An Explanatory Model for Restoring Manufacturing Competitive Advantage in Egypt

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Abstract

In this paper, we present an explanatory model for gaining competitive advantage in the manufacturing sector. First a conceptual model of manufacturing strategy, with a view to give competitive advantage in the market, is developed and concepts such as competitive priority, product and process profile and its implication on competitive advantage are explained. Then once the model is fully developed we map it into a meta-model based on business dynamics methodology. This process will help us understand the policy that government and managers must follow to achieve the ultimate goal of being competitive in the global market.

Introduction

The Egyptian manufacturing sector has been undergoing several changes since Egypt gained independence from Britain in 1952. The manufacturing sector operated under socialist charter where planned economy was in vogue. The Egyptian market was closed to outside competition, and the market absorbed all the production. Without competition the emphasis on quality and innovation was absent at best.

With the adoption of market economy, the Egyptian manufacturing both public and privatized found themselves ill-equipped to face the competition that companies from overseas had posed for them.

As Egyptian economy is moving into a decade of WTO globalization program the manufacturer has been hit bad. Manufacturing companies unless supported by multinationals are not able to compete with cheap imports from China, India and other trading partners.

Sufficient to say, Egyptian manufacturing companies need to develop core competences in terms of quality, delivery, price and variety and be able to produce products at levels which allow them to stay put in business in Egypt and to be able to compete globally for growth and existence.

In this paper, we present an explanatory model for gaining competitive advantage in the manufacturing sector. First a conceptual model of manufacturing strategy, with a view to give competitive advantage in the market, is developed and concepts such as competitive priority, product and process profile and its implication on competitive advantage are explained. Then once the model is fully developed we map it into a meta-model based on business dynamics methodology. This process will help us understand the policy that government and managers must follow to achieve the ultimate goal of being competitive in the global market. (Figure 1)

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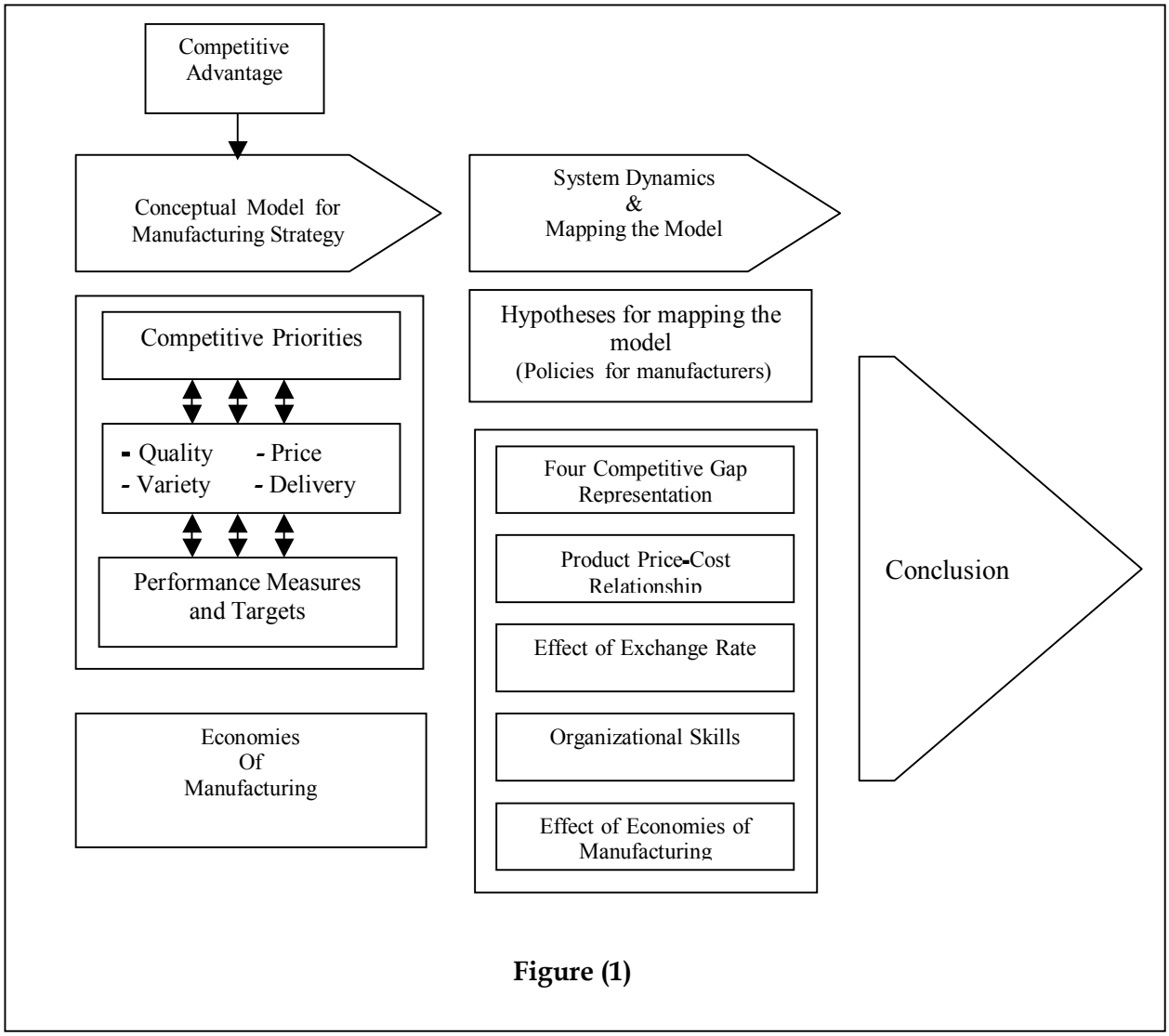

Figure (1)

Conceptual Model for Manufacturing Strategy to Achieve Competitive Advantage

Developing a conceptual manufacturing strategy model has been an area of interest to both academics and practitioners ever since skinner (1969) published his landmark article on linkage of manufacturing strategy to corporate strategy. A sound manufacturing strategy that supports a firm's corporate strategy is a key to develop a competitive advantage in the market (Skinner, 1969).

Manufacturing strategy is the mean to achieve corporate goals; that is being competitive in the market, and is developed through effective use of manufacturing strategy as a competitive weapon (Imam, 1991). In strategy literature wheelwright and Hayes (1985) have identified and delineated four stages in the evolution of manufacturing strategic role.

It ranges from internally neutral to externally supportive. Egypt at this junction is in essence of an internally neutral stage. The key to moving from internally neutral to externally positive is through elevating the level of performance in terms of competitive priorities.

