MANAGING OUTSOURCING IN A JOINT DEVELOPMENT ENVIRONMENT: IMPACT ON INNOVATION AND NEW PRODUCT DEVELOPMENT PROCESS

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ABSTRACT

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A current trend growing in popularity among companies involved in high-tech product development is to outsource the development of pieces and parts of a product and then to integrate them into a final product. This is accomplished either on a build to order basis in a manufacturing plant, such as companies like Dell Computer or IBM, or through combining various software components into a final release (for example, Microsoft). This trend offers many advantages, yet brings up many problems that have yet to be acknowledged or addressed effectively from an engineering management perspective.

In this research work, issues of concern in the outsourcing process are identified and the problems and complexities involved in joint product developments and their management are discussed. Addressed first is the joint development process. Then the identified problems of joint developments are presented, discussed and extrapolated to the dilemmas and issues currently faced by engineering managers. The research also investigates the issues of promoting and protecting innovation within this unique environment.

CHAPTER 1: INTRODUCTION

In today's high-tech industry, companies obtain competitive advantage through two main approaches. One strategy is reducing costs for similar product features, providing superior product attributes, and increasing performance versus price. A second approach is through delivering the most desirable ease of use or compatibility of a new product. In attempts to reduce costs, many companies are exploring and experimenting with outsourcing so that their business models can concentrate on the companies' core competencies. Outsourcing consists of buying a component or service instead of producing or performing it internally. A type of outsourcing growing in popularity among businesses developing high-tech products is the joint venture. This is where two companies work together to develop a component, either hardware or software, which is then separately integrated by each company into their respective products and brands [8].

Outsourcing through joint developments allows companies to share the costs and risks of developing new technologies and to reap the benefits of higher production volumes. However, when joint developments are put into practice, many conflicts and issues evolve mandating engineering managers to stay abreast of emerging issues and be prepared to handle arising, unique situations. Potential issues that arise in joint developments can directly impact the cost, schedule, scope and/or limitations of the project. Many of the issues that arise in joint ventures are not inherent to traditional in-house developed products. Some of these problems relate to the innovative and sensitive nature associated with integrating new technologies and implementing new ideas (i.e.

intellectual property) and also deriving product definitions as they correspond to competitive roadmaps. In addition, the risks of implementing tradeoffs of designing a "flexible" product that meets the functional, mechanical, electrical and quality needs for both parties can be difficult for managers to gauge when considering product differentiation (i.e. the partner markets the product against yours) and maintaining consistency across product lines [10].

Research Objectives

The main objectives of this paper are to present the structure of joint high-tech product development projects and to identify the issues that engineering management faces when attempting to follow through on their plan of record, while dealing with the outside influences of a partnering company's desires. This research provides the link between theoretical advantages of outsourcing and practical industry experiences in the areas of promoting innovation and adequately managing engineering projects which utilize joint venture interdependencies. The contribution of this research is to provide feedback to educators and engineering managers at high-tech firms on the practical issues being faced in industry amongst joint development projects. Through analysis of practitioner feedback, some resolutions are proposed that can be integrated into formal development processes in order to fully benefit from the increasingly popular joint venture outsourcing model.

Although this research explores specific topics in the area of joint product developments, there are two underlying questions that are being explored. The intent of

this research is to explore these questions in order to derive meaningful conclusions and proposed resolutions to commonly encountered issues.

1. Do problems exist with relatively new joint product development business models that are exclusive of common issues with traditionally more autonomous product development business processes?

2. If unique problems exist, what are the common business functions affected on a recurring basis and do current literature and industry practitioners differ in their resolutions to these frequent issues?

CHAPTER 2: LITERATURE REVIEW

2.1 Outsourcing Basics

Outsourcing is contracting for outside help to perform a particular task, provide an ongoing operation or supply a vital service [11]. Today, this concept is seen as a strategic tool helping companies at all levels gain a competitive edge. Several of the most popular functions being outsourced are information technology services, professional human resources, supply chain management activities, and business processes such as: call center operations and customer billing. Beyond manufacturing, business process outsourcing (BPO) is gaining momentum in areas such as finance, legal support, and facilities management. Offloading these business functions allows companies to concentrate on their key business strategies [15].

Outsourcing is based on the type of service and/or finished goods it will deliver, a partial classification list with examples is shown in table 1. The list includes general services, human resources, manufacturing, licensing, and joint product developments. This research focuses on joint product developments.

Table 1. Type of Outsourcing [17]

Type of Outsourcing	Examples
General Services	Accounting, order taking, shipment processing and tracking, IT department.
Human Resources	Contract workers, temporary labor for specific tasks.
Manufacturing	Printed Circuit Boards and their assembly. Some computer chip companies outsource production, since facilities cost more than $1 Billion.
Licensing	Paying to use another company's parts (e.g. sections of software code or hardware components) versus creating them internally.
Joint Product Development	Personal computers, complex software applications, Personal Digital Assistants, networking equipment, etc.

2.2 Outsourcing Strategies

Outsourcing has matured in the past few years from a controversial practice to a mandatory business strategy for both large and small companies in many different industries. While reducing and controlling operational costs remains a top priority, improving company focus and gaining access to top-notch capabilities are strategic reasons for companies to outsource. The number and quality of outsourcing providers is growing, creating competition that reduces price and increases quality for buyers [5]. Contrary to traditional business models that emphasized autonomy, many companies faced with new global competitors on the horizon are seeking to develop a sustained competitive edge by favoring long-term alliances through cooperation, coordination and corroboration of their competitive efforts [14]. The premise of long-term alliances being mutually beneficial in outsourcing environments is supported in today's complex global

markets by two or more organizations being able to simultaneously be each other's competitor, supplier and customer. In this environment, the idea of business processes as proprietary information, which can provide competitive advantage if kept secret is passé [13].

The costs associated with new product innovation are rising steadily; the average cost of developing and introducing a new product has jumped to over $100 million. Together, these forces are pushing firms to become more efficient in new product developments by leveraging resources and reducing the costs of projects. [7]. Accessing ''external know-how'' becomes a key strategy for subsidizing or even eliminating costs, for example, through the buying or licensing of technology. In effect, strategic outsourcing of R&D expenditures allows managers to leverage their companies' intellectual, as well as physical, resources well beyond levels available with less inclusive strategies [7]. Outsourcing provides opportunities for development teams to not have to "reinvent the wheel." Due to these reasons, taking full advantage of outsourcing strategies is becoming a more critical role for engineering managers, procurement, supply chain managers and affecting many other business functions.

2.3 Standardization in Outsourced Products

When developing high-tech products, such as server computers, or purchasing computing infrastructure in which to run a business of any size, managers are faced with the decision to create or utilize systems that are either proprietary or

based on industry standard architectures, tools and applications. IDC, a company that provides global technology forecasts and insights, highlighted some of the benefits listed below in a recent white paper investigating this issue, as it relates to business computing products [3].

Corporate Benefits of Standardized Components

- Lower cost of hardware, software applications and total cost of ownership decreases the capital investment required by IT.
- Easier and quicker deployment to provide new capabilities and increased competitiveness. Permits flexible deployment of IT resources, improving IT's ability to better support business processes and functions.
- Better availability of software and hardware.
- Better price/performance. Standards drive commoditization, which in turn drives down costs, prices and profit margins (good for customers, bad for producers).
- Economies of scale in software development, training, and application rollout. No need to split development teams across multiple platforms; the need for complex software ports or integration goes away [3].
- Increased reliability due to proven (or incremental) technologies.
- Improved negotiating power with vendors. Standards drive product differentiation toward price and service and away from features and functions once basic expectations for those features and functions are met. This benefit makes buying decisions faster and simpler to make [3].

Several barriers exist for growth in the adoptions of non-standardized high-tech products among mainstream (i.e. high volume) customer bases for business-oriented technologies, such as server computers and IT infrastructures. Some are listed in table 3 below.

Table 2. Barriers for Non-Standardized High-Tech Products

Cost	Proprietary products typically outpace the performance that standardized products can provide, while maintaining a scaleable price/performance rating, but with high capital investment requirements.
Interoperability	Interoperability becomes an issue on unique designs (software applications, hardware/networking interfacing). This ends up increasing the total cost of ownership (TCO), an important metric beyond strictly hardware/software product pricing.
Availability	Broad range of software availability is hard to come by (i.e. although high-end UNIX based server computers are excellent at their design tasks, they do not have the range of potential applications as main-stream Intel based servers.).
Sole-Source Dependence	Adopting proprietary high-tech business solutions increases risk as mission-critical operations are dependent on one vendor. This risk is mitigated when adopting standards-based products.

2.4 Joint Product Developments

The main area of interest within the various types of outsourcing is that of the cross-company joint development of high-tech products. A joint development venture is an agreement between two companies to commit resources to a common project with the intent for both parties to benefit from the creation and production of the new product [2]. Joint product development is referred as JPD hereafter. A main issue of interest is to understand how JPD works, meaning the process from initial arrangement to product/service delivery and to investigate through this process, the advantages and disadvantages to the involved parties.

2.4.1 JPD Process

There are several stages in the joint development process, defined by Gonchar [4] as shown in figure 1 below. During the investigation stage, the "make, buy or jointly develop" analysis is performed where internal resources are evaluated as well as the execution of a vendor selection process. Engineering management works closely with procurement to solicit and evaluate the qualifications of vendors and to interview multiple potential vendors.

