

Attributes of Sawn Timber Important for the Manufacturers of Value-Added Wood Products in Malaysia

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The objective of this study was to assess the attributes of selected sawn timber species for door, flooring, and furniture manufacturing in Malaysia. Sawn timber attributes are important for value-added wood products manufacturing in terms of market opportunities and consumer preferences. A questionnaire was distributed to 30 value-added wood products manufacturers, in which there were 10 manufacturers in each category: door, flooring, and furniture. The study evaluated three aspects: the choice of sawn timber species for particular types of wood products, the source of origin of sawn timber, and the attributes that determined the choice of the sawn timber species for a particular product. The common local sawn timber species include rubberwood, meranti, merpauh, merbau, and kempas species, while poplar, oak, cherry, and pine represent imported species. It was found that cost, supply/availability, product specification, and market/buyer preferences were among the most important factors influencing the selection of sawn timber species for the manufacture of value-added wood products. However, these attributes were not statistically significant among the group of manufacturers and source of origin, respectively.

Keywords: Sawn timber; Attributes; Source of origin; Door; Flooring; Furniture

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INTRODUCTION

Wood has been one of the most valuable materials for mankind, and its numerous utilizations have contributed to the continuous development of human civilization. Since the industrial revolution, forests have been harvested on a large scale for industrial roundwood production, to be used in a variety of applications. Consequently, the rapid expansion of the wood-based industry has played a significant role in the socioeconomic development of many countries throughout the world. In this context, the contribution of the wood products industry to the Malaysian economy is also undeniable, as the sector has consistently contributed almost 4% to the gross domestic product (GDP) since the early 1980s (National Timber Industry Policy 2009).

The primary processing sector, namely the production of saw logs, sawn timber, veneer and plywood, and other wood-based panels, has been the traditional export-earner for the country. However, it is noticeable that with the drive toward value-added products manufacturing, such as furniture and furniture components, builders, joinery and carpentry (BJC), and moldings, the export revenues from these products have increased significantly over the years (Ratnasingam *et al.* 2013).

The expansion in the value-added wood products manufacturing industries in the country started when the government implemented a series of Industrial Master Plans (IMPs) in the mid-1980s (Ratnasingam 2003; Ratnasingam and Ioras 2005).

Although sawmilling was one of the earliest wood-based industries in the country (Ramasamy *et al.* 2015), the sector has been experiencing a steady decline in output. This can be attributed to the declining supply of saw logs from the natural forests in the country, which is in line with sustainable forest management (SFM) principles. Although this short-fall in saw log supply was supposed to be off-set by the supply of saw logs from the plantation forests established in the country, the amount of saw logs produced has not been able to fulfill the demand (National Timber Industry Policy 2009). Inevitably, other sources of sawn timber supply are in high demand.

Although sawn timber exports were curbed through the imposition of export quotas and export levies, with the intention to ensure a consistent supply of sawn timber for rapidly expanding value-added wood products industry (Ratnasingam *et al.* 2013), the demand for sawn timber from the booming value-added wood products sector outstripped the available supply. Thus, since the late 2000s, increasing amounts of sawn timber imports have become necessary to cater to the needs of the value-added manufacturing sector. It has been reported by Ratnasingam and Lim (2015) that the volume of sawn timber imports into the country reached the 500,000 m³ mark in 2013, and this trend is envisaged to continue in years to come as the value-added manufacturing sector in the country continually increases production.

The choice of sawn timber species used in the manufacture of value-added wood products determines the perceived value and the willingness to pay for the product (Nicholls and Roos 2006). It has been shown that sawn timber attributes (which includes its physical character, strength, durability, environmental-friendliness, cost, and availability) not only determines its application but also its market acceptance (Eastin *et al.* 1998; Bowe and Bumgardner 2004; Ratnasingam *et al.* 2007). The definition of attribute, as given by Brandt and Shook (2005), suggests that it is a feature of the product that differentiates it from other similar products in the same product category. It must be emphasized that the attributes and properties of the sawn timber species are important to value-added wood products, as it is strongly associated with the prevailing market opportunities and consumer acceptance.

Although several studies have been carried out on the attributes of sawn timber that influence the selection of a particular sawn timber species for a particular product or application in the United States and other European countries (Forbes *et al.* 1994; Arowosoge and Tee 2010), studies on the influences of sawn timber attributes on value-added wood products manufacturing in Malaysia are limited. In fact, reports on the success factors of particular sawn timber species for value-added wood products manufacturing are not available (Ratnasingam and Lim 2015). Therefore, in this study, an assessment of the sawn timber attributes and species preferences for selected value-added wood products manufacturing was carried out. The objectives of this study were as follows: (1) to determine the sawn timber species preferences by the manufacturers and (2) to assess the attributes that influence the choice of sawn timber species for door, flooring, and furniture manufacturing.

