International Software Product Development for World Markets in a Software Start-up

Nazmun Nahar[1], Timo Käkölä[2], Najmul Huda[3] and P. S. Deo[4]

[1&2] Department of Computer Science and Information Systems, University of Jyväskylä, Jyväskylä, Finland
[3] Department of Information Processing, Tallinn Technical University, Tallinn, Estonia
[4] S.N. Bose National Centre for Basic Sciences, Calcutta - 98, India

Abstract

This study investigates software companies' international software development approaches for world markets. It has been conducted by a) analyzing the resource-based theory and cooperation and network theories, b) reviewing the literature in the field of international software product development for world markets, c) performing a case analysis of a software start-up company's international software product development for world markets, and d) interviewing experts and practitioners in the field of international software product development.

This study contributes both in terms of theory and practice. At the theoretical level, the study introduces a framework of international software product development for world markets. It can be used as a basis for further research. This study presents an empirical case analysis of international software product development of a start-up company, which is using innovative technologies and a holistic approach to develop software for wireless telecommunications industry. Their software product development spreads over two continents (i.e., USA and India) and targets world markets from the outset. At the practical level, the research results will help small software companies to avoid the problems and obtain benefits from international software product development. This study also suggests directions for future research.

1. Introduction

Software industry is one of the largest and fastest growing industries in the world. Software-intensive high-tech businesses are operating in a closely linked global, liberalized economy (Palvia 1997; Tersine and Harvey 1998). Software products and services market can be divided into five major industry segments (Hoch et al. **1999**):

- Professional software services (planning, building, integrating, and maintaining customized software systems for individual customers).
- Enterprise solutions (relying on both products and professional services that adapt and integrate the products for customer needs).
- Packaged mass-market software (designing and selling of software products for the public).
- Internet-based applications rented by Application Service Providers.
- Embedded software including services.

Software industry evolves rapidly and in unexpected ways. A powerful shift from customized software systems toward packaged off-the-shelf enterprise solutions has taken place. This shift has broad ramifications for the industry. It decreases the need for software engineering and increases the need for people and companies with excellent systems development and integration, change management, and social competencies. These competencies are needed to develop complex products in globally distributed partnership networks and introduce them in organizations so that

resistance and inertia can be overcome and full business benefits can be reached.

Software businesses tend to be challenging to manage. Each industry segment requires a very different business model. Moreover, businesses operating in small local markets usually have to operate in several segments in order to grow, thus requiring them to run multiple business models in parallel. For example, small enterprise solution providers may rent application services through Internet and sell standardized products, training, and consulting services so customers can integrate and adopt these products and services. Such a diversified strategy may succeed as long as a company stays in local markets, but it is a complicated and expensive model to implement, thus making the company vulnerable to attacks by larger, more focused competitors. The strategy is very unlikely to work if the company wants to target international markets to reap significant growth opportunities because competition is ferocious in foreign markets (Käkölä 2003; Nahar, Käkölä and Huda 2002a, 2002b).

Indeed, software businesses in small local markets often spread their resources too thinly. For example, they may create customized, unrelated systems simply because somebody is willing to sponsor such development projects. Success in the international markets typically requires a focused, product family-based business model: developing and marketing a holistic product family that offers a complete solution to a well-specified set of problems in a clearly specified market segment (c.f., Jacobsen et al., 2001). The gap between the professional services model and the product family-model is so wide that it is easy to fall in the middle and fail (Käkölä 2003).

Product-based businesses provide customers with the best products and target significant market shares in mass-markets. They compete by trying to launch new products faster than their competitors, innovate features markets are most willing to pay for, cannibalize their products before their competitors can do it, and move rapidly to new products and uncontested markets (Cusumano and Selby 1995). If they are successful with these competitive strategies, they can generate maximum revenue streams and optimal competitive positions. They operate within a context of rapid technological advances, short product life cycles, organizational transitions, and turbulent markets. Their environments are increasingly competitive and global. Product innovation strategy dominates all software industry segments except for the professional software services segment.

