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The role of Flexibility in Linking Operations Strategy to Marketing Strategy

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Abstract

Flexibility plays a major role in linking operations strategy to marketing strategy in which it gives an organization the ability to introduce new products, adjust capacity rapidly, and customize products. It enables organizations to respond effectively to changing circumstances, particularly, when dealing with the turbulent environment that may be characterized by rapid changes such as short and uncertain product life cycles, innovative process technologies, and customized products. More specifically, flexibility addresses operations strategy in which it is a quick response to change production volume, for example, expansion flexibility links marketing to operations strategy when dealing with growth strategies such as venturing into new markets. At the same time, flexibility interacts with marketing strategy in which it enables an organization to respond effectively and efficiently to change product mix, customization of product and introducing new products.

1. Introduction

Marketing and operations strategies are integrated in which they are interrelated and correlated strategies and each one of them is considered when formulating and implementing the other as the both strategies must be clearly linked with business and corporate strategies of a firm. However, these strategies are not only correlated ones but also they contributed to forming the competitive advantage of a firm. Flexibility as a competitive weapon in the arsenal of any firm practices its activities in a turbulent environment is required for coping with uncertainty. Uncertainty according to Cheng et al., 1997 and Narian et al., 2000) emerge from two perspectives: marketing function and manufacturing function. Flexibility is the ability to respond effectively to changing circumstances (Mandelbaum, 1978). Therefore, flexibility as a multi-dimensional concept (Sethi and Sethi, 1990) can be used for addressing and analyzing the relationships between marketing and operations functions where the emphasis should place on using the different dimensions of flexibility in coping with changes associated with marketing and operations functions, particularly, when dealing with business environment. To highlight the role flexibility in linking operations strategy tot marketing strategy, flexibility dimensions should be clearly understood. In the next Section some of the flexibility dimensions are defined and identified explaining their basic functions in dealing with specific types if uncertainty.

According to Corrêa (1992) Hayes and Wheelwright (1984) identify five main competitive priorities: low cost/price, high performance (product features, tolerances and customer services), dependability (product, delivery and field service), flexibility (broad line, customized products, fast response and delivery time) and innovativeness

(new products and latest technology). Thus, manufacturing companies, according to Corrêa, (1992, p. 14) are addressing the following main competitive priorities:

- *Cost*— manufacturing and distribution of the products at low costs;
- *Cost dependability*— meeting the required or intended costs;
- *Productivity*— achievement of better utilisation of process technology, labour and material resources;
- *Product quality*— manufacturing of products with high performance and conformance to standards;
- *Range of products*— manufacturing a broad range of products;
- *Innovativeness*— introduction of new products or processes;
- *Delivery speed*— reacting quickly to customer orders;
- *Delivery dependability*— meeting delivery schedules or promises; and
- *Flexibility*— changing easily what is being done.

2. Flexibility dimensions

Flexibility is characterized as a complex process since there is disagreement about its concept and definition. For this reason, Sethi and Sethi (1990) consider it as a complex multidimensional concept, which is hard to capture. Furthermore, Upton (1994), points out that flexibility has been an elusive quality in manufacturing and operations. The term is used for many purposes, each of which characterizes a different quality or capability of a system. The taxonomies of flexibility are useful, in that they provide general types that can be used to distinguish one form of flexibility from another. These categorizations have been an important step in providing better understanding when managers deal with them depending on their concerns (Upton, 1994).

Based on reviewing the literature on flexibility, the present paper has adopted the operational definitions with supported literature for the following types of flexibility:

Product flexibility

- The ability to introduce novel products, or to modify existing ones (Slack, 1987).
- Is the ease with which new parts can be added or submitted for existing ones (Sethi and Sethi, 1990).

Volume flexibility

- The accommodation of shifts in production for a given part (Gerwin, 1982).
- The ability to vary production with no detrimental effect on efficiency and quality (Suarez et al., 1995).
- Is the ability of a manufacturing system to be operated profitably at different overall output levels, thus allowing the factory to adjust production within a wide range (Gupta and Somers, 1996).
- The ability to operate efficiently, effectively and profitably over a range of volumes (Parker & Wirth 1999).
- The ability to rapidly adjust capacity so as to accelerate production in response to changes in customer demand (Vickery and Calantone, 1999).
- The ability of a manufacturing system to vary aggregate production volume economically (Narasimhan and Das, 2000).
- The ability of the organisation to operate at various batch sizes and/or at different production output levels economically and effectively (Zhang et al., 2002).

