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Impact of product customization on supply chain network and performance - The case of automotive industry in Morocco

Mohamed HANSALI
Departement of economics and management
Hassan II University
Casablanca, Morocco
hansali.mohamed1@gmail.com

Abdelouahed GOURCH
Departement of economics and management
Hassan II University
Casablanca, Morocco
agourch@gmail.com

Khalid HERRADI
Departement of economics and management
Hassan I University
Settat, Morocco
herradikhalid@hotmail.com

Abstract— **Numerous studies today focus on the configuration of the supply chain for markets requiring complex products, otherwise known as highly customized products, and the required performance. The purpose of the present research is to ensure first of all this relationship between product customization, supply chain network configuration and performance in the context of the automotive industry in Morocco. The results show that product customization has an impact on the supply chain network which in turn impacts its performance.**

Keywords **- Turbulent markets, supply chain network, product customization, impact assessment.**

I. INTRODUCTION

Nowadays, many markets are turbulent and this forces supply chains to adapt [1]-[2]-[3]. Researchers and practitioners are thus trying to develop operational models of the supply chain in order to face the volatile demand [4]-[3]. Like the agile model that is now designed to cope with turbulent markets [5]. However, some researchers and practitioners note that the agile model developed in response to market turbulence reduces or even eliminates the effect of certain criteria such as complexity (advanced level of customization) [6]. Indeed, as complex or hard customized products are studied, they challenge the agile model, which among its basic principles is to drive out complexity [7]-[8].

References [7]-[8] show that it is not possible to cope with turbulent markets in different situations ; each market situation requires a specific supply chain network. Otherwise, references [9]-[10]-[11] highlight the importance of the supply chain capabilities to deal with turbulent markets. However, certain supply chains remain guided more by efficient practices rather than coping with market changes and being reactive [12].

The objective of this article is to ensure if the supply chain of the automotive industry in Morocco meets the requirements of the market. If so, the next qualitative studies may deepen the question in this context by studying how the capabilities and the supply chain network of the automotive industry in Morocco are configured to allow the delivery of highly personalized products (car and components). Our questioning becomes the following: **What impact does product customization have on the supply chain network and its performance in the automotive industry in Morocco ?**

II. HARD AND SOFT CUSTOMIZED PRODUCTS

However, it is not always possible to afford these two practices. Indeed, it is necessary to distinguish between products that allow reducing complexity called soft-customized product and products that do not allow it called hard-customized product [7]-[8]. Hence, complexity requires to be integrated into models that study the supply chain in turbulent and volatile markets [6].

References [7]-[8] show that it is not possible to cope with turbulent markets in different situations ; each market situation requires a specific supply chain network. As far as soft customized products are concerned, these allow for long distribution channels, unlike hard customized products that require shorter distribution channels, the producer is required to deliver the products directly to the final consumer via dealers just as the case of the automotive industry or gardening machinery. Hard customized products affect also all suppliers and strong interactions are needed, some suppliers come even to settle near their customer's plant. Unlikely to soft customization which affects only swappable components suppliers.

However, when demand fluctuates in terms of volume, engagement with suppliers may be problematic. When demand increases some suppliers may become bottlenecks and not keep up [7]. When it goes down, the commitment with the suppliers would become a burden, and in general a very strong relationship with the suppliers risks making the supply chain less responsive to the variation of the demand in term of volume [7]-[13].

Reference [7] shows that ‘’ *the degrees of freedom customers have in specifying product features, heavily affects the supply-chain configuration, as well as product architecture and, ultimately, firm performances* ’’.

H1 : The level of complexity of the products demanded by the market (demand variety) and demand variability (market turbulence) have an impact on the supply chain network.

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H2 : Supply chain network has an impact on supply chain performance.

H3 : Supply chain performance can directly be explained by customization product that market demands.

