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Identification of Success Factors of Products and Services for Industrial Sustainability: A Structural Equation Modeling Approach

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Abstract—*Globalization leads towards innovations which in turn escalates market volatility. New product development (NPD) is one of the vital characteristic of the firm for achieving competitive advantage in this crucial environment. Similarly, service development is also established as an addition feature in the present era. Identification of factors critical for success and survival of the company becomes inevitable phenomenon for sustaining in the competition. This empirical research develop a framework depicting the role of market analysis as a critical success factor for new product as well as service development and quality of product and service as a success measure using Structural Equation Modeling (SEM) approach.*

1. INTRODUCTION

Product development (NPD) has become a necessary and unavoidable phenomenon for firms and organizations to sustain in the competition of rapidly growing global market [5]. Same as the product, the trend of increasing attention of management practitioners and researchers towards service development has been observed in recent days [12]. The importance of various factors controlling the firm's improvements, famously known as critical success factors, has been proven by previous literatures [4, 12]. Empirical researches strengthen the inevitable role of these factors for the success and survival of any firm both in product and service development field. In case of product development there are various factors considered by previous researchers which are critical to success, such a technology [25, 29, 38], research and development (R&D) [14, 37, 38], cross-functional team collaboration [9, 10, 13, 34], market analysis [28, 32], top management support [16, 38], planning [32, 35], HR management [28, 32, 35], strategic management [5, 28]. Likewise the product developments there are various success factors in service development impacted on success of the firm. These factors influence the decision making of the firm for service development for providing better service [1]. As per literatures success factors for service development are customer requirements [1, 20, 24], stakeholders participation [3, 30], communication and collaboration [8, 22]. Same as the various success factors, numerous measures of product and service development success indexed in previous literatures [17, 19, 23, 27] are essential for measuring the final success of the firm. This success can be expressed in different perspectives like time, cost, quality, customer, technology and additional features as per experts' opinion of various industries.

The objective of this research is to segment the factors of product and service development in three sections such as social factors, environmental factors and business & economic factors. After clustering success factors into aforesaid divisions the very next step is to develop a framework concerning the factors of each sections such as framework for social variants, environmental variants and business & economic variants. In this study a framework has been developed concerning the importance of market analysis as a success factor and quality related success measures for both in product and service field and analyze the effects of the factors on product and service development by hypotheses testing using Structural Equation Modeling (SEM) approach.

2. METHODOLOGY

The Structural equation modelling (SEM) approach is used here to build the relationship among those factors which are critical for organizational success and survival and correlate them with the new product development. SEM is a methodology for representing, estimating, and testing a theoretical network of (mostly) linear relations between variables. It is a comprehensive statistical approach for testing hypotheses about relations among observed and latent variables. In this paper a SEM model has been developed using the above mentioned factor which is technological improvements and hypothesis to relate with the product development success for industrial sustainability. Here, manufacturing industries in India are chosen for the survey purpose and data are collected from their NPD personnel and managers. The statistic used in this work is obtained from the

respondents of product and service development companies' in India. The reliability of the survey data is examined by Cronbach's Alpha Reliability test. SPSS 22.0 software package is used to calculate the value of the alpha (α) [31]. AMOS 22.0 software is used to build the SEM structure for the above mentioned 19 variables problem. Thus, this paper provides empirical data supporting the objective of our study, which is to examine the relation in between technological improvements and its manifests variables as well as the relation of technological improvements with product development success, in terms of technological measures, as perceived by personnel and managers of the Indian manufacturing industries.

This work involves formulation of hypothesis in between input and output latent constructs which have been tested using Structural Equation Modelling (SEM) on primary data set obtained from survey. This Hypothesis is mentioned below.

H1: Market Analysis (MA) positively influences the product and service development success (PDS).

3. RESULTS AND DISCUSSIONS

3.1. Analysis of measurement validity

To accomplish research objectives, questionnaire consisting of manifests of input and output latent variable that is market analysis as success factor and quality as success measure to quantity product and service development success respectively listed in TABLE 1 has been developed to survey the implementation of aforesaid market analysis as a success factor from the experts of Indian industries as mentioned before. The 7 point likert scale has been used to rate all measures where 1 denotes completely disagree and 7 denotes completely agree to rate the importance of the factors and for implementation purpose 1 denotes very low and 7 denotes very high. The reliability of the survey data for individual construct has been computed using Cronbach's Alpha (α) reliability test using IBM SPSS 22.0 software and its values have been enlisted in TABLE 1 which show that survey data are reliable as $\alpha \geq 0.8$ [31]. After that, SEM approach is applied to examine the impacts of market analysis as success factor on product and service development success which is represented in terms of quality related measures by hypotheses testing using IBM AMOS 22 software.

