Outsourced Design: Strategic Implications and Effective Management of Dispersed, Inter-firm Product Development

by

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Outsourced Design: Strategic Implications and Effective Management of Dispersed, Inter-firm Product Development

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Abstract

The growth in outsourcing is one of the dominant trends in business today. As the acceptance of outsourcing grows so does the willingness to outsource more functions, some of which are critical to a firm's success. For a company that develops innovative products, the most crucial function and typically the last to be outsourced is product design. Yet there exists a growing trend toward more outsourced design, particularly in the electronics industry. This trend has been accelerated by the appearance and growth of electronic manufacturing services (EMS) companies and original design manufacturers (ODM). In deciding to outsource a company must first understand its core competencies or key competitive advantages. These competencies typically take the form of technological know-how, unique process capability, or valuable partnerships. This work proposes that when outsourcing the design of products with integral type architecture products, the strength of the collaborative relationships is the most important of the triad. The way these relationships are considered and managed is crucial to their performance. The nature of the relationships is first considered based on a literature review and woven throughout are excerpts taken from interviews conducted at a large product development company that is in the process of growing its outsource design capabilities. The work concludes with some recommendations for the firm to improve the performance of its current relationships.

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1. Chapter 1. – Introduction to Outsourcing

The goal of this chapter is to introduce some of the general notions about outsourcing and to explore some of the underlying business trends. One of the salient features of outsourcing is the fear of creating a competitor or obviating the need for the original company. The possibility is considered along with some concepts that will be used for further analysis of outsourcing.

1.1. Growth in Outsourcing

Outsourcing is not a new business method. For centuries businesses have relied on outside suppliers for such services as accounting and legal advice. Even the modern rise of contract manufacturers has roots extending back at least 150 years. In the 19^{th} century gun manufacturers in England often employed a few master gun makers and functioned as contracting companies. The master gun makers would outsource the manufacture of parts and the final assembly of the guns to small groups of skilled craftsmen (Domberger 1998).

Despite being a useful and practiced business approach for more than a century, in recent decades the use of outsourcing has increased. There are three underlying factors that support the expansion of outsourcing: (1) a shift to a more knowledge-based economy, (2) reduced trade barriers, and (3) decreased transaction costs. Firm level performance metrics demonstrate the growth in knowledge-based activity. Standard & Poor's reports that in the year 2000 the market-to-book ratio of the S&P 500 was six times greater than it was in 1981.(Casale 2000) The decline in the market since 2000 has likely affected this ratio somewhat, but it is still a credible indication of the declining importance of tangible assets and a reflection of a trend in business away from capital intensive and asset based activities toward knowledge-based activities.

The value of international trade as a percentage of GDP in the developed world peaked in the 1920s. With the depression, world wars, and subsequently rebuilding, international trade didn't reach the same levels until the 1960s. In the developed countries, as a result of reduced barriers initiated after World War II and continually expanded, world trade continues to grow. However, as an indication of the growth in outsourcing, the type of trade has changed. Over the last 50 years, in the 11 largest world economies, there has been a steady shift away from agricultural products and raw materials toward manufactured goods. After discounting for foreign direct investment by multinational firms[1] and importing of finished goods ready for consumption, the trend between 1974 and 1995 has been a doubling or tripling of import of intermediate goods across most industries (Feenstra 1998). This data reveals that around the world, companies are increasingly sourcing components and subassemblies from outsource suppliers. In fact, whole industries, e.g. apparel, have moved to an outsource model as a natural way of doing business.(Feenstra 1998)

With increased and less expensive travel, shipping, and communication, the cost of each transaction has fallen. Lower transactions costs allow the market to become a more efficient means of coordinating the inputs of goods. Figure 1 compares the types of inputs and the coordinating mechanisms. Figure 2 graphically depicts the regions by number of transactions where markets are more efficient. For very low transaction numbers or very high transaction numbers, the cost of management becomes relatively high. The market does a better job of producing goods, ensuring quality, achieving fair prices, and leveraging across companies. For a broad number of transactions, the coordinating costs of management are lower than market coordination costs. This region is likely at the core of the business. As transaction costs shift lower, the tendency is to flatten out the curve representing market coordination costs resulting in an ever-smaller region where the firm is the preferred coordinating mechanism. The focus on transaction costs as a driver for outsourcing is well known in the literature and is considered by some as one of the primary drivers in increased outsourcing. (Price 2001) Studying transaction costs provide an interesting and informative understanding of outsourcing, but one must also consider the types of functions outsourced.

[1] A multinational firm setting up an operation in a foreign country is, of course, not outsourcing merely changing production location. Foreign direct investment is used as an indicator of the shifts of production location within a firm.

	B-dimension: is the firm or the market the chosen instrument for coordination	
	The vertically integrated, do-it-yourself firm. Management does the job of coordination **B1**	The specialized firm, contracting out if possible. Markets do the job of coordination **B2**
A-dimension: Goods with a high proportion of local content **A1**	***A1, B1*** General store in small town, Monopolized public utilities Vertically integrated retailers	***A1, B2*** Dentists, artisans, building firms, hospitals seeking efficiency gains from outsourcing, members of a specialized agglomeration complex
A-dimension: Goods with a high proportion of international content **A2**	***A2, B1*** Traditional MNCs, keeping control over the production chain to preserve proprietary technology and know-how	***A2, B2*** International subcontracting parts of the production process, leading to intra-product trade and 'supply chain management' transactions, costs kept low by agglomeration effects

Figure 1: The Fragmentation Matrix (Price 2001)

At the firm level, outsourcing provides a way to adapt to the shifting economic activity. Across large and small corporations, outsourcing has become a standard business practice. Almost 50% of businesses with revenues greater than $50 million have outsourced some of their business functions.(Casale 2003) In fact, contracting for services such as accounting, janitorial, security, payroll, etc. has become, for many businesses, the preferred way of doing business over the last few decades (Bragg 1998). There are a multitude of reasons why a firm may choose to outsource a business function. With outsourcing a company can dump operational headaches and underutilized capacity, capture cost savings, reduced investment, and avoid labor conflicts and management deficiencies. The growing acceptance of outsourcing and the growing number of capable buyers and suppliers has led to significant growth in outsourcing. In 2000 outsourcing was growing much faster than the US economy, 15 percent vs. 3.5 percent, and increasingly going global with 1 out of every 10 US outsourcing dollars spent abroad. (Casale 2000)

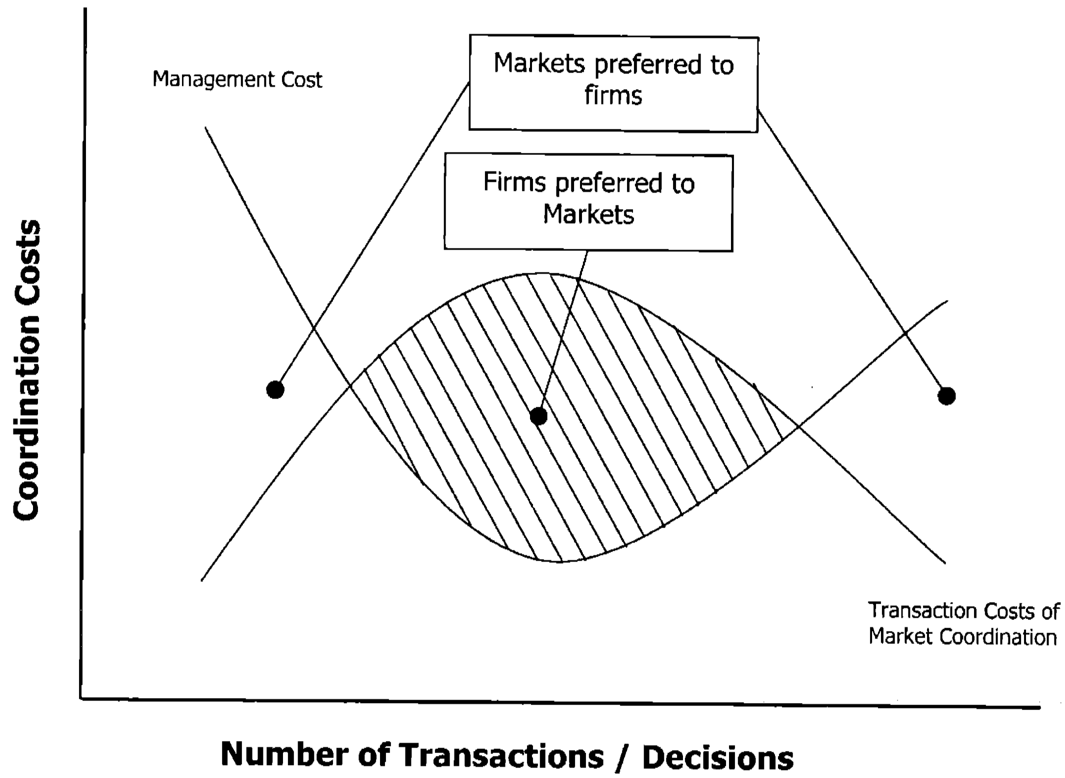


Figure 2: Management or Market? (Jones and Kierzkowski 2001)

1.2. Initial Worries

In the 80s there was a significant concern about the loss of manufacturing in the US. The fear was not only the loss of skilled labor jobs, but also the loss of significant technical knowledge and the subsequent hollowing out of US corporations and the industrial base. (Business Week, March 3 1986) The worry was driven in large part by the growth in manufacturing outsourcing of components as well as final products to foreign manufacturers. The reliance on a network of small and low-cost suppliers was breaking down the traditional manufacturers' vertical structures. The fear was that eventually the suppliers would possess enough key product knowledge to displace the traditional manufacturers. There are a number of stories of just such a dynamic playing out in the market place.

1.2.1. IBM PC: Outsourcing the Operating System and the Rise of Microsoft

In 1984 IBM owned 41% of the market for PCs. IBM's dominant position had grown from nothing only 3 years earlier. In 1981 when launching the development of the PC, IBM chose to source most of the major components from the marketplace. The operating system came from a tiny startup, Microsoft, the processor came from Intel, several other components from other manufacturers. Even distribution was outsourced to Sears and ComputerLand. By coordinating the output of this group of suppliers IBM was able to release its first product in only 15 months.

However, time revealed the flaws of IBM's approach, and ultimately the company's hollowness. With an open architecture and broad standardization, the importance of IBM's coordinating role was lessened after the first introduction. At first competitors struggled to reach full compatibility with IBM's architecture. However, with the broadly distributed knowledge, competitors eventually achieved full compatibility. Full compatibility essentially erased IBM's competitive advantage. Competitors could buy the same components from the same suppliers and even sell the finished product to the same retailers and distributors. By 1995 IBM's share of the PC market had fallen to a mere 7.3%. (Chesbrough and Teece 1996) Later, realizing its falling significance, IBM tried to make itself relevant to the PC market by regaining control of the architecture and the operating system. However, the efforts came too late to displace the entrenched clone makers and suppliers such as Intel and Microsoft. IBM continues to compete in the PC market, and maintains approximately 6% market share (staff 2002), but clearly most of the value of the market has been captured by suppliers like Intel and Microsoft.

1.2.2. Bicycles: The Fall of Schwinn and the Rise of Giant

Schwinn started in 1895 as a manufacturer of bicycles and related products. During its early years the company produced bikes that a number of companies then sold under their own labels such as Sears and Goodrich. Superior product design and advanced process technology enabled Schwinn to become a leader in bicycles. With its growing reputation and the swelling popularity of its products, Schwinn eventually stopped making branded products for resellers and switched to exclusively making and selling products under its own name. To compete against lower cost producers Schwinn started buying components and eventually complete bicycles from Asia. Taiwan was home to the leading supplier, Giant Manufacturing. Giant was nearly bankrupt when it first started working with Schwinn in 1977. However, the partnership with Schwinn launched the company to profitability and exponential growth. Schwinn taught Giant how to design and manufacture high quality bicycles. The bicycles were of such high quality and low cost that Schwinn eventually closed nearly all of its US manufacturing in just a few years. By 1982 Schwinn became jealous of Giant's success as a supplier and feared the power that Giant had accumulated as the primary supplier of over 80% of Schwinn's products. Seeking to hedge its risk, Schwinn engaged China Bicycles Company. The move upset Giant who retaliated by focusing more effort on selling their products under their own brand name. As with Giant, Schwinn worked with China Bicycles to improve their designs and manufacturing quality. China Bicycles also prospered under Schwinn's tutelage and, by the eventual purchase of Western States and its Diamond Back label, went on to become one of Schwinn's top competitors. Schwinn couldn't keep up with its suppliers. In the market place the Asian firms were forcing the pace of quality and technology as well as price. As the supplier's market positions strengthened, they became less willing to work with Schwinn which ultimately contributed to the company's bankruptcy in 1992.(Crown and Coleman 1996)

1.2.3. Microwaves: Samsung from Assembler to Leading Designer

The start of the boom in microwave sales started in 1970. By 1972 the market had nearly quadrupled to 2.2 million units. In the late 1970s GE developed and started marketing its own microwave. In 1980 the market had expanded to over 31 million units with GE enjoying the largest market share at 16%. Due to increased cost pressure, the company started looking for low cost suppliers. Samsung was new to the market, but their prices were attractive so GE sent them a small order in 1983. Unfortunately the designs and quality were very poor. GE sent engineers and managers to Korea to work with Samsung to improve the microwaves. By 1985 Samsung had achieved world-class design, quality, cost, and scale forcing GE to close its domestic production as non-competitive. By 1996, Samsung had replaced GE as the top selling US microwave brand with an 18% share of the market while GE had fallen from the top 8 selling brands. (Magaziner and Patinkin 1989; staff 2002)

1.3. Strategic Implications and Core Competencies

These three examples are just a sample of the widely told stories of how outsourcing can go awry and allow a supplier or partner to take over the market position of the outsourcer. The examples highlight the often-cited concerns about outsourcing. Once a company starts outsourcing, it becomes dependent on suppliers and subject to being replaced by the very suppliers it helped educate. Figure 3 depicts the reinforcing loop that outsourcing can establish. The inherent, self-reinforcing behavior of outsourcing produces much of the fear of outsoucing. As a company increases the functions it outsources, the in-house knowledge is distributed to the supply base. With increased knowledge comes an increase in supplier capability. Capability leads to an increased willingness to outsource and more outsourced functions. For the manufacturer, knowledge generation and learning lessen the in-house capability dwindles. With diminished capability the investments necessary to restore capability become larger resulting in a reduced willingness to invest in rebuilding those capabilities leading to increased outsourced functions as the only viable business solution. Two reinforcing dynamics play out that lead to a knowledge and capability transfer from the manufacturer to the supplier.[2] The three earlier examples demonstrate how easily these dynamics are set in motion and how quickly their effects can result. We will return to these examples in the later discussion to better understand the dependence loop and how to outsource without becoming subject to it.

[2] The system dynamics models throughout this thesis are based on the text of Sterman, J. (2000). Business Dynamics: systems thinking and modeling for a complex world. Boston, Irwin/McGraw-Hill.

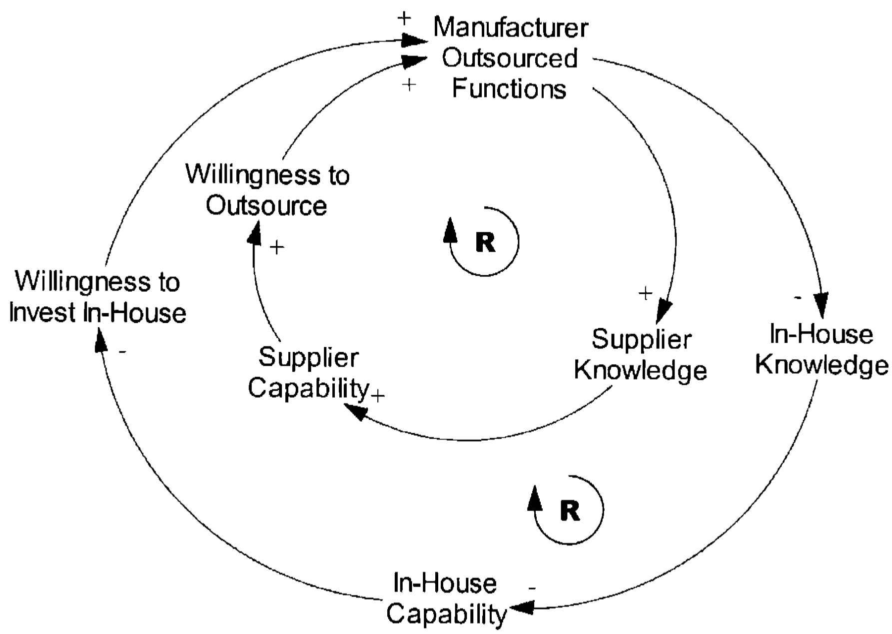


Figure 3: Dependence Loop

1.4. Outsourcing and Fruit Flies

In his book Clockspeed, Charles Fine observed that some companies and industries are subject to much faster product life cycles and business dynamics than other companies or industries. The inherent rate of change in an industry he refers to as the industry's "clockspeed." One can study the fast-paced industries to observe general trends and to extract lessons that are applicable to many other slower clockspeed industries. This notion is supported by the observation that much groundbreaking research and many new insights in the life sciences have come from studying the effects of different stimuli on the subsequent generations of the short-lived fruit fly. The quick lifecycle, or fast clockspeed, of the fruit fly allows many experiments to be run in a very short time.

The electrical and electronics products industry is arguably one of the faster clockspeed industries. As such, it provides one of the more interesting areas for researching the trends in outsourcing and the impact these trends are having on the companies and industries. This observation also highlights the caution with which a company in this industry needs to approach outsourcing. An effective strategy for today may quickly become a competitive disadvantage in such a fast clockspeed industry.

1.5. Outsourcing Trends in Electronic and Electrical Products

The global electronics industry has been particularly active in pursuing outsourcing. In particular, manufacturing has become more and more outsourced. Over the last decade or so much of the manufacturing has moved overseas to take advantage of a growing electronics manufacturing services (EMS) industry. In 2002, approximately 20% of the cost of goods sold, or $110 billion, in the global electronics industry was outsourced to EMS companies (Savas, Dwivedi et al. 2002). Furthermore, the average OEM was hoping to outsource 73 percent of its manufacturing and 40 percent of all OEMs were hoping to outsource the manufacture of 90 percent or more of their final products. (Doig, Ritter et al. 2001)

There has also been a recent shift in the nature of outsourcing in the electronics industry complicating the decision to make or buy a product or its components. In the recent past, OEMs had only to decide which company, including them, should manufacture their products. Comparing service levels and manufactured costs across internal resources and EMS providers such as Solectron or Flextronics provided straightforward metrics for making the decision. Now the decision is getting convoluted because of the growth of the original design manufacturers (ODMs). ODMs not only build a product, but they also design it for an OEM. In many cases the ODM will design and build products and sell them (or very similar models) to several OEMs. The OEMs then market the products under their own brand names. Further complicating the picture is the growth of the contract design firms. While contract design has always been an option, the growth of firms, especially those based in lower cost, developing countries, specializing in only the design of products has added one more choice for OEMs.

ODM companies are in a particularly interesting position in the industry. Despite the general slow down in electronics, ODMs are seeing steady growth. Total ODM revenue was $24.5 billion in 2001 and is expected to more than triple to $77.8 billion in 2005, according to EMS industry market researcher Technology Forecasters. The ODM industry originated with motherboard companies in Taiwan. Companies such as Hon Hai, Inventec, Compal, Delta

Electronics Industrial, and Gigabyte then moved from motherboards into computer systems. In fact, over 60% of laptops today are built by ODMs and the proportion is expected to rise to 80% by 2004 (Serant 2002). They are now moving up into desktop PCs and servers; telecommunications and handsets; and computer peripherals (Carbone 2003).

The growing use of ODMs is not the only significant trend in electronics product development. The distinction between EMS companies and ODM companies is becoming blurred. EMS companies may run ODM programs for customers and ODM companies may outsource manufacturing to EMS companies. ODMs typically don't have a global footprint, instead both the design and manufacturing are usually located in Asia. If an ODM has a customer in Europe, then they may outsource the manufacturing to an EMS provider. EMS companies typically have facilities located around the globe that allow them to manufacture in any particular region if required.

