Revisiting the leagility supply chain migratory model: the case of halal food

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Abstract. Since the development of supply chain evolution theory, i.e., supply chain migratory model, there has been a tendency to view it as a conceptual and summary of time-series observations. This article shows that this view is too simplistic. Confirming the theory using empirical evidence is challenging given the dynamism of supply chain cycle. The study uses the supply chain migratory model with the emerging halal food industry used as sample. A quantitative analysis of data set of 230 local firms is used in this study to assess the market qualifiers and performance metrics of the transition. It is our aim that the evidence and insights can be developed and used: (a) to assist our understanding of the generalizability of the supply chain migratory model in different settings; and (b) to clarify if the market qualifiers are similar so that equivalent approach can be used as a guide. The paper provides the evidence suggesting that the migration of the supply chain is cyclical and the implementation and operational and business strategy can be prepared way ahead of time to win the market.

Keywords: migratory model, leagile, halal, Malaysia

1. INTRODUCTION

The concept of the lean and agile was introduced by Ben Naylor in 1998 and has attracted more than 100 independent citations from over 60 journals of international standing (Naim and Gosling, 2011). The studies on the lean agile concept have been carried out in many settings and methods. However, there is still room for scientific value to be explored. For example, Naim and Gosling (2011) highlighted that future research of leagility can be addressed from the context of clarification and associated performance characteristics of lean, agile and leagile supply chain. Following this, there is a need to study the business metrics of these three different paradigms.

Moreover, the literature highlighted that the studies on the leagility supply chain are mostly conceptual studies. In lieu of this, the methodologies commonly adopted are case studies and observation. The survey method can be used to investigate leagility, but not many studies are using this approach in which is a powerful tool for the purpose of the generalizability. In addition, the empirical method can also be used as means to confirm the model that has been developed, especially the one that has been developed using case study or observation.

This paper, therefore, aims to empirically test the leagility supply chain migratory model that has been proposed by Christopher and Towill (2000); and to determine the accuracy of the model's business metrics of market winners and qualifiers. In particular, the paper will answer the following questions:

- Is the leagility supply chain evolution phase similar and generalizable to all sectors?
- Are market winner and qualifiers similar across the industry?

Hence, this paper provides explanations on the leagility in the context of food supply chain. Moreover, the business metrics of the migratory model also discussed about its applicability.

Following to this introduction, there is a section on literature review discussing the theoretical dimensions of migratory model and the current situation of food supply chain. This is followed by a description of methodology utilized in the study. The next section presents the result of analysis, followed by discussion, recommendation for future research, and conclusion.

2. LITERATURE REVIEW

2.1 Definitions and dimensions of leagile supply chain migratory model

Murakoshi, (1994) investigated the evolution of the manufacturing system in Japan using companies as the study's example. In his report, there are four phases of evolution of Japanese manufacturing, i.e. from product-out (technology-oriented) system to market-in (customer-driven) system. The literature aims to set a direction for firms by proposing a framework using the example of more advanced firm. Therefore, a pattern of evolution in the industry is documented for the emerging firms.

This concept has been adopted by Christopher and Towill (2000) to support their argument on evolvement of personal computer supply chain. They reported how demand from the marketplace shapes the firm's paradigms from the context of lean and agile. They further argued that the two paradigms are distinct; however, firms are forced to adjust accordingly to stay competitive. The literature introduces the concept of decoupling point to obtain the benefits between the two paradigms. Moreover, their works focus on the relative importance of business metrics that change with time in accordance to the philosophy and type of supply chain as shown in Table 1.

Mason-Jones et al. (2000) discussed the different market winners and market qualifiers for lean and agility supply. In the literature, for lean supply the market winner is cost and the qualifiers are quality, lead time, and service level. Meanwhile for agile supply, the service level is the market winner; while quality, cost and lead time are considered as market qualifiers. This view is expanded by Christopher and Towill (2000) whereby business metrics are associated with the market winners and qualifiers are dynamics, advocated by the manufacturing strategies (Hill, 1993).

