

## The factorial structure of the design innovation construct: insights from the furniture manufacturing firms in Malaysia

Puteri Fadzlina Tamyez<sup>1,\*</sup>, Norzanah Mat Nor<sup>2</sup>, Syed Jamal Abdul Nasir<sup>2</sup>

<sup>1</sup>*Faculty of Industrial Management, UMP, Pahang, Malaysia*

<sup>2</sup>*Arsyad Ayub Graduate Business School, UiTM, Shah Alam, Malaysia*

---

**Abstract:** The purpose of this research is to validate the underlying factorial-structure of the design innovation measurement scale and subsequently investigate its psychometric properties. The analysis was based on a sample of 101 furniture manufacturing firms throughout Malaysia. Exploratory factor analysis (EFA) was performed to determine the factorial structure of design innovation. Subsequently, to confirm and validate the factorial structure and assess the psychometric properties of design innovation, confirmatory factor analysis (CFA) was executed. In addition, to establish the nomological validity of design innovation a structural model was developed to examine the effect of design innovation on brand performance. It is unveiled that design innovation is a second order six-factorial structure construct and its scale has adequately met the psychometric criteria, thus could permit interpretation of results confidently. The findings have important implications for future research directions and management of design innovation towards a better performance for firms pursuing branding.

**Key words:** Design innovation; Malaysian furniture industry; Brand performance

---

### 1. Introduction

Brand performance has become a paramount importance in most organizations (Aaker, 1996; Hoeffler and Keller, 2002; Keller, 2001). Some scholars determine brand performance through the customers' perspective of their awareness and image towards a brand (Aaker, 1996; Keller, 2003). Hu, Chang, Hsieh, and Chen (2010) stated that brand performance acquired intangible assets apart from tangible assets in a product itself. According to Collins and Montgomery (1995); Delaney and Huselid (1996); Hamel and Prahalad (1989); Hu et al. (2010); Penrose (1959); Wong and Merrilees (2007), brand performance acts as a tool to measure the level of accomplishment and success of an organization mission and objectives within the market.

Subjective judgments need to be carried out to assess the firm's performance where the ultimate objective is to improve a firm's finance and profits. Branding performance as the most valuable asset must be continuously monitored to ensure a longer life and survivability of a business (Ahmad, 2009). Five indicators by Wong and Merrilees (2008) were modified to fit the context of furniture product branding and used to represent the brand performance construct. Advertising or promotion is crucial in creating the desired brand image in the market, which eventually will determine the success of a brand on a particular product (Wong and Merrilees, 2005). Customers should become aware

of a particular brand when purchasing a product, and this indicates a basic dimension to measure brand performance (Chaudhuri, 2002).

However, there is little empirical evidence in the literature that examine implicitly predictors of design innovation associated with brand performance. Therefore, there still remains a gap to examine empirically what are the underlying factors that contribute to the formation of higher order construct which is design innovation. In this regard, the Malaysian furniture industry is the chosen sample for this study. The Malaysian furniture industry is known as one of the largest contributors of the country's economic growth albeit being classified as a low-tech industry (Unit, 2011). Robiyah (2012) and Kam and Heng (2010) revealed that Malaysia has become a star performer of the timber industry and witnessed accelerated growth as it ranks the eighth in Malaysia's furniture export (Brandt and Wei, 2012). In relation to that, the exports of both timber and timber products amounted to RM20.3 billion in 2012, and estimated to reach RM23.7 billion by the end of 2013 (Nee, 2013).

### 2. Literature review

There are numerous studies concerning innovation as determinants of brand performance. The uniqueness of the innovation determines target customers' to purchase and create a brand loyalty. Nonetheless, in the context of the Malaysian furniture industry, the theory of design innovation pyramid is more reliable.

---

\* Corresponding Author.

Based on extensive literature on design innovation, the design innovation pyramid by Rampino (2011) will be applied to measure design innovation in this research. The dimensions involved in the design innovation pyramid are considered suitable in the context of the furniture industry to examine the types of design innovation applied by the furniture firms. The innovation pyramid provides a promising explanation to replace innovation in the brand strategy model.

