1,769	1,780	1,677	1,875	1,894	2,556	2,147	15,767
Others Institutions:										
6. *Institut Latihan Perindustrian*, (Industrial Training Institute) (ILP)	59	51	70	30	90	65	49	42	92	548
7. *Institut Kemahiran Belia Negara*, (National Youth Skills Institute) (IKBN)	98	79	72	16	78	70	81	80	71	645
8. Institut Kemahiran MARA (IKM)	15	15	54	81	33	190	70	58	25	318
9. Perbadanan Hal Ehwal Bekas Angkatan Tentera (PERHEBAT)	16	9	30	38	n.a.	8	45	58	33	237
10. Others (Pusat Giat MARA & Politeknik	n.a.	n.a.	n.a.	n.a.	206	251	331	n.a.	275	1,063
Subtotal	173	139	172	84	407	584	576	180	496	2,811
Total	**1,039**	**1,342**	**1,941**	**1,864**	**2,084**	**2,459**	**2,470**	**2,736**	**2,643**	**18,578**

Sources: MTIB, FITEC, TTITC, STIDC, FRIM, ILP,IKBN, IKM, Pusat Giat MARA, Politeknik, PERHEBAT
n.a. not available

6.5 FUTURE NEEDS OF TALENT DEVELOPMENT

Together with new consumer needs and product trends, the globalization of the furniture industry and the difficulties experienced by manufacturer in competing with the prices of world imports have moved the design function to the forefront. Consumers also increasingly prefer high-end, low maintenance, quickly installable products, with customization options to cater for their specific needs. Today's businesses are becoming more customers centric with more people opting for smartly designed furniture with a stress on functionality. Hence, in Europe, furniture manufacturers regard design as the best means of differentiating their product from mass production and of acquiring access to the high-income market segments.

6.5.1 Research and Innovation

Research and innovation, product and design development are crucial factors and key strengths of the furniture industry. The cultural essence and diversity in Malaysia as well as the outstanding education in design are the basis for unique furniture design. The only sustainable strategy for the sector still remains focusing on innovation, research, fashion and design, creation and quality, and the use of new technology.

Sustainability should be embedded into educational content. This will help to encourage a change in the way people understand their social, technological, ecological and political environments. From previous workshops, the main issue identified is the raw material availability. Wood and wood products are the major inputs in Malaysian furniture production. The inbound distribution system of wood raw material is thus a key factor in the efficient functioning of the furniture industry. Thus it is very important for the government to provide a solution through:

a) Research and Development on Timber Species.
b) Research and Development on Alternative Material to the Wood.

Innovation in materials and technologies is another crucial competitiveness driver. Contrary to design, only a small number of Malaysian firms carry out industrial research activities internally in order to develop new material or technology for

furniture. An interesting field of innovation which can potentially affect the furniture sector in the near future is represented by nanomaterial and nanotechnology. Looking at the current market, the use of manufactured nanomaterial in furniture product is still at its infancy since the cost is quite high while the confidence of furniture manufactures and consumers are also still low.

6.5.2 Education Program

Changes in eduction and training are required to equip the future workforce with new skills required in the future. The program in furniture design must provides students the framework for their development as designer and maker. To this end, Technical Vocational Education and Training (TVET) systems should also be adapted to include new sector-specific skills and competences.

6.5.2.1 Specific Program on Furniture Design

Furniture design is generally interpreted as the sum of the aesthetic content of furnishing product: from function to form, from material to colour, and finishing. In general terms, the contribution of designers is most important during the first phases of the generation of a new product. To become a good furniture designer, a specific program on furniture design and manufacturing should be establish at the university level through a new approach curriculum which combine a broad range of skills and knowledge in the following areas such as:

a) Aesthetics.
b) Basic Business Practices.
c) Consumer Trend Analysis.
d) Ergonomics.
e) Computer-Aided Design.
f) Marketing.
g) Furniture Materials and Processes.
h) Mechanics and Engineering Techniques.
i) Furniture Manufacturing Method.

Therefore, to sustain the Malaysian furniture industry, the awareness on environmental should be raised. This could be done by fostering sustainable culture to Malaysian through embedding sustainable elements into school and university curriculum.

6.5.2.2 Research Centre

Research centres are important to the development of new instruments or methods in order to strengthen the ties among technical teaching institutes, design institutes, and companies.

6.5.2.3 Innovation in Design

Innovation is another competitive edge for furniture manufacturers. Concerning technological innovations, while some years ago mechanical technologies were the only frontier of research in the furniture sector, today a growing role is also played by ICT. Indeed, both wireless remote controls and smartphone apps are increasingly used to control home appliance or furniture such as mattresses, chairs and sofas, while the use of digital material for promotion and sales is also on the rise. Therefore, in the production process, new production methods should be introduce to allow for energy saving. For instance, the furniture production line can be equipped with an environmentally-friendly woodchip burner that recycles all the waste and chippings as fuel in the production facilities. While, protecting innovations and enforcing intellectual property rights (IPRs) should be a priority to ensure that the Malaysian furniture can continue to compete in the global economy despite increasing international counterfeiting and piracy in many sectors.

6.6 MACHINE BUILDING AND MAINTENANCE INDUSTRY

A visit to the furniture hub in Lecong, China, had revealed how the furniture industry in China had evolved over the past decade. The Chinese furniture industry started as a skilled craftsman industry and highly labour intensive. The labour cost being low had

attracted significant foreign investment. But as the demand for more and higher quality furniture increase coupled with rising labour cost, this had pushed the industry towards automated solutions for furniture manufacturing. This in turn had created a demand for a machine building industry. Automation in the furniture industry had given them the capability to manufacture furniture at a higher volume and with better quality than manual work.

The Chinese furniture industry had also concentrated on their local market first before exporting the furniture to the international market. The local market can help sustain the company against the volatility of the international market as the supply and the demand of the local market is highly predictable. In addition this had instilled confidence on the design and quality of their furniture.

Automated machineries for the furniture industry are less precise than automated machines for other industry such as electronics or automotive industry. Only certain specific part of the furniture required high precision machineries. Thus, less precision machine are usually cheaper to manufacture and had thus propelled China towards having a furniture machine building industry to cater for local demand (Figure 6.2). In the long term it would be prudent for Malaysia to research and develop machineries and automated systems for the Malaysia furniture industry.

Figure 6.2: Machine Building Company in Foshan Producing Furniture Making Machines for Local China Market.

6.7 SUMMARY

In this chapter we have highlighted issues on talent development for the Malaysian furniture industry. Talent development in Malaysia is generally divided into the academic stream and technical and vocational (TVET) stream which focuses on skills training.

The academic stream, aims to produce furniture designers, production engineers, or material researchers. Programs are offered at various levels from diploma level, bachelor degree level, master's degree level or doctorate level. However, the existing academic programmes are general in nature and not specific to furniture Design and manufacturing

In technical and vocational (TVET) stream, the teaching is focused to groom the talent in acquiring the necessary skillset to make furniture from general woodworking, wood-machining, wood crafting. Although the TVET provides more specific course for furniture industry, the current courses offered are only up to advanced diploma level.

However, both academic and TVET streams did not offer courses for a crucial supporting industry for the furniture industry namely machine building. The machine building industry has proven to be crucial in the development of the furniture industry in China leapfrogging it into the world biggest furniture exporter.

CHAPTER SEVEN
PROPOSED STRATEGIES

7.1 GENERAL BACKGROUND

Despite the positive projection of Malaysian furniture industry for the future, the real situation is quite different. From the early 80's the Malaysian furniture industry had grown dynamically where it has transformed from traditional based operation to a technological driven industry. However starting from 2004, the industry seems to be stagnant with the export revenue hovering at 7 to 8 billion per year for 10 consecutive years with an average annual growth of only 3.98% (MFPC, 2013). In the Third Industrial Master Plan (2006-2020), the Malaysian furniture industry is one of the sectors that has been urged to improve its product competitiveness at a global level through innovation and is expected to grow at 6.4% annually. In order to move Malaysian Furniture Industry towards a high technology industry, a concerted effort is needed from all stakeholders.

7.2 TIMBER MATERIALS

7.2.1 Sustainability of Rubber-wood Supply

Since rubber-wood furniture has become the Malaysian furniture flagship, so it is vital to maintain the rubber-wood supply at competitive price in the future through replanting programs as well as research on tissue culture for introducing new breed of rubber plant that has shorter mature age and capable of producing good quality timber (less brunches, bigger sizes and etc.). This would involve agencies such as Rubber Industry Smallholders Development Authority (RISDA), Rubber Research Institute Malaysia (RRIM), Ministry of Plantation, Industries and Commodities (MPIC).

7.2.2 Introduction of New Wood Species

Research in Institute and universities have been established to provide R&D to support the furniture industry for example the Forest Research Institute Malaysia (FRIM) and

Fibre and Bio-composites Development Centre (FIDEC).According to MPIC (2009), there are several new clones developed by Rubber Institute of Malaysia namely RRIM 900, RRIM2000 and PB series which are harvestable in a shorter rotation period of 12-15 years. Research activities should be increased and findings should be extended to the manufacturers. Further research is needed to translate these findings into usable furniture product. For example, conducting research to find types of furniture products that can be produced and also types of manufacturing processes that is cost effective.

7.2.3 Reducing Dependency on Wood

New materials should be introduced in modern furniture design. Bio-composite materials have been shown to be effective as an alternative to wood and could reduce deforestation. For example: wood plastic composites are made of wood fibres and plastics that contain lignocellulosic fibres and several non-organic filler materials. Local universities and research institute should be encouraged and provided with funding to develop new materials including testing and manufacturing process up to commercialization.

7.2.4 Lack of Certified Sustainable Timber

Chain of Custody (CoC) certification is a non-mandatory and a self-voluntary initiative thus it should be promoted among furniture manufacturers to source certified timber. The Malaysian Timber Certification Council (MTCC) has to be more proactive in providing training/program to produce “Certified Sustainable Timber”. It is important that measures are taken so that supplies can be sourced locally thus reducing the production cost as a result of increasing demand for CoC timber sources.

Related agencies such as the Malaysian Timber Certification Council (MTCC), Malaysian Timber Industries Board (MTIB) and Malaysian Furniture Council (MFC) will have to work together to realize this strategy.

7.3 ENCOURAGING THE USE OF HI-TECH / AUTOMATIC MACHINERY

Single hi-tech machinery is capable of replacing a few foreign workers; however the initial cost of acquiring such technology is far higher compared to hiring foreign workers as well as the risk if the business is not doing well. Most hi-tech machineries are manufactured abroad, resulting in the price of the hi-tech machinery to be very expensive. A proactive action can be taken by the government to reduce the risk of automation by either reducing the import tax imposed on hi-tech machinery or by giving incentives to manufacturer that can reduce the numbers of foreign workers through acquiring hi-tech machinery. Another approach is to develop the machine building industry locally especially in the state-of-art computer numeric control (CNC) Machine, computer aided design (CAD) system, 3D printing and etc. The manufacturing industry should also look at the way it operates which should move towards 'Agile Manufacturing' responding quickly to customer demand, mass customization and extensive collaboration in the supply chain.

Related agencies are Malaysian Timber Industries Board (MTIB), Malaysian Furniture Council (MFC), and Malaysian Industry-Government Group for High Technology (MIGHT).

7.4 BUSINESS

7.4.1 Brand Creation

The local industry also need to move away from the strategy of original equipment manufacturing (OEM) towards original design manufacturing (ODM) and ultimately to original brand manufacturing (OBM). This would involve innovative and creative designers that will produce design that are competitive in the global market.

Related agencies are Malaysian Furniture Promotion Council (MFPC), Malaysian Timber Industries Board (MTIB), and Malaysian Furniture Council (MFC).

7.4.2 New Emerging Marketing Method and Online Marketing

With the growth of Internet as a global medium, buyers and sellers can conduct business across borders in seconds. Online marketing is become increasingly important to all types of businesses. Lazada and Rakuten are example of companies that are selling products for other companies online. The problem with furniture industry will be the delivery time and warranty. This can be solved through a globally optimized sustainable supply chain management.