	Market Qualifiers	Market Winners
Agile Supply	1. Quality 2. Cost 3. Lead Time	1. Service Level
Lean Supply	1. Quality 2. Lead Time 3. Service Level	1. Cost

Figure 1: Market winners-market qualifiers matrix for agile versus lean supply (Mason-Jones et al., 2000)

Table 1: Migratory model summarizing the transition in personal computers supply chain operations (Christopher and Towill, 2000).

Supply chain evolution phase	I	II	III	IV
Supply chain time marker	Early 1980s	Late 1980s	Early 1990s	Late 1990s
Supply chain philosophy	Product Driven	Market Oriented	Market Driven	Customer Driven
Supply chain type	Lean functional silos	Lean supply chain	Leagile supply chain	Customized leagile supply chain
Market winner	Quality	Cost	Availability	Lead time
Market qualifiers	Cost	Availability	Lead time	Quality
	Availability	Lead time	Quality	Cost
	Lead Time	Quality	Cost	Availability
Performance metrics	Stock returns	Throughput time	Market share	Customer satisfaction
	Production cost	Physical cost	Total cost	Value added

2.2 Leagility in food supply chain

Leagile supply chain is argued as being unsuitable in food supply chain due to its inflexibility (van der Vorst et al., 2001). Therefore, exploiting customer order and information of decoupling points may be limited.

In more specifics, there are mixed findings of lean application in food industry. Heymans (2009) highlighted that the application of lean management is feasible, but it is a daunting task in food industry. This is due to the nature of food production, for example, large batch processes, large mixing centers, long supply chain, uncertain demand, continuous process of stochastic product, and 'carcass imbalance' along the supply chain that do not lend themselves to the comprehensive adoption of lean management (Ali and Tan, 2013; Cox and Chicksand, 2005a; Heymans, 2009). However, the importance of lean application in the food industry has been an increasing focus to staying sustainable and competitive (Langhauser, 2008). Partly as a consequence of this breadth of coverage, we review literature discussing lean application from the food industry perspective.

A number of authors have investigated various aspects of lean application in food context. Cox and Chicksand (2005) explored strength and weaknesses of lean management thinking in food and farming industry in the UK. They highlighted that the lean management thinking is better and appropriate to be implemented in functional silos rather than at the supply chain level. However, the authors conceded that a firm intending to implement lean in its supply chain will be bound to high level of dependency on buyers and decreasing levels of profitability. Moreover, they also reported that the issue of 'carcass imbalance' that cannot be fully resolved in the supply chain militates the belief of commercial benefits in both short and long terms for all actors in the supply chain.

Heymans (2009) reported the obstacles for food industry in adopting lean manufacturing practices. He highlighted that the obstacles of lean application in food industry are similar to other type of business and are generally due to the lack of: (a) persistence and leadership, (b) understanding and vision on what may achieved, (c) patience and follow through, and (d) management and employee involvement. He also added that the resistance to change is also a factor that prevents the food industry from adopting lean application. The barriers of lean implementation is also investigated by Manzouri et al. (2013) in the context of halal food. In their findings, less than 30% of the firms believed that lean practices may improve their overall performance. They reported that, majority of barriers which impede the lean practices will eventually hinder the lean supply chain implementation. Moreover, the study highlighted that the firms suffered from the external barriers in implementing lean supply chain. More emphasis on the external barriers than internal issues is also suggested by the literature.

From the context of agile in food related sector, Cox and Chicksand (2008) highlighted that integrating agile with lean practices in the UK beef supply chain is problematic. They reported that the issues were due to the combination of long lead-times and volatility in supply and the difficulty of managing 'carcass balance'. On the contrary, the view of agile in the food related sector, is being studied under the need for urgency such as humanitarian supply chain, e.g., Cozzolino et al. (2012). The literature focuses in the principle of agile and lean practices using the case of the United Nations World Food Program. The literature highlighted that type of food supply chain needs to be reassessed whenever a crisis emerges.