Mix flexibility

- Mix flexibility represents the number of products that a system produces at any point in time. For example, a plant that produces two very different products (such as a personal computer and a laptop) should have greater mix flexibility than a plant, which produces two similar products (such as the two personal computers that differ only in speed and RAM characteristics) (Suarez et al., 1995).
- The ability of a manufacturing system to switch between different products in the product mix.
- The ability of the organisation to produce different combinations of products economically and effectively, given a certain capacity (Zhang et al., 2002).

Machine flexibility

- Machine flexibility deals with the variety of operations that the machine can perform without incurring high costs or expending a prohibitive amount of time in switching from one operation to another. Machine flexibility allows small batch sizes. This yields lower inventory costs, higher machine utilization, the ability to produce complex parts, and improved product quality (Gupta and Somers, 1996).
- The easiness and/or ability of making the changes required to a machine/set of machines to shift from a definite set of part types to another (Braglia and Petroni, 2000).
- The ability of a piece of equipment to perform different operations economically and effectively (Zhang et al., 2002).

Labor flexibility

- Is the ability of the workforce to perform a broad range of manufacturing tasks economically and effectively (Zhang et al., 2002).

Market flexibility

- Is the ease with which the manufacturing system can adapt to changing market environment. It allows the firm to respond to changes and exploit new business opportunities (Gupta and Somers, 1996).
- The ability of the manufacturing system to respond to or influence market changes (Das, 2001).

Process flexibility

- Process flexibility is defined as the ability of a manufacturing system to produce a set of part types without major setups. Process flexibility is useful in reducing batch sizes and, in turn, inventory costs. Because it allows machines to be shared, it minimizes the need for duplicate machines (Gupta and Somers, 1996).
- The ability of a manufacturing system to process a given set of components with different processes, operation sequence and materials (Chen et al., 1992).

New product flexibility

- The ability of a manufacturing system to introduce and manufacture new parts and products (Das, 2001).
- The ability to create new products quickly (Kara et al, 2002).

Expansion flexibility

- Expansion flexibility of a manufacturing system is the ease with which its capacity and capability can be increased when needed (Sethi and Sethi, 1990).
- Is the extent of overall effort needed to increase the capacity and capability of a manufacturing system when required. This flexibility may help shorten implementation time and reduce cost for new products, variation of existing products, or added capacity (Gupta and Somers, 1996).

- The capability of building a system and expanding it as easily and modularly as needed (Braglia and Petroni, 2000).

3. The interaction between marketing and operations strategies

As operations and marketing functions are integrated, then the purpose of addressing the relationships between marketing and manufacturing functions on the one hand is to achieve company goals (Sawhney and Piper, 2002), and to avoid conflicting objectives and plans of action on the other hand (Malhorta and Sharma, 2002). However, the conflict that may occur between the two functions is related to objectives associated with each one of them. The marketing function aims to increase revenue while production aims to reduce cost. These two objectives are often in conflict. For example, marketing would like a wide product range to increase sales while production would like to have long production runs to reduce costs (Parente, 1998).

Therefore, marketing and operations are interrelated functions in which planning the capacity is aimed at meeting market requirements. This notion is supported by Grittenden (1992) who indicated that capacity allocation involves key decisions at the interface between production and marketing functions. Therefore, capacity flexibility should be emphasized since it allows managers to:

- Change production volume to respond to customer demand;
- Produce different products on the same equipment (product mix) to respond to changing customer needs; and
- Alter product technology and process technology to maintain or improve an organization's competitive position.