Software businesses are always located within one or more business webs (Hoch, et al. 1999). Each web is built around a common platform such as an operating system or an enterprise resource planning product. Shapers of the web are large high-tech companies that build the web by creating the platform that has a truly substantiated value proposition for the customers. They leverage the product-innovation strategy. They use R&D, complementary product or service, marketing, and implementation and maintenance partners from various parts of the world to

- close the gaps in product portfolio, R&D expertise, and distribution channels,
- focus on their key competencies,
- accelerate time-to-market, and
- increase market penetration.

In their R&D, they are increasingly leveraging outsourcing providers or joint venture partners from nations with low cost and high quality software industries to increase the speed, capacity, and flexibility of product development (Nahar, Käkölä and Huda 2002b).

Internationally distributed product development is very complex and risky. Large companies often encounter difficulties in utilizing it and for small and medium-sized companies (SMEs) failures are common primarily due to their lack of internationally and multiculturally experienced software professionals and financial resources (Nahar, Käkölä and Huda 2002b). Internet based collaborative IT tools, software engineering tools and methods, and modern software project management practices help mitigate

risks and manage the complexity. They have enabled the transformation of product development processes from the centralized, co-located form of development to a form in which global software teams collaborate across geographical, organizational, cultural, and national borders.

There is limited research covering the product-innovation strategy (Seppänen, et al. 2001). Moreover, the literature deals with product development methodologies, tools, and techniques for large companies having multiple products (Cooper, Edgett and Kleinschmidt 2001). It rarely addresses the context of small software product start-ups. We are not aware of effective frameworks to guide start-ups in developing and delivering products for global markets through international software product development.

More research in this area is needed because effective internationalization through distributed product development is essential for most small software product businesses. They need to have advanced product development capabilities, follow competitive and systematic software development processes, and develop and introduce products in the global marketplace quickly in collaboration with their customers, suppliers, and alliance partners to compete effectively and satisfy the needs of demanding customers. Large companies are also critically dependent on the complementary innovations of small companies in shaping their business webs and striving to become platform leaders (**Garver** and Cusumano 2002). After all, the webs compete with each other. The more partners there are in a web and the higher their combined product and service quality is, the more successful the web and the platform are likely to be.

In this paper, we will focus on small software product businesses and their international product development strategies and processes. The research problem of this study is how software product start-ups can reach global markets through international software product development? We provide a conceptual framework and illustrate it with an empirical study of an enterprise solutions start-up to help the businesses expand into the global markets and leverage long-term growth opportunities.

The paper proceeds as follows. A literature review is carried out in Section 2. Section 3 presents a framework for analyzing international software product development. Section 4 describes the research method applied in this study. Sections 5 and 6, respectively, analyze the case company and develop a framework for the collaborative software development processes. Finally, conclusions and directions for future research are discussed in Section 7.

2. Product Strategies, Processes, and Tools for Software Start-ups

2.1. Product strategies for start-up software firms

Software product companies are operating in a competitive and rapidly changing technological and economic environment. Plans become obsolete rapidly (Berry 2002; Brown and Eisenhardt 2002). Business and product strategy formulation and implementation are essential for the long-term growth of small companies as they serve as roadmaps in a chaotic environment and provide guidelines for the use of resources. Product strategy addresses the questions "where are we going, how will we get there, and why will we be successful" (McGrath 2000). It links the company's product development to its business strategy (McGrath, Anthony and Shapiro 1996).

Product strategy formulation and implementation is important for technology based companies (Scott 2000). Product strategy is very much linked to the success of start-ups and small companies (Berry 2002; Smith 1998; Zahra and Bogner 1999). It should be coordinated with the company's marketing and operations strategies (Krishnan and Ulrich 2001). It ensures that products are targeted to appropriate markets (McGrath 2000) and enables the making of critical product development decisions (e.g., concerning the features and release schedules) (Krishnan and Ulrich 2001; Mintzberg, Ahlstrand and Lampel 1998).

Product strategy formulation is commonly done on an ad-hoc basis (Krishnan

and Ulrich 2001). This is particularly the case in small companies (Brouthers, Andriessen and Nicolaes 1998). They lack the management and financial resources for doing strategic planning (Brouthers, Andriessen and Nicolaes 1998) and are very much involved in day-to-day urgencies. They often fail due to their problems with the software product strategy (Brouthers, Andriessen and Nicolaes 1998; Mello 2002; Smith 1998). They may also fail due to inexperience, time-to-market pressures, and unsystematic requirements management (Carlshamre et al. 2001).

