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Empirical modeling of manufacturing competency and manufacturing firm performance

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ABSTRACT
The manufacturing sector in India is growing with double digit is likely to continue its growth story in future due to its labor advantage in terms of skill and availability of raw materials. In this research paper authors has conducted an in depth research to establish that how manufacturing competency of Indian manufacturing sector plays a significant role in superior performance.

Introduction:

Why do some companies perform well, while others do not (Collins, 2009). Does manufacturing competency of the firm have any influence on the success or failure of the firm? To what extent does the manufacturing ability play a role in the growth and performance of a single manufacturing company? These are the major questions that will be addressed in this study. Strategies are formulated to determine the way in which organizations can move from their current competitive position to a stronger one. This can only be achieved by improving specific functional competencies (Feurer et al, 1994).

The Indian manufacturing sector experienced a strong resurgence in the last three years. It witnessed an average annual growth rate of around 10.13 per cent in 2004-07, compared to 5.7 per cent during the preceding five years. Buoyed by this impressive growth in the manufacturing sector, the Indian economy grew at an average annual rate of 8.6 per cent in 2004-07 compared to just 5.4 per cent during 2000-04. Given, India's stage of development, manufacturing would be considered to be the engine of development. However, this is apparently not happening as the growth has been primarily driven by services. In fact, Kochhar *et. al.* (2005) point out that the change in the share of manufacturing in GDP in India between 1980 and 2000 has over time, it the share of value added by the manufacturing sector in India's GDP has been stagnant. From 1965 to 2004 the decline in agriculture's share was nearly matched by the increase in service's share. However, the share of industry increased from 21 per cent to 27 per cent but the increase in manufacturing sector's share was only from 14 per cent to just over 16 per cent, over a period of 40 years. Surprisingly, the share of manufacturing sector has declined since 1995 when it peaked at just over 18 per cent. It declined to 15 per cent in 1999, before settling around 16 per cent in recent years. The contribution of the other components of industry, namely, mining, construction, electricity, water and gas, has increased steadily from 6 per cent to 11 per cent.

The literature indicates that there is a strong relationship between competitiveness sources and enterprise's performance. Some studies also show that different competitiveness sources (such as manufacturing, research and development, and marketing) have different impacts on performance results (Droge et al, 1994; Li, 2000; Hitt and Ireland, 1985).

However, most of these studies have been conducted in a developed countries context. Very few studies have been done for developing countries as well as none in India.

The objectives of this study are:

- To empirically test the relationship between the dimensions of manufacturing competencies and the firm's performance of manufacturing companies in India.

To provide the recommendations.

Literature review

The purpose of this chapter is to provide a theoretical foundation that is relevant to the development of a conceptual model and hypotheses for this study.

Conceptual framework underlying the literature review:

The Figure 1 shows the framework which is underlying the literature research. The key points of this framework are highlighted as follow:

The distinctive competencies of an organization arise from two complementary sources: its resources and capabilities. A distinctive competency is unique strength that allows one company to achieve superior efficiency, quality, innovation or customer responsiveness and thereby to attain a competitive advantage.

The primary objective of company's strategy is to achieve a competitive advantage.

Consequently, the company will earn a profit rate substantially above the industry average. Details of these concepts and relationship are presented in the following sections.

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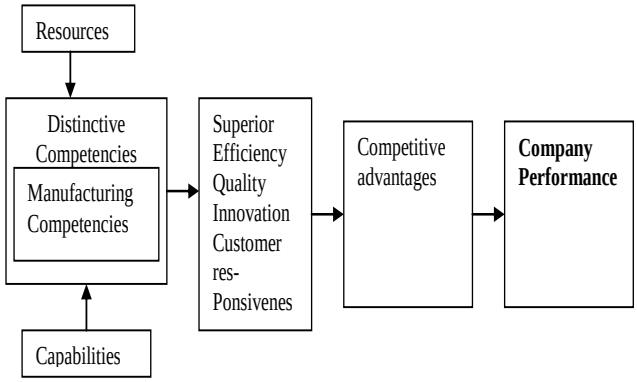


Figure 1: Conceptual framework underlying the literature review (Source: Adapted from Hill and Jones, 2001, p.138)

Resources, capabilities and competencies:

Term and categories of resources:

