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An empirical investigation of dynamic capabilities in managing strategic flexibility in manufacturing organizations

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Abstract

Purpose – The purpose of this paper is to evaluate the relative impact of dynamic capabilities on various dimensions of strategic flexibility in Indian manufacturing industry.

Design/methodology/approach – In this study, 102 manufacturing organizations have been extensively surveyed, to assess the relative impact of different dynamic capabilities on various dimensions of strategic flexibility. The correlations between dynamic capabilities and strategic flexibility have been evaluated and validated by employing various statistical tools.

Findings – The research focuses upon the significant contributions of dynamic capabilities such as human resource capabilities, innovative capabilities, technological capabilities, alliance capabilities and research and development capabilities, towards managing flexibility at strategic level in manufacturing organizations.

Originality/value – This study provides the first empirical evidence of such a relationship with a relative choice between dynamic capabilities for managing strategic flexibility in large and medium scale organizations in India.

Keywords Manufacturing industries, India, Flexible organizations, Strategic management, Supply chain management, Strategic flexibility, Dynamic capabilities, Manufacturing flexibility, Supply chain flexibility, New product flexibility, Technological capabilities, Innovative capabilities

Paper type Research paper

1. Introduction

Manufacturing industry has experienced an unprecedented degree of change in the recent years due to highly uncertain environmental dynamism. As a result of this volatile and turbulent dynamism, a firm faces an unpredictable environment characterized by very fast changes in technologies, aggressive variations in customer demand and intense fluctuations in supply of materials (Yang and Li, 2011). Due to rapid and unpredictable changes in competitive environment, managers are

Management Decision
Vol. 51 No. 7, 2013
pp. 1442-1461

0025-1747
DOI 10.1108/MD-05-2012-0332

The authors thank the All India Council for Technical Education (AICTE), New Delhi, India for providing funding for this research through project file no. 8023/RID/RPS/09/11/12/752. The authors are also thankful to the reviewers who have critically analyzed this work and given valuable suggestions for improvements.

increasingly concentrating on flexibility as a way to achieve new forms of competitive advantage (Gerwin, 1993; Jordan and Graves, 1995; Upton, 1995). Organizations need to develop flexibility at strategic level in order to cope with the external pressure posed by frequent changes in customer's expectations, changing market trends and competitor action (Aaker and Macarenhas, 1984; Eppink, 1978; Harrigan, 1985; Shimizu and Hitt, 2004).

The investigation of strategic choice of aligning flexibility development with the external environment that manufacturing managers face, considering uncertainties in demand, material supply, competition and new product technology, indicates the need of matching the flexibility with environmental uncertainty to ensure profit and sales performance (Chang *et al.*, 2002). Strategic flexibility allows a firm to support the development of future manufacturing strategies, and these enable it to react swiftly to the changing nature of internal and environmental conditions (Lau, 1996). These types of changes and intensification in competition are viewed by number of authors (Hum and Sim, 1996; McNamara *et al.*, 2003; Meredith *et al.*, 1994; Spina *et al.*, 1996; Wiggins and Ruefli, 2005).

In order to respond to hypercompetitive environment effectively, the organizations not only require valuable resources and capabilities, but they also need dynamic capabilities to develop and renovate their organizational resources and capabilities (Teece *et al.*, 1997). These dynamic capabilities are necessary to enhance the flexibility of the organizations at strategic level (Aaker and Macarenhas, 1984; Eisenhardt and Martin, 2000).

Strategic flexibility is a very important tool that provides organizations with the ability to change levels of production rapidly, to develop new products and to respond quickly to competitive threats. This requires managers to find the right balance between committing the resources necessary to carry out a decision and avoiding investment of good money in bad projects (Shimizu and Hitt, 2004).

The aim of this paper is to contribute to the strategic management literature by identifying different dimensions of dynamic capabilities as well as strategic flexibility, and to analyze empirically, whether these dynamic capabilities have any impact on flexibility at strategic level.

The paper is organized as follows: first, the theoretical context in which this paper is based has been presented; second, existing literature on dynamic capabilities and strategic flexibility dimensions and their interactions has been built; third, based upon the outcomes of empirical analysis, a regression model has been developed; and finally, the implications of the study have been discussed and the limitations of the proposed model and research perspectives have been proposed.

2. Literature review

The literature has been reviewed on the subject of strategic flexibility, dynamic capabilities and interplay of relationships between different capabilities and flexibility constructs to achieve strategic flexibility. The methodology to be used for carrying out the research has also been reviewed and presented.

2.1 Flexibility defined

The review of literature on flexibility reveals that there is not a definition of flexibility that is universally accepted. The problem of definition is felt to a significant extent.

Along with the difficulty of a conceptual unification of the terminology there is also the great variability in the fields of application of the concept of flexibility (Toni and Tonchia, 2005).

From a general point-of-view, flexibility is defined in numerous ways. Gerwin (1987) defined flexibility as the firm's ability to deal with uncertainty. The flexibility bestows on a firm the ability to respond promptly to market opportunities and changing technologies and most likely to continue with ever increasing changes in the marketplace. Eppink (1978) is of the viewpoint that flexibility makes an organization less vulnerable to, or better able to respond successfully to, unforeseen environmental changes. Shewchuk (1999) stated that flexibility has become one of the most sought after properties in modern manufacturing systems. Sethi and Sethi (1990) discovered through an extensive survey that most of the literature focused only on the taxonomies of flexibility. They presented a set of eleven types of flexibility, which were grouped into system flexibility and aggregate flexibility. They summarized that flexibility is a complex, multidimensional and hard-to-capture concept. Correa (1994) defined the flexibility as the characteristic of the interface between a system and its external environment. The various types of flexibility are distinguished by the speed of response and the variety of capabilities related to each type (Volberda, 1996). Bertalanffy (1973) defined the flexibility as a degree of homeostatic control and dynamic efficiency of a system, whereas Toni and Tonchia (2001) see flexibility as capability of adaptation/change. Dixon *et al.* (1990) associated the flexibility with quality, product, service and cost. Upton (1995) argued that the flexibility of the plants depends much more on people than on any technical factor. Dangayach and Deshmukh (2001) identified various dimensions of flexibility. They classified it into structural flexibility and infrastructure flexibility.