2.2. Product development process and tools

To compete effectively, software product companies need to develop and execute a systematic product development process, that is, "a disciplined and defined set of tasks and steps that describe the normal means by which a company repetitively converts embryonic ideas into salable products or services" (Crawford and Benedetto 2002, p.12).

Various tools and methods such as the Stage-Gate™ (Cooper, Edgett and Kleinschmidt 2001) model are used for managing new product development. However, they may not be suitable for software development. For example, the Stage-Gate™ model does not provide specific guidelines for developing the project incrementally. Agile software development methods (Kalermo and Rissanen 2002) are better suited for small software companies but they have not yet been fully developed to explicitly target the needs of product businesses. Moreover, their support for distributed product development remains unclear.

Two categories of IT tools assist international software development: generic collaborative technology and collaborative technology to support software engineering (CT-SE) (Carmel 1999). Generic collaborative technologies include the common tools (e.g., e-mail, audio- and video-conferencing, and groupware platforms). CT-SE is a set of software development (e.g.,

software configuration management, project management, and computer aided software engineering) tools. Most start-up firms have limited financial and human resources. They cannot afford expensive tools and train developers to use the tools and associated methods. Therefore, they need to find the lightest possible set of tools that can accommodate high product and process quality requirements with reasonable costs.

2.3. International production for software start-ups

Software product companies, including start-ups, face intense competition in their domestic and foreign markets (Battin et al. 2001; Carmel 1999; Carmel and Agarwal 2001; Ebert and Neve 2001; Herbsleb and Moitra 2001). Success in software product business depends on the management of complex set of activities such as managing both innovative product development and latest technology at the same time (Cusumano and Yoffie 1998) and delivering product and accompanied services at the right time and in high quality (McGrath 2000). Substantial new product development investments are needed to overcome the market entry barriers and facilitate effective entry in the markets. They are often beyond the scope of start-ups. Companies may encounter barriers due to language differences, small domestic markets, negative cultural attitudes toward risk taking, lack of venture capital firms, and unfavorable policies of governments toward software industry.

Software development methodologies and activities have spread to newly industrialized, emerging, and developing nations (Carmel 1999). The rapid advancement and spread of IT and the liberalization of polices in these countries (e.g., India) have created opportunities for international software development.

Some large companies are participating in international software production (Heeks et al. 2001). They typically encounter great challenges in managing the transfer of domain expertise, quality, coordination, and cultural and time differences in international production. Commonly, small companies are

unable to participate in international software production.

3. A Framework for the Analysis of International Software Product Development

There is a lack of a unified theoretical framework, which would facilitate investigation of international software product development. In this section, we suggest a resource-based theory and cooperation theory for the analysis of international software product development

3.1. Resource-based approach

A resource-based view of companies maintains that organizational performance is linked to its resources. The resources of a company are firm specific, rare, and difficult to substitute or imitate (Barney 1991a). They are classified as physical, human, and organizational (Barney 1991a, 1991b). They are composed of patents, technologies, secret expertise, capital, knowledge, employees, information systems, organizational design, rules, and procedures that are controlled by the company.

IT is an important resource for improvements in the performance of enterprises (Chatfield and Bjorn-Andersen 1997; Mata, Fuerst and Barney 1995; Ross, Beath and Goodhue 1996). IT resources (IT infrastructures, technical and managerial IT skills, external IT resources) of a company affect the IT-supported globalization of software development. For example, the Internet and Extranet can eliminate the barriers of distance, time, and geography and facilitate worldwide communication, coordination, and collaboration (Nahar 1999, 2001; Nahar, Huda and Tepandi 1999).

3.2. Cooperation and relationship-based theoretical perspectives

International software development in business webs requires cooperation between all the stakeholders. Cooperation and relationship-based theoretical perspectives can thus provide relevant insights for studying international software production.

One can investigate a process by thinking of it as cooperation between actors.

