Extent of Automation and the Readiness for Industry 4.0 among Malaysian Furniture Manufacturers

Jegatheswaran Ratnasingam *et al.*
Universiti Putra Malaysia

Presentation at Erasmus + Project Meeting on MAKING4.0 in Warsaw, Poland from 1 – 5 July 2019

Project Collaborators

Prof. Dr. Jegatheswaran Ratnasingam
Lee Yan Yi (M.Sc. Student)
Dr. Amir Affan Abdul Azim
Hazirah Ab Latib (M.Sc. Student)

Dr. Ragunath Ramachandran
Dr. Tarmizi Hj Zainuddin

Mr. Albert Khoo
Mr. Vincent Teo

Ms. Sally Yim
Puan Zurinah Hj.Hashim

IF Grant (846110) for Study on Effective Adoption of Industry 4.0

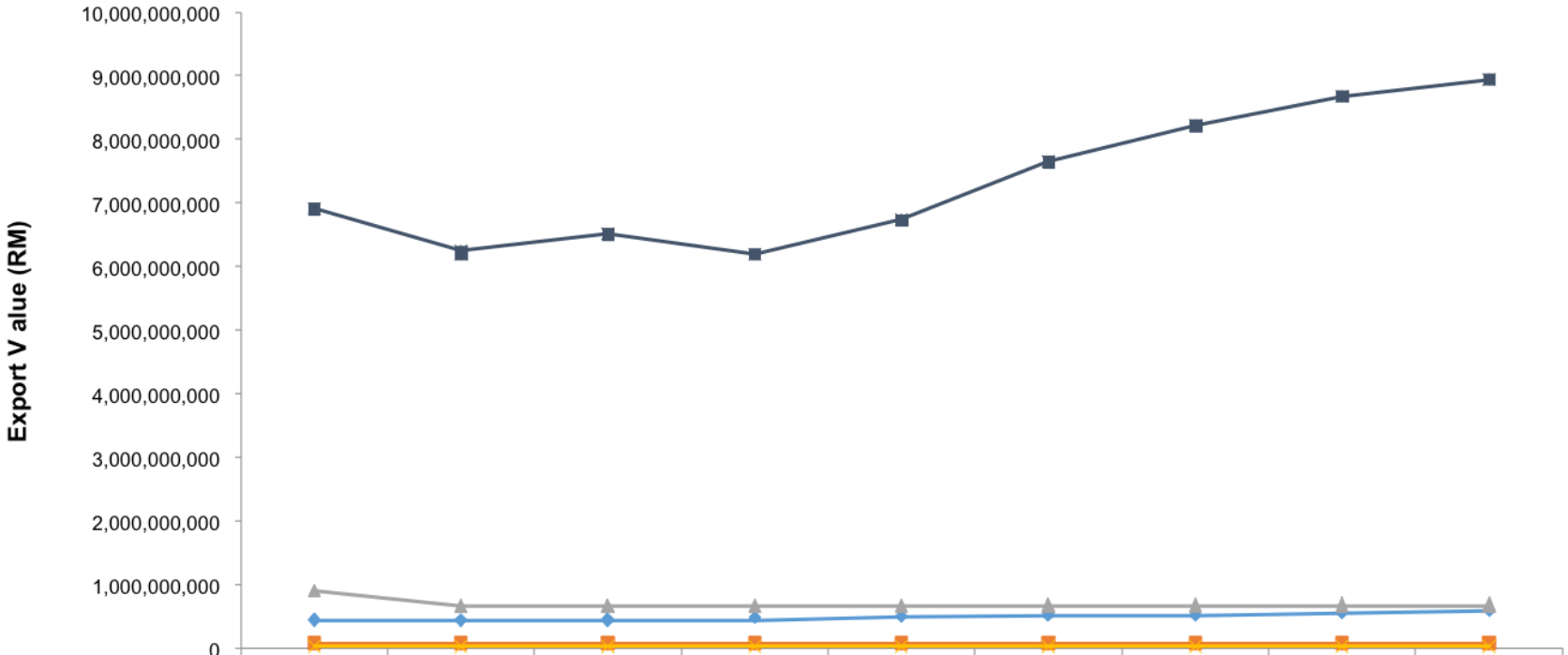
2018 – 2020

Sample Size: 768 mills

INTRODUCTION

- The fastest growing sub-sector within the Malaysian wood-based industry has been the furniture sector.
- Its rapid export growth from about RM 40 million in 1982 to RM 9.83 billion in 2018.
- The Malaysian furniture industry is currently an important socioeconomic sector in the country, contributing USD 2 billion annually in foreign exchange, while providing employment to 93,000 workers.
- The net volume of furniture produced within the country exceeds USD 3.2 billion per annum.
- Hence, the furniture industry has earned the accolade of being the star performer within the overall Malaysian wood industry.

