

CHAPTER 7

COMPETITIVE ADVANTAGE IN TECHNOLOGY INTENSIVE INDUSTRIES

Frank T. Rothaermel

ABSTRACT

This chapter introduces the reader to the meaning of competitive advantage and posits that a firm's strategy is defined as the managers' theory about how to gain and sustain competitive advantage. The author demonstrates how a firm creates its competitive advantage by creating more economic value than its rivals, and explains that profitability depends upon value, price, and costs. The relationship among these factors is explored in the context of high-technology consumer goods-laptop computers and cars. Next, the chapter explains the SWOT [s(trengths) w(eaknesses) o(pportunities) t(hreats)] analysis. Examining the interplay of firm resources, capabilities, and competencies, the chapter emphasizes that both must be present to possess core competencies essential to gaining and sustaining competitive advantage through strategy. Next, the chapter describes the value chain by which a firm transforms inputs into outputs, adding value at each stage through the primary activities of research, development, production, marketing and sales, and customer service, which in turn rely upon essential support activities that add value indirectly. After describing the PEST

Technological Innovation: Generating Economic Results
Advances in the Study of Entrepreneurship, Innovation and
Economic Growth, Volume 18, 201–225
Copyright © 2008 by Elsevier Ltd.
All rights of reproduction in any form reserved
ISSN: 1048-4736/doi:10.1016/S1048-4736(07)00007-0

[p(olitical) e(conomic) s(ocial) t(echnological)] Model for assessing a firm's general external environment, the chapter explains Porter's Five Forces Model. The chapter then describes the strategic group model and illustrates that model by reference to the pharmaceutical industry. The author notes that opportunities and threats to a company differ based upon the strategic group to which that firm belongs within an industry. Finally, the chapter explores the importance of strategy in technology intensive industries and emphasizes that sustained competitive advantage can be accomplished only through continued innovation.

1. WHAT IS COMPETITIVE ADVANTAGE?

Gaining and sustaining competitive advantage is the defining question of strategy. Accordingly, strategy research is motivated by attempting to answer fundamental questions like, "why do some technology start-ups succeed, while others fail?," or "what determines overall firm performance?," and "what can you as an entrepreneur or manager do about it?" The unifying element of strategy research is a focus on explaining and predicting *interfirm-performance differentials*. Thus, strategy researchers seek answers to practically relevant questions like "why is Sony, as a new entrant into the market for home video games dominating the incumbent firm Sega, who helped create the industry?," or "why is Dell continuously outperforming Gateway?"

Strategy researchers believe that the answer to these fundamental questions lies in the differences in firm strategy. A dictum of strategy, therefore, is that overall firm performance is explained by a firm's strategy. *A firm's strategy is defined as the managers' plan about how to gain and sustain competitive advantage* (Drucker, 1994). This strategic plan reflects the managers' assumptions about the company's strengths and weaknesses as well as the competitive dynamics in the external industry environment. A strategic plan is, therefore, expressed in a logical coherent framework based on an internal analysis of the company's strength and weaknesses [S(trength) W(eaknesses)] as well as of the external (environmental) opportunities and threats [O(pportunities) T(hreats)] it faces, making up the so-called *SWOT Analysis*. A firm's strategy details a set of goal-directed actions that managers intend to take to improve or maintain overall firm performance. If the managers' assumptions align closely with the competitive realities, successful strategies can be crafted and implemented, resulting in superior firm performance.

This definition of strategy highlights the pivotal role managers play in setting and implementing a firm’s strategy, and thus in determining firm performance. Achieving sustained superior performance over a company’s direct rivals, therefore, is the ultimate challenge in strategy.

Simply put, a firm that outperforms its competitors has a competitive advantage. If this firm is able to dominate its competitors for prolonged periods of time, the company is said to have a sustained competitive advantage. For example, through the innovative use of IT and other strategic innovations, the world’s largest retailer Wal-Mart was able to outperform its competitors, Target and Costco, throughout the 1990s and early 2000 in terms of financial performance. Thus, we can say that Wal-Mart had a sustained competitive advantage during this time period. A firm that enjoys a competitive advantage not only is more profitable than its competitors, but also grows faster because it is able to capture more market share, either directly from competitors or from overall industry growth, due to the firm’s stronger competitiveness.

In the simplest terms, profit (Π) is defined as total revenues (TR) minus costs (C), or $\Pi = TR - C$, where $TR = P * Q$, or price times quantity sold. Revenues, therefore, are a function of the value created for customers and the volume of goods sold. Both volume and profit margin drive overall profit, one measure of competitive advantage as depicted in Fig. 1.

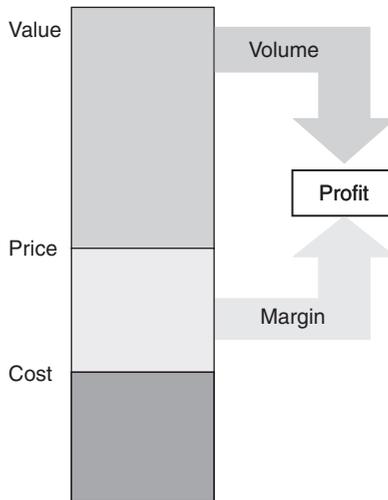


Fig. 1. Volume and Margin as Drivers of Profit.

In more abstract terms, one can say that *a firm has a competitive advantage when it is able to create more economic value than its rivals*. Economic value, in turn, is simply the difference between the perceived value of a good to a customer and the total costs per unit, including costs of capital, to produce the good. Thus, the magnitude of a firm's competitive advantage is the difference between the perceived value created and the costs to produce the good or service compared to its direct competitors. If the economic value created is greater than that of its competitors, the firm has a competitive advantage; if it is equal to the competitors, the firms are said to have competitive parity; and if it lower than its rival firms, the firm has a competitive disadvantage.

If we take a closer look at the equation $\Pi = TR - C$, where $TR = P * Q$, we realize that firm profitability depends, simply put, on three factors: (1) perceived *value* created for customers; (2) the *price* of the product or service; and (3) the total *costs* of producing the product or service. The perceived value of a good, for example, is assigned by customers based on the product's features, performance, design, quality, and so on. For example, customers value a BMW M3 sports car more than a Dodge Intrepid, and accordingly are willing to pay more for the BMW M3 (and have lots more fun driving it!). The price of a product (or service) is simply the dollar amount the customer pays to purchase the good. Indeed, trade happens because both sides, sellers and buyers, benefit. That is because buyers generally value the goods they buy at a higher dollar amount than they actually pay for it. Sellers, on the other hand, generally sell their products or services above cost.