The perspectives suggest that the parties' needs for one another's contributions are the basis of business cooperation and the establishment of relationships between partners. Instead of focusing on static events, they deal with processes and relationships that evolve over time (Nahar 2001, 2000; Nahar, Käkölä and Huda 2001; Huda, Nahar and Tepandi 1999) and are based on the exchange of resources and benefits. Partners want to be involved in the web and work together to obtain and offer benefits. Many researchers underline the influence of trust and goodwill in cooperative arrangements. Trust tends to have a stabilizing effect on relationships.

IT enhances cooperation between organizations. For example, the use of IT improves international collaboration amongst employees of different organizations (Nahar 2001, 1999; Nahar, Huda and Tepandi 1999).

4. Field Study

In this study, we analyze and develop the international software product development approach. This study examines "how" and "what" type of research questions. A research method is needed that is suitable for answering such types of questions. In order to gain an in-depth understanding of this phenomenon, a qualitative case study method has been utilized to execute the research project (Yin 1994).

Following Yin's (1994) suggestion, special attention was given to the case company selection. The selection of the case company was based on the following key criteria:

- Being a heavy user of IT
- Having produced software products for international markets
- Having extensive knowledge and experience in international software product development processes
- Willing to share their knowledge, views and insights

The selected case X^1 has already successfully developed software products for international markets through a distributed, IT-enabled product development process spreading over the U.S. and India. It targets the products to wireless telecom industry and markets them to leading software markets in the U.S., Europe, and Asia.

Interviewing the knowledgeable people was of significant importance to the quality and importance of our research. We selected the following interviewees to acquire information and insights from different perspectives:

- Vice President of Product & Technology Development
- Vice President of Operations
- Project manager

In addition, we interviewed experts, practitioners, and researchers who are knowledgeable in the field of international software product development and were willing to share their opinions and insights.

Empirical data was collected from the Indian site in June 2002 by using several in-depth face-to-face interviews. Sometimes the interviews lasted more than five hours. In addition, a variety of electronic tools and traditional methods and tools were used to collect data. Additional documents were also collected from the interviewees and analyzed. These included annual reports, internal company magazines, articles published in magazines, press releases, and other archival materials.

The interviews were conducted at several stages. The initial interviews were open-ended and the major questions included: **Which major activities compose your international software product development process and how do you perform these activities**?

The initial open-ended interviews gave the necessary data for designing a more focused interview guide in the later stages. The following issues of international software product development were emphasized in interviews:

---

^{1} The company name is confidential in this research.

- International software development process and its phases
- Use of generic IT tools and software development tools
- Reuse of software components
- Concurrent product development
- Alignment of the software product strategy to:
  - o Business strategy
  - o Major environmental & software industry trends
  - o X's core competences, other internal capabilities, and resources
  - o Partners' capabilities and resources
- Knowledge management emphasizing international software product development
- Company culture towards adopting new technology
- International cross-functional teams
- Customers' involvement in international software projects
- Subcontractors' involvement
- Alliance partners' involvement in global supply chain
- International software project management
- Global release project leader and managers

Several activities were performed to conduct the data analysis. We took field notes during the interviews, recorded the interviews, listened to the tapes, and wrote down the important ideas related to the research questions. This study followed these steps for qualitative data analysis: data reduction, data display, and conclusion drawing (Miles and Huberman, 1994). The following measures were used to enhance the validity and reliability of the study: questions were tested, secondary data were checked, and answers were verified.

5. Case Description and Analysis

In this section, we investigate and analyze the international software development process of a small start-up that is producing enterprise solutions for global markets.

5.1. Background of X

X is a start-up established in July 2001. One interviewee explained how X was started:

> "This is a start-up. The life cycle of product development in this company is the life cycle of the company. It is not an old company that has come up with a product. It is a team of people who understand the need of a particular industry and then they felt that the industry needs a solution and so why do not we build a product and sell to this industry. That is how the company idea, not only the product idea but also the company idea came. … The founders were able to convince the financer, the venture capital fund, that we have a good idea, a good prototype, and we have clients lined up for this product and so on".
> (Vice President of Product & Technology Development).

