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Flexibility, a subset of Manufacturing Strategy

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Abstract

This is a study about flexibility, a strategic dimension of a manufacturing strategy. The need for flexibility is driven by the varying customer demand, global competition, and technological advancement. Therefore in addition to quality, cost and time, flexibility has become an important competitive weapon for manufacturing companies. In manufacturing strategy, it is necessary to understand the flexibility concept based on literature review. The impact of flexibility is assessed on manufacturing strategy in view of flexibility types, evaluation methods and its application of specific business needs. The measurement of flexibility is assessed based on literature review. With rapid advancement of technology, equipment, and manufacturing methods, it is necessary to understand the implications of selecting resources. The incorporation of flexibility in manufacturing requires strategic implementation of decisions related to structure and infrastructure of the organization. This paper presents investigation into factors that influence the selection of particular flexibility by evaluating various dimensions of flexibility which enhance the competitive position of the manufacturing firms. Also this paper suggests the benefit of adoption of strategic flexibility.

Keywords: *Flexibility, Manufacturing Strategy*

Introduction

In the current manufacturing scenario, industries are facing tremendous market pressure of diversified nature due to more sophisticated market, changing customer choice and global competition. Market pressure now necessitates a strategic and tactical framework that allows companies to behave in an adaptive/flexible manner that permits continuous evolution in the market. In such a competitive scenario companies have to search for new processes, new materials, new vendors, new shop floor design and new channels to deliver their products and services at competitive prices.

The need of manufacturing strategies and operations are as follows:

- Companies are competing on global platform, which means that individual organizations have to compete now across wider array of product features.
- Reduction in lead time and life expectancy of products. Shorter life cycles require different enterprise structures focused on customers, rapid innovation, rapid response, and good quality, all at the lowest cost.
- Diversification of demand: In addition to expecting more choice of products, customers want the product they desire.
- New technologies: Technology is no longer the prime mover for improving competitiveness. Good utilization/integration of technology with business needs is now more important than ever.

In such a scenario firms needs a manufacturing strategy that address the requirement of the market. Manufacturing objectives cover such things as cost, quality, delivery and flexibility and usually there are trade-offs between them. Trade-off decisions are also required in a number of key areas in order to support the manufacturing objectives. There are five decision areas: 1) plant and equipment; 2) production planning and control; 3) labour and staffing; 4) product design / engineering; and 5) organization and management Hays and Wheelwright (1984).

Skinner (1992) has specified the performance objective that needs to be considered evaluating the performance of the manufacturing firm. These are as under:

i) Cost, efficiency, productivity,

ii) Delivery lead time,

iii) Quality,

iv) Service reliability,

v) Flexibility for product change,

vi) Flexibility for volume change and

vii)The investment required for production system.

Flexibility is one of the strategic dimensions of manufacturing strategy. In a framework of manufacturing strategy audit, Platts and Gregory (1992) assessed that flexibility is important dimension of the market need. Comparing the performance factors, Thun (2008) found that flexibility to change product mix and flexibility to change volume are significant factors which improves performance of a manufacturing firm. The capability of the firm can be improved by reinforcing advanced manufacturing system, flexible manufacturing system, computer-integrated manufacturing and other programmable automation(Mitenburg,2008). Amoako-Gympah and Acquaah (2008) have found that flexibility is important and significant factor of manufacturing strategy. Thus, along with cost, quality and time, flexibility is a strategic weapon for manufacturing firms. This paper emphasizes on defining, classifying and measuring flexibility based on literature in the light of manufacturing strategy. Also elaborate the factors responsible for selection of particular flexibility which will help in developing manufacturing strategy, which in turn improve competitive position of the manufacturing firm.

Importance of flexibility in manufacturing strategy:

Since the realization of Hays and Wheelwright (1984) and others that manufacturing actually has a strategic role to play in many firms, external conditions have continued to create pressure for fast and agile development of manufacturing in many firms. The competitive environment is changing for many industrial firms these days. Technology push and market pull work in combination to create more dynamic and unstable conditions, thereby making the concept of manufacturing strategy ever more crucial for firms.

Indian firms are facing a very different competitive scenario compared to the past. The Indian perspective on manufacturing is characterized as a support activity for marketing and finance and invited little top management attention. International competitors are continuously working on improving manufacturing, bringing new products and making manufacturing more proactive and responsive (chandra,shastri,1998). The new competition is in terms of reduced cost, improving quality, products with higher performance, a wider range of products and better service, all delivered simultaneously.