From the literature, it can be concluded that the lean application in the food industry is in the embryonic stage. However, the stage of the migratory model is yet to be confirmed in literature. In relation to Christopher and Towill (2000) and Murakoshi, (1994) of the supply chain migratory model, the study hypothesized two models to test the lean application in the food supply chain migratory model especially for : (1) lean functional silos supply chain and (2) lean supply chain. Therefore, as shown in Figure 1, the study hypothesized that:

H1a: Production cost has positive relationship with product quality in lean functional silo supply chain

H1b: Product availability has positive relationship with product quality in lean functional silo supply chain

H1c: Production lead time has positive relationship with product quality in lean functional silo supply chain

H2: Product quality has positive relationship with firm performance in lean functional silo supply chain

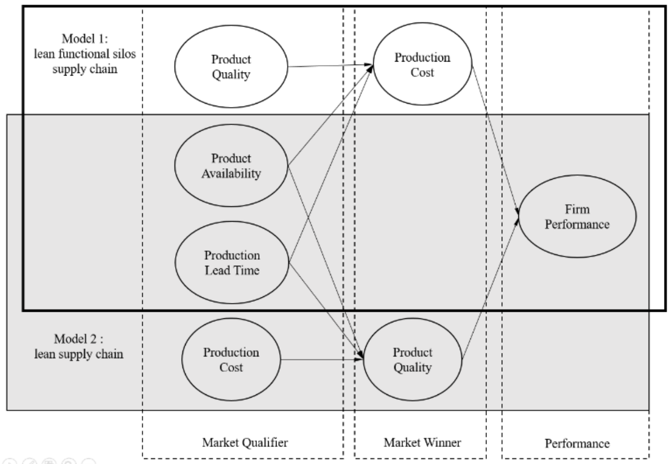

Figure 2: Conceptual Model (Model 1 and Model 2)

For the lean supply chain, it is hypothesized that:

H3a: Product quality has positive relationship with production cost in lean supply chain

H3b: Product availability has positive relationship with production cost in lean supply chain

H3c: Production lead time has positive relationship with production cost in lean supply chain

H4: Production cost has positive relationship with firm performance in lean supply chain.

3. METHODOLOGY

This study focused on Malaysian halal food manufacturing firms for three key reasons. First, there has been lack of emperical investigation on the leagility conducted in food industry; thus, leaving a gap for theory verification (Flynn and Sakakibara, 1990). Second, the halal food is an emerging indutry and the Malaysian government has placed halal on the national agenda (Ali and Suleiman, 2016; Ali et al., 2014; Lever and Miele, 2012; Othman et al., 2009; Regenstein et al., 2003). Third, the current state of halal food production is still at the early stage of leagile application (Manzouri et al., 2013).

Table 2: Demographic characteristic of the respondents

Demographic characteristic	Percentage of sample
Position of respondents	
Owner	18
Director	41
Manager	43
Halal executive	56
Number of employees	
>200	22
<200	125
Sales revenue (in USD)	
<1M	102
1M to 3M	29
3M to 5M	5
>5M	11

The sample for this study was obtained from Malaysian halal certifying body, namely, Malaysian Department of Islamic Development (JAKIM). A final mailing list of 1000 firms were established and the survey was sent to respondents identified as owner/ chief executive officer (CEO), director, operations manager, supply chain manager, and halal executive. The selection was made based on their knowledge on halal and best practices and operational performance of their firms. Table 2 summarizes the demographic characteristics of the respondents. The questionnaire was sent to 600 Malaysian firms and yielded 147 useable responses (24.5% response rate).

The data were then examined for the non-response bias using Mann-Whitney U test (Lo and Power, 2010). The test was conducted by testing the first 50 questionnaires received (early responses) at the earlier of stage of data collection; and were compared with the final 50 questionnaires received later (late responses) (Swafford et al. 2006). The Mann-Whitney U test results indicated there is no statistical difference between the early responses and late responses as the p-values of number of employees, position of respondents, and sales revenue were at 0.094, 4.02, 2.62 respectively, all of which were greater than $p<0.05$. The result indicated that the data were not affected by time of response which increases the confidence of the absence of non-response bias. In addition, the study carried out common method bias check using the Harmann's one factor test (Podsakoff et al., 2003). From this test, the common method bias was expected whereby the factor was explained by majority of the variance among the variables. The result from this test indicated that the first factor was at 35.021% which did not affect the validity of the results.

3.1 Measures and questionnaire design

All measures of our key constructs were adapted from the literature as shown in Table 4. The study adapted the existing scale to measure product quality (Wong et al., 2011), production cost (Wong et al., 2011), product availability (Wang et al., 2003), production lead time (Droge et al., 2004), and firm performance (Cao and Zhang, 2011).