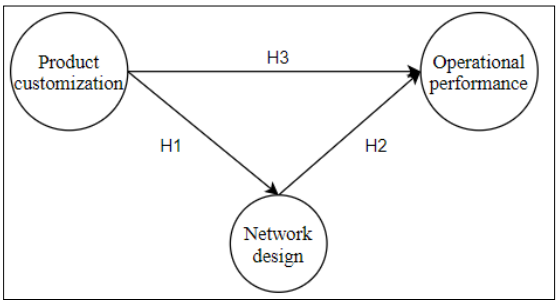

Figure 1. Structural model

IV. External Measurement Model Evaluation

Before assessing the causality between the variables, it is necessary to check the reliability and the validity of the measurements. To evaluate convergent validity, it's necessary to consider the outer loadings or factor loadings of the indicators and the average variance extracted (AVE). The first must have at least a value of 0.7 or more, while the second must have at least a value of 0.5 which means that the construct explains more than half of the variance of its indicators. If not, more variance remains in the error of the items than in the variance explained by the construct [14]. It is therefore necessary to remove certain items with a factor loading of less than 0.7. However, those can remain if their factor loading is between 0.4 and 0.7 and allow the improvement of the AVE. But if it's less than 0.4 it must be removed [15]-[16]. Much like Cronbach's alpha, composite reliability measures the internal consistency, with a threshold of 0.7 [17].

TABLE I
Results of Measurements Model – Convergent Validity

	Network design	Operational performance	Product customization
LDN 2	0.696	0.374	0.274
LSN	0.906	0.612	0.497
Q	0.407	0.637	0.196
C1	0.465	0.769	0.127
D1	0.419	0.671	0.248
F2	0.465	0.705	0.475
AV	0.315	0.130	0.618
HCP	0.450	0.409	0.905

The above tables show acceptable results and thus confirm the convergent validity, after which we move on to the discriminant validity which tests whether the construct is represented by itself. This implies that the measurement items do not overlap, neither measure another model construct [14]-[18]. For this reason, an indicator's outer loading on the associated construct should be greater than any of its cross-loadings. It's also necessary to assess the discriminant validity by the Fornell-Larcker criterion. It compares the square root of the AVE values with the latent variable correlations, the objective is to avoid multicollinearity issues" [14]-[19].

TABLE II
Latent Variable Correlations

	Network design	Operational performance	Product customization
Network design	**0.808**		
Operational performance	0.632	**0.697**	
Product customization	0.500	0.387	**0.775**

TABLE III
Discriminant Validity- Cross Loading

Constructs	Items	Loading	CR	AVE
Product Customization	AV	**0,618**	0,760	0,612
	HCP	0,905		
Supply chain network design	LDN2	**0,696**	0.787	0.653
	LSN	0,906		
Operational performance	Q	**0.637**	0.790	**0.486**
	C1	0.769		
	D1	**0.671**		
	F2	0.705		

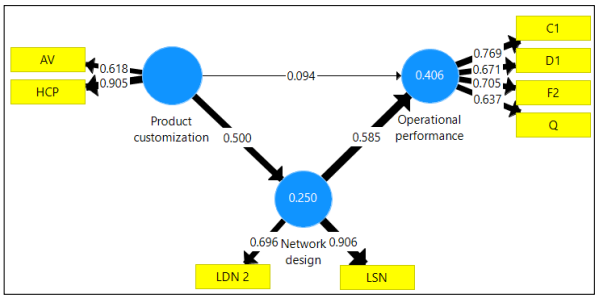

Figure 2. Conceptual model results

V. Internal Measurement Model Evaluation

In order to test the research hypotheses, the first step is to calculate the standard beta, standard error, t and p value and the latter (the p-value) must be less than 0.05 [14].

TABLE IV
Path Coefficient of Research Hypotheses

Hypo	Relationship	Std. Beta	Std. Error	T-value	P-value	Decision
H1	Product Customization→ network design	0.519	0.132	3.798	**0.000**	Supported **
H2	Network design→ Operational performance	0.601	0.164	3.571	**0.000**	Supported **
H3	Product Customization→ Operational performance	0.105	0.216	0.435	**0.663**	Rejected

According to the results shown in the table above, hypothesis one and two are accepted while the third is rejected.