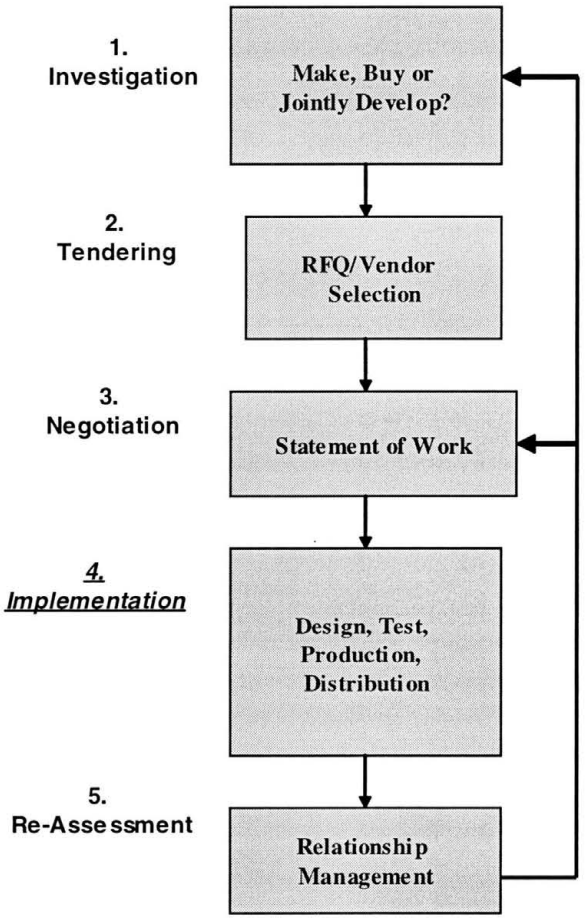

Figure 1. Joint Development Process Flow [4]

During the tendering stage, a Request for Quote (RFQ) is distributed to potential vendors describing the scope of the project, such as the schedule, high-level product definition and expectations of the vendor. Proprietary information is kept to a minimum, since no legal documents are in place yet.

The received responses are evaluated and the companies with the most engaging responses are further investigated. At this point, the negotiation stage begins, where a Statement of Work (SOW) is distributed to the top potential vendors, a.k.a. suppliers or Original Equipment Manufacturers (OEMs). The SOW more specifically expresses the expectations and deliverables for both companies in relation to the project (lower level product specifics, factory integration, supply chain, engagement model, etc.). It may be necessary to create nondisclosure agreements (NDAs) during this phase, since more intellectual property (IP) may have to be revealed. The SOW becomes the basis of the legally binding Master Purchase Agreement (MPA) for the project. Once the MPA is finalized, the implementation phase commences and the vendor may put together a preliminary design, which is then reviewed, altered and solidified as both parties implement their requirements.

The primary concern here is with the engineering management of the **implementation phase** of this process, which consists of the design, testing and production of the product or component. The final stage of the JPD is the re-assessment of the venture, which includes post-evaluation of cost, product quality and schedule milestones for the project. This is the stage where the relationship

with the venture partner is evaluated and either another project begins in the negotiation phase with the same vendor or the investigation phase begins again with potentially another vendor selection process.

During the implementation phase of JPD, many design tradeoffs are constantly made that impact the schedule, cost and product features. To minimize disagreements and avoid potential stalemates between the various designers and managers, a common practice in hardware projects is to offer bill-of-materials options and dual footprints on printed circuit boards for circuits, so that each company can populate their desired features and functions into the common board design. Chip designers can make certain logic functions active or inactive for each company through configuration registers. In addition, software designers can modularly cause different code paths to be taken depending on the application in which the program is being used. Both parties will inevitably reveal more intellectual property during the implementation phase as they integrate their respective features into the joint product.

Depending on the contractual specifics, the vendor may own the final design IP (e.g. schematics, source code, etc.), which can complicate the legalities of idea ownership and the ability to prove whether proprietary ideas that appear in competitors' products originated from the vendor.

2.4.2 Advantages of Joint Product Developments

JPDs present many challenges to all parties involved; nevertheless, a JPD presents significant advantages. Some of the advantages include:

- Minimizes overall risks and expenses for both parties, since the expenses are shared and efforts are executed in parallel.
- Allows both parties to take advantage of cross-organizational strengths [18] and utilize their core competencies.
- Increases access to technology, funding, information and experience [16].
- Lower international labor costs equate to scaled economies that facilitate good technical talent at a fraction of the domestic price.
- Leveraged procurement efforts between companies and their suppliers nourish better component pricing and ability to multi-source components.
- Reduced shipping and handling costs occur because one unit is purchased and shipped from the vendor versus many separate components assembled by the initiating company.
- Different work hours between partners in international JPD ventures means the project is always being worked on during each company's respective workday. Effectively, the project's human resources double since information sharing occurs through email, conference calls, etc.

2.4.3 Comparison of JPD & Standard In-House Developed Managerial Requirements

Engineering managers in JPDs have different responsibilities and areas of involvement than within traditional in-house projects. Some of these management functions are described in table 2.

Table 3. Comparison of JPD and Standard In-House Developed Managerial Requirements

Area	Standard Development	Joint Product Development
Product decisions are made by:	One Product Manager (internal control).	One Product Manager from each company (On-the-fly compromises are common – stalemates are damaging to the schedule).
Human Resources	Require full internal support from Design and Test teams.	Require fewer resources working with and managing the vendors' activities.
Product Design	Design for 1 set of features (e.g. mechanical, thermal, electrical, GUI).	Design for both companies' set of features, mechanicals, applications, etc. – Creates design complexity.
Testing Efforts	Test plans, methodologies, execution is internally managed.	Responsibilities, test plan reviews and methodologies are divided and executed by both companies in parallel.
Factory Integration	Traditional production control.	Integration of outside products into manufacturing process can be complex and could destroy cost savings.
Failure Analysis and Support	Internal resources provide ongoing support such as analyzing production line failures and supporting shipping products.	Potential for stop shipment increases unless vendor reps are present to analyze production failures and customer returns. Ongoing support responsibilities can be absorbed by the vendor.

2.5 Issues and Complexities with Joint Product Developments

Many of the issues that arise in JPD are not inherent to traditional in-house developed products. Some of the JPD issues and complexities relate to the innovative and sensitive nature inherent to integrating new technologies, implementing new ideas (i.e. intellectual property) and deriving product definitions as they correspond to competitive roadmaps. In addition, the risks of implementing tradeoffs involved in designing a "flexible" product that meets the functional, mechanical, electrical and quality needs for both parties can be difficult for managers to gauge when considering product differentiation (the partner assuredly markets the product against yours) and maintaining consistency across the product line. Some of the issues and complexities observed in industry are listed in Table 4 below. As many of these issues and complexities emerge, their implications to innovation and different areas of the product development process are significant. Product development is a creative act, and creativity is "inherently interruptive, unpredictable and chaotic" [18]. Thus, joint developments can experience some of the issues below.

Table 4. Common Issues in Joint Product Developments

Issue	Description
Intellectual Property Ownership	During the JPD, both sides cooperatively create *intellectual property* in the forms of patents, disclosures, trade secrets, etc. Both companies must decide upon the ownership of the IP rights before the project is started. Vendors typically deal with many customers, where maintaining idea integrity is difficult to track.
Non-Disclosure Agreements	NDAs are often a must. Innovation and progress during JPDs can be hindered by delays in communication of technical, project management and procurement information (pricing differences, coordinated schedules, shipping dates, etc.) that are crucial for managing a successful project.
Lack of Efficient Real-time Communication	Email and shared databases are often not enough to address development issues. Conference calls have many participants on one line of communication, which can bring miscommunication among parties. Dropped calls and background noise are distracting. The inability to effectively interact with drawings or diagrams that illustrate and facilitate joint/remote problem solving can be a hindrance.
Cultural Differences	Language, working hours, and different holidays need to be addressed carefully.
Customs (Import/Export) Issues	Customs, tariffs and shipping impediments often induce unexpected cost and delays into development schedules. Many high tech devices have stringent requirements that must be constantly coordinated by all parties involved to prevent avoidable hindrances.
Authority for Product Decisions	Slower decisions occur since all parties must be informed on arising issues. Total control is impossible for any one point of contact, thereby increasing schedule risk.
Project Management Uncertainties	Cost and schedule can easily get out of control when both parties rely more on each other and their suppliers. Dealing with ambiguity becomes more important.
Priority Synchronization	Task and issue prioritization differences can cause major problems for either party. Clear communication and frequent prioritized lists of action items minimize disconnects.
Confidentiality	Ensuring that the vendor does not integrate your company's ideas in other products they may sell to competitors can be challenging [6].
Legal Responsibilities	Contractual implications and their detail levels are complex. Defining what constitutes breach-of-contract is difficult. The required short time to market for high tech products can be hindered by legal ramifications.

Brainstorming / Sharing ideas	Often times, new innovations come in the form of unique ways to solve problems encountered during the implementation phase of new technology development. Not having sole IP ownership discourages creativity.
Common Interfaces	As both companies have unique requirements for the common product, agreeing on interfaces (cable mating mechanisms, chip pin definitions, modular code parameter passing, etc.) can often be difficult.
Partitioned Facilities	JPDs often have to be done in neutral facilities or in less than optimal conditions since suppliers/vendors work with competing products within their labs and offices.