A draft study questionnaire was submitted to academicians and practitioners for their review. We also conducted focus groups with researchers who had the expertise in operation management to review all the items. The resulting questionnaire was then pilot tested on a sample of 15 respondents from relevant companies before the full-scale launch of the survey. Where necessary, we discussed the survey responses face-to-face with managers who were directly involved with halal operation to clarify the meaning of the items. For all the variables in the survey, the research used Likert scales (e.g., 1=not at all, to 7=to a great extent). The scales were derived from the English-language literature and therefore had to be translated into the Malay language. The items were refined through three stages (Flynn et al., 2010): (1) initial translation from English (existing literature) into Malay by operation management academics in Malaysia; (2) the Malay version was back-translated to English to check on the validity by another academic; and (3) the translated English version was checked against the original questionnaire for any discrepancies.

4. RESULTS

This study tested the hypothesis using *SmartPLS* package 3.0.M3, a component-based structural equation modelling (SEM) (Ringle et al., 2005). The analysis involved two stages; measurement and structural model.

4.1 Reliability and validity (measurement model)

The measurement model of the study is summarized in Table 4. All composite reliability values of 0.859 or higher were taken to indicate internal consistency reliability. AVE for all constructs were higher than 0.672 and exceeded the threshold value (>0.5), showing convergent validity. All items loaded significantly (>0.7) on their posited construct with the exception for PC4, but this was retained as the composite reliability and AVE was already above the threshold value and the item's measurement would be important for content validity (Peng & Lai, 2012). Discriminant validity is shown as per Table 3, where the square root of the AVE value has the highest value in diagonal construct.

Table 3: Inter-Construct Correlations, Discriminant, Convergent Validity, and R^2 Test (N=147)

		1	2	3	4	5	R^2	
							Model 1	**Model 2**
1	Product Availability	**0.827**						
2	Production Cost	0.509	**0.828**					0.365
3	Firm Performance	0.516	0.434	**0.824**			0.519	0.186
4	Production Lead Time	0.517	0.488	0.439	**0.820**			
5	Product Quality	0.605	0.428	0.718	0.514	**0.865**	0.429	

Table 4: Constructs 'measures

Reflective construct source / Indicators		Loadings	CR	AVE
Product Quality (Wong et al., 2011)			0.922	0.748
PQ1	High performance product that meet customer needs	0.806		
PQ2	Produce consistent quality product with low defects	0.780		
PQ3	Offer high reliable products that meet customer needs	0.850		
PQ4	High quality products that meet our customer needs	0.811		
Production Cost (Wong et al., 2011)			0.896	0.686
PC1	Produce product with low costs	0.897		
PC2	Produce product with low inventory cost	0.916		
PC3	Produce product with low overhead cost	0.796		
PC4	Offer price as low or lower than our customer needs	0.683		
Product Availability (Furst et al., 1996; Wang et al., 2003)			0.864	0.684
PA1	Product variety and features for different seasons are adequate	0.857		
PA2	Product variety and features for different physical surroundings adequate	0.864		
PA3	Product variety of different market sectors adequate	0.756		
Production Lead Time (Droge et al., 2004; Khanchanapong et al., 2014)			0.859	0.672
PL1	Procurement lead time	0.754		
PL2	Manufacturing lead time	0.836		
PL3	Delivery speed	0.864		
Firm Performance (Cao and Zhang, 2011)			.894	0.679
FP1	Growth of sales	0.780		
FP2	Return on investment	0.850		
FP3	Growth in return on investment	0.811		
FP4	Profit margin of sales	0.853		

4.2 Hypothesis testing (structural model)

Our hypotheses were tested using bootstrapping procedures of 147 observations per sub-sample, 500 subsamples and no sign changes. As indicated by the *t*-statistics and 95% of confidence interval, the path coefficients yielded mixed findings. The values of R^2 of the endogenous constructs in the Model 1 were at 0.519 and 0.429 for the production cost and firm performance respectively. The values of R^2 for endogenous construct in Model 2 were at 0.365 for the product quality and 0.186 for the firm performance. The summary of the hypothesis testing is presented in Table 5 and explained in the following sub-section.