Table 1: List of manifest variables of latent constructs

Latent Variables	Manifest Variables with α values
Market Analysis (MA) α = 0.88	1. Turbulent market environment (MA1) 2. Importance of generation of well-established market plan (MA2) 3. Degree of Market growth (MA3) 4. Emphasis on customer satisfaction (MA4) 5. Knowledge about consumption pattern (MA5) 6. Need for identification of target market (MA6) 7. Market testing (MA7) 8. Investment towards market research for proper market dynamics (MA8) 9. Advertising and promotional activities (MA9) 10. Duration of the product total life cycle until definitive replacement (MA10) 11. Effort in competitor monitoring (MA11)
Quality (Q) α = 0.90	1. Meet quality guidelines (Q1) 2. Achieved product performance goal (Q2) 3. Achievement of design goals (Q3)

3.2. Hypotheses Testing

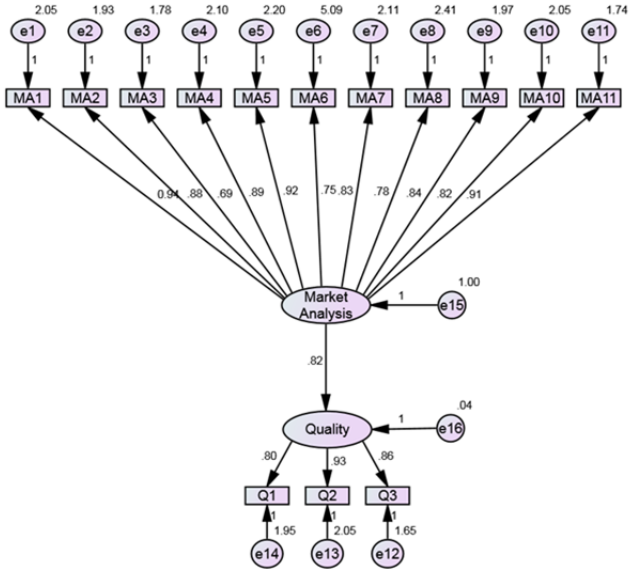

Fig. 1: Structural equation modeling (SEM) model after execution

Fig. 1 shows the path diagram developed by AMOS 22 software which demonstrates the hypothesized relationships among latent constructs. The values over the arrows indicate the associated standardized regression weights obtained after execution of SEM analysis. The factor loadings of each manifest variable have been enlisted in Table 2 and the statistics of path estimates have been listed in Table 3 which shows hypothesis considered that is the technological

improvements have a positive impact on product development success is proven right because the path estimate is positive and >0.6 which is quite acceptable. The inferences drawn here are on the basis of the path estimate values. Validation of the model has been conducted by various fitness measures. Standard values of fit indices [6] and values obtained from the test have been listed in Table 4 and Table 5 respectively.

Table 2: Factor loadings of manifest variables

Manifest Variables	Factor Loadings
Turbulent market environment (MA1)	0.94
Importance of generation of well-established market plan (MA2)	0.88
Degree of Market growth (MA3)	0.69
Emphasis on customer satisfaction (MA4)	0.89
Knowledge about consumption pattern (MA5)	0.92
Need for identification of target market (MA6)	
Market testing (MA7)	0.75
Investment towards market research for proper market dynamics (MA8)	0.83
Advertising and promotional activities (MA9)	0.78
Duration of the product total life cycle until definitive replacement (MA10)	0.84
Effort in competitor monitoring (MA11)	0.82
Meet quality guidelines (Q1)	
Achieved product performance goal (Q2)	0.91
Achievement of design goals (Q3)	0.80
	0.93
	0.86

Table 3: Statistics of path estimates

Description	Path	Hypothesis	Estimate
Market Analysis (MA) and Product & Qualty (Q)	MA-Q	H1	0.82

Table 4. Fitting indices [6]

Fit Indices	Desired Range
χ^2 /degrees of freedom	≤ 2.00
RMSEA(Root Mean Square Error of Approximation)	Values less than 0.05 show good fit Values as high as 0.08 represent reasonable fit Values from 0.08 to 0.10 show mediocre fit
Fit Indices	Desired Range
Goodness-of-fit index (GFI)	Values > 1.0 show poor fit
Average Goodness-of-fit index (AGFI)	≥ .90 ≥ .90

Table 5: Model fitting parameters

Chi-Square(χ^2)	df	χ^2/df	GFI	AGFI	RMSEA
188.552	99	2.046	0.925	0.908	0.0429

As per Table 5, both the fit indices GFI and AGFI are within the desired range i.e. 0.925 and 0.908 respectively. The Chi-square value is also satisfactory and the value of χ^2/df is also considerable and RMSEA value is quite small as it should be. As the values of all fitness parameter indices are well within permissible range it can be stated that technological improvements play a vital role in successful product development in Indian industries.