Think about the laptop you bought for college. How much did you pay for it? Let's assume you paid \$1,200 for it. But, how much do you value it? That is, how much is it worth to you? This can be determined by thinking about how productive and enjoyable college would be for you without a laptop (and assuming you do not have convenient access to a close substitute like a desktop). You quickly realize you would have been willing to pay much more for a laptop than you actually paid for it. Indeed, if you were pushed, you probably would have paid several thousand dollars for it, given the way it enhances your productivity. If you would have been willing to pay, let's say, \$8,000 for your laptop, but paid only \$1,200 for it, you actually captured value in the amount of \$6,800. This amount is the difference between the value you place on the laptop and what you paid for it. In economics, this is called consumer surplus, because it is the value you, as the consumer, capture in the transaction of buying the laptop. Finally, the total costs C is simply the average unit costs that the manufacturing of a

product incurred, including costs of capital. Let's say it costs that company \$500 to make your laptop; it will capture a profit of \$700 when it sells the laptop to you (this is called producer surplus in economics). Thus, trade is beneficial to both buyers and sellers, because transacting parties capture some of the overall value created.

Fig. 2 graphically illustrates how these concepts fit together. V is the value of the product to the consumer, P the price, and C the average unit cost. Thus, $V-P$ is the value the consumer captures (or consumer surplus), $P-C$ is the profit margin, while $V-C$ is the value created by this transaction.

Based on these concepts, one realizes that a firm has two levers to create competitive advantage: (1) the value created to customers V ; and/or (2) the costs of production C . Often higher value goes along with greater cost. Given the earlier example, while the BMW M3 creates more value than the Dodge Intrepid, the BMW M3 also costs more to create than the Dodge Intrepid. Yet, some firms were able to overcome the trade-off between value created and costs incurred to produce that value. For example, Toyota, through its lean manufacturing system, was able to produce cars that were perceived to be of higher value by customers due to superior quality and features, while at the same time the unit cost was lower, when compared to cars manufactured by U.S. or European car makers in the same class. This situation is depicted in Fig. 3, where Firm B is able to capture competitive

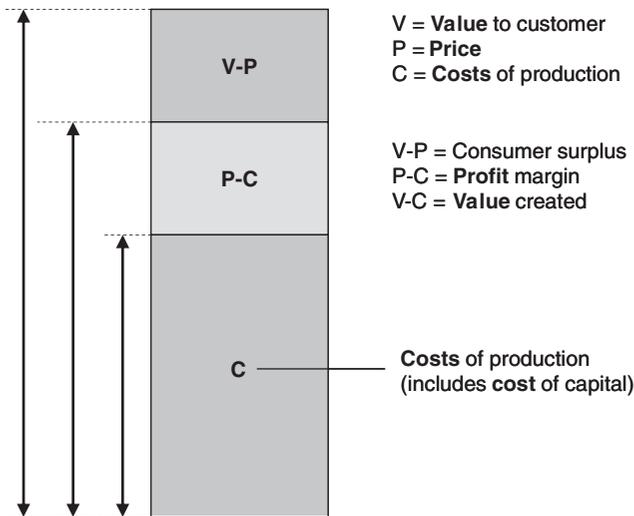


Fig. 2. Value, Price, and Costs.

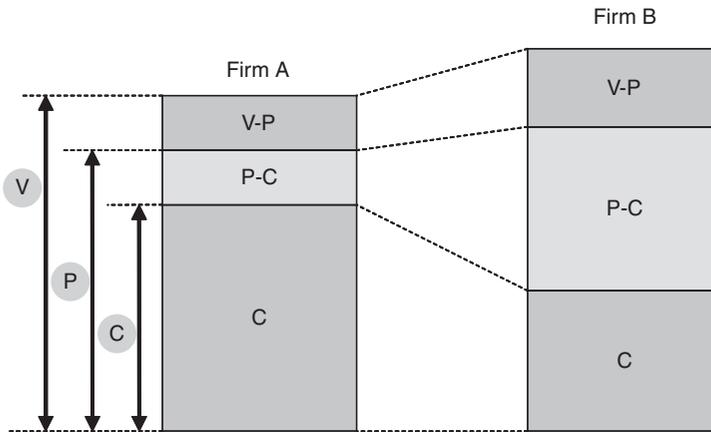


Fig. 3. The Role of Value Creation and Costs in Competitive Advantage.

advantage on both levels, with higher perceived value created than Firm A, with, at the same time, lower costs to produce the good or service. Thus, Firm B can charge a higher price than Firm A because Firm B creates more value than Firm A. In addition, Firm B is more profitable than Firm A, because Firm B has lower cost than Firm A. While competitive advantage only requires a firm either to achieve higher value created (assuming costs are equal) or lower costs (assuming value created is equal) than its competitors, some firms are able to gain and sustain a competitive advantage through a twofold superior performance based on higher value created *and* lower costs.

2. INTERNAL AND EXTERNAL ANALYSIS (SWOT)

To create and sustain competitive advantage, the firm's managers must understand the firm's internal strengths and weaknesses as well as its opportunities and threats that present themselves in the firm's external environment. This is done through a SWOT. Internal strengths and weaknesses concern issues such as quantity and quality of the firm's resources, capabilities, and competencies. The goal here is that a firm's strategy should leverage a firm's strengths while mitigating its weaknesses, or acquire new resources and build new capabilities and competencies to turn weaknesses into strengths. To understand the external environment,

**Competitive Advantage Requires Strategic Fit between a Firm's
Internal Strengths & Weaknesses and External Opportunities and Threats**

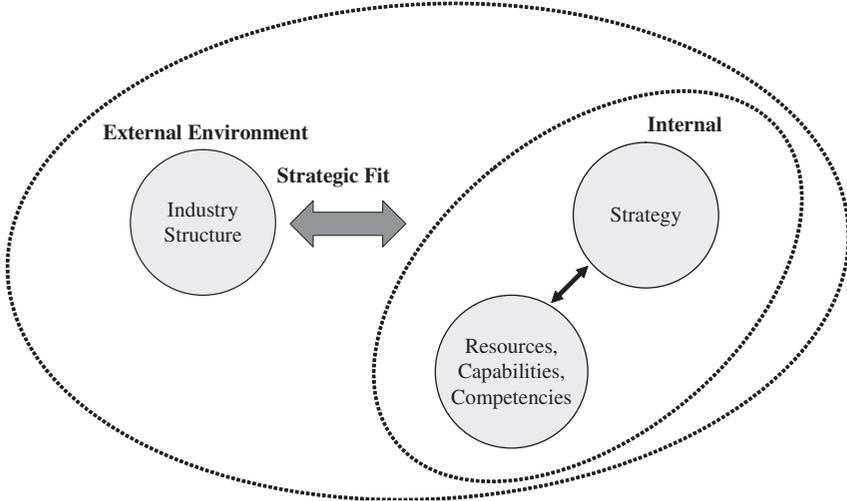


Fig. 4. Strategic Fit.

the managers must analyze the structure of the industry in which they compete, because overall firm profitability is determined not only by firm effects but also by industry effects (McGahan & Porter, 1997). The latter point implies that not all industries are equally profitable, and thus some industries are more attractive than others. For example, the average industry rate of return on invested capital is many times higher in the pharmaceutical industry than in the grocery industry, and this has been so for decades. The ultimate goal of the SWOT analysis is therefore to aid managers in formulating a strategy that allows a coherent fit between the company's resources, capabilities, and competencies, on the one hand, and its industry structure, on the other hand (as depicted in Fig. 4).

