A framework for sourcing product development services

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Introduction

Purchases of outside goods and services have always played an important role in the corporate cost structure, reaching as high as 80 percent or more of the total cost of goods sold in some industries (Anderson and Katz, 1998). In today’s global marketplace, customers have become more sophisticated and the intensity of competition has increased. As a result, product life cycles have been reduced, while product complexity has increased. This has driven new product developers to deliver more products at faster rates than ever before. Yet, even today’s most agile firms rarely have all the skills and capabilities necessary to realize these sophisticated products. When firms enter joint development or long term arrangements with other firms to acquire some necessary aspects of product development, this is referred to as building an extended enterprise (Jagdev and Browne, 1998; Dyer, 2000).

Knowledge regarding how to build the extended enterprise is still in its infancy. Up until the mid-1990s, procurement professionals carried out most outsourcing decisions. Traditionally, procurement had been treated as a lower level operating function that had little to do with overall competitive strategy; its core role was to support the production and operation activities with an uninterrupted flow of materials and services (Watts and Kim, 1995). At the same time, most of the buyer-supplier relationships were based on the “arms-length model”, in which a buyer and a seller tend to view each other as adversaries competing for larger shares of the resources rather than as a cooperating member of an overall supply chain (Helper and Sako, 1995). This adversarial emphasis requires that firms establish bargaining power over their counterparts, influencing the relative distribution of wealth between them.

The need to support the manufacturing function in the most efficient way and the arms-length model with suppliers bias the outsourcing decisions towards cost optimization (Laios and Moschuris, 1999). The Boston Consulting Group studied more than 100 major companies doing extensive outsourcing and concluded that most Western companies outsource primarily to save on overhead or short-term costs (The Economist, 1991). As a result, firms often fail
to take into consideration the long-term effects of outsourcing, producing a hollowing effect in several industries. As expressed by Bettis et al. (1992, p. 18):

Many managers view sourcing as a defensive, operational measure. The approach tends to be incremental and financial. Their mindset is often scorekeeping-oriented - reduce costs, improve returns or increase brand share. This view leads directly to an emphasis on a financial analysis of direct costs, overhead, working capital and returns as they stand today. What is troubling in the context of outsourcing is that managers often fail initially to see these issues as intimately connected to the ability to build and sustain a competitive advantage over a significant period of time.

Cross-functional product development teams, with explicit responsibility for making outsourcing decisions, is one way to rectify this problem and obtain more balanced participation in these decisions. While many researchers have noted the importance of achieving a more balanced participation in the outsourcing decision model, they do not go any further, failing to offer guidance as to how, when and under what circumstances these teams should be formed (Welch and Nayak, 1992).

In this paper, we reflect on the experience of three product development teams within a company called DataTek and build a framework to aid in the process of strategic sourcing[1]. We briefly describe DataTek and compare the three projects studied. We then focus on the patterns observed across these projects in terms of challenges in strategic sourcing. Building from these observations, we propose a decision-making framework that enables product development teams and managers to make informed product development sourcing decisions.

**Method**

This paper draws from the experience of three different project teams of the late 1990s. These projects were selected for several reasons beyond their experience with the extended enterprise. They varied in their size, both in terms of total investment and projected profitability. They also varied in the type of organization undertaking them and the type of work that was being outsourced.

A semi-structured interview protocol was followed with all subjects. For each project, we interviewed a cross section of each of the development teams, including the module integration manager, VP of delivery, systems integration manager, program manager (materials and engineering), procurement manager, product architect, design engineer, and manufacturing engineering manager. A total of 19 subjects were interviewed, eight in Project A, six in Project B and five in Project C. An additional seven individuals from another organization were involved with a focus group to test the framework proposed in this paper. Internal documentation was also reviewed.

Data were analyzed using what Miles and Huberman (1994) call “in case displays”. Interviews were coded into several categories (see Table I for a summary of these categories). Coded segments were then separated from the field notes and placed in a comparative matrix, in which the coded segments were categorized and placed in a matrix in order to explore how the plants differ from one another. In this matrix, a mixture of direct quotes and summary phrases were used (Yin, 1994).

