

ROLE OF FIRM CHARACTERISTICS AND PRACTICES ON THE NEW PRODUCT DEVELOPMENT PRACTICES IN FABRICATION INDUSTRY: AN EMPIRICAL ANALYSIS

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***Abstract:** New product design and development becomes mandatory to the firms irrespective of the nature of products produced in the economy. The success and sustainability of the business depends on the product line and range held by the firm. This is applicable to engineering fabrication industry also in the recent past. The primary factors could be advent of new technology and the customers drive towards replacement models rather than repair and reuse models. New product development involves many dimensions of issues and factors due to involvement of money, risk associated with the investments and feasibility and commercial viability of the product. The aim of the present study is to find out the relationship between the Firm characteristics and the new product development practices in fabrication industry. For the purpose of study engineering firms in Chennai is selected and data is collected from the employees through simple random sampling method. The analysis reveals that the firm features has close relation with new product development practices and the relationship is highly significant at 1% level.*

***Keywords:** Technology- Investment capacity-risk bearing- creativity-Innovation*

INTRODUCTION

Engineering is a key driver of human development. India in particular has a very small engineering capacity which results in many states in India being unable to develop crucial infrastructure without outside aid. The attainment of many of the Millennium Development Goals requires the achievement of sufficient engineering capacity to develop infrastructure and sustainable technological development. Engineering companies in many established economies are facing significant challenges ahead with regard to the number of skilled engineers being trained, compared with the number retiring. This problem is very prominent in the developing countries. There are many economic and political issues that this can cause, as well as ethical issues. It is widely agreed that engineering faces an “image crisis”, rather than it being fundamentally an

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unattractive career. Much work is needed to avoid huge problems in the developed and well as the developing and other third world war economies. The firm characteristics are also important in the development engineering fabrication industry.

STATEMENT OF THE PROBLEM

New product design and development becomes mandatory to the firms irrespective of the nature of products produced in the economy. The success and sustainability of the business depends on the product line and range held by the firm. This is applicable to engineering fabrication industry also in the recent past. The primary factors could be advent of new technology and the customers drive towards replacement models rather than repair and reuse models. New product development involves many dimensions of issues and factors due to involvement of money, risk associated with the investments and feasibility and commercial viability of the product. At any point of time the designs can change due to market factors. New product development in engineering firms takes lot of time. In some cases, before introduction of a new product, another advanced and economical product may emerge as substitute. In this case the risk is very high. This is external environment related. But, internal factors role in new product development is equally holds good. The role of firm's demographics is indispensable in nature. There is no comprehensive study covering the issues and concerns pertaining to new product design and development in fabrication engineering industry. Hence, the present study is taken up for the research.

SCOPE OF THE STUDY

The scope of the current study is limited to selected engineering firms operating in Chennai and its suburban areas. The engineering firms in the study included both public Limited and Private limited firms. The operations of the sample firms are spread across all the domains and verticals of design, development, site engineering, servicing and consultancy services in engineering domain. The employees in the survey cover the range of age groups, experience groups, working at different levels of management. In addition equal opportunity is given to all the employees by sending a digital survey structured questionnaire for expressing their views on the topic and the various dimensions of impact of the same. The findings of the study may be applicable to the firms operating elsewhere in the same environment in the country. However the personal bias and perceptual differences may be exists.

NEED FOR THE STUDY

There is both practical and theoretical significance of conducting a research study of this nature. Fabrication engineering is a specialized job with multiple skills involvement to design a product and to operationalise the same either for individual customer or for an institutional customer. Being domestic and traditional engineering firms in the sample area are slowly coming out of the industry either through diversification or buyout. The reasons for the same are organizational and environmental in nature.