Increasingly OEMs need help with design because development budgets are being squeezed by the continuing economic stagnation and because development cycles and product life cycles are shortening. Using ODMs or demanding design services of EMS partners are ways to overcome the shortfall of design expertise. Flextronics, Celestica, and Solectron all report increasing design services, largely at the behest of customers (Carbone 2003). Another encouragement for EMS companies to begin offering design services is the larger margin that ODMs currently enjoy. ODMs have historically garnered margins of 20% to 25% compared to about 10% for the EMS sector (Serant 2002)

1.6. Thesis Focus

Outsourcing provides and interesting and growing field for study; however, the field is much too broad to cover in a short thesis. Instead, this work will focus on the design outsourcing or product development outsourcing of electronic devices, in particular those products with an integrated architecture (see section 2.6). The goal is to understand how the development of these products is changing and to underscore the approaches that may yield long-term success. As such, it is mostly considering high tech type products, but will draw on examples from other industries to highlight certain aspects of integrated product development. The results are likely applicable to these other industries as well. Some examples of the types of integrated products considered here include VCRs, printers, copiers, cell phones, etc. The goal of this thesis is to show:

- ✓ Outsourcing is increasing (Chapter 1)
- ✓ Highlight general concerns with outsourcing (Chapter 1)
- ✓ Understand trends for increased outsourcing (Chapter 1 and 2)
- ✓ Demonstrate design is the most critical of outsourcing functions for a product company (Chapter 2)
- ✓ Understand why design outsourcing is increasing (Chapter 3)
- ✓ Understand some of the benefits of increased design outsourcing (Chapter 3)
- ✓ Understand why design outsourcing relationships frequently fail (Chapter 3)
- ✓ Highlight a particular area of focus for design outsourcing success (Chapter 4)
- ✓ Understand some of the other critical factors necessary to make a design outsourcing relationship successful (Chapter 4)
- ✓ Conclude with some recommendations and implications of this work (Chapter 5)

1.7. Methodology

The bulk of the work of this thesis is based on a literature study. The literature provides the backbone for understanding the latest trends and theory behind outsourcing. The literature is also insightful in explaining and uncovering some of the shortcomings in the current approaches to design outsourcing.

The literature study was supplemented by interviews and discussions with MIT professors, fellow Management of Technology students. In addition, several interviews were conducted with employees of a large multinational corporation. The interviewees ranged from engineers to senior managers. The company has a history of working with outsource design providers, ODMs, and EMS companies. To prevent revealing any confidential information, the company will simple be referred to as Prodco. Currently the company is working on expanding its use of design outsourcing for a number of products. Observations from the interviews appear throughout the remainder of the work.

2. Chapter 2 – Increasing Outsourcing

We have established that outsourcing is growing despite the potential pitfalls. In outsourcing a company risks developing a supplier or supply base that can effectively obviate the need for the original innovator or product developer. This chapter adds to the understanding of the previous chapter for the increasing use of outsourcing. It then explores the growth in design outsourcing and cautions why design outsourcing is the most dangerous function to outsource. The chapter concludes by considering the outsourcing implications for products with integrated architectures.

2.1. Reasons for Growth in Outsourcing

For business activities such as security and janitorial services, outsourcing is fairly easy to understand and justify. Thinking in terms of competitive advantage and strategic importance to the firm, few companies would argue that they are more competitive because they are able to keep their bathrooms cleaner than the competition or have proprietary methods for cleaning them. Similarly, a best-in-the world security function is usually not a significant driver of competitive advantage. Furthermore, outsourcing functions that are competitively bid usually result in much lower costs than in-house functions (see section 3.1.1). Everybody knows that less money spent on ancillary functions contributes to the bottom line. So the success of outsourcing these more basic services is easy to measure. Are the agreed upon service levels being met and are the total costs lower? But as the function becomes more strategic to the goals of the company or more integrated with how the products are developed and delivered to the customer, the decision becomes more difficult and more time and experience is needed to fully evaluate the alternatives, as shown in Figure 4. The strategic importance of the function significantly determines the readiness of a firm to outsource.

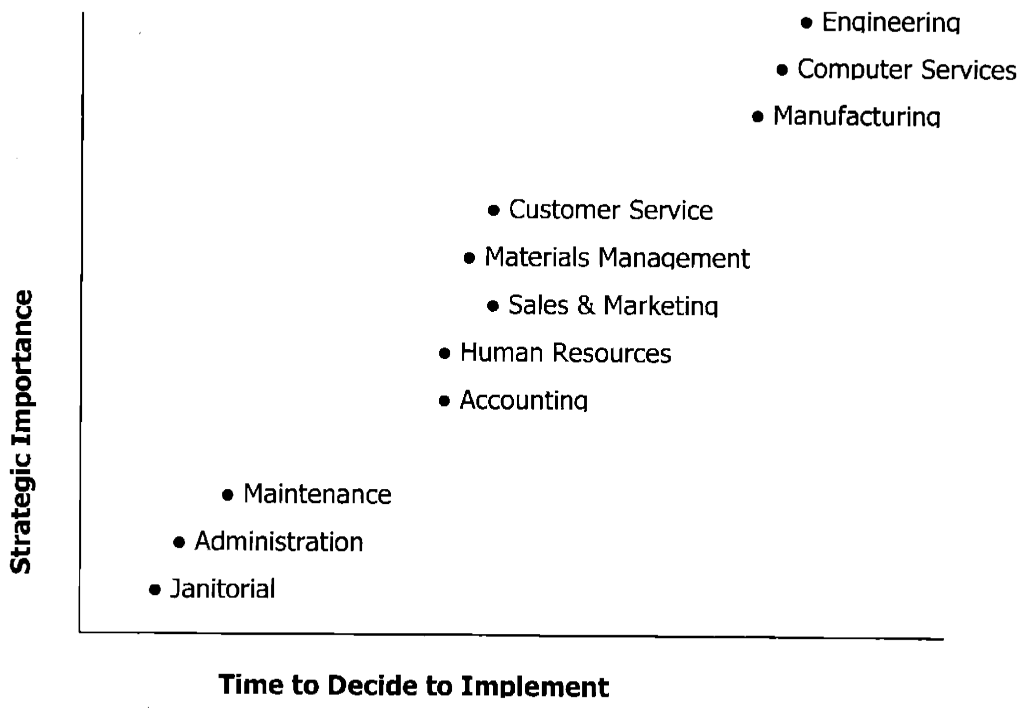


Figure 4: The Typical Outsourcing Path (Bragg 1998)

A simple system dynamics model helps to explain the reinforcing nature of a decision to outsource. A firm may start with a low willingness to outsource any functions. Compelled by the business literature or the availability of low cost alternatives in the market, the firm may decide to outsource janitorial or maintenance functions. As the firm gains experience in structuring and managing outsource relationships, some success will follow. With increased success in outsourcing comes an increased ability to outsource. Growing willingness to outsource will follow thus increasing the ability and therefore the success with outsourcing. As a company and its management become more adept at using outsourcing they will begin to adapt and develop tools and processes better tailored to each situation. The adaptability and experience leads to further success. The sum is that as a firm gains success with outsourcing, its use will grow.

The intuitive dynamic is supported in empirical research. In a study of firms that use outsourcing as a tool to achieve business objectives, the highest performing firms tended to use more outsourcing and a range of the outsourcing tools available from working with a trusted supplier in some critical situations to competitively bidding for some of the more standard business functions (Kakabadse and Kakabadse 2002).

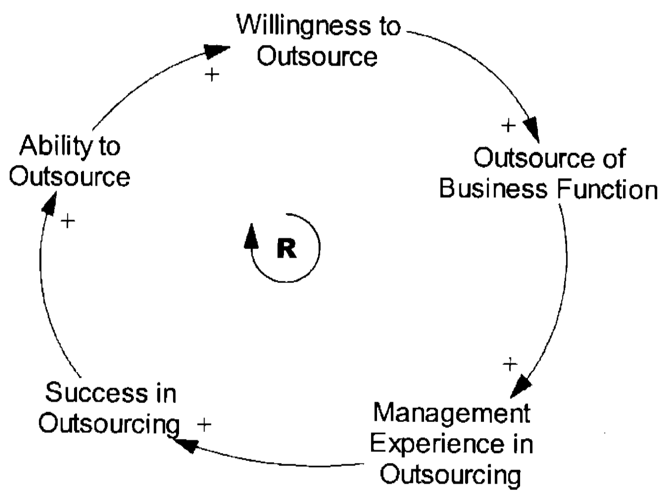


Figure 5: System Dynamics Model of Willingness to Outsource

As a firm comes to accept outsourcing as another tool to accomplish business goals, the nature of the outsourcing will shift. The firm will begin to look beyond the simple tactical reasons for outsourcing and shift to a more strategic focus. (Casale 2003) The outsourcing relationships will reach deeper into the core of the business.

Considering the growth in outsourcing discussed in Section 1.1 and Figure 4 which shows the tendency to higher level outsourcing over time, one could argue that the electronics industry is into the phase of outsourcing engineering and design. The last few decades have seen a significant portion of the electronics manufacturing transferred to EMS, ODM, and other companies. The natural next step would to see firms beginning to explore design outsourcing.

The progression toward design outsourcing was evident at Prodco. At one time all the manufacturing of the products was done in-house. The company believed that it was the best source to build the complex products at the required levels of cost, quality, and schedule. However, over the last decade the company has shifted to largely outsourcing production, as have most other companies it the electronics industry. Many people within the company felt that design outsourcing was the just the next step in the use of outsourcing.

2.2. Growth in Design Outsourcing

If one considers the reinforcing nature of outsourcing decisions as highlighted in Figure 3 and Figure 5 along with the natural progression up the strategic importance hierarchy of Figure 4, one would anticipate a growing use of design outsourcing. In fact, that is the case. Increasingly companies are looking at components and subassemblies in their products and asking others to design them. (Leach, Pureetip et al. 2001) Companies are also increasing outsourcing of research and development as a way to leverage internal R&D resources and expand R&D's strategic importance. (Zhao and Calantone 2003) As the economic downturn puts pressure on product development budgets, managers are finding it expedient, efficient, and necessary to outsource at least some of their design work (Johnson 2003),(2002). Grant, a former student at MIT, also studied design outsourcing and identified a similar trend in its growing use and acceptance (Grant 2000).

As discussed in the section 1.5, whole segments of the electronics industry, namely PCs and notebooks, have been dominated by firms growing from assemblers and component manufacturers to design and manufacturer firms. In part, the movement of contract manufacturers from simple assembly to more complex and technically demanding tasks is part of a natural progression. As a company learns and excels at one function there is a natural desire to try a new activity and increase the company's contribution. Firms that establish foreign manufacturing plants have seen the same progression. The site has a natural tendency to progress from assembly to component adaptation and sourcing to whole product redesign and eventually to product design. It is not uncommon for the recipient site to always be pulling more capability than the transferee is willing or able to provide. (Leonard 1995). Furthermore, OEMs are encouraged to use design outsourcing, especially ODM relationships, as an efficient means to expand or plug holes in product lines and leverage brand names across broader markets.

2.3. Design is Most Critical Business Product Function

For a product company, the design of its products is the most crucial of its functions. As a company function, design combines the most of both product knowledge and customer knowledge. While marketing or order fulfillment may benefit from more specific knowledge of the customer and their needs, design is the juncture of deep customer knowledge with the deep product knowledge needed to design the product. Design embodies not only the product concept but also the entire myriad of details necessary to bring a functioning product to fruition.

Design is especially critical for an integrated product. According to the nature of the integrated product, the product designer needs to know how to integrate each of the subassemblies of which it is constituted. This is particularly true if the product is pushing some performance frontier such as weight, size, or other critical metric. Additionally, the integrator must understand the details of each subassembly to avoid being subject to supplier hold up or to assist the supplier should technical problems arise during integration.

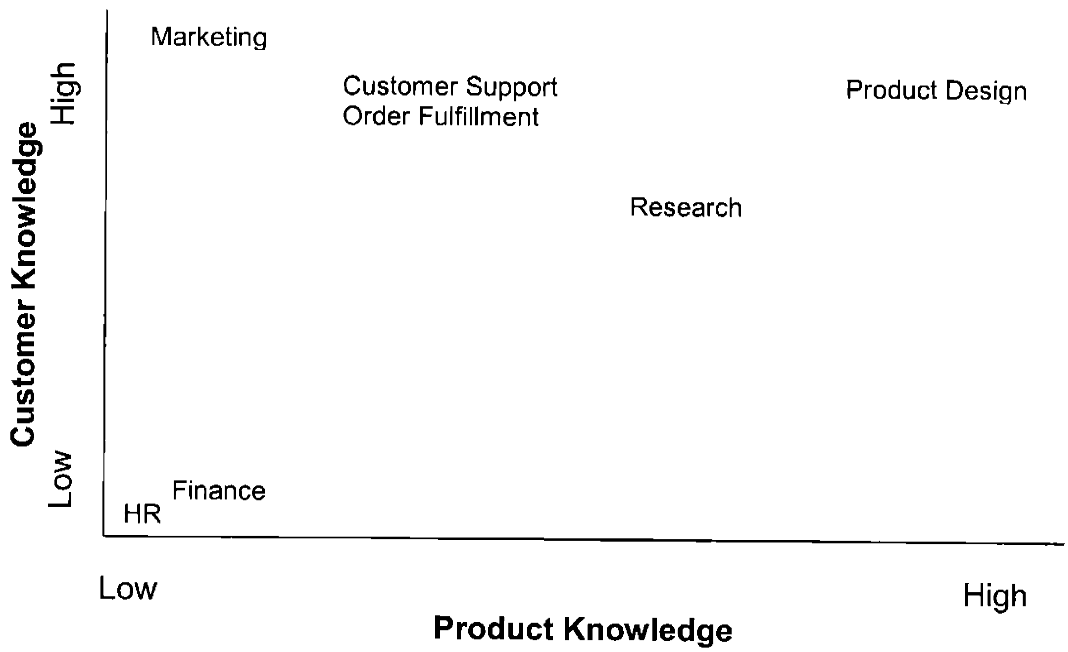


Figure 6: Functions by Customer and Product Knowledge

Design is also an obvious and important determiner of a product's appeal. It is through design that a firm can gain broader market appeal and enjoy higher revenues.(Ulrich and Pearson 1998) Additionally, design has a strong influence on product cost. Design can account for as much as 80% of a product's cost. (Ulrich and Pearson 1998) Reliability is strongly influenced by the thoroughness of design and design evaluation. Often it is only through improved design that higher quality products can be achieved.(Reed and Lemak 1996) For maximum gain, the timing of a product's introduction is critical. Mistakes or problems that cause the product's schedule to slip can significantly influence the ultimate profit that a company receives from a product. (Ulrich and Pearson 1998)

Each of these considerations leads to a careful analysis of all the factors that must be considered during design. These include: (Tarasewich 1996)

- ✓ Strategy
- ✓ Supplier involvement
- ✓ Customer involvement
- ✓ Cost
- ✓ Time
- ✓ Manufacturability
- ✓ Management
- ✓ Usability
- ✓ Marketability
- ✓ Serviceability/Disassembly

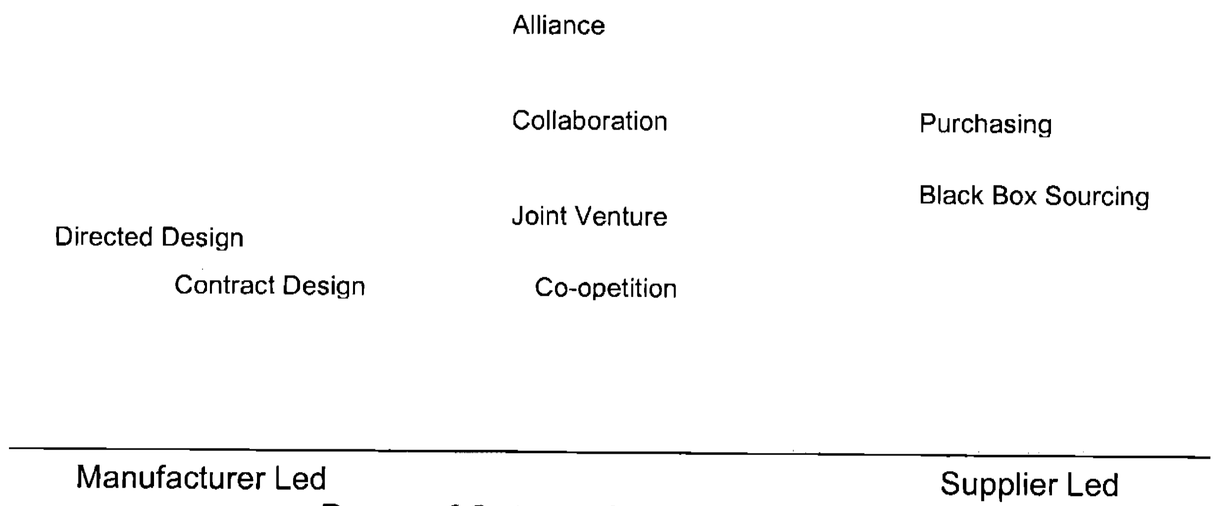
2.4. Challenges to Outsourcing Design – Knowledge Transfer

Within the firm reside two types of knowledge tacit and explicit. Explicit knowledge can be codified or documented is embodied in things like specifications, drawings, procedures, etc. Tacit knowledge cannot be codified. It is elusive and difficult to communicate. As one moves from public or scientific, to industry, to firm specific the knowledge tends to be more tacit. Both types of knowledge finally come together within the firm to generate a product. A product is the manifestation of an organization's knowledge. (Leonard 1995) Through outsourcing design, a firm embarks on a program of transferring knowledge across company boundaries. Some of which will be easy to transfer or readily exists in industry, but some will be unique to the firm and very difficult to transfer. However, for a successful design the knowledge transfer is critical.

One needs to also consider the avenues of incorporating new knowledge into designs. At the start of a design, the final product is far from complete. Additional knowledge is required to combine existing knowledge in new ways to arrive at a useful product. For example, research has shown the value of getting designers to visit customers. However, with outsourced design the difficulty of achieving such exchanges increases. Will the design firm be willing and able to listen to customers? Does the outsourcer want them to? What about the boundaries of knowledge that is considered proprietary? How effective will the firm be at partitioning the knowledge that is appropriate for sharing and what cannot? These are obvious but critical questions that need to be addressed in design outsourcing.

2.5. Types of Sourcing Agreements

This work is primarily concerned with the design outsourcing of integrated architecture products. The types of outsourcing mechanisms that can be used in this situation vary widely. The figure below describes the range from manufacturer led to supplier led. This discussion will not try to explore in detail the different possible sourcing arrangements or the most effective application for each. For the purposes of this work, all of the possible arrangements are lumped together as a means of leveraging the design and engineering talent of the manufacturer. From this perspective the range of applicable literature is quite broad. These types of relationships are variously termed: outsourcing, collaborations, co-opetitions, alliances, joint ventures, directed design, etc. With this in mind the terminology used to refer to the design outsourcing will vary. There has been no careful effort to tailor the discussion to only a single type of arrangement. Instead the focus is on the implementation of design outsourcing in general.



Range of Outsourcing Relationships

Figure 7: Range of Design Outsource Relationships

2.6. Integral Architectures and Outsourcing Design

The architectures of products differ widely and therefore the applicability of design outsourcing and the methods a firm uses also vary. Products can be loosely classified by their architectures as either integrated or modular. Integrated architectures are characterized by components that perform many functions, or that are in close proximity or close spatial relationship, or that are tightly synchronized. Some common examples are copiers, motorcycles, cameras, etc. These products differ from products with modular architectures in that modular architectures feature separation among components such that components are interchangeable, are individually upgradeable, have standard interfaces, or can be described by localized failures, examples include PCs, phones and service, some models of bicycles and automobiles (Fine 1998). In many cases there is considerable tension in choosing between an integrated and a modular product architecture. Demanding applications or complex technical products tend to favor integrated architectures, while business concerns such as development cost or schedule tend to favor modular architectures.

