

AN EXPLORATORY RESEARCH IN PRODUCT INNOVATION IN AUTOMOBILE SECTOR

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Abstract

The purpose of this research is to analyze the determinants of product innovation. This study focused on the statistical technique using the factor analysis on constructing the new factors that lead to product innovation in Automobile Sector. The researcher used quota sampling dividing into the Delhi/ NCR amongst four automobile companies i.e. the four of them are market leaders as per their market share and in each of these areas purposive sampling is used for the purpose of survey. It is a sampling techniques in which the sample is obtained by selecting convenient population units. For the purpose of the study, primary data was collected with the help of a well-drafted Questionnaire given to Top and middle executives in the automobile organizations (N=423). Cronbach Alpha was used to evaluate the internal consistency of the scale items. The methodologies used were descriptive statistics, factor analysis and non-parametric technique using the Kruskal-Wallis test. The results showed seven new factors were successfully constructed using factor analysis and assigned as the factors affecting the learning styles; which are 1) Intelligence Generation, 2) Intelligence Dissemination 3) Quality 4) Flexibility, 5) Dependability/ Delivery,6) Marketing support of the product 7) Technology Selection

Keywords— Factor analysis, Automobile sector, Innovation

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INTRODUCTION

The meaning of product innovation is the launching of new products and unique services with major improvements in their salient features and applications. This consists of considerable enhancements in technological disclaimers, tools and resources, integrated programs, customer easiness and supplementary purposeful features. The success of any organization can be traced or linked with successful products and this based on their capability to search the wants of clients and to quickly make goods that fulfil these demands. Therefore, product development can be described as the life blood of any business organization Brown and Eisenhardt (1995), Balbutin *et al.* (2000), Efcharis *et al.* (2008), Chux Gervse Iwe (2010). According to the Oslo Manual (OECD,2005, p.46) a minimum condition for an innovation is that the product, process or technique innovation must be novel to the organization, which includes both novelty that the company is foremost to increase and those that are accepted from other organizations. Following from this disagreement, an innovation is considered to be *new-fangled to the market* if the firm is the primary to introduce the modernization on its marketplace (OECD, 2005, p.58). Christensen (2006) examines the term *sustaining innovation* in opposition to *disruptive innovation*. A nourishing innovation does not have a troublemaking effect on old market place but could include both existing improvements (i.e. improving a product in an old market place in demanding styles) and radical alterations (i.e. developing a new marketplace by understanding the upcoming opportunity in a new style). Generally, sustaining innovations improve buyer worth by providing a higher amount of manufactured goods routine. A disorderly innovation, conversely, brings a completely diverse worth proposition to the marketplace that has not survived before.

During modern decades increasing ecological concerns have become a well-built encouragement to creative thinking. Ecological system will exert huge weight on production industries,

which will augment in the upcoming time, enabling a more surviving globe for coming generation. The automobile industry is one of several industries causing ecological pollution where cars have a important impact on all stages of the life cycle; manufacturing, use, reusing and dumping (Orsato and Wells, 2007). Automakers have also shown an escalating awareness of the ecological impact of their products as environmental rules and market demands for ecologically less disparaging cars have augmented. The centre on reducing CO2 has become a well-built driver in the growth of not only less ecologically vicious cars, such as Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV), but also of mass-reduction way-outs. The heaviness of the car is one necessary factor that has a consequence on CO2 emissions for both expected cars and for EVs and HEVs. An uneven estimate recommends that a mass reduction of 100 kg marks in decreased fuel flaming up of 5% (Swedish Association of Green Motorists, n.d.).The basic fact is that a 10% heavy decrease results in a 4e6% diminish in fuel utilization representing some of the prospective in focusing on frivolous concepts in the automotive business. Even though automakers realize and largely master sensible difficulties with choices to the all-steel body, and despite various phases of aluminium-intensive cases vehicles or low- quantity, high-performance sports cars, the conventional industry has even now majorly engaged the all-steel parts. A General opinion in the innovation theory is that big, developed organizations in the automobile business generally face problems in enabling major innovations (Henderson and Clark, 1990; Utterback, 1996) and in spite focus the growth and application of marginal innovations (Dougherty and Hardy, 1996). The information regarding how to handle scratch and drastic innovations is very few because the methods, tools and processes to handle such innovations are vague (Pavitt, 2005) resultant in marginal enhancement which is considered to bring low threat and instant return (Dougherty and Hardy, 1996; Leifer *et al.*, 2002., McDermott and O'Connor, 2002). At the core of innovation action is the capacity to, for instance, making and sharing of ideas, to join old innovations into novel way

outs or use old way outs in a novel manner. Product innovation makes the healthy environment inside the firm that enhances the growth, improves the financial returns and superior brand image (Liu *et al.* (2002) (Walker, June, 2004)

