Role of Technological Innovativeness in the Manufacturing Performance of Indian SMEs

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Abstract Technological innovativeness is one of the most important dimensions of a firm's overall innovativeness, as they look for global competitiveness. This study deployed a survey questionnaire to investigate the role of technological innovativeness in the manufacturing performance of the Indian SMEs. The study also explored various parameters associated with customer orientation, technology orientation, technological alliances, product and process innovativeness of the firms. It was found that SMEs in India have started exploring the latest developments related to technology in their particular sectors, which is one of the good indicators of them having acquired technological innovativeness. Technological innovativeness in this context has in fact increased significantly. The study also found that the majority of the SMEs have reported incremental innovations. The study further revealed that the Indian SMEs give topmost priority to quality in the context of manufacturing performance, product uniqueness and customer orientation.

Keywords Technological innovativeness · Technology orientation · Manufacturing performance

1 Introduction

Innovativeness is the key enabler for survival and growth of any firm involved in manufacturing and related activities [1]. Extant literature in the area shows that it is important to understand the current scenario of technological innovativeness and manufacturing performance in India, especially as its presence in the SMEs still remains unexplored to a large extent. It is also important to understand and

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explore various enablers of technological innovativeness, which include customer orientation, technology orientation and technological alliances. Product and process innovativeness are also very important and are needed for a better manufacturing performance. “Make in India” initiative at the national level is expected to improve technological innovativeness of SMEs and many Indian SMEs have also started making entries into new markets. A deeper understanding is therefore required to know as to how the SMEs reposition themselves in competitive markets, by making changes in their technological capabilities, in spite of their financial constraints. SMEs now have been given much more importance by the governments and the research institutions, because of their technological capabilities. It is also known that many special schemes have been launched recently for the benefit of SMEs in India.

2 Literature Review

Technological innovativeness is the extent to which, the new technologies are incorporated in a new product [2]. There are few studies that have been conducted on two basic dimensions of innovativeness, i.e., organizational innovativeness and technological innovativeness [3, 4].

Strategic alliances are defined as voluntary agreements between firms involved in any exchange, sharing or co-development of products, technologies or services [5]. Alliances are the need of hour, as many OEMs and SMEs in India are in the process of making alliances, considering the current industrial and economic scenario.

A technology-oriented firm can be defined as a firm, with the ability and the will to acquire a substantial technological background and then use it in the development of new products [6]. Technology monitoring and technology adoption are two important dimensions of technology orientation [7]. Technology orientation is more important than the customer orientation in explaining product newness to customers [8]. Technology-orientated firms promote openness to new ideas that use the state of art technologies [9]. Technology orientation plays an important role in the development of innovation capabilities [10].

Customer orientation is one of the most important dimensions of what is broadly the market orientation of firms. Customer orientation is defined as the set of beliefs, that give priority to customer’s interest first, but keeping in mind not to exclude all other stakeholders of the firm [11]. Studies have found that the customer orientation has a positive effect on SME’s performance [12].

There are three important dimensions of product innovativeness, which include newness to the firm, newness to the customer and new product uniqueness [13]. Product innovativeness consists of having incrementally new products, moderately innovative products and really new products [14]. Process innovativeness captures the introduction of new production methods, new management approaches and new technologies [15]. This study has considered the Manufacturing aspect of the firm performance, especially in the context of Indian SMEs. Manufacturing performance is a key

determinant in the firm's success [16]. The important dimensions of manufacturing performance are quality, cost, flexibility and delivery [17–20].

3 Research Methodology

In order to achieve the basic research objectives, a survey instrument was developed with the help of relevant literature review and expert's guidance. The first part consisted of the general profile of the SMEs, which included name, year of establishment, number of employees and sector type. The respondents' profile included name, designation, qualification, experience and contact information. The second part consisted of parameters associated with the technological innovativeness and firm performance. There were a total of nine constructs considered in the survey instrument and a total of 42 items, measuring different constructs. The measuring items for the constructs were identified with the help of an elaborate literature review. Previously tested and established scales were used in the research.

Likert-type scales were used to measure technological innovativeness, technological orientation, process innovativeness, product newness to customer, product uniqueness and customer orientation. Technological alliances and manufacturing performance were measured using the ordinal scale. Product newness to firm was measured using the binary scale.

In this study, SMEs were randomly selected from the database available in the business directory. Prior appointment was taken as per the availability and convenience of the respondents. A covering letter, addressing the purpose and importance of the study, was provided to the respondents. Around 78 SMEs were selected for the study, of which 28 refused to answer, because of their busy schedule. The responses were received from 50 manufacturing SMEs, ensuring a response rate of 64%.