Related agencies are Malaysian Furniture Promotion Council (MFPC), Malaysian Timber Industries Board (MTIB), and Malaysian Furniture Council (MFC).

7.4.3 New Business Model

There is multiple business models that can implemented for the Malaysian furniture industry such as:

a) Furniture retail support service company (mainly B2B).
b) Furniture brand concept companies.
c) Integrated furniture companies.
d) Bespoke high end furniture makers.
e) Specialist high end furniture retailers.

7.4.3.1 Furniture Retail Support Service Company (mainly B2B)

It involves designing furniture collections, market them to wholesalers and retailers who will sell these collections under their own brands, and handle the logistics from manufacturing to delivery to store. It can be commercially sensible for some of the company to outsource the manufacturing as they may lack the relevant skill-sets and their capital is often tied up in costly design related expenses such as prototyping and marketing (catalogue printing, participation in trade fairs).

7.4.3.2 Furniture Brand Concept Companies

A classic example of this model is; IKEA who design its own brand as total concept collections (furniture and accessories), market their brand to consumers, and typically sell through retail franchise/licence dealers. Local players should develop a similar business model with their higher end furniture collections.

7.4.3.3 Integrated furniture companies

In this model companies are involved from end to end on the furniture value chain (design, manufacturing, brand marketing and retail). Examples include Rozel and Ashley Furniture.

7.4.3.4 Bespoke high end furniture makers

In this approach companies sells customised pieces of furniture that are designed and crafted in house according to the requirements of their customers who are mainly the end users of the furniture as well. Retail footprint is typically minimal or in locations with lower rents as their limited production capacity means they seldom generate sufficient revenues to cover retails overhead.

7.4.3.5 Specialist High End Furniture Retailers

This type of companies acts as curators and retail platform for niches brands and designers. Their value proposition lies in their understanding of customers' preferences and their ability to customise their retail mix accordingly. For own bespoke designs, manufacturing is typically contracted out to skilled furniture makers.

All this business models can elevate the whole of the value chain in every aspect such as having more designers, marketer and skill workers working in this industry.

Related agencies in this effort include Malaysian Furniture Promotion Council (MFPC), Malaysian Timber Industries Board (MTIB), Malaysian Furniture Council (MFC), Industries, and Malaysia External Trade Development Corporation (MATRADE).

7.4.4 Lack of Business Competitiveness

With Malaysia becoming increasingly uncompetitive compared to countries such as Vietnam as a base for OEM manufacturing, it is necessary to go into the manufacturing of higher value add products which require more customization and technical expertise as well as serving markets with stickier customers who value consistent product quality and good customer service . For furniture, this means venturing into design, branding and retail. While the present focus is on facilitating OEM players to move towards ODM/OBM business models, it must be acknowledged that there are multiple business models for capturing this higher value add margin.

7.5 HUMAN CAPITAL

7.5.1 Strengthening the Institutional Support and Improving the Delivery System Related to the Industry

Local design skill need to be nurtured by empowering furniture design program offered in most of the higher Malaysian institutions and develop more training institutions focusing on furniture manufacturing process, management skills, design, working skills, obtain human resource development funds and other resources. This will involve all educational institutions, technical educational institutions.

7.5.2 Foster Smart Public-Private Partnership between the Industry, Government Machinery, Public Research Institute and Universities

Collaboration between the industry and local education and training institutions will be encouraged in the areas of design and engineering to upgrade and promote the use of suitable technologies and production processes.

7.5.3 Enhancing R&D Related to New Technology

The Malaysian industry is characterized by a unique proficiency in design and product development. Most of them have established close connections with international suppliers, following the highest technical standards. Many companies are looking to good designers to deliver innovation, to establish and build brands, and to improve production systems and sales. R&D centres should be established to develop new technologies in furniture manufacturing, producing new design and diversified materials.

Related agencies involved should be all educational institutions, technical educational institutions and Malaysian Industry-Government Group for High Technology (MIGHT).

7.5.4 New Technical Wood Working and Furniture Institute

We need to bring world class wood working institute to better attract students and establish more effective apprenticeship programs. With this program, we will able to have more skill workers as the manufacturer are now dependent on older generation of workers with their succession plan at risk.

Related agencies are all Educational Institutional, Technical Educational Institutional and Malaysian, Malaysian Industry-Government Group for High Technology (MIGHT) Malaysian Furniture Promotion Council (MFPC), Malaysian Timber Industries Board (MTIB), Malaysian Furniture Council (MFC), and the Malaysian furniture industries.

7.6 OEM TO ODM

An initiative should be taken by the government sectors and furniture companies to transform the simple furniture product into high-end custom design furniture (ODM). Yet, the product transition also requires specific skilled carpenters and woodworkers. In addition, transition into ODM also requires great understanding of the targeted market which our local furniture companies are lacking of. Large export market such as Europe and United States, remain sceptical of the design by Malaysian furniture companies

unless it comes with an established brand. It is impractical for new furniture companies to penetrate the foreign market without having a well-known brand. Furthermore, the best way to alleviate this problem is by being an OEM but incrementally moving towards a few own design and brand products. Joint ventures between new ODM furniture companies with recognized brand companies can also be a solution.

The Malaysian Furniture Promotion Council (MFPC), Malaysian Timber Industries Board (MTIB), Malaysian Furniture Council (MFC), Malaysian furniture industries can work together on this aspect.

7.7 GOVERNANCE

7.7.1 Holistic Sustainability Policies and Action Plan

In order for the Malaysian Furniture Industry to be better prepared and equipped to tackle current and future sustainable concerns several new policy measures are needed:

a) Sustainable Education and Training;

   There is a need to introduce or include sustainability practices in current and future training and education curriculum of furniture manufacturing industry related program. This would further increase the awareness and imparting necessary knowledge to industry players in implementing sustainable manufacturing practices.

b) Continuous Public Awareness Programs;

   In order to push green furniture to the domestic market there is a need for program and initiative to create awareness among the public. The market needs to be informed and introduced with green/eco labelling, PSS models, and should be introduced in order to increase the demand of sustainable furniture.

c) Green/Sustainability policies and regulations;

   To increase sustainability practice thus increasing the sustainability image of local furniture products. There is a lack of green regulations and enforcement. In order to promote the industry towards sustainable practices, there is a need to support business with financial investment support such as through tax relief and initial grants.

7.7.2 Streamlining of Governing Institutions

It is critical to incorporate sustainability concerns into land use planning and forest plantation development planning as well as develop a reputation for stringently enforcing legality and sustainability standards to ensure marketability of Malaysia timber products. From the business point of view, the government can assist in alleviating raw materials shortage and streamlining policies from each state such as Sabah and Sarawak. Ideally, the policies should be streamlined into single national regulatory authority and a single national industry development body for the entire timber value chain. Nonetheless, another additional issue that constrains the streamlining is state sovereignty over forest resources and land use.

7.7.3 Revisiting the National Foreign Workers Policy

While mechanization and automation has been cited as potential solutions to lower foreign workers requirement it needs to be understood that there are limits to what is possible within the furniture industry. A revisit of the National Foreign Worker Policy may be necessary to mitigate the shortage of general workers in the industry in the short term.

7.7.4 Reduce Bureaucracy

Manufacturers are facing a lot of bureaucracy and need to go through a barricade of processes in order for them to operate. This causes some delays in production as well as increasing in cost which is transferred into product costs. For example, to build a legal factory needs approval from at least three agencies (DOE, Pejabat Tanah and PBT).

7.8 EMERGING FOCUSED SEGMENT

The elderly will become a significant proportion of the future population. In order to attract buyers from this segment of the population, the design and function of furniture must have characteristics that cater for their needs and lifestyle. This includes:

a) Ergonomic furniture that has motorized recliner and rise
b) Easy to handle
c) An improved safety for instance couch cane for sitting motion, avoid slippery accidents, and optimizing space visibility
d) Embedded health care electronic monitoring system such as temperature and blood pressure checking
e) Encourage social interaction

Urban lifestyle is among the emerging market segment where the Malaysian furniture industry can explore. Due to rapid urbanisation, increasing density of population and cost of urban land, there is a continuing reduction in living space.. Thus the requirement for furniture will be smaller, lightweight, multipurpose and energy-efficient. Furniture characteristics to meet the requirement of urban living, among others, are:

a) Full utilization of space such as vertical stacking furniture, under the stairs cabinet, corner mounted shelf, or nesting table.
b) Furniture designed for Small Office Home Office (SOHO)
c) Light weight furniture
d) Transformable room and furniture according to the residents living. For example modular concept, multi-function, foldable, extendable, and height adjustable furniture
e) Translucent furniture to made bigger space illusion.

It is believed that furniture designers are already aware of the trend towards aging population and urbanization. However there is a lack of motivation to focus in this area as the furniture industry has no interest in such research. On the other hand, furniture

designers should be constantly encouraged to understand how to improve the life of the aging population in their everyday activities or their health care needs. The elderly population requires more accessibility to health care and social services. This can be done by integrating technology such as IOT into furniture design.

7.9 SUMMARY

In this chapter we have highlighted the proposed strategies to drive the Malaysian furniture industry to a higher level. The main idea behind the proposed strategies revolves around the transformation of the furniture industry manufacturing practices namely sustainable raw materials, encouraging automation in manufacturing practices, branding, exploring new marketing strategies, starting new ODM companies, fostering public-private partnership, enhancing R&D, sustainable policies, streamlining governance and reduction of bureaucracy as well as addressing new market segments for the elderly citizen and smaller space urban living.

CHAPTER EIGHT
ROAD-MAPS

8.1 GENERAL BACKGROUND

The government policies are administered by different bodies with different goals. As a result the industry finds it difficult to fulfill different and sometimes confusing requirements. In addition, the policies are often inconsistent and redundant. With Malaysia becoming increasingly uncompetitive compared to countries such as Vietnam as a base for OEM manufacturing, it is necessary to provide a healthy bussiness enviroment for the industry to grow in the future. The short term, medium term, and long term goals are discussed and a road map proposed in this chapter.

8.2 SHORT-TERM GOALS

There are many strategies that have been proposed to enhance wood based industries in general and the furniture industry in particular in a report by NATIP (MPIC, 2009) and in the Third Industrial Malaysia Plan (IMP3). For the short term goals, the government need to strengthen existing policies and increase available resources. These goals are:

8.2.1 Governance

National policies, action plan and standards are improved to include:

a) Increasing the portion of agricultural land converted into planted forest wood (Teak, Kelampayan, Rubberwood) for furniture resource instead of for logging.
b) Reduction of foreign general workers through engaging local youngsters into the industry.
c) A seamless governing system through a one stop centre or a commissioner for furniture example like SPAD for transport.

8.2.2 Research and Development

There is a need to have a Centre of Excellence for collaborative research between university and industry on alternative materials, sustainable species to sustain raw materials availability and manufacturing process optimization. Many government agencies and universities are conducting research in silos and the research findings are not easily accessible to the industry. The centre of excellence also can collect case studies and share manufacturers' best-practices that can be accessed by manufacturers in order to improve their design and operations.

8.2.3 Sustainability

A sustainability awareness program for the public at all levels. In particular sustainability awareness on sustainable resources and production need to be imbedded among furniture manufacturers in way that they see it as a compulsory practice for them if they want to stay competitive in the future. The manufacturers must see that emphasising on sustainable initiatives will help them get bigger market share and achieve cost benefits. The availability of sustainable products in the market can in turn increase customer sustainable awareness and influence their lifestyle.

8.3 MEDIUM-TERM GOALS

8.3.1 Human Capital Development

a) Furniture related programme in institution of higher learning such as degree in furniture manufacturing management, furniture design and manufacturing, and forest management becomes courses of choice.
b) Continuous learning for all levels of furniture employee such as furniture designer, technicians, general workers, craftsmen, manager.