Flexibility can be considered as a major competitive weapon for manufacturing organizations operating in increasingly uncertain environments and turbulent markets that provide organizations with the ability to change levels of production rapidly, to develop new products more quickly and more frequently, and to respond more rapidly to competitive threats.

2.2 Strategic flexibility

The concept of strategic flexibility has gained significant importance in the recent times. Although it appeared in the management literature as early as 1950s yet it gained importance amongst researchers in the past decade. Till date, the concept has been defined in several ways and has become shrouded in vagaries and ambiguity (Johnson *et al.*, 2003). Strategic flexibility has been considered by previous research in strategic management, economics, organization theory and marketing. Consequently this term has a varied range of definitions (Genus, 1995). Hitt *et al.* (1998) defined strategic flexibility as the capability of company to proact or respond quickly to changing competitive conditions and thereby develop and/or maintain competitive advantage. According to Ansoff (1965) flexibility can be measured by two proxy objectives: external flexibility achieved through a diversified pattern of product-market investments, and internal flexibility through liquidity of resources.

Aaker and Macarenhas (1984) defined the strategic flexibility as ability of the organization to adapt to substantial, uncertain and fast-occurring environmental changes that have meaningful impact of the organization's performance. Harrigan

(1985) considered the flexibility as the ability of firms to reposition themselves in a market, change their game plans, or dismantle their current strategies when the customers they serve are no longer as attractive as they once were. Strategic flexibility is a firm's capability to identify changes in the environment, to quickly commit resources to new courses of action in response to changes, and to act promptly when it is time to halt or reverse such resource commitments (Shimizu and Hitt, 2004). Evans (1991) proposed a simple definition of strategic flexibility as capability to modify strategies. Masutik and Hill (1998) conceptualized strategic flexibility as firm's ability to respond quickly to changing market conditions.

Strategic flexibility depends jointly on resource flexibility and the company's flexibilities in applying those resources to alternative courses of action (coordination flexibility) (Li *et al.*, 2011; Pauwels and Matthyssens, 2004; Sanchez, 1995). Resource flexibility is determined by the inherent properties of the resources, while coordination flexibility reflects a firm's capabilities to apply the resources (Grewal and Tansuhaj, 2001). Because of the significant differences between resource flexibility and coordination flexibility, they function differently on the linkage between product innovation and firm performance (Sanchez, 1995). Liu *et al.* (2009) conducted a study to describe the relationships between resource flexibility (RF), operational coordination flexibility (OCF), and new product introduction capability (NPIC). The results of their study showed that OCF has a positive effect on NPIC but the effect of RF on NPIC is represented by an inverse U-shape graph.

Beach *et al.* (2000) and Roberts and Stockport (2009) had classified strategic flexibility into two observable dimensions: external and internal. The externally observable dimensions were categorized as: manufacturing process flexibility, operational scope flexibility, market flexibility, product flexibility, procurement flexibility and financial flexibility. Further the internal observable dimensions were divided into: ability to implement strategy, value chain flexibility, control flexibility, learning flexibility, functional flexibility, human resource flexibility and information system flexibility.

Strategic flexibility is a multidimensional concept. Previous attempts to conceptualize strategic flexibility have been inconsistent and short of any unified approach. In view of developing testable propositions regarding enterprise system impact on strategic flexibility, MacKinnon *et al.* (2008) suggested five first order constructs which comprise strategic flexibility. They are:

(1) *Operational flexibility*. The flexibility of a firm's production and/or business processes.

(2) *Human capital flexibility*. The "flatness" of a firm's organizational structure, and commitment to a culture of flexibility including knowledge sharing/management, cross-functional training, outsourcing, and other nontraditional work arrangements (e.g. telecommuting).

(3) *Information flexibility*. The flexibility of a firm's information system, particularly a firm's ability to obtain required information from both its transactional and analytical systems. Information flexibility can be separated into two sub-constructs: reporting flexibility, which is a firm's ability to extract and view relevant data from its transactional systems, and analytical flexibility, which is a firm's ability to extract and utilize historical data from its data archives for analysis and decision support.

(4) *Supply chain flexibility*. A firm's ability to quickly and efficiently remove, add, and exchange information with its external supply chain partners.

(5) *Financial flexibility*. A firm's resource commitment to, and ability to absorb the cost of exercising flexibility until it begins to pay for itself.

Shimizu and Hitt (2004) concluded that maintaining strategic flexibility is one of the most important tasks of managers and organizations in a dynamic environment. Strategic flexibility involves the creation, maintenance and realization of options for firm's future (Bowman and Hurry, 1993). From the review of literature, it can be concluded that strategic flexibility is not a unitary concept, but it is governed by a variety of flexibility types.

In context with the present study, strategic flexibility has been defined as the "ability of a firm to proact, react, reposition quickly or to adapt to highly volatile market environmental conditions, with the help of its resources and capabilities, so as to maintain its competitive advantage".