Hayes and Wheelwright(1984) defined manufacturing strategy as a consistent pattern of decision making in the manufacturing function which is linked to the product-market strategy of the firm. Hayes and Wheelwright define four stages of progression toward attainment of a truly competitive manufacturing strategy. Stage-1 (internally neutral) is a fire-fighting, reactive form of decision making where top-management is not concerned with manufacturing. In stage-2 (externally neutral), the rationale for manufacturing strategy is to keep up with industry, in a sense of industry parity. In stage-3 (internally supportive), manufacturing is closely linked to the business strategy of the corporation and becomes a force in supporting the business. Finally, in stage-4 (externally supportive), all of the functions are closely linked together, and manufacturing is a basis for competitive advantage.

Chambers (1992) has suggested five step manufacturing framework. He suggested that for manufacturing strategy the decision about structure and infrastructure of the firm plays vital role for utilizing the characteristics of manufacturing flexibility. Table-1 shows five steps of manufacturing strategy framework. Step-2 influences the decision about Step-4 (structure) of the organization). Step-3 shows how critical is for manufacturing to act together with marketing strategy in an increasingly competitive environment. It also provide basis of definition of manufacturing flexibility types for their role in manufacturing.

Table-1:Five Step Manufacturing Strategy Framework

Corporate objective Step 1	Marketing strategy Step 2	How do product win order in the market Step 3	Manufacturing strategy	
			Process choice Step 4	Infrastructure Step 5
Growth Survival Profit ROI	Product Market and segment Range Mix Volumes Standardization/ Customization Level of innovation Leader/follower	Price Quality Delivery Speed Reliability Demand Increases Color change Product range Design Leadership Technical support	Choice of Processes Trade-offs in Process Choice Process Positioning Capacity Size Timing Role of Inventory	Function Support Planning and Control Systems QA/QC Procedures Payment System Work Structuring Organizational structure

Source: Chambers (1992)

Gerwin (1993) has specified flexibility as one of the important competitive priorities or manufacturing performance objective. The flexibility is multi-dimensional and companies should select type of flexibility consistent with business strategy. Strategy includes understanding and securing the means by which the firm will satisfy customer's requirements. The strategy formulation process can include inventing new markets; almost mean reformulating the nature of operations processes that the firm currently employs (Steve Brown, 2000). Rosenzweig et.al.(2003) assessed the hypercompetitive consumer product firms where frequent change in volume product mix and schedule occur. He found that manufacturers with high integration intensity achieve superior product quality, delivery, reliability, process flexibility and cost leadership.

Manufacturing flexibility:

Sethi and Sethi (1990) have classified manufacturing strategy into three levels:

- Component or basic,

- System and
- Aggregate level.

The flexibility at basic level consists of machine flexibility, material handling flexibility and operation flexibility. It is defined as follows:

- Machine flexibility: It is the ease with which various types of operation can be performed on a machine without substantial effort in switching from one operation to another.
- Material handling system flexibility: It is the ability to transfer different parts efficiently for proper positioning and processing through the manufacturing system.
- Operation flexibility: It is the ability to be produced in different ways i.e. through different sequence of operation.

The flexibility at system level consists of Process, Product, Routing, Volume, Expansion flexibility. It is defined as follows:

- Process flexibility: This is the ability of manufacturing system to adapt to changes in production process. The changes in production process are due to changes in schedule, sequence of operations. Process flexibility is seen as operation flexibility. The benefit of operational flexibility is reduced batch size and inventory costs.
- Product flexibility: It is an ease with which new products can be introduced or substituted for existing parts. It enables companies to bring new products quickly to the market.
- Routing flexibility of manufacturing system is its ability to produce a part by alternate route through the system. Routing flexibility allows efficient scheduling of parts.
- Volume flexibility of manufacturing system is its ability to operate a firm profitably at different output levels. Chambers (1990) found that the choice of process is important factor as the utilization of the plant capacity may go up or down. This will affect the volume during peak or slack season.
- Expansion flexibility: It is an ease with which capacity or capability of a firm can be increased when needed. Expansion flexibility is important to firms with growth strategies such as venture into new markets and considered as long term or strategic flexibility (Begtsoon, 2001).

The flexibility at aggregate level consists of Program, Production, and Market flexibility. It is defined as follows:

- Program flexibility is the ability of the system to run virtually undisturbed for long period.
- Production flexibility is the set of part types that the manufacturing system can produce without adding major capital equipment.
- Market flexibility is the ease with which the manufacturing system can adapt to the changing market environment.