Figure 8 depicts the relationship of product architecture to supply chain architecture. The lesson is that a modular product naturally fits into a modular supply chain and an integrated product is best built from an integrated supply chain. The 4 dimensions upon which to integrate a supply chain are geography, organization, electronic, or culture. Matsushita Electric Industrial Co., Ltd provides many good examples of integrated products (VCRs, vacuums, etc) that are realized through a vertically integrated supply chain. The vertically integrated company provides organizational and cultural proximity. Airbus also achieves integrated products by integrating its supply chain through organization and electronic proximity. PCs are a famous example of a modular products and supply chain, as are the plethora of phones and service. Suppliers are free to develop products according to their own roadmaps and capabilities and are only brought together at the product integrator or customer.

Product Architecture \ **Supply Chain Architecture** (Geographic, organizational, cultural, and electronic proximity)	**Integral**	**Modular**
Integral	Matsushita Electric products Airbus	RARE SUCCESS
Modular	RARE SUCCESS	PCs Phones and Service

Figure 8: Product and Supply Chain Architecture (concept from (Fine 1998))

Another decomposition of this matrix is to consider how product architecture relates to the potential for outsourcing. Figure 9 looks at outsourcing by dependency for knowledge capacity and product architecture. For integrated products, there exists only one viable option for outsourcing, which is to depend on the suppliers for capacity only. This implies that there needs to be a redundancy maintained for knowledge. The supply base needs to know how to build the components or products that are specified, but the outsourcing company also needs to maintain sufficient knowledge to prevent being displaced by its partners and to remain a knowledgeable buyer.

Product Architecture \ Knowledge and Capacity Dependency	Dependent for Knowledge & Capacity	Dependent for Capacity Only
Integral	**A Potential Outsourcing Trap** Your partners could supplant you	**Best Outsourcing Opportunity** You understand it and can plug it into your product and process
Modular	**Worse Outsourcing Situation** You don't understand what you are buying	**Can Live with Outsourcing** You know how to integrate

Figure 9: Product Architecture and Outsourcing (Fine 1998)

3. Chapter 3 – Design Outsourcing Challenges

Given the long history of outsourcing and its increasing popularity, one would expect a high success rate among outsourced activities and an increasing trend of success. However, a high percentage of outsource arrangements do not live up to expectations. In 1999, 40% of executives said they saw no clear benefits or were dissatisfied with the results of their outsourcing relationships (Doig, Ritter et al. 2001). Dun & Bradstreet report that 20 to 25 percent of all outsource relationships fail within 2 years and that 50 percent fail within 5 years.

This chapter explores some of the reasons why a design outsourcing relationship, in particular, may be difficult to maintain and to succeed. Some of the common reasons for outsourcing are first considered followed by a brief listing of some of the common sources of outsourcing failures.

3.1. Reasons for Outsourcing Design

The number of reasons for entering an outsource relationship are practically limitless. Each company's unique situation has the potential to call for a custom solution. In my interviews with Prodco, three primary motives were mentioned by nearly everyone: (1) reduce costs, (2) increase design capacity, and (3) access special skills or technology. In addition to these three reasons, five other common reasons were identified in the literature and were mentioned by at least one person in my interviews.

3.1.1. Reduce Costs

A common motivation for outsourcing is to reduce costs. Studies of outsourcing functions have revealed significant cost savings. There are typically 3 sources of cost reductions in outsourced relationships: (1) reduced corporate and other overheads, (2) improved operating costs, and (3) lowered material costs. Reduced overhead costs result from distributing the typical overhead of the function across many customers instead of one firm carrying the burden on its own. Improved operating costs are typically the result of larger investments in training, special equipment, and focus that a more focused firm can make.

Finally, because the outsource provider is now a bigger consumer of inputs, frequently better pricing on input goods is possible. The savings from outsourcing are especially prevalent in contracts that are put out for competitive bidding. An Australian study showed competitive bidding can reduce costs on average by as much as 48%, depending on the function outsourced (Domberger 1998). In most cases a thorough analysis reveals outsourcing can reduce costs from between 20% and 45% (Doig, Ritter et al. 2001).

In the electronics industry, there are a number of factors that contributed to lower manufacturing costs for OEMs from outsourcing. First, the rise of the EMS sector allowed companies like Flextronics and Solectron to build large factories. The large factories enabled economies of scale, and because a number of different products were produced, economies of scope. Second, the large component volumes required to feed the factories afforded significant buying power resulting in lower input costs. Third, because the factories were diversified across a number of firms and products, the risk premium required on the factor investment was lower. Fourth, the range of products and the interactions with a number of different companies allows the EMS companies opportunities to learn from each product and apply those learnings across all of their manufacturing. A single company would have the same exposure to potential sources of cost reductions. Sixth, in addition to the economies of scale and scope, OEMs also benefit from avoiding the large fixed cost burden of a factory. The common notion is that each of these cost-reducing factors should carry over into design outsourcing.

At one point there was some very unique, fast changing, complicated process technology involved in manufacturing electronic products. Today much of that process technology is widely understood and adopted in the market. As the technology matured, its presence in the market grew and spread across a large number of suppliers. As the number of suppliers increased the potential of supplier hold-up lessened and companies became more comfortable outsourcing. The same trends, growing capabilities and market alternatives, are occurring in design. The growth of ODMs and design services offered by EMS companies are indications of this trend.

Laptop computers and software can be considered as the fruit flies of design outsourcing. As noted in Chapter 1, most laptops are now designed and manufactured by

ODMs largely because of lower costs. Software is also increasingly outsourced to companies with development labs in China and especially India where costs are only 10 to 20 percent of what they are in the US. (Klepper and Jones 1998) These two industries may be early indicators of a growing trend.

At Prodco, reduced costs was almost always the first reason mentioned for design outsourcing; however, less than 25% of the people I interviewed believed any significant cost savings would result from outsourcing design. Three reasons were typically given. First, the internal development costs are not precisely known. Projects are typically very complex and involve designers at many locations with varying levels of involvement making exact cost allocations impossible. Second, each development project has a unique schedule, technology requirement, leverage of existing knowledge, etc. Fair comparisons across projects are simply impracticable. Third, the outsourcing relationships are in their early stages. It would be unfair to compare the costs of a company just starting to learn to design to Prodco's requirements against the well-developed internal expertise.

3.1.2. Increase Design Capacity

Design resources are frequently limited. During the recent economic boom electronics companies found high performing engineering talent was in short supply. These companies had difficulty finding, attracting, and retaining top performers. Now, with budgets squeezed by the economic slowdown many companies were forced to downsize. These companies are now finding it impossible to execute on all their corporate plans. Furthermore, without signs of a healthy recovery, few firms are willing to take on a bunch of new employees knowing that they may have to lay them off again in the near future if the economic upturn doesn't appear soon. These considerations have increased the use of outsourcing as a way to leverage internal talent to get more projects done with the same internal resources. (staff 2002)

The product life cycles and product design cycles of many high tech products have shortened in recent years. The shortening project schedules and product lives increase the demand for design talent. As Gomory reminds, the ability to quickly execute on projects allows incremental innovations to occur and reach market faster resulting in a significant competitive advantage (Gomory 1997). These two factors, shortening life cycles and responding to evolving competition, require additional design resources.

A third factor that increases demand for design skills is increasing fragmentation. As a market matures, as is the case for many product segments of the electronics industries, the market will tend to fragment. (Fine 1998) Competitors will find small portions of the market based on local market conditions, regional preference, special needs, etc. and build a product targeted for that market. A company with a leading market position will find itself under attack in many different segments of the market by a number of different competitors. The company will be forced to adapt its products to compete in each market. The adaptation and tailoring of products increases the burden on the design teams.

The need for increased design capacity was the most often given justification for outsourcing at Prodco. For many years there has been a list of potentially profitable projects that far exceeded the internal design capacity. Prodco saw outsourcing as a way to leverage the high value technical expertise into more products. The range of products could be expanded to better address market and regional niches along with faster refreshes to existing designs. Both were considered important for Prodco's continued long-term success.

3.1.3. Access Special Skills or Technology

For many small firms, outsourcing provides a method to tap into very specialized knowledge that would not be affordable or cost effective to develop internally. For example, many small companies cannot afford to keep an industrial designer on the payroll. Frequently these companies find it necessary to contract out the design to firms that specialize in this area. Furthermore, an outside design firm is able to specialize in this area and follow changing consumer tastes and design directions much easier than an in-house designer. The best design firms are able to draw from the breadth of exposure to create designs that are better than in-house talent could normally provide. One can see the same trend in the semiconductor industry. Companies are increasingly relying on outside firms to design the more standard portions of a new chip.

Interestingly in my interviews at Prodco, many people mentioned access to special design skills or technology as a reason for outsourcing, but no one saw any obvious technology or skills that the outsource designers could provide. In some cases, the outsource designers were believed to possess skills and experience far inferior to the internal design resources. The company considered these outsource projects as aimed at developing the skills of the supply base to enable future projects.

3.1.4. Focus on Core Capabilities

The most requested article from Harvard Business Review explores the importance of core competence to the corporation (Prahalad and Hamel 1990). Numerous works since then have reinforced the importance to a firm of understanding its core competencies or capabilities. Key to this argument is research finding that integrated firms have underperformed their peers on a number of financial performance measures. The underperformance is usually attributed to an organizational structure that creates inflexibility and prevents change. (Rumelt 1974) Realigning the firm to focus only on those areas where a core competency and competitive advantage exist should lead to higher performance. All the other functions should be shed to strengthen focus of the resources and improve performance. Recent research suggests that upon serious investigation a company will find 60 percent to 90 percent of their in-house activities are services that are neither being performed at best-in-world levels nor contributing significantly to competitive edge – and they are not very risky to carefully outsource. (Quinn 1999) Another work argues that a firm focused only on a key area in which it has competitive advantage has an economic incentive to increased innovation compared to integrated firms. (Corts 2000)

In considering design outsourcing, a firm should focus on only those design-related activities that contribute directly to a product's competitive advantage. For example, all electronics devices include a power supply. There is a large number of firms that specialize in the design and manufacture of power suppliers. With such a vibrant supplier market, it follows that few OEMs can achieve competitive advantage by developing internal power supply design capabilities. An OEM focused on core capabilities should therefore outsource the design of its power suppliers.

The semiconductor industry provides another example. Increasingly OEMs are relying on foundries and design houses to provide designs for portions of their chips. There is strong trend away from in-house design for more standard portions of semiconductors as a way to meet schedules, take advantage of unique manufacturing processes, and focus on unique areas of competitive advantage. (Cataldo 2002)

At Prodco there was a general sense that the design centers were involved in some activities that were not the best use of the company's resources. Outsourcing some of the less technically demanding projects and redesigns of older products was considered one way to improve the value of the internal resource contribution. However, very few people spoke in terms of core competencies or core capabilities. In fact, the only general agreement on core competency was an acknowledgement that the company had a deep understanding and strong intellectual property position in the technology of one part of its products. None of the rest of the activities of the company were consistently viewed as core competencies. There are a number of possible explanations for the lack of clear understanding of the company's core competencies. First, core competencies are elusory (or illusory depending on your view). Core competencies are not obvious. Second, there has been no concerted effort to identify and communicate throughout the organization the core competencies.

3.1.5. Increased Innovation

A firm can get locked into internal methods of developing products. The core capabilities and skills that have led to past successes become reinforced by structures, rewards, and methods while other competing or complementary skills atrophy. The result is core rigidities that lock a company into decreased influx of new ideas, technologies, and innovations (Leonard 1995). Outsourcing design is one way to cause some abrasion or undermining of the core capabilities and thus open the firm to new sources of innovation.

An outsource design firm will also tend to develop specialized knowledge and capabilities. Frequent interaction with a variety of customers is one source of this unique knowledge. Through outsourcing, a company has the potential to access this specialized knowledge and find ways to incorporate it into better final products.

Further innovation can result from a design problem being considered at both the outsource design firm and at the OEM. Studies have shown that innovation and problem solving is highly dependent on the context and perspective from which the problem is viewed.

By shifting the product, design problems, and prototypes among locations it is possible to assess and innovate in a manner that may not be possible at only one location or within one firm (Tyre and Hippel 1997).

3.1.6. Improved Time-to-Market

Related to the idea of trying to do more through outsourcing, a firm can also use outsourcing as a method to get to market faster. An outsource design firm may be able to quickly shift resources to a project enabling much faster project completion. With shortening life cycles, the market window also shrinks. Getting a product to market on time not only has a significant impact on the potential profitability of a product but has also been shown to strongly influence customer satisfaction. (Patterson 1993)

The notion of improving time-to-market is closely related to earlier discussion of increasing design capacity. At Prodco, the current limitation on many products is the availability of design resources. For this company, having more design teams working simultaneously will allow more products to reach market faster.

3.1.7. Improved Quality

Improved product quality through outsourcing can come from 3 sources: (1) more objective design review, (2) more testing, and (3) better alignment with subordinate processes such as manufacturing or distribution. With less invested in the detailed design, an OEM is able to provide a more objective view of the results of an outside design supplier. Frequently this objectivity can provide increased product quality through identifying design shortcomings. Additionally, a company may be able to pull in its own top internal talent for design reviews and concept analysis in a way that is not always possible on internally developed products. Frequently outsourced designs are tested not only at the design firm but also at the recipient firm to verify performance. This provides more opportunities to uncover potential design flaws. Lastly, a design firm, particularly if the firm also does the manufacturing, has the ability to better tailor the design to their unique manufacturing processes. Besides lowering cost, the better fit of design to manufacturing often results in fewer defects during manufacture.

At Prodco there was a strong perception that outsourcing, at least initially, would result in lower product quality. Based on recent experience with the design outsourcing of other projects, many believed that the first designs would need significant Prodco input to guarantee that the final products were high quality.

3.1.8. Political Motivations

Of course, with any business activity there are people and their egos involved in the decision to outsource. Some of these people may have motives other than the best interests of the business that motivate the decision to pursue outsourcing. Often these political motivations will be hidden behind claims of cost reductions or core competencies. In any outsourcing situation one needs to carefully evaluate the underlying business advantages and explore the motives of the individuals involved to make sure the business reasons are valid.

3.2. Failures of Outsourcing Design

Despite the number of reasons that design outsourcing may seem like a good idea, a number of cautions are also obvious. Here some of the most frequent mentioned during my interviews and that were also highlighted by the literature review.

3.2.1. Creation of Competitors

As noted in the introductory chapter, this is perhaps the most frequent concern about outsourcing. Especially through design, competitor or supplier can learn the techniques and skills necessary to develop high quality products and then can simply bypass the OEM to deliver products to the market. Each of the three examples reinforce this concern.

At Prodco there were two concerns about creating competitors. First, there was the potential that some of the outsource design companies would decide to become ODMs and offer their designs to competing companies. Second, one of the outsource design firms was itself a large multi-national corporation. There was a fear that the company would learn from Prodco how to design and market products and then launch a competing line under its own brand.

3.2.2. *No Cost Advantage*

There is a significant amount of contradictory literature on the issue of cost savings. In 3.1.1 some of the possible cost reductions and sources were listed. However, managerial perception is that outsource providers frequently cost as much or more than equivalent internal development (staff 2002). Many firms have also seen their costs increase with outsourcing or the relationships have failed to provide any economic or financial improvements (Cunha 2002). Although frequently ignored, one also must not overlook the monitoring costs associated with outsourcing. The costs typically range from 1% to 9% of contract cost (Domberger 1998).

Aside from the surface contract price, one also needs to consider the underlying economic drivers that enable the lower cost. Does the outsource firm have an advantage in specialized capital, unique skills, lower cost labor, lower cost structure, acceptance of lower returns, etc. that underlie the lower cost of the outsource. Remember that the receiving firm not only needs to provide the function or service but also generate enough profit to cover the extra marketing and profit costs that an in-house service or function would not. Some firms have entered into agreements that appeared advantageous on the surface only to realize later that the price was not supported by any underlying economic advantage. The result was later surprise extra costs or failure to meet performance requirements. (Baldwin, Camm et al. 2000).

Another consideration is the internal awareness and tracking of costs. Managers accustomed to meeting internal benchmarks frequently have no idea of how their costs compare really compare to those available in the marketplace. Outsourcing firms can use this to their advantage to keep prices high or overcharge for services. Lax cost accounting or complicated internal structures can also provide an opportunity for outsource providers to inflate their prices. (Doig, Ritter et al. 2001)

3.2.3. *Increased Coordination Costs*

As noted previously, with design outsourcing the need to have people engaged at both companies becomes critical. The costs of coordinating work across the firms can wash out many of the benefits originally expected when entering into a design outsourcing agreement. The increased management and coordination costs, especially of things like travel, employee relocation, etc. cannot be ignored and may be a significant additional cost.

3.2.4. Loss of Capability

One of the other frequently cited concerns about design outsourcing is the loss of specific product knowledge. Since knowledge originates from product development and experimenting, the loss of these functions will impair a company's ability to know about all the technology included in its products. Sections 1.3 and 2.6 discussed this concern and some of the dynamics and the relationship to integrated products.

Loss of capability also considers the loss of advantage afforded by specific intellectual property. Design outsourcing has the potential to transfer product knowledge more effectively than other types of outsourcing. Interestingly, this was the most often cited concern among my interviews at Prodco. The assumption was that with knowledge transfer came design capability and expertise that would eventually allow the outsource design company to displace Prodco.

3.2.5. Product Architecture

As highlighted in section 2.6, the product architecture can have a significant influence on the likelihood of continued success through outsourcing. For integrated products, the OEM has to decide if a push to a modular architecture is the best way to grow outsourcing or if outsourcing the integrated product is the best option. At Prodco, it was widely believed that moving to a modular architecture, while it would permit easier outsourcing, the extra costs that it would impose on the products would make them non-competitive in the marketplace.

3.2.6. Communication Challenges

One of the biggest challenges in outsourcing an integrated design is effective communication. By its architecture, an integrated product cannot be decomposed into clean modules that a can be independently designed to a specification. Effective communication and collaboration is required to ensure the designs are well integrated and function within the system. With design outsourcing the challenge grows because the physical and organizational separation grows. Research has shown that likelihood of communication drops off precipitously with distance reaching a low after only 30 meters (Allen 1977). Other studies have shown that it can be difficult to even understand a design problem unless one is emersed in the local context. (von Hippel 1994) The problem is compounded if the design teams also have to overcome language, cultural, and time differences. This is a problem that we will return to in section 4.7.3.

3.2.7. Trust

Trust among organizations is one of the biggest determiners of success. A lack of trust can hinder communication and collaboration as individuals fear loss of knowledge or jobs. This is also a topic that will be discussed in section 3.2.7. In my interviews with Prodco this was consistently seen as a problem, in particular when the design supplier was also a competitor or potential competitor in another area.

3.2.8. Organizational Challenges

Outsourcing will inevitably lead to changes in the methods that work is done. These changes should be reflected and reinforced by structural changes within the organization. The types of changes and organization structure will depend on a number of factors including the importance of the outsourcing relationship, the decision making structure (independent or centralized), the strength of connection between the decision makers, the type of outsourcing control (contractual or relationship), etc. At Prodco the organizational challenges are compounded by a need to continue the in-house learning and product development on some projects, which tends to favor the existing successful organizational structure and by the need to become skilled at outsourcing projects, which favors different structures. At Prodco this area was just beginning to be explored.

3.3. Chapter Summary

Many outsourcing relationships fail and many others result in disaster for the originating firm. While there are numerous reasons to undertake a design outsourcing approach to product development, there are as many reasons why such relationships be disastrous for the firm or fail to achieve the desired results. Figure 10 provides additional information on some of the potential positive and negative effects that have been observed in outsourcing.

Positive Effects	***Negative Effects***
Increased efficiency and employee productivity	Compatibility between outsourced systems and control over operations and proprietary information
Better use of human resources	Violation of psychological contracts (job security and opportunities for advancement)
Better managerial compensation and incentives	Decreased organizational citizenship behavior and firm-specific knowledge
Increased company flexibility	Decreased job satisfaction, physical health and mental health
Adaptation to technological change and access to new skills	Perceptions of untrustworthiness
Concentration on core competencies	Lower investments in training and development
Faster development of new products and services	Decreased probability of obtaining a return on knowledge
New ventures	Decreased internal networking

Figure 10: Potential Positive and Negative Effects of Outsourcing (Cunha 2002)

4. Chapter 4 – A Different Focus for Design Outsourcing

One of the most interesting aspects of core competencies and core capabilities is that they are incredibly hard to identify, yet the recent business literature considers core competencies and the ability of a firm to focus on its competencies as critical to the firm's long-term success. Companies are reminded that each new project or activity affects the core capabilities. Every project has the potential to add to the existing capabilities of a firm and grow the potential to undertake new projects and challenges. This building loop is shown in Figure 11.