The organizational reasons could be lack of second generation management to take up the firm and to run on profitable and professional manner. The environmental factors includes the entry of new age firms with latest technology, lack of skilled labour to engage in manufacturing operations in design and development of customer specified products, decreased demand for standard and uniformed products. In this scenario, fabrication industry is at cross roads, especially run by the traditional management firms. There is no comprehensive research is done with reference to fabrication industry issues and concerns in terms of new product design and development. Of course, in engineering side few models, strategies and quality measures are introduced based on the Japanese experience and few companies succeeded in that. The continuous adoption and application of those are restricted to standard manufacturing divisions. But the fabrication division is depending on the customer specific products design and development, hence, every product is heterogeneous and every product required a new model and new requirements in terms of resources and talents. In this scenario, a comprehensive study on the issues, concerns, motives, strategies adopted and factors influencing the new products design and development in fabrication engineering industries could be value addition to the existing literature and identifying the success factors of new products in fabricating industry could be of practical use to the industry. With this philosophy in mind the current project is undertaken. The social relevance of the same is abundant and hence it serves the social needs of the industry in specific and society at large.

The specific objectives of the study are: To find out the role of firm characteristics in the new product development in fabrication industries in the sample.

HYPOTHESES

On the basis of the objectives of the study, the following hypothesis were framed and administered on the sample data.

- (i) There is no significant difference between the various kinds of firms with regard to various dimensions of new product development aspects in fabrication industry in the sample.

SOURCES OF DATA

For the purpose of study, data required is collected from both primary and secondary sources. The primary data is collected from a structured questionnaire prepared and tested through pilot study. The secondary data is collected from both print and electronic sources. The print sources includes, magazines, newspapers, books, journals, reports, research based thesis, review reports, policy documents and other unpublished data from the libraries and milk producing firms in the sample area. The electronic sources includes, data bases, e-journals, web sources, websites of research companies, industry associations, government sites and other media sources.

DATA COLLECTION TOOLS

For the purpose of the study both primary and secondary data sources are used. The primary data is collected through a structured questionnaire prepared and tested through pilot study and reliability. The secondary data is collected from both print and electronic media. The print sources include books, journals, magazines, reports, documents etc. The electronic sources include websites, e-books, digital reports, and cloud data in mobile phones through apps like whatsapp. For the purpose of data required for the analysis and to test the hypotheses, the primary data is collected through a structured questionnaire prepared on the basis of review of literature and tested through pilot study.

PILOT STUDY AND RELIABILITY TEST

The pilot study was conducted by distributing 125 questionnaires to executives from the engineering companies in the sample area. Cronbach Alpha Test was used to determine the degree of consistency among the multiple measurements of each factor. It measures the inter-item reliability of a scale generated from a number of items. The overall alpha is found at 0.896. Ideally, the reliability coefficient above 0.5 is considered acceptable as a good indicator of constructing reliability (Nunnally, 1976), above 0.6 is treated satisfactorily (Robinson *et al.*, 1991), but alpha above 0.7 is considered sufficient (George and Mallery, 2001; Pallant, 2005).

RESEARCH METHODOLOGY

The current study is descriptive in nature. For the purpose of study fabrication engineering firms from Chennai are selected by using the industrial association dictionary from guindy industrial estate firms association. From the list of fabrication industries having more than 20 years of experience in the industry is selected for the study. There are 49 firms having more than 20 years of experience in fabrication industry. While approaching for studying 16 companies rejected the entry permission, sharing of data and distribution of structured questionnaires to the employees. From the remaining 33 firms are permitted to visit during rest hours and shift change timings to meet the employees. From the list of 33 all the companies are given due and equal weightage and distributed 20 questionnaires to each company on quota sampling basis. There are 481 filled in questionnaires were collected back and scrutinized to remove the unfilled and partially filled questionnaires. It is noted that 442 questionnaires are filled in all respects and found usable for further analysis. Based on the same, by using SPSS version 24.0 is used to perform the analysis and the results are presented in the following lines. Initially a pilot study was conducted with 125 questionnaires and the reliability for the same was calculated by using Corn Bach's Alpha Score and found at 0.896 (89.6 Percent) as reliable.

SAMPLE ADEQUACY AND SAMPLE SIZE

Since the population is unknown, the sample is determined by using a qualitative technique of reasonability and justified with large sample size. The sample covers the

entire sample area in terms of the prominent engineering firms in Chennai city. The convenient sample technique is adopted to survey the employees working in the sample firms. The sample size and wide coverage are taken care, to avoid errors and validity issues relating to research. The sample size is determined by using the scientific method, by using the pilot study standard deviation of the sample of 125 respondents, by allowing the standard error at 5% level. The sample size should be $= (N) = (ZS/E)^2 = (1.96 * 0.535 / 0.05)^2 = 439.82$, actual is 442.