### 2.1. Design Innovation

Rampino's (2011) pyramid describes four types of design innovation. Aesthetic that is embedded in products has established design as a prominent feature in developing a product (Council, 2010; Lojacano and Zaccai, 2004; Veryzer and Mozota, 2005). Three factors exist in form and styling, which are 1) external form: outline which includes proportion, scale, feature of boundary lines; (2) internal form: refers to structure that includes various composition and connection patterns between lines, faces and bodies; (3) material form: material and its texture characters. Abbing (2010) posited that even though design tends to be more innovative, more profitable and grow faster than other competitors, the application of design is in fact much broader than the aesthetics and merely on the looks of the products. Deukjoo (2012) agrees with Abbing (2010) and added that a product that catches the eyes of customers is not sufficient and must at least have an optimal purpose. The appeal must be derived from one key point and in the flood of the information age; one must only keep the customer interested in one single point. Technological innovation or functional innovation molds the evolution of markets and industries through radical or incremental approach of innovation (Marc Bourreaux, Gensollena, and Moreaub, 2012).

In the furniture industry, flexibility must be cultivated among machinery and tool producers to dominate business in many countries (Yong, 2013). The technology development within the wood processing industry is driven by rapidly changing wood materials quality, increasing production as well as energy costs, increasing responsiveness to environmental pressures, and increasing consumer demand for wood products that are greatly enhanced in comparison to products from other materials (Ratnasingam, 2013). Meaning innovation requires a certain product design language and signs that would communicate with the users through innovative meanings and values (Dell 'Era and Verganti, 2009). Typological innovation is discovered by Rampino (2011) from a phenomenological analysis which is apart from aesthetic innovation, innovation of use or functional innovation, and meaning innovation. This radical innovation is the opposite direction of user-centered innovation as they propose breakthrough vision rather than focusing on user needs (Verganti, 2009). This particular innovation forms a new creation of

product category and simultaneously diverts from its formal category of product (Rampino, 2011).

### 3. Research methodology

Guided by the extent of literature review and the methodological procedure suggested by Churchill (), the scale is developed, tested and purified to measure the furniture manufacturers assessment of design innovation on their brand performance. The scale was based on the literature of Rampino (2011), where its scale utilized in this study are likert scale (5-point scale: 1=strongly disagree to 5=strongly agree). Stratified random sampling was applied where it involves small, medium and large-sized firms. Participants' brand performance was gathered through the use of a questionnaire survey. In total, 550 contacts were made, with micro-sized firms omitted as it was unsuitable for the sample, 6 questionnaires were not fully completed with totaled questionnaires returned as 204 samples. The survey achieved a 37.5 percent return.

### 4. Results

#### 4.1. Demographic profile of respondents

The respondents comprised mainly of female, 42 respondents (20.59 percent) and 162 males (79.41 percent). The biggest single group of respondents in the ethnicity distribution (97.06 percent) was Chinese, and followed by Malay (2.94 percent). This finding is consistent with Board (2010b) on the dwindling numbers of Bumiputera furniture manufacturers in Malaysia. Thus, we can conclude the translated version of Mandarin language has eased their ability to comprehend with the structure of the questionnaire. Most of the respondents (30-39 percent) fell in the 40-49 age groups and more than 35 percent of the respondents are among owners and managers. The majority of the respondents have experience in the industry for more than 20 years. Additionally, the majority of respondents are working in private limited firms of more than 20 years operation. A significant percentage of furniture firms i.e. 90.2 percent, operating for more than 20 years; indicating that furniture firms may be reluctant to exit or graduate to become large firms. Only 1 percent of the furniture firms are among 6 to 10 years. In terms of size, the majority of respondents of 39.22 percent are small-sized enterprises with a number of 1-100 workers. This is consistent with the total of furniture firms in Malaysia where the small-sized firms (49.26 percent) are dominant in comparison to medium-sized (21.04 percent) and large firms (8.43 percent) (Corp, 2012). The majority of their businesses is export-oriented and operates in one plant only. Thus, we can conclude that the respondents are sufficiently well versed with the operations of the company and able to comprehend the needs of the questionnaire (Table 1).

