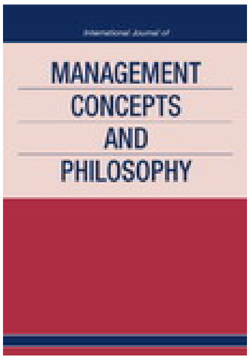


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# Strategic impact of technological competencies on manufacturing performance of Indian manufacturing industries

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# Strategic impact of technological competencies on manufacturing performance of Indian manufacturing industries

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**Abstract:** Technological competencies have long been recognised as essential for establishing a competitive edge in the market by quickly adapting to changing opportunities. This paper presents an insight into technological competencies and their impact on manufacturing performance. The survey and quantitative data analysis of the Indian manufacturing industry in the northern region is the focus of this paper. The data for this study was gathered by a questionnaire survey, and then analysed using several methods. The organisation's turnover, the number of employees working, and the company's market share were the main demographic characteristics analysed. An analysis of variance significant level was drawn using the chi squared test. Quantitative approaches such as correlation analysis and multiple linear regression analysis were utilised to identify the factors that have a greater impact on organisational performance.

**Keywords:** technological competency; ANOVA; multiple linear regression.

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## 1 Introduction

The study of competences has recently gained a lot of theoretical interest (Danneels, 2007; Martín-Rojas et al., 2011; Real et al., 2006), where competence is defined as the capacity to apply knowledge and abilities in a variety of situations (Singh and Kaur, 2021). Competency encompasses comprehension, critical thinking and judgment, all together and considers the social elements of the tasks to be performed (De los Ríos-Carmenado et al., 2015). Competency is the ability and preparedness of an individual to behave successfully and self-organised when confronted with unexpected, unstructured, or difficult events or tasks, as well as the ability to find solutions for future scenarios (Kinkel et al., 2017). The fact that establishing employee competencies in a manufacturing firm allows for swift problem solving and continual improvement throughout the whole production process emphasises the relevance of competencies in the production branch (Hertle et al., 2015; Vu and Nwachukwu, 2021).

Technology was chosen as a competency area because it has shaped humanity's history for centuries. Technology, in conjunction with the right application of that knowledge, allows for higher-quality and faster product (Grunwald and Achternbosch, 2013). Technology is extremely important in driving commercial prospects and growth in a country's economy. But the technologies are not used effectively. Due to this most of the time firms cannot take profit as they can by utilising technology in efficient manner (Danneels, 2007). Technologies, in particular, may require additional development before they can be integrated into the existing manufacturing system (Azhar and Subramanian, 2022). As a result, firms must change their resources, competencies, to match the technology. To keep pace with the technological advancement is the need of the hour for the survival in the global market. For outstanding performance of the firm than its rivals in the market, it must accept and make use of difficult technologies which cannot be imitated by the competitors. For the growth of new product in the market, one should keep on upgrading the existing technologies gradually which can result in a unique concept of making a new product (Gërguri-Rashiti et al., 2017). Moreover, the industry's technical knowledge and the usage of technology seem to be analytical in delivering the authentic product to the market which adds to the performance of the firm. The manufacturing firms which use latest technology tend to deploy new strategies to innovate superior product designs to gain an advantage over others in the market (Sehgal et al., 2021).

As a result, technological competencies have long been recognised as essential for establishing a competitive edge in the market by quickly adapting to changing opportunities (Martín-Rojas et al., 2013; Prahaland and Hamel, 1990). In order to generate sources of competitive advantage, a firm utilises resources. These resources are used to create products and services that are beneficial to customers. The resources have to be useful and unmatchable for better outcome of the firm due to which the firm's performance can be enhanced (Barney, 1991). It is also worth noting that a single resource can handle a wide range of services; in other words, resources are fungible. The replication of the optimum resources is expensive which implies that it is difficult for competitor to imitate exact process of making the product (Barney and Hesterly, 2010). The resources are frequently underutilised, and each firm has accumulated a huge number of underused productive services; the known productive services inherent in a resource do not leverage the resource's full potential at any given time (Freitag and de Oliveira, 2021). A technological competency, defined as a collection of technology resources, can, for example, deliver a variety of services. The acquisition of key resources and the integration of knowledge from other sources may be facilitated by technological competence (Baert et al., 2016).

## 2 Literature review

In recent years, the concept of competence has been extensively researched in the field of technology (Hafeez et al., 2002; Prahaland and Hamel, 1990; Sanchez and Heene, 1997). For a company's technical competency to grow, it needs a wide range of technological resources and capabilities (Dosi, 1982; Miyazaki, 1995; Prahaland and Hamel, 1990). One of the most pressing problems for small and medium-sized businesses, particularly those in the manufacturing sector, is determining technological competency. Main purpose of review is to gain in depth knowledge of origin and effects of technological competencies related to manufacturing field.