2.1. Internal Analysis: Resources, Capabilities, and Core Competencies

Superior firm profitability is the result of a firm's gaining and sustaining competitive advantage through strategy. To be able to leverage a strategy into competitive advantage, however, a firm must possess *core competencies*, that allow the managers to manipulate the underlying drives of profitability,

i.e., perceived value and cost. To obtain a competitive advantage, a firm must have competencies that allow it to create higher perceived value than its competitors or to produce the same or similar products at a lower cost, or to do both simultaneously. For example, the core competence of Honda Motor Company is to produce small, highly reliable, and high-powered engines. This allows the company to create superior value in the mind of the consumer. Yet, it is important to realize that the final product (e.g., an Acura MDX, a crossover SUV in Honda's luxury line of vehicles) is only the visible side of competition. What is even more important to think about is the science, engineering, and managerial competencies needed to create the Acura MDX and its high-performing engine. While products and services are the visible side of competition, underneath are a diverse and deep set of competencies that make this success happen. This implies that companies compete as much in the product and service markets as they do on developing competencies. Superior or core competencies allow managers to create higher perceived value and/or achieve a lower cost structure (Prahalad & Hamel, 1990).

Core competencies are built through the complex interplay between resources and capabilities. *Resources* are assets on which a company can draw when executing strategy. Resources fall into two categories: *tangible* (such as land, buildings, plant, and equipment) and *intangible* (such as brand name, reputation, patents, and technical and market know-how). Finally, a firm's *capabilities* are the managerial skills necessary to coordinate and orchestrate a diverse set of resources and to deploy them strategically. A firm's capabilities are by their nature intangible, and are captured in a firm's routines, procedures, and processes (Teece, Pisano, & Shuen, 1997). As depicted in Fig. 5, the interplay between resources and capabilities allows managers to create core competencies, which are then leveraged to formulate and implement strategy with the goal of attaining a competitive advantage and thus superior profitability.

It is important to realize that competitive advantage can stem from both the resource and the capability side. To be the basis of a competitive advantage, a firm resource must be: (1) valuable (*V*), thus allowing the managers to exploit opportunities or mitigate threats in the firm's external environment; (2) rare in terms of scarcity (*R*); (3) imitation protected, so only imperfect imitation is possible (*I*); and (4) substitution protected (*N*), in the sense that equivalent substitutes are not readily available (Barney, 1991). In short hand, this resource-based framework is termed *VRIN*.

Yet, managers need to be aware of a critical distinction. While resources can have some or even all of the *VRIN* attributes, unless a firm has the

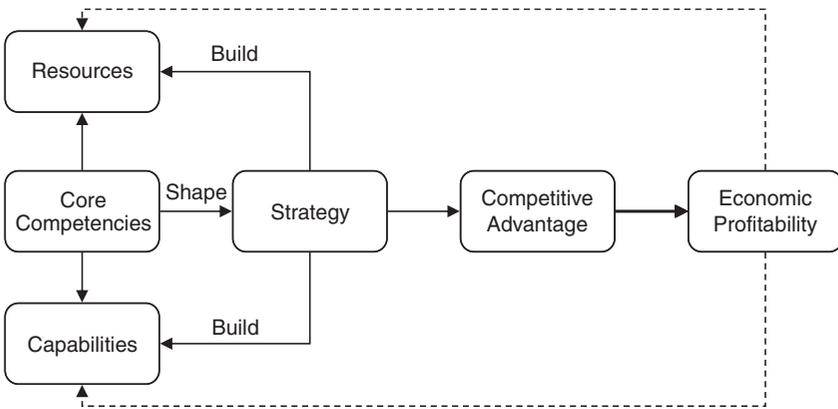


Fig. 5. The Interplay between Resources, Capabilities, and Competencies.

(science, engineering, and managerial) capabilities to orchestrate and deploy these resources in an effective and efficient manner, the managers will not be able to create a core competence and thus will fail to achieve a firm-level competitive advantage. On the other hand, the managers may be able to draw only on average resources that do not fulfill any of the *VRIN* requirements, but the firm possesses superior capabilities of coordinating, orchestrating, and deploying the average resources that results in superior performance. For example, it can be argued that McDonald's or the U.S. Army draw on average human resources, but both possess superior capabilities, systems, and structures that allow these organizations to deploy these resources globally in a superior fashion that has not been matched by their rivals. Taken together, competitive advantage requires that a firm possesses either (1) resources that can be classified by any or all of the *VRIN* attributes (e.g., an important and enforceable patent or thicket of patents) and the capability to deploy these resources or (2) average resources but superior capabilities at deploying, orchestrating, and managing the bundle of average resources. It comes as no surprise that a company that can combine *VRIN* resources with superior capabilities is in the strongest position to achieve and sustain competitive advantage.

2.2. The Value Chain and Activity Systems

The concept of the value chain captures the notion that a firm engages in a number of activities to transform inputs into outputs, and through this

process adds value at each stage (Porter, 1985). This transformation process is composed of a set of distinct activities, such as research, development, production, marketing and sales, and customer service. While these so-called primary activities directly add value by transforming inputs into outputs as the firm moves a product or service horizontally along the value chain, each of the distinct primary activities along the way is supported by other activities, such as information systems, operations management, human resources, finance, accounting, and general management. Together, the latter activities are called support activities, as they add value indirectly, while primary activities add value directly. Fig. 6 depicts a generic value chain containing both primary and support activities.

Competitive advantage requires different positioning strategies through strategically choosing a different mix of value chain activities in order to deliver a unique value at a competitive price (Porter, 1996). Activities are therefore the basic units of competitive advantage. It is important to note, however, that competitive advantage or competitive disadvantage at the firm level is the outcome of the interplay among all of the firm's activities, not only a selected few.