4. CONCLUSION

This empirical study explores the market analysis as a vital factor of product and service development success in Indian industries as well as the manifests to measure this factor. At the same time the quality related measures are considered as the success measure in this work. Market analysis is such a factor which is very much important in both product and service development fields. Based on the questionnaire survey from Indian industries, the SEM model has been established which depicts that the market analysis can be measured by various manifest variables which have been already discussed above and all of them will influence the overall quality improvements of a firm. Again these improvements have a positive impact on product and service development success which is expressed in terms of quality related measures described before. In the practical scenario, though these measures are equally important for product and service development success, but their implementation is not always being possible. The main reason behind that is the lack of investments in market analysis fields. This study concerns the degree of implementation of these variables and helps to improve the product and service development performance of Indian industries by implementing those variables in near future which will be helpful for their industrial sustainability in global competitive environment.

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REFERENCES

[1] Ahonen, T., Reunanen, M., and Ojanen, V., "Customer value driven service business development", *Outcomes from the Fleet Asset Management Project*, 2010.

[2] Akgu¨n, A. E., Byrne, J. C., Lynn, G. S. and Keskin, H., "New product development in turbulent environments: Impact of improvisation and unlearning on new product performance", *Journal of Engineering and Technology Management*, 24, pp. 203-230.

[3] Amabile, T. M., and Kramer, S. J., "The power of small wins", *Harvard Business Review*, 89, 5, 2011, pp. 70–80.

[4] Bhuiyan, N., "A framework for successful new product development", *Journal of Industrial Engineering and Management*, 4, 4, 2011, pp. 746-770.

[5] Buyukozkan, G., and Arsenyan, J., "Collaborative Product Development: A Literature Overview", *Production Planning & Control*, 23, 1, 2012, pp. 47-66.

[6] Byrne, B. M., Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming, New York, Taylor and Francis Group, LLC, 2010.

[7] Chiang, Y. H. and Shih, H. A., "Knowledge-oriented human resource configurations, the new product development learning process, and perceived new product performance", *The International Journal of Human Resource Management*, 22, 15, 2011, pp. 3202–3221.

[8] Clark, M., Ferrell, G., and Hopkins P., Study of early adopter of shared services and cloud computing within further and higher education. Newcastle upon Tyne, UK: HE Associates JISC, 3, 2.1, 2011.

[9] Cooper, R.G., and Kleinschmidt, E.J., (2007) "Winning Business in Product Development: The Critical Success Factors", *Research- Technology Management*, 50, 3, 2007, pp. 52-66.

[10] Ernst, H., Hoyer, W.D.H., and Rübsaamen, C., (2010) "Sales, Marketing, and Research-and-Development Cooperation across New Product Development stages: Implications for Success", *Journal of Marketing*, 74, 5, 2010, pp. 80-92.

[11] Ernst, H., "Success Factors of New Product Development: a review of the empirical literature", *International Journal of Management Reviews*, 4, 1, 2002, pp. 1-40.

[12] Ettlie, J. E., and Rosenthal, S. R., "Service versus manufacturing innovation", *Journal of Product Innovation Management*, 28, 2, 2011, pp. 285–299.

[13] Fazilah, A.A., Jaafar, N.N., and Suraya, S., "Critical Success Factors of New Product Development and Impact on Performance of Malaysian Automotive Industry", *Advanced Materials Research*, 903, 3, 2014, pp. 431-437.

[14] Fain, N., Kline, M., and Duhovnik, J., "Integrating R&D and Marketing in New Product Development", *Journal of Mechanical Engineering*, 57, 7-8, 2011, pp. 599-609.

[15] Fekri, R., Aliahmadi. A., and Fathian, M., "Identifying the cause and effect factors of agile NPD process with fuzzy DEMATEL method: the case of Iranian companies", *Journal of Intelligent Manufacturing*, 20, 2009, pp. 637-648.

[16] Felekoglu, B., and Moultrie, J., "Top Management Involvement in New Product Development: A Review and Synthesis", *Journal of Product Innovation Management*, 31, 1, 2014, pp. 159–175.

[17] Hart, S., "Dimensions of success in new product development: An exploratory investigation", *Journal of Marketing Management*, 9, 1993, pp. 23-41.

[18] Huang, S. C. T., and Tsai, K. H., "Exploring the drivers of new product success for businesses in Asia: A meta-analysis", *Asia Pacific Business Review*, 19, 3, 2013, pp. 303-319.