Technology is a world of continuous development and evolutions that is becoming more of a staple in our everyday lives (Singh and Kaur, 2021). It is recognised that if technology is used in an efficient manner then firm can attain better performance. For this, technological competencies play an important role (Gupta and Barua, 2018).

According to the researchers, technological competence development is one of a firm's most important dynamic capacities, involving the learning of new knowledge, the identification of possibilities, and the discovery of new ways to rearrange a firm's direct and indirect resources. When a company begins to adopt a value-creating strategy that uses resources that are not being used by any other existing or potential competitor, it is seen to have a competitive edge (Oztemel and Ozel, 2019). The degree of competitiveness of an industry is directly related with the adoption of an innovation by a firm (Frambach et al., 1998). Initially, the firms have a certain level of technological expertise, which is based on a thorough knowledge of science and technology (Deeds et al., 2000). Investing in technological competency is crucial for accumulating knowledge, assisting in the generation and exploitation of innovation opportunities, and growing a company's potential to succeed with innovation (Martín-Rojas et al., 2013, 2017). Manufacturing firms adopting a technologically focused strategy have higher turnover and are more difficult to copy. Firms that do not acknowledge technological advancement have faced tough competition. In order to attain maximum competitive advantage, a firm may struggle to establish complete alignment [World Trade Organization and Temasek Foundation Centre for Trade & Negotiations (TFCTN), 2013]. Technology competencies are necessary for manufacturing firms but they have to face different types of obstacles to adopt these technologies in the firm. As a result, businesses must develop resources, capabilities, competences, and core competencies for each technology (Deuse et al., 2015). Using technology, SMEs demonstrate long-term growth and performance and they must put a priority on their ability to evaluate technology requirements for greater productivity and efficiency (Rahman et al., 2016). Small firms are regarded to be the secret to their success because they employ technology to innovate, providing them a competitive edge in the industry (Chege et al., 2019).

The technology competence plays a favourable role in technological diversification and finds the relationship between technological diversification and firm growth. For organisations to properly manage and leverage technological diversification for growth, technology competency is required (Kim et al., 2016). The association between technological competencies variables such technical capability, firm innovativeness, and management consulting firms' business success was established by a survey questionnaire among owners of professional small and medium size firms. According to the regression models, technological capability is the most important factor that influences business performance, followed by e-business practises and corporate innovation. As a result, technical capability is the most important predictor of commercial performance for all sorts of businesses (Ainin et al., 2010). The technology management capability (TMC) has a strong impact on NPD performance, demonstrating that it is a vital capability to incorporate in a company's product creation process (Wu et al., 2018).

Firms that value innovation are more likely to encourage the use of new technology (Anandarajan et al., 2002). The relation between innovation and company performance has been extensively studied, with numerous studies indicating a positive and significant association between the variables (Birkner and Máhr, 2016). Entrepreneurs should design creative tactics to materialise corporate success, according to the report (Chege et al., 2019). It has been noted that firms and governments are shifting their investments into new and emerging technology in order to provide circumstances for the advancement of local innovation to increase their global competitiveness and ensure their survival (Chattopadhyay and Bhawsar, 2017). Government policy should concentrating on the development of ICT infrastructure, encouraging SMEs' technical externalities within the industry, to help SMEs perform better. Top management is considered as most influential in the firm when it comes to adopt a technology to meet the needs of the current market An attempt was made to examine at how technological competence and management assistance can help a company implement ubiquitous customer relationship management improve its business performance (uCRM). The findings demonstrate that technology expertise and leadership support can assist an uCRM-dependent company achieve better business outcomes (Chatterjee et al., 2019).

From above review it is confirmed that competencies have good effect on the firms or organisations if these are used in an efficient manner. But technological competencies can do better for the manufacturing firms to survive in the present competitive scenario. So the main purpose of the study is to find several sources of a company's technology competences and their impact on manufacturing performance in Indian companies.

## 3 Demographic profile

Prior to interpretation of responses obtained during survey are elaborated, it is appropriate to get summary of demographic analysis used by marketers since it has an influence on the generalised views impact of technological competencies on Indian manufacturing industries' performance in terms of manufacturing. The following is the distribution of respondents based on several demographic variables:

### *3.1 Turnover*

Table 1 shows that data has been collected from Punjab, Himachal Pradesh, Haryana, and other states. Companies have been split into four categories based on their turnover. According to 'turnover,' the first category is 10 crores, the second is 10 to 50 crores, the third is 50 to 100 crores, and the fourth is more than 100 crores. Punjab has received 67 responses, with 07, 23, 30, and 07 falling into the first, second, third, and fourth categories, respectively. From Himachal Pradesh, 25 responses were collected, with 03, 05, 08, and 09 falling into the first, second, third, and fourth categories, respectively. From Haryana, 43 responses are calculated, with 07, 08, 10, and 18 falling into the first, second, third, and fourth categories, respectively. From other states, 32 responses are collected, with 05, 07, 09, and 11 corresponding to the first, second, third, and fourth categories. On the whole in first category (<10 crores) there are 22 industries in Punjab, Haryana, Himachal and other states whose response have been collected. In second category (10–50 crores) data have been collected from 43 industries. In third category (50–100 crores) there are 57 industries and in fourth category (>100 crores) data have been collected from 45 industries. In total, from Punjab, Himachal, Haryana and other states 40.11%, 14.97%, 25.74% and 19.16% data collected, respectively.