2.3 Dynamic capabilities

For several decades, a variety of scholars have described or documented growing levels of competition in the business context (Bettis and Hitt, 1995; D'Aveni, 1994; Kraatz and Zajac, 2001; McNamara *et al.*, 2003; Wiggins and Ruefli, 2005). To survive in such turbulent environments – where competitive advantages can be nullified rapidly – firms need to develop and deploy various kinds of dynamic capabilities. Particularly higher order capabilities that enable fast reconfiguration of the resource base (Eisenhardt and Martin, 2000; Helfat *et al.*, 2007; Teece *et al.*, 1997), changing the nature of activities (Aaker and Macarenhas, 1984), or dismantling of current strategies (Harrigan, 1985).

The concept of capabilities was first proposed by Penrose (1959) who suggested that resources are comprised of a bundle of potential services. While these resources are available to all firms, the capability to assemble, integrate, and deploy them effectively is heterogeneously distributed (Amit and Schoemaker, 1993; Russo and Fouts, 1997; Schendel, 1994).

Researchers have widely discussed the capabilities in the "resource-based" literature (Collis and Montgomery, 1995; Conner, 1991; Eisenhardt and Martin, 2000; Mahoney and Pandian, 1992; Tallman, 1991; Teece *et al.*, 1997). From a resource-based perspective, capabilities are intangible resources or assets, made up of constituents such as skills, learning and knowledge in deploying tangible or other intangible resources or assets. These resources can fall into one of three analytical categories: physical capital, corresponding to all of a firm's tangible, physical assets; human capital, its know-how, ability and social networks; and organizational capital, the formal and informal structures and processes that delegate authority and responsibility for allocating assets (Barney, 2001).

Teece *et al.* (1997) viewed that the dynamic capability was the kind of capability to realize the integration for the adaptation and fast changing external environment and the reform interior and exterior organization. Eisenhardt and Martin (2000) argued that dynamic capabilities are a set of specific and identifiable processes such as product development, strategic decision making, and alliancing. They are neither vague nor tautological. Fan *et al.* (2004) summarized the aspects of dynamic capabilities, defined as competencies that allow a firm to quickly reconfigure its organizational structure and

routines in response to new opportunities. They discussed the dynamic capabilities that are related with cost reduction, outsourcing, knowledge networking and knowledge management. Davila *et al.* (2006) have classified dynamic capability as: financial management capability, product development capability, human resource management capability, strategic planning capability, sales and marketing capability, partnership management capability. Ho *et al.* (2011) studied the effect of technological capabilities and design capabilities on technology commercialization and found that both technological and design capabilities have a positive effect on technology commercialization.

Zott (2003) summarized that it is not the sheer existence of dynamic capabilities that makes them relevant for the success of a firm in a volatile market environment but rather the characteristics of those dynamic capabilities. Capability must be the convention which would be carried out repeatedly and displayed extemporaneously. The dynamic capability belonging to the top level capability was the kind of capability used by enterprise's main policy-maker to redesign enterprise's resources with the suitable expected way and convention. Both resource management and market dynamism are essential to dynamic capabilities. Teece (2007) had emphasized upon the opportunities that come from dynamic market. Wu (2006) found that, in an unstable environment; resources, whether from the firm itself or from associated support firms, did not directly influence performance. Instead, resources influenced performance through exercising dynamic capabilities. It is rational to operationalize dynamic capabilities by resource management processes (Xiao *et al.*, 2008). da Silveira and Sousa (2010) suggested that improving performance in areas such as quality, flexibility, and delivery can be achieved through building capabilities.

Wang and Ahmed (2007) identified three component factors of dynamic capability across firms which are adaptive capability, absorptive capability, and innovative capability. Teece *et al.* (1997) identified three organizational and managerial key processes which are essential for dynamic capabilities:

(1) coordination/integration of both internal and external activities;

(2) learning seen as social and collective and defined as repetition and experimentation which enables tasks to be performed better and quicker; and

(3) reconfiguration and transformation of resources based on the ability to scan the environment to evaluate the markets and competitors.

Isabel *et al.* (2009) measured dynamic capabilities as a multi-dimensional construct that was built on knowledge processes associated with product development. He *et al.* (2006) proposed six component factors of dynamic capability via a theoretical analysis which include orientation of customer value, technology system, structure system, institutional system, isolation mechanism, and drive for change. Yang *et al.* (2008) concluded that dynamic capability has remarkable positive influence to relationship quality as well as on cooperation performance.

According to Fan *et al.* (2004) it is not enough anymore for firms (or countries) to just improve their internal competency in doing R&D. Rather, firms need to develop higher-order capabilities that enable learning from and leveraging of both internal and external resources, knowledge and sources of advantage. In hypercompetitive and dynamic business environment, the organizations must develop the organizational capabilities as a key factor for effectively managing the economic and financial crisis (Kunc and Bhandari, 2011).

2.4 Dynamic capabilities for achieving strategic flexibility

Strategic flexibility reflects the presence of higher order capabilities oriented at changing the nature of activities and the goals of the organization (Aaker and Macarenhas, 1984). Broadly defined, strategic flexibility reflects the capacity of an organization to respond to various kinds of external change. This capacity depends on the presence of dynamic capabilities to effectuate change and the responsiveness of the organization to facilitate change. A wide variety of capabilities relate to strategic flexibility (Eisenhardt and Martin, 2000): creating new product market combinations (Krijnen, 1979), dismantling current strategies (Harrigan, 1985), using market power to deter entry and control competitors (Porter, 1980), the ability to shift or replicate core manufacturing technologies (Galbraith, 1990), and the capability to switch gears relatively quickly and with minimal resources (Hayes and Pisano, 1994). The capabilities for strategic flexibility can be thought of as dynamic capabilities (Eisenhardt and Martin, 2000; Teece *et al.*, 1997), because they are associated with new resource configurations required to lead or deal with change.