- The wooden furniture category is the largest constituent (Figure 1), accounting for almost 80% of the total furniture exports.
- The furniture industry is on track to achieve its target of RM 12 billion in export receipt by the year 2020.
- The furniture manufacturing industry is a low-wage economy, with diminishing profitability attributed to lack of innovation and value-addition.
- It is not attractive to the local workforce due to its 3D character (*i.e.*, dirty, dangerous, and difficult) and low wages.
- The furniture industry is highly dependent on foreign contract workers, especially those from Bangladesh, Myanmar, and Nepal, who make up almost 63% of the total workforce in the industry.



	2008	2009	2010	2011	2012	2014	2015	2016	2017
Furmiture Parts	441,974,001	436,997,096	442,318,925	474,446,286	494,441,206	505,515,010	513,444,210	546,788,110	589,762,004
Others Furniture	77,943,141.00	74,283,490	88,081,923	86,630,777	87,110,040	90,442,141	91,040,565	91,768,122	91,918,111
Metal Furniture	904,485,593	672,683,422	665,017,694	666,145,287	666,545,110	689,141,030	694,223,011	701,110,442	704,114,313
Rattan Furniture	34,616,349	29,636,368	31,158,474	25,051,936	25,010,334	24,889,101	24,766,100	24,101,224	23,877,141
Wooden Furniture	6,921,086,966	6,248,217,943	6,521,646,488	6,201,495,360	6,743,515,216	7,656,711,040	8,217,813,200	8,678,994,114	8,944,567,810

Figure 1. Type of furniture export from Malaysia, 2008-2017. Values are shown in RM Million. (Source: Department of Statistics, Malaysia).

Growth Drivers?

- Growth in the furniture industry is driven by incremental capital inputs, especially raw materials and labor; any negative impact on any of these factors may influence the growth trajectory of the industry as a whole.
- Figure 2 depicts the clearly declining growth rate of the furniture industry in Malaysia, suggesting that the industry is losing its comparative advantage due to diminishing advantages derived from the factor inputs and its importance as an significant economic sector.
- Its contribution towards the national GDP is also steadily declining.