#### *3.1.1 Chi-square test*

The observed and expected cell totals, as well as the chi square statistics, for each cell displays in the contingency Table 2. The chi square statistic for the cells above is 19.95, with a p-value of 0.0181. The results are significant because the p-value is less than 0.05, and there is minimal difference in respondents' perspectives, despite the fact that they are from different states.

**Table 1** Comparison of state-wise turnover

| *Turnover (state-wise)* | *<10 crores* | *10–50 crores* | *50–100 crores* | *>100 crores* | *Grand total* | *Percentage* |
|---|---|---|---|---|---|---|
| Punjab | 07 | 23 | 30 | 07 | 67 | 40.11% |
| Himachal | 03 | 05 | 08 | 09 | 25 | 14.97% |
| Haryana | 07 | 08 | 10 | 18 | 43 | 25.74% |
| Others | 05 | 07 | 09 | 11 | 32 | 19.16% |
| Total | 22 | 43 | 57 | 45 | 167 | 100% |

**Table 2** Contingency table

| *State wise turnover* | *<10 crores* | *10–50 crores* | *50–100 crores* | *>100 crores* | *Row total* |
|---|---|---|---|---|---|
| Punjab | 7 (8.83) [0.38] | 3 (3.29) [0.03] | 7 (5.66) [0.31] | 5 (4.22) [0.15] | 22 |
| Himachal | 23 (17.25) [1.92] | 5 (6.44) [0.32] | 8 (11.07) [0.85] | 7 (8.24) [0.19] | 43 |
| Haryana | 30 (22.87) [2.22] | 8 (8.53) [0.03] | 10 (14.68) [1.49] | 9 (10.92) [0.34] | 57 |
| Others | 7 (18.05) [6.77] | 9 (6.74) [0.76] | 18 (11.59) [3.55] | 11 (8.62) [0.66] | 45 |
| Column total | 67 | 25 | 43 | 32 | 167 (grand total) |

### *3.1.2 Evaluation of variance results*

Table 3 shows four distinct states that is Punjab, Haryana, Himachal and other states. In these states there are four categories in which the industries are divided which are represented by N.

Furthermore, Table 4 illustrates the findings that have been taken from ANOVA (f-test and p-value). Table 4 reveals that the calculated value of F is determined to be 1.028352 with a p-value of 0.414689, which is less than the value in the table 3.490295 at the 5% level with df being $v_1 = 3$ and $v_2 = 12$ and as a result, it is possible that it happened by chance. The null hypothesis, that there is no change in means, is supported by this analysis. We can conclude that the difference in output due to variations is minor and purely coincidental.

**Table 3** Descriptive statistics

| *Groups* | *N* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Punjab | 4 | 22 | 5.5 | 3.666667 |
| Himachal | 4 | 43 | 10.75 | 68.25 |
| Haryana | 4 | 57 | 14.25 | 110.9167 |
| Others | 4 | 45 | 11.25 | 22.91667 |

**Table 4** One way ANOVA

| *Source of variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between groups | 158.6875 | 3 | 52.89583 | 1.028352 | 0.414689 | 3.490295 |
| Within groups | 617.25 | 12 | 51.4375 | C | | |
| Total | 775.9375 | 15 | | | | |

The conclusion said that the data results are statistically same as shown by chi-square and ANOVA, with a p-value of 0.018165 in the chi square test and a p-value of 0.414689 in the respective ANOVA. Furthermore, the data being non-significant at $p < 0.05$ revealed that the perspective of different respondent of different states is not much.

### *3.2 Number of employees*

The total number of employees received from various responders collected from different states is shown in Table 5. Division of employee is done according to their strength in industries. The first category includes 200 employees, the second category includes 201–500 employees, the third category includes 501–1,000 employees, and the fourth group includes more than 1,000 employees.

Sixty seven responses were gathered from Punjab, with 05, 24, 29, and 09 falling into the first, second, third, and fourth categories, respectively. From Himachal Pradesh, 25 replies were gathered, with 05, 05, 08, and 07 falling into the first, second, third, and fourth categories, respectively. Haryana provided 43 responses, with numbers 09, 07, 10, and 17 falling into the first, second, third, and fourth categories, respectively. Thirty two replies were obtained from other states, with 06, 07, 08, and 11 falling into the first, second, third, and fourth categories, respectively.