**Table 1:** depicts the demographic of the sample (n= 204)

Demographic	Frequency	(%)
Gender		
Male	162	79.4
Female	42	20.59
Race		
Chinese	198	97.06
Malay	6	2.94
Age		
20-29	34	16.67
30-39	50	24.51
40-49	62	30.39
>50	58	28.43
Position in company		
Owner and CEO	49	24.02
Owner and Manager	73	35.78
Manager but not Owner	82	40.20
Experience in the industry		
<10	12	5.88
10-20	42	20.59
21-30	87	42.65
31-40	63	30.88
Legal form of business		
Sole Proprietor	2	0.98
Private Limited	196	96.88
Partnership	6	2.94
Age of Company		
6-10	2	0.98
11-15	6	2.94
16-20	12	5.88
>20	184	90.20
Company size		
1-100	80	39.22
101-250	70	34.31
250 and more	54	26.47
Export Intensity		
1-50%	97	47.55
Heavy (>50%)	107	52.45
Business operates		
More than one plant	83	40.69
One plant only	121	59.31

#### 4.2. Exploratory factor analysis (EFA)

The design innovation items were subjected to EFA reliability analysis. The EFA used principle component extraction with varimax rotation. The factor loadings for the 28 items ranged from 0.55 to 0.95, well above the threshold value of 0.35 (19). The results reveals both Bartlett test of sphericity at  $p = 0.001$  and the Kaiser-Mayer-Olkin measure of sampling adequacy ( $KMO = 0.839$ ). The 4-factor solution was extracted with Eigenvalues greater than 1. The EFA performed to assess the factor structure of the design innovation scale which comprises of 28 items resulted in the deletion of 8 items. This is due to the failing to fulfill the criteria of low factor loadings ( $<0.5$ ) or high cross loadings ( $>0.3$ ). The remaining 20 items resulted in a 4 structure solution; F1: Aesthetic innovation (7 become 3), F2: Functional innovation (8 become 5), F3: Meaning innovation (8 become 7) and F4: Typological innovation (5). Table 4.3 illustrates the design innovation EFA. The variables (aesthetic innovation, functional innovation, meaning innovation and typological innovation) are parts that contribute to a model development from the integrated the original model by Wong and Merrilees (2008). Due to the newness of the design innovation scale, a major concern is its reliability and validity, therefore pilot testing the scale is needed. Hence, EFA needs to be carried out to ensure its compatibility with the rest of the variables in this model. The EFA analysis is not carried with the same data set as Confirmatory Factor Analysis (CFA), in Table 2.

**Table 2:** The EFA analysis is not carried with the same data set as Confirmatory Factor Analysis (CFA)

No	Design Innovation	F1	F2	F3	F4
1	Stylish and fashionable	0.75			
2	By satisfying the aesthetics and functionalities	0.80			
3	Impact of design on products that are similar to those that are already exist	0.72			
4	Regularity learning of relevant technologies that were not used or fully utilized in the past		0.90		
5	Efficient product manufacturing		0.90		
60	Impact of design on product low cost		0.85		
7	Impact of design on product that introduce new functions and easy to use		0.87		
8	Impact of design on product ergonomics		0.87		
9	Dialogue with the world of culture (events, museum, theatres)			0.94	
10	Unique and ultra-fun			0.88	
11	Make effort to remove any technological constraints that might limit the designer			0.84	
12	Concepts proposed are not pulled by customers' requirements			0.85	
13	Long term contacts with universities and research centres			0.89	
14	Search for talented designers			0.87	
15	Able to identify hidden and unexposed emotional needs of customers			0.78	
16	Our products will achieve significant market share				0.91
17	It has become the accepted market standard in a specific product category				0.75
18	We understood that our product will not always produce commercial success				0.76
19	Our product represents a revolution				0.76
20	Our customers face difficulties in categorizing it onto an existing product category				0.60

The brand strategy items which contain brand performance were also subjected to EFA reliability analysis. The EFA used principle component extraction with Varimax rotation. The results reveals

both Bartlett test of sphericity at  $p = 0.001$  and the Kaiser-Mayer-Olkin measure of sampling adequacy ( $KMO = 0.867$ ). The 4-factor solution was extracted with Eigenvalues greater than 1. The EFA performed

to assess the factor structure of the brand strategy scale which comprises of 26 items resulted in the deletion of 4 items. The remaining 22 items resulted in a 4 structure solution; F1: Brand barriers (7

becomes 4), F2: Brand orientation (7 becomes 6), F3: Brand distinctiveness (7), F4: Brand performance (5). EFA on brand strategy dimensions are also tested as shown in the Table 3.