METHODOLOGY

Target Respondents

The study was carried out through a questionnaire-based survey of 30 value-added wood products manufacturing companies in Malaysia. Fifteen of the value-added wood products manufacturing companies used predominantly local species of sawn timber, while the other 15 manufacturers showed greater use of imported sawn timber species. The respondent manufacturers were selected from the membership list of the trade association, the Malaysian Wood Molding and Joinery Council (MWMJC), and only those manufacturers using more than 65% of the total wood resources from a particular source of origin (either local or imported) were selected. From the 39 manufacturers initially identified, only 30 manufacturers consented to participate in the study. Three types of value-added wood products were chosen for this study, which included door, flooring, and furniture manufacturing industries, as these were among the fastest growing sub-sectors in the wood-based industry in the country and most of the manufacturing outfits were classified as large manufacturers (*i.e.*, employing more than 100 workers and with an annual turnover in excess of US \$12.5 million) (Ratnasingam *et al.* 2013).

Questionnaire-based Survey

A three-part questionnaire was designed and used in this study to gather the required information. The questionnaire was prepared after discussions with the several industrial experts who were importers and wood suppliers in the country and also by referring to the previous study by Ratnasingam *et al.* (2007). This was to ensure that the questions represented by the study, in the context of preferred species of sawn timber and the attribute-related factors that influenced its selection, were relevant and could fulfill the study objectives.

The first part of the questionnaire compiled data on the background of the respondent manufacturer together with relevant information related to the wood resources consumed in their production. The second part of the questionnaire required the respondent to reveal the important sawn timber species used by the manufacturer, the quantity and quality, and the source of origin of the sawn timber. The third part of the questionnaire evaluated the factors that influenced the manufacturer to either use local or imported sawn timber species. A total of 10 attributes of the sawn timber were included in the questionnaire for assessment, which reflected the full range of attributes relevant to wood species selection for specific applications. These attributes were rated on the basis of Likert's five-point rating scale, from 1 (strongly unimportant) to 5 (strongly important). For manufacturers using local sawn timber species, the questions were focused on the reasons for not using imported sawn timber species.

Data Collection

The questionnaire was initially pre-tested among 10 randomly selected value-added wood products manufacturers in the Klang Valley, Malaysia in May 2015. After obtaining the responses and comments from the respondents, the questionnaire was modified accordingly to ensure clarity and ease of implementation. The revised questionnaires were then distributed to the senior managers at the selected value-added wood products manufacturers in July 2015. After three weeks, the answered questionnaires were collected from the manufacturers, while those who have not completed the questionnaire were given

another one-week grace period, before the questionnaires were collected. By early September 2015, all the questionnaires had been collected from the manufacturers.

Data Analysis

The data from the questionnaires were compiled and tabulated using Microsoft Excel software to facilitate analysis. The analysis of data was conducted using the Statistical Package for the Social Sciences (SPSS; IBM, USA). The effects of the sawn timber attributes and the source of the origin of the sawn timber on the types of wood products manufactured (*i.e.*, door, flooring, and furniture) were analyzed. The comparison mean between the test factors was performed using the non-parametric statistical method *i.e.*, Mann-Whitney U and Kruskal-Wallis tests, as the data in this study was an ordinal (Ho 2006). The next part of the statistical analysis was to apply the factor analysis on the ten attributes of sawn timber, to simplify it into smaller groups of several attributes that determines the choice of sawn timber species used (Nicholls and Roos 2006).

RESULTS AND DISCUSSION

The findings from the assessment of the sawn timber attributes in the door, flooring, and furniture manufacturing industries are presented in this section. The results of this study are presented in three parts: (1) sawn timber species preferences; (2) sawn timber attributes; and (3) factor analysis.

Sawn Timber Species Preferences

The selection of sawn timber species is varied among the value-added wood products manufacturers. Bowe and Bumgardner (2004) stated that consumers have different perceptions on different wood species. These perceptions can be leveraged for marketing and product development, if the manufacturers recognized and understood the consumers demand. The preferences of sawn timber species by value-added wood products manufacturers were evaluated in the context of local and imported sawn timber species.

Preferences for imported sawn timber species

A total of 21 different types of sawn timber wood species were utilized by door, flooring, and furniture manufacturers. Among all, the most preferred sawn timber species were oak (*Quercus* spp.), poplar (*Populus* spp.), pine (*Pinus* spp.), and cherry (*Prunus* spp.). Figure 1 shows the most common sawn timber species preferred by three groups of manufacturers. In this context, oak sawn timber was only used in the flooring industry due to its superior wear properties (Shmulsky and Jones 2011).