**Table 5** Comparison of number of employees

| *No. of employees* | *<200* | *201–500* | *501–1,000* | *>1,000* | *Row total* |
|---|---|---|---|---|---|
| Punjab | 05 | 24 | 29 | 09 | 67 |
| Himachal | 05 | 05 | 08 | 07 | 25 |
| Haryana | 09 | 07 | 10 | 17 | 43 |
| Others | 06 | 07 | 08 | 11 | 32 |
| Column total | 25 | 43 | 55 | 44 | 167 |

In total out of 167 organisations, 25 enterprises are having <200 employees, 43 enterprises are having 201–500 employees, 55 enterprises are having 501–1,000 employees and 44 companies are having >1,000 employees.

#### *3.2.1 Chi-square test*

The observed cell total, anticipated cell total and the chi-square statistic for each cell are all listed in the contingency table (Table 6). The chi-square statistic's p-value is 0.467786, and the chi-square statistic is 8.6751. At $p < 0.05$, the result is evident. As a result, the findings revealed that the perspectives of various respondents from different provinces or states are not very dissimilar.

**Table 6** Contingency table for number of employees

| *No. of employees* | *<200* | *201–500* | *501–1,000* | *>1,000* | *Row total* |
|---|---|---|---|---|---|
| Punjab | 5 (10.03) [2.52] | 5 (3.74) [0.42] | 9 (6.44) [1.02] | 6 (4.79) [0.31] | 25 |
| Himachal | 24 (17.25) [2.64] | 5 (6.44) [0.32] | 7 (11.07) [1.50] | 7 (8.24) [0.19] | 43 |
| Haryana | 29 (22.07) [2.18] | 8 (8.23) [0.01] | 10 (14.16) [1.22] | 8 (10.54) [0.61] | 55 |
| Others | 9 (17.65) [4.24] | 7 (6.59) [0.03] | 17 (11.33) [2.84] | 11 (8.43) [0.78] | 44 |
| Column total | 67 | 25 | 43 | 32 | 167 (grand total) |

### *3.2.2 Evaluation of variance results*

Punjab, Haryana, Himachal Pradesh, and other states are depicted in Table 7. The industries in these states are grouped into four categories, each indicated by the letter N.

**Table 7** Descriptive statistics for number of employees

| *Groups* | *N* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Punjab | 4 | 25 | 6.25 | 3.58333333 |
| Himachal | 4 | 43 | 10.75 | 78.9166667 |
| Haryana | 4 | 55 | 13.75 | 104.25 |
| Others | 4 | 44 | 11 | 18.6666667 |

The findings of a one way ANOVA are shown in Table 8. For each of the four groups, the number of items, mean (average), standard deviation, and standard error, as well as the ANOVA statistic for each cell, are all displayed.

**Table 8** One way ANOVA for number of employees

| *Source of variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between groups | 115.6875 | 3 | 38.5625 | 0.75091278 | 0.54257573 | 3.490295 |
| Within groups | 616.25 | 12 | 51.35417 | | | |
| Total | 731.93 | 15 | | | | |

The estimated value of F is 0.75091278 with a corresponding p-value of 0.54257573, which is less than the value in the table 3.490295 at the 5% level with df = 3 and $v_2 = 12$, and as a result, it is possible that it happened by chance. The null hypothesis, that there is no change in means, is supported by this analysis. We can conclude that the change in production owing to variety is negligible and purely coincidental.

Ultimately it is showed that the findings of data were exactly same as obtained by using chi-square and ANOVA. The data is not notable at $p < 0.05$ which means that the difference between the respondent of different province or state is not much.

### 3.3 Market share

Table 9 shows the comparison of market share according to the data that was collected from different states that is Punjab, Haryana, Himachal and other states. According to the data collected from Punjab, Haryana, Himachal and other states, market share of industries (state-wise) has been divided in to four categories where <20% 'market share' in first category, between 20–40% 'market share' in second category, between 40–60% 'market share' in third category and >60% 'market share' in fourth category.

**Table 9** Comparison of market share

| *State-wise market share (in percentage)* | *<20* | *20–40* | *40–60* | *60–100* | *Row total* |
|---|---|---|---|---|---|
| Punjab | 06 | 22 | 29 | 10 | 67 |
| Himachal | 05 | 06 | 08 | 06 | 25 |
| Haryana | 07 | 05 | 13 | 18 | 43 |
| Others | 5 | 6 | 9 | 12 | 32 |
| Column total | 23 | 39 | 59 | 46 | 167 (grand total) |

Responses were obtained from 67 industries in Punjab. 06, 22, 29, and 10 fall within the first, second, third, and fourth categories, respectively, of these responses. From Himachal Pradesh, 25 replies were gathered, with 05, 06, 08, and 06 falling into the first, second, third, and fourth categories, respectively. From Haryana, 43 replies were gathered, with 07, 05, 13, and 18 falling into the first, second, third, and fourth categories, respectively. Other states provided 32 replies, with 05, 06, 09, and 12 falling into the first, second, third, and fourth categories, respectively.

Overall 167 are surveyed and out of these companies 23 companies are having <20% 'market share', 39 companies are having 20–40 'market share', 59 companies are having 40–60% 'market share' and 46 companies are having >60% market share.