**Table 3:** EFA on brand strategy dimensions

No	Brand Strategy	F1	F2	F3	F4
1	Organization constraints	0.74			
2	Time constraints	0.70			
3	Lack of demand	0.64			
4	High risk	0.61			
5	Brand is essential to our strategy		0.97		
6	Branding flows through all our marketing activities		0.83		
7	Branding is essential in running this company		0.78		
8	Long term brand planning is critical to our future success		0.77		
9	The brand is an important asset to use		0.73		
10	We use stories in our company to reflect the positioning our brand		0.70		
11	Our firms has a different approach/position in the market compared with our competitors			0.92	
12	Our overall marketing strategy is very distinctive			0.87	
13	We know our main strengths and that really help us compete in the market			0.85	
14	Our products are different from those of competitors			0.84	
15	We know where we are heading in the future and how to market the business to get there			0.87	
16	Reminding about the brand across internally throughout the firm			0.85	
17	Renew the brand but leave the core values unchanged			0.80	
18	We are satisfied with our brand marketing				0.845
19	Our firm has built a strong brand awareness in the target market				0.792
20	Our firm has built strong customer brand loyalty				0.818
21	Our advertising creates the desired brand image in the market				0.783
22	Our firm has built a solid reputation				0.753

#### 4.3. Performing second order CFA for design innovation constructs

In this study, design innovation which is the main construct on its four sub-constructs namely aesthetic innovation, functional innovation, meaning innovation and typological innovation. The four latent sub-constructs are measured using certain number of items. Prior to that, the CFA was validated using measurement models of the latent variables unidimensionality, validity, and reliability and normality.

After CFA, the items remaining for sub-construct aesthetic innovation, functional innovation, meaning innovation and typological innovation are three, five, seven and five items respectively as shown in Fig. 1: It presents the fitness indexes for design innovation and factor loading for every item measuring the construct. The fitness indexes do meet the requirement level as the factor loadings are all above 0.60. The assessment for fitness indexes are presented in Table 4.

The result support a 20-item, 5-dimensional scale for design innovation.

Now these sub-constructs are ready to be modeled on its constructs as shown in Fig. 2. Typological innovation was made as the reference point.

In Table 5, all the fitness indexes for the second order have achieved the required level. The results indicated that design innovation construct loads well on its four sub-constructs. The factor loading of design innovation on aesthetic innovation, functional

innovation, meaning innovation and typological innovation are 0.40, -0.66, 0.59, and 0.55.

Table 5 shows the effect of design innovation on all sub-constructs are highly significant. The components have become exogenous constructs in the study and this research could use these exogenous constructs for further analysis. This research is purely interested in estimating the effects of these exogenous constructs on the latent endogenous construct namely brand performance. The model for estimating the causal effects is presented in Figure.

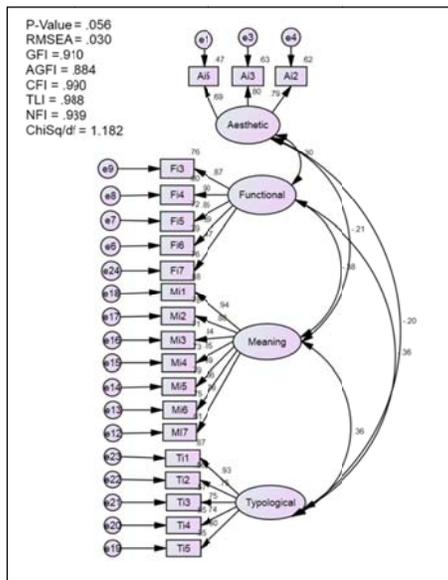
To establish the nomological validity of the design innovation scale, the present study relies on its capability in explaining relationship of design innovation with brand performance.

#### 5. Conclusion

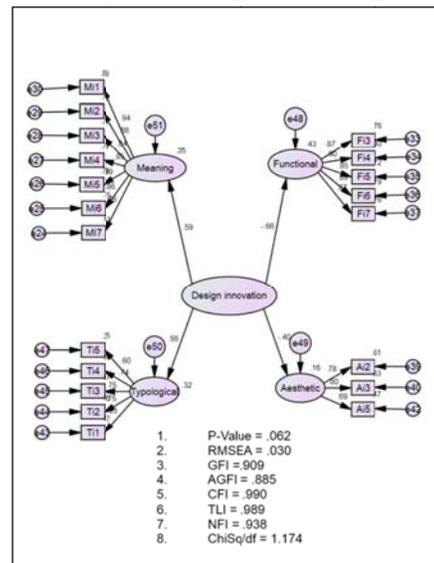
The results of this research afford contributions. First, EFA illustrates the factor structure or dimensionality of the design innovation construct. Four factors unveiled; aesthetic innovation, functional innovation, meaning innovation and typological innovation. By performing EFA, items of design innovation scale were refined to xx items. CFA provides a more rigorous estimation than EFA, suggested that xx items have to be dropped in order to improve the model fit. The final design innovation construct comprises of xx items. The xx -item construct is a reliable and valid measure to determine the underlying factorial structure of design innovation.