DATA ANALYSIS AND INTERPRETATION

Table 1
Distribution of sample on the basis of Firm's Experience in new product development in years

<i>Experience</i>	<i>Frequency-(N)</i>	<i>Percentage- (%)</i>	<i>Valid Percentage-(%)</i>
Below 5	155	35.1	35.1
5-10	122	27.6	27.6
10-15	41	9.3	9.3
15-20	47	10.6	10.6
Above 20	77	17.4	17.4
Total	442	100.0	100.0

Source: Primary Data / Questionnaire

Table 1, represents the firm's composition in the sample on the basis of experience in the new product development industry. The sample represents that, 35.1 percent of the employees belong to new aged firms with less than 5 years of experience in new product design and development, 27.6 percent are from 5-10 years experienced firms in the industry, 9.3 percent are belongs to 10-15 years experience firms with standard product design firms, 10.6 percent are from 15-20 years of experience with hi-tech design firms with customized technology and 17.4 percent is from above 20 years experience using IT application and having wide range of services and nature of projects in the industry indicates that the engineering industries in the sample area are professional in nature and having wide range of talents in new product design and development. This will help in the growth and development of industries with the support of engineering services. New product from engineering design industry will help the

Table 2
Distribution of sample on the basis of Prime Reasons for going to new product development

<i>Reasons for new products development</i>	<i>Frequency-(N)</i>	<i>Percentage- (%)</i>	<i>Valid Percentage-(%)</i>
To sustain in the market	36	8.1	8.1
To compete with competitors	159	36.0	36.0
To serve customer demands	129	29.2	29.2
To improve market size	96	21.7	21.7
To update technology	22	5.0	5.0
Total	442	100.0	100.0

Source: Primary Data / Questionnaire

firms to perform better with better quality of products and services. In this way, engineering industries helping in the development of the economy in the sample area. This has made the state of Tamilnadu one among the progressive states in the Country.

It is noted from the table 2, that the prime reasons for new product design and development in the engineering firms quoted by the respondents are as follows. 8.1 percent of the employees indicated as to sustain in the market, 36 percent of the employees in the sample quoted as to compete with the competitors, 29.2 percent of the employee quoted as to serve the customer demands, 21.7 percent of the employees indicated as to improve the market size, and finally 5 percent of the employees quoted as to improve the technology among the sample. It indicates that the new product development is mandatory to the firms to be in the market and to serve the customers to have sustainability and continuity in the business. Engineering industry is changing from time to time with rapid speed along with the other sectors. Hence, change is a permanent one in the market. Change alone can sustain in the market for a long period of time.

Table 3
Distribution of sample on of Sources of new product development idea

<i>Sources of new product idea</i>	<i>Frequency-(N)</i>	<i>Percentage- (%)</i>	<i>Valid Percentage-(%)</i>	<i>Cumulative Percentage-(%)</i>
Customer requirements	104	23.5	23.5	23.5
Site experience	32	7.2	7.2	30.8
Technology introduction	74	16.7	16.7	47.5
Need for change,	152	34.4	34.4	81.9
Competition and rivalry				
Planned R&D activity	80	18.1	18.1	100.0
Total	442	100.0	100.0	

Source: Primary Data / Questionnaire

The results of the table 3 indicates that the sources of new product idea among the engineering firms are revealed as 23.5 percent through customer requirements, 7.2 percent got an idea while working at site, 16.7 percent through new technology introduction into the market, 34.4 percent indicated as need for change, competition

Table 4
Distribution of sample on the basis of major type of engineering activity of the firm

<i>Major type of activity</i>	<i>Frequency-(N)</i>	<i>Percentage-(%)</i>	<i>Valid Percentage-(%)</i>	<i>Cumulative Percentage-(%)</i>
Design and development of models	137	31.0	31.0	31.0
Manufacturing of standard items	150	33.9	33.9	64.9
Customized design and production	71	16.1	16.1	81.0
Onsite Project design and development	31	7.0	7.0	88.0
Consulting and assembling	53	12.0	12.0	100.0
Total	442	100.0	100.0	

Source: Primary Data / Questionnaire

and rivalry and 18.1 percent indicated as planned R&D activity. This indicated that the need is the mother of invention and competition is the pusher for speeding up its activities from time to time in the engineering industry. It has no exception to other sectors in the economy.