#### 3.3.1 Chi-square test

The observed cell total, anticipated cell total and the chi-square statistic for each cell are all listed in the contingency table (Table 10).

The chi-square statistic has a p-value of 0.03614 and a chi-square statistic of 17.9171. The finding is significant at $p < 0.05$, showing that there is minimal variance in the perspectives of different respondents from different states.

**Table 10** Contingency table for market share

| *Market share* | *<20* | *20–40* | *40–60* | *60–100* | *Row total* |
|---|---|---|---|---|---|
| Punjab | 6 (9.23) [1.13] | 5 (3.44) [0.70] | 7 (5.92) [0.20] | 5 (4.41) [0.08] | 23 |
| Himachal | 22 (15.65) [2.58] | 6 (5.84) [0.00] | 5 (10.04) [2.53] | 6 (7.47) [0.29] | 39 |
| Haryana | 29 (23.67) [1.20] | 8 (8.83) [0.08] | 13 (15.19) [0.32] | 9 (11.31) [0.47] | 59 |
| Others | 10 (18.46) [3.87] | 6 (6.89) [0.11] | 18 (11.84) [3.20] | 12 (8.81) [1.15] | 46 |
| Column total | 67 | 25 | 43 | 32 | 167 (grand total) |

### *3.4 Evaluation of variance results*

Table 11 depicts four distinct states: Punjab, Haryana, Himachal Pradesh, and others. The industries in these states are grouped into four categories, each indicated by the letter N.

**Table 11** Descriptive statistics for market share

| *Groups* | *N* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Punjab | 4 | 23 | 5.75 | 0.916667 |
| Himachal | 4 | 39 | 9.75 | 66.91667 |
| Haryana | 4 | 59 | 14.75 | 94.91667 |
| Others | 4 | 46 | 11.5 | 25 |

There are four categories in Punjab based on the market share of the companies. The first category has a market share of less than 20%, the second category has a market share of 20–40%, the third category has a market share of 40–60%, and the last category has a market share of 60–100%. There are four categories in Haryana, Himachal Pradesh, and other states, same as there are in Punjab.

From Table 12, the obtained ANOVA (f-test and p-value) statistics between the four groups and within each group are 1.197958 F-statistic value and 0.352201 p-value, both of which are less than the tabular value of 3.490295 at the 5% level with df being $v_1 = 3$ and $v_2 = 12$, and so may have occurred by chance. Between the four groups, there is no statistically significant difference, as indicated by the p-value of $<0.05$. The chi-square test, in fact, yielded comparable results.

**Table 12** One way ANOVA for market share

| *Source of variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between groups | 168.6875 | 3 | 56.22917 | 1.197958 | 0.352201 | 3.490295 |
| Within groups | 563.25 | 12 | 46.9375 | | | |
| Total | 731.9375 | 15 | | | | |

## 4 Cronbach alpha reliability test

Cronbach alpha is a criterion for evaluating the internal consistency of different variables, or how near they are to one another. The consistency coefficient determines the parameter's reliability (reliability) (Singh et al., 2021). Cronbach's coefficient alpha ranges from 0 to 1. It is considered excellent if the value is greater than 0.9; good if the value is 0.8; acceptable if the value is 0.7; questionable if the value is 0.6; poor if the value is less than 0.5; and unacceptable if the value is less than 0.5 (Cronbach and Shavelson, 2004). The study included a total of ten components, including inputs and outputs. The first six factors chosen for the study are regarded input factors, while the remaining four are considered output factors. Responses to these factors came from a variety of industries, and Cronbach alpha was calculated using SPSS. The coefficient for the entire questionnaire is 0.988, as indicated in Table 13. The internal consistency coefficient for this value is in the excellent range.

**Table 13** Cronbach alpha reliability index of questionnaire

| | |
|---|---|
| Value of Cronbach alpha for overall questionnaire | 0.988 |

## 5 Correlation analysis

The correlation analysis technique is used to assess the link between two variables measured on the same scale (Singh et al., 2021). Only combinations with a Pearson correlation higher than or equal to 50% are regarded to have a strong relationship (Singh and Ahuja, 2014). Table 14 shows the Karl Pearson matrix with 0.05 significance levels.

**Table 14** Karl Pearson correlation matrix

| | | *Outputs* | | | |
|---|---|---|---|---|---|
| | | *y1* | *y2* | *y3* | *y4* |
| Inputs | x1 | 0.709 | 0.689 | 0.764 | 0.79 |
| | x2 | 0.674 | 0.579 | 0.678 | 0.671 |
| | x3 | 0.774 | 0.742 | 0.816 | 0.769 |
| | x4 | 0.713 | 0.583 | 0.779 | 0.767 |
| | x5 | 0.748 | 0.636 | 0.753 | 0.732 |
| | x6 | 0.691 | 0.565 | 0.68 | 0.662 |

Notes: y1 – strategic business performance, y2 – production capacity, y3 – quality, y4 – production, x1 – technological infrastructure, x2 – technology acquisition, x3 – technology capabilities, x4 – technology adoption, x5 – top management support, and x6 – information technology.
**correlation is significant at the 0.01 level (two-tailed).