CHAPTER 3: METHODOLOGY

3.1 Analysis Objectives

The quantitative and qualitative portions for this research attempt to validate the perceptions derived from literature reviews. They also compare the beliefs of current industry practitioners to the issues companies are currently facing in their joint development and outsourcing practices. The following seven topics contained in this section are explored through a survey and series of interviews with current industry managers and engineering developers who are currently involved in joint product developments. For detail on the specific areas, see the interview questions in appendix A and the survey in appendix C.

3.1.1 Growth Trend and Drivers of Outsourcing

Investigate whether high-tech companies are outsourcing more today than they were 5 years ago. If so, inquire into the specific business requirements driving this trend. This will help validate the important areas making outsourcing so attractive.

3.1.2 Standard versus Unique Products in Outsourcing

Examine how important it is for products or sub-components chosen to be outsourced to conform to industry standards. Some companies feel that to gain

competitive cost advantages, they can only outsource products comprised of industry standard components, but this topic investigates whether this is a true generalization.

3.1.3 Intellectual Property Ownership

Study the ways that companies with projects utilizing joint product developments deal with their vendors on the innovation and intellectual property issues, which inherently arise during new technology development. Evaluate whether the idea of retention versus relinquishment of IP in order to drive for standardization is being practiced in order to maintain competitive advantage in outsourcing environments. Also, find out how innovation is promoted or preserved in these environments.

3.1.4 Communication Methods

As the traditional development roles change for co-developed products, timely, clear and adequate communication is becoming increasingly more important to the success of high-tech programs. Which communication methods are companies using with their vendors (i.e. conference calls, email, etc.) and which methods are the most advantageous in JPDs?

3.1.5 Obstacles to Problem Resolution

Discover the most significant areas creating obstacles when attempting to resolve issues during co-developed projects (i.e. language, time-zone differences, etc.). Identifying the trouble areas helps both parties gain insight on areas to focus their efforts in order to increase the probability of long-term success of the strategic relationship.

3.1.6 Product Differentiation in Joint Developed Products

Among the various business functions (product integration, technical, project management, etc.), it is important to learn which ones hinder success the most often in joint development programs. If explicit areas that cause problems often on these types of programs can be identified, greater emphasis on standard practices and process flow in these areas can be made to avoid duplicating issues on subsequent programs.

3.1.7 Business Functions that Hinder Joint Development Success

Become enlightened on the marketing implications of non-exclusive outsourced products which are sold separately by the vendor to potentially compete with the initiating company's products. Determine the methods of competitive advantage and how these products are differentiated.

3.2 Data Collection

Two main sources of data collection were used to investigate the two research questions. Qualitative data was obtained through in-depth interviews with 7 individuals directly involved in the high-tech management of joint product developments for several companies in the Austin, TX area. Appendix A includes the list of interview questions that were asked to the interviewees.

Primary quantitative data was obtained through the use of a survey of individuals in the high tech industry, primarily based in the Austin, Texas area. The sample population consisted of individuals, such as technology educators and high-tech product developers and engineering managers involved in joint product developments. The survey, included in Appendix B, was devised to delve into the various areas of joint product developments, such as drivers of outsourcing trends, communication methods, IP ownership, product differentiation and obstacles in problem resolution and their relative severity.

Those surveyed had two weeks to respond from the time that they received the initiating email. Since the total survey population included individuals involved in the high-technology community, an initial email was sent out describing the purpose of the survey and included a link to a web address where the survey resided. Upon completion of the survey, respondents clicked the submit button and were forwarded to a link thanking them for their participation. The data was

automatically formatted and emailed in a format that could be collected into a spreadsheet for analysis.

The initial sample of surveys went to 60 professionals. Since the survey was electronically administered through a link to a website and respondents were encouraged to forward the invitation email to colleagues and managers that they felt could provide additional useful data, the exact number of survey recipients is unknown, therefore the response rate for this survey is approximate. A total of 29 responses were received and recorded within the two-week allocation period, yielding an estimated response rate of 48.3%. Almost half of the survey recipients completed and submitted the survey. This high rate was attributable to the survey's method of delivery (email, hyperlinks and easy buttons and drop down boxes for choices) and the relevance of the subject matter to the target population's jobs.

3.3 Data Analysis

Once all of the survey results were assimilated into a spreadsheet, Microsoft Excel™ was used to analyze the survey data. Frequency distributions and descriptive statistics were used to plot and correlate the data in order to derive meaningful trends and cross question relationships.

CHAPTER 4: RESULTS

As mentioned previously, the population of survey respondents (48.3% of the total sample) were professionals in the high tech community that have regular dealings with joint product developments. Figure 2 below shows that 27.6% of respondents were engineering managers, 51.7% were directly involved with joint developments in engineering roles, about 10% were project managers of JPDs and nearly 7% were account managers.

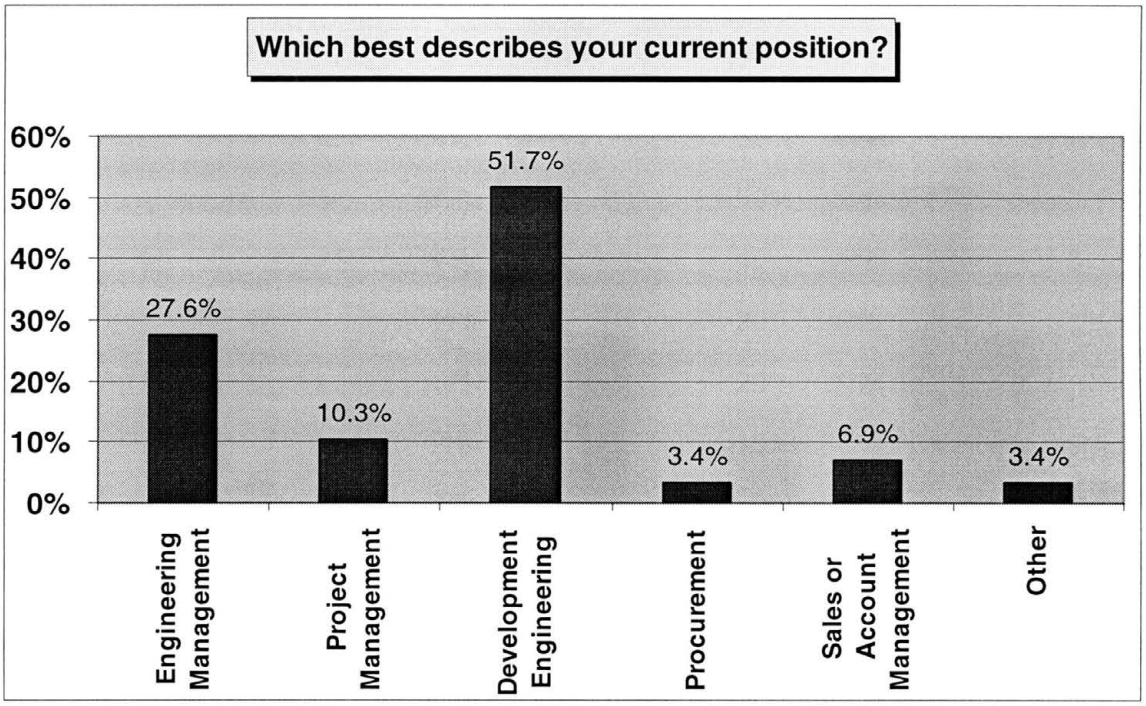

Figure 2. Survey Respondent Job Distribution

4.1 Growth Trend and Drivers of Outsourcing

The results in figure 3 help confirm that more companies are currently or are planning to outsource more than in their companies' histories [16]. An overwhelming amount of respondents, 93.1%, indicated that their companies are either outsourcing much more or at least slightly more than they were five years, with 48.5% indicating that they are outsourcing much more than they were five years ago.

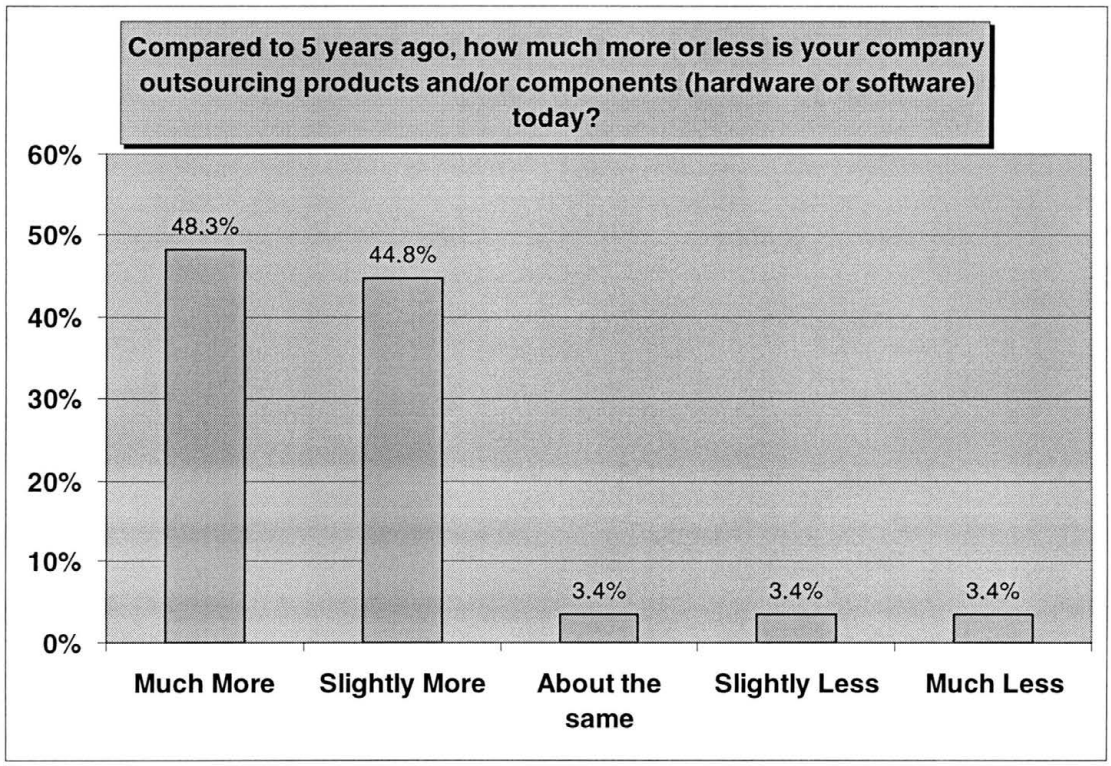

Figure 3. Five Year Outsourcing Quantity Trend

Of those whose companies are outsourcing more, Figure 4 shows the various areas that are driving this growth trend. The most important factor, at over 55%,

