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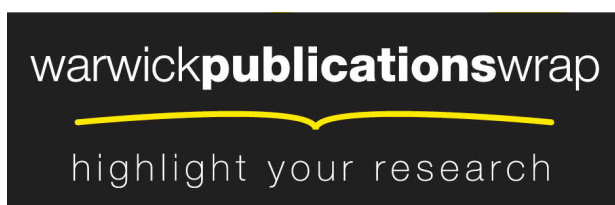
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## 6 Revisiting Porter's Generic Strategies for Competitive Environments Using System Dynamics

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### INTRODUCTION

Porter (1998) suggests that not only do investment decisions make it hard to forecast with certainty the equilibrium of industries, but also industries may evolve following different paths at different speeds depending on these decisions. Managerial decision making significantly affects the dynamics of firms. Management decisions to meet their strategic goals affect not only their firms but also the system of resources of competing firms, generating reactions that will influence their own resources in the future. The external environment is not completely exogenous but is in part created by managers and their decisions. Consequently, firms have to fit into patterns of resource exchanges and competitive actions with other firms in the industry, forming adaptive systems embedded in feedback processes. Porter analyzed this aspect of competition through the five forces framework (Porter 1998) and suggested generic strategies (cost leadership and differentiation) as a recipe for competing effectively in industries. This chapter explores the effects of business policies based on Porter's generic strategies on the performance of the firm in a competitive environment. The model portrays managerial decision-making processes using the generic strategies described in Porter's (1985) competitive strategy: cost leadership and differentiation. The model formalizes managerial decision-making processes, identifying constructs and relationships existing in each generic strategy and transforming them into equations in a process similar to the research methodology employed by Sastry (1997).

### A FEEDBACK VIEW OF COMPETITIVE INDUSTRIES

The concept of industry describes an environment where firms develop their business supplying similar products or services to customers. Basically, an industry is a feedback system comprised of firms and a market. On the one hand, firms provide services or products to satisfy customers' requirements. On the other hand, customers have requirements that they

try to satisfy with the most convenient product at the best possible price. Firms and customers interact over time through a process of adjustment between consumers' requirements and firms' products. While successful firms grow when an increasing number of customers accept and adopt their products because their products are either different from or cheaper than other competing products, less successful firms have to abandon the industry or react by improving their products or reducing the price of their existing products.

The physical structure of any business is important as it imposes operating constraints (practical rules for how resources work and combine to deliver products and services) on managers. However, the effect of operating policies (managers' decision-making processes related to the level of coordination and development of activities related to the value chain of the firm) is more relevant to the dynamic behavior of industries because operating policies regulate the competitive behavior of firms and, through the interconnections existing in the market, of the industry. Porter's generic strategies intend to be proposals for managing operating policies in a coherent way; e.g., if a firm follows a cost leadership strategy, operating policies aimed at minimizing costs are key for this firm to achieve profitability.

In System Dynamics, we can analyze firms in two areas: managerial decision making, and operating policies to control the system of resources. Management, and managerial decision making, is viewed as the process of converting information into action. This conversion process is decision making. As Forrester (1994) notes,

[I]f management is the process of converting information into action, then management success depends primarily on what information is chosen and how the conversion is executed. The difference between a good manager and a poor manager lies at this point between information and action.

Therefore, the difference between firms' performance and, as a consequence of the feedback structure of the industry, the level of competition of an industry depends on the managerial decision-making processes. However, we cannot deny that this process is influenced by the lens that managers employ to see their firms. In this aspect, Porter's generic strategies are widespread lenses used by many managers to see the positioning of their firms in a competitive environment. In Porter's words: 'Every firm operates on a set of assumptions about its own situation. These assumptions about its own situation will guide the way the firm behaves and the way it reacts to events' (1998: 58).

In System Dynamics, operating policies are normally represented as purposive adjustment of resources through goal-seeking information feedback (Sternan 2000; Morecroft 2002). It is the essence of the feedback view of

the firm (Morecroft 2002). This process of resource building is the cornerstone for the activities grouped into a value chain. Decisions stemming from operating policies lead to corrective actions intended to close observed gaps between desired and actual resources necessary to implement generic strategies. Defining and monitoring the gaps (shortages or excesses) in a firm's portfolio of resources is essentially an information-processing activity subject to the practical constraints of bounded rationality (Morecroft 1985a). While every manager has available a large number of information sources to determine an operating policy, each manager selects and uses only a small fraction of all available information that is coherent with the generic strategy selected.

### Describing Managerial Decision-Making Styles Based in Porter's Generic Strategies

While the decision-making styles of managers in an industry vary and there is not a clear typology, they can be grouped using Porter (1985) generic strategies into two main styles: cost leadership and differentiation.

The sources of *cost leadership* are varied and depend on the structure of the industry, but they are generally economies of scale or highly productive operational processes. If a firm can achieve and sustain overall cost leadership, then it will achieve above-average profits provided it can charge prices at or near the industry average (Porter 1985). However, a cost leader must also achieve parity or proximity relative to its competitors in their bases of differentiation to sustain an above-average performance. Product parity means that the price discount necessary to achieve an acceptable market share will not erode their cost advantage (Porter 1985).