More specifically, the following findings were found in the literature and they support the integration of marketing and manufacturing functions:

- Integration of manufacturing and marketing decisions impacts an organizational performance. The firm's business strategy and the demand uncertainty moderate this relationship (O'Leary-Kelly and Flores, 2002).
- In a new product development context, better functional relationships result when marketing managers know more about manufacturing and can communicate credibly with that group (Calantone et al., 2002).
- A harmonious working relationship between marketing and manufacturing is important as its impacts on a firm's competitive position and performance (Hausman et al., 2002).
- A careful assessment of the relationship between marketing and manufacturing is required to apply basic concepts such as experience curves, product life cycle analysis, and product development strategies to organize decision making (Gupta et al., 1991).
- To design a product which meets the needs of a market segment simultaneously with the manufacturing process to produce it and quickly, too (Gunasekaran et al., 2002).

Hill (1994) has addressed the relationship between marketing and manufacturing strategies as he suggested utilizing the product life cycle in conjunction with product volume data to guide manufacturing strategy development. He emphasized linking product volumes and order-winning criteria such as quality, cost, and innovation to the different stages of the product life cycle. In a similar approach, Primrose and Verter (1996) argue that defining customer needs helps managers to establish the

amount of change and uncertainty that the manufacturing facilities have to cope with, and therefore the amount of flexibility that is required. Gerwin (1993) has named different dimensions of flexibility that are required for achieving strategic objectives considering the type of uncertainty associated with marketing and operations functions. These dimensions are presented in Table 1

Table 1: Dimensions of flexibility. Source: Gerwin, 1993, p. 398

Type of uncertainty	**Strategic objective**	**Flexibility dimension**
Market acceptance of kinds of products	Diverse product line	Mix
Length of product life cycles	Product innovation	Changeover
Specific product characteristics	Responsiveness to customers' specs	Modification
Aggregate product demand	Market share	Volume
Machine downtime	Customers' due dates	Rerouting
Characteristics of materials	Product quality	Material
Change in the above uncertainties	Strategic adaptability	Flexibility responsiveness

According to *Nakane and Hall (1991*), flexibility is defined as a quick response to:

- Change production volume.
- Change product mix.
- Customisation of product (provide each customer what they want)
- Introduce new products.
- Adopt new technology.

Considering the above definition, the interaction between marketing and operations functions can be addressed to portray that interaction as follows:

(1) *Change production volume* as a basic function for manufacturing flexibility, helps organisations to respond to fluctuations in demand for each stage of the product life cycle. Production volume might be needed to be increased to meet the requirements of

growth and maturity stages, since these stages are characterised by increasing demand. At the same time, decline stage is met by reducing or stopping the production to eliminate the moribund products. Changing the production volume is carried out by volume flexibility. Volume flexibility is the ability of a manufacturing system to vary aggregate production volume economically (Narasimhan and Das, 2000). In other words, volume flexibility means" the ability to vary production with no detrimental effect on efficiency and quality (Suarez et al., 1995).

Parker and Wirth (1999) define volume flexibility as the ability to operate efficiently, effectively and profitably over a range of volumes. A greater volume flexibility is attained by having lower operating fixed costs, lower variable costs, higher unit prices, or greater capacity. Primarily this means lowering costs, variable or fixed, since often prices are market driven and capacity amount decisions are often chosen in reaction to demand expectations (Parker and Wirth, p. 435).

According to Narasimhan and Das (2000) volume flexibility is considered as an example of tactical flexibilities, which correlate to plant level. Without having this dimension of flexibility, a given organisation may find it difficult to cope with changes in product life cycle through passing a product or service from one stage to another.

According to Slack (1987), volume flexibility has two aspects, speed of response and range of variation, the former being useful in the short-term, and the latter in the long-term. The purpose of volume flexibility is to guard against uncertainty in demand levels. Gerwin (1993) suggests that the uncertainty is the aggregate product demand and the strategic objective is market share. According to Parker and Wirth (1999), the objective of a measure of volume flexibility is to gauge the range of profitable volumes and the limits of this range. Therefore, a volume flexibility measure should

not be technology specific, that is, it should be applicable to any technology and be comparable among systems of differing volumes; and it should increase (decrease) with increasing (decreasing) range of profitable production volumes (Parker and Wirth, 1999, p. 435). The analysis of the volume flexibility measure is given by Parker and Wirth (1999) as shown in Table 2

Table 2: Analysis of the volume flexibility measure. Source: Parker and Wirth 1999, p. 438.