**Literature**

During the last decade, scholars have been studying the question: how can managers determine strategically, rather than in a short term or ad-hoc fashion, which activities to maintain internally and which to outsource? Several authors present decision frameworks to assist in outsourcing decisions (Sislian and Satir, 2000; Fine, 1986b; Venkatesan, 1992; Nayak, 1992). Fine (1986b), for example, offers a framework that helps determine the risks associated with outsourcing. Venkatesan (1992) argues that companies have systematically invested in commodity parts and they have neglected developing the proprietary components that could, and must, become sources of competitive advantage. He points to the lack of effort in industry to create a list that would arrange parts in a hierarchy according to their strategic importance. The price of such oversight is costly: an eroding capability to design and manufacture components that are critical to the product and hard to make. In response to the problem, Venkatesan provides a complete
flow diagram that focuses on the subsystem level, rather than part level, in order to help decision makers in the process of defining what to make and what to buy. Welch and Nayak (1992) also propose a framework that considers several dimensions of the process technology. The focus of this framework is three different factors: first, the process technology role in providing a competitive advantage, second the maturity of the process technologies under consideration, and third, the competitors’ process technology positions. Based on these three dimensions, they developed a matrix to facilitate the decision process.

While these and other existing models remark on the importance of achieving more balanced participation in the outsourcing decision model, they do not go any further, failing to offer guidance as to how, when, and under what circumstances these teams should be formed. It is important to analyze the need of the participation coming from every area and to provide some guidelines that may relate some aspects of the product/industry characteristics with the weighting of who should drive the decision. It is also important to note that most of the literature has been based on analyzing the make versus buy problem from a manufacturing perspective (Jagdev and Browne, 1998). One of the objectives of our present work is to consider answers to the same question but in a product development environment, and offer a framework that can help product development practitioners make these difficult decisions.
Experiences with the extended enterprise at DataTek

DataTek is a diversified multinational computer manufacturer. Historically, its structure was vertically integrated, and it maintained a reputation for developing innovative and cutting edge technologies. DataTek was not known, however, for getting products to market rapidly. In the 1990s, business processes reengineering required DataTek implement a rapid market entry (RME) process throughout the company. In a matter of a few short years, DataTek was able to shorten the time it took to deliver variant products to benchmark levels. A sense of urgency was evident in all product development teams and product managers were not willing to make investments with long payback periods without senior management support from the highest levels. The extended enterprise model was viewed as a means to shorten product development cycle time, and was undertaken in a number of product areas. This study looks at the experience of three product development teams in DataTek.

Case comparisons

**Project A**

Initiated in 1995, Project A involved developing a series of computing systems for the home professional market - DataTek's low-end market segment. In fact, the architecture of the product was developed to enable numerous, rapidly introduced variant products. DataTek decided to radically alter its product development effort on this type of product, as we will explain in subsequent sections. The biggest change from past projects was that entire subassemblies, or modules, were to be designed by external firms.

**Project B**

During this same period of the 1990s, DataTek had developed some new technologies that promised to open up new markets in enterprise computing, where entire businesses were controlled by a single computing solution. Numerous vendors of hardware and software in an immature industry had left customers trying to build their own systems. Enterprise computing was fairly expensive and offered little flexibility. DataTek's latest concept could open new markets with this new technology, paving the way for growing its revenue stream provided by numerous software add-ons and service. Project B was born. The problem for Project B was that it required an extremely large investment in development and engineering. DataTek had a strategic desire to enter a business and was faced with operational realities typical of the times. It needed help in developing this breakthrough product, but it lacked the resources to do it all internally. The team looked toward the extended enterprise model, in which suppliers would develop some portion of the product.

**Project C**

The third project was housed in a subsidiary of DataTek that designs and manufactures solutions based on scanners. Around 1997, using an OEM scanner and a proprietary printer, this organization developed a specific application scanning/printing product. By the end of 1998, they were looking to develop a new scanner that would replace the OEM scanner using its own technology. Together with the development of the new scanner, several areas of improvement were identified, many of them dependent on the interaction between the response of the scanner and the image processing power existing in the processing unit. Since the project team did not have the internal capability to develop the image-processing path at the time of Project C's development planning, it decided to outsource this capability from an external entity.

Table I compares the new product development projects. Even though the projects varied, four broad themes emerged that were common to all three cases. These common issues were:

**Theme 1: teams did not seek balanced participation in outsourcing decisions**

Decisions about which elements would be outsourced were left mostly to the technical community. This presented a problem because technical communities were only sensitive to a limited set of issues. For example, in one project, the technical staff did not understand the customer value associated with a trivial technology and, therefore, was willing to outsource it readily. While this appeared to them as a good tactical decision, it was a strategic mistake that may not have been made if outsourcing decisions were
made with the input of both marketing and supply chain managers. In the one project where more disciplines were involved, the team, for the most part, achieved better results. This suggests that having a multidisciplined team involved in the partner selection process is an important, yet overlooked, aspect of making outsourcing decisions.