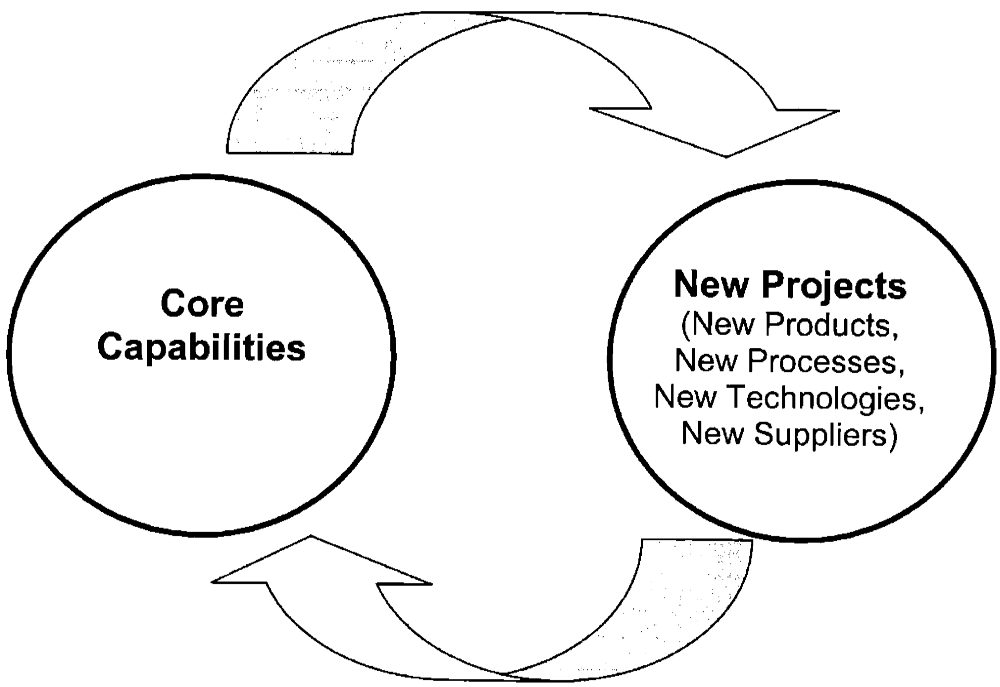


Figure 11: Core Capabilities and New Projects

A number of studies seeking to understand core competencies have identified that competencies fall into three basic groups: superior technological know-how; reliable processes; and close relationships with external parties. (Mascarenhas, Baveja et al. 1998) No matter the company or industry, a firm can achieve its strongest position by developing significant competencies in each group. Focusing on core competencies allow a company to leverage its investments and build formidable barriers to the entry of competitors. One can imagine the relationship like a barstool. Core competencies form the seat or the primary support for firm. The core competencies are supported by three legs: technological capability, reliable processes, and external partnerships. For the strongest, most stable stool, it is important that the firm build expertise in each of the three areas. With multiple competencies it becomes harder for any single competitor to displace the firm.

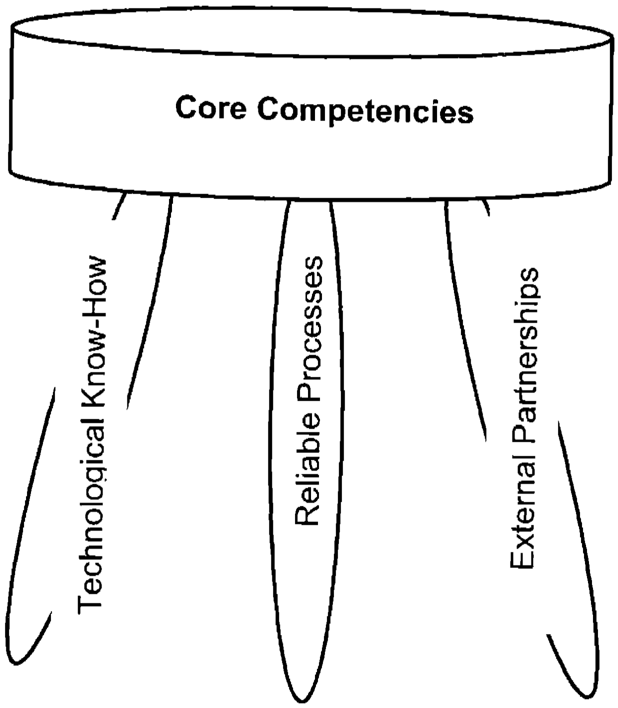


Figure 12: Stool and Three Legs of Core Competencies

Prodco is a good example of a company that inherently recognizes the important structures depicted in Figure 11 and Figure 12. The company has developed a technology that underpins its products. With each new project the company invested in refining and improving the technology. As the technology matured and the product volumes increased, the company became more focused on developing reliable processes for product realization, from research and development to product logistics and customer service. Each successive project added to the growing capabilities of the company. The next step is to increase the competencies and capabilities that come from strong outside partnerships.

Developing a close relationship with external parties can never be the first thing a company pursues in trying to establish core competencies. To interest a partner, the company has to have developed something of value on its own, namely some technological know-how or a reliable process. Canon, widely known for its partnering capabilities, exemplifies this necessity. Canon first approached Hewlett-Packard seeking a partner to expand the reach of its laser print engines. Hewlett-Packard at first gave Canon the cold shoulder. It was only through the development and demonstration of the technological know-how embodied in their extensive patent portfolio and high quality products that Canon was able to interest Hewlett-Packard and other companies. (Kaku 1997)

With the growing popularity of outsourcing and the expanding options in the supplier base, electronics companies are finding the pressure to outsource too great to resist. Once a core technology or process is mastered, companies start to search for partners to help turn that technology into a product. If the company already has a successful product, then it starts looking for ways to leverage that product to increase market penetration or respond to competitive pressures. The latter is the position of Prodco. The company has a successful line of products and is now trying to leverage its investment in product development and R&D through outside design suppliers. The company has selected a handful of key partners that it wants to use for design outsourcing. The company also has several product divisions. Matching of supplier to project across divisions has resulted in a web of relationships that interconnect each division with several suppliers. Prodco also has a well-developed procurement function and has spent considerable time researching and evaluating alternate suppliers to arrive at the preferred handful. While not critical to this discussion, Figure 13 displays a typical selection process and the possible outcomes. The process flow shows four possible outcomes: (1) return to supply or abandon process, (2) ask supplier to design entire product, (3) ask supplier to update existing product, (4) ask supplier to complete product design. The details of each of these outcomes is not particularly important for the purposes discussed here, it is included simply as a reminder that the level of undertaking by a design supplier will vary some with capability, experience, project selection, etc.

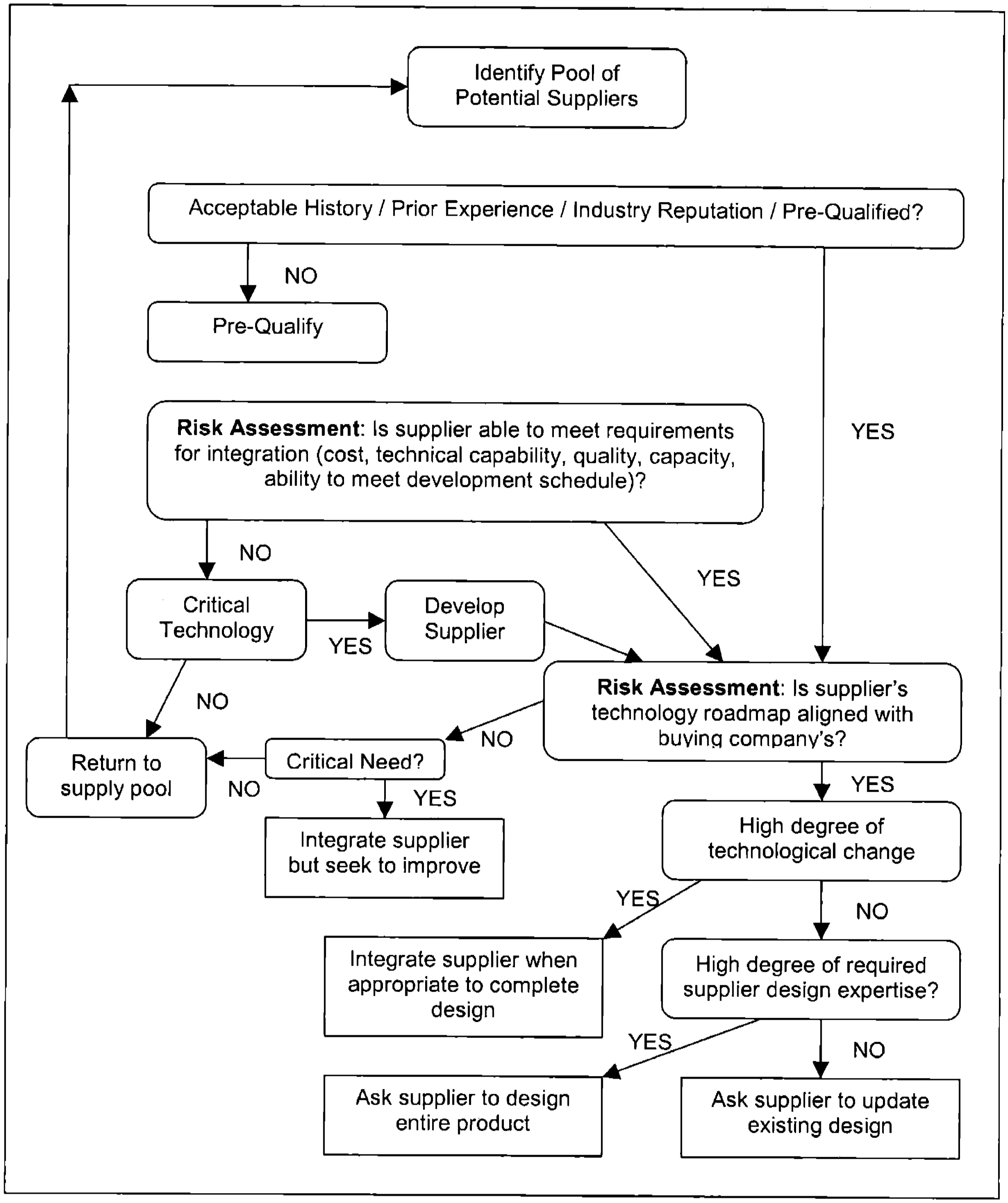


Figure 13: Process Model on Supplier Selection and Integration

Given Prodco's current position the company should be focusing on expanding its partnerships and becoming more adept at building strong alliances. The company already has a solid technology base and strong product realization processes that give it a robust market position. The next step is to build on these capabilities by focusing on partnerships. Because of the work involved, the relationships need to be much more than the transactional relationships typical of many outsourced functions. With a janitorial or security service one doesn't need much more than a basic understanding and few simple contracts to manage the service. The relationships here need to go much deeper. The companies need to collaborate and trust each other. Deep insight into the values and structures of each company is required. It is only through these kinds of deep partnerships that a durable and valuable core competency and competitive advantage can be obtained.

4.1. Viewing Outsourcing Failures Through a New Lens

Each design outsourcing relationship is complex with much tacit and explicit information flowing between the two parties. As such, any few paragraph analysis in a business or management write-up is likely to be a simplistic and misguided attribution of the reasons for the real failure. Acknowledging this difficulty and potential to mislead readers, let me throw my view on the pile anyway. Through his work on dialogue, William Isaacs proposes that the Tone of a relationship or partnership is the underlying structure from which models, structures, and eventually behaviors flow. This model has been successfully used to develop some lasting understanding and progress in very volatile and hostile situations. (Isaacs 1999)

The model is based on an idealized representation of a flame or candle as shown in Figure 14. At the center of the flame, where the key action occurs that starts the heat and light producing reaction, is Tone. The attitudes that the two companies bring to the relationship, the value they place on it, the outcomes they expect, the amount of respect they have for each other will establish the tone. Based on this tone, each company will develop models that will anticipate the actions of the other party. The models, whether explicit or implicit, will set expectations for the behavior of the other party based on certain conditions, for example, the model will predict under what conditions opportunistic behavior by the other party will occur. Because of the models or predictions of behavior, each company will develop structures for monitoring and guiding the actions of the other party. The structures will also establish or ground the actions of the company itself. The structures may be policies on interactions and travel, contract clauses on termination, reporting hierarchy, etc. The sum of the tone, models, and structures produce the behaviors. Often an organization or individuals will try to change the structures in the hope of modifying behaviors, but without reconsidering the underlying models and tone, failure is almost certain. The behaviors will continue as before.

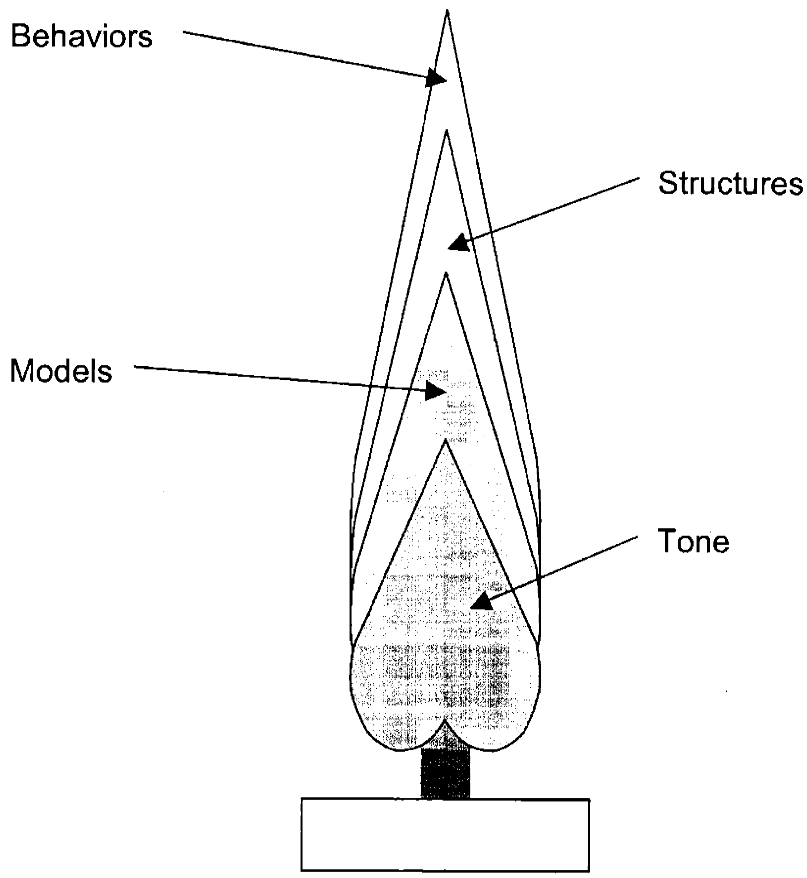


Figure 14: Candle Model of Tone to Behaviors

This model has important implications for outsourcing, particularly outsourcing of sensitive functions like design. To understand the behaviors and actions that result from an outsourcing agreement or partnership one needs to first understand the tone or attitudes that were in place when the relationship was started and endured through the relationship. Returning to the examples from Chapter 1, IBM never viewed the PC as a serious computer. The company was focused on its large computing platforms and considered the PC as just a toy that would never receive wide acceptance. All serious computing would always be done with a mainframe computer. The company openly rejected the notion that the PC would ever grow to a significantly profitable or important segment of the computer market. (Utterback 2002). This tone was reflected in the company's haphazard selection of suppliers,[3] and its decisions to forgo opportunities that the company had for equity stakes in Intel and Microsoft (Fine 1998). These were decisions that ultimately greatly reduced the influence and the value of the company. The distrust and conflict that resulted in the fall of Schwinn is a fascinating story that reads like a classic tale of arrogance and intrigues and eventually was told in a popular book. (Crown and Coleman 1996) GE viewed Samsung as just another low cost vendor who had to be taught how to manage quality and how to deliver acceptable goods to GE. Samsung was never considered a partner nor were efforts ever made to build an enduring relationship.

Considering successful ventures also leads one to consider the importance of tone. Caterpillar and Mitsubishi Heavy formed a joint venture in 1963. The alliance initially produced high growth for both companies. As the market shifted away from products originally included in the alliance, a spirit of cooperation based on past success allowed them to work together to expand the alliance and include more products, double the size of the alliance and create more opportunities for give and take. (Berry and Bowers 1991) Today the partnership is still strong as demonstrated by joint scenario planning that allowed both companies to respond quickly to supply disruptions caused by the recent longshoremen strike. (Bacheldor 2003)

Another example is the collaboration between Hewlett-Packard and Canon for developing laser print engines. John Chambers, CEO of Cisco, recently described the relationship as the model for lasting collaboration in high tech, and perhaps the only enduring example. Canon focuses on its relationships through a process known as "kyosei," which translates roughly to "spirit of cooperation." Hewlett-Packard is similarly recognized for its strong, cooperative partnership skills. It is this close cooperative spirit that has allowed the relationship to endure for 17 years despite continuing competitive threats and eroding prices.

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[3] Microsoft was only selected as the default operating system supplier after the CEO of the original supplier skipped a meeting with the IBM purchasing team Anderson, H. (2003). lecture on venture capital in software industry in Managing in Adversity class at MIT Sloan.

The companies also continue to compete vigorously in other markets such as digital cameras and ink jet printers, yet collaborate on laser printer development. Despite the competition and other efforts by Hewlett-Packard to develop its own print engines (Damore 1993) and brief partnership with Konica, both companies remain committed to the collaboration on laser printers.

4.2. Relationship View of Outsourcing

There is a significant recognition in the literature that top performing companies are shifting their cultures from a command and control framework to one based on cooperation and empowerment. Companies are beginning to realize that shared visions, caring about employees as individuals, and empowering employees are important determiners of employee and company success. (Kouzes and Posner 2002) So why are alliances often treated so differently? Much of the existing literature on alliances, joint ventures, co-development agreements, and, especially, outsourcing focuses on the transactional nature of the interactions and on the power in the relationships. As Chapter 1 and Chapter 2 mentioned, there is a whole body of research that explores outsourcing, even design outsourcing, as a result of changing transaction costs and the only job of the outsourcer is to avoid supplier hold-up or displacement by an upstart supplier. But as the previous outsourcing examples demonstrate, the nature of the transactions and the power in the relationships can shift very quickly. A once dominant firm can quickly find its power eroded by a growing and prosperous supplier or partner. Without an underlying tone of cooperation and mutual respect, the relationships are doomed to fail.

The recent literature also tends to focus on core competencies or core capabilities of the firm and how strategy should be used to support these competencies or capabilities. However a growing stream of literature is beginning to emerge that highlights the importance of nurturing relationships and that increased learning and execution excellence are the only sources of competitive advantage. At the individual level and at the firm level there appears to be a growing acceptance of relationships as one of the key drivers of business success.

In the electronics industry the product realization steps from design to finished good are highly fragmented and distributed among a number of firms. The most competitive firms of the future will understand how to put together a product value chain to deliver high value products to consumers effectively. One of the key skills is the ability to effectively partner with other firms in developing new products. This chapter attempts to explore some of the key concepts necessary for building successful relationships with outside suppliers.

The SPARSE model[4] is proposed as a way look at relationships as the foundation of a corporate entity. It is through the relationships of employees to each other that strategy is put into action, that value is created for customers, that resources are distributed, that systems are developed, and that employees are empowered. This same view of relationships is the foundation for a different perspective on design outsourcing. The SPARSE model puts customers at the top of the model. The focus of any corporation or outsourcing activity needs to start with the customer. Next one needs to consider how the company creates value for the customer. Value creation comes from the processes enacted by the company. To put together processes, one needs to first start at strategy and work around the circle. From strategy come processes. The processes are held together by an overarching architecture. Resources need are assigned and managed by this architecture. Systems provide a way to measure the performance of the resources and a basis upon which to empower people. Finally, at the center of the circle affecting each step are the relationships between people and among companies.