Purpose	**Criteria**	**Compatibility**
To guard against aggregate demand fluctuations	Should increase (decrease) with an increasing (decreasing) range of profitable volumes	Yes
To be applicable to a variety of production technologies	Should not include aspects particular to specific manufacturing systems or technologies	Yes
To gauge the range of profitable volumes for a multi-product firm	Should permit a direct comparison between single product and multi-product firms Should be able to compare systems of differing volumes and capacities	Yes Yes
To be used as a quick reference for operational managers	Should be easily calculable	Yes

(2) *Changing the product mix* is carried out by mix flexibility. Mix flexibility is measured by the number of products that a system produces at any point in time (Suarez et al., 1995). Mix flexibility contributes to satisfying customer needs' variations in the target market by producing products and introducing services for all market segmentations.

Mix flexibility supports competitive advantage by enabling an organisation to compete on a basis of variety of products and services. In other words, mix flexibility might help organisations in preparing, improving, and developing their reactive and

proactive marketing strategies to deal with competitors' actions. According to Gerwin (1993) mix flexibility is used as a strategic objective to cope with uncertainty associated with market acceptance of kinds of products.

(3) *Customisation of product* (provide each customer what they want). Customisation of product means the quick response to deal with customers' needs and wants to satisfy all levels of customer expectations.

(4) *Introduce new products*. New product flexibility is characterised as one of the strategic flexibilities (Narasimhan and Das, 2000). New product flexibility means the ability of a manufacturing system to introduce and manufacture new parts and products. An organisation needs new product flexibility to respond to new cycle of the product, which requires producing new products to cope with new changes and situations in the target market segmentations. However, new product flexibility gives the power and ability to translate the first stage of the PLC into action since this stage is started by launching new products. Therefore, an organisation is unable to cope with these changes without having this dimension of flexibility.

(5) *Adopt new technology*. Adopting new technology is an equivalent concept to expansion flexibility. Expansion flexibility of a manufacturing system is the ease with which its capacity and capability can be increased when needed (Sethi and Sethi, 1990).

According to Sethi and Sethi (1990) the capacity is in terms of output rate per unit time, whereas capability refers to such characteristics as quality, the technological state and other types of flexibilities. In contrast with volume flexibility, expansion flexibility is concerned with capacity (i.e., the maximum feasible output level). Expansion flexibility makes it easier to replace or add machinery by providing for

such possibilities in the original design. Ease in this connection refers to the overall effort needed for the expansion. It would include the direct cost, the indirect cost of interruption in production because of the expansion, and the speed with which the expansion can be accomplished (Sethi and Sethi, 1990, p. 309).

Expansion flexibility is important for firms with growth strategies such as venturing into new markets, since it permits step-by-step adaptation of the system for expansion. In contrast, volume flexibility serves survival strategies such as maintaining existing markets and profitability. Expansion flexibility helps to reduce implementation time and cost for new products, variations of products, or added capacity. (Sethi and Sethi, 1990).

4. The use of flexibility dimensions in linking operations strategy to marketing strategy

To provide a better understanding for the role of flexibility dimensions in linking operations strategy to marketing strategies, there is a need for determining the specific functions for each dimension of flexibility in planning the operations and marketing strategies as follows:

4.1 Product flexibility:

The following marketing strategies are required when introducing new products into the markets:

- Create product awareness and trial;
- Customer knowledge;
- Market segment; and
- Customer follow-up.

These strategies need to be integrated with the following operations strategies:

- Crude production facility;
- Small production runs;
- Subcontracting; and
- Attracting competent employee.

The above strategies can be carried out using product flexibility to introduce novel products to create awareness of customers in the target market. Product flexibility is more specifically the ability to handle difficult, non-standard orders, to meet special customer specifications, and to produce products characterised by numerous features, options, sizes or colours (Vickery and Calantone, 1999). Product flexibility allows the company to be responsive to the market by enabling it to bring newly designed products quickly to the market (Kara et al., 2002).