[19] Huang, X., Soutar, G. N., and Brown, A., "Measuring new product success: an empirical investigation of Australian SMEs", *Industrial Marketing Management*, 33, 2004, pp. 117–123.

[20] Hurst, J. L., Niehm, L. S., and Littrell, M. A., "Retail service dynamics in a rural tourism community: implications for customer relationship management", *Managing Service Quality: An International Journal*, 19, 5, 2009, pp. 511-540.

[21] Iamratanakul, S., Patanakul, P., and Milosevic, D., "Innovation and factors affecting the success of NPD projects: Literature explorations and descriptions", *International Journal of Management Science and Engineering Management*, 3, 3, 2008, pp. 176-189.

[22] Jolly, L., and White, S., "Communication, Collaboration, and Enhancing the Learning Experience: Developing a Collaborative Virtual Enquiry Service in University Libraries in the North of England", *New Review of Academic Librarianship*, 2016, pp. 1-16.

[23] Kazerouni, A. M., Achiche, S., Hisarciklilar, O., and Thomson, V., "Impact of the Business Innovation Strategy on New Product Development Success Measurement", Paper Presented at the International conf. on Innovative Design and Manufacturing. 318-323 August 2014 Quebec, Canada.

[24] Kurajdova, K., and Táborecka-Petrovicova, J., "Literature Review on Factors Influencing Milk Purchase Behaviour"', *International Review of Management and Marketing*, 5, 1, 2015, pp. 9.

[25] Lau, A. K.W., "Critical Success Factors in Managing Modular Production Design: Six Company Case Studies in Hong Kong,China, and Singapore", *Journal of Engineering and Technology Management*, 28, 2011, pp. 168-183.

[26] Lee, K., and Yoon, B., "The idiosyncrasy of research and development efficiency across types of small- and medium-sized enterprises: evidence from Korea", *R&D Management*, 45, 3, 2015, pp. 250-266.

[27] Lipovetsky, S., Tishler, A., Dvir, D., and Shenhar, A., "The relative importance of project success dimensions", *R&D Management*, 27, 2, 1997, pp. 97-106.

[28] Medeiros, J. F., Ribeiro, J. L. D., and Cortimiglia, M. N., "Success factors for environmentally sustainable product innovation: a systematic literature review", *Journal of Cleaner Production*, 65, 2013, pp. 1-11.

[29] Mendes, G.H.D. S., and Ganga, G.M.D., "Predicting Success in Product Development: The Application of Principal Component Analysis to Categorical Data and Binomial Logistic Regression", *Journal of Technology Management & Innovation*, 8, 3, 2013, pp. 83-97.

[30] Ommen, N. O., Blut, M., Backhaus, C., and Woisetschläger, D. M., "Toward a better understanding of stakeholder participation in the service innovation process: More than one path to success", *Journal of Business Research*, 69, 7, 2016, pp. 2409-2416.

[31] Ong, C. S., Lai, J. Y., and Wang, Y. S., "Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies", *Information & Management*, 41, 2004, 795-804.

[32] Sadeghi, A., Azar, A., and Rad, R. S., (2012). "Developing a Fuzzy Group AHP Model for Prioritizing the Factors Affecting Success of High-tech SME's in Iran: A case study'', *Procedia-Social & Behavioral Sciences*, 62, 2012, pp. 957-961.

[33] Sarja, J., "Explanatory Definitions of the Technology Push Success Factors", *Journal of Technology Management and Innovation*, 10, 1, 2015, pp. 204-214.

[34] Thamhain, H.J., (2011) "The Role of Team Collaboration in Complex Product Developments" in IEEE-PICMET 2011: Proceedings of IEEE international conference on Technology Management in the Energy Smart World, Portland, OR, pp. 1-7.

[35] Tsai, C. C., "A Research on Selecting Criteria for New Green Product Development Project: Taking Taiwan Consumer Electronics Products as an Example", *Journal of Cleaner Production*, 25, 2012, pp. 106-115.

[36] Verworn, B., "A structural equation model of the impact of the "fuzzy front end" on the success of new product development", *Research Policy*, 38, 2009, pp. 1571-1581.

[37] Wang, K.J., and Lestari, Y.D., "Firm Competencies on Market Entry Success: Evidence from a High-Tech Industry in an Emerging Market", *Journal of Business Research*, 66, 2013, pp. 2444-2450.

[38] Yeh, T. M., Pai, F. Y., and Liao, C. W., (2014). "Using a hybrid MCDM methodology to identify critical factors in new product development", *Neural Computing & Applications*, 24, (3-4), 2014, pp. 957-971.