It would be naïve to think the only determiner of success in outsourcing is the relationship among the people and corporations involved. However the relationships at the organizational and the interpersonal level are beginning to be recognized as an important contributor to the success of alliances. (Olk and Earley 2000) A successful relationship considers all 4 facets o the relationship: the nature of the technology, the strategies of the organizations, the governance structure and organizational structures of the exchange, and the relationships. Much of the research in outsourcing and alliances has overlooked the importance of the relationships.

At Prodco, the technology, structures, and strategies were at the forefront of everyone's minds. The relationships were just beginning to be considered. The remainder of

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[4] Adapted from Greenhalgh, L. (2001). Managing Strategic Relationships. New York, The Free Press.

this chapter will look at the relationship dimension and look at some of the aspects that are important for success.

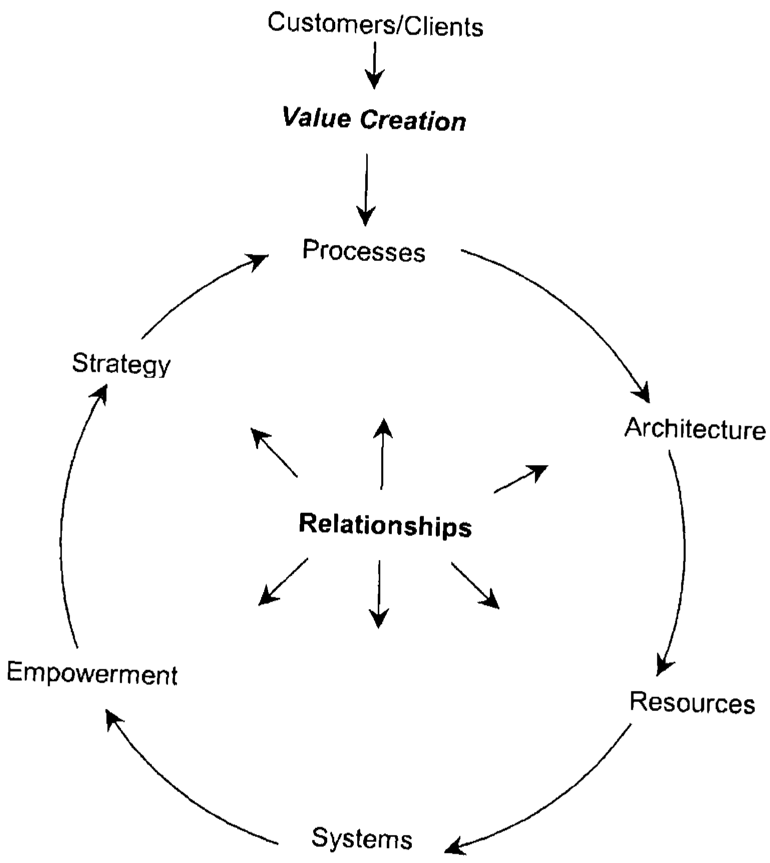

Figure 15: SPARSE Model (Greenhalgh 2001)

4.3. Strategy

Value creation is the central element in the strategy. A firm needs to understand how it creates value for its customers. In my interviews at Prodco everyone generally agreed that the focus of the past was on developing products. This produced leading technology products and improved products year after year. Now the focus was shifting away from leading technology products targeted at a mass market and more toward smaller niche products aimed at specific customer segments. The technology embodied in many of the products is seen as mature or maturing. Thus the technology is seen less as a differentiator between products and more as an enabler for a broader range of narrowly targeted products. Additionally, the products are beginning to be seen less as an end in themselves and more as an integral part of larger system that can easily meet customer needs.

Strategy in this context refers only to the value creation that Prodco hopes to achieve through its partnerships with design outsource providers. Of course, technology competencies and process capabilities are not completely independent of these discussions, but for the most part this work will avoid analysis of Prodco's strategies that detail the roadmap of the technology evolution and further improvements in the product realization process.

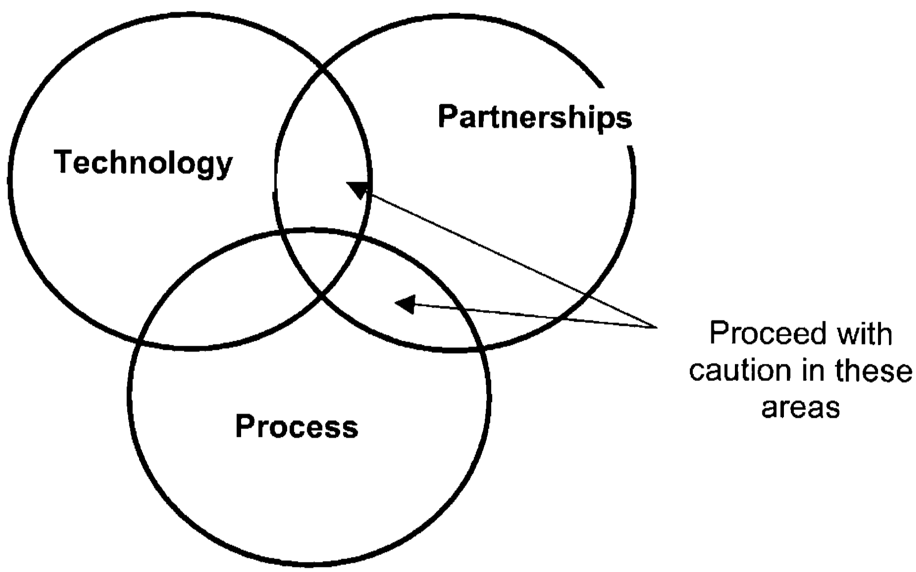

Figure 16: Intersections of Technology, Process, and Partnerships

Figure 16 shows the interaction of process, technology, and partnerships. While each is important, it is at the intersections that a firm obviously needs to be cautious. The overlaps are the sources of intellectual property and knowledge leaks. A firm needs to be careful and closely manage the intersections. The intersections represent the area on which much of the literature focuses. Notice that a much bigger portion of the partnerships lies outside these intersection areas. It is the entire partnership, not just the overlapping boundaries that a firm needs to develop for maximum benefit of the partnerships.

4.3.1. Alignment

For those involved in the relationships and collaboration with an outside partner, the strategy forms a core alignment framework. (Mohrman, Klein et al. 2002) It is through the articulated strategy that people begin to see their actions in the larger context of the goals of the corporation. One of the most important considerations in developing a partnership strategy is considering the importance of the relationship to the partners. Problems of commitment can arise if the partnership is targeted at the core of one business, as it is for Prodco's products, and not at the partner's. It is critical that individuals in both organizations understand how the partnership fits with the strategies of the organizations. For example, Prodco is working to expand the design outsourcing provided by one of its EMS partners. A better understanding of the strategy of the EMS partner and how growth in design supports that strategy would help alignment and collaboration across the organizations.

However, a one-time assessment of strategic fit isn't enough. Prodco needs to consider and actively manage the strategic fit of the companies as evolving internal capabilities, strategic choices, and market developments may pull them in separate directions. Starting with core alignment and openly and constructively managing the diverging partner interests is critical for starting commitment and reinforcing trustworthiness that is crucial to long-term durability of the relationship. (Parkhe 1998)

The strategy also needs to consider the extent of the alignment between and shared knowledge about customers and core business processes. Issues of knowledge transfer include both what is to be shared and what is expected in return. Part of the knowledge sharing also must account for what areas are not to be shared. The ownership and decision rules need to clear. The strategy is facilitated by clear definition of who owns what, the whole product, parts, improvements, etc.(Leach, Pureetip et al. 2001) This notion will be returned to in discussions of the relationship structure.

An effective strategy also considers the long-term evolution of the products and product line. Carefully planning today can be used to develop platforms and capabilities that can be leveraged into new products at much lower costs. Efficient platforms allow the firm to produce derivative products at roughly 10 percent of the cost of developing associated base platform architectures.(Meyer, Tertzakian et al. 1997) This level of efficiency can only be sustained over time with a policy of continuous platform renewal. Otherwise, as a particular platform ages, its design becomes an ever-greater obstacle to engineers as they tried to meet new customer requirements. Timely and cost-effective development of successive generations of a product family should be performed over time in a planned, rational manner as opposed to heroically. (Meyer, Tertzakian et al. 1997)

4.3.2. Capabilities

Section 2.6 discussed some of the challenges of outsourcing the design and development of integral products. Whether outsourcing part of the product or the entire product, the OEM needs to maintain high levels of knowledge to avoid getting stuck in a dependency trap. As design outsourcing adds to the partnership capabilities of Prodco, the company needs to carefully select internal projects that allow it to maintain a leading edge understanding of the components and their integration into its products. At the same time the firm needs to be cognizant of the internal capabilities that will result from the relationships. Sourcing an entire product from a partner will require levels of collaboration and teaching different than sourcing redesigns of existing products or sourcing of subassemblies. The strategy should account for these differences and align the need of the partner to learn with the capacity and desire of the OEM functions to teach. Research has shown that the willingness and capacity to learn of both parties and of the OEM to teach influence the performance of both organizations. (Wang, Singh et al. 2001)

The outsourcing strategy should also consider the dynamic nature of capabilities. The clockspeed of certain components and the relevance of those components into the future should be factors in determining the approach to outsourcing. For areas of the design where the clockspeed is slow and there are numerous suppliers, the risk and reward for increased outsourcing is less. For those areas of the design with higher clockspeeds and few suppliers, Prodco should be careful about sharing too much or letting the outsource design firm gaining an advantage.

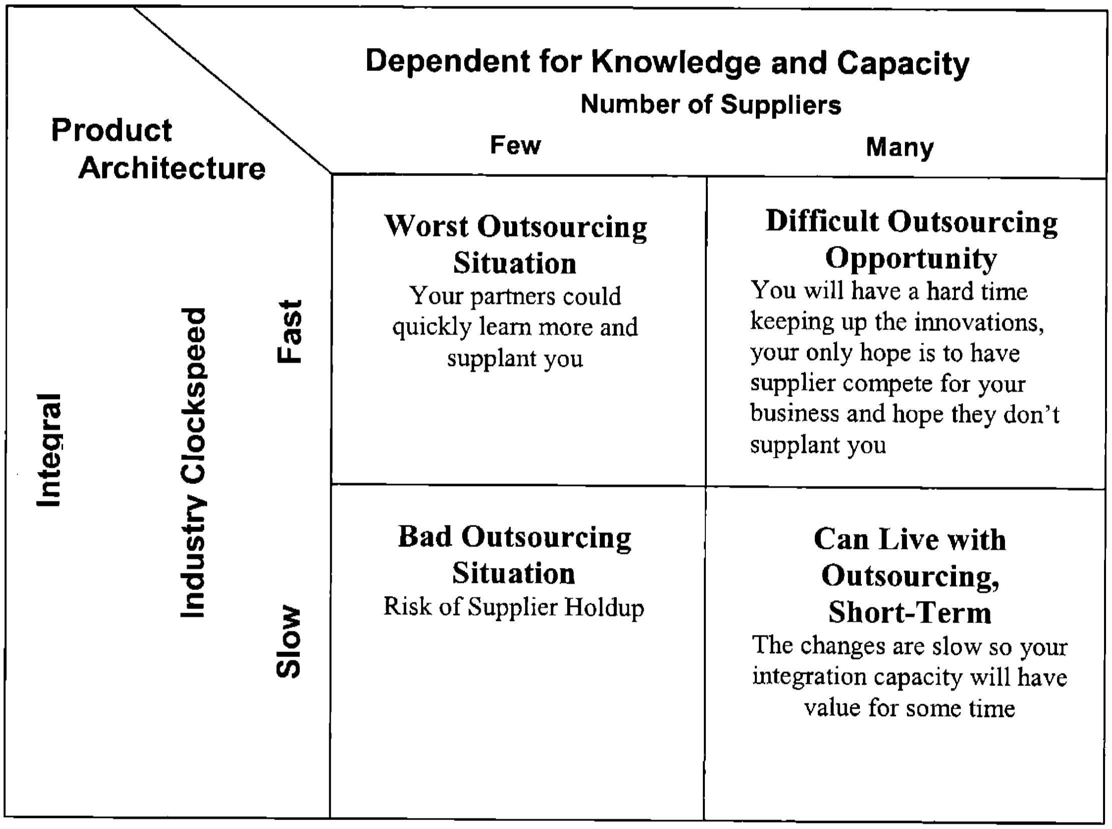

Figure 17: Market and Clockspeed

The role of innovation and hands-on experimentation also plays an important role in developing the outsource strategy with respect to capabilities. In a study of innovative, and successful firms, innovators carried out more of the activities necessary to successful innovation. (Dougherty 1995) A corollary finding to this research is the observation that firms that have the ability to in-source a majority of components performed higher. (Kotabe 1992) There is an important distinction, the firms only had to have the ability to source the parts internally, not that they necessarily did. This finding is in agreement with Fine's observation that the strongest companies depend on suppliers and partners for capacity and not for knowledge. (Fine 1998) The same studies have revealed that firms who outsource production have an observable reduction in process innovations. (Kotabe 1992) This implies that retaining and building in-house development capabilities is important not only to remain a knowledge buyer, but also to enhance innovation.

4.3.3. Long-Term Learning

Prodco is pursuing outsourcing as way to leverage R&D investment into more products and shorter time to market. This implies a short term need for efficiency gain. But there are two potential effects of interorganizational relations whether buyer-supplier, joint venture, alliance, or consortia in product development: short-term efficiency-increasing and longer-term learning enhancing effects. A clear tradeoff exists between these two options. (Sobrero and Roberts 2001) If the goal of the relationships is to build a large supply base that can deliver more and better products to market, then the initial projects will have to sacrifice some short-term efficiency to establish the longer-term learning benefits.

The basis of the relationship is important to its long-term success. Successful collaborations align the long-term strategy with growth of the partnership. If the relationship is founded on a negative motive (to mask weaknesses, prempt competitors, etc.) then is less likely to succeed and endure than relationships based on a positive motive (to pursue future growth opportunities) (Kanter 1994). While one may try to hide the negative motives, they are inevitably expressed in subtle actions and behaviors of the firm.

An effective long-term strategy recognizes that new product development partnering is not a discrete event but a maturation process involving several stages including awareness, exploration, commitment, and dissolution. (Millson and Raj 1996) Part of the maturation process will identify partners' needs, capabilities, and relative size and account for shifts in each of these characteristics.

The long-term vision of the strategy and the partnership is an extension of the earlier discussion of tone. The tone underlies the behaviors that result and are observed by the partner. For a successful design relationship, the long-term strategy needs to be clear and provides the basis for subsequent actions that can strengthen the relationship or be the source of its undoing.

4.3.4. Extending Strategy

The early work on core competencies suggests that core competencies are really limited to technology. (Prahalad and Hamel 1990) The risk in this point of view is that the core competencies can become detached and abstracted from practice, representing a historical practice that does not relate to current experience. More recent works expand the concept by proposing that core competencies are instead concerned with the relationship of the firm's technology with user needs, or an appreciation of how the firm's technology could provide solutions for actual customer problems.(Dougherty 1995) Successful strategies consider the role that the outsource is to play as an extension or expansion of the firm and does not lose sight of the potential for changing customer needs. One needs to consider how the partner's core capabilities and competencies complement the existing core capabilities and what expanded capabilities result. The peripheral activities that support and enable the core capabilities are also important considerations in the strategy.

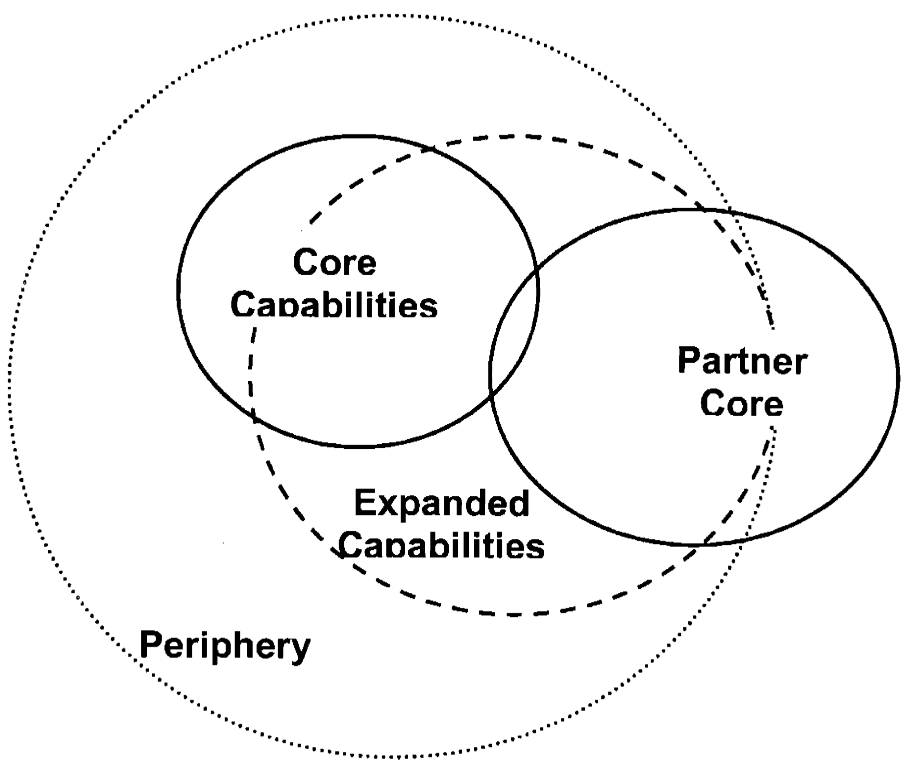

Figure 18: Concept of Parntershp as Extension of Firm

4.4. Processes

After the partnership ship strategy is considered, the next consideration is the alignment of processes toward value creation for the customer. In this context, we are considering the product development process. The OEM has to consider how the outsource relationship may change its internal product development processes and the outsource provider has to adapt its methods to the requirements of the OEM. Both parties are likely to have had prior experience that will initially guide the approach. The goal is to arrive at a mutually agreed upon set of processes.

4.4.1. Product Development Process

The primary consideration should consider the changes that will be required as the product generation spans the boundaries between the two organizations. The most successful collaborations result in major changes to the product development process. (Handfield, Ragatz et al. 1999). The firm that recognizes this and begins to adapt the product generation process can realize advantages that reinforce and extract value from the partnership. However, firms frequently fail to recognize the required or subtle changes that will result and instead try to apply the standard product develop model that was successful in the past. (Dougherty 1995) Failure or decreased productivity and innovation often result.

The first step is to consider the extent of the differences in the industries and the technologies of the two companies. The differences can be both technical and social. Where there are differences, the buyer may need to modify his expectations about the suitability of imparting certain new technologies, and the supplier may need to consider whether he needs to adjust his own thinking to accommodate new principles and practices.(Langfield-Smith and Greenwood 1998) This level of study can only be undertaken after a thorough understanding of both parties' normal development processes.

4.4.2. Core Rigidities and Core Incompetencies

Two notions from the literature underscore the need to examine and change or adapt the development process. The first is core incompetencies (Dougherty 1995); the second is core rigidities (Leonard 1995). The two are closely related. Identification and focus on core competencies leads to rules that reinforce thoughts and actions. Some of these rules are necessary to build and expand on the core competencies and are part of the social and organizational structure of a company. Without core competencies the new products and processes would never become part of the company's strategy or capability set. The core competencies anchor the past successes. The anchoring leads to reification of the network of rules surrounding competencies freezing a firm in core incompetencies. The core incompetencies come to dominate because they were like habit, easy to use without thinking, and allow people to go about their complicated work of designing, without worrying about communicating or interacting with others. Core rigidities, in a similar manner, recognize that whatever guiding principles of rewards and values that gave rise to core capabilities at the same time downplay or degrade other capabilities. The result is a focus or lock on capabilities termed core rigidities. The process a firm undertakes to develop a new collaborative project needs to deal with these incompetencies and rigidities. If the theories organizational and behavioral theories are correct, the rigidities cannot be completely eliminated because of institutionalization and structuralization; however one goal of such a process should be to undermine or cause some creative abrasion or tension among the core capabilities that can lead to further innovation and development or modification of existing capabilities. Success based on core competencies does not lead to future success if the core incompetencies are not destroyed. (Dougherty 1995) Two ways to prevent core rigidities are to avoid firm task partitioning allowing some fluidity in the workflow and by forcing the design teams to draw on multiple perspectives throughout the development process.