was labor costs or human resource staffing in research and development. The second biggest theme influencing this trend, at over 50%, was the advantage in costs of materials. Also, a significant 45% felt that consistent decreased time to market is promoting more outsourced projects. Over 25% felt that advantages in reduced overhead costs or the ability for a company to better concentrate on their core competencies are helping to drive outsourcing.

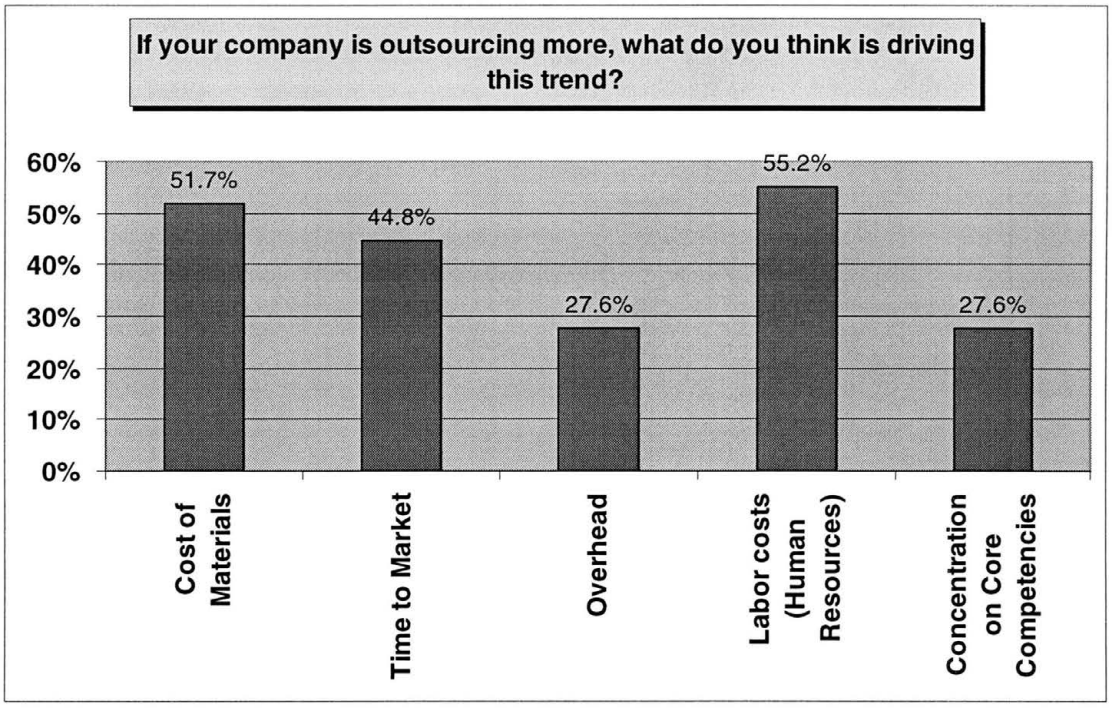

Figure 4. Drivers of Growth in Outsourcing

Given the option to comment on other drivers of outsourcing growth, some interesting comments were volunteered by respondents: {"Rare skills required to do the work in the market place that we have not been able to fill internally", "Vendor has better efficiency, and greater productivity, hence lower cost", "Shortage of qualified engineers due to cutbacks" and "Commoditization"}

4.2 Standard versus Unique Products in Outsourcing

When asked whether companies must conform to industry standard architectures or tools when considering whether to outsource a given component, 65.5% felt that it was very important (see figure 5). 13% felt that it was somewhat important and only about 7% were either neutral or did not feel that it was important. 13% could not clearly say, because the decision varied depending on the type of project being executed.

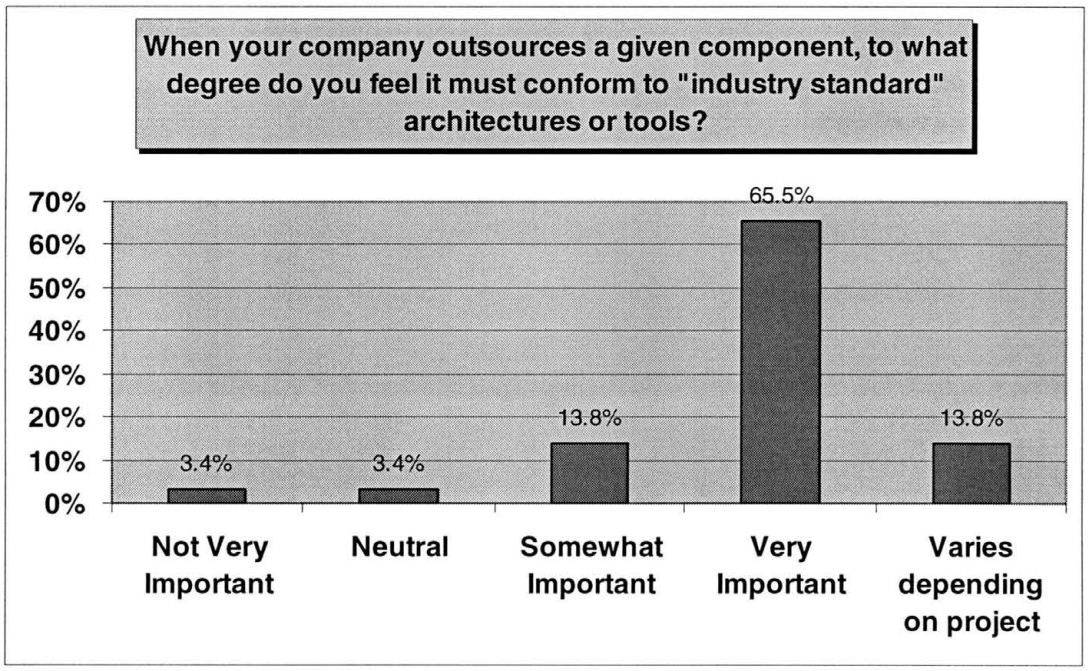

Figure 5. Standard vs. Unique Products in Outsourcing

4.3 Intellectual Property Ownership

When asked about each company's practices with respect to the ownership of intellectual property generated through joint development projects, figure 6 shows that over 40% of those surveyed though that the main host company always retained exclusive rights and the vendor/supplier retained none. 14% said that they relinquished exclusive rights of all the new IP over to the supplier in exchange for better pricing, etc. Only 3.4% felt that their company was involved in the development process or were not in a position or concerned with generating innovation in the products or components they co-developed. 44.8% felt that their company's policy for IP in JPDs was some combination of retaining total rights, relinquishing total rights or being involved only in the development process.

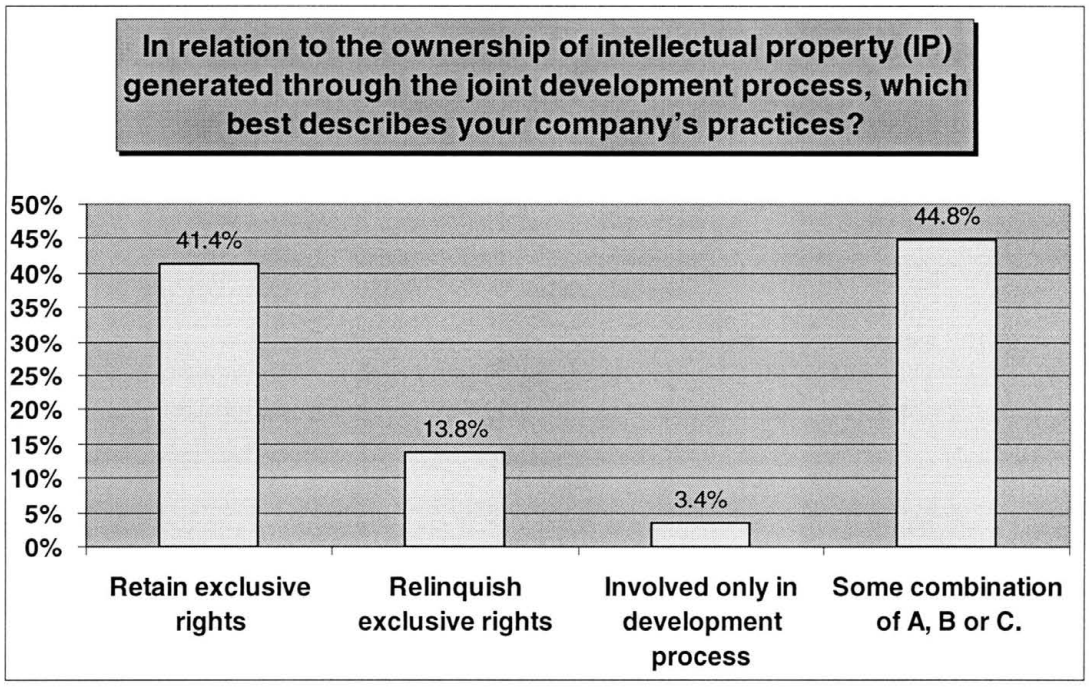

Figure 6. IP Ownership in Joint Product Developments

When evaluating the responses of those who believe joint developments must use industry standard architectures or components in order to be successful compared with their organizations' views on IP protection, 78% (65% Very Important + 13% Somewhat Important) felt that conforming to industry standards was advantageous in JPD environments. Figure 7 shows that only 13% relinquish exclusive rights of the IP generated on their projects. This is a counterintuitive result since one would normally conclude that driving toward the use of standardized components and architectures would inherently require more inter-company sharing of information. Therefore, it seems practitioners would like to obtain the cost, time-to-market and risk benefits of driving toward commoditization/standardization of new technologies while protecting the ideas behind unique implementations that help them differentiate their products in the market.