It is critical to understand that operational effectiveness, accomplished through such programs like Six Sigma, is a *necessary but not sufficient condition for competitive advantage*. This is true because these type of

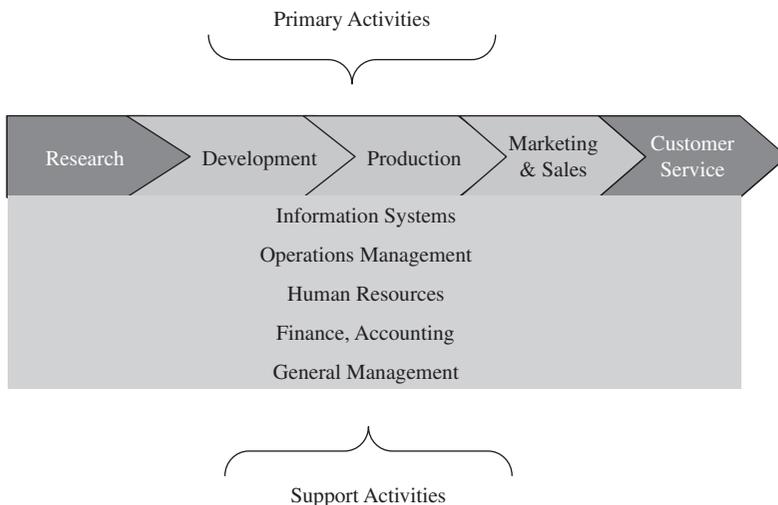


Fig. 6. The Value Chain.

programs are available to all companies and are taught to MBAs, and thus diffuse widely and rapidly within industries. While they accomplish an absolute increase in competitiveness of each firm implementing these programs, they do not change firms' relative advantage vis-à-vis one another. To truly create competitive advantage, a firm must not only be operationally effective, but also choose a different strategic posture based on its unique system of activities. A sustainable strategic position, therefore, requires important trade-offs. For example, it is often not possible to provide innovation at low cost, because innovation requires (very) high and ongoing R&D investments over time. One could argue that Carly Fiorina's tenure at HP was brought to an end by her intended strategy of creating "high-tech at low cost." This ambitious strategy required overcoming what appears to be insurmountable obstacles due to significant strategic trade-offs between the goals of innovation and low cost.

Strategic positions are sustainable if they require trade-offs with other positions. Therefore, the essence about strategy is to choose what activities to engage in, and more importantly, what not to do. Companies with a clear strategic profile and posture outperform companies that attempt to be too many things to too many customers. Strategy therefore is about combining activities into a complex system that not only creates competitive advantage, but also protects from imitation. For example, when attempting to answer the question "what is Southwest Airlines' core competence that creates its superior performance?," one would need to identify a set of activities and how they are coordinated and orchestrated to form a coherent strategy. Ideally, the activities pursued are consistent to one another, while at the same time they also reinforce one another. This implies that the interconnected system of activities is more than the sum of its parts. Understanding competitive advantage as embedded in a system of activities also explains why imitating an entire system of complex activities is so difficult. While one can easily observe several elements of an activity system, what cannot be observed are the capabilities necessary to orchestrate and manage the network of activities.

Strategic Activity Systems, such as the one for Southwest Airlines depicted in Porter (1996), show how a firm's strategic position is built on a network of diverse activities. When activity systems are developed to a mature stage, a number of core strategic themes and a number of supporting strategic activities can be identified and implemented through a network of tightly linked activities (Siggelkow, 2001, 2002).

The following is an excerpt from an interview with Kevin Rollins, Vice Chairman at Dell Computer, that highlights the complex interdependencies

between strategic positioning based on a diverse set of consistent and reinforcing value chain activities (Fishburne, 1999).

Question (Q): What is it about the direct sales model and mass customization that has been difficult for competitors to replicate?

Answer (A): It's not as simple as just having a direct sales force. It's not as simple as just having a mass customization in-plant or manufacturing methodology. It's a whole series of things in the value chain: from the way we procure, the way we develop product, the way we order and have inventory levels, and manufacturer and service support. The entire value chain has to work together to make it efficient and effective.

Q: What is the competition looking at?

A: So many of our competitors are really looking at our business and saying "Oh, it's the asset management model – seven days of inventory. That's what we're going to do," rather than looking at every one of 10 things and replicate those.¹

3. EXTERNAL ANALYSIS: OPPORTUNITIES AND THREATS

Besides internal analysis, the second major input for strategy formulation is a deep understanding of the firm's external environment. This is done to identify opportunities and threats, with the goal of leveraging opportunities and mitigating threats. Events in the external environment, such as changing demographics, sociocultural norms, deregulation, globalization, technological change, macroeconomic changes, as well as political and legal changes, can all create opportunities and threats for companies. One way to understand a firm's external environment is to apply the *PEST Model*. This entails assessing the firm's general environment along the following dimensions: Political/legal, Economic, Social, and Technological (PEST).

While an accurate understanding of a firm's general external environment is necessary, many of these work through affecting the underlying structure of the firm's industry. An important first step, therefore, is to analyze the *structure of the industry* in which you are competing, or planning to compete. An industry is defined as set of companies that offer comparable products and services (i.e., substitutes); an industry is thus the supply side of the market. It is important to keep in mind, however, as industries converge (e.g., computing, biotechnology, and nanotechnology), it becomes harder

and harder to produce accurate definitions of an industry. Thus, industry boundaries will be increasingly difficult to define.

As mentioned earlier, industries show different average profitabilities over time. This is due to different industry structures, some of which are clearly more favorable than others. For example, the average rate of return on invested capital for the time period between 2000 and 2003 was 22.6% for the pharmaceutical industry, 15.9% for the software industry, 11.9% for the publishing industry, 11.2% for the retail industry, 6.6% for the steel industry, and only 1.8% for the air transportation industry (Hill & Jones, 2007).

These differences in underlying industry profitability are explained by each industry's structure, which is assessed along such industry dimensions as the number and size of competitors, the similarity and differences in the product and service offerings, the height of entry and exit barriers, scale economies, and thus the cost to overcome these barriers. One simple dimension to understand industry structure is the size and number of competitors. If there are many small firms in an industry, the industry is fragmented, and generally exhibits low average profitability (what economists call "perfect competition"). If there are only a few large firms in an industry, this industry structure is more favorable and can exhibit higher industry returns ("oligopoly"). The most favorable industry structure is the monopoly, where only one firm supplies the entire market. To more deeply understand industry structure, and how it affects firm performance, we now turn to the well-known Five Forces Model developed by Michael Porter.

3.1. Porter's Five Forces Model

Porter's Five Forces Model helps managers to understand the underlying industry structure, and thus aids in identifying threats and opportunities. This model is depicted in Fig. 7, and highlights five forces that shape competition within an industry, and thus determine the overall industry profitability and its attractiveness. The viewpoint is that of an incumbent firm already active in an industry. These forces are: (1) the risk of entry by potential competitors; (2) the bargaining power of buyers; (3) the bargaining power of suppliers; (4) the threat of substitutes; and (5) the resulting intensity of rivalry among existing competitors (Porter, 1980).