The second generic strategy is *differentiation*. Firms that employ this strategy in the industry seek to be unique along some dimensions that are widely valued by buyers (Porter 1985). Management selects some attributes considered to be important by the potential and actual consumers, and tries to position itself to meet their needs. Firms in this position may be able to charge a premium price. Differentiation can be based on the product itself, the marketing approach or other resources and attributes valued by consumers. An above-average performer using differentiation strategy must have their extra costs incurred for being unique well below the price premium charged. Consequently, a firm achieving differentiation must also aim to have cost parity or proximity relative to its competitors.

Table 6.1 displays the expected differences in four key issues (market size, customers' requirements, asset stocks that need to be developed and competitors' reactions) faced by firms following the two generic strategies based on an analysis of Porter's generic strategies. These key issues are translated into differences in the managerial decision-making styles employed in the simulation model to explore firm performance.

Table 6.1 Differences in Decision-Making Styles Using the Porter (1985) Generic Strategies

Key Issues	Cost Leader	Differentiation Leader
What is the expected market size?	The expected market size is based on extrapolations of past market growth rate.	Market size is based on the number of consumers that the managers expect to attract with the product.
What are the requirements of potential customers?	Broad requirements in terms of product characteristics, but highly sensitive to price.	The consumers are highly demanding in terms of product characteristics and less sensitive to price.
What is the set of resources necessary to satisfy customers' requirements and maintain a competitive advantage?	Management expects to build their competitive advantage by improving the efficiency of the existing operations. Thus, they allocate most of their investment to increase the effectiveness of their operational resources as a means to reduce costs. Market share is a key goal for the achievement of economies of scale. However, they try to maintain close product parity with the differentiation leader.	Management believes that customers' requirements are mostly related to better products rather than lower prices. Consequently, management allocates most of the investment in the development of new product technology as a means to achieve a competitive advantage.
How will the firms react to competitors' actions?	Management will increase their efforts to reduce costs without increasing the gap with their competitors' product.	Management will tend to further differentiate the product from competitors if they face competitive pressures.

### Model Formalization

The model formalization process follows the steps suggested in Sastry (1997). The first step in formalizing the theory was to identify constructs and relationships that provided the basis for the formal model through a textual analysis of Porter's (1985, 1998) books and to identify and code statements into categories relevant for the simulation. The next step was to relate variables to each other through stock and flow networks that represent the performance of organizational processes mentioned in the value chain. Then formulations reflecting managerial decision-making processes were represented. Finally, real-world observations, such as examples described in Porter's (1985, 1998) books, informed the modeling process as much as possible.

The decision-making processes simulated describe decision functions as simple rules of thumb similar to behavioral simulation models (Sternan 1987; Morecroft 1985b). Figure 6.1 represents a simplified view of the structure

of the simulated firms using both the value chain and sector map concepts. Management focuses its attention on sources of information related to the performance of the firm such as profits or market share to coordinate the sectors of the firm. There are four sectors that represent the main resources of the simulated firm: financial, technology, operational and market (equations can be requested from the author). Financial resources are basically accumulated profits, which are later invested in resources related to the competitive positioning of the firm. For example, the level of profits and the existence of financial resources determine the investment in technology. Technology resources are employed to increase the attractiveness of the product. Higher product attractiveness and competitive actions (promotions and advertising) lead to an increasing number of customers and revenues and increasing profits. This is a reinforcing feedback process. Increasing the number of customers leads to requests for more products, which are produced using operational resources. However, operational resources increase operating costs that reduce the level of profits. This is a balancing feedback process.