Strategic flexibility is a result of both organizational responsiveness and external information processing capabilities and that firm size has opposing relationships with these dimensions. The degree to which strategic flexibility reduces the response time to unpredicted detrimental events depends greatly upon the people involved, organizational values, structure, decision-making process, degree of formality, management technology, etc. (Eppink, 1978).

Callaway *et al.* (2009) studied the impact of dynamic capabilities like information technology (IT) on strategic flexibility. From the study, it was concluded that under conditions of low environmental dynamism, IT capabilities are associated with greater reactive strategic flexibility. Specifically, IT capabilities enabling the management of internal activities were significant. Under conditions of high environmental dynamism, IT capabilities are associated with greater proactive strategic flexibility. Specifically, IT capabilities enabling the management of competitor information was significant.

The hierarchy of flexibility types reflects the relative order of dynamic capabilities. Higher order dynamic capabilities are required for achieving strategic flexibility (Ansoff and Brandenburg, 1971; Helfat *et al.*, 2007; Johnson *et al.*, 2003; Toni and Tonchia, 2005; Volberda, 1996). Grant (1996) argued that capabilities can be utilized efficiently only if the hierarchy of capabilities corresponds to the architecture of the firm, i.e. if the configuration of a firm's technology, structure, and culture correspond with the capabilities they support.

The literature supports the fact that dynamic capabilities are foundations which support different pillars of strategic flexibility dimensions. In the scope of this study, five dimensions of strategic flexibility namely market flexibility (MKTF), expansion flexibility (EXPF), new product flexibility (NPF), manufacturing flexibility (MFF) and supply chain flexibility (SCF) have been identified. Further, dynamic capabilities have been categorized into six constructs namely advanced technology (AT), technological capabilities (TC), research and development capabilities (RND), innovative capabilities (INC), alliance capabilities (ALC) and human resource capabilities (HRC). Interplay of relationships between different capabilities and flexibility constructs in achieving strategic flexibility is depicted in Figure 1.

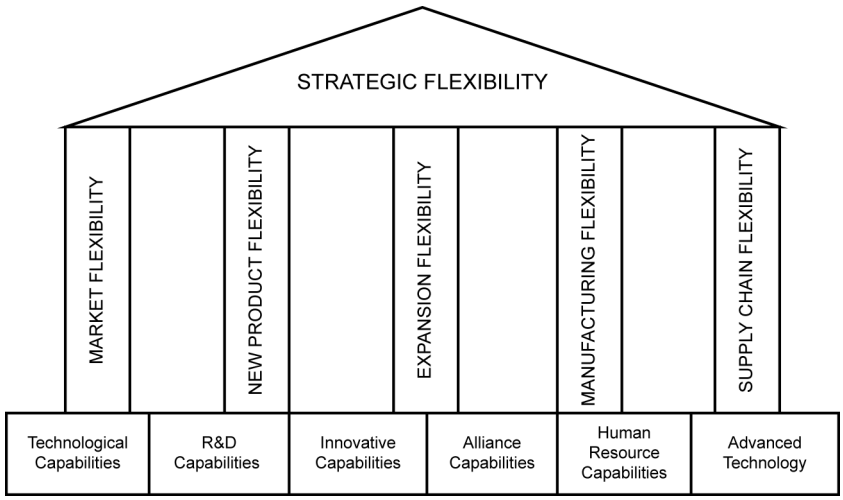

Figure 1.
Interplay of relationships between different capabilities and flexibility constructs in achieving strategic flexibility

3. Design of study

This section introduces overall design of study and the methodology adopted for carrying out the research work.

Churchill (1995) provided an overview of the different types of survey-based research. In this study cross-sectional research methodology has been adopted. The use of cross-sectional research is far more useful in this study and is considered as the most important type of survey-based research as measured by the number of times it is used as compared to other methods. First of all, cross-sectional research provides a snapshot of the variables of interest at a single point of time. Second, the sample of elements selected is considered to be representative of some known universe. The methodology employed to study the impact of dynamic capabilities on different dimensions of strategic flexibility has been depicted in Figure 2.

3.1 Survey questionnaire and respondent profile

Indian manufacturing industry is an emerging sector and has the ability to enhance the economic development of the country. In spite of this, Indian manufacturing industry has not been competitive enough. The primary reason for this is the significant presence of unorganized and unregistered small manufacturing units across the country. Apart from this, uncertainty in economic conditions, uncertainty in orders, power shortage and competition from imports are potential threats to Indian manufacturing industry.