X develops and delivers application integration solutions through international collaboration for the wireless telecommunications industry worldwide. The industry-specific solutions help wireless operators streamline critical business processes, establish connectivity between disparate business and operational support systems, and provide a common device-independent user interface for multiple applications. They help wireless operators to integrate heterogeneous systems (e.g., billing, customer acquisition, CRM, and financial accounting systems) that they might deploy **at their sites**.

X is a software product company, not a service company. Its business and revenue model is a licensing model.

The Kolkata office employed 27 people in software and technology development and human resource management. The U.S. office employed 8 people and was responsible for marketing and decision making in determining policies. X developed and delivered the first release of its product through a large software project in October 2001, that is, only three months after X was established. The international product development of X is composed of the elements described in Figure 1. The process is supported by an extensive use of generic IT tools, collaborative tools, and software engineering tools.

5.2. Alignment of product strategy to business strategy

A firm's product strategy and development should be linked to the business strategy. Business strategy refers to how a company develops and sustains a competitive advantage in an industry. It also determines how a company will compete in the industry. X is developing three highly differentiated software products for the wireless telecom industry. It is also using Indian high quality and low cost software development resources extensively, allowing X to capture the low cost position. X has developed significant competitive advantage through the differentiated products and low costs. It has been able to achieve both the cost leadership and differentiation strategies, which is very rare (Porter 1990). Firms should typically pursue only one strategy (Porter 1990), that is, either cost leadership or differentiation in the case of X. The product strategy mix of X is described in Table 1.

Customer focus: X focuses on understanding the problems and needs of lead customers. It develops and delivers software products solving the problems and meeting the needs.

> "We are not doing the kind of product development that we go to our lab and come up with a product. The way we are doing it is that right from the birth of the product we are involved with the lead customers. We are actually trying to build the product almost by solving customer problems from day 1. We started the company in July 2001 and we solved the problems in October 2001. So very early on, not only the companies heads, almost every developer is also keenly aware of customer needs" (Vice President of Product & Technology Development; Vice President of Operations).
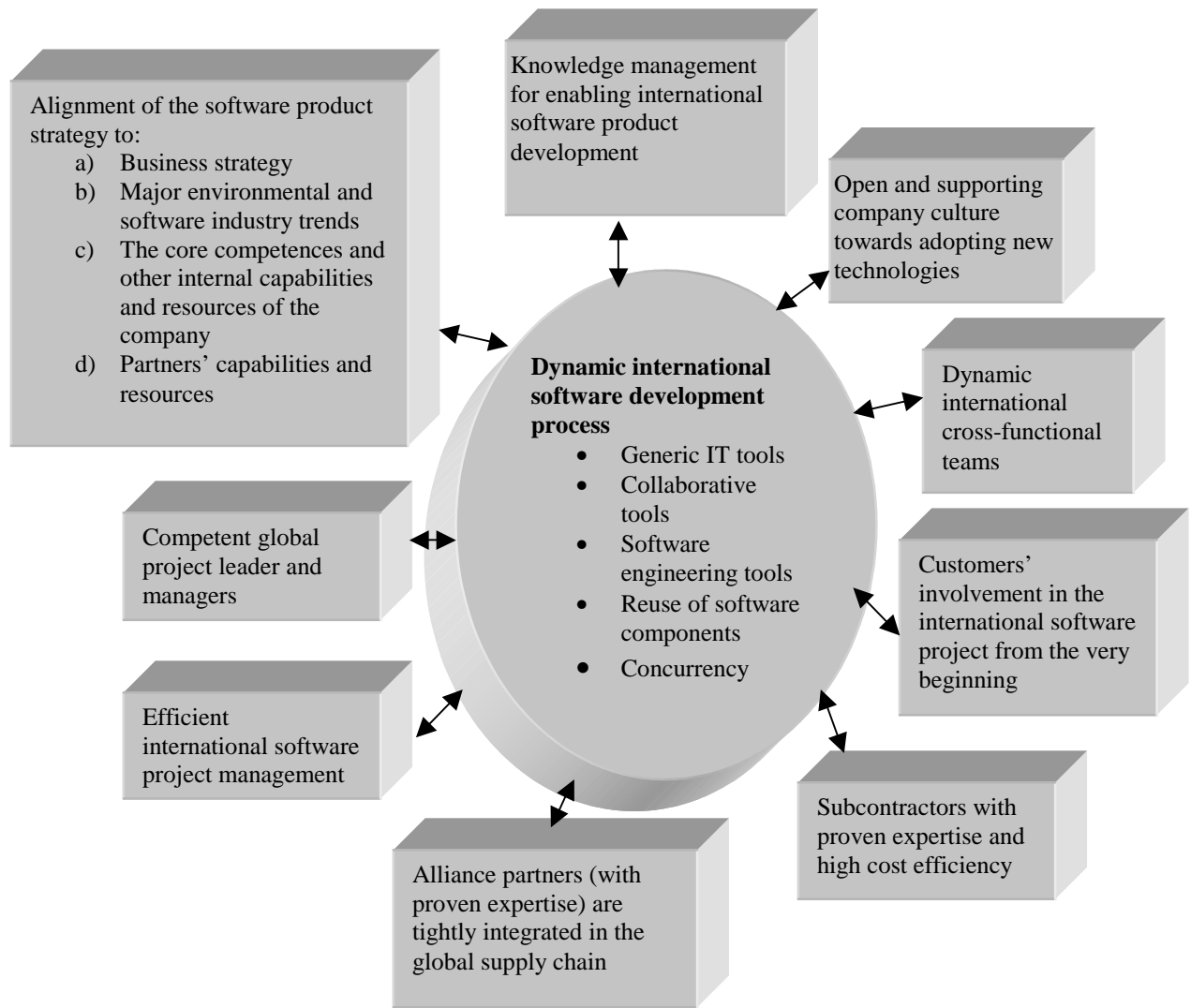
Figure 1: The framework for the international software product development of X