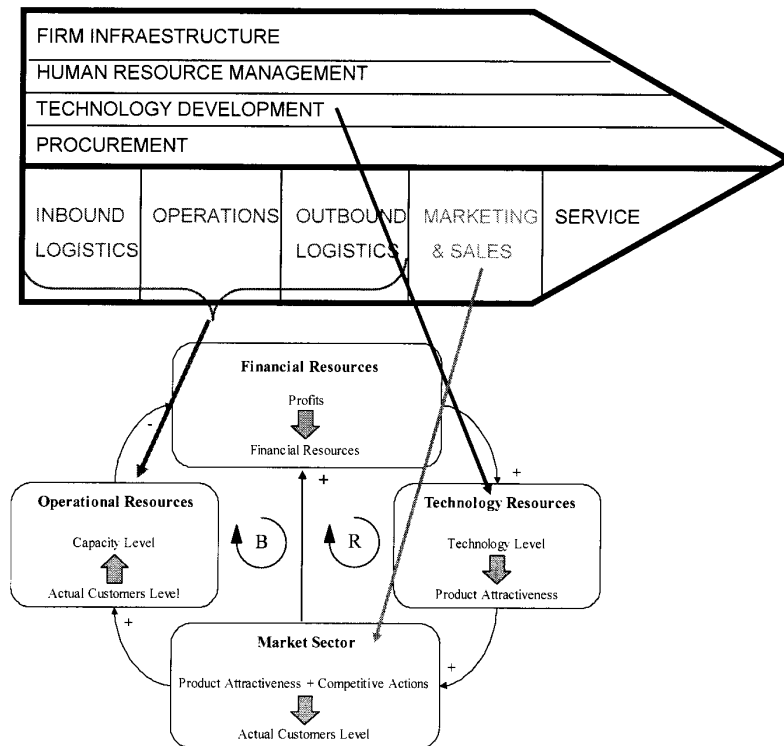


Figure 6.1 Model sectors and the concept of value chain.

## Financial Resources

The goal of the operating policy in the financial sector is to maintain the rate of operating income over time, which can be associated to a ratio between actual operating income and expected operating income. Management will allocate more financial resources to change the configuration of the source of competitive advantage (technology or the productivity of operational resources) if the operating income over time falls below its expected level, for example a ratio lower than one. If the rate of profits is considered to be satisfactory (ratio equal to or higher than one), management will reduce the allocation of resources to product technology because they believe that there is no need to change the product technology. This behavior follows the concept of satisficing rather than maximizing, as occurs in economic models (Winter 2000). In other words, management tries to maximize the level of financial resources by finding the right level of product technology.

## Technology Resources

This set of resources is responsible for the competitive advantage and superior performance. Technology resources comprise two resources: product technology and operational efficiency. Product technology, which describes the technological level of the product portfolio, is a key resource for firms following a differentiation strategy, and operational efficiency, which indicates the level of productivity of the operational resources, is a key resource for firms following a cost leadership strategy.

Product technology represents an index of the level of the product characteristics. The product characteristics can be directly associated to the level of potential customers' requirements; for example, a product technology level of 100 is fairly close to covering all the possible customers' requirements, and, consequently, the firm may be able to attract a huge number of customers from the total available market. Moreover, a higher product technology level relative to competitors' level will attract not only potential customers but also customers from existing competitors. Product technology is related to the concept of product innovation (Chapter 8 in Porter 1998). Cost leaders will allocate few resources to changing the technology of their products because that would erode the gains obtained from investing in operating efficiency. The negative effect of inefficiency from innovations is related to the concept of disruptive innovation suggested by Sastry (1997) where too much innovation erodes the coordination of the organization increasing operating costs. However, if there is a widening gap in technology between a differentiation-based firm and a cost leader firm, a cost leader firm will allocate more financial resources to promptly reduce the existing gap (Chapter 3 in Porter 1985). Management's decisions to change the level of the product technology are implemented through the allocation of financial resources to product development projects.



Management can also invest financial resources to increase the efficiency of operational resources. Operational efficiency represents the cumulative efforts of the firm to refine the actual operating technology of the existing products. Operational efficiency reflects management efforts to reduce costs independently of the economies of scale achieved through the level of operational resources. Operational efficiency is related to the concept of process innovation (Chapter 8 in Porter 1998). A firm following a differentiation strategy will invest financial resources in operational efficiency only when its management perceive that the actual product technology level is accepted in the market (Chapter 8 in Porter 1998). On the other hand, a management team following a cost leader strategy believes that their main competitive advantage is to have the lowest cost. Consequently, management will invest most of their financial resources to increase the efficiency of the firm's operational resources and less in the technology of the product.

### Market Sector

Porter (1998: 24) says, '[B]uyers compete with the industry by forcing down prices, bargaining for higher quality or more services, and playing competitors against each other—all at the expense of industry profitability'. Porter describes the industry equilibrium as result of the bargaining power of buyers. Additionally, Porter mentions that one of the forces driving the evolution of an industry is related to the changes in demand growth (Porter 1998, Chapter 8). The following paragraphs describe the implementation in the model of these two processes: consumers' decision making based on pricing, quality and advertising leading to different market equilibrium and changes in demand growth.

### Competitive Actions and Industry Equilibrium

Management usually takes short-term competitive actions related to the process of attracting competitors' customers. The model represents two short-term actions: price adjustments and advertising expenditure.

The pricing policy is based on "cost plus margin". Price adjustments, as a result of the non-attainment of the market size goal, are implemented through the adjustment of a gross margin. While a reduction of the gross margin affects the profitability in the short term, the model considers some benefits from this action: a reduction in price will attract more customers to improve the operating income in the long term (if the discount does not exceed the benefit of higher unit sales) as the firm achieves economies of scale, which will be used to invest in cost reduction through operational efficiency.

Advertising expenditure is usually used to attract actual customers from competitors or increase brand loyalty of actual customers. In the model, advertising is considered only to pull customers towards the company but it

does not change the long-term loyalty of customers. Advertising is a short-term action that improves the long-term perspective not only of the firm but also of the industry since it helps to draw potential customers to the industry, expanding the total market.