Table 4 represents the results on the major type of engineering activity performed by the sample firms indicates as follows. The results indicated that, 31 percent of the firms always performs the design and development of models as standard and as per customer specifications, 33.9 percent of the firms are into manufacturing of standard products and supplying to the market, 16.1 percent performs the customized design and production, 7 percent of the firms performs onsite project design and development and 12 percent of the companies performs Consulting and assembling activities in the sample. It indicates that there is no hard and strict restriction on the type of projects and products designed and developed by the engineering firms in the sample. Based on the expertise, the firms choose the works and produce the same. Major activities like customer specific design manufacturing and supply may be undertaken by a few firms. Many are restricted themselves to standard products and services. It is voluntary affair to the individual firms and based on the convenience and the requirements of the firm, companies are adopting and implementing the new product design and development in the engineering industry. All the firms can adopt and practice the same for the mutual benefit of the employees, firm and the stakeholders at large.

Table 5
Distribution of sample on the basis of number of employees working in the new product development teams

<i>Number of employees working</i>	<i>Frequency-(N)</i>	<i>Percentage-(%)</i>	<i>Valid Percentage-(%)</i>	<i>Cumulative Percentage-(%)</i>
Less than 50	85	19.2	19.2	19.2
50-100	211	47.7	47.7	67.0
100-150	85	19.2	19.2	86.2
Above 150	61	13.8	13.8	100.0
Total	442	100.0	100.0	

Source: Primary Data / Questionnaire

It is observed from the results of the table 5, that 19.2 percent of the firms working with less than 50 engineers on the new product development projects, 47.7 percent of the engineering firms allotted 50-100 engineers on new product development projects, 19.2 percent of the firms are working with 100-150 employees on new product development and only 13.8 percent of the firms working with above 150 engineers on new product development in the sample. This indicates that majority of the engineering firms are mid size and undertake medium level of budget projects with risk assessment from time to time. Hence, one can conclude that the Chennai based engineering firms are conservative in nature and traditionally grown companies with sustainability as a base.

Table 6
Distribution of sample on the basis of type of products manufactured

<i>Type of Products manufacturing</i>	<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Standard design products	163	36.9	36.9
Customer specified Products	174	39.4	39.4
New products with new technology	105	23.8	23.8
Total	442	100.0	100.0

Source: Primary Data / Questionnaire

It is observed from the sample responses represented in the table 6, that 36.9 percent of the firms are into manufacturing of standard design products, 39.4 percent of the firms are into manufacturing of customer specified products and 23.8 percent of the firms in the sample are into design and development of new products with new technology. This clearly indicates that less than one fourth of the engineering firms only are into core new product design and development. It indicates that the risk conservatism adopted by many engineering firms in the sample. Because, proto models design, development, manufacturing and commercialization is a risky activity. Is product fails the whole loss recovery may take lot of time and the financial crunch in the firm will impact the all other divisions. Hence, traditional and risk aversion companies stand in the second line for design and development of new products in the engineering industry.

Table 7
Distribution of sample on the basis of Perceptions on Management attitude towards new product development

<i>Perceptions on Management attitude towards new product development</i>	<i>Frequency-(N)</i>	<i>Percentage- (%)</i>	<i>Valid Percentage- (%)</i>
Professional tool to build good teams	98	22.2	22.2
Performance measure	191	43.2	43.2
Customer retention measure	84	19.0	19.0
Motivational tool for growth	45	10.2	10.2
Brand building tool	24	5.4	5.4
Total	442	100.0	100.0

Source: Primary Data / Questionnaire

Table 7 represents the results of the data analysis pertaining to management attitude towards new product development among the engineering firms in the sample. It is noted that 22.2 percent of the sample perceived that management observed new product development as a professional tool to build good teams, 43.2 percent of the sample represents as a performance measure, 19 percent represents as a customer retention measure, 10.2 percent of the sample represents as a motivational tool for growth and 5.4 percent of the sample represents as a brand building strategy. It is inferred from the analysis that new product development is used with a good intention to build and retain talented employees for the benefit of the firm and to protect the stake holders interests at large.