In this study, a reasonably large number of Indian manufacturing organizations were extensively surveyed, to assess the impact of dynamic capabilities on strategic flexibility dimensions in the Indian manufacturing industries. Survey of medium and large scale Indian manufacturing industries was carried out through a specially designed questionnaire for understanding and assessing the prevailing situations. In Indian context, a medium scale industry is one where the investment in plant and machinery is more than Rs.5 crore (Rs. 50 million) but does not exceed Rs.10 crore (Rs. 100 million) and in large scale industry, investment in plant and machinery is more

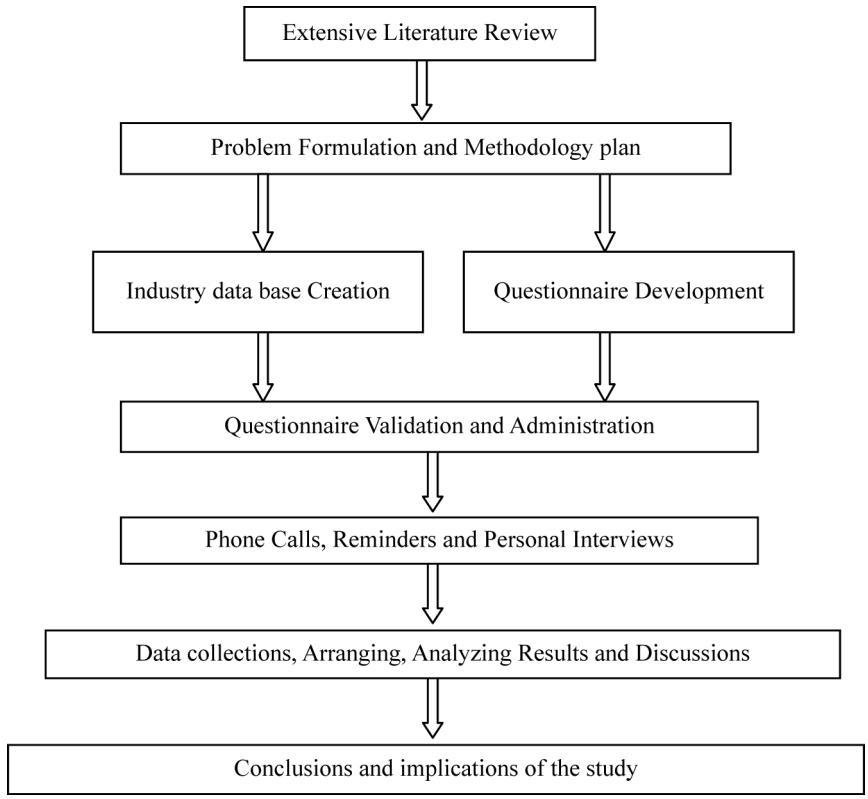

Figure 2.
Methodology adopted for the study

than Rs.10 crore (Rs. 100 million). For effectively conducting the survey, the questionnaire was designed through extensive literature review and validated through peer review from academics, consultants, and senior managers from the industry. The questions framed were based on five-point likert scale ranging from 1 to 5 designed to generate meaningful statistical measurements by obtaining meaningful quantitative answers to restricted closed questions.

Data collection was undertaken in three stages. The first stage involved detailed discussions with manufacturing executives in selected plants in different organizations, to confirm questionnaire validity and sample frame characteristics. The objective is to confirm that responses were based on correct interpretations of the questions. In the second stage, a final structured survey questionnaire was generated and mailed to 800 members chosen at random from among the membership of the Confederation of Indian Industry (CII) and ACMA members. CII is a non-government, not-for-profit, industry-led and industry-managed organization, seeking to play a proactive role in India's development process. CII has direct membership of over 7,100 organizations and indirect membership of over 90,000, from around 250 national and regional sectoral associations. The Automotive Component Manufacturers Association of India (ACMA) is the nodal agency for the Indian Auto Component Industry. ACMA represents over 600 companies, whose production forms a majority of the total auto

component output in the organized sector. During the third stage, a reminder with a duplicate survey was sent to all non-respondents to the initial mailing. A total of 112 responses were received, constituting a response rate of 14 percent. This compares well with the response rates for studies in operations management (Handfield and Pannessi, 1995; Oberoi *et al.*, 2008; Suarez *et al.*, 1996) (Figure 3). A comparison between the respondents to our first and second mailings revealed no significant differences in terms of organization size or respondent level. Elimination of unusable responses resulted in 102 responses.

3.2 Tests of reliability and validity of data

Internal consistency reliability is the most commonly used psychometric measures in assessing survey instrument and scales (Nunnally, 1978). Test of reliability on a measurement instrument has been carried out to determine its ability to yield consistent measurements. Cronbach alpha (α) is the basic formula for determining the reliability based on internal consistency. Therefore, the Cronbach's α for various dynamic capabilities and dimensions of strategic flexibility have been evaluated to ascertain the reliability of the input and output data collected through the questionnaire. The value of Cronbach's α for various variables has been shown in Table I. The Cronbach's α values for all the input and output categories, in excess of 0.6 indicates the significantly high reliability of data for various input and output categories (Narasimhan *et al.*, 2004; Nunnally, 1978; Oberoi *et al.*, 2008).

Discriminate validity, the second major type of construct validity, refers to the principle that the indicators for different constructs should not be so highly correlated as to lead one to conclude that they measure the same thing. This would happen if there were definitional overlaps between constructs. Discriminate validity analysis refers to testing statistically whether two constructs differ (as opposed to testing

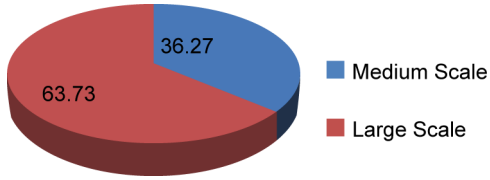

Figure 3.
Breakdown of responses

S. no.	Construct	Abbreviation	Cronbach Alpha	SD	Variance
1	Advanced technologies	AT	0.936	0.918	0.843
2	Technological capabilities	TC	0.910	0.667	0.445
3	R&D capabilities	RND	0.952	0.922	0.851
4	Innovative capabilities	INC	0.917	0.793	0.628
5	Alliance capabilities	ALC	0.924	0.798	0.637
6	Human resource capabilities	HRC	0.961	0.786	0.617
7	Market flexibility	MKTF	0.898	0.645	0.417
8	New product flexibility	NPF	0.886	0.833	0.694
9	Expansion flexibility	EXPF	0.855	0.708	0.501
10	Manufacturing flexibility	MFF	0.921	0.676	0.457
11	Supply chain flexibility	SCF	0.899	0.640	0.409