It has been argued that today's manufacturing environment can be characterised by intensified competition, rapid market changes, and increased product variety and short product life cycles. These conditions require a manufacturing enterprise to be flexible by responding rapidly to product demand changes (Persentili and Alptekin, 2000). Therefore, product flexibility is a basic type of flexibility required to deal with uncertainty. In the empirical work by Abdelmalek et al. (2000), product flexibility was strongly selected as the most important type. The primary reason for this is that it helps achieve product diversification and family marketing strategy.

According to Kara et al. (2002), the following indications from the literature support the role of product flexibility as a key competitive priority in the operations literature:

1. Product flexibility allows the company to be responsive to the market by enabling it to bring newly designed products quickly to the market (Carter, 1986; Gerwin and Tarondeau, 1989);
2. Product flexibility becomes important to design and develop the production facility to be-product flexible (Sethi and Sethi, 1990);
3. Product flexibility provides the company with a formidable competitive weapon to respond to flux markets and uncertain product life cycles (Sethi and Sethi, 1990); and
4. Smaller companies in many industries often adopt a strategy of competing on the basis of product flexibility, that is, their ability to handle difficult, non-standard orders and to lead in new product introduction (Sethi and Sethi, 1990).

Based on the above argument, it can be concluded that product flexibility plays a major role in linking marketing strategy to operations strategy.

4.2 New product flexibility

The manufacturing firms need to be flexible to introduce and manufacture new parts and products. As product life cycles dramatically decrease, increasing strategies emphasis is being placed on bringing many new products to market as quickly as possible (Kara et al, 2002).

New product flexibility gives an organization the ability to introduce new products to the markets in responding to changes associated with customers' expectations. New product flexibility integrates marketing strategy with operations strategy. Marketing strategy through meeting customer satisfaction and operations strategy through acquiring the facilities and resources that are required for manufacturing the products

or parts that satisfy the customer needs and wants considering the decrease of product life cycle. In the same vein, Kara et al. (2002) argue that new product flexibility gives a firm the ability to create new products quickly. This is an attribute that has become extremely important in many industries. As technology advances at an ever-increasing rate, and customers become more sophisticated, rapid product introduction can give firms a *significant* competitive advantage. (Kara et al., 2002, p. 93). Thus, "new product flexibility is needed in technology intensive markets" (Viswandham and Raghavan, 1997).

It seems that today's marketplace is characterised by rapid changes and shorter product life cycles, which place a greater emphasis on having the ability to launch new products to respond to these changes. The following from the literature on flexibility support the above argument:

- The environments of firms are changing in dramatic ways- product life cycles are shorter, demand for product customisation is swelling, pressures of globalisation and technological innovation are overwhelming (Arsis and Zhang, 2002).
- The external business environment in which a firm competes changes continually, so an organisation needs to adapt to that environment continually (Badri et al., 2002).
- Fast and dramatic changes in customer expectations, competition, and technology are creating an increasingly uncertain environment (Zhang et al., 2002).
- In today's fast paced environment, characterised by short product life cycles and increasing product variety, manufacturing flexibility is emerging as a key competitive weapon (Vokurka and O'Leary-Kelly, 2000).

- The rapid proliferation of new process and product technologies as well as intense competition has led to shorter product life cycles and faster rates of product obsolescence (Franza and Gaimon, 1998).

Based on the above argument, it can be concluded that new product flexibility should be taken into consideration, as companies need to increase their market shares by gaining new customers in order to develop the competitive advantage. Therefore, the need for dealing with new product flexibility supports the competitive advantage of a firm to meet the customers' expectations since they are continuing to change at an increasing rate. In other words it can be concluded that the following reasons place a greater emphasis on having new product flexibility to satisfy the customer needs and expectations simultaneously:

- Customers switch to different brand products or services or stop using a particular product or reduce the consumption of the product or service (Karakaya, 2000).
- Customers move into different family life-cycle stages and eventually decrease consumption (Karakaya, 2000).
- In most case, customer's exit from a market is clearly the dominant response to dissatisfaction (Foretell and Wernerfelt, 1987).
- Changes in customers' tastes, psychographics, or demographics result in market decline or force products to enter the decline stage of the product life cycle (Karakaya, 2000).
- Competitors' actions and their abilities to launch new products impact on entry to or exit from the markets (Kim et al., 1999).
- In response to shortened product life cycles, many firms attempt a more rapid entry to new product markets (Griffin, 1993).