4.4.3. Customer Focus

Customer focus is critical to new product development. The focus must extend beyond just the conceptualization phase and continue through the development as difficult tradeoffs and decisions are made. Research on innovation and innovators has shown that the most successful innovators work closely with customers in a multidisciplinary team, usually through multiple visits, while failed innovators do not.(Dougherty 1995) The design team also must consider where the product is the thoughts of the customer. Is it in driving decisions or just an afterthought? The firm should target in on customers, but not over focus. A firm has to consider not only existing customers but also find new customers or emerging segments that are being underserved. (Christensen 1997) Too much focus on current customers and markets can miss developing opportunities.

In collaborations dealing with customers becomes a tough issue. Frequently the OEM wants to limit access to market information or contact with customers to prevent giving away to much customer information. The development process should consider how customer focus will be maintained and clearly delineate the decision processes and information flows.

4.4.4. Innovation

Second a company needs to recognize that innovation can occur anywhere in the product development process. Frequently, the architecture or conceptualization of the product is seen as the time of innovation. After the product concept is defined and some feasibility demonstrated the rest of the process is often viewed as simple execution to plan. The failure to see each step in the product development as an exercise in innovation further reinforces core rigidities. (Leonard 1995) Four aspects of innovation and innovative organizations should be accounted for the in the development process. First, the greatest source of innovation its at the interface of organizations and specialties. (Kotabe 1992) This implies a need for frequent exchange between organizations and the functions within the organizations. The most innovative organizations describe their interactions as reciprocal not linear. Second, the makeup of the design teams needs to include people with T-shaped expertise, that is broad knowledge across a range of activities but with deep expertise in one field. (Leonard 1995) Third, limit organizational constraints so people can more easily maintain the integrity of their work. Fourth, recognize that the most innovative organizations allow frequent involvement of both internal and external customers in their design work. (Dougherty 2001)

4.4.5. Experimentation

Firms engaged in more experimentation (and with more resources allocated to experimentation) and different types out perform those that do not. (Leonard 1995) (Iansiti and West 1997) Experimentation explores the boundaries of existing knowledge and is often the source of innovation. Experimentation should test three levels of product generation: the product, the processes, and the organization. Each of these may have a different clockspeed and ability to absorb change, but the experimentation should nonetheless be testing at each level. At the product level, the implication is obvious. Designers should be encouraged to explore new options. At the process level, new methods of work can be tested. At the organization level experimentation is inexpensive and can often lead to large gains in productivity

4.4.6. Models

For years architecture schools have recognized the importance of models. (Henn 2002). Prototypes and sharing of models is one of the best methods of communicating knowledge. Real objects move discussions away from abstract descriptions and specs to engage with the real object Artifacts are frequently a driving source of discussion and innovation. Physical objects also act as boundary spanning objects that help communication. (Leonard 1995)

4.5. Architecture

The term architecture is used to describe the next consideration on the circle of relationships. The term architecture is used because it really means more than just structure. The architecture refers to the tone, intent, and building nature of the relationships beyond just the structure.

4.5.1. Tone

Section 4.1 introduced the idea that the tone of a relationship really drives behaviors by first affecting the mental models that people construct around their partners expected motives and behaviors. Structures like reporting relationships, rules, decision processes, monitoring processes are built from the mental models. The structures help channel actions, but it is the integration of all three tone, models, and structure that really determine behavior.

Effective partnership architectures recognize and work across all four levels, but the most important, the most critical to start right is tone.

An enduring relationship considers the long-term best interests of both parties and works to align them in the partnership activities. It is critical that each partner try to understand the values of each company, that is the agreed upon rules and norms that guide how employees treat each other, their customers, and their partners. Alignment of tone leads to higher levels of mutual trust and respect and an increasing willingness to cooperate to develop new possibilities. Relationships based on mutual trust, respect, and a spirit of cooperation tend to endure and achieve higher performance. (Kanter 1994; Langfield-Smith and Greenwood 1998)

The tone or attitudes throughout the organization need to be considered. Frequently collaboration is agreed to and strong relationships built at one level of management only to be undermined by the attitudes and behaviors of subordinates. (Kanter 1994) The possibility is especially prevalent in organizations where workers may feel that they are cooperating themselves out of a job. In these cases the business strategy needs to be clear and understandable by all parties, but the attitudes can still persist unless overall job opportunities are expanded. (Langfield-Smith and Greenwood 1998)

4.5.2. Mental Models

Mental models are constructs that people rely upon to understand complex situations and predict outcomes and behaviors. An important aspect of mental models is their ability to aid or hinder the knowledge-gathering and sharing among people. (Leonard 1995) To achieve effective teamwork it is critical to achieve a shared understanding. The flow recognition of knowledge is one aspect of coming to a shared understanding. The team members need to know the tacit and explicit rules which each other uses to make decisions. One successful technique for surfacing both the desired tone and the operating mental models for improved shared understanding is dialog. Dialog focuses on building a shared container or space for understanding. In one variation participants are asked to list what they consider good teamwork or communication practices. The practice surfaces mental models and tacit beliefs by recalling past experiences that reflected these practices. The results of using this dialog technique are a much faster team cohesion, and stronger collaboration that persists over time. (Tan, Wei et al. 2000)

4.5.3. Relationship Connections

The next challenge of architecture is to understand at what stage in the product development should the interaction focus. There are two relevant concepts that provide some tension in making the decision. First, one needs to consider the tradeoff between learning and efficiency again. Design relationships that provide for clear task partitions and fewer interdependencies are more efficient but provide fewer learning opportunities. For one seeking the highest efficiency or productivity, achieving task interdependency is more important than careful selection of the type of work involved. (Sobrero and Roberts 2001)

Second, even if it were clear whether learning or efficiency were the goal, task partitioning is not easy and may not be desirable for other reasons. To reduce problem-solving interdependence among tasks we must be able to, first, predict which tasks are likely to be the source of important new information; second, predict which other tasks in the network are likely to be affected by that new information; third, use such predictions to adjust task specification.(von Hippel 1990) Even if one can surmount the task partitioning difficulties, there is research that suggests interaction across certain boundaries or task partition, in particular R&D and marketing or design and manufacturing is associated with much higher levels of innovation and resulting project efficiency. .(von Hippel 1990) The firm must also be concerned about the effects of task partitioning on the long-term capabilities as discussed in section 4.3.2.

4.5.4. Asset Specificity

Partnership asset specificity refers to the tangible and intangible investments that each company has made to develop something useful that is of little or no value without the partnership. Asset specificity is an important factor in deciding between in-house, market, or partnership coordination of development. As Figure 19 demonstrates, where little asset specificity is required, there is no competitive advantage for the firm in investing either in in-house capability development or partnerships. However, as the need for asset specificity grows, competitive advantage can be obtained by developing specific assets, especially if those assets will be hard for competitors to duplicate. As the asset specificity becomes even higher, it will be harder to attract partners who are willing to make the large investment to develop the specific assets, and as a buyer the risk of supplier holdup risk becomes greater.

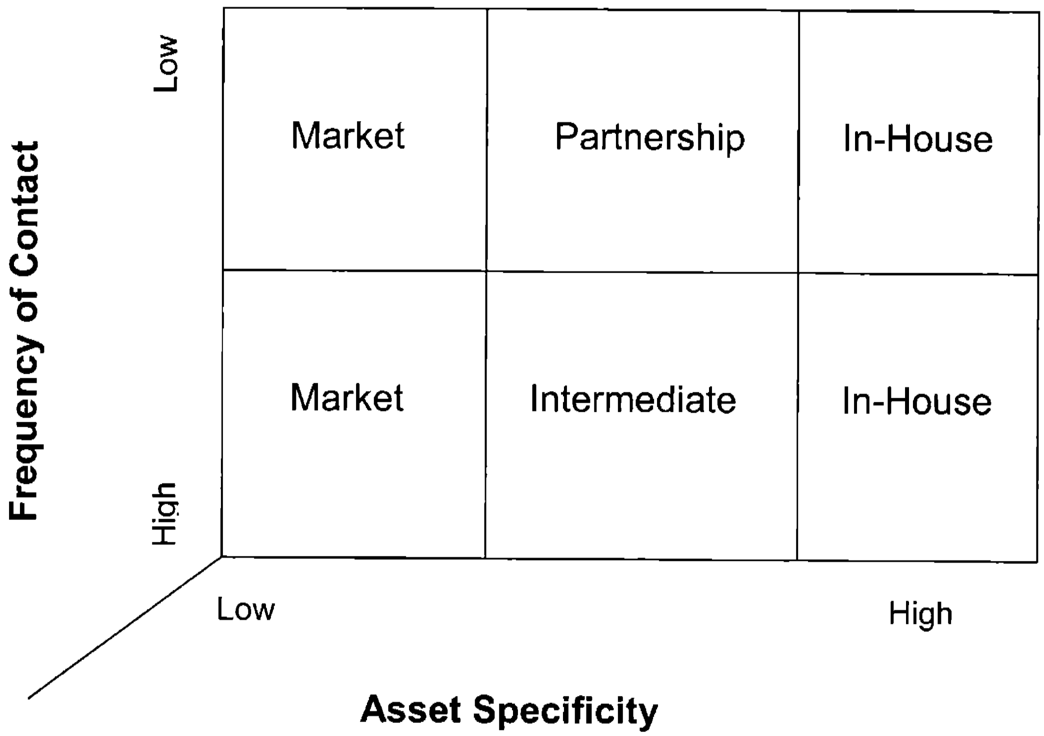

Figure 19: Sourcing Decision by Asset Specificity and Contact Frequency

Outsourced design will inevitably lead to some development of assets specific to the relationship. The supplier will make investments in understanding the unique technology and development processes of the buyer that enables closer collaboration, but that will be of little value if the partnership dissolved. Likewise, the buyer will invest in developing capabilities in working with the unique situation of the supplier. Each company may also develop special capabilities that have value only in the partnership, but each is unwilling to share. An example might be a supplier who finds a way to extract higher performance from a buyer's technology. The development has no value without the buyer's technology, but to prevent other suppliers from gaining an advantage, the supplier may be unwilling to share its new developments. An effectively architected partnership will recognize the potential and even encourage the development of specific assets through the partnership. In fact, the development of specific assets typically leads to higher performance of a cooperative relationship attributed to the signaling of trust and commitment to the relationship. (Langfield-Smith and Greenwood 1998; Kotabe, Martin et al. 2003)

4.5.5. Ownership

One last consideration in partnership architecture is providing for clear ownership of roles and responsibilities. The partners should make it clear up front what information and knowledge is to be shared and the processes to be used. The earlier and clearer this is established, the easier and more effective it is to manage over the long-term (Hamel, Doz et al. 1989). Clear ownership also facilitates accountability if there is sensitive or proprietary information over which a partner does not wish to lose control.

4.6. Resources

The strategy is in place. The partners have aligned their development processes to ensure that they are both focused on the highest value creation. The architecture of the relationship encourages cooperation and works to maximize the contribution and interaction of the partners' processes. The next step is to consider which resources and what skills each partner will contribute.

4.6.1. People at interface

There exists a boundary between companies that is characterized by culture, time, physical separation, organization, etc. At every interaction, the people involved will have to cross that boundary to get collaborative work done. Some will consider the boundary spanning activity as an exciting challenge and critical to the project's and their own success. Others will be disinterested or unclear about their role. Management recognition and assignment of individuals focused and responsible for boundary spanning activities or gatekeepers can increase performance by shifting boundary spanning from a haphazard collection of interactions to a more structured network driven by a champion.

The champions or gatekeepers will develop better collaboration if they recognize that a social system will crystallize at the interface in one of three ways. (1) The boundary spanners will work out a harmonious working relationship by integrating elements of the two main cultures as each culture manifests itself locally. They can reconcile general organizational frameworks to come up with a compromise or yield to the cultural practices of the other group, innovating a new cultural practice, divide tasks to minimize the need for negotiation. This is typically a low trust environment resulting in a harmonizing behavior. (2) A distinctive culture may emerge that draws on the elements of each organization but is different from either. The actors create new cultural dynamics and specific frames of reference and norms. Their behaviors in this context are consistent with high-trust relations. Boundary spanners struggle together to make sense of their world. (3) The boundary spanners will be unable to harmonize elements at the interface and get stuck in recurrent patterns of behavior that view each other's behavior as destructive and which threatens the viability of the partnership and indicates a normative context of distrust. Polarization and sour relations result.(Cascio 2002)

The role of the gatekeepers is threefold. First, they must recognize that the goal of the relationship is to build something larger than the capabilities of each organization independently. This requires a high degree of collaboration and trust. This comes from understanding the partner and its management and creating goals that encompass and integrate the objectives of the partners. It is fostered by closely listening to ascertain the partner's real needs and interests. They must also demonstrate the behavior desired from the partner, be explicit about what information will and won't be shared and refrain from testing the partner. Make intentions known before acting so that the tone and models for action built earlier are visible and reinforced. (Millson and Raj 1996)

Second, because it will be necessary to protect proprietary information, the gatekeepers can monitor what is shared to prevent loss of critical information. (Hamel, Doz et al. 1989) This is especially critical if the partnership, as in Prodco's case, spans several divisions and projects. Monitoring is necessary to make sure that each division or project is sharing information that the partner will be able to agglomerate and use to reverse engineer the proprietary knowledge.

Third, the boundary spanners can reduce the costs of the necessary cross boundary problem solving by assisting in task partitioning and dynamically adjusting the partitions as needed and by developing robust communication channels. (Sobrero and Roberts 2001). It is part of their jobs to eliminate bottlenecks. Product development bottlenecks occur when information flow is restricted or the rate of adding value to information is not keeping up with demand.(Patterson 1993) Opening up bottlenecks can significantly enhance the performance of the product development team.

For the gatekeepers to be effective close personal ties between the parties are key. Limiting employee turnover at the interface and shifting responsibilities and roles can help build the required relationships. (Parkhe 1998) Of course there is a delicate balance. Management must also watch for the ties becoming too collegial and the gatekeepers building a stronger identity and commitment to the partnership than with the original companies. (Hamel, Doz et al. 1989)

Finally, the roles at the interface need to occur on at least three levels, the strategic, the tactical, and the operational. Effective relationships across all three levels are indicative of higher performing relationships. (Kanter 1994; Quinn 1999) However, a study by Coopers & Lybrand showed that senior management involvement dropped precipitously with time.

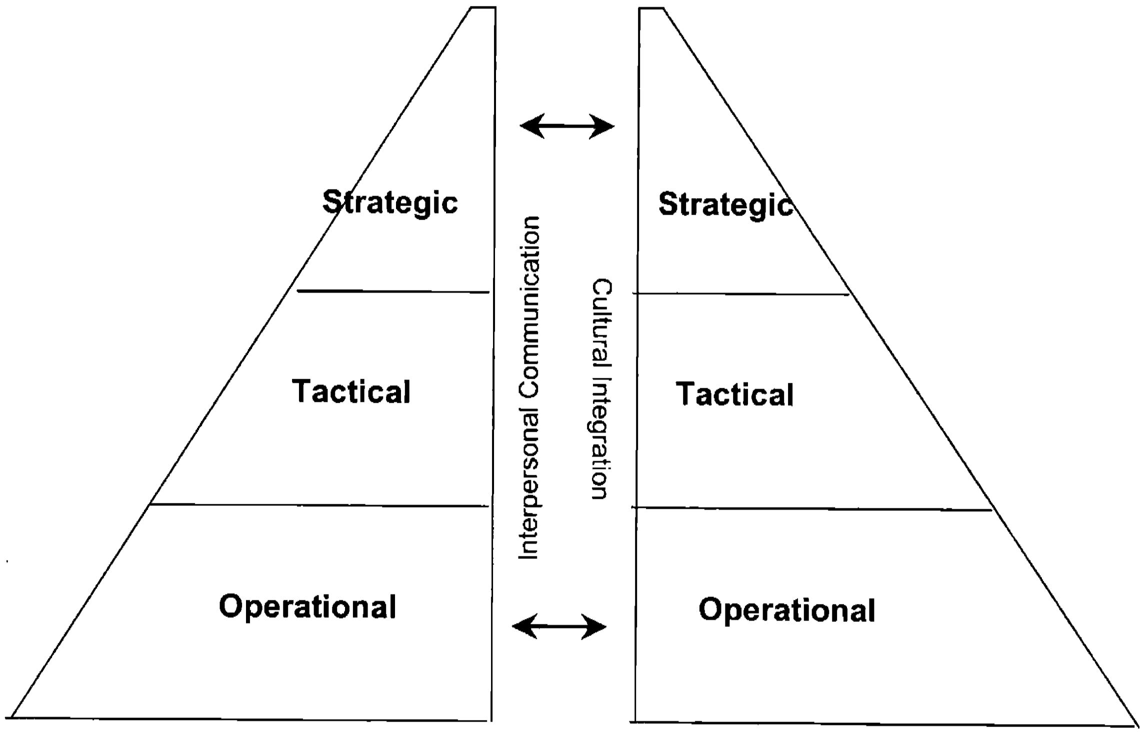

Figure 20: Three Levels of Partner Relationships

4.6.2. Learning teams

One of the challenges for the teams and especially for management in developing a partnership is recognizing that the partnership will require that companies get comfortable with a new way of working. A learning organization is one that is skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights. (Kandemir, Ghauri et al. 2002) The challenge will be to develop new ways of collaborating together instead of relying on the existing processes and methods. Much of the direct experience and feedback possible with in-house development is removed. The recognition of this change will require a focus on learning. The attention and dedication to learning often dictates how strong a partner exits a relationship. (Hamel, Doz et al. 1989) The dedication to learning is manifest in 4 activities.

First, the team has to be willing to adapt and experiment with new methods for doing and organizing work. As noted previously, experimentation is a cornerstone of innovation. By considering alternate methods and continuing to test and modify the structures and processes the individuals in the partnership open themselves to discovering improvements, to tapping into the expertise of each firm, and to increasing the firms capabilities.

Second, the teams have to have the authority and power to modify the relationships and activities to seize new opportunities as they arise. Acting quickly on opportunities as they arise from experimentation can accelerate a company's evolution and its performance. (Fine and Whitney 1996) High level management support or a team leader with clout who can get things done in the organization are less important than the ability of the team involved in the activity to respond and quickly implement key learnings.

Third, the most successful learning teams engage in real-time learning. They analyze and draw lessons from the process and experiments as they unfold and respond to developments. Real-time learning has been shown to be more pivotal in the performance and learning of a team rather than the more traditional debriefs, project audits, and after-action reviews often cited as key to learning. (Edmondson, Bohmer et al. 2001)

Fourth, the most successful teams are managed and built with a focus on learning. Learning teams recognize that all the learning is purely technical. Building a strong partnership involves as much social and organizational learning as technical learning. Team leaders need to acknowledge the other dimensions of learning and emphasize the importance of each member's contribution. Team's whose members are comfortable making suggesting, trying new methods that may not work, pointing out potential problems, and admitting mistakes will be more adept at learning. With these factors in mind, the team makeup should consist of people who are willing to learn and challenge deeply ingrained patterns of communication and behavior.

4.6.3. Team makeup

The people that make up the interorganizational team are critical to the collaboration's success. Recognizing this fact leads to three considerations for team selection. First, a firm needs to recognize that if it can't foster collaborative internal relationships, it won't be any good at making such relationships externally. (Parkhe 1998) Therefore, an important selection criterion should be the demonstrated ability to initiate and nurture internal relationships within a function and across functions within the company.

Second, the team makeup should focus on individuals with a penchant for learning and demonstrated ability to experiment and adapt to new understanding. It is therefore important to allow for volunteers rather than to assign people based on availability or technical skills. Faster learning will come from teams consisting of people interested and committed to the endeavor. (Edmondson, Bohmer et al. 2001) Of course the technical skills are important. As mentioned earlier, the most innovative teams combine people with deep technical skills with a team that has a broader understanding. However, the highest performing teams also include a strong commitment to learning among members.

Third, large differences in extroversion and communication style can hinder development of constructive communication styles (Potter and Balthazard 2002) The firm needs to consider the culture and operating style of its partner and select team members who are acceptably close in communication styles. Compatible levels of extroversion result in higher performance than assigning the more extroverted to a project as a way to kick start communication.