### Factors Affecting Demand Growth: Product Attractiveness and Market Structure.

The simplest model of the evolution of markets over time is the Bass diffusion model (Bass 1969). The Bass diffusion model has been extensively used in System Dynamics to describe the diffusion of innovations (Sternman 2000). I include two modifications to the Bass diffusion model in this simulated market. First, the stock of potential customers, fixed in the Bass traditional model (Sternman 2000), may change over time as product functionality changes, attracting other segments of people which have not been interested in the product yet. The function represents the process of attracting different segments of the total population as product technology evolves. When the industry improves its product technology (or product functionality), the proportion of the total population interested increases (and the fractional rate of attraction per time increases). However, the rate of growth of the industry diminishes over time, as few members of the population remain without using the products of the industry. Second, I include behavioral variables to represent a basic consumer decision-making process at the adoption of a new product. A weighted value is obtained for each alternative (cost leader or differentiation leader alternatives) in function of the relative weights that heterogeneous customers (price or product functionality sensitive adopters) have about each dimension (price, product functionality or advertising) and the relative strength of each alternative in these dimensions with respect to the existing alternatives in the market (e.g., cost leader product functionality compared to average product functionality). The components are then combined in an overall value for that alternative in terms of share of the potential customers that adopt any of the existing alternatives in the market (cost leader alternative or differentiation leader alternative).

To summarize, consumers employ information about price, product functionality and advertising to define the best alternative to adopt, as a first-time buyer, and, later on, to replace the actual product as a repetitive buyer. Customers may change the product as competitors offer better products for the same price or a lower price for the same product technology. The movement of customers between firms in the industry is regulated by a perception of the relative position of each alternative (cost leader alternative or differentiation leader alternative) in each dimension (price or product technology). For example, customers may perceive situations where the prices of the differentiation leader is 28 per cent higher than the cost leader as "natural", but only if the differentiation leader's product is at the

same time 28 per cent better than the product of the cost leader. Whenever firms in the industry change these perceived relationships, customers will respond by switching to the firm that offers the best combination of price and product technology. If competitors do not react promptly, they may find themselves out of the market. For simplicity, I do not model the effect of learning processes at the consumer level that may change the relationships between alternatives in a certain dimension.

### Operational Resources

The concept of operational resources captures physical and human assets stocks that are necessary to provide the products requested by customers. Firms start with an initial endowment of resources that reflects their initial investments. The development of these resources depends on the expectations that managers have about the evolution of the market. In the model, there will not be backlogs or any effect related to delivery of products on consumer behavior like other System Dynamics models, e.g., the market growth model (Stermann 2000), if the demand is higher than the level of operational resources. Consequently, the potential sales revenue (the unit sold to actual customers—repetitive buyers—and the unit sold to new customers—first-time buyers) is reduced by the availability of products (level of units of operational resources multiplied by the productivity per unit of operational resource). There are a series of additional assumptions related to operational resources.

- The level of operational resources determines the basic cost per unit of product, which decreases influenced by the effect of economies of scale.
- Operational efficiency determines the productivity per unit of operational resource. Higher productivity reduces the cost per unit of product in addition to the economies of scale obtained by the level of the operational resource.
- Operational resources are subject to a normal depreciation rate; however, when the firm changes its technology that increases the normal depreciation rate due to technological obsolescence.

### Summary of the Model

The initial set of resources, e.g., technology, financial and operational resources, is not similar among the participants in the industry. There are two reasons for this assumption. First, I assumed that strategically heterogeneous resources drive the initial selection of a generic strategy. Second, I want to explore in these simulations the result of dissimilar managerial decision-making styles in a competitive industry. Table 6.2 presents a summary of the main decisions in each sector existing in the model of the firm.

Table 6.2 Main Decision-Making Processes Existing in Each Model of the Firm

<i>Management Decisions</i>	<i>Cost-Oriented Firm</i>	<i>Differentiation-Oriented Firm</i>
<b>Financial Resources</b>	The objective is to maintain a stable operating income. If actual profit rate is lower than past profit rate, more financial resources will be allocated to the development of technology or operational efficiency in order to increase revenues.	The objective is to maintain a stable operating income. The evolution of profits determines the intensity of the resources allocated to technology development.
<b>Technology Resources</b>	The configuration of technology resources is principally oriented to reduce costs by increasing operating efficiency. However, if there is an important gap with competitor's product, resources allocated to technology are mostly used to reduce the gap with competitor's technology.	The source of competitive advantage is believed to be the development of new products. Consequently, the resources are mostly allocated to develop the product technology.
<b>Operational Resources</b>	The expected size of the market, which is adjusted by an extrapolation of the actual market growth rate, determines the expansion rate of this asset stock.	Operational resources are developed over time based on the management's expected size of the market. Managers have defined a priori a certain market size.
<b>Market Sector/Competitive Actions</b>	Price: it aims to be lowest in the market by reducing costs of goods sold and, later on, gross margin.  Advertising intensity: lower budget than the differentiation leader.	Price: higher than average in market but it will tend to cut gross margin aggressively if the expected market size is not achieved. However, it will increase price very fast when expectations about market size achieved are fulfilled.  Advertising intensity: highly intensive.