The *risk of entry* concerns potential competitors that are not yet competing in your industry, but have the capability to do so if they choose.

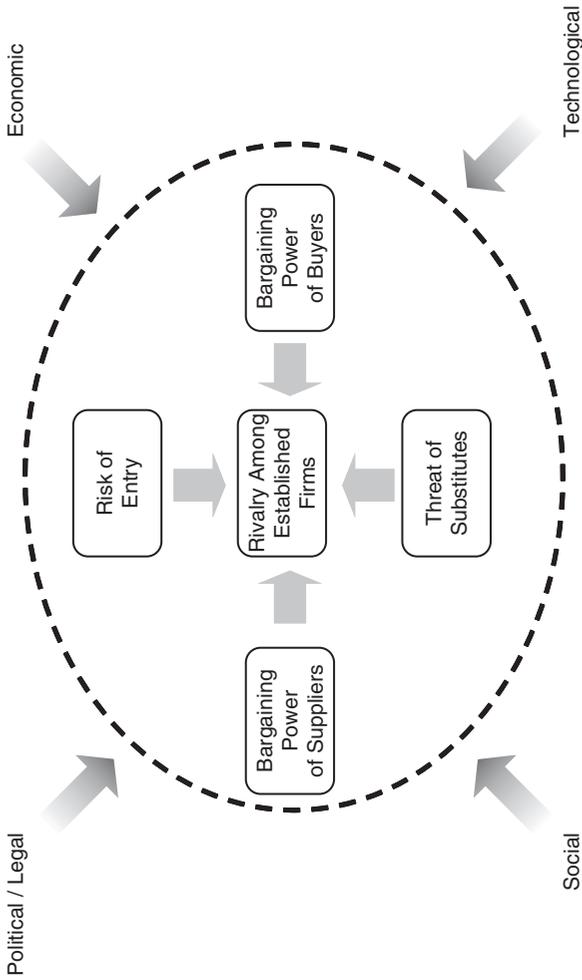


Fig. 7. Porter's Five Forces Model Enfolded in PEST Environment.

For example, in the Southeastern U.S. the TV cable company, Comcast, has entered the business for residential and commercial telephone services and Internet connectivity (as Internet Service Provider), thus emerging as a competitor for AT&T and Bell South, who recently merged. The risk of entry by potential competitors is determined by the barriers to entry, i.e., how costly an investment is it to enter the industry? Indeed, the height of barriers to entry has been found consistently to be the most significant predictor of industry profitability. For example, the pharmaceutical industry in the U.S. experienced between the end of World War II and 1975 only one entry, which was Syntex, based on the breakthrough innovation of the contraceptive pill. Thus, the industry was characterized by extremely high barriers to entry, which in turn was reflected by fairly average industry profitability (over 20% return on invested capital year after year). With the emergence of biotechnology, which represents a radical process innovation through which new drugs are discovered and commercialized, new entrants in the form of biotechnology start-ups were able to circumvent the entry barriers. As a consequence, over 2,000 new biotechnology firms entered the industry and clearly changed the underlying industry structure (Rothaermel, 2000, 2001a; Rothaermel & Hill, 2005). In general, the heights of entry barriers are determined by factors like government regulation, economies of scale, product differentiation, and customer switching costs.

The *bargaining power of buyers* concerns the pressure buyers can put on the seller's company's margin through demanding a lower price and higher product quality. Strong buyers can act to reduce the company's revenues. Buyers have strong bargaining power when they purchase in large quantities and control many access points to the final customer. For example, Wal-Mart and Home Depot can exert tremendous pressure on their suppliers to lower prices and to increase quality, because these two companies will choose not to place the suppliers' products on their shelves. Buyers also are extremely powerful when they are the only customer buying a certain product. Many modern defense technologies rely on the latest innovations, and thus are clearly technology and engineering driven, but frequently these products are bought by only one buyer, the U.S. Department of Defense, which has considerable bargaining power to demand lower prices and higher quality. Buyers are also powerful when they can credibly threaten to backward integrate. This is commonly observed in the auto component supply industry, where car manufacturers like GM, Ford, or DaimlerChrysler have the capability to backwardly integrate to produce their components in-house, should their demands for lower prices and higher product quality not be met by their suppliers. Also, if the buyers' switching costs are low,

this adds to the strength of this force, because buyers can play off the suppliers against each other. This threat is particularly pronounced if the products sold to buyers are non-differentiated commodities, like agricultural products. Thus, buyers can possibly extract the profitability earned in the industry (see Chapter 1).

The *bargaining power of suppliers* attempts to capture pressures that suppliers to the industry can exert on industry profitability. Inputs into the production process concern raw materials, labor (may be individuals or labor unions, where the company faces collective bargaining), and services. While strong buyers have the power to reduce a company's revenues, a powerful supplier can raise the company's cost through demanding higher prices for its input or delivering lower quality inputs. Thus, any profits earned in the industry may actually be appropriated by the suppliers (see Chapter 1).

Suppliers are powerful, relative to the firms in the industry, if only a few substitutes are available for the products and services supplied. For example, crude oil is still a critical input in many industries, and oil suppliers are fairly powerful in raising prices and squeezing industry profitability where products and services rely heavily on oil as a critical input. Suppliers are also in a more powerful position when the extent of competition among suppliers is low, which often goes along with a small number of large suppliers. Supplier power is further enhanced when the supplied product is unique and differentiated or when the companies in the industry face significant switching costs. Supplier power is also strengthened when suppliers provide a credible threat of forwardly integrating in the companies' industry, or when the companies in the industry buy only small quantities from the suppliers. Microsoft's power as supplier of operating systems in the market for personal computing stems from the fact that Windows is the de facto standard in the industry, consumer switching costs are high, and the product is fairly unique and differentiated.

The *threat of substitutes* concern the questions whether any available products or services come close to meeting the needs of your customers. Close substitutes place limits on the ability of companies in the industry to raise prices; if they do, customers will switch. For example, if coffee prices would increase significantly, customers might switch to tea or other non-alcoholic beverages to meet their needs. One reason Microsoft has such a powerful position is that there are only few viable substitutes for the Windows operating system (e.g., Linux). Thus, the threat of this force is determined by the existence of substitutes with attractive price and performance characteristics that result in low switching costs.