Competitive Priorities

Researchers (Wheelwright and Hayes, 1978; Hayes and Schemenner, 1978; Krajewski and Ritzman, 1987) introduced and expanded on the concept of competitive priorities. Krajewski and Ritzman (1987) suggest seven competitive priorities: cost, quality consistency, quality level, delivery time, delivery dependability, product flexibility, and volume flexibility.

Competitive priority then is an externally focused variable and performance measures need to be developed for each competitive priority so that a competitive benchmark can be developed for sustainable competitive advantage. Competitive priorities can be defined as a collective judgment of the market in choosing among competing alternatives (Schlie, 1987).

The mission of competitive strategy is to achieve differentiation of the company product or group of products and to maximize the value (both embedded and perceived) by the proper choice of attributes for the product. These attributes are called competitive priorities. In this paper we take into account only four competitive priorities namely: delivery, quality, variety and price.

We are looking here at the performance impact of competitive priority as an element of strategy. *One way to think of this is to ask a question: If two competitors were active in a market segment of equal attractiveness in economic terms, had an identical product (e.g. automobile), and had equal capacity to take advantage of this segment, what impact would the way they chose their competitive priority, or cluster of competitive priorities, have on their relevant performance in the market?*

Bundling of Competitive Priorities

Let a product's attributes, which are perceived as a competitive advantage for a customer group, be represented by a vector notation CPP.
Then,

Competitive Priorities of a Product CPP
= f (Price, Quality, Variety)
= f (P, Q, V)

The right hand side of the equation is functionally targeted at the elements of the right hand side, which may vary from one competitive priority to a full set of competitive priorities. The products (1 to n) are the same physical products and having different logical attributes attached to them,

Product 1: CPP = f (Price)
Product 2: CPP = f (Price, Quality)
Product 3: CPP = f (Price, Quality, Delivery)

It is sufficient to say that many combinatorial possibilities occur, each one of them can have further ranking in terms of its elements stated. In the above examples, each unique combination, which will be of competitive value to the customer, will manifest itself in a competitive product or products.

Performance Measures and Targets for Competitive Priorities

Competitive priorities are not scalar in nature, but rather vector quantities. The concept of quality is ambiguous unless a target level is defined in terms of different components of quality like performance, reliability, durability…etc, then quality can be used as a relevant goal for the manufacturing strategy process.

Competitive priorities need to be benchmarked against competitors, and hence performance measures need to be developed for each of the competitive priorities. Performance targets need to be evaluated on a continuous basis as they are constantly changing due to the market dynamics. Performance target is an exogenous variable, which is transparent to the customer and therefore has a critical influence on the competitive strategy, vis-à-vis competitive priorities.

The quality and the effectiveness of the competitive priority or priorities will determine the success or failure of the firm in terms of growth, revenue, or market share. A set of four competitive priorities and their performance measures that are relevant to the manufacturing system in achieving a sustainable competitive advantage are suggested and listed in figure (2).

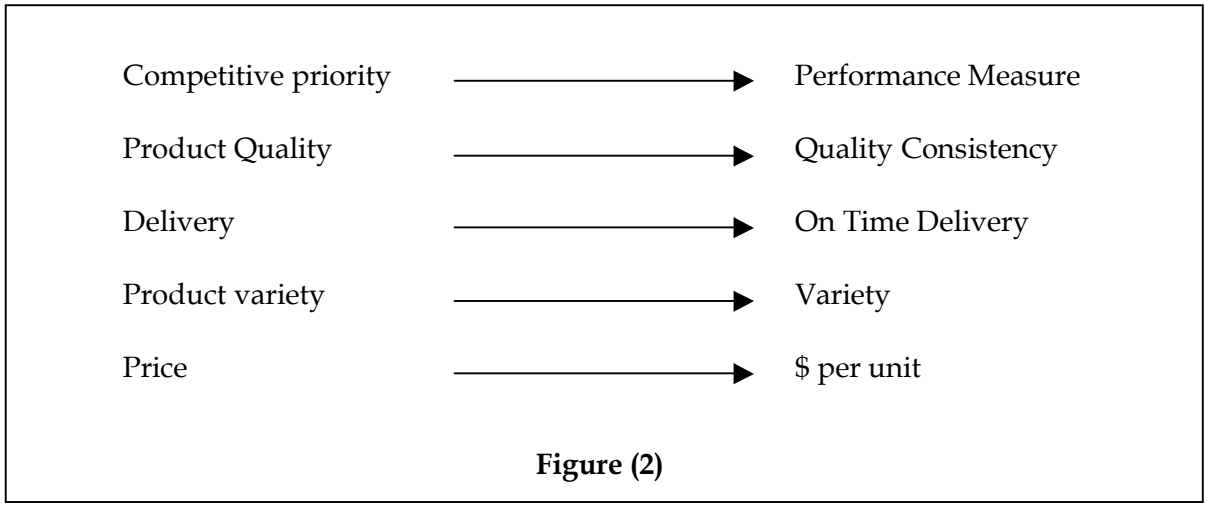

Figure (2)

The proposed competitive priorities are now discussed in details.

Product Quality

The American Society for Quality Control defines quality as the totality of features and characteristics of a product or service that bears on its ability to satisfy given needs (Evans et al., 1990). Quality then represents one of the attributes of the product that differentiates it with that of a competitor's product or products within a segment.

Skinner (1969) and Wheelwright (1978) have suggested quality as a competitive priority. Garvin (1987) and Plsek (1978) have both suggested eight different dimensions of product quality which enhances the competitiveness of a product.

Products compete on the basis of quality level. Garvin (1987) holds the view that managers need to have an aggressive strategy to gain and hold markets with high quality as a competitive lynchpin. Chase and Acquilano (1989) echo his contention by writing that "quality is not simply a problem to be solved, it is a competitive weapon."

A number of studies in both manufacturing and service firms indicate that quality is highly correlated with market share. The two examples given bellow illustrate and reinforce the notion of quality as a dominant competitive weapon:

1. Businesses that improved quality during the 1970s achieved market share gains three to six times higher than those whose quality did not improve or declined (Plsek, 1987).

2. The results of a 1987 Gallop survey of top executives showed that executives viewed the task of improving service quality and product quality as the most crucial challenge facing companies over the next few years. These executives ranked quality improvement ahead of such issues as: productivity, product liability, government regulations, and labor relations. The survey recognized that quality is a major weapon that could be used to restore the United States competitive position in world markets. Most experts feel that quality has been a dominant factor in the success of the Japanese in world markets (Evan et al., 1990).

Both practitioners and academic researchers have come to a consensus that quality is an important attribute of a product and is a dominant factor in enhancing differentiation from competitors. The importance of quality as a competitive priority of a business cannot be overemphasized. A robust performance measure for quality is the quality consistency at a level which a product is targeted for.