8.3.2 Science, Technology and Innovations

a) Furniture industry operated at a high efficiency level with the following investment:
   i. Cost-saving technology and machineries.
   ii. Advanced manufacturing technology.
   iii. Operation management and Industrial Engineering skilled workforce that can work on efficient and effective shop floor layout, material and manufacturing planning, inventories, logistics etc.

8.3.3 Governance

a) Government support for companies to implement sustainability programs.
b) Implementation of green manufacturing policies.
c) Infrastructure and logistics in East Malaysia comparable to Peninsula.
d) Exit of foreign general workers or less than 10% of foreign general workers is employed through implementation of automated manufacturing system.
e) High value added and sustainable downstream timber industries become a new focus on a new policy. Government should encourage on high value added and downstream timber industries such as on finished furniture, and this should be translated into relevant policies, regulations and initiatives.

8.3.4 Business

a) Furniture Solution and lifestyles are marketed with Malaysian own brand and design.
b) Several ODM and OBM companies from Malaysia leading the market sectors.

8.4 LONG TERM GOALS

a) A well-developed local machineries industry able to produce automated machineries and manufacturing system for furniture.
b) Internet of things and smart furniture becomeing niche components and prominently featured as Malaysian furniture.

c) Establishment of a world class furniture university.

d) Furniture industry operating at high efficiency using advanced manufacturing technology.

8.5 ROAD MAP

Figure 8.1 depicts the road map from 2016 to 2050 of the goals that need to be achieved at various stages of the development of the furniture industry.

8.6 SUMMARY

In this chapter we highlighted the proposed roadmap toward a competitive Malaysian furniture industry in 2050. The roadmap is divided into short-term, medium term and long term. The roadmap focuses on the manufacturer, educational institution, as well as the government as the main stakeholders. This proposed roadmap lays the milestones for the furniture industry to become a technological driven industry in 2050 and shifting away from the labour intensive industry it is now.

Figure 8.1: Road Map of the Furniture Industry.

CHAPTER NINE
RECOMMENDATIONS

9.1 GENERAL BACKGROUND

Six Regional Furniture Industry Sector Consultative Workshops had been organized in order to solicit feedback from stakeholders in the furniture industry in Malaysia. In these workshops, current status, issues and challenges, future needs of the industry as well as recommendation for the government to help the Malaysian furniture industry achieving high-tech status was discussed.

9.2 SHORT-TERM

9.2.1 Governance

Revisit the current national policies, action plan and standards to:

a) Ensure the replanting program of rubber plant successfully carried out in order to ensure sustainable rubberwood supply for the furniture industry in the future.
b) Reduce the dependency of foreign labour (to limits that are possible within the furniture industry) by revisiting current foreign labour policies.
c) Minimize the bureaucracy in the governing system to encourage industry to grow.
d) Reduce the redundancies by multiple policies of different governing bodies.

9.2.2 Research and Development

More grants should be provided for the industry and universities/technical institute/research institutes to undertake mutual collaboration and R&D on sustainable alternative material, advance manufacturing technology, and aging population and urban furniture trends for furniture makers. Furthermore, the Malaysian furniture industry requires well-trained machine specialists who are capable maintaining and repairing

machineries. Thus, training centres for advance machine maintenance and repair are urgently needed.

9.2.3 Sustainability

Sustainability elements embedded in schools and university curriculum. Government can continue enhance the efforts and create more public awareness on sustainability in general, sustainable products and sustainability consumption. For manufacturers, government can promote sustainable manufacturing practices as an initiative that can help the companies get a larger share of market share (e.g. in Europe) and help companies to cut production cost.

9.3 MEDIUM-TERM

9.3.1 Human Capital Development

a) Enhancing existing educational program to attract and convince the youth to choose furniture technical program as the main preferences.

b) Improvement of existing human capital development for all levels skill set needed such as:

   i. Furniture Designer – Designing skill needs to be nurtured by empowering furniture design program offered in most of the higher Malaysian educational institutions.

   ii. Skilled Workers – encourage youngster to join skilled based training such as furniture manufacturing process and wood working technology program to multiply the local skilled workers.

   iii. Craftsmen – Recognized skill and talent of the craftsmen through certifications.

   iv. Embed existing educational program (including skill based and craftsmen) with the proven capability and fast development of software (CAD/CAM, CAE) to improve the industry especially in material and resources planning.

v. World class wood working institute to better attract students and establish more effective apprenticeship programs to counter the shortage of local skilled workers.

vi. Awareness on environment should be raised by fostering sustainable culture to Malaysian through embedding sustainable elements into in school and university curriculum.

9.3.2 Science, Technology and Innovations

Encourage furniture industry to increase their operations efficiency by investing on:

a) Cost-saving technology and machineries by upgrading the control system of machinery or process from manually operated to computer numerical control (CNC) or fully automated or robotic process.

b) Advanced manufacturing technology which are able to increase the operational flexibility and new innovative technology for mass customization.

c) Commercialization of niche furniture market: furniture for urban and healthy lifestyles, furniture for senior citizen care.

9.3.3 Governance

a) Incentives/reward system to the company who are willing to reduce the foreign labour through investment on STI.

b) Government support in terms of grants and tax incentives on companies with sustainable practices.

c) Holistic national governing policies and acts on green manufacturing implementations.

d) Building a furniture hub that is furniture business friendly focusing on infrastructure and logistics especially for Sabah and Sarawak to reduce the economic gaps as well as to reduce migration.

9.3.4 Business

a) With Malaysia becoming increasingly uncompetitive compared to countries such as Vietnam as a base for OEM manufacturing, it is necessary to go into the manufacturing of higher value add products which require more customization and technical expertise as well as serving markets with stickier customers who value consistent product quality and good customer service . For furniture, this means venturing into design, branding and retail.

b) OEM to ODM Program by facilitating OEM players to move towards ODM/OBM business models.

9.4 LONG TERM

a) Development of local furniture manufacturing technologies to support the local furniture industries as well as reducing the dependency of the local industries player to technological advancement from other countries especially from Taiwan and China due to low cost.

b) A continuous Government related institutional support of R&D programs on the technology of wood cutting tools, wood processing machinery and wood processing technique.

c) New National Policy regarding foreign labour, encouragement of increasing the downstream industries, Rubber Plantation and timber wood sustainability, minimizing the governance bureaucracy and sustainability.

d) Striving to become world market leader in senior citizen care and urban lifestyles furniture as these market segments will become a niche market in the future.

9.5 SUMMARY

In this chapter we have highlighted the recommendations for the main industry players, educational institution and the government toward a technological driven Malaysian furniture industry in 2050. The recommendations can be implemented in short-term, medium term and long term.

TEAM MEMBERS

	Name and Position
Leader	PROFESSOR DR. ZAHARI BIN TAHA PROFESSOR IMAMS LAB, FACULTY OF MANUFACTURING ENGINEERING, UNIVERSITI MALAYSIA PAHANG
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Expert 3	SARIMAH BINTI HAJI MOHAMAD SABUDIN CHIEF EXECUTIVE OFFICER, MALAYSIAN FURNITURE PROMOTION COUNCIL

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APPENDICES

Summary of Data Collected Through Regional Workshops and Factory Visits

Regions	Current Status and Challenges	Current Technology
Central	• Competitive price. The quality comes with affordable price. • SMEs also export furniture together with big companies. • Malaysian cannot be compared with China because Malaysian furniture industry is unique; ability to meet order in due date. • Malaysia export OEM, therefore does not need product innovation	• Difficult to shift into automation • The industry reluctant to choose automation because the domestic market is small. Domestic volume is low therefore automation is not cost effective • Moreover, differences in design is hard to change mechanization of automation
South	• Since 2015 no more logging approval from Sultan, thus raw material decreased • Get wood supplies from other state such as Pahang, Terengganu and Kelantan, but the supply also decreasing • The manufacturers maximize the raw material usage (e.g using wood chips) • Many pallet factory • Mostly SMEs in Muar - Many problems with SMES - Illegal factory - Illegal workers - Not safe work environment - No budget to invest on environmental monitoring tool and systems - Located in housing area • To build the legal factory need to get approval from 3 agencies – DOE. PBT and Pejabat Tanah (need to build on industrial land)	• Very basic. Air pollution measurement equipment used is cheap and not following standard. Many SMEs don't have any equipment • Some companies implement conveyer system and automate as much as they can
Sarawak	• Difficult to get raw materials. The manufacturers have to outsourced abroad even for Sarawakian logs e.g. Taiwan • Received High demand, but no materials • Timing issue due to logistics problem • Sarawak exporting raw material and semi -finished products but not finished products (no local brand) • Many exporter went bankrupt due to raw material input problems • A lot of problems with transportation/ logistics e.g no port, high logistics cost • Only several manufacturers survives • Threat from china which China offers cheaper furniture, and part supplies • Must import raw material from overseas (even for Sarawak material) • Labour intensive. Majority low skilled labour except in wood crafting • Foreign worker (culture problem) • Issue on workers loyalty. Easy to leave, thus company need to find and train new	• Would like to use automation but volume issues • Machines are bought from overseas, maintenance problems due to logistics

	workers	
Sabah	• Problem to get wood • Steel is expensive. Also due to no recyclers in Sabah thus no value chain • A lot of bureaucracy in government sectors. • State policy not friendly and facilitating the manufacturer • Customs in Port Klang not efficient, resulting longer lead time and lost orders • Cabotage policy	• Would like to use automation but have volume issues and unstable electricity supply
North	• Use mixed materials e.g solid wood (medium density) due to for local market, the customers looking for affordable furniture • Material is imported	• Bigger factory using CNC. Also provide service to smaller factories
East Coast	• In furniture design, there is not much aid in furniture design • Furniture design made is not considering sustainability (limited support of eco design) • Consumers always opt for trend instead of buying because appreciating the furniture design • Innovation based on sustainability is less important or not considered • At university level, designers (industrial designers) are not taught of sustainability policies. • Monotonous furniture design • Designers only aware of design safety but not about product ergonomics • Furniture industry in Terengganu is left few years behind • Manufacturers in Terengganu are having problems after sustainability implementations is strengthen • Reluctant to use machineries for wood carving because it has no soul. • Frustration of furniture manufacturers with the sawmill companies (not selling raw material to them – high price)	• Most manufacturers in Terengganu use semi-auto machineries but one company which provided by MFPC-MTIB funding program. • Furniture carving needs workmanship skills

Report on Central Region Furniture Workshop

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 47 participants who participated in the workshop on the 10th June 2015 at Academy of Sciences Malaysia, MATRADE Tower. The event was officiated by Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

The objective of the workshop were thus to present survey findings done during Export Furniture Exhibition 2015 (EFE 2015), identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Three groups were formed for detailed discussion on the furniture sector in Malaysia. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
3.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Strategic Recommendation	Propose recommendations to achieve preferred future
6.	Four Futures	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers

According to LFA discussion, the members agreed that fully automation system in manufacturing line is difficult to be implemented due to diversification in design. Malaysia's furniture export trademark is home furniture. The production of home furniture is believed to be complex hence changing to fully automation is not a cost-effective solution. Under the circumstances, the production cost would be impractical to be reduced. Malaysian furniture is high in quality but not cost effective.

In the meantime, China is seen as one of the most advanced country in furniture manufacturing because of high demand in both domestic and international market which had facilitated China manufacturers to produce furniture at high volume. The demand in Malaysia domestic market is low to be compared to the international market. Malaysian manufacturers believe that high demand of domestic market is the key to the cost effectiveness of full automation implementation.

Each group had come out with desired furniture criteria for future society. The brainstorming session of impact diagram figured out several important attributes which are:

a) Design (flexible design / Original Brand Manufacturing)
b) Green advanced technology (following international sustainability standard)
c) Regulation (specific education focused on furniture industry / incentive)
d) Human Capacity Development (focusing in designers and skilled workers)
e) Manufacturing (high technology machineries)
f) Research, development, and commercialization (Intellectual Property / alternative materials)
g) Marketing and promotion (online virtual / trade hub)

During the group discussion, each group came out with a plan series towards defining the desirable future. The three groups were: Multi-App Furn, Intelligent

Wellness Furniture, and Eclectic Furniture. Multi-App Furn targeted to attain RM30 Billion export market in 2050. Meanwhile, Eclectic Furniture expects the furniture industry to develop a comprehensive furniture that embedded with features current needs.