Table 8
Distribution of sample on the basis of new product development strategy adopted by the engineering firms

<i>NPD strategy adopted by the Engineering firms</i>	<i>Frequency-(N)</i>	<i>Percentage-(%)</i>	<i>Valid Percentage-(%)</i>	<i>Cumulative Percentage-(%)</i>
Growth strategy	78	17.6	17.6	17.6
Product differentiation strategy	115	26.0	26.0	43.7
Competitive strategy	140	31.7	31.7	75.3
Diversification strategy	39	8.8	8.8	84.2
Turnaround strategy	70	15.8	15.8	100.0
Total	442	100.0	100.0	

Source: Primary Data / Questionnaire

It is noted from the table 8, that the new product development used by the engineering firms indicated as growth strategy by the 78 respondents, product differentiation strategy by the 115 respondents, competitive strategy by 140 respondents, diversification strategy by 39 employees and turnaround strategy by 70 employees in the sample. It indicates that new product development is widely used as competitive strategy and it is followed by product differentiation to expand the market by attracting new customers. It is appreciable and advised to extent to other possible areas in the firm and use for the benefit of the employees and to the benefit of the stake holders at large.

Inferential statistics

Null Hypothesis: There is no significant difference between the perceptions of the employees from the companies having and not having NPD department with prototype testing technology with regard to motives for new product development and strategy adopted in new product development in fabrication engineering industries in the sample.

Table 9
Group Statistics of Perceptions on motives for new product development and strategy adopted in new product development in fabrication engineering industries along with t-test results

	<i>Status of having NPD dept with proto testing facility</i>				<i>t-value</i>	<i>P value</i>
	<i>Yes</i>		<i>No</i>			
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
Overall motives for new product development	38.19	5.59	36.45	6.38	2.957	0.003**
Kinds of strategies adopted in new product development	38.00	5.39	36.39	6.05	2.848	0.005**

It is noted from the table 9, the p value is recorded at 0.003 and 0.005 indicates less than 0.01 and rejected the null hypothesis, There is no significant difference between the perceptions of the employees from the companies having and not having NPD

department with prototype testing technology with regard to motives for new product development and strategy adopted in new product development in fabrication engineering industries in the sample. Hence, it is inferred that, there is a highly significant difference between the perceptions of the employees from the companies having and not having NPD department with prototype testing technology with regard to motives for new product development and strategy adopted in new product development in fabrication engineering industries in the sample. Based on the mean value, it is found that, the companies having NPD department with proto testing facilities are highly endorsed the motives and strategies adopted in new product development in fabrication engineering industries when compared to others in the sample. This is due to the regular involvement in the new product development and practicing proto testing for future development. The companies need to have a separate department in order to bring out the more number of innovative designs and products to compete with the competitors in the market.

Perceptions of employees from the companies having and not having NPD department with prototype testing technology with regard to factors influencing NPD, barriers in NPD and success factors of new products in fabrication engineering industries in the sample.

Null Hypothesis: There is no significant difference between the Perceptions of employees from the companies having and not having NPD department with prototype testing technology with regard to factors influencing NPD, barriers in NPD and success factors of New products in fabrication engineering industries in the sample

Table 10
Group Statistics of Perceptions on factors influencing NPD, barriers in NPD and success factors of new products in fabrication engineering industries

	<i>Status of having NPD dept with proto testing facility</i>				<i>t-value</i>	<i>P value</i>
	<i>Yes</i>		<i>No</i>			
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
Factors influencing NPD in fabrication industry	57.52	4.78	56.22	5.99	2.476	0.0040**
Barriers in NPD	37.27	6.51	34.70	7.91	3.657	0.000**
Success Factors of NPs	37.92	5.68	36.09	6.30	3.091	0.002**