The notion of resources was introduced into the strategic management field in the 1970s when Ansoff (1965) categorized skills and resources according to the major functional area, i.e. research & development (R&D), operations, marketing, general management and finance. But until the mid 1980s did the concept of resources as a source of sustainable competitive become dominant in the strategic field. There has been resurgence of interest in the role of the firm's resources as the foundation for firm strategy. The firm's resources can be defined as stocks of available factors that are owned or controlled by the firm. The final products or services are produced by using a wide range of other firm assets and bonding mechanisms such as technology, management information systems, incentive system, trust between management and labour, and more (Amit and Schoemaker, 1993). Grant (1991) defined resources as the inputs into the production process, which are the basis of analysis. To identify resources, financial balance sheets are notoriously inadequate because they disregard intangible resources and people-based skills – probably the most strategically important resources of the firm (Grant, 1991).Barney (1986, 1991) also suggested that not all aspects of a firm's physical capital, human capital, and organizational capital are strategically relevant re-sources.

Company performance

Many of the perspectives that nominated the early thinking concerning firm performance have their roots in traditional economic theory with an emphasis on market power and industry structure as determinants of firm performance (Chadwick 1999; Chandler, 1994; Knight, 1997; Wiklund, 1999).For measuring a firm's performance, objective and subjective measures have been used.

The objective measures include measures such as return on assets, market share, sales, export proportion, growth rates in domestic and export sales growth. Similar measures are used by previous researcher (e.g. Hitt et al., 1982, 1985). Similarly, the subjective measures of performance include management's perceptions of productivity, profitability, market share, and customer satisfaction relative to competitors. The possibility of using subjective performance measures (the management perceptions) was suggested by Dess and Robinson (1984) if the accurate objective measures are unavailable. Subjective measures of performance have been used by several researchers (e.g. Li, 2000, Akimova, 2000).

The Table 1 provides the review of performance measures that have been used in competitive advantage research.

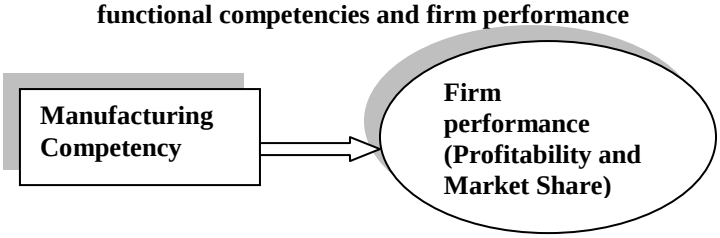
Author	Performance measures used in research
Snow, Charles.C and Hrebi- niak, Lawrence.G (1980)	Ratio of total income to total assets
Hitt, M.C, Ireland, D.R and Stadter, G (1982)	Price earning; return on equity (ROE); return on capital (ROC); sales volumes and earning per Share
Hitt, M.C and Ireland, D.R (1985)	Market return (Derived from geometric mean an- nual stock return; geometric mean annual risk free rate and beta measure of systematic risk)
Droge, C. and Vickery, S. (1994)	Return on Investment (ROI) and ROI growth; Market share and market share growth Return on Sales (ROS) and ROS growth
Sharma, Bishnu. and Fisher, Tom. (1997)	Sales per employee; Return on Asset (ROA); Market share; Sales; Export proportion, growth rates in domestic; Export sales growth; Perceived performance: productivity, profitability; customer satisfaction; market share)
Li, Ling. X. (2000)	Sales volume; Profit after tax Market share Return on Investment (ROI)
Akimova, Irina. (2000)	Return on Investment (ROI) Profit Sales volume; Market share; cash flow

(Source: Author)

Conceptual framework, measurement instrument development and data collection

Recent studies show that only when a firm can convert its functional competencies can become more competitive in the market place (Evans and Lindsay, 1996; Hill and Jones, 2001; Porter, 1990; Droge and Vickery, 1994; Li, 2000). Many researchers have concluded that desired level of performance cannot be achieved in organizations which fail to respond effectively to relevant environmental demand (e.g., Lawrence and Lorsch, 1967; Dill, 1976; Pfeffer and Salancik, 1978; Ansoff, 1979; Poter, 1980; Hitt et. al., 1982). Since environ- mental demands vary across organizations, different firms may have to emphasize the development of different mixes (or combinations) of key functional area competencies (Corbert and Wassenhove, 1993, Hitt et al., 1982, Li, 2000). In addition, many researchers had emphasized the importance of an integrative perspective (Berry, Hill, Klompmaker and McLaughlin, 1991; Droge and Vikery, 1994; Hitt et al., 1982, 1985, Li, 2000). Therefore, this study integrates several functional competencies to examine the relationship between sources of competitive advantage and organizational performance. On the basis of the preceding discussion and the synthesis of the existing literature, a proposed conceptual framework for the current research is designed as shown in Fig.2.