Multi-App Furn Group targeted to achieve RM20 Billion export in 2030 and to explore market into ASEAN countries. Starting from now to 2020, alternative to current raw material should take place in the market and the production line shifts from Original Equipment Manufacturing (OEM) to Original Design Manufacturing (ODM). Research, development, commercialization, and innovation is targeted to enhance the furniture industry in promoting new testing, new technology, and the various numbers of prototypes and intellectual properties for furniture product. The emergence of new technology in innovation chain can ensure the success of commercialization later on. The Home Grown Technology (HGT) program with effort for creativity and innovation expects to arise beforehand. The HGT program may inspire furniture manufacturers to carry out significant innovations at pilot production level towards final marketing of a product. The encouragement of HGT program is viewed can remove the hesitation of furniture manufacturers to try out new technologies that is new to them as well as to the market. The desirable future for Multi-App Furn is to reach RM30 Billion with the market expansion to Europe and Middle East Countries in 2050.

The prospect of a success furniture industry in the future is observed to be a green growth industry, revamp its functionality and has quality of life value. Multi-App Furn believed the unwillingness to change towards alternative material may lead to high dependable to timber, which is not sustain in the future. At the worst case, the current export market share may be keep on stagnant at RM8 Billion or decrease in the future. Sunset industry is the disaster for the furniture industry as well as widespread of deforestation.

Eclectic Furniture agreed that revamping the education system that is focusing in Technical Vocational Education and Training (TVET) specifically in furniture sector should be taken into consideration immediately by the government. By then, furniture sector will become graduates prevalent career. This is important to make sure the technology growth in the industry is growing faster.

Preferred future of furniture industry was pictured to change towards the usage of high technology equipment, shift into Original Design Manufacturing based (ODM) or Original Brand Manufacturing (OBM), and capable to receive international recognition. Similarly, the furniture product also was visualised to upgrade its quality in term of function, size, and designed with the niche of Malaysian identity. There are quite a lot of interesting furniture product characteristics yet to come, for example, self-repairing furniture, renewable-material furniture, intelligent wellness furniture together with artificial intelligence expose, lightweight, mobility, multifunctional with robust material, and electronic embedded furniture.

Towards the end of the workshop, several strategic pathways were recommended. It is worth to mention that every group came to an agreement that revamping the education system that is focusing in Technical Vocational Education and Training (TVET) specifically in furniture sector should be taken into consideration

immediately by the government. By then, furniture sector will become graduates prevalent career. This is important to make sure the technology growth in the industry is growing faster. As for market research, currently the biggest importer of Malaysian furniture is from developed country. The new market prospect in ASEAN countries are aimed to be established with hope the export revenue will increase to achieve RM 20 Billion in the next 15 years. Currently, the export revenue of furniture product is stagnant between RM 7 to 8 Billion since last 10 years. For this reason, new strategies are needed such as concentration on research, development, commercialization, and innovation in promoting the various numbers of prototypes and intellectual properties for furniture product. Research and development in discovering alternative materials should take place immediately as well as structured replanting of wood. Henceforth, sustainability of forest management is guaranteed. Beside, basic electronic and robotic devices that embedded into the current furniture product can assure its advancement in the future. The emergence of new technology in innovation chain can ensure the success of commercialization later on. The Home Grown Technology (HGT) program with effort for creativity and innovation expects to arise beforehand. The HGT program may inspire furniture manufacturers to carry out significant innovations at pilot production level towards final marketing of a product. The encouragement of HGT program is viewed can remove the hesitation of furniture manufacturers to try out new technologies that is new to them as well as to the market.

Furniture manufacturers in Malaysia dominantly are Chinese. These manufacturers are sole independent in the industry with perception “not enough support” from the government. The incentive in product marketing by the government program is numerous. There are many exhibitions organized by the government for them to market their product. However, it is a relief if there would be more promotion incentives from the government in starting the furniture manufacturing business in term of financial assistance.

Prepared by: Date:

_____ 24th July 2015

(Nurul Qastalani Radzuan)

Report on Southern Region Furniture Workshop

Introduction

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry for the southern region in Muar, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 20 participants who participated in the workshop on the 5th August 2015 at Conference Room, Muar Traders Hotel, Muar. The event was officiated by Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

Objective

The objective of the workshop were thus to identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Methodology

Participant has been grouped into three groups according to their background (manufacturer, governance or Designer) assist by area expert appointed by ASM to discuss in details on the furniture sector in Malaysia. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
3.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Four Scenarios	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers
6.	Strategic Recommendation	Propose recommendations to achieve preferred future

Result

1. Logical Framework Analysis (LFA)

The Logical Framework Analysis (LFA) focused the discussion on three main areas which is manufacturing, design and sustainability practices. For each area, the discussion will review the current state, current technology, challenge, the knowledge gap, the future as well as the participant suggestion. According to the grouped discussion, the participants have agreed:

i. Manufacturing

The issue of compliance certificate from different government agencies were highlighted where some of the documents required were redundant and different fees were paid to these government agencies. Some of the manufacturing premises were built on an agriculture land.

ii. Design

The design trend is always drives by the market and the local designer must cope with the trend.

iii. Sustainability Practices

Furniture industries in Malaysia are still lack in sustainability awareness and practices.

2. Preferred Future

Each group has portrayed their desired future furniture. The furniture was mention as “Smart Craft and Technology Furniture”, “Green Furniture”, and “Multi-purpose furniture”.. While preferred future of furniture industry was pictured as utilize

of high technology equipment, having broad market, huge scientific data and capable to receive international recognition.

3. Impact Diagram

The brainstorming session of impact diagram figured out several important attributes which are:

i. Design – Develop huge scientific database on human wellness.
ii. Sustainable practice – Sustainable in term of the heritage value.
iii. Governance (specific education focused on furniture industry / incentive)
iv. Manufacturing – The product/component produced locally through 3D printer, D.I.Y concept and virtual/hologram)
v. Marketing – The furniture product could have a broad market segment.

4. Back Casting

The timeline to reach the "Preferred Future" in 2050 where most of the group expecting:

2050	"Preferred Future Furniture"
2040	Enabling technology is ready as well as public awareness and governance policies. Stricter enforcement of the law & furniture policy.
2030	Institutional awareness, R&D on manufacturing technology and training workforce. Awareness through education and R&D. Specialized programme for furniture
2020	Government incentives for sustainable furniture manufacturing Government policy to support investment of sustainable furniture.

5. Four Scenarios

i. Best Scenario – Furniture made in Malaysia are in high demand, and the industry is able to match the production.
ii. Business as Usual – Raw material depletion, Mass imported raw material as local wood resources not able to supply raw material further.
iii. Worst Case – No 2nd generation to continue the furniture manufacturing, Malaysia lag behind in the top 10 world furniture manufacturer, Wood resources no longer available.
iv. Outlier - Furniture manufacturer will no longer in Malaysia

Strategic Recommendation

As the southern region especially Muar is the main producer of Malaysian furniture, support from the government is highly needed especially in term of new investment of technology in manufacturing practices or sustainable practice. A clear policy regarding furniture wood replanting is urgently needed to supply the need of the industry. A pioneering status with specific incentives for manufacturer / new investment on sustainable practice may be given.

Prepared by: Date:

_____ 12th September 2015

(Jessnor Arif Mat Jizat)

Report on Kuching Furniture Workshop and Factory Visit

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 23 participants who participated in the workshop on the 11th August 2015 at Academy of Sciences Malaysia, MATRADE Tower. The event was officiated by Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

The objective of the workshop were thus to present survey findings done during Export Furniture Exhibition 2015 (EFE 2015), identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Three groups were formed for detailed discussion on the furniture sector in Malaysia namely Governance Group, Design Group, and Manufacturers Group. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
3.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Strategic Recommendation	Propose recommendations to achieve preferred future
6.	Four Futures	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers

Through LFA discussion, it can be seen that the development of furniture industry in Sarawak is a bit late than in Peninsular Malaysia. Sarawak aims to have at least 6 companies that following sustainability certification by 2017. This is vital for the company's products to market their furniture in Europe. Other companies which haven't applying for sustainability certification are targeting to market at other countries which do not require certified furniture product.

Sarawak is blessed with huge number of tropical solid woods. However, it was revealed by Governance Group that export from Sarawak is dominated by timber log of Acacia and other wood types. Very few export of furniture products from Sarawak to overseas. Pn Rozaini binti Mohd Zahir from Small and Medium Industry (SMI) Division of Ministry of Industrial Development, Sarawak disclosed that companies in Sarawak are having difficulty to export due to cabotage policy.

On 1 January 1980, the Government of Malaysia implemented a national cabotage policy with an aim to protect and promote a strong national shipping-owning industry. Cabotage policy is allowing only Malaysian ships or Malaysian-registered ships to load and unload cargo at any Malaysian ports. The strategy is to create the container load center, which Port Klang is the principal concentration port for container / container hub-port in Malaysia meanwhile Penang port is the feeder port.

Under the policy, all goods from wherever they originate and even if the source is closer to Sabah and Sarawak must still first go to Port Klang before proceeding to Sabah and Sarawak in domestic ships, an arrangement that costs time, money and additional charges for handling, etc. However, the shippers do not face the squeeze because the additional costs are transferred to the consumer through higher-priced items. This problem also faced for exports from Sarawak including furniture products.

During the group discussion, each group came out with a plan series towards defining the desirable future. The preferred future of furniture industry is as follows:

Table 2: Preferred future

GROUP	SARAWAK WORKSHOP	
DESIGN GROUP	- Malaysian pride/identity	- Spirituality element/characteristic
	- Furniture with carbon footprint tagging	- Indigenous furniture design
	- Bio composite material base furniture	- Bio mimicry furniture design
	- Government incentives/funding for designer/manufacturers/researcher.	
GOVERNANCE GROUP	- Require specific policy on furniture	- One stop centre for high tech manufacturing plant
	- More incentive on furniture industry	- Multipurpose furniture
	- Sarawak may have its own port to export	- High tech furniture
		- Niche material: solid wood
MANUFACTURERS GROUP	- High value furniture for export	- Sarawak design - carving Sarawak motive, people recognise it is from Sarawak (branding) but following market demand
	- Wooden furniture using local timber	- Green furniture with eco label (comply with all green regulation/standard/world standard
	- Fine workmanship (high quality)	

Back casting activity was interesting as it gave clear view of targeted activities should be done. Back casting of each group activities are as follow:

Table 3: Back casting

Year	DESIGN GROUP	MANUFACTURERS GROUP	GOVERNANCE GROUP
2050	- Distinct Malaysian Identity Furniture	- High value furniture	- High tech furniture (component for furniture)
2040	- Worldwide recognition of Malaysian Identity Furniture	- Good climate for furniture industries - raw material, workers, support	- Government & industry working together for focused market
		- Availability of skilled workers	- Supporting industry are in place
2030	- Fully implemented Malaysian Identity Nationally	- Supporting industries (accessories machinery)	- Pool of skilled workers designer in the furniture industry (automation expert
	- Intensified research, testing, promotion, awareness	- Good infrastructure (road, port, airport, rail energy)	- Market is ready

Year	- DESIGN GROUP	- MANUFACTURERS GROUP	- GOVERNANCE GROUP
2020	- Fully stakeholders support	- Established vocational and technical program	- Industrial park near the port
	- Malaysian identity blueprint development	- Certification programmes for Sarawak timber / eco timber	- Get policy in place on high tech furniture
			- Eliminate cabotage policy
			- Capacity building
			- Established wood based skill institution
			- R&D
2015	- Awareness of Malaysian Identity	- Policy on raw material, encouragement for furniture industries, furniture industry friendly policy.	
	- Culture of "Made in Malaysia" pride in all education level	- Planting wood - High value furniture	

There was a factory visit to Gegasan Sdn Bhd after the workshop. Gegasan Sdn Bhd is a bumiputra furniture manufacturer which caters to the domestic market. The company was first start with supplying to international market as well however lately it should be stopped due to irregular supply of raw material that restrict them to meet the international order.