- A late market entry adversely affects the profitability of a product substantially more than product development or production cost overruns (Franza and Gaimon, 1998).

Therefore, the business must be active in developing its offerings so that they maintain a competitive advantage in the marketplace. New product development may be aimed at gaining a dominant position in the market or developing a particular consumer niche (Wickham, 2000).

4.3 Volume flexibility

The focus of operations function is to manage demand and capacity during the sales growth across the product life cycles as the demand is increasing while the focus of marketing function is to maximize market share and develop product loyalty. Flexibility acts as a strategic tool to avoid the imbalance between demand and capacity, which results in causing several risks for organisations such as entering competitors to the market and reducing the market share. Thus, capacity and demand concepts are related to each other. Particularly, it is the volume flexibility that is used for making the balance between demand and capacity. Volume flexibility is the ability of a manufacturing system to be operated profitably at different overall output levels. It demonstrates the competitive potential of the firm to increase production volume to meet rising demand and to keep inventory low as demand falls (Sethi and Sethi, 1990; Gerwin, 1993). Volume flexibility permits the factory to adjust production upward or downward within wide limits (Kara et al., 2002).

Organizations need volume flexibility to fit capacity with different volumes of demand across the product life cycle. Therefore, organizations should determine the

sources that contribute to generating the volume flexibility. In this context, Jack and Raturi reviewed the literature on volume flexibility to conclude the sources of volume flexibility. They distinguished between internal and external sources of volume flexibility as seen in Table 3.

Table: 3 Sources of volume flexibility (VF). Source: Jack and Raturi , 2002, p. 523

Sources	**Comment**
Internal sources of volume flexibility (VF)	
Product and process technologies	Automated manufacturing technology (AMT) such as FMS which increases VF
Batching	Large production batches require more automated equipment; which restricts VF
Production planning and control systems	Scheduling slack supports VF
Capacity	Slack capacity allows larger orders to be processed without negatively impacting on-time delivery performance
Setup-time/cost	High setup cost reduces VF
Facility and equipment	Facilities and equipment influence production cycle time which has an inverse relationship with VF
Workforce/labour flexibility	Slack work time, cross-training, overtime, multiple shifts, seasonal labour supports VF
Layout	Dedicated processes and production equipment increases VF
Product design	Cross-functional product design can facilitate a modular approach to support product postponement and increases VF
Overhead cost	Overhead cost is inversely related to VF in the long run
Inventory slack	Higher inventory of parts, materials, and finished goods facilitate upward adjustment in volume
Range of products	Smaller product range/mix requires higher VF
External resources of volume flexibility	
Vendor/supplier network	Impacts the lead-time for orders and the volume range for orders obtainable within a given lead time
Supplier relationships	Subcontractors/suppliers can absorb volume fluctuations
Network of plants	Chaining multiple plants increases product mix and VF
Off-shore plants	Off-shore plants provide surge capacity and support VF
Strategic alliances in the distribution network	Improves delivery reliability, streamlines the supply chain and supports VF

Considering the above sources of volume flexibility, it could be concluded that volume flexibility is considered when planning operations strategy. Examples of operations strategies affected by volume flexibility are mentioned by Jack and Raturi (2002) in which they believe that firms deploy varying strategies for creating volume

flexible responses; these include using overtime and temporary workers, cross training workers, developing complementary product portfolios, creating and maintaining slack resources, creating a network of facilities, improving forecasting and planning systems with information technology as well as leveraging the firm's ability to negotiate on volume with suppliers and customers (Jack and Raturi, 2002, p. 520).