Table 5: Results of modelling analysis

	Model 1	Model 2	Hypothesis Results
Model 1: Lean functional silos supply chain			
H1a) Production Cost --> Product Quality	β = 0.088, t = 1.23^{ns}		Not supported
H1b) Product Availability --> Product Quality	β = 0.433, t = 5.00***		Supported
H1c) Production Lead time --> Product Quality	β = 0.252, t = 3.35***		Supported
H2) Product Quality --> Firm Performance	β = 0.721, t = 22.33***		Supported
Model 2: Lean supply chain market qualifier			
H3a) Product Quality --> Production Cost		β = 0.091, t = 1.042^{ns}	Not supported
H3b) Product Availability --> Production Cost		β = 0.299, t = 3.559***	Supported
H3c) Production Lead time --> Production Cost		β = 0.321, t = 3.51***	Supported
H4) Production Cost --> Firm Performance		β = 0.432, t = 6.40***	Supported

ns = not significant, *** p<0.01

4.2.1 Results of lean functional silos supply chain.

The coefficient of market qualifiers (Product Availability and Production Lead Time) was found to be significant with market winner halal (Product Quality) (β=0.433, p<0.01) and (β=0.252, p<0.01) respectively. The results supported the study hypotheses; H1b and H1c. However, there is no significant relationship found between production cost and product quality, which leads the study to reject H1a. In regard to the relationship of market winner with firm performance, significant connection was found; suggested by value of coefficient of 0.721 at p<0.01, supporting H2.

4.2.2 Results of lean supply chain.

The relationship between the market qualifier in lean supply chain: Product Availability and Production Lead Time with Production Cost (market winner) were found to be significant at p<0.01; β=0.299 and β=0.321 respectively. The coefficient provides the evidence to support the H3b and H3c. However, no significant value is found in the relationship of Product Quality with Production Cost; suggesting the study to reject H3a. In regard to H4, a significant coefficient was found between Production Cost and Firm Performance (β=0.432, p<0.01), supporting H4.

The study performed further analysis to examine the influence of market winners to firm performance. First, the analysis was carried out on the path coefficient between market winners in each model with firm performance. Second, the value of R^2 was analyzed to evaluate the coefficient of determination so as to measure the predictive accuracy. According to Hair et al., (2011) and Henseler et al., (2009), the values of R^2 of 0.75, 0.50, or 0.25 for the latent variables (i.e. firm performance in this study) can be roughly described as substantial, moderate, or weak respectively. Therefore, the comparison between Model 1 and 2 indicates that Product Quality (R^2=0.519) is superior to Production Cost (R^2=0.186).

5. DISCUSSION

Christopher (2000) highlighted that it is the supply chain that competes, not firms; and suggested the application of leagile in the supply chain. Using Murakoshi (1994), Christopher and Towill (2000) identified the supply chain migratory model to identify the transformation of the supply chain from lean functional silos to customized leagile supply chain.

Food industry is not exempted from this phenomenon and is bound for change. The lean adoption has provided an adequate example of its benefits in many industries but not in food supply chain. The value of the lean effects in the food industry is seen as a mixed point of views in literature. In addition, the concept of lean is commonly seen as the promising concept to be applied in the food industry. However, for many studies in lean-food literature, the obstacles of lean application are still being discussed (i.e. Cox and Chicksand, 2005b, 2008; Heymans, 2009); suggesting that the lean practice is not suitable to be implemented by the supply chain in the food industry. In contrast, van der Vorst et al., (2001) argued that leagile concept can be a very helpful in innovating the supply chain of food industry. However, they also highlighted that quality is the uppermost important in the food industry, whereby the results in this study corroborate. In specific, the results have shown that product quality is more superior in determining firm performance in comparison to the production cost. Furthermore, consumers are willing to pay more for food quality (Alam and Sayuti, 2011; Ali et al., 2015; van der Vorst et al., 2001).