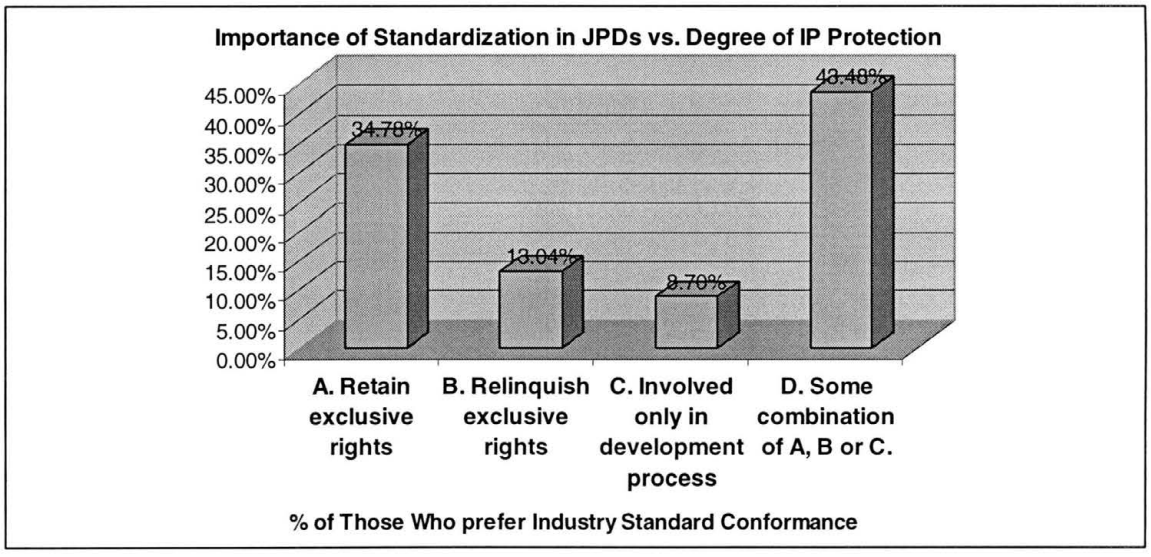

Figure 7. Comparison of Use of Standardized Components to the Degree of Practiced IP Protection

4.4 Communication Methods

The survey also evaluated the preferred or most productive methods of communication when dealing with vendors or co-developers on design and development issues. Figure 8 below shows that a significant 90% of people felt that face-to-face meetings were the most productive. 72% felt that conference calls were the next most productive method, followed by 66% choosing email. It can be observed that the most preferred communication mediums involved direct voice interaction over written mediums such as email. This is because there is no lag of information exchange or potential for misunderstandings when all parties verbally agree. Several respondents and interviewees commented that in order to clarify and disperse information that comes from verbal lines of communication, a written form of meeting minutes should be distributed to all participants and others immediately following the meeting. This will quickly dispel any misconceptions and ensure that everyone understands the results and action items.

21% of respondents use video conferencing as their primary method of communication with vendors, the least amongst the various categories. Even though it is only 21%, this quantity is assuredly much higher than in the past, mostly due to the technology advancements and dropping costs of high quality video conferencing systems. This method is preferred since it is lower cost than face-to-face meetings (potentially expensive and long travel times) and allows the meetings to be recorded. Also, participants interact differently with the advantages of a face-to-face meeting.

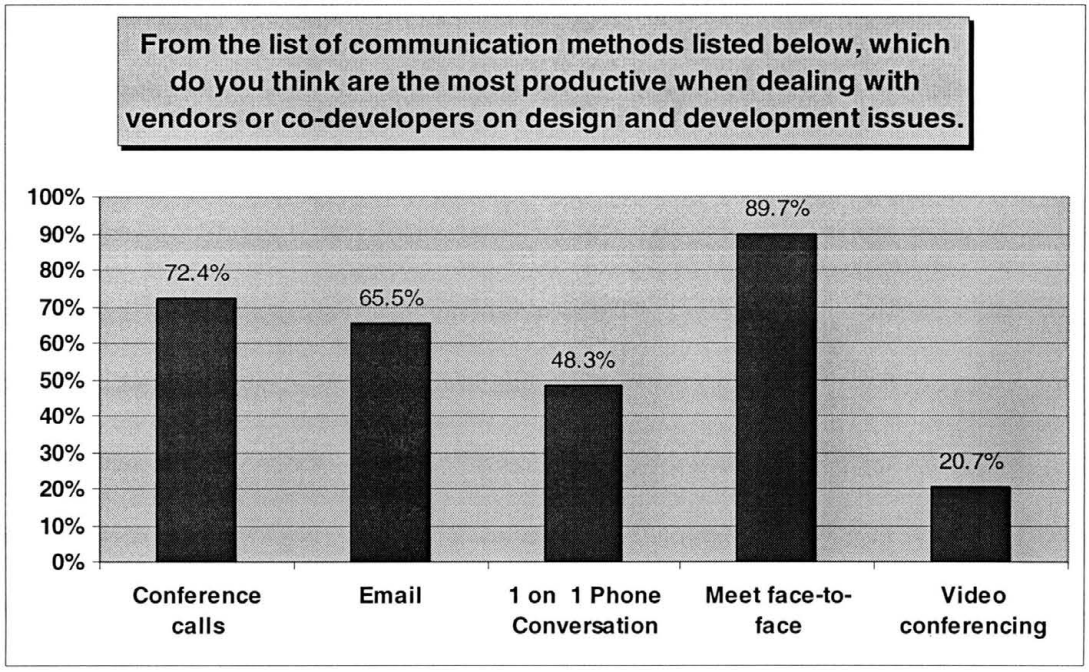

Figure 8. Productive Communication Methods

4.5 Obstacles to Problem Resolution

The survey attempted to find out the biggest obstacles that developers and managers encounter when attempting to resolve problems arising during the execution of jointly developed projects. Figure 9 below shows that over 50% of respondents thought that time zone differences were the biggest obstacle to resolving problems. When suppliers are located across the world, such as the growing trend of manufacturing moving to Taiwan, China and other Far Eastern countries, resolving issues quickly can be difficult. Direct communication methods typically occur outside of each company's normal working hours or indirect communication methods, such as email, have a one working day response time. The lag in information exchange when using direct mail can be devastating

to the project. Almost 50% of respondents felt that language (verbal or written) was an inhibitor to efficient problem resolution.

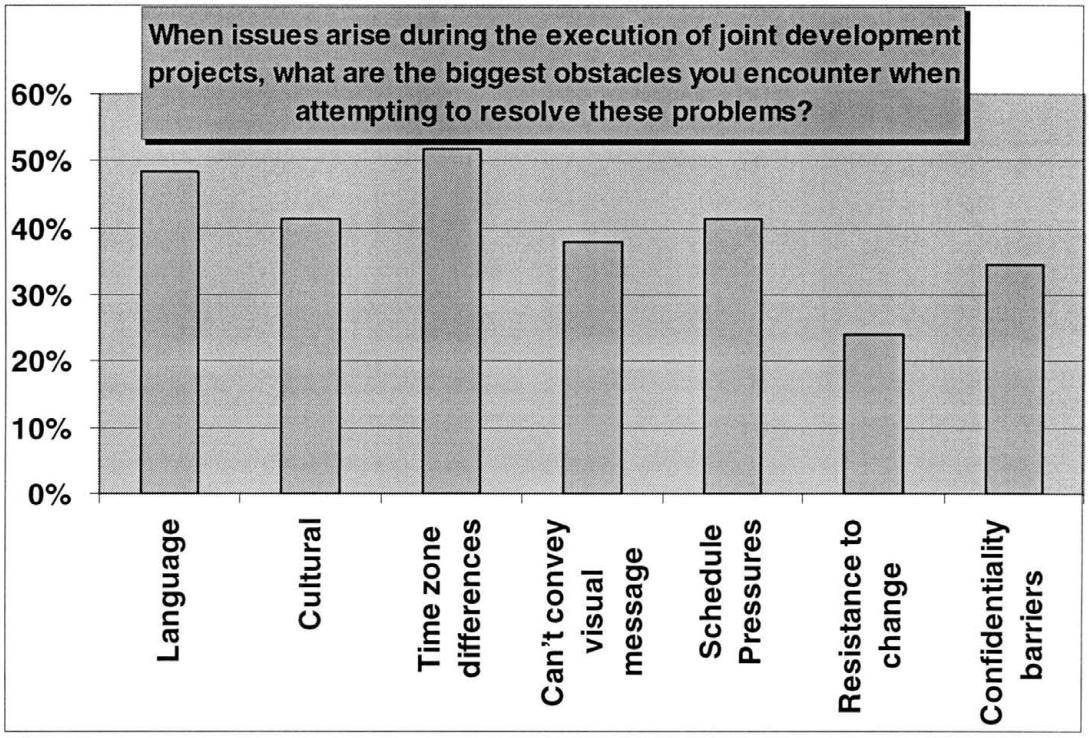

Figure 9. Obstacles to Problem Resolution

About 35% felt that confidentiality barriers (i.e. lack of free-flow of information) prevented quick problem resolution. The same percentage of respondents, about 41%, thought that cultural differences amongst the interacting parties and aggressive schedule pressures negatively impact issue resolution efforts. Only about 24% of respondents thought that resistance to change impacted their efforts. 38% felt that not being able to convey their communications through visual means was a barrier to overcoming obstacles.