TABLE V
Test of Model Quality

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Construct	R^2	Adjusted R^2
Supply chain network design	0.25	0,229
Operational performance	0.406	0.372

Regarding the quality of the model, the R-squared must be greater than 0.1 [20]. Reference [21] suggests that the R-squared values of 0.67, 0.33, and 0.19 can be considered as substantial, moderate, and weak, respectively. In this case, our R squared of 0.25 ; between 0.19 and 0.33 and this relationship can be considered weak. The effect size f^2 is the degree of impact of each variable separately on the endogenous variable. The Effect size, on the other hand, is the degree of impact of each variable apart on the endogenous variable and which is, in our case, of a value of 0.432 greater than 0.35. The effect of supply chain work design on performance in this case is large [22]. The effect size Q^2 above 0 indicates that the exogenous variable has a predictive power over the endogenous variable, and in this case is 0,14.

DISCUSSION AND CONCLUSION

Through this study, the relationship between product customization and the supply chain network is confirmed and can jugged strong with p-value of 0.
We can deduce that the automotive supply chain network partly follows the nature of the market being characterized by a complex product. This is in line with the results of studies carried out in markets delivering complex products different from the automotive sector, such as gardening machines, microwaves and others [7]-[8] .

These markets require that suppliers be located close to, or at least very close to, the manufacturer's plant so that they can make just-in-time (daily deliveries) or synchronous (delivery within a few hours) deliveries [23]. The results obtained in our study confirm this.

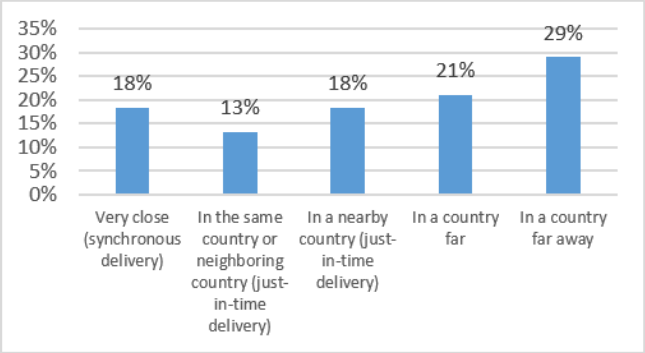

Figure3. Type of delivery made by the supplier

In our sample, 68% of companies report that their suppliers make synchronous or just-in-time deliveries. Synchronous delivery represents only 18%. But this result remains quite significant because this type of delivery is not easy to establish and requires a heavy investment, in addition to the long-term commitment with the supplier in question [23]. This is also due to the variation in demand in volume, which also does not encourage deep relationships with suppliers, as the supply chain may become unable to keep up with market trends and lack its adaptability [13]. If demand increases, suppliers may become bottlenecks [7].

With regard to the distribution chain of responding companies, 8% deliver synchronously and 55% deliver just on time for the same reasons cited for procurement.

It turns out that network design also has an impact on performance and this justifies the structure of the automotive industry's supply chain, which produces a very personalized product.

However, it is not possible to explain the performance of the supply chain directly by the market requirements in terms of product customization.

Future exploratory inductive research may focus more on the design of the supply industry network for the automotive industry in Morocco, which is designed to meet market requirements, unlike capabilities which are more oriented towards efficiency than reactivity. Other research can also ensure this by carrying out an impact study whose object is the relationship of supply chain capabilities in the automotive industry in Morocco with financial performance (cost control) as well as operational performance (Quality – delivery – flexibility).

References

[1] M. L. Fisher, « What is the right supply chain for your product? », *Harvard business review*, vol. 75, p. 105-117, 1997.

[2] M. Waller, M. E. Johnson, et T. Davis, « Vendor-managed inventory in the retail supply chain », *Journal of business logistics*, vol. 20, p. 183-204, 1999.

[3] G. C. Stevens et M. Johnson, « Integrating the Supply Chain … 25 years on », *International Journal of Physical Distribution & Logistics Management*, vol. 46, n° 1, p. 19-42, févr. 2016, doi: 10.1108/IJPDLM-07-2015-0175.

[4] G. C. Stevens, « Integrating the Supply Chain », *International Journal of Physical Distribution & Materials Management*, vol. 19, n° 8, p. 3-8, août 1989, doi: 10.1108/EUM0000000000329.