Table I.
Values of reliability and variability measures for all the constructs

convergent validity by measuring the internal consistency within one construct, as Cronbach's alpha does). An 11 factor correlated model representing each of the elements has been used to examine discriminate validity. The within-group and between-group variances for all the constructs are contained in Table II. The diagonal cells contain the within-group variances, the off-diagonal cells in the lower triangle contain the between-group variances, and the off-diagonal cells in the upper triangle represent correlations among the constructs. As can be seen in the Table II, the within-group variances of any two constructs exceed the variance between those two constructs, thereby supporting discriminate validity.

Hence this data has been tested for convergent and discriminate validity and found to be free from any systematic or non-random error.

3.3 Analysis and results

From the extensive literature survey and critical examination of large and medium scale Indian manufacturing industry, it has been found out that few organizations have made reasonably significant interventions for achieving strategic flexibility, while rest of the organizations have yet to made a significant head-start regarding implementation of these drives.

In the present study, the target respondents are the organizations that have made serious interventions in the field of strategic flexibility. The target organizations were randomly selected organizations that have made significant investments in upgrading their existing technology, improving R&D facilities, human resource welfare policies and developing new products. These organizations hold a major market share in their respective product domain. The responses received have been compiled for analyzing them critically to ascertain the performance of the Indian industry regarding various strategic flexibility related issues.

In order to establish relationships among strategic flexibility dimensions (dependent variables) and various dynamic capabilities (independent variables), bivariate correlation, multiple regression and canonical correlation techniques have been used. The correlations have been worked out to ascertain the significant factors contributing to achieve strategic flexibility in the organizations. Only those pairs with Pearson correlation greater or equal to 40 percent and statistically significant at 1

	AT	TC	RND	INC	ALC	HRC	MKTF	NPF	EXPF	MFF	SCF
AT	0.843	0.694*	0.602*	0.570*	0.599*	0.601*	0.572*	0.415*	0.691*	0.466*	0.705*
TC	0.425	0.445	0.716*	0.578*	0.709*	0.746*	0.739*	0.521*	0.707*	0.561*	0.733*
RND	0.510	0.442	0.851	0.639*	0.460*	0.453*	0.552*	0.372*	0.569*	0.477*	0.643*
INC	0.415	0.307	0.466	0.628	0.457*	0.465*	0.554*	0.676*	0.475*	0.708*	0.607*
ALC	0.430	0.380	0.342	0.289	0.637	0.724*	0.672*	0.521*	0.682*	0.480*	0.673*
HRC	0.433	0.390	0.474	0.288	0.455	0.617	0.612*	0.409*	0.655*	0.431*	0.733*
MKTF	0.339	0.319	0.331	0.283	0.348	0.312	0.417	0.595*	0.617*	0..543*	0.714*
NPF	0.317	0.291	0.286	0.446	0.348	0.266	0.320	0.694	0.488*	0.680*	0.534*
EXPF	0.451	0.334	0.373	0.266	0.387	0.366	0.284	0.288	0.501	0.471*	0.768*
MFF	0.289	0.252	0.298	0.379	0.259	0.229	0.237	0.383	0.225	0.457	0.528*
SCF	0.404	0.313	0.379	0.308	0.344	0.369	0.295	0.285	0.348	0.228	0.409

Note: *Correlation is significant at the 0.01 levels

Table II.
Discriminate validity testing and Pearson correlation matrix

percent level of significance are considered as having a strong association. The objective has been to extract those factors, which are significantly associated with strategic flexibility dimensions.

The notations used and their meanings are given below:

- R – Multiple correlation co-efficient.
- r – Pearson correlation coefficient.
- β – Regression coefficient (beta coefficient).

As an initial step, the Pearson correlations values have been calculated to find the level of inter correlation among dynamic capabilities and dimensions of strategic flexibility. The correlation coefficients (r) are found to be high and significant at $p = 0.01$ significance level in most of the cases. This indicates that most of the dynamic capabilities are significantly related to various dimensions of strategic flexibility. The correlation (r) values through exploratory method using SPSS 20.0 are shown in Table II.

The correlation values indicate a strong correlation between technological capabilities (TC) with market flexibility (0.739*), expansion flexibility (0.707*) and supply chain flexibility (0.733*). Also the innovative capabilities have high correlation with new product flexibility (0.676*), whereas alliance capabilities have shown significant correlation with market flexibility (0.672*) and expansion flexibility (0.682*). Advanced technology has high correlation value with expansion flexibility (0.691*) and supply chain flexibility (0.705*), and human resource capabilities with supply chain flexibility (0.733*).