Preferences for local sawn timber species

A total of 15 different local sawn timber species were utilized by door, flooring and furniture manufacturers. The most preferred local sawn timber species were rubberwood (*Hevea brasiliensis*), meranti (*Shorea* spp.), kempas (*Koompassia malaccensis*), and merpauh (*Swintonia* sp.). Figure 2 shows the most common sawn timber species preferred by the three groups of manufacturers. Similarly to oak, kempas was only used for flooring manufacturing due to its superior strength and hardness (Shmulsky and Jones 2011).

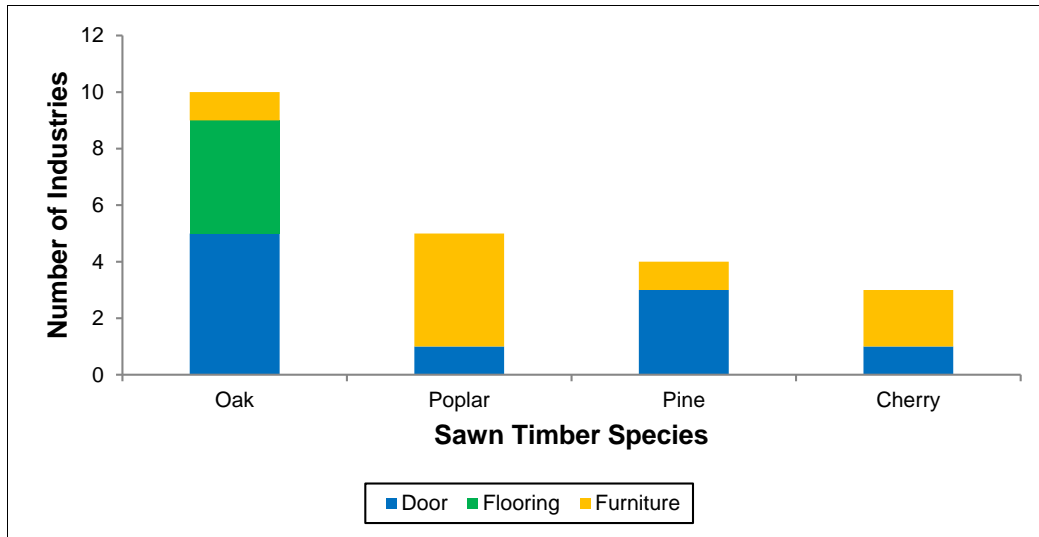


Fig. 1. The most common imported sawn timber species by value-added wood products manufacturers

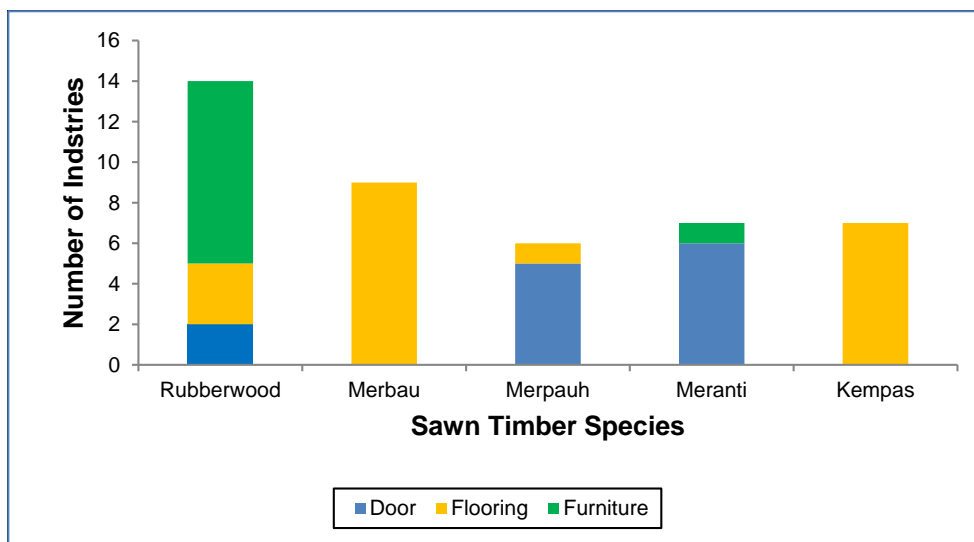


Fig. 2. The most common local sawn timber species by value-added wood products manufacture

Several factors were reported by value-added wood product manufacturers regarding their preferences for using local sawn timber species in the production. The factors are summarized in Table 1. Among all the factors, it is obvious that the higher price of imported sawn timber encouraged the particular door, flooring, and furniture manufacturers to use local sawn timber species.