These four forces conspire to determine the *rivalry among existing competitors* in the industry, and they thus determine overall industry profitability. The threat of rivalry refers to the competitive intensity within an industry, which can range from cut-throat to genteel. Competitive intensity is determined by how hard existing firms fight among themselves to gain market share from each other, or to capture a significant amount of industry growth. Competitive weapons include price discounting, product and service differentiation, and advertising spending. The stronger the rivalry in the industry, the lower the industry profitability, because intense competition leads to lower prices (and thus lower revenues) and greater costs, squeezing out profitability in the industry (which can be captured by consumers, as in the airline industry in the years following the September 11 terrorist attacks). On the other hand, firms may prefer non-price competition and compete on advertising and innovation, thus avoiding head-on competition. This scenario has been observed for extended periods in the soft drink industry (Coke vs. Pepsi) and in the automobile industry. The threat of rivalry among existing competitors is strongest (weakest) in an industry that has many (few) firms, has excess (no excess) capacity, low (high) industry growth, low (high) differentiation, low (high) switching costs, no (a) history of cooperative pricing with an emphasis on non-price competition, and high (low) exit barriers.

At this point, however, it is important to note that Andy Grove, former CEO of Intel, has suggested that Porter's Five Forces Model is incomplete in the sense that it does not consider the strength, power, and competence of *complementors* (Grove, 1996). These are companies that provide products and services (or competencies) that add value through complementing the original product offering, because when these two products (or competencies) are used in tandem they provide more value to the customer. Clearly, Grove was thinking of the complementary relationship between Microsoft's operating system, Windows, and Intel's microprocessors' chip architecture, which together built the Wintel standard in personal computing today. But Grove's idea that complementors are critical to creating firm value can be easily extended to other industries. For biotechnology start-ups that have developed new drugs due to their strength in drug discovery and early stage development, existing pharmaceutical are often complementors, because they have an existing strengths in large-scale manufacturing, in managing FDA clinical trials and regulatory approval, and in distributing drugs via armies of detail people (sales forces) to doctors, hospitals, and Health Maintenance Organizations (HMOs). This has led to a cooperative equilibrium in this industry through a division of labor in scientific discovery and

commercialization, in which each partner focuses on its comparative strengths (for more detail, see Chapters 1 and 8) (Gans & Stern, 2000; Rothaermel, 2000, 2001a, 2001b; Hill & Rothaermel, 2003; Rothaermel & Hill, 2005).

In sum, the stronger a competitive force, the greater the threat it represents. On the flip side, the weaker the competitive force, the greater the opportunity it presents. The strengths (or the weakness) of the forces together determine overall industry attractiveness.

While a useful model to understand industry profitability, an important caveat is that the Five Forces Model is static, and thus it provides only a snapshot of moving target. One cannot use it to determine the speed of change in an industry or the rate of innovation. Moreover, the strength of each competitive force changes throughout the industry life cycle. Thus, managers need to repeat the Five Forces analysis over time to create a more accurate picture of their industry. In addition, both external and internal industry factors can alter industry structures. These factors include change in external environment discussed above, but also innovation or firm strategy can change the structure of an industry, and thus the Five Forces. Finally, identifying attractive industries does not imply that one can easily enter them.

Perhaps even more important is the fact that the Five Forces Model cannot say much about inter-firm differentials, because it is a model of industry profitability, not a model of predicting why one firm outperforms another *in the same industry*. Thus, the Five Forces Model cannot explain why Southwest Airlines is outperforming the legacy carriers like Delta, American, or Continental, because they all compete in the same industry. To overcome this shortcoming to some extent, scholars offer the Strategic Group Model, to which we turn next.

3.2. *Strategic Group Model*

When comparing Southwest Airlines to the legacy carriers, it becomes clear that firms in the *same industry differ along important dimensions*. While they are competing in the same industry, Southwest Airlines offers low cost, point-to-point connections, while the legacy carriers offer basically all destinations in the world via a hub and spoke system, combined with a differentiated product offering. More generally speaking, companies often use a different positioning in their strategy in terms of technological leadership, product quality, pricing policies, market segments served, distribution channels, and customer service. As a consequence of differences

along such important strategic dimensions, it is often possible to identify groups of competitors in an industry, where group members pursue a similar strategy that results in a similar positioning, while at the same time that group is different from other groups of firms. In many industries such *strategic groups* can be identified along a fairly small number of dimensions. While belonging to the same industry, different rates of performance are generally observed in different strategic groups (Nair & Kotha, 2001; McNamara, Deephouse, & Luce, 2003). This implies that firm performance is partly determined by strategic group membership.

For example, in the global pharmaceutical industry, two main strategic groups have been identified (see Fig. 8) (Cool & Dierickx, 1993). One strategic group has chosen a positioning strategy based on discovering and developing new (blockbuster) drugs. This group includes companies like Aventis, Eli Lilly, Merck, and Pfizer. Developing new drugs requires consistently high R&D expenditures (generally spending upwards of 10% of sales on R&D), because it takes easily 10–15 years for a newly discovered

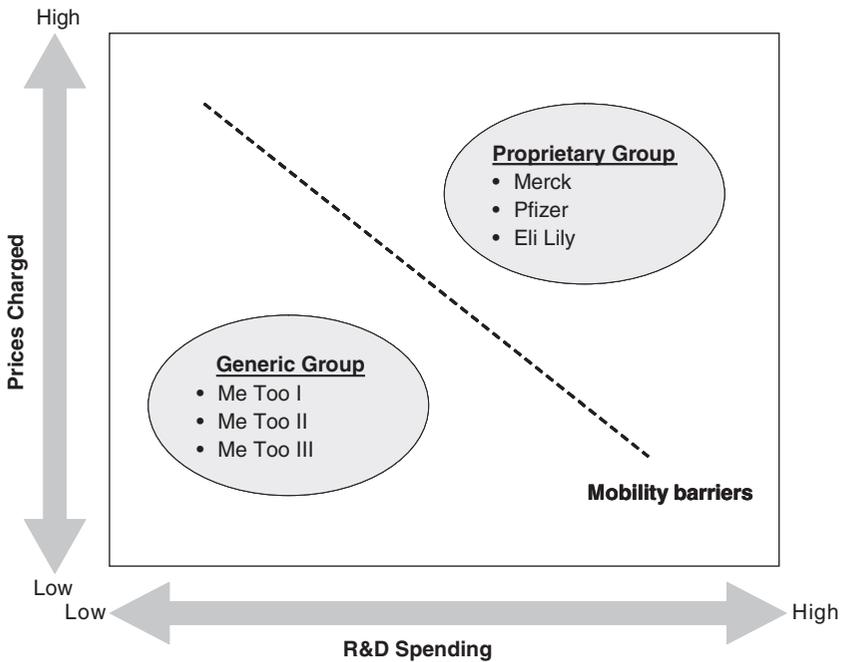


Fig. 8. Strategic Groups and Mobility Barriers in the Pharmaceutical Industry.

molecule to reach the market for drugs. Moreover, drug discovery and development costs have risen drastically, and can reach \$1 billion. The strategy of focusing on the discovery and development of proprietary drugs also has an extreme risk element to it, because only one out of 10,000 discovered molecules will make it to the market for pharmaceuticals² (Rothaermel & Deeds, 2004, 2006). This implies that the firms in the strategic group focusing on proprietary drugs are pursuing a high risk, high return strategy. The strategy is clearly high risk, given the very low odds of discovering and developing new drugs that are also commercially viable, i.e., serve a large enough market to recoup the firm's investment (and to pay for all the other failures along the way). On the other hand, with a high risk comes a potential for high returns. Should a new drug be discovered, firms will patent protect it, and thus be able to extract monopoly rents for a considerable time (as long as exclusivity of the patent lasts, see Chapters 3–5).