**Table 4:** The assessment for fitness indexes are presented

Name of category	Name of index	Index value	Comments
Absolute fit	RMSEA	0.03	The required level is achieved
	GFI	0.910	The required level is achieved
Incremental fit	CFI	0.990	The required level is achieved
Parsimonious fit	Chisq/df	1.182	The required level is achieved



**Fig. 1:** The CFA for the Sub-Constructs of Design Innovation



**Fig. 2:** Estimating the factor loading for the main construct (second order) design innovation

**Table 5:** all the fitness indexes for the second order have achieved the required level

			Estimate	S.E	C.R	P
Aesthetic Innovation	←	Design Innovation	-.552	.162	-3.398	***
Functional Innovation	←	Design Innovation	-1.115	.251	-4.434	***
Meaning Innovation	←	Design Innovation	1.050	.234	4.488	***
Typological Innovation	←	Design Innovation	1.000		Reference point	

Second, convergent validity and discriminant validity were upheld by factor loadings and correlations between factors in CFA model respectively. Subsequently, CFA establishes that second-order four factor of design innovation provides the best representation of the data.

From the stand point of design innovation, this study has shown to what extent design innovation influence aesthetic, functional, meaning and typological innovation. This is a valuable piece of information linking the types of design innovation. Understandably, in the furniture industry there is a need to understand their brand strategy and innovation values.

Fourth, this research has provided a better understanding of the design innovation by studying four different dimensions; aesthetic innovation, functional innovation, meaning innovation and typological innovation. Under a new empirical research which is drawn from various theories, it satisfies all conditions to bring a desired level of fit to the data. Furthermore, this research completely differentiates design innovation from the existing literature where mostly derived from case studies with comprehensive qualitative findings. The constructs of model in literature have not been well-defined through quantitative findings, and therefore

creates a contribution by developing a validated design innovation scale which builds an impact on brand performance. Previous studies has in general emphasized on design innovation related to branding (Abbing, 2010; Best, 2008; Beverland, 2005; Mozota, 2004; Verganti, 2009). In essence, the understanding of design innovation in the Malaysian furniture industry is important particularly on the manufacturers of the furniture SMEs and large firms. The proposed framework strengthens the clarification of the concept of brand performance, its antecedents, and its performance impacts on small, medium and large-sized firms. To conclude, this research provided a good starting point in investigating brand performance in non-western countries with the inclusion of design innovation. Policies should be also reviewed as deep as possible. A strong brand will create a valuable asset which would avoid any imitation and difficulty for any competitors to copy (Merrilees, 2007; Wong and Merrilees, 2008). Further work needs to be carried out on the role of brand managers through their responsibility in developing both design innovation and branding towards a stronger brand performance. More broadly, research is also needed to determine the guidance in developing their capabilities to performance.

## Acknowledgements

The researcher would like to thank the Malaysian Furniture Promotion Council in facilitating this research and the furniture manufacturers in Malaysia who have given much cooperation throughout this study