4.4 Machine flexibility

Machine flexibility is the ability of a piece of equipment to perform different options economically and effectively (Zhang et al., 2002). It refers to the ability of different types of operations that the machine can perform without requiring a prohibitive effort in switching from one operation to another (Sethi and Sethi, 1990). It has been argued that many technological sources of machine flexibility. Lack of these sources result in a less machine flexibility. According to Kara et al. (2002), technological sources of machine flexibility are numerical control, easily accessible programs, rule-based languages, sophisticated part-loading and tool-changing devices. These are built in to ensure easy changeability of work pieces, tools, size of the tool magazine, availability of sufficient pallets and fixtures, number of axes, automatic chip removal, adaptive control to optimise metal removal, diagnostic software, and integration CAD[1]/CAM[2] Therefore, operators need to be trained to acquire programming, maintenance, and diagnostic skills (Kara et al., 2002, p. 88-89).

By linking the above benefits of machine flexibility to marketing and operations strategy, it can be noted that organisations need to be flexible by:

[1] CAD: Computer -Aided Design
[2] CAM: Computer -Aided Manufacturing

1. Allowing lower batch sizes results from prerequisites that are related to changes associated with the introduction and decline stages of product life cycle.
2. Achieving higher machine utilisations should be highlighted for all stages of product life cycle to manage fluctuations in demand, and link them to available capacity.
3. Saving in inventory cost can be met by producing reasonable quantities of production to meet customer needs and expectations. Machine flexibility helps in achieving this goal when dealing with small batch sizes according to the replaced orders, which satisfy the present requirements.

Shorter lead times for new products are resulting from the rapid changes in the marketplace. Therefore, machine flexibility is able to deal with these changes by maximising machine utilisation in accordance with demand and capacity management

4.5 Mix flexibility

The literature on operations strategy supports the idea that organizations use mix flexibility to cope with uncertainty. It could be matched with capacity strategies uncertainties experienced by the changes in product life cycle (Awwad, 2004). Mix flexibility gives organizations the ability to produce different combinations of products economically and effectively given certain capacity (Sethi and Sethi, 1990; Gupta and Somers, 1992, Zhang et al., 2002). However, Zhang et al. (2002) have found a positive impact of mix flexibility on customer satisfaction by providing the kinds of products that customers request in a timely manner.

Mix flexibility may reduce volume fluctuations, which may theoretically reduce the need for volume flexibility (Suarez et al., 1995). Mix flexibility may be achieved through skilled workers or programmable equipment (Kara et al., 2002). In addition,

mix flexibility is important when a firm has a broad product line and caters for different market segments (Viswandham and Raghavan, 1997).

The above argument supports the idea that mix flexibility links operations strategy to marketing strategy in the following issues:

- Mix flexibility affects the investment decisions.
- Mix flexibility gives a valuable insight into planning the operations strategy.
- Mix flexibility is considered when predicting the changes associated with product life cycle.
- Mix flexibility is considered when planning manufacturing strategy.
- Mix flexibility is considered when planning capacity strategies.
- Mix flexibility affects the decisions of facilities expansions.
- Mix flexibility can be used as a predictive tool in forecasting demand.

4.6 Process flexibility

The literature on flexibility supports the role of process flexibility in planning operations strategy and marketing strategy. Process flexibility represents the ability of the system to adjust to and accommodate changes/disruptions in the manufacturing process. Examples of these changes/disruptions found in the literature are machine breakdowns, change in the production schedules, or job sequencing.Process flexibility, according to Gerwin (1989), satisfies the strategic need for being simultaneously able to offer to consumers a range of product lines (Sethi and Sethi, 1990, p. 302). Berman (2002) indicated that process flexibility is used by mass producers to deal with mass customisation strategy. In other words, process flexibility is more relevant to be linked to mass customisation strategy because mass customisation firms rely on small production lot sizes, appeal to the unique

preferences of individual consumers, seek very low levels of inventory, and attempt to cut the costs of small production runs by reducing both set-up and changeover times (Berman, 2002, p. 53). Therefore, it is believed that process flexibility enables a firm to meet customer's expectations and needs, in particular, when adopting the customisation strategy where the firms rely on small production lot size. By linking the Berman's (2002) view for process flexibility to marketing-operations interface, it could be concluded that that process flexibility gives manufacturing companies the ability to respond to the low demand that may take place in the introduction and decline stages of product life cycle where the number of customers is few due to the changes that affect the shape of product life cycle.