Scenario of Indian Automobile Sector

The automobile business involves two distinct businesses: (i) the automotive business; and (ii) the auto segment business. The automotive business further has three sub-parts: (a) two-wheelers; (b) three-wheelers; and (c) four-wheelers (passenger and commercial vehicles). While the history of India's growth in the economy is known in the last two decades, it is usually termed as a services-leading concept. The automobile industry's addition is not only in terms of sales revenues, incomes, taxes to be paid and jobs, but more particularly in production-process superiority, efficient enhancements and state of the art. The automobile industry is the most important place of the state of the art in Indian production. It stands for the 2nd highest average expenditure by business on research and development, followed by the pharma business. The automobile industry is the pillar of global economy, a main driver of macro economic growth, stability and technological advancement in developed and developing countries, covering many adjacent industries (Kearney, A.T, 2013). According to the Society of Indian Automobile manufacturers (SIAM), India's auto industry is world's sixth largest producer of automobiles in terms of volume and value and has grown 14.4% over the past decade. The industry contributes to 7% of India's GDP and absorbs 8% of the total employed population having more than 35 automakers.

Need for studying Product Innovation

The success of any organization can be traced or linked with successful products and this based on their capability to search the wants of clients and to quickly make goods that fulfil these demands. Therefore, product development can be described as the life blood of any business organization Brown and Eisenhardt (1995), Balbutin *et al.* (2000), Efcharis *et al.* (2008), Chux Gervse Iwe (2010). Contending the wants of clients is not only a commerce obstacle neither is it only a architecture hurdle or production hurdle. It is new product development problem. Product development is an integrative function that needs help from almost all the activities of a company, however three activities are nearly focussed to a product development achievement. This consists of commerce, architecture and production (Ulrich and Steven Eppinger, 1995; Ulrich and Eppinger, 2007). The commerce activities arbitrate communication between the company and its clients. Commerce usually aids the recognition of client demands. Commerce also commonly organizes for interaction between the company and its clients fix prices and introduce and advertise the product internationally (Ulrich and Eppinger, 2007) (Zahra, 1993). The architecture activities edges the term of the substantial type of the good to better meet client's demands. The architecture activity could be construction, business, advertising or all of them, (Ulrich and Steven Eppinger, 1995) (Zahra & Covin, 1995). The production activity is mainly culpable for making and functioning of the manufacturing system in order to make the goods. Widely delineated, the producing activity also involves buying, allocation and setting up (Ulrich and Eppinger, 2007). Product development defines contributing novel or enhanced goods for current market place. By informing the current market demand, a company may see way outs to alter or improve goods characteristics, make many superior phases, or summate different forms or breadth by launching novel models of known plans i.e. properties of radical changes.

Objectives of the study

This study aims at studying impact of product innovation on the financial performance of the organizations and to evolve a model for practicing product innovation within the organizations. The objective of the study is:

- To analyse the factors that lead to product innovation in Automobile sector

RESEARCH METHODOLOGY OF THE STUDY

The study is based on the empirical research on product innovation. The complete study has been divided into two parts, i.e. pilot study and questionnaire based survey study.

The pilot study of select organizations has been carried out to identify the determinants of product innovation. The unit of analysis for the study is the firm. The data has been analyzed statistically using univariate, bivariate and multivariate analyses techniques. Based on the results seven new factors were successfully constructed using factor analysis. Empirical Cum Descriptive Research Design is used for this research to find out the solution of the problem through the collection of primary and secondary data. For pilot Survey, Judgemental and Purposive has been used to collect the data of 100 respondents. It means questionnaire were filled through references from the firms of auto sector. EFA (Exploratory Factor Analysis) was conducted to know the number of factors extracted.

For this research, firms who are market leaders in the Automobile sector in Delhi-NCR Region are taken as population based on facts that shows the passenger car market share in India in the fiscal year of 2019 (Source: SIAM- Society of Indian Automobile Sectors). This states to the origin from which the sample were to be taken. For this research, firms in Delhi/NCR, India were the respondents. The participants were selected based on the theory of based on the Theory of Vijay Sathe (2005), where Market share and Performance such as sales turnover, Profitability etc. is considered in the Auto sector. (SIAM- Society of Indian Automobile Sector. Four major players were selected: Maruti Suzuki, Hyundai, Mahindra & Mahindra and Tata Motors. For this research, Non-random Purposive/Judgmental and Snowball Random Sampling were used. It is an inspecting method in which the sample is taken by choosing advantageous population units. With the final target of research, important data was collected with the help of a commonly made questionnaire provided to staff in the chosen firms. Additionally, Judgmental or purposive inspecting method was used taking into consideration that the participant's selection will have enough general information of innovation since they happen to be using many innovation practices.