### Results of the Simulation

The model consists of a duopoly. The model was calibrated so as to have an initial run with the industry in equilibrium given a certain set of initial conditions (see Table 6.3) and no changes in the conditions over time. The rest of the chapter presents different simulations to show the impact on firm performance of Porter's generic strategies under diverse industry settings.

Table 6.3 Initial Conditions for Each of the Two Firms

Variables: Initial Values	Differentiated Firm	Low-Cost Firm
Price	2.02	1.62
Unit Cost	0.81	0.51
Advertising	100	100
Operating Resources	5,000	5,000
Technology	16	12
Productivity per Unit of Operating Resource	1.00	1.25

### Scenario 1. The Industry in Equilibrium Considering a Similar Distribution of Buyers Sensitive to Price and Functionality

The industry has two firms; one follows the cost leadership strategy and the other the differentiation leadership strategy. The total population is equally divided among people willing to buy products according to their functionality given a certain price—which is not necessarily the lowest (functionality-sensitive adopters)—and those willing to buy products at the lowest price given a certain level of product functionality (price-sensitive adopters). In the first simulation, I left the initial conditions (price and product functionality) fixed during all of the simulation. Figure 6.2 presents the evolution of the market during the simulation. Lines 1 and 2 represent the evolution of the number of customers captured by each firm. Since the proportion of people sensitive to price and to product functionality is equal, both leaders captured the same number of customers achieving equilibrium. Therefore, the model was started in equilibrium in aspects such as market share and profits.

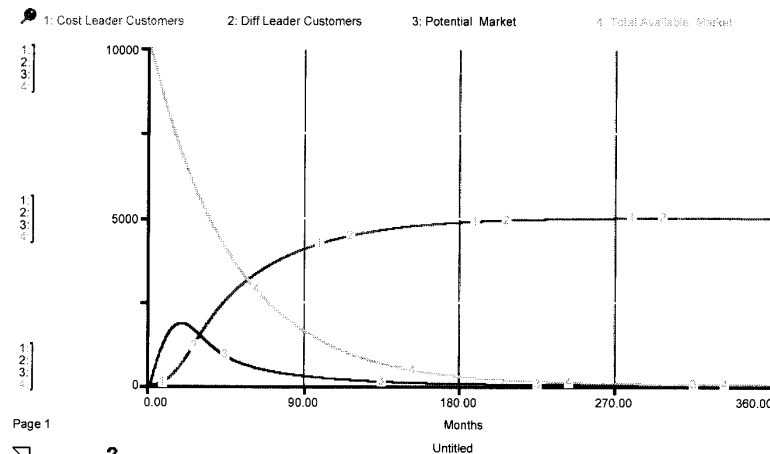


Figure 6.2 Market evolution under the initial conditions—industry equilibrium.

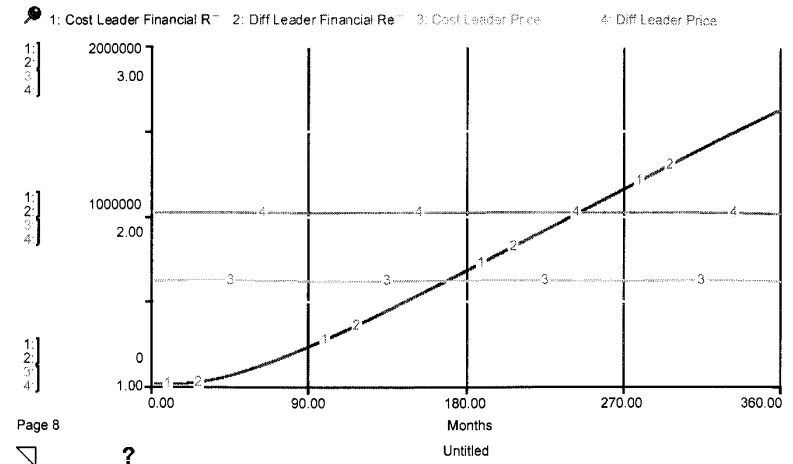


Figure 6.3 Cost leader financial resources (line 1) and price (line 3) and differentiation leader financial resources (line 2) and price (line 4).

Figure 6.3 presents the evolution of price and financial resources for the two firms during the period of the simulation. The price of the differentiation leader was higher than the cost leader price but the operating income of both companies was equal because the premium price for a better product was compensated by higher costs than cost leader.

### Scenario 2. Industry with a Cost Leader and a Differentiation Leader

Now, I simulated the industry with a cost leader and a differentiation leader. They followed operating policies based on the generic strategies' assumptions in order to achieve their goals. The market reaches equilibrium after quarter 180 without any significant difference between the market shares of both firms. The number of customers who chose to switch based on product functionality is similar to those customers who switched based on price. Consequently, the net movement of customers between firms is closer to zero.