Price

Price as a competitive priority reflects the emphasis the company places on its ability to achieve competitive advantage. The Japanese have a considered low price as a dominant competitive priority as opposed to North American executives who list it as their fifth and sixth important criterion for competing in the market (Miller et al., 1985).

Schroder et al. (1986) suggest that price is an externally focused variable and managers use low price to express the competitive emphasis of the company. Some authors (Wheelwright, 1978; Hayes and Wheelwright, 1987; Krajewski and Ritzman, 1987) consider production cost as reflecting the competitive emphasis of the company. This notion of cost – as opposed to low price – creates confusion in the sense that low production cost dose not necessarily need to be translated into low price for competitive advantage, yet for a company to compete on the basis of low price, it necessitates a low per unit production cost.

Porter (1985, 1998), in his generic strategy model, examines two major marketing planning concepts, and alternatives available with each competitive scope and competitive advantage. There are two different cost-based strategies: cost leadership and cost focused. Low price is what is transparent to a customer and is an externally oriented variable, as opposed to cost which is an internally focused variable and is the output of the manufacturing system. The performance measure here is the level of pricing that the company attaches to its product.

Product Variety

Product variety is a means to achieve differentiation across segments. When a firm tailors its offering to the specific needs of each segment, it enhances its chance of competitive superiority. The extent to which competitive superiority is achieved is incidental to the degree of differentiation within the segments its competitors have pursued. Variety, then, is never a standalone competitive priority to achieve competitive advantage.

Researchers in the area of manufacturing strategy (Wheelwright, 1984; Krajewski and Ritzman, 1987) have not considered product variety as a competitive priority, but have instead defined product flexibility as a competitive priority.

Wheelwright (1984) defines product flexibility as the ability to handle non-standard orders and to introduce new products. This definition pertains to the internal capability of the firm rather than a strategic and eternally focused parameter. Product variety is an element of competitive strategy set, and hence drives the internal capability of the firm.

It can be argued that product variety enlarges the domain of competitive strategy by differentiating across segments, and enhances the competitive advantage of a firm dramatically if coupled with differentiation within a segment. Because of globalization and rising income around the world, markets for consumer goods and intermediate goods are becoming more sophisticated. Markets are also becoming more segmented and specialized; not everyone is prepared to accept the same product designs and specifications.

Goldhar and Jelinek (1983), Talaysum et al. (1987), and Schlie and Glodhar (1989) have all suggested a movement from economies of scale to economies of scope, clearly implying that product variety is a competitive priority. The degree to which a company enlarges its product offering, both in terms of depth and breadth, is a measure of its performance in relation to its product variety.

Noori (1990) in his book "Managing the Dynamics of New Technology," has suggested, citing Steinberg (1983), that there is a trend towards highly segmented markets, and that firms competing in fragmented markets will find that they need the flexibility of a manufacturing system capable of producing a variety of products in various volumes and in vendor orders.

Product variety as a marketing concept is more in line with the concept of competitive priority, whereas product flexibility is a more internally focused attribute of the manufacturing system. Variety (breadth and depth) can be considered as a performance measure for product variety.

Delivery

All firms deliver products to their customers, where customers may be internal or external. The notion of delivery becomes important when the concepts of time and reliability become the attributes of delivery.

Delivery by itself has no competitive edge, it is only when the time elapsed between the customer order and its filling is superior to other competitors does it contribute towards augmenting the product. This time spread between the order and actually filling it can be defined as delivery speed or time.

Notwithstanding, delivery speed, the firm can differentiate its product on the basis of reliability of delivery has been suggested as competitive priority by many researchers (Wheelwright and Hayes, 1987; Krajewski and Ritzman, 1987)

Conceptual Model for Manufacturing Strategy

The development of the competitive priorities was predicated on the fact that firms develop corporate strategy, and subsequently business strategy, to seek a competitive position in an industry and operationalize these strategies through bundling of competitive priorities at an appropriate level of performance

The competitive priorities are essentially strategic variables and are logical in nature. Whereas the competitive advantage and the value of the product can be determined logically at a business strategy level using appropriate competitive priorities, it can be only physically realized by operationalizing the competitive priorities at the manufacturing tasks level. Gaining competitive advantage or acceptance by the customer does not, however, necessarily guarantee the survival of the firm. It is important to understand that the value of said advantage or acceptance created by the firm for its product line should exceed the cost of creating that advantage or acceptance to be able to survive and grow.

Competitive priorities by themselves do not create cost as they are logical variables; they must be operationalized at a physical level, i.e. manufacturing to understand the impact on cost in attaining competitive advantage or gaining acceptance by the customer.

Strategic variables (competitive priorities) are clustered at a certain level of performance to create demand for the product line in the market and the value at which it can sustain the demand. It also imposes on the manufacturing system a level of performance at which it should be operating with its associated operating costs. As there are multiple strategic variables (competitive priorities), which in turn drive multiple manufacturing tasks, the cost of achieving the target level of performance of the strategic variable is a function of multiple manufacturing cost factors. These multiple manufacturing cost factors can be termed as the economies of manufacturing.

The ultimate success of the manufacturing strategy process lies in the fact that the value of the product line to achieve competitive advantage in the industry should be more than the cost due to the Economies of Manufacturing.

Economies of Manufacturing for Competitive Advantage:

The Economies of Manufacturing is premised on the fact that when there is a movement in the strategic variables (competitive priorities) it will create a certain change in demand for the product line in the market. This demand will be a function of how the competitive priorities are bundled in terms of their weights and their levels:

Demand = f (competitive priorities)
= f (quality, variety, deliverey, price)

The demand of a product/product line is a surrogate variable of the competitive advantage a firm creates in an industry. Low levels of demand for a product represent a low degree of competitive advantage, and high levels of demand represent a high degree of competitive advantage for the firm. However, each firm should develop a demand function for each of its product lines based on the dynamics of the market. In a certain market, price can be a dominant competitive priority and therefore may have a high weight factor. This essentially means that demand will be very sensitive to price changes. In another market, quality consistency may be the key factor to gain competitive advantage and create more demand.

To be in a certain market, the product line needs to be at a certain level in terms of each of its competitive priorities. This may be termed as the *necessary condition*. To have a distinct competitive advantage, and therefore a high degree of demand, one or all of the competitive priorities may need to be at a higher level of performance. This condition may be termed as the *sufficient condition*.