The results of stepwise regression analysis are depicted in Table III along with corresponding values of R/R^2, p values and F values. The results for market flexibility show that the tolerance value for all the significant factors is greater than 0.401 (1-0.599), indicating that there is no problem of multicollinearity (overlap between dependent variables). Similarly for market flexibility the value of multiple R is 0.780

Flexibility dimension	Significant factor	Beta value	t-value	p-value	R/R^2 value	Adjusted R^2	F value	Tolerance/ VIF
MKTF	TC	0.441	4.501	0.0001	0.780/0.608	0.599	50.903	0.409/2.445
	ALC	0.281	3.128	0.002				0.488/2.047
	INC	0.170	2.195	0.031				0.659/1.518
NPF	INC	0.656	7.107	0.0001	0.731/0.534	0.530	37.451	0.561/1.782
	ALC	0.389	3.858	0.0001				0.741/1.350
	RND	−0.189	−2.048	0.043				0.556/1.798
EXPF	TC	0.274	2.721	0.008	0.788/0.621	0.615	52.877	0.391/2.632
	AT	0.328	3.703	0.0001				0.496/2.017
	ALC	0.291	3.213	0.002				0.470/2.126
MFF	INC	0.576	6.865	0.0001	0.732/0.536	0.525	57.135	0.663/1.509
	TC	0.228	2.716	0.008				0.663/1.509
SCF	TC	0.243	2.479	0.015	0.817/0.668	0.658	65.767	0.352/2.845
	HRC	0.360	4.076	0.0001				0.434/2.304
	AT	0.320	3.897	0.0001				0.502/1.642

Table III. Results of multiple regression analysis

($R^2 = 0.608$) and the adjusted R^2 is 0.599, leading to the connotation that 59.9 percent of the variance in market flexibility can be predicted from AT, TC, RND, ALC, INC and HRC combined. As the results indicate that, only technological capabilities ($p < 0.01$), alliance capabilities ($p < 0.01$) and innovative capabilities ($p < 0.05$) are statistically significant and thus play a major role in achieving market flexibility.

The role of ALC ($p < 0.01$), INC ($p < 0.01$) and RND ($p < 0.05$) has been found to be significant in case of new product flexibility. The tolerance value for these factors is greater than 0.470 (1-0.530), indicating the absence of multicollinearity in this case also. The adjusted R^2 is 0.530 indicates that 53 percent of the variance in new product flexibility can be predicted from the combination of the six factors discussed earlier. In order to achieve expansion flexibility, TC ($p < 0.01$), AT ($p < 0.01$), and ALC ($p < 0.01$) have been found to be significant factors. The tolerance values for all these three factors have been found to be greater than 0.385 (1-0.615), confirming that there is no multicollinearity. The results further reveal that INC ($p < 0.01$) and TC ($p < 0.01$) play major role in achieving manufacturing flexibility. The tolerance values for these variables are greater than 0.475 (1-0.525). The results depict that TC ($p < 0.05$), HRC ($p < 0.01$) and AT ($p < 0.01$) have significant influence on supply chain flexibility. The tolerances values for these variables are again found to be greater than 0.342 (1-0.658) confirming the nonexistence of multicollinearity.

The data was further analyzed using canonical correlation analysis. Canonical loadings measure the simple linear correlation between an original observed variable in the dependent or independent set and the set's canonical variate. The canonical loading reflects the variance that the observed variable shares with the canonical variate and can be interpreted like a factor loading in assessing the relative contribution of each variable to each canonical function. The methodology considers each independent canonical function separately and computes the within-set variable-to-variate correlation. The larger the coefficient, the more important it is in deriving the canonical variate. The computation of canonical cross-loadings has been suggested as an improved method to interpret the results in canonical correlation analysis as compared to canonical weights or canonical loadings (Hair *et al.*, 1998). Thus cross-loadings provide a more direct measure of the dependent-independent variable relationships by eliminating an intermediate step involved in conventional loadings. Generally the first set of variates satisfies these conditions and is used for interpretation.

The results of canonical analysis (Tables IV and V) indicate strong and significant canonical correlation function ($r = 0.899$ at F statistic probability of 0.00) between dynamic capabilities and various dimensions of strategic flexibility. The redundancy indices were 0.535 and 0.540 for the dependent and independent canonical variables,

Table IV.
Results of canonical correlation analysis

	Results with all variables	Results after deletion of AT	TC	RND	INC	ALC	HRC
Canonical correlation analysis between dynamic capability dimensions and dimensions of strategic flexibility							
Canonical correlation	0.899	0.895	0.888	0.899	0.885	0.888	0.897
Canonical root	0.808	0.801	0.789	0.808	0.783	0.789	0..805
F statistic probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Canonical loadings	Canonical cross loadings	Canonical loadings					
Dependent variate								
MKTF	−0.853	−0.767	−0.860	−0.832	−0.853	−0.855	−0.842	−0.858
NPF	−0.721	−0.648	−0.748	−0.714	−0.720	−0.616	−0.711	−0.731
EXPF	−0.843	−0.758	−0.820	−0.848	−0.843	−0.892	−0.834	−0.841
MFF	−0.744	−0.669	−0.765	−0.739	−0.743	−0.649	−0.750	−0.752
SCF	−0.911	−0.819	−0.897	−0.924	−0.911	−0.923	−0.921	−0.900
Shared variance	0.668		0.672	0.664	0.668	0.636	0.664	0.70
Redundancy index	0.535		0.534	0.513	0.554	0.560.	0.532	0.536
Independent variate								
AT	−0.804	−0.723	–	−0.819	−0.804	−0.838	−0.815	−0.802
TC	−0.903	−0.812	−0.903	–	−0.903	−0.925	−0.911	−0.905
RND	−0.738	−0.664	−0.734	−0.750	–	−0.759	−0.752	−0.737
INC	−0.787	−0.708	−0.806	−0.797	−0.787	–	−0.801	−0.793
ALC	−0.833	−0.749	−0.832	−0.839	−0.833	−0.855	–	−0.836
HRC	−0.807	−0.726	−0.799	−0.822	−0.808	−0.844	−0.820	–
Shared variance	0.662		0.667	0.649	0.686	0.715	0.675	0.666
Redundancy index	0.540		0.538	0.524	0.540	0.498	0.524	0.539

Table V.
Results of canonical correlation analysis

respectively. The redundancy index indicates the amount of variance in a canonical variates explained by the other canonical variates in the canonical function. The canonical loadings for independent variates ranged from 0.738 to 0.903 whereas canonical loadings for dependent variates ranged from 0.721 to 0.911. Further to assess the validity of the canonical loadings, stability runs were made by dropping one variable at a time and re-executing the canonical correlation analysis. Canonical loadings measure the correlation between dynamic capabilities and various dimensions of strategic flexibility and their respective canonical variables. Canonical loadings are found to be similar in interpretation to factor loadings. Based upon above results, a framework has been developed as shown in Figure 4.