The responses collected were analyzed for descriptive statistics and reliability analysis for the constructs under consideration.

4 Results and Discussion

The study reported respondent's profile, which included their designation, qualifications and SMEs profile. The details of the respondent's designation are given in Table 1. The respondents with different designation in the study consisted of 46% managing directors, 10% CEOs, 28% design heads/engineers and 16% marketing/sales head. Table 2 describes the qualification of the respondents. Majority of the respondents were 34% graduate engineers, 28% are postgraduates, 30% are diploma holders, 6% are SSC and 2% under school level. Table 3 describes the profile of the SMEs. The study sample comprised of 34% plastic mold manufacturers, 28% machine manufacturers, 8% plastic products, 8% equipment manufacturers, 4% rubber, 4% chemical, 4% metal and others 10%.

Table 1 Respondents designation

Designation	No.	%
C.E.O.	05	10
Managing director	23	46
Design/head engineer	14	28
Marketing/sales head	08	16

Table 2 Respondents qualification

Qualification	No.	%
Postgraduate	14	28
Graduate	17	34
Diploma	15	30
SSC	03	06
Under SSC	01	02

Table 3 SMEs profile

Type	No.	%
Plastic molding	17	34
Machine manufacturers	14	28
Plastic products	04	08
Equipment manufacturers	04	08
Rubber products	02	04
Chemical	02	04
Metal	02	04
Others	05	10

The constructs under consideration were analyzed using SPSS software for its internal consistency. Further, it was observed that the Cronbach alpha value for the technological alliances construct was less than 0.6. This indicated that the scale for this construct was not reliable. The value of Cronbach alpha for other constructs ranged from 0.632 to 0.891, indicating that the items representing the constructs were highly reliable. The reliability measures of the constructs are shown in Table 4. The values of the corrected item to total correlation for all the items of the reliable constructs were more than 0.3, indicating the acceptability level. Among the constructs under the study, product uniqueness was the most important aspect, having the mean value of 37.06, which ranked among the first. Process innovativeness stood at the second position with the mean value of 28.04. All other constructs followed the next positions in that order. Also, the subcriteria of the constructs under consideration were studied in detail. Table 5 shows the item statistics for product uniqueness. The maximum mean value was 6.47 for higher quality. This indicated that the product's higher quality was being considered as most important dimension in the context of product uniqueness.

Table 4 Reliability measures

Sr. No.	Construct	Items	Cronbach alpha	Mean	Standard deviation
1	Product uniqueness	06	0.89	37.06	4.57
2	Process innovativeness	05	0.88	28.30	5.15
3	Technological orientation	05	0.80	28.04	4.21
4	Customer orientation	04	0.78	24.63	3.31
5	Technological innovativeness	05	0.79	19.92	2.66
6	Manufacturing performance	04	0.63	16.19	2.18
7	Product newness to customer	04	0.87	7.50	5.59
8	Product newness to firm	01	NA	0.14	0.35

Table 5 Item statistics for PU

Subcriteria	Mean	Std. deviation
MPP	5.97	0.97
UNI	6.10	1.03
MU	6.12	0.91
HQ	6.47	0.74
ST	6.10	1.01
MCN	6.27	0.96

Table 6 shows the item statistics for technology orientation with the highest mean value of 5.90, indicating that the policy of Indian manufacturers has been to consider the most updated technology available in the market. Table 7 shows that the highest mean value for the subcriteria of process innovativeness was 5.92, indicating that the technology of the main machinery in use was updated. As shown in Table 9, the highest mean value of the subcriteria for the technological innovativeness was 4.30, indicating that the SMEs gave priority on exploring the technological developments

Table 6 Item statistics for TO

Subcriteria	Mean	Std. deviation
UPT	5.90	1.03
NME	5.78	1.01
NPD	5.40	1.26
BQS	5.34	1.13
CC	5.62	1.17

Table 7 Item statistics for PI

Subcriteria	Mean	Std. deviation
MM	5.92	1.17
MP	5.52	1.38
PM	5.50	1.19
FIP	5.68	1.20
FIM	5.68	1.23

in their respective sector. The maximum mean value of the subcriteria for customer orientation was 6.48 as shown in Table 8. It indicated that most of the firms use information from customers to improve their product quality.