Next, a potential relationship is investigated between the respondents who felt that dealing with confidentiality barriers created large obstacles for joint developments and how their organizations dealing with IP protection. 20% relinquish IP rights on their jointly developed products as seen in figure 10. This group gives up complete rights over their IP, but thinks that there are still too many confidentiality related issues. Meanwhile, 70% either are attempting to retain exclusive IP rights or at least some rights by those whose organizations used some combination of methods. This makes sense that a majority of those concerned with protecting the IP resulting from their efforts (even though the other company benefits by it residing in the shared product) felt that not revealing their information to the vendors impedes joint development success.

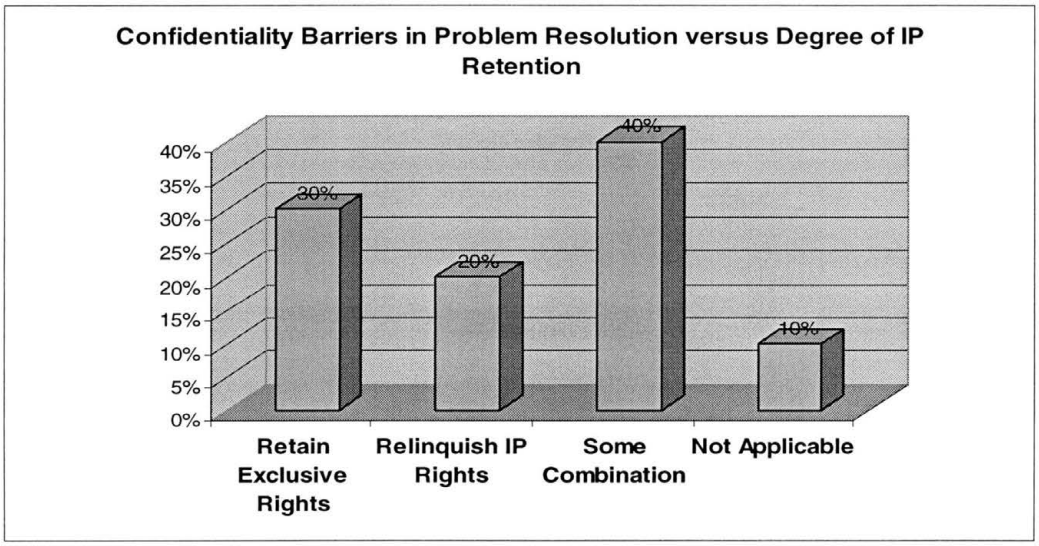

Figure 10. How People Who Think Confidentiality Barriers Impede JPD Success Deal with IP

4.6 Product Differentiation in Joint Developed Products

As seen in figure 11, 72% of those surveyed co-develop products or sub-components that are sold separately by the vendor/partner.

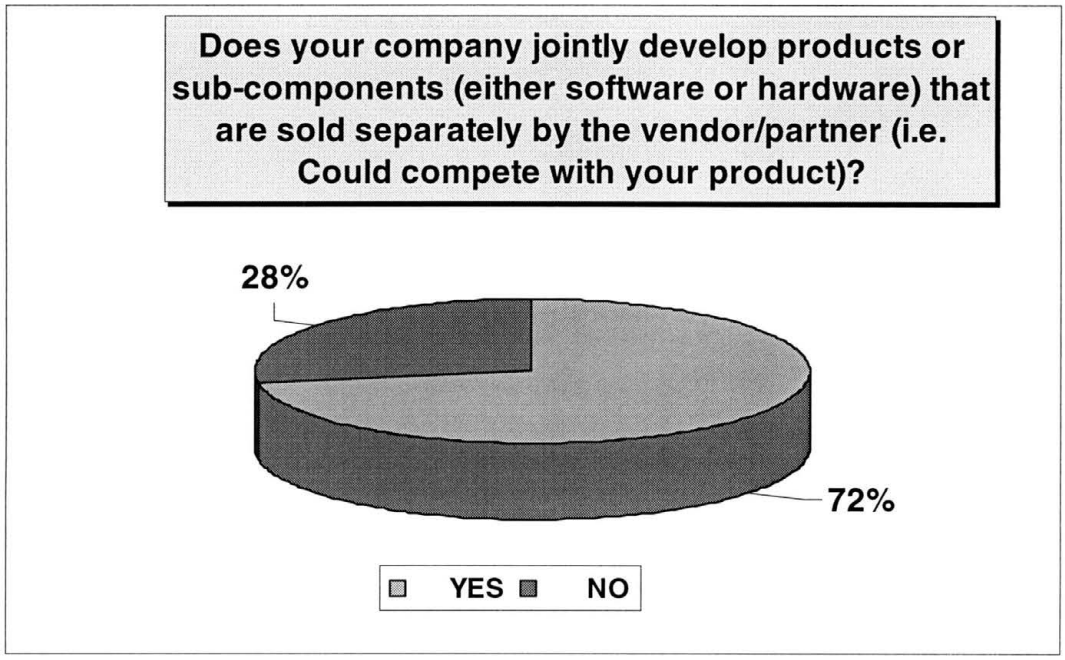

Figure 11. Level of Competition amongst Jointly Developed Products

This raises an interesting topic of how the products or sub-components are differentiated between the partnering companies under the condition that the products can be sold separately into the same markets and effectively compete against each other.

As seen in figure 12, the most used differentiating mechanisms were branding through name or aesthetics and providing better customer service at 61% and 59%, respectively. After that, offering better technical product support at 48% and adding features independent of the shared component(s) at 41% were chosen.

About 28% differentiated by offering better pricing and 24% provide added services to the base product. Some of the additional comments provided by those surveyed were: better time to market, customer relationships and having a superior supply chain for mass production and distribution.

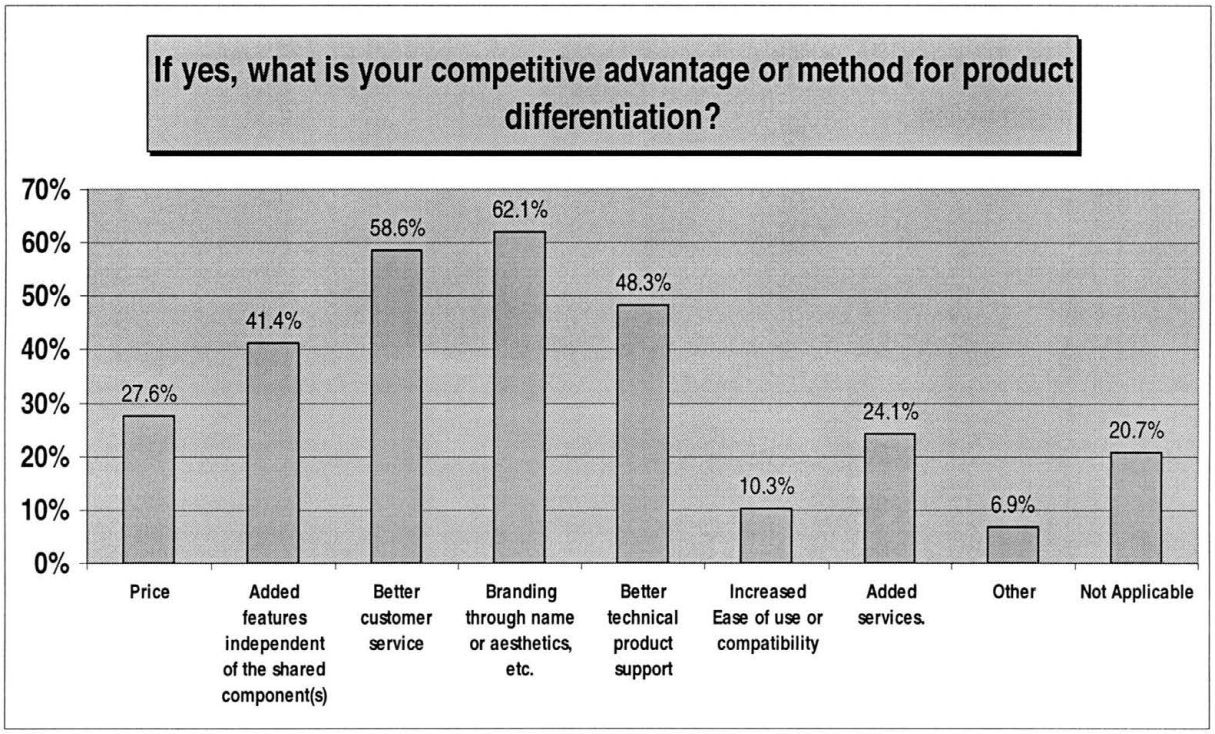

Figure 12. Product Differentiation amongst Co-Developed Products

4.7 Business Functions that Hinder Joint Development Success

A detailed question in the survey looked at various business functions, such as project management, marketing, etc. and evaluated how significant they are in obstructing the success of outsourced, high-tech projects on a habitual basis. Figure 13 shows the results. The outlying data points of the three middle columns are worth evaluating. Among the functions that continually cause the most significant problems in JPDs are: 1. Testing and product integration of the outsourced component into a final product, 2. Project management, and 3. Technical issues that arise during the project. Engineering management, marketing and meeting contractual deliverables all had less than 10% responses of being significant.