4. Implications and conclusions

This paper provides the first empirical evidence of such a relationship with a relative choice amongst sub dimensions of dynamic capabilities for achieving strategic flexibility in large and medium scale organizations in India.

The proposed research framework studies the impact of various dynamic capabilities in manufacturing organizations on flexibility at strategic level. It is also proposed that these dynamic capabilities of the organization have a positive impact on strategic flexibility. This model contributes to the existing literature in several ways.

The major key contribution of this work is identification of various dynamic capabilities and strategic flexibility dimensions for manufacturing organizations. It has also been found that firms are able to compete and survive not only due to their ability to exploit and use their existing resources, but also need to utilize their ability to renovate and develop their organizational capabilities (Teece *et al.*, 1997).

It is believed that this topic is of importance because of its novelty, since it has not been frequently mentioned in the literature, and also because of its relevance. The

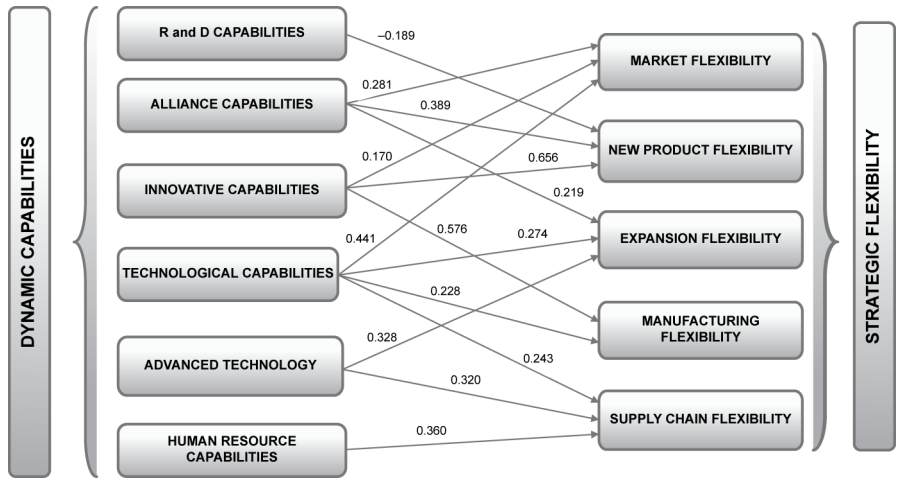

Figure 4.
Dynamic capabilities-strategic flexibility (DC-SF) significance model

findings of this work could also improve current firms' management by enabling them to survive and respond in a better manner in the turbulent environments. This study has identified six key dimensions of dynamic capabilities that firms possess, each of which contributes to achieve strategic flexibility. It is proposed that these dynamic capabilities will allow managers to achieve flexibility at strategic level for their organizations.

Finally, for academics and practitioners alike, this paper presents the possibilities for developing dynamic capabilities, which are the key factors for the growing number of manufacturing organizations seeking to enhance their strategic flexibility.

The results reveal that technological, innovative and alliance capabilities have strengthened the manufacturing organizations to respond effectively and efficiently to unpredictable and hypercompetitive business environment. The impact of technological capabilities has come out to be highly significant in developing most of the strategic flexibility dimensions. Advanced technologies have revealed a positive relation with expansion flexibility and supply chain flexibility of the organization.

In order to achieve new product flexibility, the organizations must build up their innovative and alliance capabilities. Interestingly, it has been observed that R&D capabilities have developed the significant though negative relationship with new product flexibility. This can be attributed to the fact that manufacturing organizations need to realign and strengthen their R&D capabilities by developing infrastructural, technological and intellectual competence in-house. However, these competencies can be strategically sourced for meeting the uprising demand of new product development flexibility in terms of response and range. Flexibility in supply chain can be enhanced by developing technological capabilities by making more investments in advanced technologies and giving more emphasis to human resource welfare related activities like training and education, recruitment policies, providing incentives on job training facilities and multi-skilling of the employees etc.

The results indicate that in order to respond to various market fluctuations, an organization must be capable of doing innovations and at the same time must have good alliance and technological capabilities. Similarly; alliance capabilities,

technological capabilities and investments in advance technology have shown positive impact on expansion flexibility of the organization. The results of the study also indicate that large scale manufacturing organizations in India have comparatively higher flexibility at strategic level as compared to medium scale organizations.

It can be concluded that the organizations having clear vision regarding their technological priorities and capable of doing innovations can effectively respond and survive in highly turbulent market conditions.

In this paper, the impact of dynamic capabilities on strategic flexibility in large and medium scale Indian manufacturing organizations has been studied. Since India has a strong manufacturing base, the generality of results obtained from this study is open to question. Secondly, the scope of this study was limited to manufacturing industry only and can be extended to other categories of industry also. Finally, the item measures identified for various constructs have been considered to be equally important in the study, however in real life situations, some item measures may be more important than the others. The study can be extended by attaching appropriate weights to these item measures through qualitative techniques.

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