Another point to argue is that, it is clearly shown that the inferiority of production cost in determining the firm performance shows that cost reduction is not the main agenda in the food industry whilst maintaining the product quality. There are two main lessons that can be learned from these insights. First, the food industry prefers the isolation of lean practices within the firms compared to the supply chain. The implementation of waste and cost reduction in the lean supply chain may result in poor quality due to the cost saving efforts. This point is evident from the results as there is no significant relationship between production cost and product quality and vice –versa in the food industry. Second, the result clearly shows that the food industry especially the halal industry is still in the lean functional silos supply chain stage, focusing on quality to win the market. Despite lean practice being able to provide an additional value to the supply chain such as waste reduction and greener supply chain, food supply chain is still at product driven philosophy. This is due to the insufficient supply of food globally. This point of view defeats the lean practice aims of managing waste from overproduction. Another example is due to the food perishability; which has forced the food industry to opt for more specific transportation, i.e., reefer container that leads to higher cost. Ironically, the issue of food waste is still an emerging area in literature. Thus, the lean practice is still applicable if seen from this context.

The results also shows that not all market qualifier contributes to market winner as argued in the migratory model of personal computer by Christopher and Towill (2000). Therefore, the migration model cannot be applied to the food industry to a large extent. The two idiosyncratic paradigms of cost and quality cannot be simultaneously achieved in the food production

6. CONCLUSION

Food industry is yet to venture into the leagile food supply chain due to its inability to excel in the lean. There are many obstacles found by the literature that can impede-the efforts. Theoretically, the study has found empirical evidence that maintaining quality of a food product encumbered the lean application in food industry. Managing waste in lean supply chain is a daunting task due to the long food supply chain, inability of one to assess the quality of the stochastic unfinished product within the supply chain, and insufficient food which forced the manufacturing firm to mass produce. Practically, practitioners may take these research insights as guidance in the selection of business metrics especially in determining the market qualifiers and winners of the firm. Moreover, the production cost has less impact on firm performance from the result; which can also be interpreted as opportunities for firms to excel in creating uniqueness in winning the market.

This research suffers from some limitations. First, the study has been carried out from the halal food perspective alone; thus, the generalizability to the food industry is debatable. Second, the study focuses on a single, Malaysia marketplace which might not represent other geographical segments. Even though other industries are already migrating and enjoying the benefits of leagile supply chain, the evolution of food supply chain is still at the beginning – i.e. lean functional silos. However, a different and unique migratory model of food supply chain may be developed in future research. The specific migratory model may be more meaningful for the researchers in lean-food industry rather than investigating the factors that hinder lean application; which leads to inevitable downfall of leagile in food industry which we leave for future research.

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REFERENCES

Alam, S.S. and Sayuti, N.M. (2011), "Applying the Theory of Planned Behavior (TPB) in halal food purchasing", *International Journal of Commerce and Management*, Vol. 21 No. 1, pp. 8–20.

Ali, M.H. and Suleiman, N. (2016), "Sustainable food production ; Insights of Malaysian halal small and medium sized enterprises", *International Journal of Production Economics*, available at:http://doi.org/10.1016/j.ijpe.2016.06.003.

Ali, M.H. and Tan, K.H. (2013), "100% Beef versus honest food: the role of lean in food integrity", *LeanTech'13, 2nd International Scientific Conference on Lean Technologies*, University of Belgrade, Belgrade, Serbia, pp. 139–144.

Ali, M.H., Tan, K.H., Makhbul, Z.M. and Pawar, K. (2015), "The impact of supply chain integration on food integrity: Evidence from halal food manufacturers", *23rd International Conference for Production Research, ICPR 2015*.

Ali, M.H., Tan, K.H., Pawar, K. and Makhbul, Z.M. (2014), "Extenuating Food Integrity Risk through Supply Chain Integration: The Case of Halal Food", *Industrial Engineering and Management Systems*, Vol. 13 No. 2, pp. 154–162.

Canavari, M., Pignatti, E. and Spadoni, R. (2006), "Trust within the organic food supply chain: the role of the certification bodies", *99th EAAE Seminar "Trust and Risk in Business Networks"*, pp. 621–630.

Cao, M. and Zhang, Q. (2011), "Supply chain collaboration: Impact on collaborative advantage and firm performance", *Journal of Operations Management*, Vol. 29 No. 3, pp. 163–180.