Once the demand function has been developed, the firm needs to gauge the perceived value that it has created for its product/product line. The surrogate variable for value is price. It is a robust measure for what the customer perceives the value to be. Price is also a competitive priority, and therefore represents an essential linkage between demand and perceived value. Another factor in the scheme of developing the manufacturing strategy is the costs due to Economies of Manufacturing that are created when a firm needs to develop a competitive advantage and a value for its product.

It is sufficient to say that each component of the economies of manufacturing is a variable which can improve the economics of the system by realigning it.

System Dynamics and Mapping of Conceptual Model for Manufacturing Strategy

In this section, we operationalize the conceptual model using modeling techniques as developed in the system dynamics literature (Forrester).

Based on the competitive priorities and variables described in the economies of manufacturing a system dynamic model is developed to represent the issues that are prevalent in the manufacturing sector in Egypt. The key issues such as closing the gaps between internally neutral to being externally positive is explored in the model. By using feedback loops that affect the closure of the gap and allows us to develop policy statements about taking the manufacturing to a different level of competitive advantage. Variables have been added to the basic conceptual model to enhance the robustness of the business dynamic model.

Modeling of Competitive Gap Using System Dynamics

To map the competitive priorities in a system dynamics model, we developed some loops, which are relevant to each of the variables such as quality, price, delivery, and variety. These loops represent the operational software and hardware needed to manifest competitive priorities and their impact on competitive advantage.

Subsequent to developing these loops that affect the performance measure of the competitive priority we have developed hypotheses (policies), which are responsible for the overall interaction of all tractable variables that are necessary in moving the Egyptian manufacturing to a level where it has a positive input into the competitive advantage in terms of overall business. The policies we have developed act in a collaborative fashion and they mesh into a socio technological system with its unique DNA.

The system dynamics tool gives us a unique opportunity and capability to map and measure the consequence of multiple policies. We have developed a series of models each fitting into the subsequent model and ultimately a model representing the composite all policies by which we can evaluate the needs of a firm in terms of the product and process reengineering that is needed to gain competitive advantage by closing the gaps in competitive priorities.

Policies

In this section the policies and the rationale behind their selection are presented. The dynamic policies presented in this section, and its interaction as manifested by business dynamic modeling, can be used by policy makers as a premise for drafting strategies for the revival of the Egyptian manufacturing sector.

Policy 1: Egyptian manufacturing companies need to invest in updating their production technologies to stimulate growth.

The first policy addresses the effect of investing in advanced production technologies. Upon surveying Egyptian manufacturing companies we can easily find that the existing production technology is relatively old. This naturally occurred since many Egyptian manufacturing companies were established a long time ago, and most of their existing production technology date back to the inception of these factories without any significant updating.

Further, many relatively new factories were built using outdated refurbished equipment acquired from manufacturing companies abroad that were being renovated with more advanced technologies. This resulted in a manufacturing base that is incapable of producing advanced products with high quality at cheaper costs. Consequently, to stimulate growth, the Egyptian manufacturing companies need adopt the upgrading of Production technology to gain competitive advantage.

Policy 2: Egyptian manufacturing companies need to invest in updating their manufacturing systems to stimulate growth.

The second policy deals with the issue of updating Egyptian Manufacturing Systems. This policy addresses the adoption of the latest managerial tools in manufacturing systems such as Lean Production, Just-in-Time production, and Total Quality Management. The benefits of updating the manufacturing systems could be realized in various ways. First, through adopting Just-in-Time production, Egyptian Manufacturing can free the huge capital and idle capacity tied up in inventory, which can be used to solve liquidity problems and stimulate growth.

Further, through engaging in Total Quality Management programs, Egyptian Companies can improve quality throughout their entire supply chain, leading to reduction in waste in the form of scrap, which in turn leads to the reduction of production costs as well as the production of products with superior quality.

Policy 3: Egyptian manufacturing companies need to invest in increasing the local component to stimulate growth.

The third policy deals with the effect of increasing the local component in Egyptian products compared to the foreign component. Currently Egyptian manufacturing companies import most of their raw materials and other components required for manufacturing their products. This results in having a small percentage of the product value-chain added in Egypt, which not only leads to increased demand on foreign currency to import the required components, but also to fewer jobs being created in the Egyptian Economy compared to the countries that sell those components.

Moreover, as Egyptian manufacturing companies invest in increasing the local component, economies of scale can play a role in reducing the cost of the local component and thus the total product cost. It will also provide Egyptian Manufacturers with the opportunity to make increase their profit margins and progressively grow.

Policy 4: Egyptian manufacturing companies need to develop foreign markets for their products to stimulate their growth.

The fourth policy tackles the important issue of the development of foreign markets for Egyptian products. The development of foreign markets directly affects the growth of the Egyptian Manufacturing sector in various ways. First, as manufacturing companies develop export markets, their sales will grow leading to the increase of the scale of production, hence facilitating economies of scale to reduce the per unit cost. Second, as the Egyptian exports increase, the foreign currency supply will increase, which will make it easier for Egyptian manufacturing companies to find the foreign currency resources needed for importing raw materials and technology upgrades. Third, the growth of Egyptian exports is the only way for a healthy economy in Egypt.

An economy capable of creating more jobs directly in the manufacturing sector as well as in other sectors that deal with handling the export process. Such expansion in the job market will have a positive impact on the per capita income, leading to the increase of the domestic purchasing power.

Explanation of the Mapping Process and the Development of the System Dynamics Model

Four Competitive Gap Representation

The first step in formulating the causal model is to define the four competitive priority gaps that the model is based on; price gap, quality gap, variety gap, and delivery gap, figure (3).