Fourth, higher performing teams manage the team's polarity. Polarity refers to both the level of disagreement among the team on important project features like contribution to firm, strategic fit, technological difficulty, etc. and to the certainty of team members in their views and opinions. The three most important areas where agreement needs to be reached are in product superiority or uniqueness, fit of project to company capabilities and resources, and market opportunity. Agreement on these three attributes is an important determiner of a projects success. (van Engelen, Kiewiet et al. 2001)

4.7. Systems

Now that the resources are considered with respect to the relationship, the next step is to consider the systems and performance metrics that will monitor the relationship over time. The systems should provide enough structure to help drive performance where necessary and give the frequent feedback necessary for adjustment.

4.7.1. Cost

Sections 3.1.1 and 3.2.2 discussed some of the challenges to understanding the cost advantages of outsourcing. Due to the nature of the work, design and product development is probably the hardest to accurately measure. Variations in technology and risk will require different levels of investment and rework to produce a finished product. However, even with this difficulty there are two steps a company can take to manage costs. First, the firm should understand its development costs. Only by knowing what the current costs are can a firm make honest evaluations about the value of outsourcing. Benchmarking and competitive bidding, where possible, are other methods a firm may use to get a better understanding of the benefit a partner can provide. Second, although it is tempting to base a design relationship on contracted hourly rates, it is much more productive and increases motivation if the agreements provide an incentive for the outsource provider or partner to realize a benefit by exceeding expected levels of performance. (Quinn 1999) The outsource provider or partner will be driven by their own self-interest to deliver more than was initially expected. There can be an expected reduction in costs or equivalent increase in performance over time, but the buyer should not become jealous or overly concerned with the income of the partner or provider. The buyer should instead be regularly evaluating the partnership to make sure that it is better off through the deal than it would be on its own.

4.7.2. Schedule and Patterns

Section 3.1.6 discussed the importance of rapid product development and achieving expected time to market. Collaborative design relationships and outsourcing make schedule coordination more difficult because of the expanded network of contributors that must be brought together on time. One way to extract the most value from contracts and partnerships is to establish an agreed upon schedule of milestones or production along a verifiable dimension. However the risk is that the supplier will simply do what is required to meet the milestones and let the other unverifiable or unspecified performance metrics slip. Appointing a tough gatekeeper to actively monitor and push the supplier or collaboration is one way achieve higher levels of performance. (Dearden and Klotz 2002)

A second topic of note is the importance of establishing a rhythm or time pacing of a project. In a study of virtual teams, the most successful were those that engaged in a strict time pacing or governed strategic transitions with deliberate rhythms based on time. The study found that face-to-face meetings were an important synchronizing event that drove completion on a large number of tasks and that resulted in more frequent and productive interchanges between the major synch pulses. Teams that failed to establish a rhythm to their interactions and communications significantly underperformed those that did. (Montoya-Weiss, Massey et al. 2001)

The integration of these two concepts yields an approach that provides for a committed schedule with verifiable milestones, a tough gatekeeper who drives performance to those metrics while also pushing along unmeasured or unverifiable dimensions, and an established rhythm.

4.7.3. Communication

The need to develop two-way communication to improve performance is critical. In design collaboration, each partner needs to be aware of the changing work done by the other. But not all communication is equivalent. The communication needs to consider the three main dimensions of the communication interaction: decision process (information gathering, problem solving, idea generating, comprehensive decision making, or committing to action), message complexity (single and simple to multiple and comprehensive), and form (medium and duration). The highest performing teams match the decision process and message complexity to the form of communication. (Maznevski and Chudoba 2000) For similar reasons, other studies have found that groups who also had face-to-face meetings tended to achieve higher levels of performance. (Potter and Balthazard 2002).

The implication is that effective teams need not only focus on simply communicating, but also tailoring the medium and duration of the interaction according the decision process employed and message complexity.

4.8. Empowerment

Empowering workers and teams has come to be an almost meaningless cliché.[5] However this is an important consideration in building effective relationships and taking action in collaborations. There are three important factors to consider in empowerment (1) decision information, (2) trust, and (3) motivation. (Malone 1997) A common understanding of the decentralization of the decisions will help people to understand the real power at their control and avoid feeling of disempowerment. For empowerment to be effective, the decision makers have to have as much relevant information readily available as possible. This includes strategic intent, an understanding of the processes and resources available, etc. Trust determines at what level the organization is comfortable allowing people to make decisions for it. And motivation is measure of the vitality and commitment people bring to their job and their willingness to search out the options and integrate information to arrive at a sound decision. Empowered workers feel comfortable seeking information at any level in the organization. Such a willingness to search out information and the ability to do this without fear of reprisal is an important facet of empowerment. Especially for design collaboration there is a need to match skill to task. The people in the collaboration need to be able to see into each respective organization to ensure that the best fit is always used.(Burbage 2003)

4.9. Relationships

A relationship between companies is a nearly nonsensical idea. Companies are merely abstract legal fictions. It is the people and the one-to-one interactions among the people that define the larger corporate relationships. It is these interactions that are crucial to building an effective collaboration and as such are at the center of the model of Figure 15

4.9.1. Interaction

The manner in which the individuals interact is an important characteristic of relationships. The interactions can be categorized as constructive, passive, or aggressive (Potter and Balthazard 2002). Figure 21 summarizes the characteristics of the three types of

[5] Unfortunately the brief discussion of empowerment included here only adds to the cliché nature of the discussion.

interaction styles. A study recently showed that interaction style had a bigger influence on team performance than did expertise. While expertise was positively correlated with positive outcomes, it was only possible when the groups developed a constructive style.(Potter and Balthazard 2002). The same study showed that virtual teams had less tendency to develop aggressive or constructive styles and more tendencies to develop passive interaction styles.

Style	***Characteristics***
Constructive Style	• Balanced concern for personal and group outcomes • Cooperation • Creativity • Free exchange of information • Respect for others' perspectives • Fulfills need for personal achievement and for affiliation
Passive Style	• Emphasis on fulfillment of affiliation goals only • Maintaining harmony in the group • Limiting information sharing, questioning, and impartiality
Aggressive Style	• Emphasis on personal achievement • Personal ambitions placed above concerns for group outcome

Figure 21: Interaction Styles

4.9.2. Conflict Resolution

How virtual teams manage internal conflict is a crucial factor in their success. Figure 22 lists the five potential styles that a team may develop to deal with conflict, the characteristics, observed results of those behaviors on performance. (Montoya-Weiss, Massey et al. 2001) One of the interesting aspects of this research is that it revealed that competition and collaboration styles had a significant positive influence on performance. It supports the notion that collaboration, even some competition that doesn't damage the underlying relationships can lead to higher performance. Compromise conflict resolution however leads to lower performance. Another important finding of this particular study was that the presence of strong temporal coordinating mechanism, as discussed in section 4.7.2 has a moderating effect on the negative interaction styles.

Style	Characteristics	Outcome Influence
Avoidance	• Evasiveness • Failure to confront others • Apathetic toward conflicting points of view and outcomes in general	*Negative effect*
Accommodation	• Obliging concern for others	*No significant effect*
Competition	• Pursuing own interests without regard for others • Concealment of information • Competitiveness • Negative attitudes toward alternative solutions • Involve the use of power and domination to force views on others	*Positive*
Collaboration	• Try to identify and achieve outcomes that integrate the interest of all parties involved • Openness to others' points of view • Objective consideration of all information • Shared efforts to solve problems and reach a jointly optimal solution	*Positive*
Compromise	• Intermediate concern for self and others • Work toward settling on some middle ground	*Negative*

Figure 22: Conflict Resolution Behaviors and Team Performance

4.9.3. Trust

There is a longstanding managerial tradition that links control to efficiency and performance; however, in a collaborative design environment, the organizational and geographic dispersion makes direct control impossible. The foundation for such a collaboration to work is trust.

There are three types of trust: (1) process-based, (2) characteristic-based, and (3) institutional-based. People are initially unsure of the other's trustworthiness, so they need to match observed behaviors against expected behaviors. This alignment of expectations with behaviors is the foundation for building trust and adapting to new situations with little control.(Katz 1997) Trust is usually slow to build but quick and easy to tear down. As such managers need to first prevent erosion. In the early stages it is critical to avoid surprises, be trustworthy, and be known as trustworthy. Each party needs repeated reinforcement of positive experiences to nurture trust. Companies that can develop a track record of cooperation and reciprocate partners' behaviors can sustain cooperation and trust even despite short-term incentives to defect.(Kotabe, Martin et al. 2003)

Such process based trust often has a positive spill-over to the relationship as a whole. The guiding principles should be to do no harm and resolve behavioral discrepancies quickly and amicably. One key requirement for such mutual comfort to arise is sustained involvement at all phases of an alliance by people at operational, tactical, and senior management levels, as discussed in section4.5.3. That is trust needs bonding and touch; the more concerned that people are about each other, the more likely they are to deliver. (Handy 1995)

Process based trust can also come initially by reputation. The better a company's past record the better its reputation. The reputation should be nice (never be first to cheat) and provocable (always swiftly taking reprisals against partners who cheat). Charles Handy reminds us that trust needs to tough and ruthless.(Handy 1995) When people do not live up to expectations or cannot be relied upon to do what is needed they have to be let go.

A further aspect of process-based trust is issue spotting, a partner doesn't wait for the other to raise issues. The proactive actions help to reduce surprises and readily deal with performance issues before they explode. Nice is taking a winning strategy; it is constructive and investing effort to learn about the partner's legitimate needs and working hard to fulfill them. Trust is a shared passion and commitment for the same goal.

Fairness is an important aspect of building process-based trust. Fairness encompasses two types of justice: distributive justice, or the perceived fairness of the outcomes received, and procedural justice, or the perceived fairness of the powerful party's process for managing the relationship. (Parkhe 1998) A partner is more likely to trust one who he sees acting with fairness, even if the outcomes are not as beneficial as hoped.

Character based trust comes from societal and corporate cultures. These can be managed with sufficient investment in time and effort. Investing in communication and acknowledging countless differences comes from intercultural awareness training, encouraging informal contact, and improving behavior transparency. Partner cultural sensitivity is an important contributor to trust-building for international alliance partners.

Institutional based trust comes from cooperative behaviors. These can come from reducing the attractiveness to cheating, increased cost of cheating, and increased gains from cooperating. Companies should show good faith in upfront commitments such as reciprocal agreements. Formal social structures also signal one's trustworthiness.

Trust is not blind. The first time companies work together the chances of succeeding are very slight.(Parkhe 1998) It is unwise to trust people who you do not know well, whom you have not observed over time, and who are not committed to the same goals. Building trust slowly allows one to verify and reconcile the acknowledged goals and motivations with actual behaviors. There is a tender balance that people at each level must strike. Too little trust can hinder the progress of the relationship and leads to excess effort and cost verifying performance or scouting for partner actions. Too much trust opens a firm to loss of significant competitive advantage.

4.9.4. Teamwork

Teamwork is another important measure of the quality of the relationships. Teamwork allows the collaboration to draw on the specific knowledge and capabilities of each partner to create a new capability that neither had before. With this in mind it is useful to explore the factors that affect the success of teamwork in innovative projects. A useful construct for exploring the relationship is Teamwork Quality or TWQ (Hoegl and Gemuenden 2001). The six facets of TWQ are communication, coordination, balance of member contributions, mutual support, effort, and cohesion. Because innovative tasks are highly complex and dynamic, they require the integration of a wide range of skills to achieve high efficiency and effectiveness. It is this integrative function that teams with innovative tasks must fulfill, and TWQ is a measure of just how well this is done.

Communication is an elementary component of exchange within a team. It is characterized by frequency, i.e. how much time is spent on communication, the degree of formalization, which relates the degree of spontaneity of communication, its structure, which is the ability to communicate with anybody in the teams, and openness.

Coordination is the degree of common understanding regarding the interrelatedness and current status of individual contributions and also determines the quality of the teamwork performed.

Balance of member contributions measures the the balance of teamwork with respect to the individuals specific knowledge and expertise. No one should be limited in presenting or bringing in new ideas or contributing relevant knowledge to the team.

Mutual support is the measure of cooperative rather than competitive framework to their tasks. For interdependent tasks mutual support is more important than competition. Working toward a common goal requires a degree of respect. Competitive leads to distrust and frustration.

Effort describes the norms built up around the shared expectations regarding the behavior of team members. Workload sharing and prioritizing of team tasks can help to establish expectations and shared understanding of the amount of effort. The team needs to understand and accept the work norms concerning sufficient effort.

Cohesion refers to the degree to which team members desire to remain a part of the team. Three forces of cohesion exist: (1) interpersonal attraction of team members (2) commitment to team task, and (3) group pride or team spirit. If team members feel little desire to keep the team going, then they are not likely to engage in intense collaboration.

In sum, TWQ can explain as much as 40% of the variation in a team's performance on efficiency and effectiveness.(Hoegl and Gemuenden 2001)

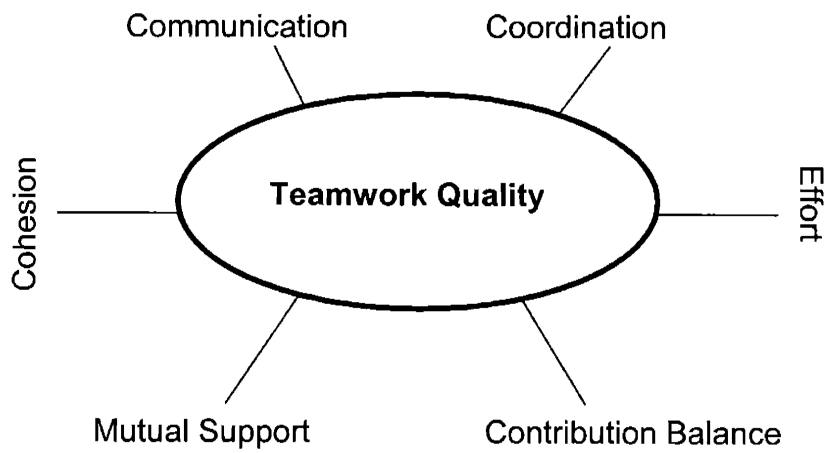

Figure 23: Teamwork Quality Construct

4.9.5. Sensemaking

Sensemaking is a kind of catchall term for acknowledging that information gathering, turning that information into knowledge, and finding a way to apply that knowledge is a messy process. Sensemaking is the process through which the various bits of information, insight, ideas, and intuition coalesce in some meaningful way. (Dougherty, Borrelli et al. 2000) This process is ongoing and the results emerge from efforts to create order and make retrospective sense of what occurs. Sensemaking is not a solitary undertaking it is a social process that requires frequent contact drawing on the information, perceptions, and experiences of others as well.

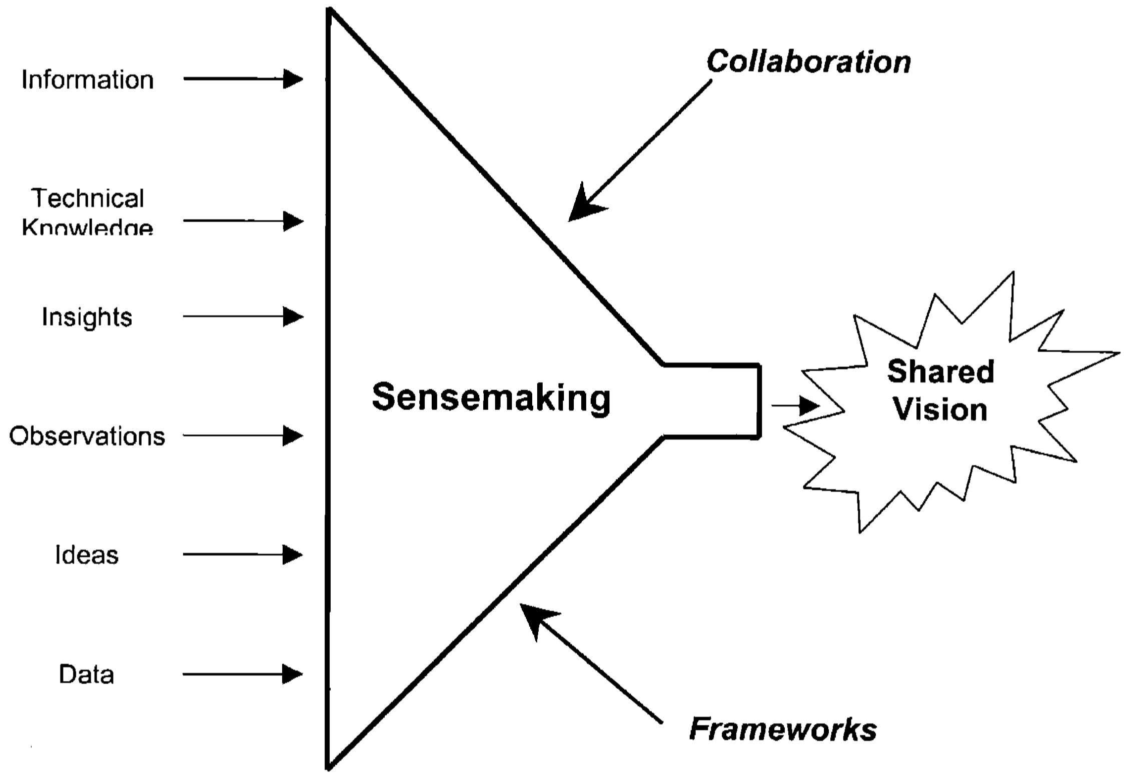

Figure 24: Sensemaking Process

Product development is a particularly complex sensemaking system. (Mohrman, Klein et al. 2002) The teams change dynamically to respond to problems and challenges and while delivering product and process innovations. A intricate web of linkages connect the teams to upstream and downstream partners and while lateral linkages coordinate and integrate the diverse knowledge across dispersed teams. Product development requires identifying customer needs and market opportunities and defining products to satisfy those needs while relating specific technical and market knowledge within the guiding strategic intent of the business unit and corporation. (Mohrman, Klein et al. 2002)

Sensemaking comes from two sources: interactive collaboration and alignment frameworks, or those defined and articulated rules, roles, procedures, etc. that do not require additional collaboration. Developing products with integrated products necessitates collaboration, as does a changing perception of market opportunities and customer needs.