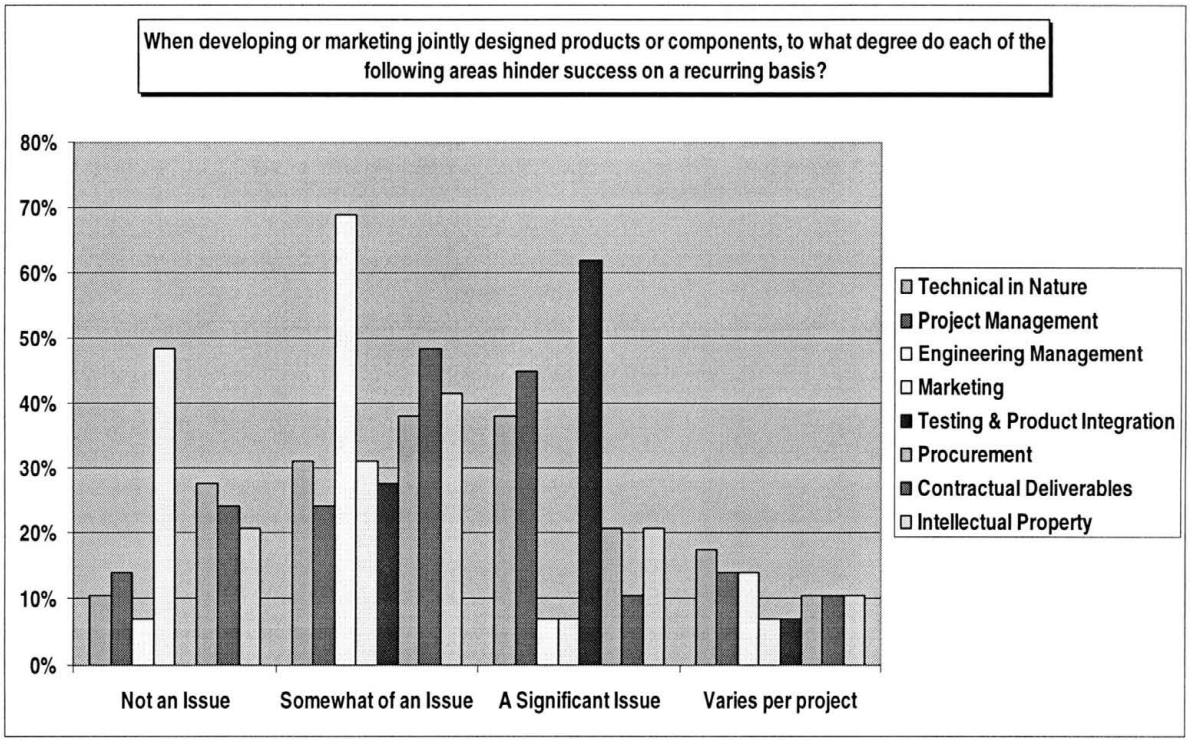

Figure 13. Severity of Recurring Hindrances for Various Joint Development Business Functions

For the category of functions that are continually "somewhat of an issue", it was surprising that about 70% of respondents chose engineering management. This contrasts the 6% that thought engineering management was either not an issue or a significant area of concern. It was equally interesting that 48% and 42% thought that getting a vendor to meet contractual deliverables and dealings with intellectual property ownership, respectively, were medium severity issues. It is also worth pointing out that 38% of respondents thought that procurement (logistics/supply chain management) was an issue in outsourcing projects more than for in-house projects.

Of the functions that were believed to be less problematic more often, marketing at 48% had the highest response rate. This is because most companies that outsource technically oriented products or especially only sub-components assume the marketing role for their products. From the other extreme, 0% of respondents thought that product integration was never an issue, thereby supporting its significance in the product development functions. Only a small percentage thought the problem areas of the various business functions fluctuate greatly per project, suggesting that many of the areas of continual concern during joint developments are consistent.

4.8 Study Limitations

Even though the survey's response rate was high, the overall population size could have been more encompassing to gain more statistical significance, although the target population included individuals in specifically chosen positions, such as engineering managers. Increasing the population size much more could have diluted the relevance of the responses by incorporating a much more diverse population of respondents from different disciplines (i.e. non high-tech, few dealings in joint developments, etc.). Also, with more resources, the quantity of interviews could have been expanded to included individuals from more high-tech companies, additional disciplines such as intellectual property lawyers and interviews with managers.

In addition, during the analysis of the survey results, it was realized that more detailed qualitative analysis could have been performed on the resulting data if some of the questions were phrased in a more continuous fashion versus multiple-choice format. Due to time constraints, analyses were limited to the reporting of results or testing for the difference in the various means.

CHAPTER 5: CONCLUSIONS

5.1 Proposed Resolutions

Through investigation into these research areas, the following lessons learned can be applied to industrial joint development projects. The proposed resolutions are examples of common fallacies that deteriorate joint development projects in high-tech industries:

- Use of primarily industry standard components greatly eases the development process and reduces schedule risk, as well as the many other advantages explicitly spelled out earlier in the standardization of outsourced products section.

- Schedule must be flexible and have room to move. However, driving the vendor to meet schedule usually requires communicating a more aggressive critical path than is absolutely necessary.

- Mandate a minimum of weekly conference calls for long-term projects with follow-up written communication detailing specific action items and responsibilities.

- Maintain all of the appropriate contact on email threads but not those without a need to know about that particular issue.

- Understand the differences in corporate culture. Vendors may have smaller teams and can react quickly, whereas the initiating company may have larger teams with more technical depth and breadth but may respond more slowly.

- Complicated multi-way relationships with partners, sub-component vendors and suppliers induce a time lag in information transfer. In other words, keeping all parties informed of only the necessary information as it pertains to the project.

- Companies in the Far East are traditionally more efficient at implementing current technologies versus emerging technologies. This is where driving toward Industry-standard components can be beneficial.

- Vendors may need to be aggressively managed with frequent conveyance of priorities. Since early beta or prototype testing is on the shoulders of both parties, reviews of all test plans and real-time results are required. This is so progress can be tracked and defects can be root-caused early. The cost of fixing design problems significantly increases as the project approaches full production.

- Use of a secure, shared web-based defect tracking system with access to only the relevant parties is recommended. This enables both organizations to track issues throughout the project. Inclusion of the issue severity assists in the active coordination of real-time testing efforts and conveyance of results.

- All relevant design and project data should be kept on a secure, backed-up server that guarantees continuous access to only the relevant parties. Since documents are electronic, the need for the strictest confidentiality must be relayed to all parties involved.

5.2 Summary

With the economies of scale between in-house/domestic development projects and joint/international projects, the advantages of the joint development path, in terms of reduced costs, time-to-market, etc. far outweigh attempts to focus resources and capital in areas that are not a company's core competency. However, identifying recurring issues and developing effective business processes that set the engagement model for JPD engineering managers will help overcome common pitfalls that hinder time-to-market and inflate development budgets.

The results of the literature and data analysis contained within this report safely confirm the first research question, on whether profound problems exist that are unique to joint developments. Many unique issues are being repeatedly encountered by joint development projects in many high-tech industries; however companies are going through self-discovery in order to adapt their business and development processes in order to increase the efficiency and effectiveness at capitalizing on the advantages of outsourcing.

Examples of identified issues are the effectiveness of various communication methods and how companies are differentiating their joint products over their vendors/partners. The growing need for real-time communication in JPD environments that require global interaction with various team members is

causing the 9-to-5 working hours a figment of the past and is creating new technology applications, such as videoconferencing, to replace the face-to-face meetings of the past. However, many critical project milestones are still desired to be handled via face-to-face meetings due to the essential nature of clear, unambiguous communication.

The quantity of high-tech projects being outsourced is increasing substantially. In addition, since more-and-more outsourced products utilize standardized components and architectures, product differentiation is being driven toward price and service and away from features and functions, once basic expectations for those features and functions are met.

With respect to the second research question on exploring the differences in current literature versus industry practitioners' views on the unique issues and resolutions that mostly affect common business functions within joint development projects, this report identifies many new issues that previous literature has not fully explored in this context. A prime example is how companies involved in joint product developments are changing their development procedures to protect their intellectual property in final products that are shared, re-branded, de-featured, etc. This must be accomplished while promoting adequate flow of information with both short and long term partners, thereby increasing the probability of sustained success and achieving the advantages that make joint product developments a good decision for both

businesses and customers. Everyone wins with the continual replenishment of cheap, reliable, rapidly deployed, relevant technologies that ride the relatively high profit margin curve, while being conducive to economies of scale, longer useful product lives before obsolescence, and most importantly for the bottom line, a low total cost of ownership.