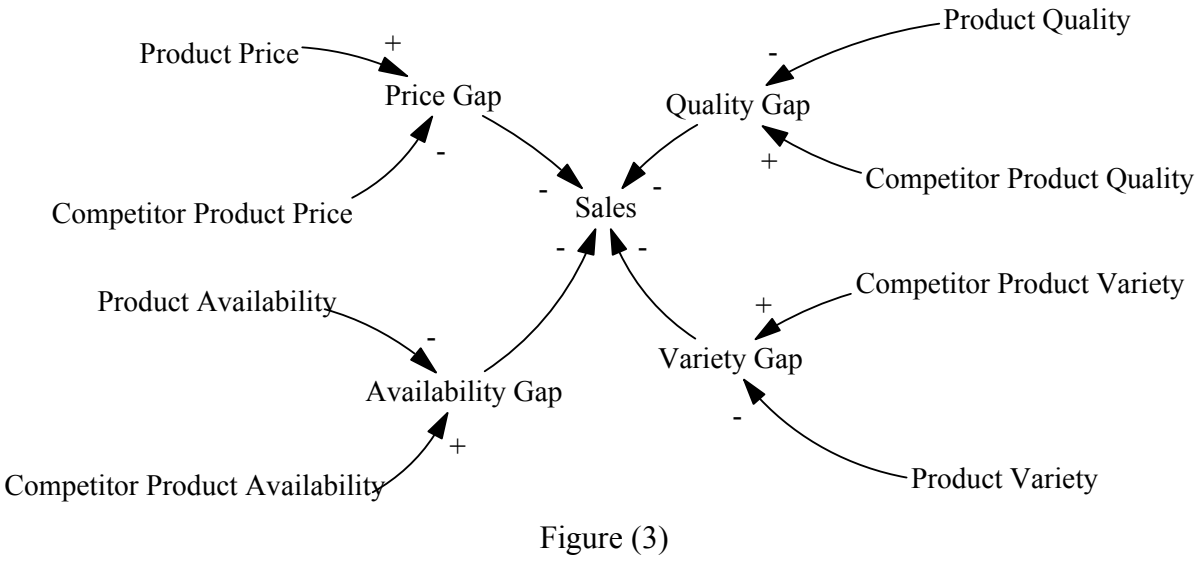

Figure (3)

The first gap, Price Gap, is defined as the difference between the company's product price and that of the competition. The effect of the price gap is felt as the company's product price increase; an associated increase in the gap is experienced. This increase will then play a role in actually decreasing the company's product sales.

The second gap, Quality Gap, is defined as the difference between the competitor product quality, and the company's product quality. A positive gap value indicates that the competitor's product is of a higher quality, indicating that the company's product sales are going to be negatively affected.

Similarly the third gap is defined as the difference of features that the competitor product offers compared with those offered by the company. A positive increase in the gap will also be translated to a negative impact on the company's competitive priority, leading to a decrease in the company's product sales.

Finally, the availability gap is defined as the difference between the competitor market availability, in terms of quantities offered in the market, and the company's product. A positive value of the gap indicates a decline of the company's competitive priorities, and causes a decrease in sales.

Product Price-Cost Relationship

After identifying the four competitive priority gaps, we move to defining the product price-cost structure. In doing so, the cycle in figure (4) has been considered. First, the product cost consists of the following elements; raw material cost, production cost, distribution cost, and process improvement cost.

The raw materials cost represents the total cost of raw materials used in the production process, which is divided into local raw material cost and imported raw material cost.

The production cost represents all costs incurred in the production process. This cost is affected by the economies of manufacturing which is discussed further in the following section.

The third element of the cost is the distribution cost. This cost includes the cost of all activities the company engages in to deliver the product to the customer. Such activities include the opening of new markets, and the delivery of the products to these markets and eventually to the customers.

The fourth element of the cost deals with process improvement costs. Such costs include improvements in process technology, process quality, and process delivery.

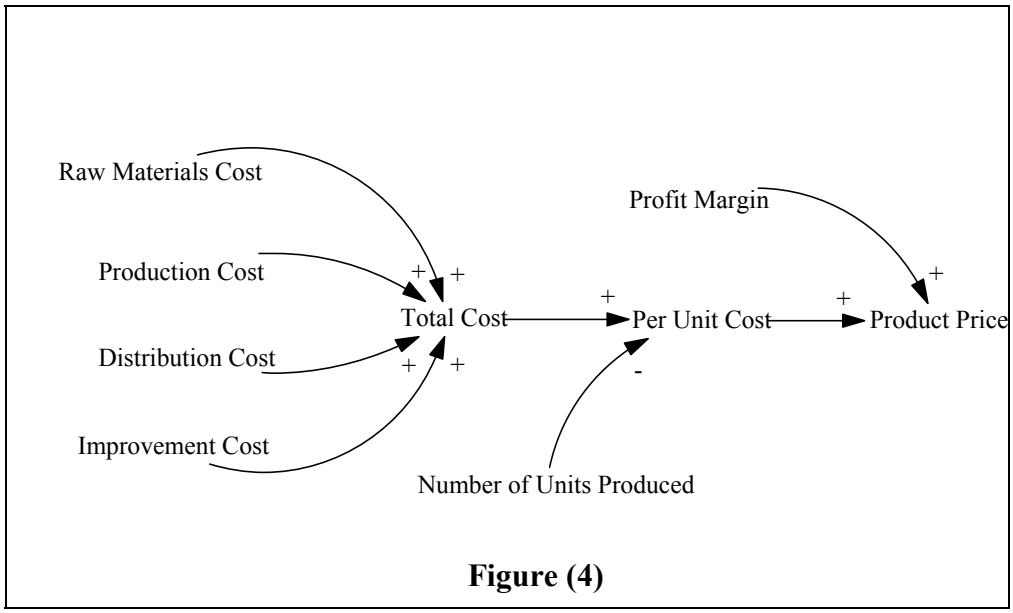

Figure (4)

Effect of Exchange Product Cost and Product Price

The recent trend of the devaluation of the Egyptian Pound has had serious effects on profitability and performance of Egyptian manufacturing companies. Such effects are felt in two different ways. First, this devaluation has caused an increase in the cost of foreign raw materials component, which in turn resulted in an increase in the

total cost of the Egyptian made products. Second, a different effect of the devaluation is the opportunity it creates for Egyptian products to be attractively priced in foreign markets. In developing the model, we have identified the following feedback loops, figure (5), that the currency devaluation plays in improving the competitive advantage.