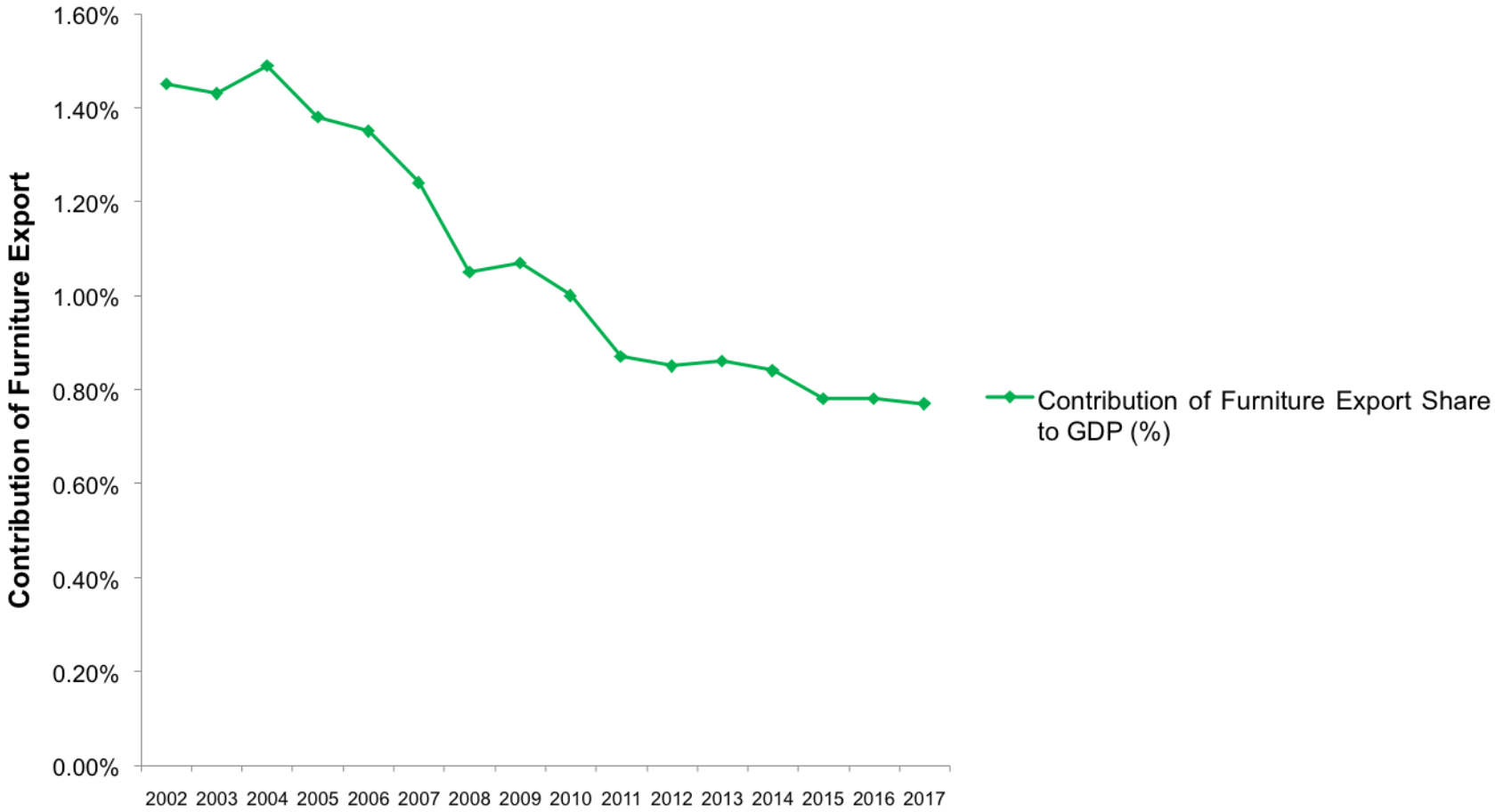


Figure 2. Contribution of furniture export value share to gross domestic product (GDP) of Malaysia (Source: Department of Statistics, Malaysia)

Value Addition Trend

- Value-addition is the amount by which the value of an article is increased at each stage of its production, exclusive of initial costs.
- In this context, the declining value-addition growth as evident in Table 1, reflects an industry devoid of extensive innovation.
- Thus, the declining growth rate and value-addition intensity result from diminishing returns from factor inputs.
- One pathway to reverse this declining trend is the adoption of automation and related technologies in line with the transformation towards the era of Industry 4.0.

Table 1. Value Addition Trend

Year	Value Addition Growth* (%)	Value Addition Intensity* (%)
2000	33.50%	31.77%
2001	-8.20%	31.48%
2002	-4.60%	25.08%
2003	-2.40%	24.35%
2004	14.80%	23.08%
2005	16.00%	23.56%
2006	6.10%	23.48%
2007	3.80%	22.40%
2008	7.20%	23.33%
2010	1.70%	28.00%
2012	-51.67%	26.35%

Note: Data is not available for year 2009 and 2011; *Calculation by the author.
Source: DOS

- The results from the study revealed that the present application of automation in the Malaysian furniture manufacturing industry is focused primarily on panel-based furniture manufacturing rather than solid-wood or other types of furniture products (Figure 3 and 4).
- This preference among panel-based furniture manufacturers to apply a higher degree of automated technologies in the manufacturing facility is driven by the need for consistent quality, lower unit cost, standardized components, and compliance to various standards.
- It was evident that panel-based furniture manufacturing applied a higher level of automation compared to solid-wood furniture manufacturing, primarily due to the standardized components and raw materials used.