5.3 Future Directions of Study

The results and conclusions drawn within this report are in no-way intended to be a comprehensive analysis of the structure and pitfalls of all joint development relationships. This study serves as a pilot treatment for validating whether unique JPD problems exist and identify many of the major issues. However, as a continuance of the research contained herein, further study in the following areas would be beneficial to academia, as well as businesses engaged in or considering whether to become involved with joint development projects:

- Researching further into the legal ramifications of high-tech development relationships, especially within foreign/domestic alliances, foreign IP protection practices and how the shortening high-tech product cycles are creating problems for long-term IP protection.

- Investigating the supplier/vendor side of the joint relationship versus solely from the initiating host company's perspective.

- Continue exploring the areas causing the biggest recurring issues hindering today's joint development success with the intent to establish and educate the growing "outsourcing" business community on successful common practices and frequent fallacies.

- Studying the economic impacts of the most prevalent problems that occur during joint product developments in terms of product costs, time-to-market, supply chain management and long-term strategic supplier relationships.

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APPENDIX

A. Interview Questions

Managing Outsourcing in a Joint Development Environment: Impact on Innovation and New Product Development Process

Questions and Topics:

Target Interviewees: Engineering Managers, Engineering Directors, Engineers, Project Managers, Marketers, Procurement and Educators of future high-tech leaders.

Purpose: The intent of this interview is to gain insights into your company's general practices as they relate to managing and working within joint development projects.

- Even though no individual or company names will be revealed, responses will be integrated into a publicly available report. I ASSURE YOU THAT YOU OR THE COMPANY YOU WORK FOR WILL NOT BE IDENTIDIED OR QUOTED. If you do not wish to respond to a particular question, for ANY REASON, please feel free to generalize the answer or skip the question.

Interview Questions:

- What methods of communication do you use in your Joint Product Developments (JPDs)? Email, Conference calls, videoconferencing, face-to-face meetings, etc.
  - A. Which do you prefer and why?
  - B. Ranking (pros and cons)?

- In the implementation phase of joint product developments, to what degree do you think face-to-face communication with your vendor or counterpart is important and why? How regular do face-to-face meetings occur for a given project?

- What methods or techniques do you use during joint development projects to maintain your company's intellectual property? How much emphasis is put on the protection of IP when jointly developing or outsourcing products or components?

- Being in a high tech development role, how do you promote innovation and preserve it in joint development projects? How important is this to the company?

- How is control or decision-making power determined within the joint development environment?
  - What is the basis of who has control?

- What are your biggest or recurring areas of concern that arise in an outsourced or joint project versus projects developed in-house and what tactics do your company use to handle them.

  Such as:

  - Decision control
  - Human resources or talent
  - Product design
  - Testing and/or Integration into your final product
  - Factory Integration
  - Geographic challenges
  - Confidentiality
  - Other?

- What tools or processes do you use to maintain consistent practices among various simultaneous projects? How do you maintain consistency amongst various vendors or outsourcing partners?

- Do you jointly develop products or sub-components (either Software or HW) that are sold separately by the vendor/partner? What is your competitive advantage or method for product differentiation?

- How do you validate the performance of vendors and joint partnerships?

Thank you for your time.

B. Survey Invitation Email:

To Whom It May Concern;

Managing Outsourcing & Joint Development Projects Survey

Purpose

The following is a short survey for the purpose of a **graduate thesis research project** by a **Southwest Texas State University MBA student** over current managerial issues and strategies relating to your dealings with outsourcing.

Survey Location: http://www.swt.edu/~tl59842/

Total Completion time should be less than **2 minutes**.

Your participation is a result of being identified as a professional directly or indirectly involved with outsourcing or joint developments within the Austin-area high-tech community.

The main areas of focus are on dealing with the issues that arise, how traditional processes have changed and how innovation is promoted within the growing environment of outsourcing and joint product developments.

Your participation in this survey is important to this research and your time and effort are greatly appreciated.

Please feel free to forward this email to others that you feel could provide additional insight.

Consent

Information provided will be **completely anonymous**. Specific **companies** or **individuals will not be revealed.** Final study results will be compiled into a research report presented to the SWT Graduate School and will be generally available through subsequent publication.

Survey Background

A popular and growing current trend in high-tech development is to outsource pieces and parts of a product and then to integrate them into a final product. This trend offers many advantages, yet generates new problems that have yet to be effectively addressed from an engineering management perspective. In this research work, issues of concern in the outsourcing process are identified and the problems and complexities involved in joint developments and their management is investigated.

C. Survey Webpage

Outsourcing and Joint Development Survey

This survey will be treated as anonymous and no persons' names or company's names will be disclosed.

Please answer the questions below and click submit.

1. Compared to 5 years ago, how much more or less is your company outsourcing products and/or components (hardware or software) today? (Select One)

A. Much More
B. Slightly More
C. About the same
D. Slightly Less
E. Much Less

2. If your company is outsourcing more, what do you think is driving this trend? (Check all that apply)

- ☐ **Cost of Materials**
- ☐ **Time to Market**
- ☐ **Overhead**
- ☐ **Labor costs (Human Resources)**
- ☐ **Concentration on Core Competencies**
- ☐ **Other** **Please Comment:**
- ☐ **Not Outsourcing More (Not Applicable)**

3. In general, when your company outsources a given component, to what degree do you feel it must conform to "industry standard" architectures or tools? (Select One)

A. Not Very Important
B. Neutral
C. Somewhat Important
D. Very Important
E. Varies depending on project

4. In relation to the ownership of intellectual property (IP) generated through the joint development process, which best describes your company's practices?

(Select One)

- A. Retain exclusive rights
- B. Relinquish exclusive rights for reasons such as better pricing
- C. Involved only in the development process (consultant role, no exchange of source code or detailed design information, etc.)
- D. Some combination of A, B or C.
- E. Not Applicable

5. From the list of communication methods listed below, which do you think are the most productive when dealing with vendors or co-developers on design and development issues.

(Check all that apply)

- **Conference Call**
- **Email**
- **1 on 1 Phone Conversation**
- **Face-to-face meeting**
- **Video conferencing**
- **Snail Mail**
- **Fax**

6. When issues arise during the execution of joint development projects, what are the biggest obstacles you encounter when attempting to resolve these problems?
(Check all that apply)

- **Language**
- **Cultural**
- **Time zone difference**
- **Lack of ability to visually convey message (Conference Calls, etc.)**
- **Schedule Pressure**
- **Resistance to change**
- **Confidentiality barriers preventing information exchange**
- **Other**

7. When developing or marketing jointly designed products or components, to what degree do each of the following areas hinder success on a recurring basis? (Degree of Significance)

A: Technical in nature (Design Tradeoffs, reliability, regulatory, etc.)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

B: Project Management (Schedule, cost, shipping time, etc.)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

C. Engineering Management (Decision Control, Human Resources)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

D. Marketing (Product Features, Branding, Time-to-Market, etc.)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

E. Testing and Integration into a final product.
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

F. Procurement (Supply chain continuity, Component pricing, Logistics, etc.)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

G. Legal (Contractual Deliverables)
1. Not an Issue
2. Somewhat of an Issue
5. A Significant Issue
6. Varies per project
5. Not Applicable

H. Legal (Intellectual Property)
1. Not an Issue
2. Somewhat of an Issue
3. A Significant Issue
4. Varies per project
5. Not Applicable

I. Other (COMMENT BOX)

8A. Does your company jointly develop products or sub-components (either software or hardware) that are sold separately by the vendor/partner (i.e. Could compete with your product)?

☐ Yes ☐ No

8B. **If yes, what is your competitive advantage or method for product differentiation?**
(Check all that apply).

- ☐ Price
- ☐ Added features independent of the shared component(s)
- ☐ Better customer service
- ☐ Branding through name or aesthetics, etc.
- ☐ Better technical product support
- ☐ Increased ease of use or compatibility
- ☐ Added services.
- ☐ Other Please Comment:
- ☐ Not Applicable

Which best describes your current position?

- ☐ Engineering Management
- ☐ Project Management
- ☐ Engineering/Development
- ☐ Marketing
- ☐ Procurement
- ☐ Sales or Account Management
- ☐ Other

SUBMIT

THANK YOU very much for your time and effort. Your input is very important to this educational study.

For any questions, please contact Tim Lambert at TL59842@swt.edu, or my supervising professor Dr. Cecilia Temponi at ct01@swt.edu.

VITA

Timothy Michael Lambert was born in Ft. Hood, Texas, on September 21, 1975, the son of Charles and Quinn Lambert. After graduating from Mt. Pleasant High School, Mt. Pleasant, Texas, in 1994, he attended Northeast Texas Community College and earned with honors his Associates of Science degree in 1995. He then graduated from the University of Texas at Austin in May 1998 with a Bachelor of Science in Electrical Engineering. He subsequently worked for IBM in Austin, TX, for nearly three years designing and developing RS/6000 UNIX workstations and servers, where he filed his first patent and received several technical and leadership commendations. He currently works for Dell Computer Corporation designing and developing Intel-based servers, with the intent to enter engineering management. Tim will be earning his MBA from Southwest Texas State University in May 2002.

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