Figure 2: A conceptual model of the relationship between functional competencies and firm performance



The specific hypothesis is presented as follow:

Hypothesis: There is a positive relationship between the manufacturing competency and profitability performance.

Measurement instrument development

To do survey research, a survey instrument for this study is to be scientifically developed. To begin with, a review of the extensive literature on the four main concepts - including manufacturing, marketing, research & development and human resource and firm performance - were done to identify the key is-sues and a draft of measurement instrument borrowed from those of other re-searchers. This was followed by expert interviews, which was performed to develop the valid survey instrument for the research.

Independent variables

Independent variable that has been identified in the conceptual framework presented in the previous section. They include the manufacturing competency. The items used to operationalize these four functional competencies in this study were adopted from several studies of Clark, 1982; Conant et al., 1990; Craig and Douglas, 1982; Droge et al., 1994; Evans and Lindsay, 1996; Ha, 2002; Hayes and Wheelwright, 1984; Hitt and Ireland, 1985; Li, 2000. Porter, 1980, 1985; Simerly, 1997; Tunaly, 1992.

Dependent variables:

Previous studies show that there is no standard measure of the firm's performance (Droge et al, 1994; Hitt and Ireland, 1985; Li, 2000); Sharma and Fisher, 1997; Snow and Hrebiniak, 1980). Commonly used approaches include: market based indicators and financial based indicators. However, getting Asian companies to disclose their financial data is often difficult and the data are not comparable across firms (Bae and Lawler, 2000).

Expert opinion

In conducting the research, the survey questionnaire is important to the quality of data. To ensure that complete and correct constructs, expert opinion was conducted to decide which items from among those adopted from previous studies were most suitable for the survey questionnaire. The purpose of doing it here was to assess the validity of questions for each concept included in the questionnaire. Total eight experts were invited to refine and validate measures for each concept. They are four academic faculties from economics and management department of University of Petroleum & Energy Studies, who specialize in the four functional areas and four managing directors of manufacturing companies. The four companies are operating in four different industries including steel, cement, textile, and automobiles. The experts asked to provide their opinion on items used to measure each concept.

Questionnaire instrument:

Resulting from the intensive measurement instrument development process, the questionnaire for respondents was finally consolidated into three sections: personal and business details, firm performance and functional competencies. The first section asks general information about the respondent and the enterprise including company's name, job title of respondent, ownership, operating areas, years of operation, number of employees, revenue and profit.In the second part were questions related to the performance of the enterprise. The respondents were asked to indicate their level of firm performance in comparison to other organizations that do the same kind of work.The third part was related to the functional competencies. In this section, a total of twenty-five statements were used to measure the four functional competencies. The respondents were asked to indicate the degree to which their firms would employ the practices commonly seen in the four functional areas.

Data collection and assessment

Data collection

There is no collected data source from previous research conducted on the same content and context as those of this study. Primary data is therefore imperative for the study. Primary data for this study was gathered from manufacturing companies located in India.

Target population and sample design

This study focused on the manufacturing companies in India. The manufacturing companies in India were identified through database of CII. It provides the list of companies operating in India, their contact address, their type of business, and their type of ownership. Here 725 manufacturing companies were randomly chosen to send the questionnaires.

The survey

A mail survey was conducted during May and July 2009. Data collection proceeded by calling randomly the targeted respondents in order to confirm their mail-address, inform them about the study and to encourage them to respond. A total of 725 questionnaires were then sent by mail to the 725 manufacturing companies. Each mail includes a letter of introduction, a questionnaire and a mailed back written address envelop with a stamp for respondent to mail back when they complete the questionnaire. Consequently 125 questionnaires were mailed back at gross response rate of 17.24%. Total number of used questionnaire is 110 achieving respondent rate of 15.17%.