The goal of a product development is to innovate, and sensemaking systems affect innovation. People in innovative firms understand the technical and market knowledge as skills, resources, and practices that move and evolve over time. The products, processes, and business capabilities are linked to this knowledge but are also changing. The customers' needs, capabilities, and relationships are similar drifting. The innovative organizations are actively engaged in sensemaking and modifying the sensemaking systems in response to these changes. Non-innovative firms tend to see knowledge as more static. It is created and stored in response to typically self-defined problems in current activities and operations. (Dougherty, Borrelli et al. 2000)

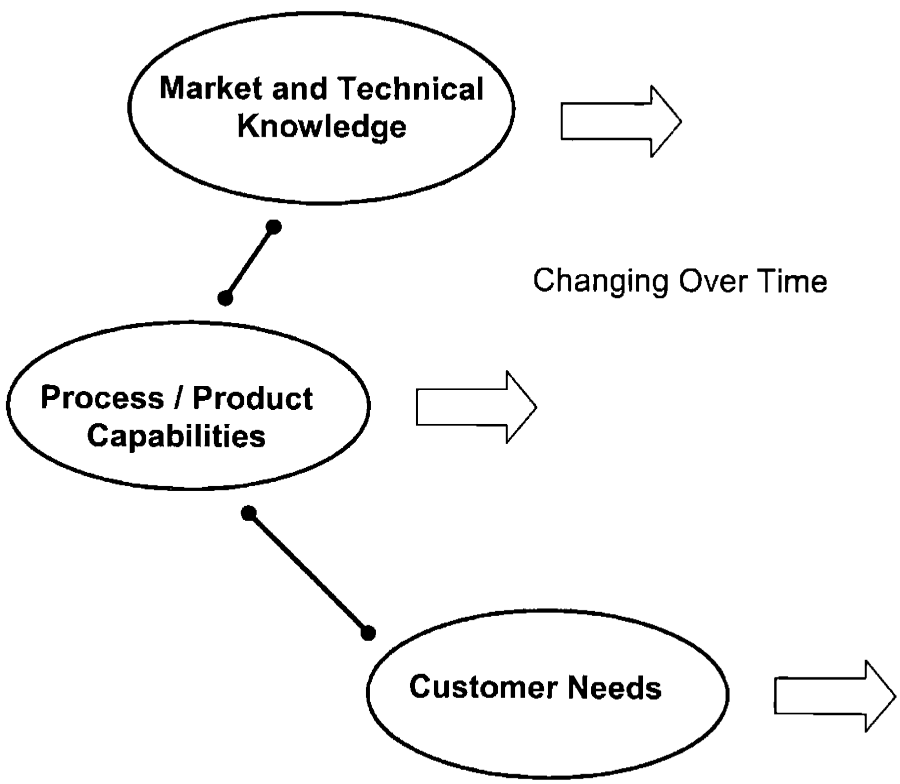

Figure 25: Innovative Firm Sensemaking

Three tensions were identified in innovative firms that help pull in new knowledge. It is important to recognize that most of the knowledge is tacit and only becomes transferable through direct experience. The first operates at the product level looking for unfolding changes in technology, products, customers, resources, and processes to exploit emerging opportunities. The second operates at the business level building on business trends and shifting capabilities to leverage across business units and product lines. The third functions at the strategic level to business capabilities and changing strategies might be linked and evolve over time to fit future directions and construct a long-term path. (Dougherty, Borrelli et al. 2000)

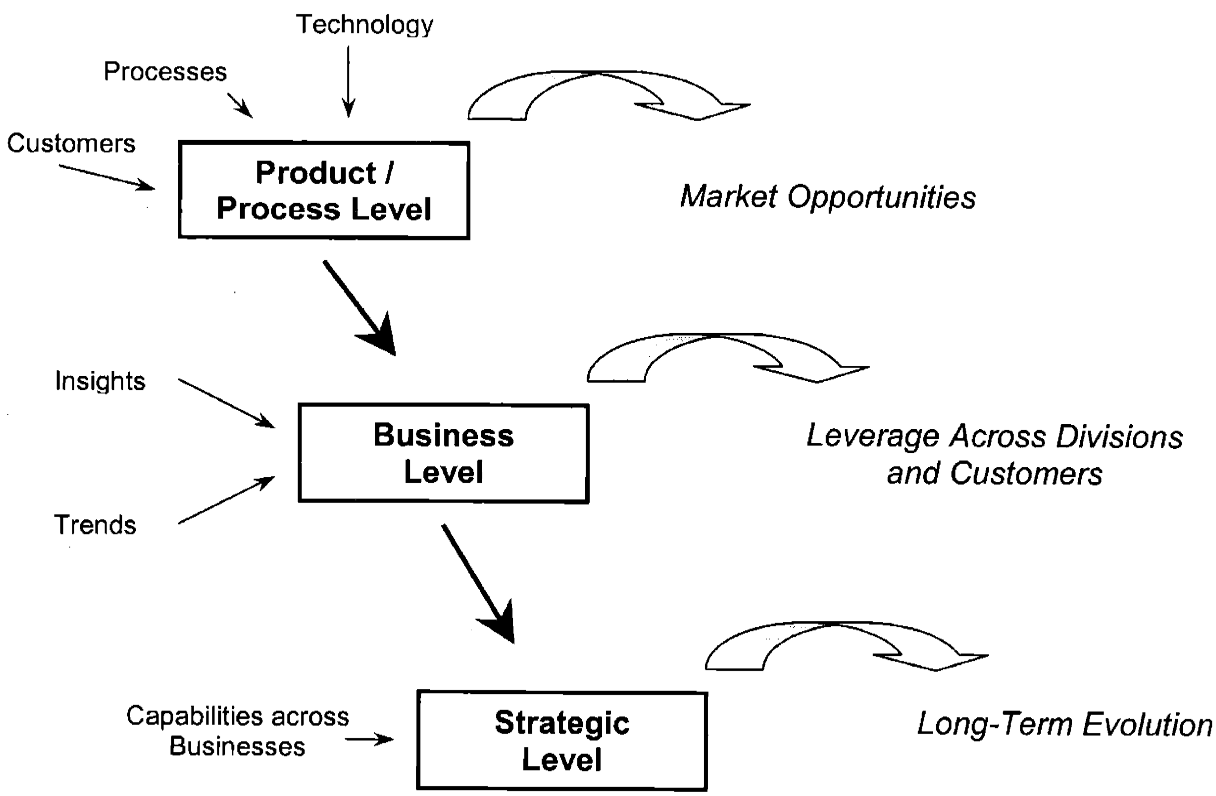

Figure 26: Three Levels of Sensemaking Tension

Recognizing that sensemaking is an important part of product development leads to efforts to make customer, technical, market, and strategic knowledge dispersed across the organizations involved. The knowledge not only has to be dispersed, but the opportunities for interactive collaboration need to be nurtured. People need to be moved around and available for collaboration in meetings and informal interactions and to experience the local conditions and norms. To improve an organization's ability to create and use knowledge for innovation it is necessary to deal directly with the sensemaking system in all its messiness and complexity and not assume that changing structures, styles, strategies, or processes will change the sensemaking. (Dougherty, Borrelli et al. 2000) Recent work highlights some of the best practices in sensemaking for a globally dispersed team (Mohrman, Klein et al. 2002)

1. Develop familiarity across sites. Translate and integrate company strategies and practices into local cultures and norms.
2. Don't expect shared understanding without investing in collaboration to align the frameworks, knowledge, and expectations across sites
3. Devote time in meetings and travel to making and nurturing personal relationships and network building.
4. Rotate people to distribute knowledge and promote sensemaking
5. Use technical knowledge sharing as a means to align global frameworks of understanding

5. Chapter 5 – Conclusions and Recommendations

Outsourcing has been a practiced business method for centuries. However, in the last few decades its acceptance has widened and spread across a number of functions. One of the more interesting aspects of outsourcing is its increased use in the design of new products. For many companies the product designs are critical to success, yet more and more companies are finding it advantageous to outsource design. Engineering and design outsourcing are the next logical steps in the progression of outsourcing for many firms. This trend is particularly evident in the electronics industry and has given rise to the EMS and ODM sectors. However, design outsourcing also represents probably the most challenging activity to outsource.

The literature has historically focused on the technological and strategic implications of outsourcing. Only recently have firms and academia begun to study the important interactions of governance structure and transaction attributes on the success of outsourcing. (Leiblein, Reuer et al. 2002) A further extension of this work is to understand the importance of the relationships that underlie design outsourcing and how to build strong interorganizational ties. The difficulty is that as the other importance of these other facets of outsourcing are studied, the less likely are the results to provide a general prescription for success in design outsourcing. Each technology, strategy, product architecture, and partner attributes are likely to demand different outsourcing approaches. Despite these difficulties, considering design outsourcing from the perspective of the organizational and interpersonal relationships provides some insights into the methods that companies can use to foster strong, long-term relationships.

Hopefully this work has underscored the importance of setting up the relationship and some of the considerations that are important for building enduring relationships. Applying these ideas to Prodco may provide some useful insights. Two of Prodco's outsourcing endeavors are interesting to examine from this perspective. In one relationship, the company is considering expanding its design activities with an EMS partner. The company is committed to expanding the use of design outsourcing with this firm. However, there is a perception within the company that the EMS company does not have the required capability and will take some time to develop the capability. Prodco is working on transferring the required knowledge and product realization processes. The challenge for the company will be to recognize the potential for innovation at the EMS partner and to work to develop strong relationships that will allow Prodco to encourage the innovation and to bring the insights back into the general product lineup. Research has shown that outsourcing production results in fewer process innovations; the challenge will be to make sure that design outsourcing does not similarly result in reduced design innovation. The natural inclination will be view the work of the outsource design company as "turn the crank" engineering or as simple execution of architected products. The disdain or discounting of the importance of the final product development can result in the loss of relevance of the original firm as IBM demonstrated with its outsourcing of the PC development. The second interesting relationship being developed at Prodco is with another large corporation. The challenge for this relationship will be to develop a long-term, cooperative agreement. The preceding chapters have hopefully provided some insights into the importance and methods of how to build such a relationship. If GE had thought through the issues and tried to develop a cooperative relationship it may have continued to be relevant to Samsung after its initial role as a teacher. Of course, it is also possible that Samsung's only goal was to quickly displace GE as the market leader in microwaves. In that case, there may have been nothing that GE could have done to prevent its eventual irrelevance to the market, but by exploring the relationship dynamics it may have realized the mistake earlier and found a more suitable partner.

References

(1986). The Hollow Corporation: The Decline of Manufacturing Threatens the Entire US Economy. Business Week: 56-85.

Allen, T. J. (1977). Managing the Flow of Technology. Cambridge, MA, MIT Press.

Anderson, H. (2003). lecture on venture capital in software industry in Managing in Adversity class at MIT Sloan.

Bacheldor, B. (2003). Nimble, Quick Supply Chains in Demand. Informationweek: 24.

Baldwin, L. H., F. Camm, et al. (2000). Strategic Sourcing: Measuring and Managing Performance. Santa Monica, RAND.

Berry, V. and T. Bowers (1991). "Restructuring Success." McKinsey Quaterly **1991**(4): 96.

Bragg, S. M. (1998). Outsourcing: A guide to selecting the correct business unit, negotiating the contract, maintaining control of the process. New York, John Wiley & Sons, Inc.

Burbage, T. (2003). lecture on Joint Strike Fighter Program in Leadership and Organizational Change course at MIT Sloan. L. a. O. C. class. Cambridge.

Carbone, J. (2003). ODMs offer design expertise, quicker time to market. Purchasing: 11-13.

Casale, F. J. (2000). 2000 Outsourcing Index: Strategic Insights into US Outsourcing, The Outsourcing Instititue and Dun & Bradstreet. **2000**.

Casale, F. J. (2003). Outsourcing Outlook 2003, The Outsourcing Institute. **2003**.

Cascio, W. F. (2002). The Virtual Organization. The New World of Work. R. J. Burke and C. L. Cooper. Padstow, Blackwell Publishers Ltd.: 19.

Cataldo, A. (2002). Foundries put IP on Strategic Fast Track. Electronic Engineering Times: 1-4.

Chesbrough, H. W. and D. J. Teece (1996). "Organizing for Innovation: When is Virtual Virtuous?" Harvard Business Review **74**(Jan - Feb): 65-71.

Christensen, C. M. (1997). The Innovator's Dilemma: When New Technologies Cause Great Frims to Fail. Boston, Harvard Business School Press.

Corts, K. S. (2000). "Focused Firms and the Incentive to Innovate." Journal of Economics & Management Strategy **9**(3): 339-362.

Crown, J. and G. Coleman (1996). No Hands: The Rise and Fall of the Schwinn Bicycle Company. New York, Henry Holt and Company, Inc.

Cunha, R. C. e. (2002). Privatization and Outsourcing. The New World of Work. R. J. Burke and C. L. Cooper. Padstow, Blackwell Publishers Ltd.: 18.

Damore, K. (1993). HP to Design Its Own Laser Engines. InfoWorld. **15:** 24.

Dearden, J. A. and D. E. Klotz (2002). "Contracting, Gatekeepers, and Unverifiable Performance." RAND Journal of Economics **33**(4): 723-741.

Doig, S. J., R. C. Ritter, et al. (2001). "Has outsourcing gone too far?" The McKinsey Quarterly(4): 25-37.

Domberger, S. (1998). The Contracting Organization: A Strategic Guide to Outsourcing. Oxford, Oxford University Press.

Dougherty, D. (1995). "Managing Your Core Incompetencies for Corporate Venturing." Entrepreneurship: Theory & Practice **19**(3): 113-135.

Dougherty, D. (2001). "Reimagining the Differentiation and Integration of Work for Sustained Product Innovation." Organization Science **12**(5): 612-631.

Dougherty, D., L. Borrelli, et al. (2000). "Systems of Organizational Sensemaking for Sustained Product Innovation." Journal of Engineering and Technology Management **17**: 321-355.

Edmondson, A., R. Bohmer, et al. (2001). "Speeding Up Team Learning." Harvard Business Review **79**(9): 125-132.

Feenstra, R. C. (1998). "Integration of Trade and Disintegration of Production in the Global Economy." The Jornal of Economic Perspectives **12**(4): 31-50.

Fine, C. H. (1998). Clockspeed. Reading, Massachusetts, Perseus Books.

Fine, C. H. and D. E. Whitney (1996). Is the Make-Buy Decision Process a Core Competence? Cambridge, MIT: 31.

Gomory, R. (1997). The Technology-Product Relationship: Early and Late Stages. Managing Strategic Innovation and Change. M. L. Tushman and P. Anderson. New York, Oxford University Press: 121-128.

Grant, P. L. (2000). Outsourced Knowledge: Knowledge Transfer and Strategic Implications from Design Outsourcing. Sloan School of Management. Boston, Massachusetts Institute of Technology: 108.

Greenhalgh, L. (2001). Managing Strategic Relationships. New York, The Free Press.

Hamel, G., Y. L. Doz, et al. (1989). "Collaborate with Your Competitors and Win." Harvard Business Review **67**(1): 133-139.

Handfield, R. B., G. L. Ragatz, et al. (1999). "Involving Suppliers in New Product Development." California Management Review **42**(1): 59-82.

Handy, C. (1995). "Trust and the Virtual Organization." Harvard Business Review **73**(3): 40 - 50.

Henn, G. (2002). "lecture on Architecture Development in Architecting the Knowledge Company course at MIT Sloan."

Hoegl, M. and H. G. Gemuenden (2001). "Teamwork Quality and the Success of Innovative Projects: A Theoretical Concept and Empirical Evidence." Organization Science **12**(4): 435-449.

Iansiti, M. and J. West (1997). "Technology Integration: Turning Great Research into Great Products." Harvard Business Review **75**(3): 69-79.

Isaacs, W. (1999). Dialogue and the Art of Thinking Together: A Pioneering Approach to Communicating in Business and in Life. New York, Currency.

Johnson, A. L. (2003). "Industrial Research Institute's R&D Trends Forecast for 2003." Research Technology Management **46**(17): 17-22.

Jones, R. W. and H. Kierzkowski (2001). A Framework for Fragmentation. Fragmentation: new production patterns in the world economy. S. W. Arndt and H. Kierzkowski. New York, Oxford University Press Inc.: 17-35.

Kakabadse, A. and N. Kakabadse (2002). Smart Sourcing: international best practice. Chippenham, Palgrave.

Kaku, R. (1997). "The Path of Kyosei." Harvard Business Review: 55-63.

Kandemir, D., P. N. Ghauri, et al. (2002). The Strategic Role of Organizational Learning in Relationship Quality in Strategic Alliances. Cooperative Strategies and Alliances. F. J. Contractor and P. Lorange. Amsterdam, Elsevier Science: 799-828.

Kanter, R. M. (1994). "Collaborative Advantage: Succesful Partnerships Mangage the Relationship Not Just the Deal." Harvard Business Review **72**(4): 96-108.

Katz, R. (1997). Organizational Socialization and the Reduction of Uncertainty. The Human Side of Managing Technological Innovation. R. Katz. New York, Oxford University Press: 25-38.

Klepper, R. and W. O. Jones (1998). Outsourcing Information Technology, Systems & Services. Upper Saddle River, NJ, Prentice Hall.

Kotabe, M. (1992). Global Sourcing Strategy. New York, Quorum Books.

Kotabe, M., X. Martin, et al. (2003). "Gaining From Vertical Partnerships: Knowledge Transfer, Relationship Duration, and Supplier Performance Improvement in the U.S. and Japanese Automotive Industries." Strategic Management Journal **24**: 293-316.

Langfield-Smith, K. and M. R. Greenwood (1998). "Developing Co-Operative Buyer-Supplier Relationships: A Case Study of Toyota." Journal of Management Studies **35**(3): 331-353.

Leach, M. E., T. Pureetip, et al. (2001). "Contract Engineering Back in Style." Computer-Aided Engineering **20**(7): 38-40.

Leonard, D. (1995). Wellsprings of Knowledge. Boston, Massachusetts, Harvard Business School Press.

Magaziner, I. C. and M. Patinkin (1989). "Fast Heat: How Korea Won the Microwave War." Harvard Business Review **67**(1): 83 - 94.

Malone, T. C. (1997). "Is Empowerment Just a Fad? Control, Decision Making, and IT." Sloan Management Review **38**(2): 23-35.

Mascarenhas, B., A. Baveja, et al. (1998). "Dynamics of Core Competencies in Leading Multinational Companies." California Management Review **40**(4): 117-132.

Maznevski, M. L. and K. M. Chudoba (2000). "Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness." Organization Science **11**(5): 473-492.

Meyer, M. H., P. Tertzakian, et al. (1997). "Metrics for Managing Research and Development in the Context of the Product Family." Management Science **43**(1): 88-111.

Millson, M. R. and S. P. Raj (1996). "Strategic Partnering for Developing New Products." Research Technology Management **39**(3).

Montoya-Weiss, M. M., A. P. Massey, et al. (2001). "Getting It Together: Temporal Coordination and Conflict Management in Global Virtual Teams." Academy of Management Journal **44**(6): 1251-1262.

Parkhe, A. (1998). "Building Trust in International Alliances." Journal of World Business **33**(4): 417-437.

Patterson, M. L. (1993). "Lessons from the Assembly Line." Journal of Business Strategy **14**(3): 42-46.

Potter, R. E. and P. A. Balthazard (2002). "Understanding Human Interaction and Performance in the Virtual Team." Journal of Information Technology Theory and Application **4**(1): 1-23.

Prahalad, C. K. and G. Hamel (1990). "The Core Competence of the Corporation." Harvard Business Review **68**(3): 79-91.

Price, V. C. (2001). Some Causes and Consequences of Fragmentation. Fragmentation: new production patterns in the world economy. S. w. Arndt and H. Kierzkowski. New York, Oxford University Press**:** 20.

Quinn, J. B. (1999). "Strategic Outsourcing: Leveraging Knowledge Capabilities." Sloan Management Review **40**(4): 9-21.

Reed, R. and D. J. Lemak (1996). "Beyond Process: TQM Content and Firm Performance." Academy of Management Review **21**(1): 173-203.

Rumelt, R. (1974). Strategy, Structure, and Economic Performance. Boston, Harvard Business School Press.

Savas, S., S. Dwivedi, et al. (2002). Industry Primer: Technology: Hardware - Electronics Manufacturing Services (EMS). New York, Goldman Sachs**:** 39.

Serant, C. (2002). Weak Economy Proves a Drag on OEM Outsourcing Trend. EBN**:** 3.

Sobrero, M. and E. B. Roberts (2001). "The Trade-off Between Efficiency and Learning in Interorganizational Relationships for Product Development." Management Science **47**(4): 493-511.

staff (2002). Outsourcing in Times of Change. R&D Magazine. **44:** A29-A31.

staff (2002). "Special Report: 2002 Market Profile." Appliance Manufacturer **40**(4): 1-5.

Sterman, J. (2000). Business Dynamics: systems thinking and modeling for a complex world. Boston, Irwin/McGraw-Hill.

Tan, B. C. Y., K.-K. Wei, et al. (2000). "A Dialogue Technigue to Enhance Electronic Communication in Virtual Teams." IEEE Transactions on Professional Communication **43**(2): 153-165.

Tarasewich, P. (1996). "Design for Success." Industrial Management **38**(2): 28-32.

Tyre, M. J. and E. v. Hippel (1997). "The Situated Nature of Adaptive Learning in Organizations." Organization Science **8**(1): 71-83.

Ulrich, K. T. and S. Pearson (1998). "Assessing the Importance of Design Through Product Archaeology." Management Science **44**(3).

Utterback, J. M. (2002). lecture from Research Themes in Management at MIT Sloan.

van Engelen, J. M. L., D. J. Kiewiet, et al. (2001). "Improving Performance of Product Development Teams Through Managing Polarity." International Studies of Management and Organizations **31**(1): 46-63.

von Hippel, E. (1990). "Task Partitioning: An Innovation Process Variable." Research Policy(19): 407-418.

Wang, P., K. Singh, et al. (2001). "Determinants and Outcomes of Knowledge Transfer: A Study of MNCs in China." Academy of Management Proceedings.

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