**Theme 2: teams did not take a strategic approach to making outsourcing decisions**

For the most part, product development teams engaged in outsourcing activities with the primary goal of trying to achieve reduction in total spending on new product development. All three teams were engaged with major business initiatives to improve operational effectiveness. Reduction in time to market, improved worker productivity, or a combination of the two was common to all three projects, and outsourcing certain engineering functions was recognized as one way to achieve these operational goals. This proved to be an important contextual issue in the cases, as strategic issues of knowledge and long-term competence took a back seat to these more short-term concerns. Lack of strategic planning was also reflected in the organization of the partner selection process, which was mostly *ad hoc*. The ad hoc selection process led to unplanned investments in building capabilities in the suppliers, as teams did not have objective ways to measure capabilities of partners.

**Theme 3: project teams had difficulty achieving a balance between flexibility and control**

There is a delicate trade-off that outsourcing firms must achieve between flexibility and control, which tend to have an inverse relationship to one another (Quinn and Hilmer, 1994). In a changing technological environment, outsourcing firms need to be flexible enough with their supplier relationships so that they can easily move from one desirable source of innovation to another. On the other hand, the more they depend on suppliers for key technologies, the less control they have over these technologies, in turn affecting long term profitability. This trade-off was often not even recognized, let alone managed proactively, by the product teams. In one of the projects, for example, a decision to outsource a strategically important technology led to a loss of control over the development of that technology; a competitor was then able to acquire knowledge about this important technology.

**Theme 4: team members lacked skills for relationship and knowledge management**

One of the key strategic issues in outsourcing decisions is the degree to which knowledge should be maintained in-house as more activities are outsourced. Within all three projects, there was a lack of understanding regarding how much knowledge in non-core areas needed to be retained within the project team, and a lack of mechanisms to exchange and retain knowledge. A consistent understanding of the knowledge required is necessary and that knowledge, even in non-core areas, should be maintained at some level to prevent market failure and enable future product development. For example, ownership of intellectual property created as a result of the outsourced relationship was an issue in all three projects, and there were no formal mechanisms set up ahead of time to deal with these sorts of issues.

In addition, individuals in the engineering community, who have the technical capabilities, but little training in relationship management, were the main people to establish relationships with suppliers. Overall, managers recognized that to manage knowledge, longer-term relationships with partners require mechanisms that are more sophisticated than those used for more transactional, arms-length relationships, but struggled to develop these relationships. In one of the projects, this lack of relationship skills led to morale problems. As technical professionals were being asked to migrate technical knowledge to outside firms, they were also being asked to help manage the relationship with the extended enterprise partner. This has created a sense of frustration for some technical professionals who were no longer able to exercise their technical skills, and did not have the necessary skill to manage these relationships. In addition, the lack of formalized working agreements and role definition led to finger pointing and damaged relationships. Given the significance of what is at stake for the firms involved, their varying capabilities and the range of relationships possible, some
formal mechanism to clarify roles and responsibilities was necessary.

**Decision framework**

With a focus on addressing these four themes, we developed a framework for firms outsourcing product development services. Based on requirements gathered from potential users of this framework, three guiding principles have been used as the basis for the design of the decision-making framework. First, an inter-disciplinary team with a strategic focus should be formed. Second, the decision framework should have enough structure to guide the sourcing decision process, but flexible enough to promote challenging thinking and deep analysis. Third, the process should be easy to use and remember, thus key elements of the decision-making framework will be graphical.

As seen in Figure 1, we present a decision-making framework for sourcing product development services with four steps. In this section, we will develop each in turn.

**Step 1. Assemble the expertise**

As we saw in the cases, engineering often has the most control and responsibility for the product development process, and therefore feels compelled and capable of making product development sourcing decisions unilaterally. Unfortunately, without involvement of the proper expertise during the selection process, many important aspects of supplier selection and relationship management are missed. These omissions in supplier selection can lead to project delays, cost overruns, unreliable supply chains and even place long-term competitive advantage at risk. Therefore, an important part of this decision-making framework describes who should be involved in partner selection and their roles in the selection process.

An effective decision-making process for sourcing elements of new product development requires multidimensional expert participation from three key knowledge areas. Box 1 in Figure 1 represents the first piece of our graphical framework. The triangle represents the strategic knowledge necessary to make effective strategic sourcing decisions: business knowledge, architectural

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**Figure 1 The strategic sourcing framework**

![Diagram](image-url)

**Source:** Quinn & Hilmer (1994)
design knowledge and supply chain knowledge

With regard to market and business model knowledge, by understanding which product features and functions are highly valued by customers, the firm can decide which design elements provide the greatest competitive advantage. Product architecture and design knowledge is the second discipline needed to make effective sourcing decisions. The level of architectural modularity, for example, is a key consideration in the decision-making process. Product architecture that is highly modular with clearly defined interfaces between modules is better suited for outsourcing (Fine, 1998a), since each module can be designed with some level of independence. For highly integrated architectures, however, product developers concern themselves more with component attributes than module attributes in these circumstances. In this fashion, technological maturity influences product architecture and is an important consideration in determining sources of supply. Finally, supply chain knowledge brings experience on managing partner relationships, capability assessment, and market efficiency. Bringing the procurement professionals into the process increases the probabilities of successful partner selection (Krause, et al, 2001).