As said by the company's director, Tn. Haji Ibrahim bin Haji Baki, the company has to vary the product types to serve domestic market. Moreover, the domestic market also enough in bringing profit. Few products produced by Gegasan Sdn Bhd are home furniture and school furniture. The company is implementing semi automation in its production line. It is worthy to note that Gegasan Sdn Bhd only hiring local staff as labour without any foreign worker at all.

The meeting at Gegasan Sdn Bhd.

The industry in East Malaysia is left few years behind even though there are many natural resources there. Sarawak aims to be the leader in Malaysian furniture industry. A group in Sarawak workshop has the idea of franchising Sarawak furniture besides initiating umbrella system to support smaller furniture industry which later will give advantage to the furniture industry and the state development.

Prepared by: Date:

12th September 2015

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(Nurul Qastalani Radzuan)

Report on Kota Kinabalu Furniture Workshop and Factory Visit

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 19 participants who participated in the workshop on the 13th August 2015 at Academy of Sciences Malaysia, MATRADE Tower. The event was officiated by Prof. Dr. Zahari Taha, MIED (UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

The objective of the workshop were thus to present survey findings done during Export Furniture Exhibition 2015 (EFE 2015), identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Three groups were formed for detailed discussion on the furniture sector in Malaysia namely Governance Group, Design Group, and Manufacturers Group. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
3.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Strategic Recommendation	Propose recommendations to achieve preferred future
6.	Four Futures	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers

As same as situation in Sarawak, furniture industry in Sabah too is late few years behind. Through the LFA discussion, it is known that Sabah furniture is mainly made of wood. It is produced to support local demand. There is few companies that export their product however the export furniture is produced in "ready to assemble" or "knockdown made". It is important to note that furniture industry in Sabah is dying and at a critical stage because currently the exporters only remain 7 companies out of 30 companies in previous years. The industry is concentrated in Kota Kinabalu area.

We noted that East Malaysia is governed by their own policy however, in sustainability awareness, the government policy in Sabah almost the same with sustainability policy in Peninsular Malaysia. Most exporter companies are aware of the green policy and sustainability. There is no quota for timber export as in Sarawak. Malaysian Timber Industrial Board (MTIB) helps in promoting for downstream industries by providing rental premise for industries.

Sabah and Sarawak are popular with huge supply of acacia wood. The government is taking initiative in planting and replanting acacia wood. Acacia wood is proven can withstand 4 season weather therefore it is among the best wood to be used as outdoor furniture.

Few major problems that faced by the furniture industry are:

1. Lack of infrastructure development. The electricity supply is the main problem where black out often happens even at industrial area.
2. Lack of road system which required more easy access to and from industrial area.

3. Furniture products in Sabah cannot be produced at competitive prices due to high cost of freight cost, longer shipping time
4. All fitting, finishing material, machinery spare parts are imported which may increase the production and selling cost
5. Foreign workers Levi for manufacturing industries is higher than other industries (RM960 for manufacturing field and around RM300 for agriculture field)
6. Sabah too facing the problem of young & talented designers who migrate to Peninsular Malaysia
7. Cabotage policy in East Malaysia

During the group discussion, each group came out with a plan series towards defining the desirable future. In differs from other groups in other workshops, participants in Sabah Furniture Workshop wishes to explore the blue ocean industry such as maritime furniture. Exploring another new section in furniture industry needs skilled workers therefore a centre to train skilled workers is needed. On top of that, the centre may attract foreign students too.

The preferred future of furniture industry in Sabah is tabulated in Table 2:

Table 2: Preferred future

GROUP	SABAH WORKSHOP	
DESIGN GROUP	- Multipurpose, compact, mobile (light & easy) furniture	- Malaysian brand / identity furniture
	- Smart & healthy oriented furniture	- Redesign-able furniture
	- State of art of technology/ lifestyle	-
GOVERNANCE GROUP	- Mix material furniture (timber furniture niche market)	- Vendor program should in placed in Sabah furniture manufacturing
	- New player, new investor, government intervention	- Technology transfer - Sabah as hub for maritime
MANUFACTURERS GROUP	- Smart furniture	- Using recycle materials
	- Combination of multiple material	- Integrated with electronic devices
	- Controlled remotely through network/ using hand phone & android	- Multifunction

The targeted activities can be viewed in timeline below where the activities were clearly planned in line with designated year:

Year	DESIGN GROUP	MANUFACTURERS GROUP	GOVERNANCE GROUP
2050	- Redesign-able Furniture	- Smart furniture	- Maritime O&G based furniture (MOGF) industry
2040	- Manpower & technology for redesigning furniture is already in place	- Integration of electronics and new material	- Centre of excellence show case.
	- Marketing, Advertising, Brand recognition exercise	- Availability new recyclable material	- Export for the MOGF
			- Increase demand for domestic market
2030	- Superfast ICT product in place	- R&D new material	- Centre of Excellence ready- pool of knowledge worker /skilled /graduates work
	- IP protection implemented stringently		- Focused of Marketing
			- Specialized Institute for the desired industry
2020	- Manpower training started	- Training skilled workers/designers	- R&D centre for the industry
	- Institute of Higher Learning intensifies research, start specific course for furniture making, setting up centre of excellence	- Infrastructure problem solved	- Infrastructure must be ready (electrical power, policy, logistics) - International Standard in place - Start of MOGF R&D
			- Introduction to high tech precision technology
			- Introduction of MOGF training subject
2015	- Proposal for National blueprint for redesign-able furniture	- Transportation seaport	- Pioneer for the trainer
	- Development of standard, policy, regulating body.	- Energy issue solve	- Planning for specialized institute location Kudat Sepangar sandakan
		- Raw material	
		- Supporting industries	

The team was visiting Borneo Tsang Sdn Bhd in Kota Kinabalu. The company is producing wooden furniture using acacia wood and focusing in outdoor / garden furniture. The products are exported to United States and European market. The company is committed to ensure its timber is sourced from sustainable forests where it follows Forest certified under the Forest Stewardship Council (FSC). The wood is harvested in a well-managed process and meets the International Treaty Organisation (ITTO) standards.

Borneo Tsang Sdn Bhd is preferring semi automation in the production line due to limited production capacity. As furniture industry in East Malaysia is dying, many hardware are closed therefore it is difficult to get furniture accessories and spare parts for machinery. The lack of a furniture industry supply chain in Sabah to accommodate their needs from Kuala Lumpur is disruptive. The company is facing problem in delivery where the shipping cost is high. The new tax system in Sabah as increased the labour cost due to the higher up of minimum wages. It can be seen that the owner of the company, Joseph Tsang hesitates to explore new market due to high cost for joining overseas exhibition. The company also hesitates in exploring online marketing such as Lazada, Mudah.my, and Lelong.com. Furniture industry in Sabah can blossom with a proper incentive and support from federal government.

Prepared by: Date:

_____ 12th September 2015

(Nurul Qastalani Radzuan)

Report on Northern Region Furniture Workshop

Introduction

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry for the northern region, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 31 participants who participated in the workshop on the 26th August 2015 at Conference Room, Cititel Hotel, Penang. The event was officiated by Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

Objective

The objective of the workshop were thus to identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Methodology

Participant has been grouped into three groups according to their background (manufacturer, governance or Designer) assist by area expert appointed by ASM to discuss in details on the furniture sector in Malaysia. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
3.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Four Scenarios	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers
6.	Strategic Recommendation	Propose recommendations to achieve preferred future

Result

1. Logical Framework Analysis (LFA)

The Logical Framework Analysis (LFA) focused the discussion on three main areas which is manufacturing, design and sustainability practices. For each area, the discussion will review the current state, current technology, challenge, the knowledge gap, the future as well as the participant suggestion. According to the grouped discussion, the participants have agreed:

i. Manufacturing

STI's are capable to improve the furniture productivity, better part quality, reduce the utilization of foreign workers and process cycle time thus reducing product cost.

ii. Design

The fact is world furniture trend drive by Italian Furniture Industry, so in order to be acceptable by the market the local designer must follow the trend.

iii. Sustainability Practices

Furniture industries in Malaysia are still lack in sustainability awareness and practices.

2. Preferred Future

Each group had come out with desired furniture criteria for future society. Preferred future of furniture industry was pictured to change towards the usage of high technology equipment, shift into Original Design Manufacturing based (ODM) or Original Brand Manufacturing (OBM), and capable to receive international recognition. Similarly, the furniture product also was visualised to upgrade its quality in term of function, size, and designed with the niche of Malaysian identity.

3. Impact Diagram

The brainstorming session of impact diagram figured out several important attributes which are:

i. Design (flexible design / Original Brand Manufacturing)
ii. Green advanced technology (following international sustainability standard)
iii. Governance (specific education focused on furniture industry / incentive)
iv. Human Capacity Development (focusing in designers and skilled workers)
v. Manufacturing (high technology machineries)
vi. Research, development, and commercialization (Intellectual Property / alternative materials)
vii. Marketing and promotion (online virtual / trade hub)

4. Back Casting

The timeline to reach the "Preferred Future" in 2050 where most of the group expecting:

2050	"Preferred Future"
2040	Establish supply chain and businesses
2030	New material, Technique, Patent
2020	Strengthening the educational system, Research and Development

5. Four Scenarios

i. Best Scenario - Malaysian furniture industry to be fully Original Brand Manufacturing industry. Malaysia can become one of the smart furniture manufacturers if STI is fully implemented in the furniture industry.
ii. Business as Usual - Nature of furniture industry at the moment is dependent to manual labor. By maintaining the same practice until 2050, the industry may not have the capacity to grow in productivity in the future.
iii. Worst Case - The industry would be hard to survive therefore the productivity would be deteriorating and manufacturing cost may increase due to freight cost and imported raw material
iv. Outlier - furniture industry would no longer be as Malaysia's income. This situation may lead to vanishing of designers, furniture identity, and small businesses

Strategic Recommendation

Since the Malaysian export revenue of furniture product is stagnant between RM 7 to 8 Billion for the last 10 years, a new strategy is needed such as concentration on research, development, commercialization, and innovation in promoting the various numbers of prototypes and intellectual properties for furniture product. Research and development in discovering alternative materials should take place immediately as well as structured replantation of wood. Henceforth, sustainability of forest management is guaranteed. Beside, basic electronic and robotic devices that embedded into the current furniture product can assure its advancement in the future. The emergence of new technology in innovation chain can ensure the success of commercialization later on.

Prepared by: Date:

_____ 24th September 2015
(Mohd Ali Hanafiah Shaharudin)

Report on Eastern Region Furniture Workshop

Introduction

The Mega Science 3.0 Furniture Sector organised a workshop on furniture industry for the eastern region in Kuala Terengganu, as part of the Mega Science Framework Study for Sustained National Development for the period 2013-2050. There were 25 participants who participated in the workshop on the 7th September 2015 at Conference Room, Grand Continental Hotel, Kuala Terengganu. The event was officiated by Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the project's director.

ASM representative, Mr P. Loganathan elaborated that five major areas are addressed in the study which include furniture, creative, automotive, tourism, and plastics and composites; with the aim to comprehensively appraise the strategic role and potential contribution of science, technology, and innovation (STI) to the nation's drive to achieve sustained socio-economic progress. The results from the study will provide advisory inputs to the government on the strategic STI options and priorities in support of the nation's socio-economic agenda.

Objective

The objective of the workshop were thus to identifying the status, issues challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve high technology industries, and solicit feedback from stakeholders in the furniture sector in Malaysia. Stakeholders from government agencies, academic institutions, and private entities were present at the workshop. List of workshop participants is attached in Appendix C.

