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

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Topics: Innovation and new product development process; Managing complexity; Management lessons learned from technology evolution.

Abstract

A popular and growing current trend in high-tech product development is to outsource the development of pieces and parts of a product and then to integrate them into the final product. This can be done on a build to order basis in a manufacturing plant (for example, computer equipment) or through combining various software components into a final release. This trend offers many advantages, yet brings up many new problems that have yet to be acknowledged or 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 product developments and its management are discussed. We address first, the joint development process, then present and discuss the identified problems of joint developments and extrapolate them to the dilemmas and issues faced by engineering managers. We provide alternative measures through an industry scenario and investigate the issues of promoting and protecting innovation within this unique environment.

I. Introduction

In today's high-tech industry, competitive advantage on existing products is obtained by two main approaches. One approach is reducing costs for similar product features, providing superior features, and increasing performance versus price; a second approach is by delivering the most desirable ease of use or compatibility of a new product. In an attempt to reduce costs, many companies are exploring and experimenting with outsourcing so that their business models can concentrate on the company's core competencies. Outsourcing consists of buying a component or service instead of producing or performing it internally. A type of outsourcing that is growing in popularity for high-tech product developments is the joint venture, where two companies work together to develop a component, either hardware or software, that is then separately integrated by each company into their respective products and brands [7].

Outsourcing through joint developments allows companies to share the costs of development and to reap the benefits of higher production volumes. However, when joint developments are put into practice many conflicts and issues evolve and engineering managers must stay abreast and be prepared to handle the situation. 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 a joint venture are not inherent to traditional by in-house developed products. Some of these problems relate to the innovative and sensitive nature that relates to integrating new technologies and implementing new ideas (in other words, 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 (the partner markets the product against yours) and maintaining consistency across product lines [5].

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 managers are facing 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 area of promoting innovation and adequately managing engineering projects that utilize joint venture interdependencies.

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This study's contribution is to provide feedback to academicians and engineering managers at high-tech firms on the practical issues being faced in industry amongst joint development projects. This study also proposes through analysis of business scenarios some resolutions that can be integrated into the formal development processes in order to fully and continually benefit from the joint venture model of outsourcing.

II. Basics on Outsourcing

Outsourcing is contracting for outside help to perform a particular task, provide an ongoing operation or supply a vital service [7]. 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 [6].

Outsourcing has matured in the past few years from a controversial practice to a mandatory business strategy for both large and small companies. 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; this creates competition that reduces price and increases quality for buyers [3]. Since 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 development. Our research focuses on joint product developments.

Table 1. Types of Outsourcing.

Type of Outsourcing	Examples
General Services	Accounting, web hosting, order taking, shipment processing and tracking.
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.

III. Joint Product Development

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 [1]. 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.

A. JPD Process

There are several stages in the joint development process, defined by Gonchar [2] as shown in Fig. 1. 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.

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.

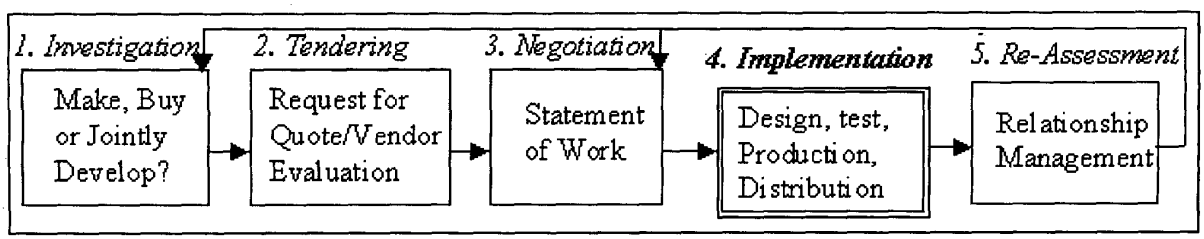

Fig. 1. Joint Development Process.

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, changed and solidified as both parties implement their requirements. We are primarily concerned 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. On the other hand, 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 came from the vendor.