**Step 2. Analyze strategic position**

During the initial stages of development, customer requirements, product features and functions and the basis of competition, are translated into development activities required to design, produce and deliver the product to the customer. To begin the process of determining whether to perform a product development activity inside or outside, the firm must assess its capability to perform the activity internally and the level of competitive advantage this activity contributes to the product being developed. Capability covers the dimensions of capacity, economic competitiveness and quality of performance. The degree of competitive advantage in a product development activity generally depends on the ability of the activity to differentiate the product and its scarcity, which will determine whether that activity will be a source of profit (Collis and Montgomery, 1998). Analysis of the strategic importance is often overlooked, but is a critical initial step (Sislian and Satir, 2000; Prahalad and Hamel, 1990; Quinn and Hilmer, 1994; Venkatesan, 1992).

To assist teams in this task, the matrix found in box 2 in Figure 1 plots competitive advantage content versus internal capability. If the capability and competitive advantage assessments place the user in the lower left or upper right quadrant of this matrix if the firm has high capability for an activity and that activity contains a high level of competitive advantage, then the firm should perform the activity internally. Alternatively, if the firm's capability is low and the level of competitive advantage for the activity is also low, then the activity should be outsourced.

It is the upper left and lower right quadrants of this matrix, however, that are typical of the conditions for the employment of the extended enterprise model. Therefore, these quadrants will be the primary focus of the following discussion. Let us start with the upper left quadrant labeled “Extended enterprise with knowledge inflow”. What is the course of action if a design activity or element contains a high level of competitive advantage and the firm has little or no capability? Venkatesan (1992) suggests that this case can be considered “spilled milk”, and he recommends outsourcing the activity, if the firm could not afford to become best in class. The danger in this is that this new and desirable capability could be essential to the survival of the firm. An alternative approach would be to consider the various possibilities of creating internal capability. The firm could develop the capability internally through training and hiring if sufficient development time exists. If there is insufficient time to develop this capability internally, this will require partnering with a supplier and designing a development plan to increase internal capability. A joint development or long term contract is the type of extended enterprise arrangement that can result in knowledge inflow.

If the firm sits in the lower right quadrant, “Extended enterprise with knowledge outflow,” it has a high capability but the design activity delivers little competitive advantage. Generally, if the activity contains a low level of competitive advantage, a financial make versus buy analysis will be performed to determine the most economical source. But, financial analysis may not tell the whole story. For example, the make vs buy decision assumes that the marketplace for this
outsourced service is efficient. That is, the supplier will not take advantage of his position by limiting supply and hence raising the price. If the skill being outsourced is limited to a few suppliers around the globe, for example, it is possible that the supplier could become a new competitor. Alternatively, a firm may decide to maintain control over some activities in order to prevent knowledge from leaking to a competitor (Morin, 1999).

Step 3. Identify appropriate arrangement
Traditionally, sourcing decisions were simply determined by a make vs buy analysis. The results tended to be binary, either a firm performed the activity inside or it purchased the activity from the outside. The extended enterprise model attempts to find a middle ground by transforming the make versus buy question into an examination of the desired level of control over the activity being considered for outsourcing.

Quinn and Hilmer (1994) present a model (box 3 in Figure 1) relating the spectrum of sourcing relationships to different levels of control and flexibility. Generally, if the technology basis of the activity being outsourced is rapidly changing, a more flexible arrangement is desired. This highly flexible arrangement is typically a short-term contract, which offers high flexibility and low control, as shown in Figure 1. Alternatively, the more specific the requirements the firm has about form-factors, details, and materials used, for example, the less flexibility or choice is available to the firm. For elements that contain the greatest competitive advantage, a higher level of control allows the firm to extract the greatest amount of value from the product and also to develop a deep understanding of features and functions. It is very important to note that a distinct trade-off must be made at this point; obtaining high control necessitates giving up flexibility.

Firms that outsource in this manner must find the balance point between control and flexibility in Quinn and Hilmer’s flexibility and control map to ensure long-term competitiveness.