Methodology

Participant has been grouped into three groups according to their background (manufacturer, governance or Designer) assist by area expert appointed by ASM to discuss in details on the furniture sector in Malaysia. There were several methodologies used in the group discussion such as Logical Framework Analysis (LFA), Impact Diagram, Preferred Future, Back-casting, Strategic Recommendations, and Four Futures. The justification of each methodology is listed in Table 1 below:

Table 1: Methodologies Used in the Workshop

	Method	Justification
1.	Logical Framework Analysis (LFA)	Identify the status, issues and challenges, gaps in knowledge, future needs, proposed recommendations, and strategies to achieve research objective
2.	Preferred Future	Brainstorm desired characteristic of future furniture industry / furniture product
3.	Impact Diagram	Identify probability that might has impact due to current furniture industry issues
4.	Back-casting	Suggest criteria to be established towards the preferred future
5.	Four Scenarios	Imagine the four criteria that might be happened such as: a) the best scenario b) business as usual c) the worst case d) outliers
6.	Strategic Recommendation	Propose recommendations to achieve preferred future

Result

1. Logical Framework Analysis (LFA)

The Logical Framework Analysis (LFA) focused the discussion on three main areas which is manufacturing, design and sustainability practices. For each area, the discussion will review the current state, current technology, challenge, the knowledge gap, the future as well as the participant suggestion. According to the grouped discussion, the participants have agreed:

i. Manufacturing

Although the STI's have all of the advantages in term of productivity, consistency part quality, cycle time and many more but still cannot replace the craftsmanship in case of artistic or heritage furniture.

ii. Design

The design trend is always drives by the market and the local designer must cope with the trend.

iii. Sustainability Practices

Furniture industries in Malaysia are still lack in sustainability awareness and practices.

2. Preferred Future

Each group has portrayed their desired future furniture. The furniture was mention as "Wellness Furniture" where the furniture used for healthy life style as well as rehabilitation. While preferred future of furniture industry was pictured as utilize of high technology equipment, having broad market, huge scientific data and capable to receive international recognition.

3. Impact Diagram

The brainstorming session of impact diagram figured out several important attributes which are:

i. Design – Develop huge scientific database on human wellness.
ii. Sustainable practice – Sustainable in term of the heritage value.
iii. Governance (specific education focused on furniture industry / incentive)
iv. Manufacturing – The product/component produced locally through 3D printer, D.I.Y concept and virtual/hologram)
v. Marketing – The furniture product could have a broad market segment.

4. Back Casting

The timeline to reach the "Preferred Future" in 2050 where most of the group expecting:

2050	"Preferred Future Furniture"
2040	Enabling technology is ready as well as public awareness and governance policies.
2030	Institutional awareness, R&D on manufacturing technology and training workforce.
2020	Awareness through education and R&D in health/well-being.

5. Four Scenarios

i. Best Scenario - Malaysian will have healthy population and increase in productivity
ii. Business as Usual – There will be no economic escalation and stagnant productivity
iii. Worst Case - The productivity deteriorate and Malaysian population will have less life expectancy
iv. Outlier - Furniture industry in Malaysia shrink and contagious disease

6. Strategic Recommendation

As the eastern region of peninsular Malaysia is famous with the artistic, cultural and heritage furniture and wood craft product, hence the support from the government is highly needed to supports the industry. A suggestion thrown to promote the artistic, cultural and heritage furniture and wood craft product by enforcing new regulation on compulsorily include the element for new government building. This will create constant demand and keep the industry sustained in the future as well as to inherit the value to the young generation.

Prepared by: Date:

_____ 24th September 2015

(Mohd Ali Hanafiah Shaharudin)

Report on Draft Final Report Feedback Workshop

1.0 Introduction

The Mega Science 3.0 Furniture Sector organised a Draft Final Report Feedback Workshop to gain feedback from furniture stakeholders on the Mega Science 3.0 Furniture Sector final report. There were 31 peoples participated in the workshop held at Academy of Sciences Malaysia (ASM) on the 27th April 2016. List of the workshop participants is attached in Appendix C.

The workshops started with ASM representative, Mr P. Loganathan presented the introduction of the Mega Science 3.0 objectives and the five areas it covers namely furniture, creative, automotive, tourism, and plastics and composites. He also presented on the proposed strategies, roadmap, and recommendation that will be presented to the Malaysian government as the outcomes of the Mega Science 3.0 project.

Then, Prof. Dr. Zahari Taha, MIED(UK), CEng(UK), FASc, the furniture sectoral leader, presented the industry current status, issues, and challenges, as well as the proposed strategies, roadmap, and recommendation gathered from the surveys, interviews, factory visits and regional workshops.

2.0 Feedback

A representative from Malaysian Automotive Institute (MAI) enquired about the prospect of the furniture industry investing further on automotive seats and upholstery. However, feedback from the industry, the niche market for the Malaysian furniture industry is wooden furniture and it has worldwide recognition. Solid wood is not suitable for automotive industry as it is heavy and bulky while automotive industry requires lightweight materials.

A representative from Malaysian furniture manufacturers association commented on the recyclability of wooden furniture. Wooden furniture can only be cut into smaller wood pieces or ground to dust in order to recycle the wood. He also claimed that fully automated factory is difficult to achieve in Malaysia furniture industry scenario; however, process mechanisation is much preferable. He also concurred that build own brand requires a large sum of investments and the government can charted more incentives to build own furniture brand.

He also shared with the participants that Malaysian Furniture Councils had come up with 5 years plan addressing the raw material, technology etc. Regarding internet of things (IoT), a collaboration between sensors manufacturers and furniture manufacturers is required as these manufacturers have different focus. In term of workers, he highlighted that lack of coordination between the training centres and the industry has led to shortage of workers in the industry even though hundreds of graduates annually.

In term of raw materials, he concurred that a higher quality logs should be used to cater Malaysian furniture industry instead of being exported to other country. However, according to Malaysian Timber Industry Board (MTIB), Malaysian currently have 500 000 hectares planted forest with 106 000 hectares is managed by MTIB.

A representative from the government agency acknowledged that 2000 skilled workers in the industry had passed the Sijil Kemahiran Malaysia Level Two and Level Three. The works in furniture factory is considered as danger, dirty and difficult by most of the training centres graduate. A representative from training centre agreed this scenario. He also added that some of the graduates reluctant to relocate from their home states. For example, many of the Terengganu Timber Industry Training Centre graduates were only looking jobs in Terengganu while most of the furniture manufacturers are located in Johor and Selangor.

A representative from a university highlighted issues of over qualification as universities usually trained designers for a bachelor degree. Their graduates had reported on difficulties of getting a job due to over qualified and higher expected salary.

The workshop ended by concluding remarks by Prof. Dr. Zahari Taha.

Prepared by: Date:

_____ 5th May 2016

(Jessnor Arif Mat Jizat

List of Workshops Participants by Regions

1. Central

No	Name	Sector	Organisation	Designation
1	En. Zuljar bin Jaafar	Government	MRM	Manager
2	En. Mohd Tamrin Ismail	Government	MTIB	Office of Chief Director
3	Pn. Zaliha Abu Samah	Government	Pembangunan Perdagangan MTIB	Assistant Director
4	Pn. Julia Pon	Government	Pemerkasaan Ekonomi Bumiputra MTIB	Assistant Director
4	Pn. Nik Zuraihah Nik Mohammad	Government	Pembangunan Industri MTIB	Assistant Director
5	Pn. Norsasuhaida Salleh	Government	WISDEC MTIB	Assistant Director
6	Pn. Norhaizurah Bt. Zurkarngain	Government	PSHEK MTIB	Assistant Director
7	Abdul Halim Bin Ali	Government	Kraftangan Malaysia	Deputy Director
8	Khairul Hafizi bin Naharuddin	Government	Kraftangan Malaysia	Chief Assistant Director (PEREKA)
9	Izzaty Asmuni	Government	MAI	Research Executive
10	Noor Hazmira Binti Merous	Government	FRIM	Economics Affairs Officer (Corporate Research)
11	Nor Azila binti Mohamed	Government	FRIM	Research Assistant (Corporate Research)
12	Mr. Md Nizam Abd Wahab	Government	SIRIM	General Manager
13	Norjanah Mohid	Government	Bahagian Industri MOSTI	Chief Assistant Secretary
14	En. Nasaruddin Mat Ibrahim	Government	HOD FITEC	Dept Manager My Kitchen
15	Mr. Mohd Sofian Bin Abd Jalil	Government	FITEC	Unit Chief (Model Development)
16	Suhana Shamshudin	Government	Sektor Teknologi Hijuau, KETTHA	Assistant Secretary
17	Najah Hainuni Hj. Mat	Government	EPU, JPM	Safety Assistant Director 2
16	Raja Khairul Anuar	Private	Pangkin Sdn Bhd	
17	Ms. Karen Goi	Private	UBM,Malaysia	General Manager
18	Mr. TJ Tan	Private	International UBM Malaysia	Project Manager-
19	Mr. Nor Azrizal Aziz	Private	MFPC	Marketing Manager
20	Mr. Ricky Chin	Private	EFE Expo Sdn Bhd	Event/ PR Manager
21	Mr. Kelvin Khoo	Private	EFE Expo Sdn Bhd	Operations Executive
22	Mr. Sunny Ter Soon Peng	Private	MFC	Vice President
23	Mr. Kang Choon Hong	Private	MFC	Industry Development Executive
24	Mr. Akmal bin Saarani	Private	MTCC	Executive (Product)
25	Mr. Albert Khoo	PrivatE	KLSFEA	Secretary General
26	Azman Bakri	Private	Servco	General Manager, Product
35	Ahmad Zabidi B. Abdul Rashid	Association and NGOs	PEKA	Admin & Finance Manager
36	Ahmad Kamal Chik	Association and NGOs	PEKA	Committee Member
37	Dato Prof. Ir. Dr. Alias bin Mohd Noor	IHLs (Academic)	CBE UTM Skudai	Director
38	Prof. Ir. Dr. Sheikh Hussain	IHLs	CBE UTM Skudai	Deputy Director

	bin Shaikh Salleh	(Academic)		
39	Prof. Dr. Paridah Md Tahir	IHLs (Academic)	INTROP	Director
40	Dr. Adlin Sabrina Roseley	IHLs (Academic)	INTROP	Lecturer
41	Dr. Norzanalia Saadun	IHLs (Academic)	INTROP	Lecturer
42	Assoc. Prof. Dr. Baharuddin Ujang	IHLs (Academic)	UiTM	Lecturer
43	Prof Dr Rosnah Mohd Yussuf	IHLs (Academic)	UPM	Lecturer
44	Dr. S. Nurmaya	IHLs (Academic)	UM	Senior Lecturer
45	Dr. A. Rizal Abdul Rahmad	IHLs (Academic)	UPM	Senior Lecturer
46	Prof. Dr. Mohd Najip Suratman	IHLs (Academic)	UITM	Office of Deputy Dean (Academic), Faculty of Applied Sciences

2. Northern

No	Name	Sector	Organisation	Designation
1	Dr. Azhari bin Md Hashim	Academic	UiTM Kedah	Head of Faculty
2	Mr. Ahmad Fazlan bin Ahmad Zamri	Academic	UiTM Kedah	
3	Mr. Azmir bin Mamat Nawi	Academic	UiTM Kedah	Lecturer
4	Mr. Hafeezur Rahman Mod Yassin	Academic	Pusat Pengajian Seni USM	Lecturer
5	Tn. Hj. Mohamed Zaini b. Abdul Rahman	Government	Jabatan Kimia Malaysia, Cawangan Pulau Pinang	Director
6	Pn. Suriati bt. Shaiddin	Government	Jabatan Kimia Malaysia, Cawangan Pulau Pinang	Section Chief IKTD
7	Mr. Teoh Choon Ping	Government	Jabatan Kimia Malaysia, Cawangan Pulau Pinang	Section Chief Analysis Center for Scheduled Disposal
8	Puan Fakhriah Binti Hj. Badri	Government	Teknologi Makanan dan Sumber Lestari MIDA KL	Deputy Director
9	Mr. Muhammad Azizul Atfi Adnan	Government	MIDA Penang	Deputy Director
10	Mr. Yuzaimi bin Mahat	Government	Pejabat Meteorologi P. Pinang	Deputy Director
11	Mr. Ibrahim bin Johari	Government	Pejabat Meteorologi P. Pinang	
12	Mr. Syed Mohd Faiz Syed Mahusin	Government	Pejabat Meteorologi P. Pinang	
13	Mr. Mohd Khair b. Napiah	Government	MTIB Cawangan Ipoh, Perak	Vice Quality Controller
14	Salasiah Yusop	Government	PSUKPP	Chief Secretary Assistant (KP & KEW)
15	Mr Koay Chee Khoon	Non – Government Organisation	Perlis Furniture Manufacturers and Traders Association	Secretary
16	Mah Kong Yeow	Non –	Penang Furniture of	Committee Members