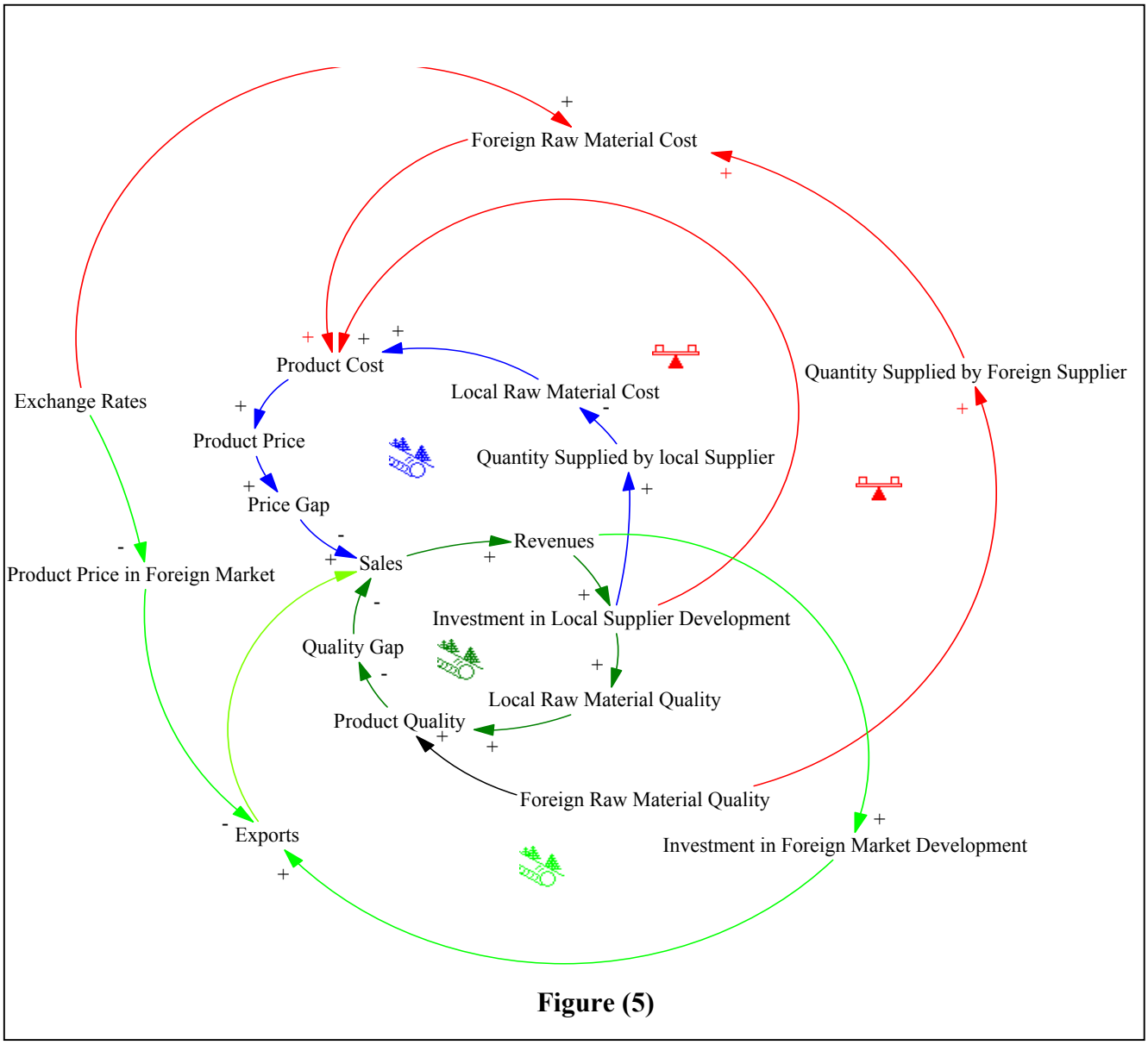

Figure (5)

The first set of loops deal with the effect of the exchange rates on the foreign raw materials. As the exchange rates increase, an associated increase in the foreign raw material cost is experienced. Such increase will in-turn yield an increase in the total raw material cost, which will be translated in an increase in the product cost, and eventually worsening the product price gap. To counter such effects of the exchange rates, companies need to increase the local content in their products as stated in the third policy. To do so, companies need to develop the local supply chain, by investing in supplier improvement programs. Such improvements will result in increased local supplier quality that will increase the quality of the products produced and improve the product quality gap to the company's advantage.

Further, the process improvements will yield cost reductions at the supplier level. Such cost reductions will further lead to the reduction in the product cost, which will eventually improve the product price advantage and hence more stimulation to sales growth.

The positive effects of the aforementioned loops could be negated by the product cost increase due to the cost of supplier development programs. Such cost increase will result in rise in the total product cost in the short-term, which will play a role in the deterioration of the price gap, hence hurting the company's price competitive advantage.

The second effect of exchange rates is incorporated in the models in the following fashion: As the currency devaluation takes place, the price of Egyptian products will be more competitive in global markets. This in turn will be translated in increased exports that will lead to increase in total sales. To achieve this, companies need to invest in foreign market development. Such development will facilitate exports and hence stimulating company growth. However, the negative side of this policy is the effect that foreign market development costs will have on increasing product costs. Such increase can have an effect in worsening the price gap against the company's competitive advantage.

Organizational Skills

Associated with any process improvements are increased levels of desired organizational skills. This creates a gap between the desired skills and the current organization skill level. To cover the gap, the company needs to invest in increasing its current skill level. This pattern of events creates a goal reaching scenario that depends on the skill gap as well as how fast the company is able to adjust its skill inventory.

The process of building needed organizational skills can have a negative effect on the growth of the company. This effect can be felt as the time of building organizational skills increases, resulting in increase in the cost of upgrading the skill inventory. This in turn can have negative effects on the cost, which in-turn will worsen the price gap to the competitive advantage, impeding the growth of sales.

On the other side, the building of organizational skills can have a positive effect in stimulating growth. This effect is experienced as the organizational skill inventory increases; an associated increase in organizational capabilities is experienced. Such improvement in capabilities will result in improving the four competitive priorities gaps in the forms of cost reduction, product quality improvements, product delivery improvements, and product variety improvements. Such improvements will form positive feedback loops that when combined can provide means for stimulating growth in sales.