A sample of 423 top and middle executive from various automobile firms were selected for the purpose of study. For factor analysis, 330 sample size is adequate (Nunally 1976; Fiedel 2001). On completing the questionnaire affirmation, it was administered to testing through a pilot survey given to a small sample of participants (100 participants). In testing, participants are chosen from total universe from which the main survey studies to be taken and the questionnaire is used on it (Thakur, 1993).

Pilot Study

The aim of the testing the questionnaire was to assure that the questionnaire was simple to accept to the participants, and to avoid the potentialities of misinterpretation, distraction and partiality. In the process of testing, 100 participants were provided the questionnaire. Therefore, each participant was asked based on questionnaire, with a target to establish the fragile areas of the questionnaire. Each participant was asked to convey the challenges confronted in writing the questionnaire and potentialities for more enhancements for simpler acceptance of the participants. The recommendations regarding dialectics, making of questions, organizing, arranging etc. were observed.

Reliability Analysis

Reliability is the amount to which a group of measurable variables would give similar outcomes if gathering of information were duplicated (Malhotra, 2007) and is checked by considering the amount of organized change in a measurement scale. Measuring

the Cronbach alpha coefficient of a measurement scale is the main generally barometer of internal similarity (Pallant, 2007), with the fair Cronbach Alpha co-efficient being over 0.7 (Hair et al. 2010). A value of below 0.7 is taken to state uncontested internal

similarity reliability (Malhotra, 2007). The following table summarizes the Cronbach's coefficient alpha for the pilot study of nine constructs with 32 statements.

Table 1: Summary of Overall and Individual Constructs Reliability analysis for the Pilot Study

Cronbach's Alpha		N of Items
.905		39
Constructs	Items	Cronbach Alpha
Intelligence generation	4	0.711
Intelligence Dissemination	4	0.859
Technology Selection	6	0.884
Flexibility	4	0.911
Dependability/ Delivery	5	0.686
Quality	3	0.736
Marketing support of the product	5	0.708
Product-Process Innovation	4	0.715

The Cronbach alpha values of all the factors were greater than 0.7, which is taken to be fair and adequate. This states high internal consistency amongst each item.

Analysis and Interpretation

The first data analysis in the Exploratory Factor Analysis process (Pallant, 2007) is the assessment of its suitability (factorability). Two statistical measures: Bartlett's Test of Sphericity and Kaiser-

Meyer-Olkin Measure of Sampling Adequacy (KMO) can be used to investigate the factorability of the data. the KMO sampling adequacy of this study information is greater at 0.761 and the importance of Bartlett's Test of Sphericity is suitable, thus the assessment outcomes gives enough proofs to manage the correct usage of Factor Analysis on the impact of product innovation measurable variables

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.761
Bartlett's Test of Sphericity	17395.719
	496
	.000

INTERPRETATION OF FACTORS

Each construct requires to be given a logo or label to featurise it and help its explanation (Tabachnick and Fidell, 2007). Each of the product innovation factors that have been obtained through Principle Component Analysis in the Exploratory Factor Analysis process of this study information is shown. The labels given to each construct are the outcome of the explanation of its product innovation construct scale variables and are analyzed in the below sub-sections.

Dependability/ Delivery

The first construct with the largest Total Variance Explained percentage, 9.862%, has been explained as *dependability/delivery* due to its incorporation of scale variables searched and adopted from previous studies surrounding impact of product innovation relating to relational aspect of dependability/delivery. Table 4.6 below displays the scale variables that load onto the construct 1.

Table 3: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
1	Dependability/ Delivery	The organization always looks to Increase the delivery speed of products.	26.742	9.862	0.753	0.781

		The organization determines and eliminates non-value adding activities in delivery related processes.			0.662	
		The organization highly focuses on increasing the ability to meet the delivery commitments.			0.693	
		The organization always look to Decrease the make span from taking the orders to the completion of delivery.			0.771	
		The organization always look to Increase the just in time delivery.			0.567	

Technology selection

The second factor with the largest Total Variance Explained value, 9.772%, has been explained as *technology selection* due to its incorporation of scale variables searched and adopted from previous studies surrounding impact of product innovation relating to relational aspect of *technology selection*. As technology

innovation can assist the organization to make the cut-throat strategies through the production of competing goods and services and much more efficient process to make such products, or developing novel businesses. Table 4.7 below displays the scale variables that load onto the construct 2.