I will analyze the simulation from quarter 1 to quarter 90 to identify the dynamics existing between the differentiation and cost firms. Figure 6.4 shows the evolution of price and financial resources for both leaders. The differentiation leader reduced its price aggressively at the beginning of the industry trying to achieve its expected market size. Most of the initial adopters were attracted by the differentiation leader's lower price (although still higher than the cost leader) and better product. When the differentiation leader raised its price trying to obtain a premium price for its better product—as it achieved

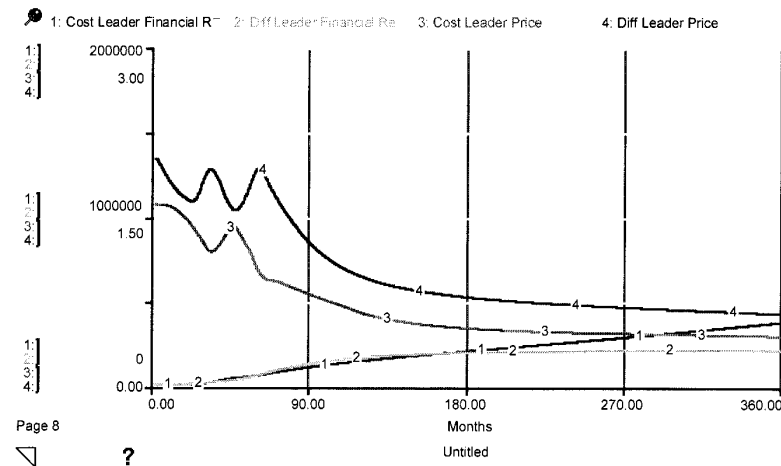


Figure 6.4 Cost leader financial resources (line 1) and price (line 3) and differentiation leader financial resources (line 2) and price (line 4).

the expected number of customers—the cost leader reacted by reducing its prices due to its previously low market share. A similar pattern occurred again before both firms started decreasing their prices as the operational efficiency process set in and they tried to achieve a higher market share. The results show that the level of financial resources was only a third of the level obtained in the previous simulation. This result clearly shows the adverse effect of competition on the financial performance of both firms.

The intensity in competition led to the development of the product technology by the differentiated firm so as to command a premium price. However, the decreasing trend in price led by the cost leader implied that the differentiated firm also had to decrease its price to maintain its competitiveness. Therefore, the industry entered into hypercompetition. Bogner and Barr (2000) suggest that hypercompetitive industries are characterized by rapid changes in technology and price and ambiguous consumer demands, which implies that firms cannot earn above-average profits for a meaningful period of time based on a single established innovation or advantage in these environments. Bogner and Barr (2000) also add that the most significant competitive threat is the steady pace of competence-destroying change that occurs and the limited ability of managers to foresee the nature of these changes. Therefore, firms, like the differentiation leader, concentrate on both doing what they already know (increasing their technology) and matching competitors' movements (reducing prices). The decrease in profitability occurs naturally even for a simulation model based in behavioral and endogenously generated decision-making processes.

In conclusion, the differentiation leader's aggressive price reduction helped it to achieve a higher market share at the beginning of the industry.

However, management propensity to raise price reduced its initial advantage as cost leader; reducing its price and customers' long-term price relationship between alternatives drove customers to the cost leader's product. The cost leader's continuous pricing reduction exploited the huge difference in prices to attract customers, which led to higher profits as Figure 6.4 shows.

Can a differentiation leader improve its results? One of the key decisions simulated in this model is the rate of investment in product technology development. I simulated different levels of investment in product technology as a percentage of the operating income and the resulting level in terms of customers. The result of no investment in product technology presents important oscillations because both firms compete only in price. Thus, a price decrease generates a decrease in the price of the competitor in the following period, reducing the stock of customers to its previous level. A high level of investment in product technology, such as 50 per cent of the operating income, generates a superior performance over time in terms of customers.

Even though moderate investment rates in technology development help to achieve higher cumulative financial performance, as Figure 6.5 shows, there seem to be two effects. On the one hand, there are trade-offs between the levels of investment, which determine the speed at which market dominance is achieved, and the financial performance of the firm. There is a decreasing effectiveness of the investment in technology. On the other hand, non-linear effects coupled with feedback processes imply that small changes in the investment rate can generate huge increases in financial performance as data between 0 and 0.20 in Figure 6.5 show.