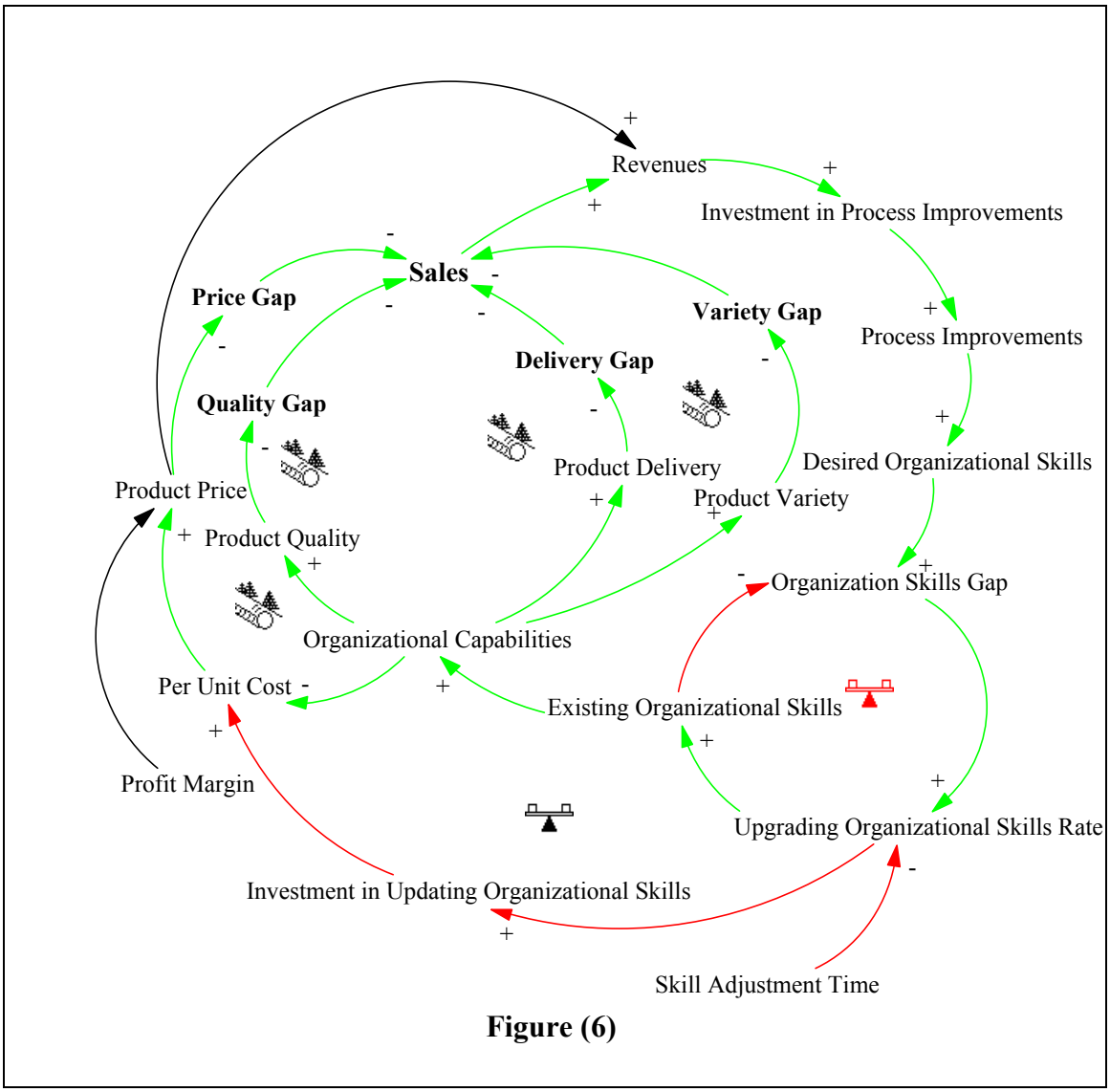

Figure (6)

Economies of Manufacturing

The concept of economies of manufacturing includes the combined effects of economies of scale, economies of scope, and quality improvements and their contribution towards the reduction of the total cost (Imam, 1991).

In describing the economies of manufacturing, several feedback loops are identified, each affects the company sales in several ways.

First, the economies of scale in its static and dynamic forms, forms two positive feedback lops. The first feedback loop is formed as the sales increase, an associated increase in the units produced occurs. Such increase has a negative effect on per unit cost, which is defined as the total cost divided by the number of units produced. Such decrease in per unit cost can be further translated into price reduction that in turn will result in decreasing the price gap and hence facilitating increase in sales. The combined effects of these interactions form a positive reinforcing feedback loop that helps in growing the sales.

The feedback loop is formed as a result of the dynamic economies of scale effects. The dynamic economies are experienced as the increase in the units produced lead to increased production experience. Such increase will have a negative effect on per unit cost due to learning curve effects. Such decrease in per unit cost will start a chain of events as described above; hence forming another positive reinforcing that will help on the growth of sales.

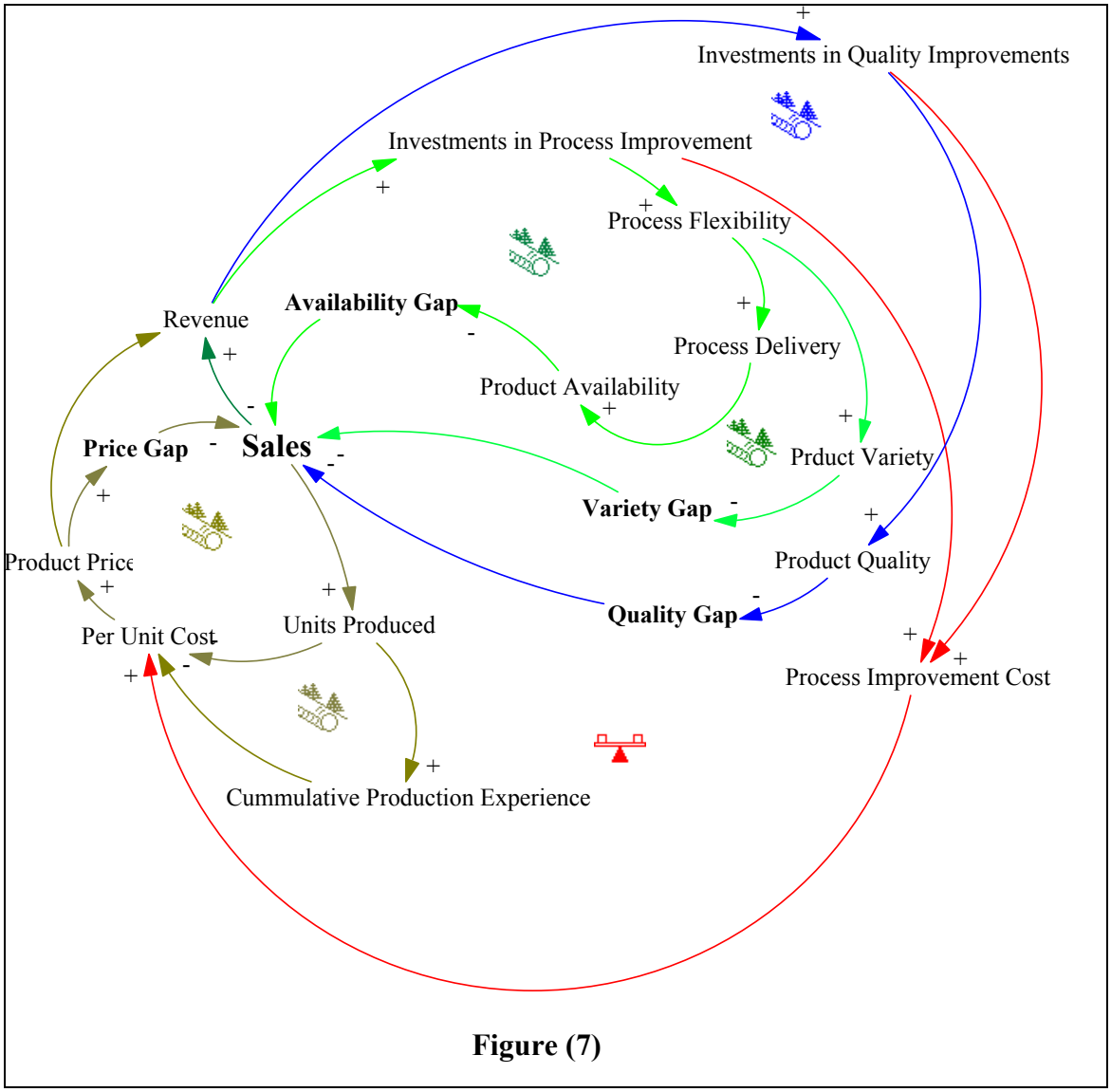

Figure (7)

The third loop is formed as a result of the improvements in product quality. Associated with the increase in sales is an increase in revenues. Such increase in revenues has a positive effect on the amount of funds available for quality improvements. The expenditures that the company will spend on improving quality will in turn have a positive effect on improving the product quality. The improvement

in product quality will help improve the quality gap to the company's benefit and leading to increase sales.