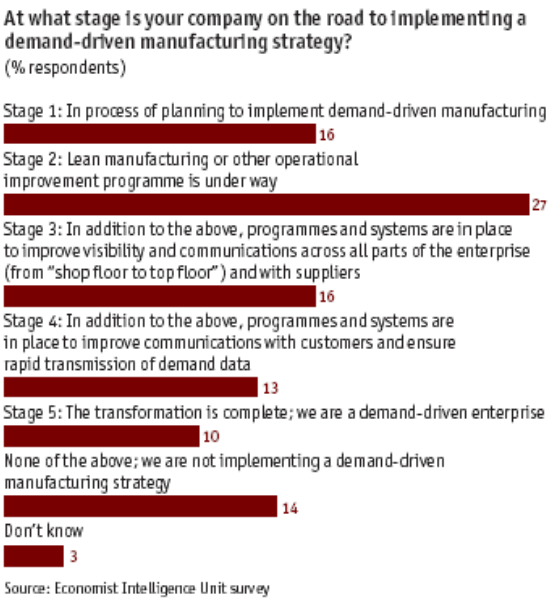
All of these flexibility types have linkages with other type of flexibility. Program

flexibility has linkages with process and routing flexibility and results in reduced throughput time by reducing the set-up time. Production flexibility has linkages with process, routing and product flexibility. Production flexibility allows firm to compete in market where new products are frequently demanded and considered as long term flexibility. Market flexibility has linkages with product, volume and expansion flexibility. Market flexibility is necessary when environment changes because of rapid technological innovation, changes in customer tastes, shorter product life cycles, and uncertainty in the source of supply and is important to firms which are under environment of change (Bengtsson, 2001).

All above flexibilities has to be weaved in manufacturing strategy framework for a firm. The deployment depends upon the trade-offs among various flexibility types. The selection of flexibility type depends upon the business environment the firm is in. Petkova & Wezel (2006) assessed need of adding exchangeability within the system and potential need for expansion of range of factors. This range of values will decide optimal value of flexibility for all the aspects of the system. When elements have similar function flexibility value will improve. For example when change in volume mix, manpower can be trained to handle range of work, the value of flexibility will increase. For seasonal variation of demand manufacturing flexibility is vital factor which allow over utilizing or underutilizing the capacity.

In order to understand customer needs manufactures need to respond on real time basis. The Economist Intelligence Unit 2008 have conducted a survey of 179 executives around the world includes respondents from chemicals, plastics, building materials, textiles, metal-processing and other sectors. The report shows that demand-driven manufacturing strategy will make the mid-size firm competitive enough to leverage the cost benefit from the rivals.

The respondents were asked to categorize their firm on the following stages:



Evaluation of manufacturing flexibility:

The flexibility is a multi-dimensional factor and difficult to quantify. Bengtsoon (2001) found that assessing one type of flexibility at a time does not provide real option. Instead all option has to be evaluated at same time. Beskese et.al.(2004) assessed the manufacturing flexibility using fuzzy concept and found relationship of parameters to find fuzzy present worth of the flexibility .The least possible value, most possible value and largest possible value of flexibility is found for continuous improvement. Rezende(2005) assessed the relationship between reputation and manufacturing flexibility of apparel industry. He presented moral hazard model in which reputation is measured by manufacturing flexibility wherein demarcated that low flexibility helps firms to maintain their reputation. Deb et.al.(2009) assessed the manufacturing flexibility using fuzzy set theory wherein

they have used hierarchical structure with two distinct level and assigned alternative under each decision criteria.

In quantifying manufacturing strategy it is found that manufacturing flexibility is strategic dimension. The measure of flexibility is required to be found out for specific manufacturing flexibility type applicable to particular firm.

Conclusion:

As first step in doing research in manufacturing strategy literature review is done. It is found that competitive factors of performance are cost, quality, flexibility, reliability. The manufacturing flexibility is found to be significant for growth of the manufacturing firms. The characteristic of flexibility type and factors that improves the value of flexibility is important for manufacturing firm to gain competitive position. The basis of manufacturing strategy is to build the capability of the firm for future endeavors. It includes developing structure and infrastructure of the organization. Developing manufacturing strategy needs proper alignment of competitive factors. Manufacturing flexibility is one of the factors which influence the decision about structure of the firm. The decision regarding the characteristic of the flexibility types needed must be evaluated and aligned with manufacturing strategy of the firm.

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