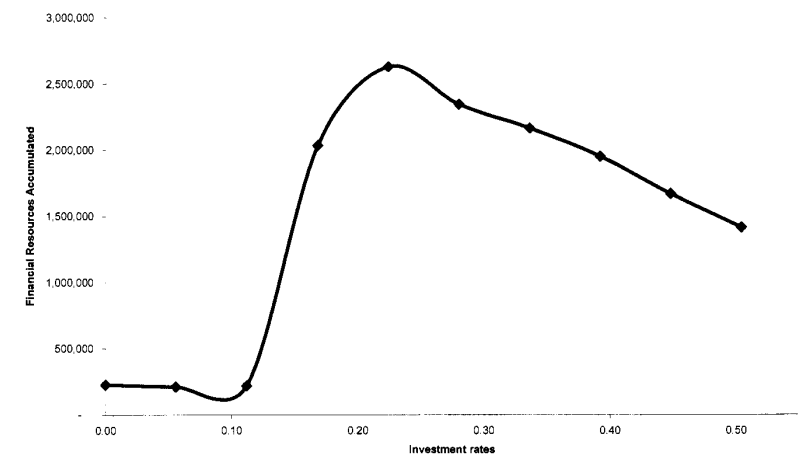


Figure 6.5 Relationship between technology investment rates and financial performance obtained for a differentiation leader.

### Scenario 3. Industry with Two Cost Leaders

The industry now has two cost leaders. The market did not split equally but one firm obtained a higher share even though both firms followed a similar strategy. Figure 6.6 shows the main difference between both cost leaders.

A small change in price after the market reached the peak in its introduction stage was responsible for the different path for similar competitors. Unfortunately, the main strategy of both firms implies that product technology declined, as they did not invest in it (lines 3 and 4 in Figure 6.6). Therefore, industries with firms engaged in cost leadership strategies will tend to focus on process innovation rather than product innovation in order to drive their prices down and achieve a higher market share. Another interesting observation is related to prices. In this industry, the level of the price is relatively higher than in the previous simulation with two firms following different strategies. Porter suggests that 'the more diverse or asymmetrical are competitors' goal and perspectives ... the harder it will be to properly interpret each other's moves and sustain a cooperative outcome' (1998: 90). Maybe similar strategies pay off more than different ones?

### Scenario 4. Industry with Two Differentiation Leaders

The simulated industry has two differentiation leaders. The market did not split equally but one firm obtained a higher share even though both firms have similar decision-making processes and initial resources. The second differentiation leader tried to exploit the market by raising its price as it achieved a higher market share. However, this increase in price was not supported by an

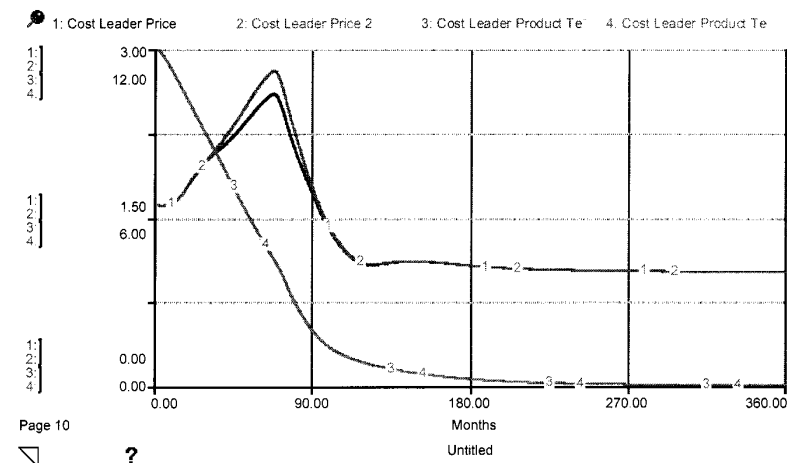


Figure 6.6 Price and product technology evolution with two cost leaders.

improvement in the performance of the product. As the second differentiation leader could not achieve its expected market size, it started decreasing its price as Figure 6.7 displays. Porter (1998) suggested that goals are important drivers in the competitive behavior of firms. When the actual performance of the firm is different from its goal, the firm will react using short-term competitive actions like price and advertising. This reduction in price deprived one of the differentiation firms from financial resources to sustain product technology development, that led it to its demise.

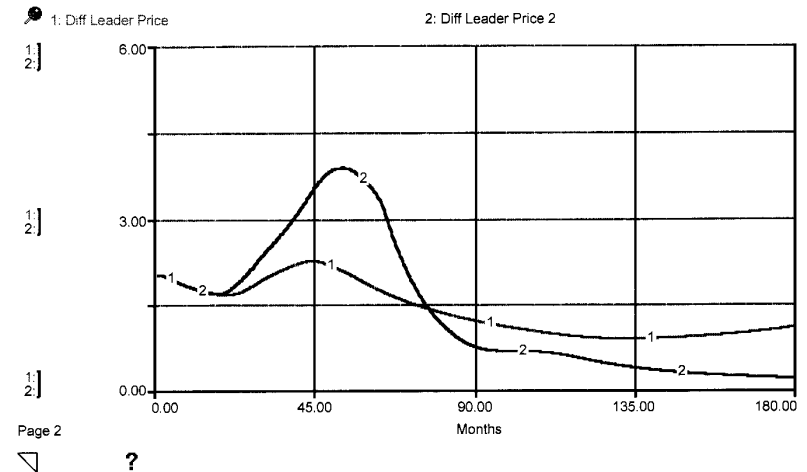


Figure 6.7 Price evolution with two differentiation leaders.