Sawn Timber Attributes

The attributes of sawn timber species preferred by manufacturers of value-added wood products were evaluated. Table 2 presents the mean ranking of sawn timber attributes on the basis of types of wood products. It is noticeable that cost, market/buyer preferences, product specification, and supply/availability factors were the main reasons that encouraged door, flooring, and furniture manufacturers to choose a particular sawn timber species for production.

Table 1. Factors for Choosing Local Sawn Timber by the Groups of Manufacturers

Industry	Factors for Using Local Sawn Timber Species
Door	Market and buyer preferences On-time delivery Easy of planning Expensive No focus to import
Flooring	Require high holding cost for imported sawn timber High prices Not familiar with the species Traditionally produced using local wood resources Buying components from local manufacturers
Furniture	No advantage for using imported sawn timber Familiar with rubberwood High price Buyer's preference Readily available

Table 2. Mean Importance Rating of Attributes According to Type of Wood Product by the Groups of Manufacturers

Attributes	Door (n=10)	Flooring (n=10)	Furniture (n=10)
Cost	4.60	4.70	4.90
Market/buyer preference	4.50	4.70	4.40
Aesthetic quality	3.50	3.80	4.10
Working properties	3.40	3.60	3.90
Supply / availability	4.50	3.90	4.20
Environmental friendly	3.70	2.90	3.30
Product specification	4.40	4.60	4.30
Durability	3.30	3.00	3.40
Strength and hardness	3.00	3.50	3.50
Price premium for finished goods	3.60	3.70	3.30

Note: Figures in bold represent the highest ranking of attributes important for each category of wood product.

These findings were contrary to other reports on the attributes that influenced the selection of a particular sawn timber species. In the study by Nicholls and Roos (2006), the appearance-related attributes received the highest importance. On the other hand, investigations by Eastin *et al.* (1998) highlighted that technical properties were more important compared to economic and old-growth characteristics of the wood species. In the study by Arowosoge and Tee (2010), it was shown that durability, followed by design, color/grain, wood species, and wood grade were the highest consumers' preferred attributes for wooden dining furniture. Bumgardner and Bowe (2002) examined several appearance-based attributes on two selected wood species for use in secondary wood products, and it was found that wood grain and color played very important roles.

The study further assessed the attributes of sawn timber species in accordance to the source of origin (*i.e.*, local or imported sawn timber). The mean ranking of sawn timber attributes on the basis of local and imported sawn timber species is shown in Table 3. It is apparent that cost, market/buyer preferences, supply/availability and product specification

were the primary factors that encouraged manufacturers to choose either local or imported sawn timber species for their product manufactured.

Table 3. Mean Importance Rating of Attributes According to Origin

Attributes	Local (n=15)	Import (n=15)
Cost	4.87	4.60
Market/buyer preference	4.67	4.40
Aesthetic quality	3.73	3.87
Working properties	3.60	3.67
Supply/availability	3.93	4.47
Environmental friendly	2.93	3.67
Product specification	4.40	4.47
Durability	3.07	3.40
Strength and hardness	3.13	3.53
Price premium for finished goods	3.07	4.00
Note: Figures in bold represent the highest ranking of attributes important for all categories of wood product		

Effect of Factors on Attributes

Tables 2 and 3 confirm that cost, market/buyer preferences, product specification, and supply/availability factors were the main reasons for manufacturers to choose selected sawn timber species for particular product manufacture. A statistical analysis was carried out to determine if the three factors had any effect on the type of wood products manufactured and the source of origin of the wood, respectively.

The Kruskal-Wallis statistical analysis was conducted to determine the significant difference in the attributes that influenced the selection of sawn timber species between the various types of wood products manufactured. The result of the study is shown in Table 4. The statistical test showed that the variables, *i.e.*, cost, market/buyer preference, and supply/availability, respectively, were not significant, as the P-values were larger than 0.05. Hence, these factors did not have any preferential influence on the door, flooring, and furniture manufacturing industries.