Table 1: Software product strategy

Product strategy	Strategic and tactical benefits	Outcomes
Customer focus	Improved customer satisfaction and shortened sales cycle	**Outcomes** Sustained competitive advantage through continual development of highly differentiated and competitively priced software products.
Time-to-market	Rapid production and introduction of new software products	
Latest technology	Products based on open and modern technology	
Product performance	Highest number and performance of software product features	
Quality	Improved quality of software products	
Standardization	Economies of scale, price competitiveness, and uniform image	
Low development costs	Cost advantage over competitors	
Low total cost of ownership	For customers, lowest cost for buying, installing and maintaining software product	
Cannibalistic new product development	Rapid production of a new release replacing the existing product	

Early involvement of the customers in the development project has helped the company to sell their products within a very short period and has improved customer satisfaction significantly. The following statement by one interviewee expresses the firm's high commitment to its customers.

"We will keep doing it with the customers at all times" (Vice President of Operations).

The installation services for the foreign customers in different markets are provided through leading systems integrators.

Time-to-market: Time-to-market refers to the length of time that it takes to develop a new product from an early initial product idea to the initial sales of the product. X aims at minimizing its time-to-market to win over its competitors.

"The market keeps changing very quickly. We need to react very fast. In July 2001, we were formed. In October 2001, we delivered products. A much more mature thing is being delivered now and things happen in months" (Vice President of Operations).

Latest technology: X focuses on the latest technology based on open standards. The integration solutions of X are easy to deploy and maintain. They are more flexible than other integration solutions in the telecom marketplace.

"We are using the open standards as well as the latest technologies. That should not be an issue at all. We will be able to integrate with more systems as we are dealing with open standards. Nothing of ours will be proprietary. … The cost of maintenance would be lower" (Vice President of Product & Technology Development).

X follows some of the best practices of the industry. For example, it uses technologies like UML and free editors for Java-based development. It uses extensively many off-the-shelf components of the Java platform.

Product performance: X focuses on the high number and quality of product features and the highest level of product performance. It understands the problems of the domain

well and can cater to that particular sector the best. The top management team's long experience with the domain allows X to develop differentiated products.

"We are more focused on the vertical of the wireless domain than our competitors are. Most of our competitors would be more general and that is why they would have certain necks. They would not be able to do things as well as we will be able to do in the specifics of the telecom domain. So that would be an example of our distinguish ability factor between our products and the competitors' product range" (Vice President of Product & Technology Development).