$H_{01}$ There is no relation between technological infrastructure and the output parameters.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between technical infrastructure and all output metrics are significant and beneficial to the organisation. It can be deduced that the technical infrastructure has a substantial significant correlation with the parameters strategic business performance (r = 0.709), production capacity (r = 0.689), quality (r = 0.764), and production (r = 0.79).

$H_{02}$ There is no relation between technology acquisition and output parameters.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between technology acquisition and all output metrics are significant and beneficial to the organisation. It can be deduced that the technology acquisition has a substantial significant correlation with the parameters strategic business performance (r = 0.674), production capacity (r = 0.579), quality (r = 0.678), and production (r = 0.671).

$H_{03}$ There is no relation between technology capabilities and output parameters.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between technology capabilities and all output metrics are significant and beneficial to the organisation. It can be deduced that the technology capabilities has a substantial significant correlation with the parameters strategic business performance (r = 0.774), production capacity (r = 0.742), quality (r = 0.816), and production (r = 0.769).

$H_{04}$ There is no relation between technology adoption and output parameters.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between technology adoption and all output metrics are significant and beneficial to the organisation. It can be deduced that the technology adoption has a substantial significant correlation with the parameters strategic business performance (r = 0.713), production capacity (r = 0.583), quality (r = 0.779), and production (r = 0.767).

$H_{05}$ There is no relation between top management support and output parameter.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between top management support and all output metrics are significant and beneficial to the organisation. It can be deduced that the top management support has a substantial significant correlation with the parameters strategic business performance (r = 0.748), production capacity (r = 0.636), quality (r = 0.753), and production (r = 0.732).

$H_{06}$ There is no relation between information technology and output parameter.

The correlation matrix analysis revealed that the null hypothesis assumed above is not acceptable, as the correlations found between information technology and all output metrics are significant and beneficial to the organisation. It can be deduced that the information technology has a substantial significant correlation with the parameters strategic business performance (r = 0.691), production capacity (r = 0.565), quality (r = 0.68), and production (r = 0.662).

## 6 Regression analysis

For the development of regression weights, several linear analyses were employed. Table 15 indicates a t-value of 1.94 at a 5% level, with t-values higher than this indicating significant parameters in Tables 15–19.

### *6.1 Strategic business performance*

The findings of multiple linear regression for the dependent variable strategic business performance are shown in Table 15.

ANOVA analysis revealed F-test = 45.75, $p < 0.05$. The regression model created is significant. The investigation found the following predictors: x3 – technological capabilities technology adoption is x4; top management support is x5; and information technology is x6.

**Table 15** Multiple regression analysis for strategic business performance

| *Model summary* | | | | | | |
|---|---|---|---|---|---|---|
| *Model* | | *R* | *R-square* | *Adjusted R-square* | *Std. error of the estimate* | |
| 1 | | 0.795 | 0.632 | 0.618 | 0.09848 | |
| *ANOVA*[a] | | | | | | |
| *Model* | | *Sum of squares* | *df* | *Mean square* | *F* | *Sig.* |
| 1 | Regression | 2.663 | 6 | 0.444 | 45.759 | 0.000[b] |
| | Residual | 1.552 | 160 | 0.01 | | |
| | Total | 4.215 | 166 | | | |

| *Coefficients*[a] | | | | | |
|---|---|---|---|---|---|
| | *Unstandardised coefficients* | | *Standardised coefficients* | *t* | *Sig.* |
| | *B* | *Std. error* | *Beta* | | |
| Constant | 0.197 | 0.046 | | 4.273 | 0 |
| x1 | 0.116 | 0.134 | 0.105 | 0.864 | 0.389 |
| x2 | 0.053 | 0.102 | 0.053 | 0.518 | 0.605 |
| x3 | 0.36 | 0.115 | 0.383 | 3.137 | 0.002 |
| x4 | 0.099 | 0.119 | 0.219 | 2.828 | 0.049 |
| x5 | 0.277 | 0.139 | 0.196 | 1.988 | 0.047 |
| x6 | 0.102 | 0.071 | 0.129 | 3.012 | 0.015 |

Notes: [a]dependent variable: y1.
[b]predictors: (constant), x6, x2, x4, x3, x1, and x5.

## 6.2 Production capacity

For the dependent variable production capacity, Table 16 illustrates the multiple linear regression outcomes. ANOVA analysis revealed F-test = 41.639, $p < 0.05$. The regression model created was significant. Technological Infrastructure, x2 – technology acquisition, x3 – technology capabilities, x4 – technology adoption, and x5 – top management support are the predictors revealed by the investigation.