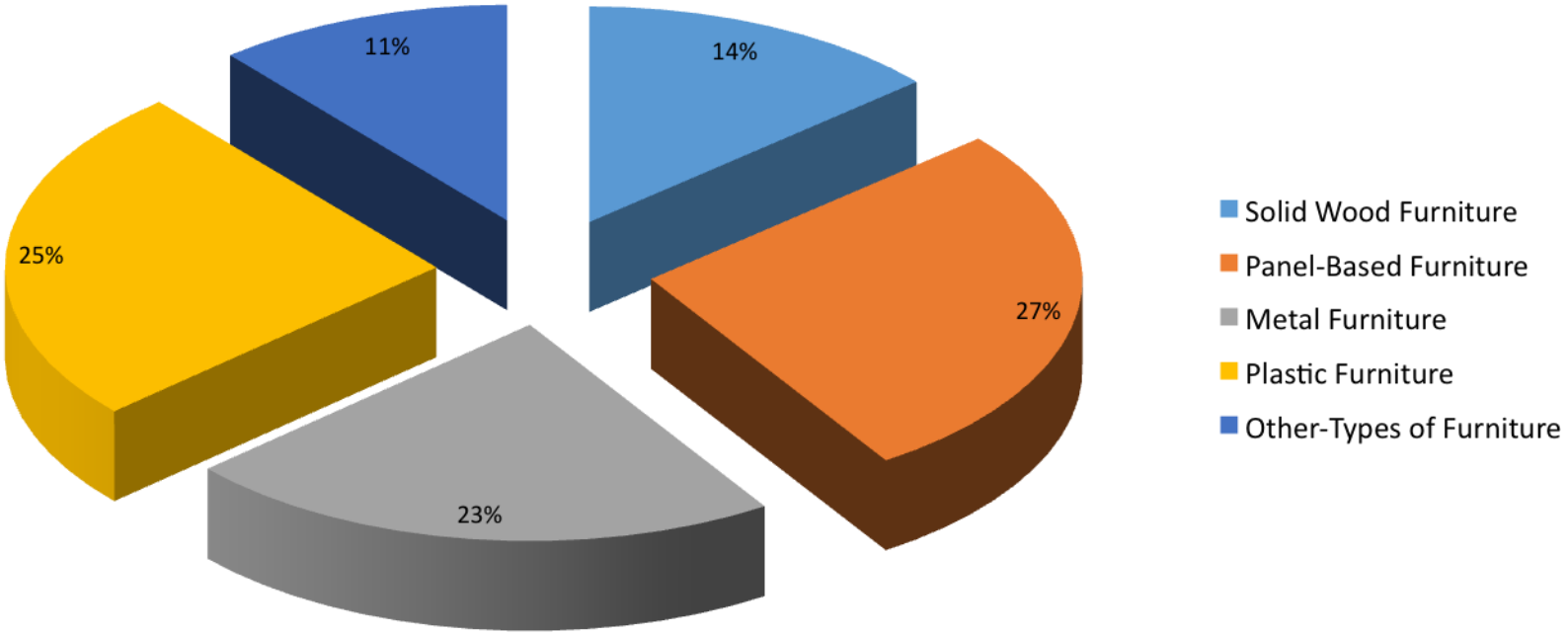


Figure 3. Extent of automation in the furniture manufacturing industry

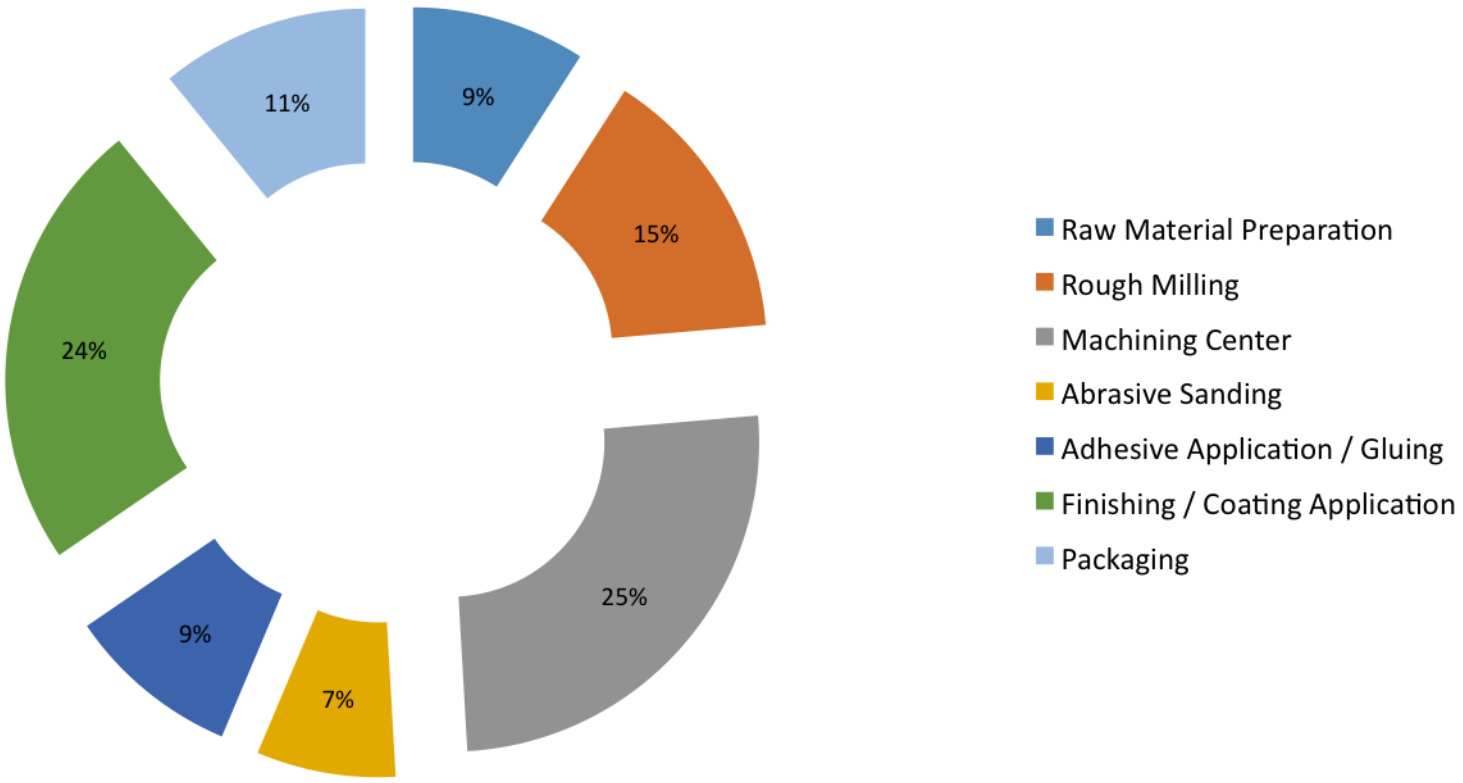


Figure 4. Application of automated technologies in the manufacturing processes of furniture

- In terms of the application of automated technologies in furniture manufacturing, the machining centers were ranked first, while the abrasive sanding operation was ranked the last (Figure 5).
- This result coincides with the development in manufacturing technologies, through the advent of robotics, sensor technologies, automated sorter, in-line defects detection systems, automatic spray finishing system, and computer numerical control (CNC) workstations, which allows some of the operations involved in furniture manufacturing to be more receptive to the adoption of such technologies compared to the others.