A. Advantages of JPD

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

- Minimize overall risks and expenses for both parties, since the expenses are shared and efforts are executed in parallel.
- Allow both parties to take advantage of cross-organizational strengths [8] and utilize their core competencies.
- Increase access to technology, funding, information and experience [7].
- Lower international labor costs means that scaled economies facilitate good technical talent at a fraction of the domestic price.
- Leverage procurement efforts between companies and their suppliers for better component pricing and ability to multi-source.
- Reduce shipping and handling costs occurred because one unit is purchased and shipped from the vendor versus many separate components that are assembled by the initiating company.
- Work at different times between 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 and conference calls.

B. Comparison of JPD and Standard Product Development Managerial Requirements

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

Table 2. Comparison of Management Functions for JPD and Standard Product Development.

Area	Standard Development	Joint Product Development
Product decisions are made by:	One Product Manager (internal control).	A Product Manager from each company (On-the-fly compromises are common – stalemates are damaging).
Human Resources	Require full internal support from Design and Test teams.	Require fewer resources that work with and manage 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 approved between both companies.
Factory Integration	Production control is traditional.	Integrating outside products into manufacturing process can be complex and destroy cost savings.
Failure Analysis and Support	Internal resources provide ongoing support such as analyzing production line failures.	Potential for stop shipment increases unless vendor reps are present to analyze line failures. Ongoing support responsibilities can be offloaded to the vendor.

IV. 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 (in other words, Intellectual Property) and 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 (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 3. 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* [8]. It is because of this that joint developments can experience some of the issues below.

V. Lessons Learned and Proposed Resolutions

Through experience and preliminary investigation into these research areas, the following lessons learned can be applied to actual industry 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.
- 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 necessary.
- Minimum of weekly conference calls with follow-up written communication detailing specific action items and responsibilities.
- Maintaining all of the appropriate people on email threads but not those without a need to know about that particular issue.

Table 3. 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 and 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 both technical (fixes for problems with design components) 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 could bring miscommunication among parties. Dropped calls and background noise are distracting. In spite of advance teleconference software, the inability to effectively interact with drawings, and diagrams that illustrate and facilitate joint/remote problem solving can be a hindrance.
Cultural differences	Language, working hours, and different holidays need to be addresses carefully.
Customs (Export compliance)	Customs, tariffs and shipping delays 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 avoid delays.
Authority for product decisions	Slower decisions occur since all parties must discuss and be kept informed on arising issues. Total control is impossible for any one point of contact, thereby increasing 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.
Priorities	Task and issue prioritization differences between two parties can cause major problems for either party. Clear communication and frequent prioritized lists of action items minimizes disconnects.
Confidentiality	Ensuring that the vendor does not integrate your ideas in other products they may sell to competitors can be challenging [4].
Legal Responsibilities	Contractual implications and their levels of detail are complex. Defining what constitutes breach-of-contract is difficult.
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 pinouts, 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 vendors work with competing products within their labs and offices.

- Understand the differences in corporate culture (e.g. vendors may have smaller teams and can react quickly; company may have larger teams with more technical depth and breadth but may respond more slowly).
- Complicated multi-way relationships with partner, 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.
- Vendors may need to be aggressively managed with priorities that need to be conveyed often.
- Since early beta or prototype testing is on the shoulders of both parties, reviews of all test plans and real-time results are required, so that progress can be tracked and defects can be logged and root-caused early. The cost of fixing design problems increases as the project approaches full production.

- Use of a shared web-based defect tracking system that has permissions in place for access to only the relevant shared directories is recommended. This enables both parties to view the current issues for the project, along with issue severity, and actively coordinate 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 everyone involved

VI. Summary

Owing to the shear economies of scale between in-house/domestic product development projects and joint/international developments, the advantages of the joint developments path, in terms of reduced costs and time-to-market, far outweigh attempting 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 model for engineering managers of JPD projects will help to overcome common pitfalls that impede time-to-market and development budgets.

VII. Future Directions

This study on JPD is being extended to a full quantitative and qualitative research. We are investigating the current issues being faced by technical managers involved in JPD strategies. A set of interviews is being conducted with engineering project managers and product managers of high-tech companies currently participating in JPDs and the integration of outsourced components. As the data collection phase of the project progresses, results and recommendations will be forthcoming in a subsequent conference presentation and journal publication.

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