While this first group is described as the *proprietary group*, a second strategic group in the pharmaceutical industry can be identified. This group is the so-called *generic group*, because their positioning strategy is to focus on the low-cost manufacturing and distribution of drugs that have come off patents (me-too products). The strategy of companies in the generic group is characterized by little R&D spending, production efficiencies (especially in large-scale manufacturing), and alternative distribution channels (e.g., over the counter). These elements combine to create a low-cost, low-risk strategy. The strategy is low cost, because the R&D investments required to understand the manufacturing behind patent-expired drugs are minimal. But this strategy is also low return; because of the lack of differentiation, these firms are unable to charge high prices; indeed, their products are commodities.

The concept of strategic groups has several implications for competitive advantage. One immediate insight is that the opportunities and threats companies face in an industry will differ based on the strategic group to which the firms belong. The threats of new entry, bargaining power of buyers and suppliers, substitutes, and rivalry among established firms are mediated by membership in a specific strategic group. For example, while the risk of entry into the generic drug group is low, it is much higher in the proprietary group. Historically, the bargaining power of buyers has been low in the proprietary drug group, because their drugs enjoy IP protection (although this appears to be changing with the rise of HMOs) and there are generally no close substitutes. In contrast, the bargaining power of buyers has been high in the generic drug group, because they are often bought in

large quantities by a few buyers (large hospitals and HMOs), and substitutes are readily available. This in turn implies that a company's direct competitors are the ones within its own strategic group, because of their similar strategic positioning. Given the existence of different strategic groups, one also realizes that the strength of the different competitive forces discussed above changes based on the strategic group to which a firm belongs. This implies that each strategic group, even though they belong to the *same industry*, *differ along the opportunities and threats* they are facing.

Another implication of the existence of strategic groups is that some groups are more attractive than others, given the impact of the competitive forces discussed. Thus, there exists performance heterogeneity across strategic groups in the same industry. For example, companies in the proprietary drug group tend to outperform companies in the generic drug group. So, why are firms not moving from a lower performing group to higher performing groups? The answer is that strategic groups are generally separated by *mobility barriers* (Caves & Porter, 1977). These are industry-specific factors that inhibit movement from one group to another. For example, the pharmaceutical companies in the proprietary drug group have built their strong R&D competence over long periods of time through large R&D investments, but also through R&D alliances and R&D acquisitions (Rothaermel & Hess, 2007). This implies that a company in the generic group cannot easily build an R&D competence necessary to compete in the proprietary group, because not only are very high investments necessary, but also these competencies tend to be built cumulatively over long periods of time. Mobility barriers, therefore, separate strategic groups from one another.

4. DRIVERS OF ECONOMIC PROFITABILITY

We are now in a position to put together the pieces that drive economic profitability (or overall firm performance). We realize that firm performance is a function of industry *and* firm effects. Industry effects, and thus the attractiveness of different markets, can be understood with the Five Forces Model and the Strategic Group Model. Firm-level competitive advantage, on the other hand, depends on the firm's value and cost positions (which are an outflow of its competencies) relative to its competitors. A firm's strategy allows managers to choose attractive industries and build the competencies necessary to gain and sustain competitive advantage. Fig. 9 depicts the

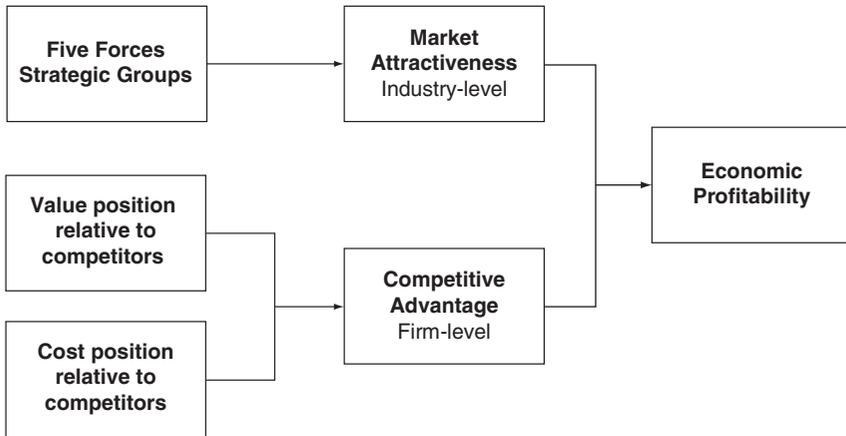


Fig. 9. The Role of Industry and Firm Effects in Understanding Economic Profitability.

individual factors that drive economic profitability, and highlights the analytical tools available to understand each factor.

5. STRATEGY IN TECHNOLOGY INTENSIVE INDUSTRIES

Today, technological innovation is in many industries the most important driver of competitive advantage. Reasons for the increasing importance of innovation in many industries include deregulation, globalization, rapid technological progress (e.g., advances in IT, biotechnology, and nanotechnology), and accelerating diffusion rates for technology-based products. These factors combine to increase the competitive intensity of almost all industries. Even in industries that are thought of as mundane, like the steel industry, technology has become one of the key differentiating factors in determining firm performance. In general, traditional industries, once considered low tech, are increasingly becoming technology intensive industries.

One could argue that technology intensive industries like the software industry change so rapidly and in such unpredictable fashion, that strategic planning is not necessary and thus a futile exercise. Nothing could be further from the truth. The opposite holds: Strategy becomes even more important

in technology intensive industries. For example, Microsoft employs a formalized strategy process that is at the same time decentralized and flexible (Hill & Jones, 2007). It is formalized in the sense that it uses standard financial information to determine resource allocation for the next budget year and holds managers accountable for their actual performance compared to their intended performance. It is decentralized in the sense that many of the ideas incorporated in the strategic plan derive from a dialogue between unit heads and top management. Moreover, Microsoft is known to be a company where many strategic initiatives, like the Internet Explorer or the Xbox, have come from mid-level managers deep within the organization. The final strategic plan is decided upon, however, only after detailed scrutiny by top management, including Bill Gates and Steve Ballmer. Finally, Microsoft's strategic planning is flexible, because all managers involved realize that the assumptions underlying the strategic plan may need to be adjusted due to unforeseen circumstances that can arise in the future. This type of strategic flexibility becomes even more important since, in our fast-paced world, the only constant is change.