## 6.3 Quality

The outcomes of multiple linear regression for the dependent variable quality are shown in Table 17. ANOVA analysis revealed F-test = 62.964, $p < 0.05$. The regression model created is significant. x1 – technological infrastructure, x3 – technology capabilities, x4 – technology adoption, and x5 – top management support are the predictors identified by the investigation.

## 6.4 Production

The outcomes of multiple linear regression for the dependent variable Production are shown in Table 18. ANOVA analysis revealed F-test = 56.624, $p < 0.05$. The regression model developed is significant. x1 – technological infrastructure, x2 – technology acquisition, x3 – technology capabilities, x4 – technology adoption, and x5 – top management support are the predictors identified by the investigation.

**Table 16** Multiple regression analysis for production capacity

| *Model summary* | | | | |
|---|---|---|---|---|
| *Model* | *R* | *R-square* | *Adjusted R-square* | *Std. error of the estimate* |
| 1 | 0.781[a] | 0.61 | 0.595 | 0.08983 |

| *ANOVA*[a] | | | | | | |
|---|---|---|---|---|---|---|
| *Model* | | *Sum of squares* | *df* | *Mean square* | *F* | *Sig.* |
| 1 | Regression | 2.016 | 6 | 0.336 | 41.639 | 0.000[b] |
| | Residual | 1.291 | 160 | 0.008 | | |
| | Total | 3.307 | 166 | | | |

| *Coefficients*[a] | | | | | |
|---|---|---|---|---|---|
| | *Unstandardised coefficients* | | *Standardised coefficients* | *t* | *Sig.* |
| | *B* | *Std. error* | *Beta* | | |
| Constant | 0.27 | 0.042 | | 6.433 | 0 |
| x1 | 0.525 | 0.122 | 0.538 | 4.307 | 0 |
| x2 | –0.239 | 0.093 | –0.268 | –2.56 | 0.011 |
| x3 | 0.594 | 0.105 | 0.714 | 5.683 | 0 |
| x4 | 0.354 | 0.109 | 0.482 | 3.266 | 0.001 |
| x5 | 0.259 | 0.127 | 0.312 | 2.039 | 0.043 |
| x6 | –0.066 | 0.064 | –0.093 | –1.02 | 0.309 |

Notes: [a]dependent variable: y2.
[b]predictors: (constant), x6, x2, x4, x3, x1, and x5.

**Table 17** Multiple regression analysis for quality

| *Model summary* | | | | |
|---|---|---|---|---|
| *Model* | *R* | *R-square* | *Adjusted R-square* | *Std. error of the estimate* |
| 1 | 0.838[a] | 0.702 | 0.691 | 0.08460 |

| *ANOVA*[a] | | | | | | |
|---|---|---|---|---|---|---|
| *Model* | | *Sum of squares* | *df* | *Mean square* | *F* | *Sig.* |
| 1 | Regression | 2.704 | 6 | 0.451 | 62.964 | 0.000[b] |
| | Residual | 1.145 | 160 | 0.007 | | |
| | Total | 3.849 | 166 | | | |

Notes: [a]dependent variable: y3.
[b]predictors: (constant), x6, x2, x4, x3, x1, and x5.

As shown in Table 19, the roles of technological competency components in gathering strategic gains in competitive dimensions were investigated using multiple regression analysis. In the data, $R^2$ values are significantly higher, showing a strong link between implementation factors and competitive dimensions. The normal distribution of the data gathered from the surveys is represented by a Durbin Watson coefficient close to 2 and tolerance values >0.2 and VIF 5 indicates that there is no collinearity between implementation factors and competitive dimensions (Randhawa and Ahuja, 2018).

**Table 17** Multiple regression analysis for quality (continued)

| *Coefficients*[a] | | | | | |
|---|---|---|---|---|---|
| | *Unstandardised coefficients* | | *Standardised coefficients* | *t* | *Sig.* |
| | *B* | *Std. error* | *Beta* | | |
| Constant | 0.278 | 0.040 | | 7.033 | 0.000 |
| x1 | 0.240 | 0.115 | 0.228 | 2.091 | 0.038 |
| x2 | –0.154 | 0.088 | –0.160 | –1.751 | 0.082 |
| x3 | 0.503 | 0.098 | 0.560 | 5.109 | 0.000 |
| x4 | 0.253 | 0.102 | 0.319 | 2.474 | 0.014 |
| x5 | 0.076 | 0.120 | 0.185 | 1.992 | 0.043 |
| x6 | –0.005 | 0.061 | –0.007 | –0.091 | 0.928 |

Notes: [a]dependent variable: y3.
[b]predictors: (constant), x6, x2, x4, x3, x1, and x5.