[5] M. Christopher, « The Agile Supply Chain: Competing in Volatile Markets », *Industrial Marketing Management*, vol. 29, n° 1, p. 37-44, janv. 2000, doi: 10.1016/S0019-8501(99)00110-8.

[6] D. Vázquez-Bustelo, L. Avella, et E. Fernández, « Agility drivers, enablers and outcomes: Empirical test of an integrated agile manufacturing model », *International Journal of Operations & Production Management*, vol. 27, n° 12, p. 1303-1332, nov. 2007, doi: 10.1108/01443570710835633.

[7] F. Salvador, M. Rungtusanatham, et C. Forza, « Supply-chain configurations for mass customization », *Production Planning & Control*, vol. 15, n° 4, p. 381-397, juin 2004, doi: 10.1080/0953728042000238818.

ISSN 1737-9237

[8] F. Salvador, M. Rungtusanatham, C. Forza, et A. Trentin, « Mix flexibility and volume flexibility in a build-to-order environment: Synergies and trade-offs », *Int Jrnl of Op & Prod Mnagemnt*, vol. 27, n° 11, p. 1173-1191, oct. 2007, doi: 10.1108/01443570710830584.

[9] M. Hallgren et J. Olhager, « Flexibility configurations: Empirical analysis of volume and product mix flexibility », *Omega*, vol. 37, n° 4, p. 746-756, août 2009, doi: 10.1016/j.omega.2008.07.004.

[10] S. J. Mason, M. H. Cole, B. T. Ulrey, et L. Yan, « Improving electronics manufacturing supply chain agility through outsourcing », *International Journal of Physical Distribution & Logistics Management*, vol. 32, n° 7, p. 610-620, sept. 2002, doi: 10.1108/09600030210442612.

[11] M. Bevilacqua, F. E. Ciarapica, et G. Giacchetta, « Business process reengineering of a supply chain and a traceability system: A case study », *Journal of Food Engineering*, vol. 93, n° 1, p. 13-22, 2009.

[12] H. L. Lee, « The Triple-A Supply Chain », *harvard business review*, p. 14, 2004.

[13] N. Fabbe-Costes, « Chapitre 1 La gestion des chaînes logistiques multi-acteurs : les dimensions organisationnelles d'une gestion lean et agile », p. 31.

[14] J. F. Hair Jr, G. T. M. Hult, C. Ringle, et M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. SAGE, 2013.

[15] R. P. Bagozzi, Y. Yi, et L. W. Phillips, « Assessing construct validity in organizational research », *Administrative science quarterly*, p. 421-458, 1991.

[16] J. F. Hair, C. M. Ringle, et M. Sarstedt, « PLS-SEM: Indeed a silver bullet », *Journal of Marketing theory and Practice*, vol. 19, n° 2, p. 139-152, 2011.

[17] R. G. Netemeyer, W. O. Bearden, et S. Sharma, *Scaling procedures: Issues and applications*. Sage Publications, 2003.

[18] A. M. Hubley, « Discriminant validity », *Encyclopedia of quality of life and well-being research*, p. 1664-1667, 2014.

[19] M. R. Ab Hamid, W. Sami, et M. M. Sidek, « Discriminant validity assessment: Use of Fornell & Larcker criterion versus HTMT criterion », in *Journal of Physics: Conference Series*, 2017, vol. 890, p. 012163.

[20] R. F. Falk et N. B. Miller, *A primer for soft modeling*. University of Akron Press, 1992.

[21] W. W. Chin, « The partial least squares approach to structural equation modeling », *Modern methods for business research*, vol. 295, n° 2, p. 295-336, 1998.

[22] J. Cohen, *Statistical power analysis for the behavioral sciences*. Routledge, 2013.

[23] G. Paché, « Logistique (gestion) », *Encyclopædia Universalis, cédérom version*, vol. 7, 2001.

[24] E. A. MORASH, « Supply Chain Strategies, Capabilities, and Performance », *Transportation Journal*, vol. 41, n° 1, p. 37-54, 2001.

[25] A. BOUSSAS *et al.*, *Voyage au coeur de la compétitivité de l'économie marocaine*. Rabat: CANAPRINT, 2018.

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