The maximum mean value of the subcriteria of manufacturing performance was 4.38, which indicated that the manufacturers gave more priority to the quality of product compared to their competitors (see Table 10). The maximum mean value of the subcriteria for product newness to customer was 2.16, as shown in Table 11, indicating that the customer does not require much effort in using the product. 62% of the SMEs are having products of higher quality. 40% of the SMEs have technology of their core machinery updated. 70% of them uses information from customer to enhance product quality. 56% agreed that the customers do not require major learning

Table 8 Item statistics for CO

Subcriteria	Mean	Std. deviation
OP	6.32	1.00
PQQ	6.48	0.86
DNP	6.14	1.04
CCC	5.67	1.28

Table 9 Item statistics for TI

Subcriteria	Mean	Std. deviation
INV	3.72	0.78
EMPT	3.86	0.80
ATD	3.76	0.74
ETI	4.28	0.67
ETDI	4.30	0.58

Table 10 Item statistics for MP

Subcriteria	Mean	Std. deviation
PQ	4.38	0.63
CEE	3.92	0.87
PDPP	4.30	0.73
PPF	4.32	0.86

Table 11 Item statistics for PNC

Subcriteria	Mean	Std. deviation
LEE	2.16	1.77
PA	2.04	1.80
PC	1.76	1.49
PNN	1.54	1.43

effort in using their product. 46% of the SMEs' product quality was better than the average compared to that of their competitors. 40% of the firms investigated new trends and technologies. 58% of them were seen to be exploring technological developments in their respective industries. 52% of them have adopted technologies available in the market. 54% of them gave importance to technological innovation. 86% of them reported incremental innovation and 14% radical innovation. Table 12 shows the KMO and Bartlett's test of Sphericity of the constructs. The Bartlett's test indicates that all the constructs under consideration are significant ($p < 0.05$). The KMO value ranged from 0.693–0.849 and was greater than 0.5, for all the constructs mentioned above. Both the tests indicated suitability of the constructs for further process.

As discussed above, there are four dimensions of manufacturing performance, and in each of these dimensions, technological innovativeness has a different role to perform. Study shows that the Indian SMEs improve their product quality by using information from the customer. Customer orientation is one of the enablers for technological innovativeness. As the study shows, the role of technological innovativeness here was by adopting a technology, for example, an Advanced CNC Milling machine, which could produce a precision machined component. Here, the technology adoption rate of precision manufacturing machine was one of the indicators

Table 12 KMO and Bartlett's test of sphericity

Sr. No.	Constructs	KMO	Bartlett's significance value (p)
1	Product uniqueness	0.849	0.000
2	Process innovativeness	0.763	0.000
3	Technological orientation	0.707	0.000
4	Customer orientation	0.721	0.000
5	Technological innovativeness	0.773	0.000
6	Manufacturing performance	0.693	0.001
7	Product newness to customer	0.774	0.000

for technological innovativeness. Product uniqueness in terms of different aspects of quality would also lead to a better performance. However, design innovativeness was also very important as to how many times firms make changes in the design, compared to their competitors to improve the quality of the product.

Cost is considered one of the important aspects of manufacturing performance and is always compared with that of the competitors. Cost of the product varies according to the type of market targeted to sell the product. In certain cases, it was observed that there is no need to invest in proprietary technology, not even adopt technologies, SMEs could outsource some of the parts. Cost also differs according to the quality and design of the product.

Technological innovativeness plays a very important role, when it comes to delivering the product on time. Firm has to identify as to which activity takes more time. For example, how frequently the firm makes changes in the quality inspection techniques to reduce time? Another way of addressing this is by knowing how frequently the firm make changes in the design for assembly to reduce the time of assembly.

Volume flexibility is the context in which, technological innovativeness can be addressed by measuring how frequently the firm makes changes in their machineries to vary production volumes. As far as the product flexibility is concerned, firm's emphasis on technological innovation plays a very important role. It can be measured by knowing, how frequently the firm makes changes in the product mix for better performance.

5 Conclusion

In this study, an attempt was made to explain the role of technological innovativeness in the manufacturing performance of the SMEs. Technological innovativeness is quality driven in Indian SMEs. Majority of the SMEs under study were recognized by the OEMs for better product quality. It was observed that the product innovation is incremental in nature but contributes considerably to the manufacturing performance.

SMEs are seen investigating new trend and technologies, which would definitely help to improve their technological innovativeness. The study also found that the Indian SMEs give first priority to quality and this is a change widely observed. This change is very important from a global competitiveness point of view and is in line with government initiatives in specific sectors.

The results obtained are based on a small sample size; however, it was important that the current scenario of technological innovativeness was explored, which could form the basis for further investigation. Further research could also focus on sector-specific role of technological innovativeness in the context of manufacturing performance.

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