Data assessment

Data examination and exploration

Data entry started with the development of a coding plan for the question items in the questionnaire. This plan was used to define variables in SPSS. The next step was the key-in of questionnaire responses in the defined SPSS data spreadsheet. With the dataset built, examination and exploratory procedures were conducted to screen the data for possible outliners. The database was examined and had indicated that the missing values were distributed at random. According to Hair et al., (1999), this situation of missing data was acceptable for multivariate data analysis.

The Cronbach's Alpha was calculated for each functional and performance construct and shown in Table 3.3.All the items in these functional constructs exceeded the item-to-total correlation criteria of 0.35. At the same time, the Cronbach's Alpha for these constructs was 0.858 (manufacturing); 0.87 (marketing); 0.803 (research and development) and 0.909 (human resource) respectively, which indicates that they highly met the requirement by Nunnally (1978).

Table 2: KMO and Barltlett's test for functional competencies and performance

KMO and Barltlett's test		Functional competencies	Organizational Performance
KMO Measure of Sampling Adequacy		0.876	0.834
Barltlett's test of Sphericity	Approx Chi-Square	1425.366	453.526
	d.f	231	10
	Significance	.000	.000

Table 3: Reliability analysis of Manufacturing competency and organizational performance

Manufacturing management (α=0.858)		0.858
Modernization of on-going plant program	0.758	0.830
capacity utilization	0.757	0.829
Quality Control (Manufacturing Process)	0.728	0.818
Inventory Control	0.656	0.834
Providing an effective equipment maintenance & replacement	0.633	0.845
Production, material & overhead cost	0.631	0.841

Table 4: Reliability analysis of functional competencies and organizational performance (cont.)

	Loading factor	Cronbach's alpha	Cronbach's alpha if item deleted
Organizational performance			
Profitability performance (α=0.942)		0.942	
ROA	0.910		0.913
ROE	0.893		0.892
Profit before tax	0.785		0.939
Market performance (α=0.759)		0.759	
Market share	0.864		
Sales growth	0.788		

The assessment of the item-to-total correlation concerning profitability and market performance is presented in Appendix 4. It is also noted that all the items of these two performance constructs also exceeded the item-to-total correlation criteria of 0.35. The Cronbach's Alpha value for the profitability and market performance was computed to be at 0.942 and 0.759 respectively. This indicates that the reliability for those items satisfied the Nunnally's requirement. In summary, the values of item-to-total correlation and Cronbach's Alpha found for each construct indicated that each construct was strongly reliable measure.

Data analysis and hypotheses testing

Factor analysis

In this research, a total 6 variables of functional competency and five variables of organizational performance were identified from the literature. As suggested by Hair et. al., (1999) factor analysis should be used to analyze and create a new set of variables.

Significance of the factor loadings

In interpreting the factor analysis solution, a decision must be made regarding which factor loadings are worth considering. Factor loading are the correlations between original variables and the factors.

The magnitude at which the factor loadings are significant depends on the sample size and the tolerance of two types of errors. With an aim of obtaining a power level of 80 per cent, we need .05 significance level.

Table 4.1 contains the sample size necessary for each level of factor loadings to be considered significant.

Table 5: Guidelines for identifying significant factor loadings based on sample size

No	Factor loading	Sample size needed
1	.30	350
2	.35	250
3	.40	200
4	.45	150
5	.50	120
6	.55	100
7	.60	85
8	.65	70
9	.70	60
10	.75	50

Note: Significance is base on a .05 significant level (α) and a power level of β=0.80

Source: Hair et al., 1998, p.112

As shown in Table 4.1, for significance, a sample size of 100 requires a loading value of at least 0.55. Similarly, a loading of 0.50 demands a larger sample size of 120. Obviously, no entry is available for the sample size of 110.50 and 0.55. As an exploratory decision rule, any value falling short of 0.50 was considered not significant at the size of 110.

Appropriateness of factor analysis

Since the objective of factor analysis is to identify interrelated sets of variables, the key requirement for the appropriateness of its application, from the statistical viewpoint, is the presence of correlations among the variables (Hairs et. al., 1998). In this study, two statistical procedures were conducted to examine the appropriateness of factor analysis. The first one was the Bartlett test of sphericity for the presence of correlations among variables. Table 3.1 shows the significance value was 0.000 (<0.05) for both functional competencies and organizational performance. This means that the variables are correlated highly enough to provide a reasonable basis for factor analysis (Leech et. al., 2005).The second one was the KMO measure of sampling adequacy to quantify the degree of inter-correlations among the variables and the appropriateness of factor analysis. This measure is an index taking value from 0 to 1 and can be constructed with the following guidelines: 0.80 or above, meritorious; 0.70 or above middling; 0.60 or above, mediocre; 0.5 or above, miserable; and below 0.50, unacceptable (Hair et al., 1998). In this study, the KMO measures was 0.867 for functional competencies and 0.834 for performance (Table 3.1), falling right on the mark of the meritorious range. In conclusion, all of the statistical indications provided a very sound support for the appropriateness of the factor analysis. The next part delves into the search for meaningful factor solution for functional competencies and organizational performance.