		Government Organisation	Timber Industry Association	
17	Mah Kong Weng	Non – Government Organisation	PFTIA	Treasurer
18	Datuk Seri Lim Ching Keat FASc	State Government Office	Academy of Sciences Malaysia	ASM Fellow/Associates
19	Mr. Jayden Chong Chin Soon	Private	Executive Northern Furniture Manufacturing PLT	Marketing Executives
20	Ms. Hasmayani binti Abdul Malik	Private	Puncak Bumi Utama Sdn Bhd	
21	Ms. Nurul binti Abdul Mukhti	Private	Puncak Bumi Utama Sdn Bhd	
22	Mr. Ahmad Fariz bin Ahmad Kamal	Private	Puncak Bumi Utama Sdn Bhd	
23	Mr. Mohd Yusri bin Harun	Private	Puncak Bumi Utama Sdn Bhd	
24	Mr. Muhammad Fadzil Ahmad Khair	Private	Puncak Bumi Utama Sdn Bhd	
25	Mr. Cha Hoo Peng	Private	Marcoco Furniture Industries Sdn Bhd	Sales
26	Ms. Serene Ang	Private	Yo soon Timber Sdn Bhd	
27	Mr. Mah Kong Yeow	Private	United Woodwork & Construction (M) Sdn Bhd	Assistant Treasurer
28	Mr. Yeoh	Private	Carpin Furniture Industries Sdn Bhd	

3. Southern

No	Name	Sector	Organisation	Designation
8	En Mohd Zaki bin Tumin	Government	Jabatan Alam Sekitar cawangan Muar	Controller Officer Assistant, C27 (1)
9	En Mohammed Mustafa Kamal bin Ramli	Government	Jabatan Alam Sekitar cawangan Muar	Controller Officer Assistant
10	En Mohd Salleh bin Yusof	Government	Jabatan Alam Sekitar cawangan Muar	Controller Officer Assistant
11	En Mohd Khairi bun Sudar	Government	Jabatan Alam Sekitar cawangan Muar	Controller Officer Assistant
12	Encik Mohamad Razib bin Saruddin	Government	Perbadanan Kemajuan Kraftangan Malaysia Cawangan Johor	Deputy Director
13	Encik Fahazanie Sandy Bin Halim	Government	Perbadanan Kemajuan Kraftangan Malaysia Cawangan Johor (PEREKA)	Unit Chief (Design and Technical) (B27)
14	Encik Mohd. Aizat Bin Shaharuddin	Government	PEREKA	Designer
15	Pn. Thilagavathy a/p Raja	Government	Johor State Forestry Department	Assistant Director (Industry and Produce)
16	En. Mohammad Umar	Government	Johor State Forestry Department	Southern Johor Forest Officer
17	Azhar Yaacob	Government	Perbadanan Kemajuan Nesen Melaka	Manager Entrepreneurial

				Development and Trade
18	Manivannan	Government	Perhutanan Johor	
19	Mr. Lim Ching Kiong	Non-Government Organisation	Muar Furniture Association (MFA)	
20	Steve Ong	Non-Government Organisation	Muar Furniture Association (MFA)	Deputy Chief
21	Ken Lee	Non-Government Organisation	Muar Furniture Association (MFA)	
22	Hock Huay	Non-Government Organisation	Muar Furniture Association (MFA)	
23	Winnie Thong	Non-Government Organisation	Muar Furniture Association (MFA)	
24	Kelvin Tan	Non-Government Organisation	Muar Furniture Association (MFA)	
25	Chua Teek Heng	Non-Government Organisation	Muar Furniture Association (MFA)	
26	En. Abu Huzaifah bin Hashim	Private	Hasro Furniture Gallery Sdn Bhd	General Manager

4. Sarawak

No	Name	Sector	Organisation	Designation
1	Dr. Alik Duju	Government	Sarawak Forestry Corporation	Manager
2	Mr. Ting King Boh	Government	Sarawak Forestry Cooperation	Training Manager Timber Technology Centre
3	Datu Liaw soon Eng	Government	Kementerian Pembangunan Perindustrian	Permanent Secretary
4	Pn. Rozaini binti Mohd Zahir	Government	Kementerian Pembangunan Perindustrian	Chief Secretary Assistant
5	Mr. Amrie bin Anwar	Government	Executive SIRIM Standards Technology	
6	Ms. Madeline George Pau	Government	Executive Forester ForestDepartment Sarawak	Committee Members
7	Puan Sherrina binti Hussaini	Government	Bahagian Alam Sekitar, Kementerian Perancangan Sumber dan Alam Sekitar	Chief Secretary Assistant
8	Siti Aishah binti Abd Wahid	Government	Jabatan Alam Sekitar Sarawak	
9	Rafi'uddin bin Rosman	Government	SIRIM Standard Tech	
10	Mohamad Hafizin bin Sawal	Government	SIRIM	
11	Aidrus Musa	Government	Malaysian Furniture Promotion Council	Market and Policy Manager
12	Dr. Saiful Bahari Mohd	Academic	Faculty of Applied and	Deputy Dean

	Yusoff		Creative Arts Universiti Malaysia Sarawak (UNIMAS)	(Postgraduate & Research) Lecturer of Design Technology Programme
13	Dr. Musdi Hj Shanat	Academic	Universiti Malaysia Sarawak – UNIMAS	Head of Design Technology Department Faculty of Applied and Creative Arts – FACA
14	Muhammad Firdaus Abong Abdullah	Academic	Universiti Malaysia Sarawak (UNIMAS)	Lecturer of Design Technology Programme Faculty of Applied and Creative Arts
15	Dr. Peter Kho	Non-Government Organisations	Sarawak Timber Association	General Manager
16	Mr. Lai Kin Ming	Non-Government Organisations	Sarawak Timber Association	
17	Ms. Erin Tan	Non-Government Organisations	Sarawak Timber Association	
18	En. Husiri b. Bisni	Non-Government Organisations	Harwood Timber Sdn Bhd	
19	Tuan Hj Abdul Hadi Datuk Hj Abdul Kadir	Private	Harwood Timber Sdn Bhd	General Manager
20	En. Bohari Awang Lair Mohammad Nazlan Annuar	Private	Harwood Timber Sdn Bhd	Assistant General Manager (Mktg & Business Dept)
21	En. Adenan Abu Kassim	Private	Giovanni Wood Industries Sdn Bhd	Admin & Project Manager
22	Mr. Isaac Moh Yii Ming	Private	Moh Sing Hiong and Sons Sdn Bhd	Admin Manager
23	Abdul Aziz Abdul kadir	Private	Gegeson Sdn Bhd	
24	Ishak Bohori	Private	Harwood Timber Sdn Bhd	Assistant General Manager (Endorsement & Shipping)
25	En. Husnimi bin Bij	Private	Harwood Timber Sdn Bhd	

5. Sabah

No	Name	Sector	Organisation	Designation
1	Mdm Sharily Johnny	Private	Adhwa bersaudara Sdn Bhd	Director
2	Mr. Hazali bin Husin	Private	Adhwa bersaudara Sdn Bhd	
3	Mr. Mohd Jailani Amir	Private	Borneo Benar Sdn BhD	Product Manager
4	Ms. Tan Siew Ling	Private	Superwood Industries Sdn Bhd	Director
5	Ms. Heng Mui Kiaw	Private	Superwood Industries Sdn Bhd	Advisor
6	Patar Seluay	Government	SAFODA Lembaga Kemajuan Perhutanan Negeri	Forest Conservationist

			Sabah	
7	Florita Godfrey Jonin	Private	ABAN-D industries Sdn Bhd	Director
8	Reimie Muhamad Salleh	Private	ABAN – D Industries Sdn Bhd	
9	Mr Ng Cheong Hoo	Non-Government Organisation	Treasurer Sabah Furniture Association	
10	Mr Yong Wai Loong	Non-Government Organisation	Sabah Furniture Association	
11	Mr Chong Chun Kat	Non-Government Organisation	Sabah Furniture Association	
12	Marni Maracus	Academics	Sabah Institute of Art	-
13	Khatijah Juhardin	Academics	Sabah Institute of Art	Management Staff
14	Brenda Ann CP	Academics	Sabah Institute of Art	Management Staff
15	Zulfadli Zaini	Academics	Sabah Institute of Art	Academic staff (full time)
16	Mr. Faizal bin Haris	Government	MATRADE Sabah	Director
17	Mr Peter Brian M. Wang	Government	MITI Sabah	Director
18	Mr. Mazree Iman	Government	MTIB Sabah	Head
19	Mr. Mohd Ameerul Abdullah	Government	MTIB sabah	
20	Mr. Md Jaidi Jaafar	Government	MTIB sabah	
21	Mr. Zainal bin Saridi	Government	Lembaga Kemajuan Perhutanan Negeri Sabah	Forest Conservationist
22	Mr. Patar bin Seluang	Government	Lembaga Kemajuan Perhutanan Negeri Sabah	Forest Conservationist

6. Eastern

No	Name	Sector	Organisation	Designation
1	Mejar (K) Haji Azlan b. Mohamad	State Government	Terengganu Timber Industry Centre (TTITC)	Director
2	Mr. Saupi Mat Nawi	Government	MTIB Pahang	Assistant Head
3	Mr. Mohd Hakimi b. Awang Su	Government	Terengganu Science & Creativity Center	Officer
4	Mr Tuan Azmi b. Tuan Sidek	Government	Terengganu Science & Creativity Center	Assistant Officer
5	Mr. Amri b. Mohd Yusof	Government	JAS	Officer
6	Hamidah bt. Mansor	Government	MTIB Terengganu	Assistant Head
7	Nor Azizan bt. Ngah	Government	MTIB Terengganu	Assistant Managing
8	Che Engku Nor Amiza bt Che Engku Chik	Government	Forestry Terengganu	Assistant Managing
9	Wan Zaizielawany bt. Wan Muhamad Zin	Government	Forestry Terengganu	Officer
10	Ramli b. Ismail	Non-Government	SEREKA	
11	Mohd Nawi b. Ali	Non-Government	SEREKA	
12	Masrul Arifin b. Mohd Nazir	Private	Ramaco Bena Sdn. Bhd	Management Staff
13	Abdul Rahman b. Ismail	Private	Ramaco Bena Sdn. Bhd	Managing Director
14	Ahmad Saifulhasni b.	Private	MYR Construction	Managing Director

	Abdullah Sani		Sdn. Bhd	
15	Prof. Madya Abdul Aziz b. Shuaib	Academics	Fakulti Teknologi Kreatif & Warisan UMK	Dean
16	Dr. Imran b. Abdullah	Academics	UnisZa	Lecturer
17	Prof. Madya Abdullah Sani Kamaludin	Academics	UnisZa	Lecturer
18	Mr. Burhan b. Ashari	Private	Cengal Timber Craft	Managing Director
19	Ms. Tan Siew Lian	Private	Trentim Wood Sdn. Bhd.	CEO