Step 4. Plan for knowledge migration
During Step 3, the firm determined the type of partnering relationship that will bring the most value to the firm. Many times, however, a firm is not prepared to enter the desired relationship, lacking either technical or relationship knowledge necessary for a successful partnership. In Step 4, a strategy is crafted to grow capabilities that are needed and aligned with the firm’s long-term goals. To assist in the development of appropriate capability, box 4 in Figure 1 holds a graphical tool that describes the relative requirements of technical knowledge and the spectrum of relationship types. These knowledge curves should only be used in a relative or qualitative sense; no research has been performed regarding the exact quantitative aspects of the curves.

Let us start with the curve representing the level of technical knowledge. Full ownership of the activity requires the highest level of technical knowledge, since all levels of the activity will be performed internally. Thus, the technical knowledge curve is highest at the "full ownership" end of the relationship spectrum. At the other end of the spectrum lies short-term contracting. Short-term contracts require the least amount of technical knowledge, as the supplying partner provides most of the value. It is important to note that the need for technical knowledge still exists even when using short term contracting. The firm must have a sufficient level of technical knowledge to communicate its technical needs and understand technological trends that may affect the firm’s competitiveness. It will also need the technical knowledge to assess deliverables from the partner and guard against market failure.

Also shown is the relationship knowledge curve, which represents the required sophistication to handle the partnership, given a spectrum of relationship types. Full ownership and short-term contracts require the least amount of relationship management skills; thus these are the low points of the relationship knowledge curve. Full ownership requires little or no partnering and short-term contracting is mostly transactional. The partnership options in the middle of the spectrum, such as joint development and long term contracting, require the greatest relationship management skills (Kanter, 1999). Thus the relationship knowledge curve is highest in the middle of the spectrum.

One situation in which this map is particularly helpful is when a firm may be exiting a technology domain given a change in the basis of competition or change in strategy. When moving towards a sourcing partnership
in the middle of the spectrum, it will require radical change in the way people work (McIvor and McHugh, 2002). Typically, the need for technical knowledge will decrease and the need for relationship knowledge will increase. These changing needs, however, are often overlooked. As seen in one of the case studies, this can create a situation that involves frustration and confusion over the role of technical professionals involved in the change process. It can also be perceived as a threat to the position and security of the technical professionals (McIvor and McHugh, 2002).

Conclusions

Increasingly savvy customers, complex products and shorter product development and life cycles impose significant challenges for product development teams and their managers. Due to these rapid changes, firms may require product development skills in entirely new areas of knowledge or need additional product development resources to accelerate time to market. For these reasons, firms are increasingly outsourcing various elements of the product development process to defend existing markets or aggressively enter new markets.

Effective strategic sourcing of product development services requires bringing together the appropriate groups of an organization, and in some cases, confronting traditionally accepted organizational boundaries within the firm. As was seen in two of three case studies, the engineering community was heavily involved in extended enterprise partner selection and relationship management, while the procurement organization was kept at arms length or was involved late in the partnership process. This limited participation creates serious gaps in the selection process, since the “partner to be” is evaluated from a narrow perspective.

Companies will be faced more and more with the challenge to correctly balance their needs for flexibility in procurement and control over knowledge when sourcing new product development services. In the end, victory in the market place will go to those who understand the long-term, strategic implications of critical subsystems and functions in their value chains. Whereas some types of relationships, such as partial ownership, offer more control over activities, others like call options provide the firm with increased flexibility. Decision makers should recognize that the balance for flexibility and control is a key aspect of the strategic decision process.

Another challenge during the implementation of an extended enterprise is changing the focus from operational to strategic considerations. In all three projects studied, we noted a tendency by project managers to concentrate on short-term needs, such as time to market and reduction of product acquisition spending. This behavior is driven by performance metrics that are operational in nature and easily measured.

The “make versus buy” dilemma points to the need for creating, divesting or repositioning knowledge. Understanding knowledge requirements is a key component of effective strategies for the future. As the three cases clearly showed, decision makers tend to focus on short-term economic questions without raising any issues regarding knowledge inflows-outflows and their relationship to long term strategic views. The effects of make versus buy decisions are important determinants in the resulting knowledge pool of companies and thus, their future success.

The framework developed in this paper was designed to help managers deal with these difficulties in outsourcing decisions. We recognize that there are limitations in the proposed framework. There are numerous political barriers to building a multi-disciplined team in firms today. Even though cross-functional teams are commonplace, product development managers do not control all the resources within these teams. Further development of this framework could address additional realities faced by product development managers, such as conflicting goals and competition for scarce resources.

Note

1 The identity of this firm has been disguised for reasons of confidentiality.

References