Table 4: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
2	<u>Technology selection</u>	The organization selects the leading strategy in our industry.	7.058	9.772	0.635	0.784
		The organization place high emphasis on R&D activities.			0.73	
		The organization selects the most advanced technology in our industry.			0.658	
		The organization develops new products with technical specifications and functionalities totally differing from the current ones.			0.667	
		In our organization, the product modifications have a better market response.			0.675	

Flexibility

The third factor with the largest Total Variance Explained value, 7.858%, has been explained as *flexibility* due to its incorporation of scale variables searched and adopted from previous studies

surrounding impact of product innovation relating to relational aspect of *flexibility*. Table 4.10 below displays the scale variables that load onto the construct 5.

Table 5: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
4	FLEXIBILITY	The organization always tries to Increase the ability of producing non-standard products.	4.652	7.858	0.654	0.811
		The organization always tries to increase the product orders with different specifications.			0.78	
		The organization possesses the ability to change machine and equipment priorities when necessary.			0.847	
		The organization always tries to Increase the ability of flexible production.			0.643	

Intelligence Dissemination

The fourth factor with the largest Total Variance Explained value, 7.440%, has been explained as *intelligence dissemination* due to its incorporation of scale variables searched and adopted from previous studies surrounding impact of product innovation relating to relational aspect of *intelligence dissemination*.

Companies behavior is based on market place brilliance consisting of the brilliance of clients and rivals. The theory of intelligence dissemination has also been focused for creative results. Table 4.11 below displays the scale variables that load onto the construct 6.

Table 6: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
5	Intelligence Dissemination	In our organization, Interaction among employees is critical success factor for product innovation.	4.457	7.44	0.744	0.751
		In our organization, the availability of appropriate infrastructure and processes are critical for improving intelligence dissemination within the organization.			0.648	
		In our organization, familiarity with colleagues facilitates the generation of ideas, is critical to product Innovation.			0.644	
		In our organization, Identifying and designing Intelligence Dissemination processes are important for product innovation.			0.718	

Quality

The fifth factor with the largest Total Variance Explained value, 5.012%, has been explained as *quality* due to its incorporation of scale variables searched and adopted from previous studies

surrounding impact of product innovation relating to relational aspect of *quality*. Table 4.12 below displays the scale variables that load onto the construct 7.

Table 7: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
6	Quality	The organization highly focuses on Increasing the product and service quality according to customer's perception.	4.167	5.012	0.649	0.736
		The organization highly focuses on Increasing the product and service quality compared to rivals.			0.771	

Linking Product- Process Innovation

The six factor with the largest Total Variance Explained value, 4.410%, has been explained as *Product- Process Innovation* due to its incorporation of scale variables searched and adopted from

previous studies surrounding impact of product innovation relating to relational aspect of *Product- Process Innovation*. Table 4.13 below displays the scale variables that load onto the construct 8.

Table 8: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
7	Product-Process Innovation	The organization determines and eliminates non value adding activities in production processes.	3.765	4.41	0.61	0.715
		The organization decrease manufacturing cost in components and materials of current products			0.674	

Marketing Support of the Product

The seven factor with the largest Total Variance Explained value, 4.047%, has been explained as *Marketing Support of the Product* due to its incorporation of scale variables searched and adopted

from previous studies surrounding impact of product innovation relating to relational aspect of *Marketing Support of the Product*. Table 4.14 below displays the scale variables that load onto the construct 9.

Table 9: Summary of Rotated Component Matrix, Cronbach's Alpha and Variance

Factor No.	Name of the dimension	Variables	% of Variance Explained		Factor Loadings	Cronbach Alpha
			Extraction sums of squared loadings	Rotation sums of squared loadings		
8	Marketing support of the product	The organization renews the design of the current and/ or new products	3.465	4.047	0.774	0.708
		The organization renews the distribution channels without changing the logistics processes related to the delivery of the product.			0.698	

CONCLUSION

It was found from the research that the major factors of product innovation are Intelligence Dissemination, Intelligence Generation, Technology Selection, Quality, Flexibility, Dependability/ Delivery, Marketing support of the product and Linking product-process innovation. The research findings related to organizational structure would help the managers to design proper structure for implementing product innovation. The various processes and systems which help to implementing product innovation would guide the mangers to design the right

kind of systems which promote product innovation. After identifying different organizational factors from literature, a discussion has been followed by an empirical study conducted to identify the impact of product innovation. This study has established that in the context of the fast changing needs of the customers, the adoption of product innovation is very important. Future research can also incorporate external environment as a major variable to understand its impact on product innovation activities within the organizations. Moreover, the corporate level strategies including the vision for product innovation and

leadership can also be an important contribution towards product innovation research.

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