The fourth loop deals with economies of scope effects. Such effects can be experienced as the company invests in improving its production processes to develop its facilities. Such improvements in process flexibility will have a positive impact on product variety, hence closing the variety gap between the company products and those of the competitor. This, in-turn will yield an increase in the competitive advantage of the products produced that will be transferred into increased sales.

Similarly, as the company invests in improving its production processes, an improvement in the product delivery will be achieved. Such improvements will have a positive effect in reducing the availability gap, resulting in an increase in sales, thus forming a fifth positive feedback loop for stimulating sales.

Added to the above mentioned positive feedback loops, there is a sixth balancing feedback loop, which if not taken into consideration, and properly managed will result in worsening the company's competitive advantage. This loop is formed as the investments in process and quality improvements will result in an associated increase in per unit cost of the product. Such increase if not offset by the improvements in other competitive priority gaps, will result in a negative effect on the price gap and the profit margins. This can result in fewer sales or less revenues if profit margins are significantly decreased. Such effect if not properly managed will yield negative effects on all the competitive priority gaps.

Conclusion and Summary

The manufacturing system is an integrated system and therefore can be conceptualized as a network where nodes represent elements both physical (e.g. process) and logical (flexibility, tardiness) and the arcs representing the information and material flow.

Elements such as quality, innovation, information processing, role of technology, organization design, manufacturing for design/assembly, implemented through cross team members, value engineering, cycle time, and other relevant factors should be considered in creating a profile of manufacturing system with a view to achieve corporate objectives vis-à-vis competitive priority.

This complex interaction of physical and logical elements when left to its own design without management intervention results in entropy of the system with an emergent behavior not conductive to competitive advantage. This can be inferred from myriads of policies that are enacted in third world countries with no measurable movement towards achieving the goal of being competitive in the world market. This paper has limited itself to the mapping of strategy using system dynamics models, which allows the study of the interaction of feedback loops, with its effect on policy from a holistic point of view.

A cursory look at the models presented will sensitize us to the complexity of policy that needs to be developed and nurtured on a temporal basis. The model will also make policy makers more cognizant of the interaction non-linear, self-organizing, adaptive and temporally spaced, path dependent, nature of policy making.

This coupled with counter–intuitive, and at times non- Newtonian, albeit emergent behavior can only be modeled by non- prescriptive non- sequential methods. System dynamics comes closest to providing us with an instrument for such a mapping.

References

- Noori, H., (1990) "Managing The Dynamics Of New Technology," Prentice Hall, Englewood Cliffs, NJ.
- Wheelwright, S. And Hayes, R., 1985 " Competing Through Manufacturing"; Harvard Business Review January - February
- Hayes, R. And Schemenner, R., 1978 " How Should You Organize Manufacturing"
- Krajewski, L. And Ritzman, L., 1987 " Operations Management And Analysis"
- Garvin, D., (1987) " Competing On The Eight Dimensions Of Quality" Harvard Business Review November-December
- Imam, S.A. 1991 " Manufacturing Strategy" Unpublished Phd Dissertation.
- Goldhar And Jelinek (1985), " Computer Integrated Flexible Manufacturing: Organizational Economics And Strategic Implications"
- Talaysum , A., Hassan , M. Z. And Goldhar , J., 1987 "Uncertainty Reduction Through Flexible Manufacturing"
- Schlie, T. W. And Goldhar, J., 1989 " Product Variety And Time Based Manufacturing / Business Management: Achieving Competitive Advantage Through CIM," Manufacturing Review, March.
- Porter 1985 "Competitive Advantage" The Free Press, New York.
- Schroeder, R., Anderson, J. And Cleveland, G., 1986 " The Content Of Manufacturing Strategy: An Empirical Study" Journal Of Operations Management Vol. 6, No. 4, August.
- Evans, J. Anderson, D., Sweeney, D., And Williams, T., 1990 "Applied Production And Operations Management" West Publ. Co., St. Paul, MN.
- Kaplan, R. & Norton, D.P. (1996) Using The Balanced Scorecard As A Strategic Management System, Harvard Business Review, 74, Pp. 75-85.
- Lema, N. & Price, A. (1995) Benchmarking--Performance Improvement Toward Competitive Advantage, Journal Of Management Engineering, 11, Pp. 28-37.
- Porter, M. (1985) Competitive Strategy--Techniques For Analyzing Industries And Competitors (New York, Free Press).
- Emerging Markets Monitor, 12/9/2002, Vol. 8 Issue 33, P17, 1p
- Egypt Quarterly Forecast Report, 2002 3rd Quarter, P11, 8p
- Diehl, Ernst, And John D. Sterman. "Effects Of Feedback Complexity On Dynamic Decision Making." Organizational Behavior And Human Decision Processes 62, No.2 (1995): 198-215.
- Ford, Andrew. Modeling The Environment: An Introduction To System Dynamics Modeling Of Environmental Systems.Washington, D.C.: Island Press, 1999.
- Forrester, Jay W. "Dynamic Models Of Economic Systems And Industrial Organizations." System Dynamics Group Memo, D-0. Massachusetts Institute Of Technology, 1956.---. Industrial Dynamics. Waltham, Mass.: Pegasus Communications, 1961.---. Urban Dynamics. Waltham, Mass.: Pegasus Communications, 1968.

- Nake M. Kamrany And Richard H. Day: 80-107. Baltimore, Md.: The Johns Hopkins Press, 1979. "'The' Model Versus A Modeling 'Process.'" System Dynamics Review 1-2 (1985): 133-134.
- Kampmann, Christian, And John D. Sterman. "Feedback Complexity, Bounded Rationality, And Market Dynamics."
- Memo D-4802, System Dynamics Group. Massachusetts Institute Of Technology, 1998

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