Ceranić, S. and Božinović, N. (2009), "Possibilities and significance of has implementation (Halal assurance system) in existing quality system in food industry", *Biotechnology in Animal Husbandry*, Vol. 25, pp. 261–266.

Christopher, M. (2000), "The Agile Supply Chain", *Industrial Marketing Management*, Vol. 29 No. 1, pp. 37–44.

Christopher, M. and Towill, D.R. (2000), "Supply chain migration from lean and functional to agile and customised", *Supply Chain Management: An International Journal*, Vol. 5 No. 4, pp. 206–213.

Cohen, J., Cohen, P., West, S. and Aiken, L. (2003), "Applied Multiple Regression / Correlation Analysis for the Behavioral Sciences", *2nd Ed Hillsdale NJ Lawrence Erlbaum Associates*, Vol. Third Edit, p. 703 S.

Cox, A. and Chicksand, D. (2005a), "The Limits of Lean Management Thinking":, *European Management Journal*, Vol. 23 No. 6, pp. 648–662.

Cox, A. and Chicksand, D. (2005b), "The Limits of Lean Management Thinking: Multiple Retailers and Food and Farming Supply Chains", *European Management Journal*, Vol. 23 No. 6, pp. 648–662.

Cox, A. and Chicksand, D. (2008), "Rethinking policy options for industry: Appropriateness in policies for industry and UK farming and food", *Public Administration*, Vol. 86 No. 3, pp. 813–836.

Cozzolino, A., Rossi, S. and Conforti, A. (2012), "Agile and lean principles in the humanitarian supply chain: The case of the United Nations World Food Programme", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 2 No. 1, pp. 16–33.

Droge, C., Jayaram, J. and Vickery, S.K. (2004), "The effects of internal versus external integration practices on time-based performance and overall firm performance", *Journal of Operations Management*, Vol. 22, pp. 557–573.

Farouk, M.M. (2013), "Advances in the industrial production of halal and kosher red meat.", *Meat Science*, Elsevier Ltd, Vol. 95 No. 4, pp. 805–20.

Flynn, B. and Sakakibara, S. (1990), "Empirical research methods in operations management", *Journal of Operations Management*, Vol. 9 No. 2, pp. 250–284.

Flynn, B.B., Huo, B. and Zhao, X. (2010), "The impact of supply chain integration on performance: A contingency and configuration approach", *Journal of Operations Management*, Vol. 28 No. 1, pp. 58–71.

Frohlich, M.T. and Westbrook, R. (2001), "Arcs of integration: an international study of supply chain strategies", *Journal of Operations Management*, Vol. 19 No. 2, pp. 185–200.

Furst, T., Connors, M., Bisogni, C.A., Sobal, J. and Falk, L.W. (1996), "Food Choice: A Conceptual Model of the Process", *Appetite*, Vol. 26 No. 3, pp. 247–266.

Giannakis, M. and Papadopoulos, T. (2016), "Supply chain sustainability: A risk management approach", *International Journal of Production Economics*, Elsevier, Vol. 171, pp. 455–470.

Hair, J.F., Hult, G.T.M., Ringle, C. and Sarstedt, M. (2014), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, *SAGE Publication Inc.*, available at:http://doi.org/10.1016/j.lrp.2013.01.002.

Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011), "PLS-SEM: Indeed a Silver Bullet", *The Journal of Marketing Theory and Practice*.

Henseler, J., Ringle, C.M. and Sinkovics, R. (2009), "The use of partial least square path modeling in international marketing", *Advances in International Marketing (AIM)*, Vol. 20, pp. 277–319.

Heymans, B.B. (2009), "Lean Manufacturing and the Food Industry", *Continous System Improvement*, pp. 1–6.

Jarvis, C.B., MacKenzie, S.B. and Podsakoff, P.M. (2003), "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research", *Journal of Consumer Research*.

Khanchanapong, T., Prajogo, D., Sohal, A.S., Cooper, B.K., Yeung, A.C.L. and Cheng, T.C.E. (2014), "The unique and complementary effects of manufacturing technologies and lean practices on manufacturing operational performance", *International Journal of Production Economics*, Vol. 153, pp. 191–203.