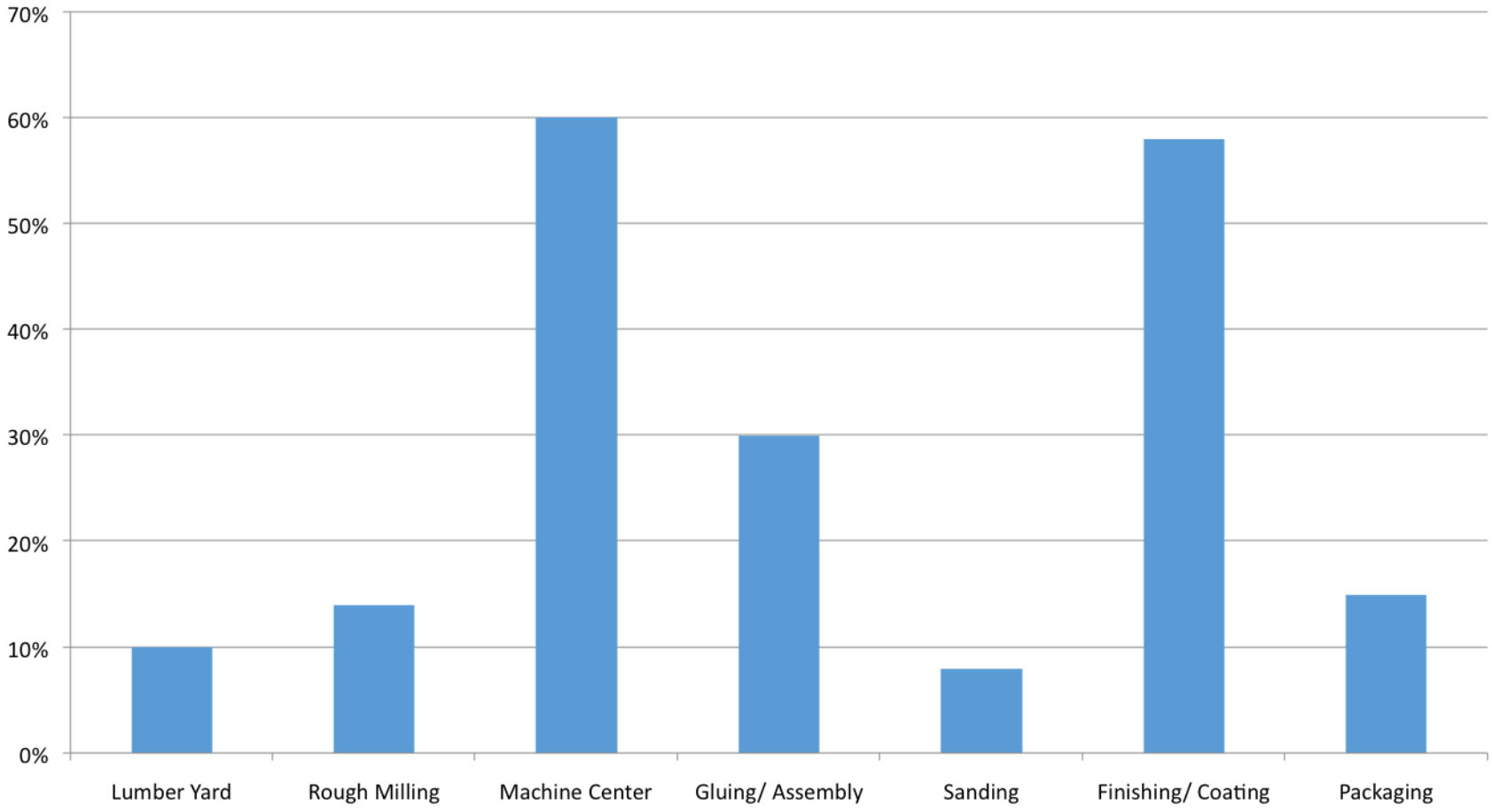


Figure 5. Application of automation in the various stages of furniture manufacturing