Since p value is less than 0.01, the null hypothesis, There is no significant difference between the Perceptions of employees from the companies having and not having NPD department with prototype testing technology with regard to factors influencing NPD, barriers in NPD and success factors of New products in fabrication engineering industries in the sample is rejected at 1% level of significance. Hence, it is concluded that, there is a highly significant difference between the Perceptions of employees from the companies having and not having NPD department with prototype testing technology with regard to factors influencing NPD, barriers in NPD and success factors

of new products in fabrication engineering industries in the sample. Based on the mean value, it is noted that, companies having NPD department with proto testing facilities are highly endorsed for the factors influencing new product development, barriers in new product development and success factors of new products in fabrication engineering industries in the sample. It may be due to direct experience with the proto models and testing the various designs before finalizing the new product for commercialization. Other companies too can have such facilities for improving the performance in new product development.

Relationship between the Firm’s Experience and the Perceptions on motives for new product development, strategies adopted in NPD, factors influencing NPD, barriers in NPD and success factor so f NPs in fabrication engineering industries in the sample.

Null Hypothesis: There is no relationship between firm’s experience and the Perceptions on motives for new product development, strategies adopted in NPD, factors influencing NPD, barriers in NPD and success factor so f NPs in fabrication engineering industries in the sample.

Table 11
Relationship between the Firm’s Experience and the Perceptions on motives for new product development, strategies adopted in NPD, factors influencing NPD, barriers in NPD and success factor so f NPs in fabrication engineering industries in the sample

		<i>Firm’s Experience in NPD in years</i>					<i>F value</i>	<i>P value</i>
		<i>Below 5</i>	<i>5-10</i>	<i>10-15</i>	<i>15-20</i>	<i>Above 20</i>		
Motives for new product development	Mean	55.82	56.89	56.54	58.53	59.29	7.039	0.000**
	SD	(5.89)	(3.89)	(4.04)	(4.00)	(6.14)		
Strategies adopted in NPD	Mean	37.01	37.59	37.07	37.09	39.38	2.308	0.057*
	SD	(6.59)	(4.90)	(4.77)	(4.93)	(6.83)		
Factors influencing NPD	Mean	36.41	37.06	37.56	37.47	40.08	5.833	0.000**
	SD	(6.23)	(4.85)	(4.64)	(5.38)	(5.65)		
Barriers in NPD	Mean	34.70	37.05	36.63	37.64	37.90	3.788	0.005**
	SD	(7.64)	(6.10)	(6.16)	(6.53)	(7.78)		
Success factors of NPs in fabrication industry	Mean	36.40	36.89	37.80	37.81	39.16	3.115	.015*
	SD	(6.34)	(5.34)	(4.88)	(4.96)	(6.76)		

It is observed from the table 11, that, the p value is less than 0.01, for the hypothesis, There is no relationship between firm’s experience and the Perceptions on motives for new product development, strategies adopted in NPD, factors influencing NPD, barriers in NPD and success factors of NPs in fabrication engineering industries in the sample. Hence, the hull hypothesis, , There is no relationship between firm’s experience and the Perceptions on motives for new product development, strategies adopted in NPD, factors influencing NPD, barriers in NPD and success factors of NPs in fabrication engineering industries in the sample is rejected at 1% level of significance. Based on the mean value, it is noted that, the firms with above 20 years of experience are highly

agreed the fact that, the impact of various factors influencing new product development, strategies adopted, motives for new product development, barriers in new product development and success factors of new products in the fabrication industry in the sample. This may be due to experience in dealing with new product development for many years at different projects. Firm's experience is a think tank and knowledge capital to the team and new product development is easy in such scenario. Hence, companies should take up new product design and development for the effective skill development of the employees in new product design and to have the sustainable growth of the firm.

SUMMARY AND CONCLUSION

The firm features influences the new product decisions in fabrication industry to a greater extent. It is due to involvement of Money, investment, risk and associated factors of business and its continuity. A single product failure can lead to a financial crunch in the firm. Hence, top management can reserve the idea of new product development based on the capacity and investment attitude on risk projects. Hence, size of the firm, experience in new product development, management attitude, NPD practices are significantly affecting the new product development practices of the firm in the sample. Hence, it is concluded that firm characteristics influences the new product development practices in fabricating engineering industries.

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