Table 4. Effect of Groups of Manufacturers on Sawn Timber Attributes

Attributes	Test Factors	n	Mean Rank	Chi-square	Sig.
Cost	Door	10	14.00	1.280	0.527
	Flooring	10	15.40		
	Furniture	10	17.10		
Market/buyer preference	Door	10	15.60	0.494	0.781
	Flooring	10	16.60		
	Furniture	10	14.30		
Product specification	Door	10	15.95	0.556	0.757
	Flooring	10	16.50		
	Furniture	10	14.05		
Supply/availability	Door	10	19.15	3.646	0.162
	Flooring	10	12.65		
	Furniture	10	14.70		

The second part of the analysis was to determine whether there was any significant difference in cost, market/buyer preference, and supply/availability between the local and

imported sawn timber species. Mann-Whitney U test was applied for this analysis. As shown in Table 5, no differences were observed between the local and imported sawn timber species for these attributes as the P-value was larger than 0.05. As a result, differences in cost, market/buyer preference, and supply/availability did not influence the choice of using either local or imported sawn timber species. However, supply/availability showed some indication of importance.

Table 5. Effect of Origin on Sawn Timber Attributes

Attributes	Test Factors	n	Mean Rank	Mann-Whitney-U	Sig.
Cost	Import	15	14.37	95.50	0.486
	Local	15	16.63		
Market/buyer preference	Import	15	14.30	94.50	0.461
	Local	15	16.70		
Product specification	Import	15	15.70	109.50	0.887
	Local	15	15.30		
Supply/availability	Import	15	18.57	66.50	0.056
	Local	15	12.43		

Factor Analysis

Factor analysis is based on the assumption that all variables are correlated to some degree (Ho 2006). The degree of correlation among the variables can be examined using the Kaiser-Meyer-Olkin method. The analysis indicated that the correlation among the variables showed an index value of 0.407, which is quite low. The Bartlett's test of sphericity of the correlation matrix yielded a value of 95.44 and an associated level of significance of smaller than 0.001. Hence, the correlation matrix had significant correlation among at least some of the variables, and it also indicated that the factor analysis was appropriate for the data in this study.

The factor analysis grouped the ten variables into three main groups of attributes which could be defined as follows: (1) sawn timber properties; (2) raw material sustainability; and (3) consumer's preferences. According to Eastin *et al.* (1998), instead of describing the attributes of sawn timber in accordance to many variables, the factor analysis resulted in the consolidation of the many variables into these three distinct groups. The grouping of variables into the factors is shown in Table 6.

Table 6. Three Factor Solutions from Factor Analysis

Attributes	Group 1 Sawn Timber Properties	Group 2 Raw Material Sustainability	Group 3 Consumer Preferences
Working properties	0.881	-0.121	0.108
Aesthetic quality	0.738	-0.035	-0.413
Durability	0.647	0.618	-0.045
Strength and hardness	0.523	0.421	-0.022
Environmental friendly	0.302	0.783	0.155
Supply/availability	-0.142	0.699	0.064
Price premium for finished goods	-0.153	0.641	-0.340
Product specification	0.044	-0.152	0.907
Cost	0.242	-0.180	-0.588
Market/buyer preference	0.371	-0.048	0.384

Group 1 includes variables such as working properties, aesthetic quality, durability, and strength and hardness. The variables in group 2 include environmental friendliness, supply/availability, and price premium for the finished goods. Variables in the study for group 3 include product specification, cost, and market preferences. The variance explained accounted for 27.5%, 17.8%, and 16.1%, respectively, of the total variance observed. The variables in group 3 were consistent except for the cost factor. The negative value of cost shows that the high cost of sawn timber may result in less usage by the three groups of manufacturers.

This study revealed that in the manufacture of value-added wood products, the properties of sawn timber and its sustainability are more important than the customer preferences for determining the choice of wood species used. This is most likely due to the fact that value-added wood products are purchased on perceived value rather than the actual value (Ratnasingam *et al.* 2013).

CONCLUSIONS

1. Consumer choice and market preferences influence selected sawn timber species for particular applications. The most common local sawn timber species used by manufacturers of door, flooring, and furniture in Malaysia were rubberwood, merpauh, meranti, merbau, and kempas. On the other hand, the predominant imported sawn timber species were poplar, cherry, oak, and pine.
2. The findings indicated that cost, market preferences, and supply/availability are the most important attributes in the utilization of certain sawn timber species, either local or imported. However, the statistical analysis did not show significant differences among the different manufacturers groups and the choice of sawn timber species used, respectively.
3. The factor analysis simplified the 10 attributes of sawn timber to three main groups, which were sawn timber properties, raw material sustainability, and consumer preferences. The results revealed that sawn timber properties and raw material sustainability had significant effects on the choice of sawn timber species used for value-added wood products manufacturing.
4. The attributes of sawn timber species may influence other fields such as wood products manufacturing, products marketing, and strategic business development.

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