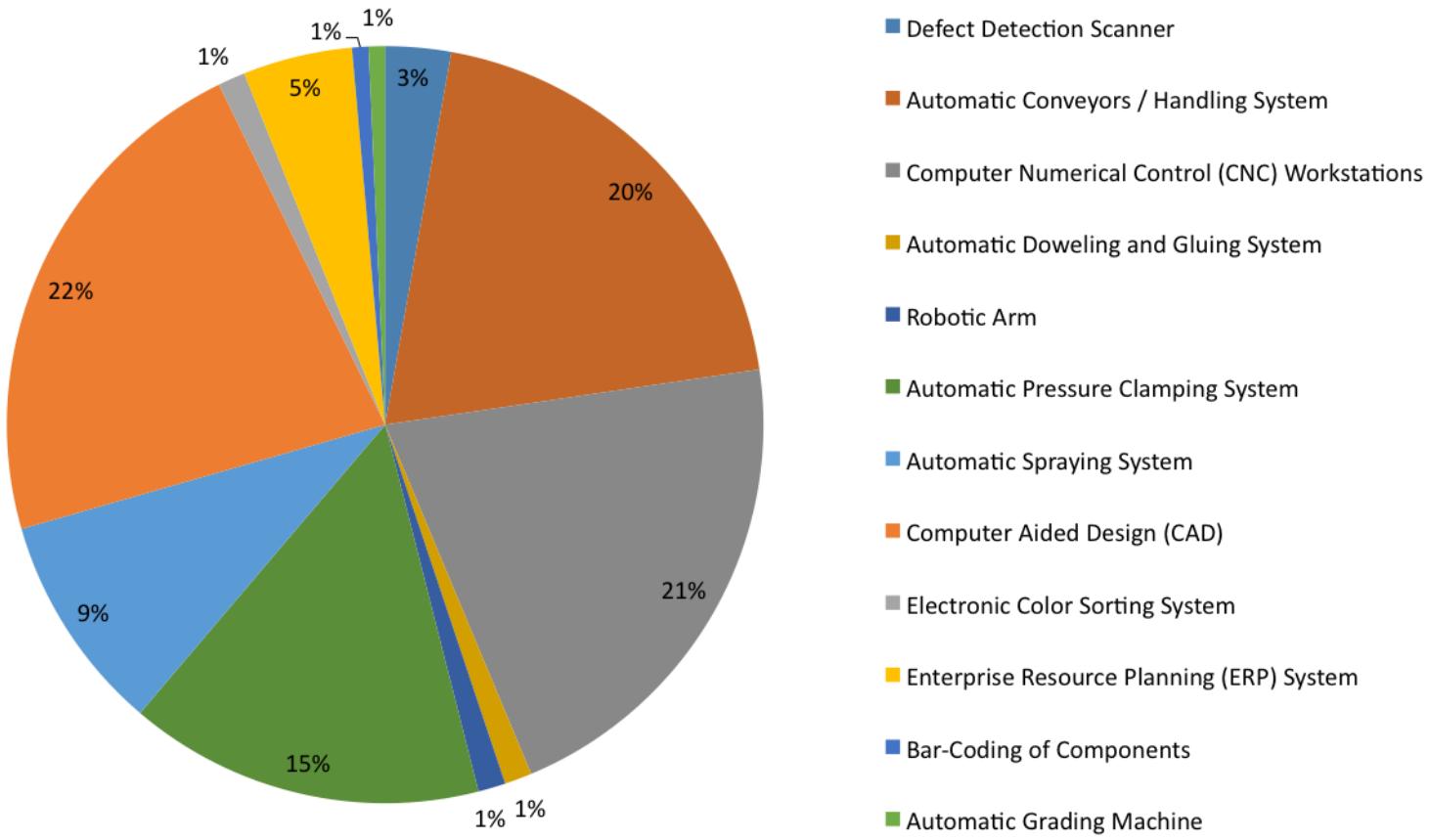


Figure 6. Specific automated technologies used in the Malaysian furniture industry

Table 2. Factors Encouraging the Use of Automated Technologies in Furniture Manufacturing Processes

Manufacturing Processes	Factors Encouraging the Use of Automated Technologies
Rough Milling	Capacity, Just-in-Time, Consistent Quality, High Productivity
Machining Centers	Lack of Skilled Workers, Low Cost, Improved, and Consistent Quality, High Number of Workers
Abrasive Sanding	Increased Productivity, Capacity, Consistent Quality, High Number of Workers, Low Cost, Reduce Pollutants
Gluing & Assembly	Just-In-Time, Consistent Quality, Capacity
Surface Coating	Improved Quality, Higher Standards, Reduce Pollutants, High Productivity, Lack of Skilled Workers, Reduce Number of Workers
Packaging	Capacity, Low Cost, Consistent Quality

Effect of Factors on Attributes

- Table 4 confirms that the lower unit cost, higher output, consistent quality, standardized components, and higher manufacturing standards are the main reasons for furniture manufacturers to adopt automated technologies both among solid wood and panel-based furniture manufacturers.

- The results of the statistical analysis shown in Table 4 revealed that only the factors of lower unit cost, standardized components, higher manufacturing standards, higher output, and increased productivity were important determinants in the more pervasive use of automated technologies in panels-based furniture manufacturing.

Table 3. Determinant Factors on the Use of Automated Technologies by Furniture Types Manufactured

No.	Attributes	Mean for Solid Wood Furniture	Mean for Panel-Based Furniture
1	Increased Output	**4.1**	**4.4**
2	Reduced Unit Cost	**4.1**	**4.4**
3	Higher Productivity	**4.0**	**4.4**
4	Consistent Quality	**4.0**	**4.3**
5	Product Diversity	**4.4**	**4.1**
6	Standardized components	**4.0**	**4.3**
7	Higher Manufacturing Standards	3.9	**4.4**

Factor Analysis of Attributes that Affected the Use of Automated Technologies in Furniture Manufacturing

- Factor analysis showed that the factors encouraging the use of automated technologies in furniture manufacturing were broken into seven groups that influence the manufacturer's decision to use these technologies.
- The application of automated technologies in furniture manufacturing in Malaysia was dependent on increasing production capacity, the cost involved, government policy, and the product characteristics.
- The attributes related to human capital, work environment, and market demand have a lesser effect on the decision making by furniture manufacturers to adopt automated technologies.
- This result supports the claims by the Woodworking Machinery Suppliers Association (WMSA) of Malaysia that the Malaysian furniture industry is very cost-sensitive, and any boost to adopt automated technologies could be realized through more stringent regulatory framework and provision of incentives.