**Table 18** Multiple regression analysis for production

| *Model summary* | | | | |
|---|---|---|---|---|
| *Model* | *R* | *R-square* | *Adjusted R-square* | *Std. error of the estimate* |
| 1 | 0.825[a] | 0.680 | 0.668 | 0.09106 |

| *ANOVA*[a] | | | | | | |
|---|---|---|---|---|---|---|
| *Model* | | *Sum of squares* | *df* | *Mean square* | *F* | *Sig.* |
| 1 | Regression | 2.817 | 6 | 0.470 | 56.624 | 0.000[b] |
| | Residual | 1.327 | 160 | 0.008 | | |
| | Total | 4.144 | 166 | | | |

| *Coefficients*[a] | | | | | |
|---|---|---|---|---|---|
| | *Unstandardised coefficients* | | *Standardised coefficients* | *t* | *Sig.* |
| | *B* | *Std. error* | *Beta* | | |
| Constant | 0.212 | 0.043 | | 4.975 | 0.000 |
| x1 | 0.557 | 0.124 | 0.510 | 4.506 | 0.000 |
| x2 | –0.202 | 0.095 | –0.203 | –2.141 | 0.034 |
| x3 | 0.270 | 0.106 | 0.290 | 2.549 | 0.012 |
| x4 | 0.233 | 0.110 | 0.283 | 2.116 | 0.036 |
| x5 | 0.005 | 0.129 | 0.205 | 1.939 | 0.047 |
| x6 | –0.027 | 0.065 | –0.034 | –0.409 | 0.683 |

Notes: [a]dependent variable: y4.
[b]predictors: (constant), x6, x2, x4, x3, x1, and x5.

Furthermore, Table 19 clearly demonstrates the importance of technological competency variables in the accumulation of considerable gains in respondent firms' performance indicators. So, on the basis of the above research four factors namely: x1 – technological infrastructure, x3 – technology capabilities, x4 – technology adoption, x5 – top management support, have been found as critical factors for strategic impact of technological competencies on manufacturing performance of manufacturing industries.

**Table 19** Multiple regressions of performance measures and input factors

| *Performance factor* | *Significant i/p factor* | *Beta value* | *t-value* | *p-value* | *R/R² value* | *F-value* | *Durbin-Watson* | *Tolerance* | *VIF* |
|---|---|---|---|---|---|---|---|---|---|
| y1 | x3 | 0.383 | 3.137 | 0.002 | 0.795/ 0.618 | 45.759 | 1.938 | 0.256 | 4.465 |
| | x4 | 0.219 | 2.828 | 0.049 | | | | 0.112 | 4.439 |
| | x5 | 0.196 | 1.988 | 0.047 | | | | 0.204 | 3.616 |
| | x6 | 0.129 | 1.449 | 0.015 | | | | 0.291 | 3.439 |
| y2 | x1 | 0.538 | 4.307 | 0.000 | 0.781/ 0.595 | 41.639 | 1.804 | 0.256 | 2.398 |
| | x2 | –0.268 | –2.560 | 0.011 | | | | 0.222 | 2.499 |
| | x3 | 0.714 | 5.683 | 0.000 | | | | 0.255 | 3.465 |
| | x4 | 0.482 | –3.266 | 0.001 | | | | 0.212 | 2.926 |
| | x5 | 0.312 | 2.039 | 0.043 | | | | 0.204 | 3.616 |
| y3 | x1 | 0.228 | 2.091 | 0.038 | 0.838/ 0.691 | 62.964 | 1.738 | 0.356 | 3.398 |
| | x3 | 0.560 | 5.109 | 0.000 | | | | 0.355 | 2.465 |
| | x4 | 0.319 | 2.474 | 0.014 | | | | 0.212 | 2.926 |
| | x5 | 0.185 | 1.632 | 0.043 | | | | 0.104 | 4.616 |
| y4 | x1 | 0.510 | 4.506 | 0.000 | 0.825/ 0.668 | 56.624 | 1.795 | 0.256 | 2.398 |
| | x2 | –0.203 | –2.141 | 0.034 | | | | 0.222 | 2.499 |
| | x3 | 0.290 | 2.549 | 0.012 | | | | 0.355 | 2.465 |
| | x4 | 0.283 | 2.116 | 0.036 | | | | 0.212 | 3.926 |
| | x5 | 0.205 | 1.939 | 0.047 | | | | 0.104 | 4.616 |

## 7 Conclusions

1. From the above study it has been concluded that the p-values obtained from demographic analysis of firms in different states are <0.05 level that means the data obtained is significant and there is not much difference between the perspectives of respondents despite they are from different states.
2. The correlation analysis shows that the results obtained are positively significant having positive correlation coefficient (r) values.
3. The reliability analysis using Cronbach alpha shows that there is internal consistency between the variables and their Cronbach coefficient falls between excellent range.
4. Critical factors which have more influence on performance of an organisation, identified from multiple linear regression are technology capabilities, technology adoption, and top management support.

## 8 Future scope

1. Technological competencies have been explored in the study and for future work other competencies can also be used for manufacturing sector.

2 This study can further be extended on particular segment of the manufacturing industries.

3 These studies can be used on other regions of the country

4 In future qualitative analysis can also be done as this focuses mainly on quantitative analysis.

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