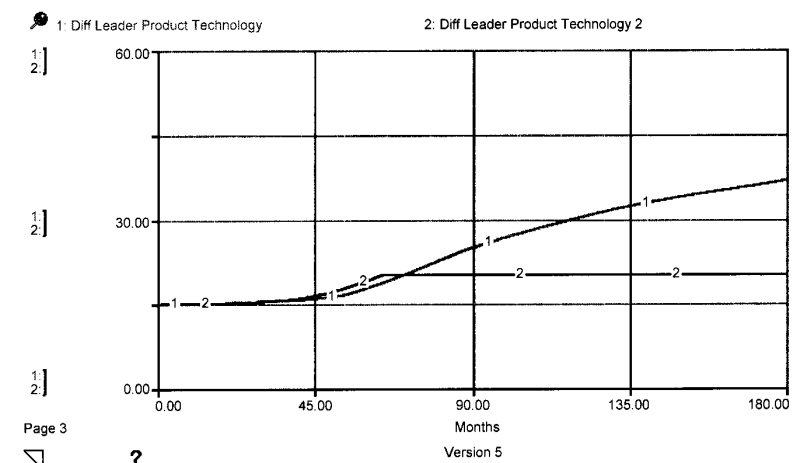


Figure 6.8 Technology evolution with two differentiation leaders.

Figure 6.8 presents the evolution of the product technology in an industry with two differentiated firms. We can appreciate that product technology increases over time, which is the opposite trend for an industry with two cost leaders. Only the second differentiation leader, which had negative operating profits, did not improve its product technology. Interestingly the firm that could provide higher product functionality (see Figure 6.8) started increasing its price which helped to finance more product development. This is an example of the reinforcing process existing in highly successful firms in many markets, e.g., Intel against its competitors in the semiconductor industry.

### Key Findings Related to Porter's Generic Strategies

While I cannot suggest that managers' mental models are cost or differentiation oriented, the modeling simulation exercise shows how bounded rational managerial decision-making processes may generate dysfunctional performance because their goal-setting process and competitive recipe did not consider the complexity of the feedback structures. Simulations also depict how the interconnection between functional areas of a company may influence its performance over time as it generates competitors' reactions, which erode the gains obtained by other areas. Interestingly, the simulations show that there are not clear good or bad competitors but different competitors, even when they followed similar strategies. In this sense, nonlinearities like the relationship between investment rates and financial performance preclude the possibility of inferring a unique recipe for success.

In terms of sensitivity analysis, the dynamics of the industry did not change significantly when I tested different proportions of the customers sensitive to price or product functionality, but I obtained quite different results when I changed the market share goal of the firms. Differences in the expectations can lead to higher competition intensity, eroding profitability. This result supports a basic tenet in Porter's analysis that industry structure determines firm profitability. In this case, industry structure is completely endogenous to firms as their strategies affect competitors. Therefore, performance may be strongly determined by competitors' moves even in simple gaming simulation (Kunc and Morecroft 2007a).

### CONCLUSION

Managers face very complex investment decisions due to uncertainties about customer acceptance, market size, technology, actions of competitors embedded in a dynamic complex feedback system. In addition, the complexity of a system of interrelated stocks and the information feedback structure of the industry raises managerial decision-making process as one of the most, if not the most, important variables to manipulate the evolution of an industry.

This chapter attempts to analyze the influence of managerial decision making on the evolution of industries' equilibrium, and more specifically on the dynamic behavior of three key components of any industry: the financial performance of firms, the evolution of the market and technology development. Porter (1991) suggests that firms can achieve superior competitive positions due to two factors: established conditions and pure managerial choices. Established conditions may be a good factor when the analysis corresponds to established industries; however, in some circumstances, established conditions can be overcome from managerial actions such as diverse goals. Pure managerial choices, such as the definition of a certain market share, provide a guide to assembly particular resources required to carry out the strategy. However, managerial choices can also generate non-desired consequences because of the complexity of the environment and the cognitive limitations of the managers, especially when there are different conceptualizations of the set of resources and the competitive actions.

System Dynamics modeling and simulation have a long tradition in corporate strategic development, and this chapter provides a glimpse of the method. While this model is purely conceptual and large due to the complexity of interpreting Porter's generic strategies, there are strategic models that serve for other purposes. Kunc and Morecroft (2007b) present two types of strategic models: a 'back of the envelope model', which is a small and insightful model to address one dynamic challenge where timing to market is very important, and 'a larger model representing not only the market but also interacting functional areas to address more complex problems' like the one in this chapter. There is not perfect models of an organization that will reveal the future outcome of strategy with certainty since modeling is fundamentally the art and science of interpreting complexity (Kunc and Morecroft 2007b: 188) even for a widespread recipe like Porter's generic strategies.

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