Koufteros, X., Vonderembse, M. and Jayaram, J. (2005), "Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy", *Decision Sciences*, Vol. 36 No. 1, pp. 97–133.

Langhauser, K. (2008), "Are You Playing The Lean Game ?", *Food Manufacturing*, pp. 1–4.

Lever, J. and Miele, M. (2012), "The growth of halal meat markets in Europe: An exploration of the supply side theory of religion", *Journal of Rural Studies*, Elsevier Ltd, Vol. 28 No. 4, pp. 528–537.

Lo, S.M. and Power, D. (2010), "An empirical investigation of the relationship between product nature and supply chain strategy", *Supply Chain Management: An International Journal*, Vol. 15 No. 2, pp. 139–153.

Luning, P. a. and Marcelis, W.J. (2006), "A techno-managerial approach in food quality management research", *Trends in Food Science & Technology*, Vol. 17 No. 7, pp. 378–385.

Manzini, R. and Accorsi, R. (2013), "The new conceptual framework for food supply chain assessment", *Journal of Food Engineering*, Elsevier Ltd, Vol. 115 No. 2, pp. 251–263.

Manzouri, M., Nizam Ab Rahman, M., Saibani, N. and Rosmawati Che Mohd Zain, C. (2013), "Lean supply chain practices in the Halal food", *International Journal of Lean Six Sigma*, Emerald Group Publishing Limited, Vol. 4 No. 4, pp. 389–408.

Mason-Jones, R., Naylor, B. and Towill, D.R. (2000), "Engineering the leagile supply chain", *International Journal of Agile Management Systems*, Vol. 2, pp. 54–61.

Murakoshi, T. (1994), "Customer-driven manufacturing in Japan", *International Journal of Production Economics*, Vol. 37, pp. 63–72.

Naim, M.M. and Gosling, J. (2011), "On leanness, agility and leagile supply chains", *International Journal of Production Economics*, Vol. 131 No. 1, pp. 342–354.

Narasimhan, R. and Kim, S.W. (2002), "Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms", *Journal of Operations Management*, Vol. 20 No. 3, pp. 303–323.

Othman, P., Sungkar, I., Sabri Wan Hussin, W., Industries, M., Sabri, W. and Hussin, W. (2009), "Malaysia as an International Halal Food Hub: Competitiveness and Potential of Meat based Industries", *Asean Economic Bulletin*, Institute of Southeast Asian Studies, Vol. 26 No. 3, pp. 306–320.

Peng, D.X. and Lai, F. (2012), "Using partial least squares in operations management research: A practical guideline and summary of past research", *Journal of Operations Management*, Elsevier Ltd, Vol. 30 No. 6, pp. 467–480.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies.", *The Journal of Applied Psychology*, Vol. 88 No. July, pp. 879–903.

Regenstein, J.M.M., Chaudry, M.M.M. and Regenstein, C.E.E. (2003), "The Kosher and Halal Food Laws", *Comprehensive Reviews in Food Science and Food Safety*, Vol. 2 No. 1994, pp. 111–127.

Ringle, C.M., Wende, S. and Will, A. (2005), "SmartPLS 2.0.M3 . Hamburg: SmartPLS, http://www.smartpls.de".

Van der Spiegel, M., van der Fels-Klerx, H.J., Sterrenburg, P., van Ruth, S.M., Scholtens-Toma, I.M.J. and Kok, E.J. (2012), "Halal assurance in food supply chains: Verification of halal certificates using audits and laboratory analysis", *Trends in Food Science & Technology*, Elsevier Ltd, Vol. 27 No. 2, pp. 109–119.

van der Vorst, J.G.A.., van Dijk, S.J. and Beulens, A.J.M. (2001), "Supply chain design in the Food Industry", *The Internation*, Vol. 12 No. 2, pp. 73–86.

Wang, Y., Lo, H.-P. and Hui, Y. V. (2003), "The antecedents of service quality and product quality and their influences on bank reputation: evidence from the banking industry in China", *Managing Service Quality*, Vol. 13 No. 1, pp. 72–83.

Wong, C.Y., Boon-itt, S. and Wong, C.W.Y. (2011), "The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance", *Journal of Operations Management*, Elsevier B.V., Vol. 29 No. 6, pp. 604–615.