- The use of automated technologies in the furniture manufacturing industry is very much at an early stage, and therefore, no rapid increase use in automation technologies could be realized in the short-term.
- The results from the survey showed that the readiness to adopt Industry 4.0 in furniture manufacturing is relatively low, as almost 96% of the respondents were wary of the high initial investment involved, their lack of networking infrastructure, and data management within their manufacturing facility.
- This sentiment is also due to the higher initial investments required tend to refrain many furniture manufacturers from exploring the benefits of automation.
- Furniture manufacturers and other wood products manufacturers in Malaysia are contended with the fact that their low-cost foreign workforce could more or less offset any benefits that could be possibility offered by automation and Industry 4.0.

Table 4. Seven Factor Solutions from the Factor Analysis of Attributes of Automated Technologies in Furniture Manufacturing

No.	Factors	Attributes	Mean for Solid Wood Furniture	Mean for Panel-Based Furniture
1	Capacity	Increased Output	**4.1**	**4.4**
2		On-Time Delivery	3.8	3.8
3		Reduced Down-Time	3.7	3.9
4		Shorter Manufacturing Cycle-Time	3.8	3.9
5	Cost	Reduced Unit Cost	**4.1**	**4.4**
6		Higher Investment	1.8	2.7
7		Higher Return on Investment (ROI)	3.1	3.6
8	Human Capital	Reduced Number of Workers	3.9	3.9
9		Higher Productivity	**4.0**	**4.4**
10		Lack of Skilled Workers	3.3	3.9
11		Lack of ICT Competency	3.7	3.8
12		Lack of Production-Network Data	3.5	3.8
13	Product Attributes	Consistent Quality	**4.0**	**4.3**
14		Product Diversity	**4.6**	**4.1**
15		Improved Quality	3.8	3.5
16		Smaller Batch Size	3.4	3.8
17		Standardized components	**4.0**	**4.4**

18	Work Environment	Reduced Waste	2.9	3.1
19		Less Pollutants	2.6	3.0
20		Improved Ergonomics	2.9	2.7
21		Improved Safety and Health Conditions	3.1	3.3
22	Government Policy	Lack of incentives	**4.3**	**4.5**
23		No Clear Policy Direction	3.8	3.6
24		Low Minimum Wage	3.4	3.1
25	Market Demand	Improved Workers Welfare	2.8	3.1
26		Higher Manufacturing Standards	**4.0**	**4.4**
27		ISO 9001 Compliance	3.3	3.6
28		ISO 14001 Compliance	3.1	3.5
29		ISO 18001 Compliance	3.2	3.5

Implications for the Industry

- The results of this study have far-reaching implications on the successful adoption of automated technologies in the labor-intensive furniture manufacturing industry in Malaysia, in line with the government's aspiration to shift towards greater automation and embrace the concept of Industry 4.0.

- Automation is more appealing to panel-based furniture manufacturers as opposed to solid-wood furniture manufacturers.

- The push for automation within the furniture industry should be more focused on this sub-sector, as it may be more successful due to the need for standardized components, higher output, lower unit cost, and type of materials used.

- Policymakers must also recognize that the adoption of automation within the furniture industry is predetermined by factors such as increasing production capacity, investment cost, product characteristics, and government policy.

CONCLUSIONS

- Computer numerical control (CNC), computer aided design (CAD), sorting system, and automatic spraying technologies were the automated technologies most prominently used in the furniture manufacturing industry.

- The panel-based furniture industry is more automated compared to other types of furniture manufacturing due to its need for standardized components, higher capacity, and lower unit cost.

- The factor analysis revealed that automation is driven primarily by higher production capacity, cost, product characteristics, and government policy, which inevitably underscores the cost-sensitive nature of the industry.

- Generally, the readiness among furniture manufacturers towards Industry 4.0 is relatively low, primarily due to the concern about the high initial investment involved.

Dziękuję Ci, Gracias, Danke dir

Terima Kasih, Thank you