The role of process flexibility is also emphasised by (Browne et al, 1984; Sethi and Sethi, 1990). They point out that the main purpose of process flexibility is to reduce batch sizes and reduce inventory costs. This can be accomplished even when there are shifts in the product mix demanded by the market. Carter (1986) also emphasises that process flexibility allows machines to be shared and thus minimises the need for duplicate or redundant machines.

4.7 Expansion flexibility

Expansion flexibility is the ability to increase capacity and capability easily when needed (Sethi and Sethi, 1990). *Expansion flexibility* is important for firms with growth strategies. Manufacturing companies use expansion flexibility to meet the fluctuations of demand, in particular, the increasing demand that may occur in the growth and maturity stages of product life cycle. In this context, Kara et al. (2002), argue that expansion flexibility makes it easier to replace or add machinery, by providing for such possibilities in the original design. Therefore, expansion flexibility

is important for firms with growth strategies such as new market ventures, since it permits step-by-step adaptation of the system for expansion.

According to Awwad (2004) expansion flexibility is linked to operations strategy, particularly, capacity strategies. Examples on capacity strategies that may be linked to expansion flexibility: are "small production runs, plant expansion, increasing production runs, back orders, hiring full time employees, standardising the products, rent capacity, share capacity, developing new channels, extending product range, entry deterrence (through capacity expansion in a market), developing new markets, etc.".

In the work by Gaimon and Singhal (1992), they indicated that short product life cycles have important implications for a firm's choice of manufacturing flexibility. They argue that in the past, firms could afford to invest in dedicated facilities to produce a single high-volume product since the product's long life cycle would extend over the useful life of the facility. However, as a result of short product life cycles, firms are faced with the challenge of planning for facilities whose useful lives are much longer than the life cycle of any individual product it manufactures. This situation requires that manufacturing facilities have the capability to be changed over to new products more frequently (Gaimon and Singhal, 1992, p. 211).

4.8 Market flexibility is the ease with which the manufacturing system can adapt to changing market environments**.** Market flexibility is important for a firm's survival in environments that are constantly in flux. It allows the firm to respond to environmental changes (change in customer tastes, short product life cycles, uncertainty in sources of supply, etc.). Market flexibility is essential if the firm's

market strategy emphasizes customized products and frequent product changes **(**Sethi and Sethi, 1990). Market flexibility plays a major role in responding to changing markets, particularly, if these markets are characterised by a high degree of predictability and less degree of changeability. Market flexibility gives organizations the ability to thrive in a turbulent environment, which is the main source of failure in manufacturing industry (Small and Downey, 1996). Therefore, the inability of employing market flexibility in coping with anticipated or unexpected changes in the surrounding environment will result in uselessness effect on planning the operations strategy including the demand and capacity strategies. However, Zhang and Sharifi (2000) urge organisations to exploit changes and take advantages of changes as opportunities in which an emphasis on market flexibility should be placed.

5. Conclusion

Managers need to deal with several types of flexibility to plan the marketing and operations strategies to cope with cope with uncertainty associated with marketing and operations functions. In other words, flexibility can act as a strategic dimension of competitive advantage which is used for linking operations strategy to marketing strategy to achieve a higher utilization of capacity and meeting the customer expectations. Therefore, to achieve the organizational objectives, managers need to link operations strategy to marketing strategy employing various types of flexibility. More specifically, authors (e.g. Gerwin, 1993) suggested that several types of flexibility are required for coping with several certain types of uncertainties. Thus, It could be concluded that making a balance between demand and capacity, is a key for planning the marketing and operations strategies. These strategies need to be linked together using different types of flexibility. More specifically, the rationale for

employing various dimensions of flexibility in linking operations strategy to marketing strategy is threefold.

1. Manufacturing companies usually face different volumes of uncertain demand across the product life cycle, which should be met by carrying out different options of capacity strategies.
2. It is usually difficult for manufacturing companies to always adopt one dimension of flexibility for managing different types of uncertainty.
3. Fast and dramatic changes in customer expectations, competition, and technology are creating an increasingly uncertain environment. These changes emphasize the role of different dimensions of flexibility in the adoption of different options of capacity strategies to fit capacity with demand across changes in the product life cycle.

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