## References

- Aaker, D. A. (1996). *Building Strong Brands* (p. 381). New York: The Free Press.
- Abbing, E. R. (2010). *Brand-Driven Innovation*. Switzerland: AVA Publishing SA.
- Ahmad, F. S. (2009). Branding Dynamic: Building the Most Valuable Asset in Business. *Brand Management*, 137–162.
- Best, P. (2008). Branding and Design Innovation Leadership: What's Next? *Design Management Review*, 19(3).
- Beverland, M., Napoli, J., and Yakimova, R. (2007). Branding the business marketing offer: exploring brand attributes in business markets. *Journal of Business and Industrial Marketing*, 22(6), 394–399.
- Brandt, T., and Wei, C. S. (2012). *Market Watch 2012: The Timber Sector in Malaysia*. Kuala Lumpur: The German Chamber Network and MGCC.
- Chaudhuri, A. (2002). How brand reputation affects the advertising-brand equity link. *Journal of Advertising Research*, 42(3), 33–43.
- Collins, D., and Montgomery, C. (1995). Competing on resources: Strategy in the 1990s. *Harvard Business Review*, 73(4), 118–128.
- Council, N. D. (2010). *Design Driven Innovation Programme*. (N. D. Council, Ed.). Norway.
- Delaney, J. T., and Huselid, M. A. (1996). The impact of human resource management practices on perception of organizational performance. *Academy of Management Journal*, 949–969.
- Dell 'Era, C., and Verganti, R. (2009). Design-Driven laboratories: organization and strategy of laboratories specialized in the development of radical design-driven innovations. *RandD Management*, 39(1-21).
- Deukjoo, K. (2012). *Strategic Ways to Approach Package Design*. (M. R. Malaysia, Ed.) Design Seminar and Workshop Malaysia-Korea Design Sharing 2012: Design As A Strategic Tool For Innovation. Seri Pacific Hotel, Kuala Lumpur, Malaysia.
- Hamel, G., and Prahalad, C. (1989). Strategic intent. *Harvard Business Review*, 67(3), 63–76.
- Hoeffler, S., and Keller, K. L. (2002). Building brand equity through corporate societal marketing. *Journal of Public Policy and Marketing*, 21(1), 78–89.
- Hu, T.-L., Chang, C. Y., Hsieh, W.-C., and Chen, K.-H. (2010). An Integrated Relationship on Brand Strategy, Brand Equity, Customer Trust and Brand Performance- An Empirical Investigation on the Health Food Industry. *International Journal of Organizational Innovation*, 89–106.
- Kam, L. V., and Heng, L. C. (2010). *Accelerating Innovations in Malaysian Industry Supply Chains*. Institute of Supply Chain Management, Malaysia University of Science and Technology.
- Keller, K. L. (2001). *Building Customer-Based Brand Equity: A Blueprint for Creating Strong Brands*. *Marketing Management*, (July/August), 15–19.
- Keller, K. L. (2003). *Strategic brand management*. (2nd ed., Ed.). Upper Saddle River, New Jersey: Prentice Hall.
- Laojacon, T. K. and G. (2007). *Commissioning Design Evidence from the Furniture Industry*.
- Marc Bourreaux, Gensollena, M., and Moreaub, F. (2012). The impact of a radical innovation on business models: incremental adjustments or big bang? *Industry and Innovation*, 19(5), 415–435.
- Mozota, B. B. D. (2004). *Design management: Using design to build brand value and corporate innovation*. Allworth Pr.
- Nee, E. A. (2013). *Design Roadmap for furniture industry soon*. The Sun Daily.
- Penrose, E. (1959). *The theory of the growth of the organisation*. New York: John Wiley.
- Rampino, L. (2011). *The Innovation Pyramid: A Categorization of the Innovation Phenomenon in the Product-Design Field*. *International Journal of Design*, 5(1).
- Ratnasingam, J. (2003). *A Matter of Design in the South East Asian Wooden Furniture Industry*. Springer-Verlag, 61, 3.
- Robiyah, H. (2012). *Furniture Industry in Malaysia - Status and Market Prospects*. Kota Kinabalu, Sabah.
- ShanZeng. (2010). *Exploring the Cultural Connotation of Innovation in Furniture Design From the Perspective of Technology*. IEEE.
- Unit, S. I. (2011). *Malaysia National Innovation Strategy: National Innovation Study in Wood-Based Industry*. Prime Minister's Department.
- Verganti, R. (2009). *Design Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean*. Harvard Business Press.
- Veryzer, R. W., and Mozota, B. B. de. (2005). *The Impact of User-Oriented Design on New Product Development: An Examination of Fundamental*

- Relationships. *The Journal of Product Innovation Management*, 22, 128–143.
- Wong, H. Y., and Merrilees, B. (2005). A brand orientation typology for SMEs: a case research approach. *The Journal of Product and Brand Management*, 14(2/3), 155–162.
- Wong, H. Y., and Merrilees, B. (2007). Closing the marketing strategy to performance gap: the role of brand orientation. *Journal of Strategic Marketing*, 15(5), 387–402.
- Wong, H. Y., and Merrilees, B. (2008). The performance benefits of being brand-orientated. *Journal of Product and Brand Management*, 17(6), 372–383.
- Yong, S. (2013). Vietnam Ranks High in Southeast Asia's Wood Export Volume. *FDM Asia*.