Descriptive analysis of manufacturing management

In general, the respondents have evaluated the activities of manufacturing management well. The overall means of all six items were varied from 3.68 to 4.07. They have much emphasized 'providing an on going plant modernization programme' (mean = 4.07).

They have also done rather well 'controlling manufacturing process quality' (mean = 3.90), 'managing production, material & overhead cost' (3.88), and 'using capacity utilization' (mean = 3.87).

However the two remaining items 'creating an effective equipment maintenance & replacement' (mean = 3.79) and 'control-ling material and inventory' (3.68) were assessed relatively lower.

Table 6: Manufacturing management

Items (*)	N	Means	Good & very good (%)
Providing an on going plant moder-nization programme	110	4.07	83.64
Using capacity utilization	110	3.87	70.91
Controlling manufacturing process Quality	110	3.90	70.00
Managing production, material & overhead cost	109	3.88	69.72
Creating an effective equipment maintenance & replacement	110	3.79	65.45
Controlling material and inventory	110	3.68	60.91

(*) Highest score is 5

The percentages of respondents perceived their manufacturing performance as good and very good were high and varied from 60.91% to 83.64%.

Table 7: Summary of hypothesis testing

Hypothesis	Description	Result of Hypothesis testing
H1	There is a positive relationship between the manufacturing competency and profitability performance	Supported

It was found that those manufacturing companies in India putting more emphasis on marketing, on research & development and on human resource competencies can expect to earn higher profitability and market performance. The study also found the positive and significant relationship between manufacturing competency and profitability. These findings are consistent with study of Droge and et al. (1994) and Li (2000). The empirical study of Droge found positive relationship between marketing, research and development and production with market share, ROI, ROI growth, ROS and ROS growth (1994).

Limitations

There are some limitations that need to be mentioned. Future studies are likely to benefit if some limitations of the present study are examined. First, studies on samples are seldom conducted without any intention to generalize the results to the whole population to which the samples belong (Coo-per and Schindler, 2001). Not all sampling techniques allow this generalization. The most known, comprehensive and pervasive technique is perhaps the simple random sampling in which each possible sample of a given size is equally like to be the one selected (Newbold, 1999). Second, perceptual performance was used in the study instead of objective measure. Although previous studies showed a positive association between objective and perceptual performance (Geringer and Hebert, 1991; Powell, 1992), the latter is not able to fully reflect the real firm performance. Objective performance data is very difficult to obtain but it is the better approach to determining the success of the companies (Pothukuchi et.al, 2002).Third, the validity of the findings regarding the relationship between four functional competencies and firm performance may be hampered by the fact that data on functional practices and organizational performance were collected at the same point in time. Consequently, the direction of causality between the two cannot be specified definitely. However, causality cannot be established without longitudinal data. Future research effort is urged to collect longitudinal data to confirm the causal relationship between four function's competencies and firm performance. Lastly, firm performance may be affected by various other extraneous variables not accounted for in this study. It would be beneficial to examine the myriad of firm performance by taking external conditions like the economic and legal situation into account.

Recommendations for future research

While this study was able to provide additional insight into four functional competencies and its relationship with firm performance, it also revealed areas that would benefit from further research. First, this study focused only on four functions of manufacturing companies. Future research could thus focus on the other functions such as finance, planning, controlling.... By doing so, a better and fuller understanding on the effects of functional competencies on firm performance may be achieved. Second, there is a strong need for longitudinal research. A longitudinal analysis of a group of companies over time would provide data to address at least two research questions: 1) is there a time lag between investing in functional competencies and achieving an expected performance, and 2) is there a particular order in which these investments should be made. Third, this study failed to support one of the proposed hypotheses related to the relationship between manufacturing and firm performance. The results of this study future research might be extended to other industries like service and to other countries both developing and industrialized.

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