List of DFR Workshops Participants

No	Name	Sector	Organisation	Designation
1	Mr. Mohd. Hanafi b. Mohd. Tani	Private	F.I.T Center Sdn. Bhd.	Head of Department
2	Mr. Umar b. Dato Md. Pishal	Private	Meranti Furniture Sdn. Bhd.	Operation Director
3	Mr. Albert Khoo	Association	The Kuala Lumpur & Selangor Furniture Entrepreneur Association (KLSFEA)	Secretary General
4	Ms. Wong Yuan Choon	Association	The Kuala Lumpur & Selangor Furniture Entrepreneur Association (KLSFEA)	Chief Operating Officer
5	Mr. Kang Choon Hong	GLC	Malaysia Furniture Council	Industrial Development Executive
6	Mejar (K) Haji Ajlan b. Mohamad	Government	Terengganu Timber Industry Centre (TTITC)	Director
7	M. Aiman b. Ajlan	Government	Terengganu Timber Industry Centre (TTITC)	Officer
8	Mr. Joel Mah Beng Seng	Private	United Woodwork & Construction Sdn. Bhd.	
9	Dato Ahmad Razali b. Yahaya	Private	Servco Resource Sdn. Bhd.	Managing Director
10	Hj. Azman b. Bakri	Private	Servco Resource Sdn. Bhd.	
11	Mr. Shamsul Azhar b. Shamsudin	Private	Servco Resource Sdn. Bhd.	
12	Dr. Abdul Hamid Saleh	Government	Forest Research Institute Malaysia (FRIM)	Section Head
13	Ms. Yanti Abdul Kadir	Government	Forest Research Institute Malaysia (FRIM)	Researcher
14	Dr. Mohd. Nor Zambri b. Mat Amin	GLC	Malaysian Timber Board (MTIB)	Director
15	Mohd Khair b. Napiah	GLC	Malaysian Timber Board (MTIB)	Officer
16	Prof. Dr. Ishak Aris	GLC	Malaysian Automotive Institute (MAI)	Director

17	Dr. Ahmad Zainal Abidin	GLC	Malaysian Automotive Institute (MAI)	Researcher
18	Noor Laila Mohamed Halip	GLC	Malaysian Timber Board (MTIB)	Officer
19	Shah Badri Mohd. Nor	GLC t	Malaysian Timber Board (MTIB)	Officer
20	Amira Haryany Mohd Amry	GLC	SME CORP.	Officer
21	Dr. Nor Khairunnisa Mazlan	Academician	INTROP, UPM	Researcher
22	Dr Musdi b. Hj. Shanat	Academician	UNIMAS	Head of Department
23	Prof. Madya Dr. Hasnizam b. Abdul Wahid	Academician	UNIMAS	Head of Institute
24	Dr. Ahmad Zuhairi Abdul Majid	Academician	USM	Researcher
25	Nujaimatul Aliah Mohd. Jais	Government	Unit Perancang Ekonomi (EPU)	Deputy Director
26	Dr. Siti Nurmaya Musa	Academician	UM	Researcher
27	Dr. Norzanalia Saadun	Academician	UPM	Researcher
28	Dr. Adlin Sabrina Roseley	Academician	UPM	Researcher
29	Mr. Akmal Saari	GLC	MTC	Officer
30	Lau Li Han	GLC	MTC	Officer

Preliminary Survey Results

Number of furniture companies participated in this survey is 40 (N = 40)

1. Product market

Product Market

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Local only	11	27.5	27.5	27.5
	Overseas only	6	15.0	15.0	42.5
	Both	22	55.0	55.0	97.5
	NA	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

2. Ownership of the firm

Ownership of firm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Malaysian fully owned	35	87.5	87.5	87.5
	Joint Venture	3	7.5	7.5	95.0
	Others	1	2.5	2.5	97.5
	NA	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

3. Number of workers

Number of workers

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Micro	< 5	1	2.5	2.5	2.5
	Small	5 to < 75	19	47.5	47.5	50.0
	Medium	75 to <= 200	5	12.5	12.5	62.5
	Big	>= 200	5	12.5	12.5	75.0
	NA		10	25.0	25.0	100.0
	Total		40	100.0	100.0	

4.Number of foreign workers

Number of foreign workers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	7	17.5	17.5	17.5
	< 5	2	5.0	5.0	22.5
	5 to < 75	10	25.0	25.0	47.5
	75 to <= 200	3	7.5	7.5	55.0
	>= 200	3	7.5	7.5	62.5
	NA	15	37.5	37.5	100.0
	Total	40	100.0	100.0	

5. Sales turn over per year

Sales turn over per year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<RM300 000	4	10.0	10.0	10.0
	RM300 000 - RM15 Million	26	65.0	65.0	75.0
	RM15 Million - RM 50 Million	5	12.5	12.5	87.5
	> RM 50 Million	3	7.5	7.5	95.0
	NA	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

6. Location of the company by region

Region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Northern	10	25.0	25.0	25.0
	Central	9	22.5	22.5	47.5
	Southern	8	20.0	20.0	67.5
	East Coast	3	7.5	7.5	75.0
	East Malaysia	10	25.0	25.0	100.0
	Total	40	100.0	100.0	

7. Business Types

Business types

		Responses		Percent of Cases
		N	Percent	
Business types[a]	Contract manufacturer	14	29.8%	35.9%
	Rebranding company	1	2.1%	2.6%
	Own Brand Company	23	48.9%	59.0%
	Component/spare part manufacturer	2	4.3%	5.1%
	Others	7	14.9%	17.9%
Total		47	100.0%	120.5%

a. Dichotomy group tabulated at value 1.

8. Product Types

Product Types

		Responses		Percent of Cases
		N	Percent	
Product Types[a]	Home furniture	28	44.40%	75.70%
	Office furniture	10	15.90%	27.00%
	Outdoor furniture	8	12.70%	21.60%
	Furniture components	5	7.90%	13.50%
	School and Universities Furniture	3	4.80%	8.10%
	Medical furniture	1	1.60%	2.70%
	Others	8	12.70%	21.60%
Total		63	100.00%	170.30%

a. Dichotomy group tabulated at value 1.

9. Types of material used

Material Used

		Responses		Percent of Cases
		N	Percent	
Material used in products[a]	Mostly wood or other forest materials	34	56.70%	87.20%
	Mostly metals or alloys	10	16.70%	25.60%
	Mostly fabric and leathers	6	10.00%	15.40%
	Mostly polymer	3	5.00%	7.70%
	Mostly composites and foams	3	5.00%	7.70%
	Mostly ceramic and glasses	2	3.30%	5.10%
	Mostly fibers	2	3.30%	5.10%
Total		60	100.00%	153.80%

a. Dichotomy group tabulated at value 1.

10. Types of waste produced

Types of waste produced

		Responses		Percent of Cases
		N	Percent	
Types of waste produced[a]	Chips wood or metal	26	36.10%	65.00%
	Sawdust	22	30.60%	55.00%
	Packaging	8	11.10%	20.00%
	Adhesive or solvents	5	6.90%	12.50%
	Others	5	6.90%	12.50%
	Oil	4	5.60%	10.00%
	NA	2	2.80%	5.00%
Total		72	100.00%	180.00%

a. Dichotomy group tabulated at value 1.

11. Environmental standards practiced

Environmental standards

	Frequency	Percent	Valid Percent	Cumulative Percent
ISO 9000 certification	7	17.5	17.5	17.5
ISO 14000	0	0	0	17.5
Others	7	17.5	17.5	35.0
None	26	65	65	100.0
Total	40	100.0	100.0	

12. Product is recyclable

Product is recyclable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	42.5	42.5	42.5
	No	13	32.5	32.5	75.0
	Planning to determine	8	20.0	20.0	95.0
	NA	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

13. Have employed environmental consultant

Employed environmental consultant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	25.0	25.0	25.0
	No	29	72.5	72.5	97.5
	NA	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

14. Focus on Sustainable manufacturing strategy

Sustainable Manufacturing Strategy Focus

		Responses		Percent of Cases
		N	Percent	
Sustainable Manufacturing Strategies	Sustainable product design	20	37.0%	83.3%
	Sustainable Manufacturing Processes	16	29.6%	66.7%
	Sustainable Supply Chain	11	20.4%	45.8%
	End of Life Management	7	13.0%	29.2%
Total		54	100.0%	225.0%

a. Dichotomy group tabulated at value 1.

15. Sustainable manufacturing performance

Sustainable Manufacturing Performance

		Responses		Percent of Cases
		N	Percent	
Sustainable Manufacturing Performance[a]	Environmental Performances	11	20.8%	47.8%
	Operational Outcomes	17	32.1%	73.9%
	Economic Outcomes	17	32.1%	73.9%
	Social Performances	8	15.1%	34.8%
Total		53	100.0%	230.4%

a. Dichotomy group tabulated at value 1.

16. Barriers to implement sustainable manufacturing

Barriers to implement Sustainable Manufacturing

		Responses		Percent of Cases
		N	Percent	
Barriers to implement SM[a]	- Difficult to change manufacturing processes	14	18.20%	45.20%
	- Cost	12	15.60%	38.70%
	- Lack of information and technical know how	11	14.30%	35.50%
	- Employee barriers	9	11.70%	29.00%
	- Design requirements inhibits changes	8	10.40%	25.80%

	- Obstacle in supply chain	7	9.10%	22.60%
	- Competition in local/global market	6	7.80%	19.40%
	- Product is complex to consider 3R	5	6.50%	16.10%
	- Managerial barriers	4	5.20%	12.90%
	- Others	1	1.30%	3.20%
Total		77	100.00%	248.40%

a. Dichotomy group tabulated at value 1.

17. Methods of R&D employed

Method of RDI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Internal only	24	60.0	60.0	60.0
	External only	0	0.0	0.0	60.0
	Both	3	7.5	7.5	67.5
	No R&D	13	32.5	32.5	100.0
	Total	40	100.0	100.0	

18. Reasons not to involve in R&D

Reasons not to have R&D

		Responses		Percent of Cases
		N	Percent	
Reasons not involve in RDI[a]	Limited Funding	14	28.6%	73.7%
	Limited expertise	12	24.5%	63.2%
	Limited technology	10	20.4%	52.6%
	Contract manufacturers	7	14.3%	36.8%
	Design bought from external party	5	10.2%	26.3%
	Others	1	2.0%	5.3%
Total		49	100.0%	257.9%

a. Dichotomy group tabulated at value 1.

19. Using own furniture design

Using own furniture design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	77.5	77.5	77.5
	No	7	17.5	17.5	95.0
	NA	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

20. Companies having automated equipment's

Having an automated equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	62.5	62.5	62.5
	No	14	35.0	35.0	97.5
	NA	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

21. Companies willing to invest on automation

Willing to invest on automation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	77.5	77.5	77.5
	No	3	7.5	7.5	85.0
	NA	6	15.0	15.0	100.0
	Total	40	100.0	100.0	

22. Benefits of automation achieved

Benefits of automation

		Responses		Percent of Cases
		N	Percent	
Benefits of automation[a]	- Reducing operating cost	25	16.70%	80.60%
	- Reducing number of worker	24	16.00%	77.40%
	- Increasing production output	24	16.00%	77.40%
	- Improving quality and consistency	23	15.30%	74.20%
	- Increasing manufacturing flexibility	15	10.00%	48.40%
	- Saving space	14	9.30%	45.20%
	- Improving health and safety	13	8.70%	41.90%
	- Reducing waste and increasing yield	12	8.00%	38.70%
Total		150	100.00%	483.90%

a. Dichotomy group tabulated at value 1.

23. Barriers to implement automation

Barriers to implement automation

		Responses		Percent of Cases
		N	Percent	
Barriers to automate[a]	- High capital investment	15	31.30%	71.40%
	- High maintenance cost	12	25.00%	57.10%
	- Incompatibility of the technologies	6	12.50%	28.60%
	- Low technological literacy amongst worker	6	12.50%	28.60%
	- Requires the retraining of workers	5	10.40%	23.80%
	- Difficult to use and not easily understood	3	6.30%	14.30%
	- Others	1	2.10%	4.80%
Total		48	100.00%	228.60%

a. Dichotomy group tabulated at value 1.

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