This type of formal, decentralized, and flexible strategic planning brings to mind the quote by General (and later President) Eisenhower, who stated: "In preparing for battle I have always found that plans are useless, but planning is indispensable." Thus, strategy making in technology intensive industries is akin to the way a fire department plans. It does not know where and when the next emergency will arise, nor does it know the magnitude thereof. Nonetheless, the managers in the fire department (e.g., fire chiefs) put contingency plans in place to address a wide range of emergencies along different dimensions. It is in the same spirit that one ought to view strategic planning in technology intensive industries. This implies that scenario planning, asking the "what if" questions, becomes imperative.

Since the only constant in technology intensive industries is change, *sustained competitive advantage can only be accomplished through continued innovation*. This in turn requires the continuous introduction of new products or services (Shay & Rothaermel, 1999). For example, the percentage of sales obtained from new products developed within the past 5 years has exceeded 40% for 3M, while Proctor & Gamble even strives for 50%. Introducing new products helps firms create more value for customers. At the same time, innovations in manufacturing (like lean manufacturing) and in business processes (e.g., re-engineering) allow firms to lower their cost structure. Thus, innovation works simultaneously to raise the overall value created and to lower the cost required to create the product or service; thus, profits margins widen and firm profitability increases.

Continued innovation creates a string of the so-called Schumpeterian rents based on temporary monopolies. The extent of how long these competitive advantages can be enjoyed depends on the speed of imitability by competitors, which is often determined by the technological and engineering difficulty of the underlying innovation (small vs. large science), the IP protection of the innovation (see Chapters 3–5), and the strategic decisions about how to appropriate returns from invention (see Chapter 1).

NOTES

1. Author's interview with a Distinguished Technologist at HP.
2. The drug discovery and development process can be broken down into distinct sequential stages. The discovery stage can take anywhere between 2 and 10 years. In the next stage, which can take up to 4 years, a lead drug candidate is developed and pre-clinical testing is undertaken. A lead candidate then enters phase I of clinical testing, which can take up to 2 years. In this phase, the lead candidate is administered to 20–30 healthy volunteers and its safety and dosage are evaluated. In phase II, which can take up to 2 years, the drug is given to 100–300 patient volunteers to check for efficacy and side effects. In phase III, which can take up to 3 years, the drug is administered to 1000–5000 patient volunteers to monitor reactions to long-term drug usage. The next stage, FDA review and approval, can take up to 2 years. This is followed by a 2-year post-marketing testing period.

ACKNOWLEDGMENTS

The author thanks Carolyn Davis and Marie Thursby for helpful comments and suggestions. This material is based upon work supported by the National Science Foundation under Grant No. 0545544. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

REFERENCES

- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
- Caves, R. E., & Porter, M. E. (1977). From entry barriers to mobility barriers. *Quarterly Journal of Economics*, 91(2), 241–262.
- Cool, K., & Dierickx, I. (1993). Rivalry, strategic groups, and firm performance. *Strategic Management Journal*, 14(1), 47–59.

- Drucker, P. (1994). The theory of business. *Harvard Business Review*, 75(September–October), 95–105.
- Fishburne, R. (1999). Kevin Rollins, vice chairman, Dell Computer. *Forbes*, 163(7), 163.
- Gans, J. S., & Stern, S. (2000). Incumbency and R&D incentives: Licensing the gale of creative destruction. *Journal of Economics and Management Strategy*, 9(4), 485–511.
- Grove, A. S. (1996). *Only the paranoid survive: How to exploit the crisis points that challenge every company and career*. New York: Currency Doubleday.
- Hill, C. W. L., & Jones, G. R. (2007). *Strategic management theory. An integrated approach* (7th ed.). Boston: Houghton Mifflin.
- Hill, C. W. L., & Rothaermel, F. T. (2003). The performance of incumbent firms in the face of radical technological innovation. *Academy of Management Review*, 28(2), 257–274.
- McGahan, A. M., & Porter, M. E. (1997). How much does industry matter, really? *Strategic Management Journal*, 18(1), 15–30.
- McNamara, G., Deephouse, D. L., & Luce, R. A. (2003). Competitive positioning within and across a strategic group structure. *Strategic Management Journal*, 24(2), 161–180.
- Nair, A., & Kotha, S. (2001). Does group membership matter? Evidence from the Japanese steel industry. *Strategic Management Journal*, 22(3), 221–235.
- Porter, M. E. (1980). *Competitive strategy. Techniques for analyzing industries and competitors*. New York: Free Press.
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.
- Porter, M. E. (1996). What is strategy? *Harvard Business Review*, 77(November–December), 61–78.
- Prahalad, C. K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 71(May–June), 79–91.
- Rothaermel, F. T. (2000). Technological discontinuities and the nature of competition. *Technology Analysis and Strategic Management*, 12(2), 149–160.
- Rothaermel, F. T. (2001a). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22(6–7), 687–699.
- Rothaermel, F. T. (2001b). Complementary assets, strategic alliances, and the incumbent's advantage: An empirical study of industry and firm effects in the biopharmaceutical industry. *Research Policy*, 30(8), 1235–1251.
- Rothaermel, F. T., & Deeds, D. L. (2004). Exploration and exploitation alliances in biotechnology: A system of new product development. *Strategic Management Journal*, 25(3), 201–221.
- Rothaermel, F. T., & Deeds, D. L. (2006). Alliance type, alliance experience, and alliance management capability in high technology ventures. *Journal of Business Venturing*, 21, 429–460.
- Rothaermel, F. T., & Hess, A. M. (2007). Building dynamic capabilities: Innovation driven by individual, firm, and network-level effects. *Organization Science*, 18, 898–921.
- Rothaermel, F. T., & Hill, C. W. L. (2005). Technological discontinuities and complementary assets: A longitudinal study of industry and firm performance. *Organization Science*, 16(1), 52–70.
- Shay, J. P., & Rothaermel, F. T. (1999). Dynamic competitive strategy: Towards a multi-perspective conceptual framework. *Long Range Planning*, 32(6), 559–572.
- Siggelkow, N. (2001). Change in the presence of fit: The rise, the fall, and the renaissance of Iiz Claiborne. *Academy of Management Journal*, 44(4), 838–857.
- Siggelkow, N. (2002). Evolution toward fit. *Administrative Science Quarterly*, 47(1), 125–159.
- Tece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533.