"Within the integration area, we handle the telecom area much better than many others. Our vision for conceptualizing this product has been based on the fact that the top management of our company is all in the telecom domain. Most of us have been in the telecom domain for more than 10 years. So we understand the domain very well and that is why we can cater. So within the small area of application integration, I think we will be able to cater to any kind of customer requirements" (Vice President of Operations).

Quality: X focuses on ensuring high product quality and reliability. It deploys rigorous software product development, uses proven technologies in software development, and employs comprehensive testing. It uses off-the-shelf tools extensively in testing.

"The products that we are developing need very high reliability. Some of those things are not even possible in a small setup in a start-up scenario as to those are used in a heavy-duty scenario. That is why, using off the shelf tools, we do heavy duty testing and make sure that we are able to deliver that kind of reliability. Some of the reliability aspects that are there are coming because of the standardization and because we are partnering with the world leaders to develop highly reliable products" (Vice

President of Product & Technology Development).

Standardization: To reach economies of scale and price competitiveness, X focuses on developing the same product for multiple countries. It designs and develops the products in such a way that it can market the same products in major software markets of North America, Europe, and Asia. They will not deal with proprietary technologies that would restrict them to sell only to certain clients (e.g., only those using legacy systems).

"We take care of all these during the design so that we can truly target a global audience" (Vice President of Operations).

"We would be careful enough in our design that we do not have restrictions in the design so that it restricts our product to be usable under other markets. For example, support for multiple languages. We do not use any technology that will close the option of open languages" (Vice President of Product & Technology Development).

Low product development costs: X minimizes its development costs by using resources and means with the low cost and high productivity. For example, the Indian software professionals and outsourcing service providers have long experience in developing high quality software with low costs.

"We can produce a high quality product at a lower cost than our competitors. Standardization of technologies and having many experts in those standards in India really helped us in producing a high quality product at low costs. We are not doing something proprietary to some big company. Rather we are using very standard technologies and the latest state of the art technologies and developing all the products in India. So we can deliver at a cost below the market - something of the highest quality. That was very important in our company" (Vice President of Product & Technology Development).

Low total cost of ownership: The total cost for using a very complex product is not just the price of the product. It can be very expensive to customize the product, implement it at the customer sites, and maintain it.

"We are focused on a wireless telecom market. So for that market, our product is closer to the final solution. When the customer buys the product, less work is required to come to the solution" (Vice President of Operations).

"Because our product is based on open and modern technology, you will find more people who know our technology" (Vice President of Product & Technology Development).

The solutions of bigger companies are very general. Therefore, more customization is needed. The solution of X is based on open standards. It is thus more maintainable, reducing maintenance costs. X has a competitive edge because its competitors cannot match the total cost of the solution.

Cannibalistic new product development: X develops new releases of products and introduces them in the market quickly. The new release is making obsolete the existing release and ceasing sales from existing product.

5.3. Alignment of software product strategy to major environmental and software industry trends

For rapid expansion of wireless telecom industry, large and complex information systems of telecom operators, require effective integration tools. Company X is developing differentiated integration solutions for these telecom companies.

5.4. Alignment of software product strategy to software company's core competences, other internal capabilities and resources

5.4.1. The core competences

The software product strategy of Company X is based on its core competences. The core competences and the various unique capabilities of the company allow developing unique software products, distinguishing it from its primary competitors and making its

products attractive to customers. The core competences of Company X include the following:

- Strong technological background in the telecom industry
- Long experience in telecom software development both in India and in the USA
- Long experience in large scale software project management
- Highly talented and loyal employees
- Management is team based
- New product development capabilities

- Product is developed and delivered in time
- Unique relationship with customers through the venture capital firms
- Unique relationship with the suppliers

The core competences of the company allow developing differentiated software products for the wireless telecom software.

5.4.2. Other internal resources

Other internal resources of the Company X include the following.

Table 2. Other internal resources

Resources	Key issues
Human resource	• Systematic recruitment of talented employees • Good & ongoing training program • Employees are highly knowledgeable in new technologies and modern working methods • English speaking employees • The company puts high efforts on cultivating individual's talent and talent management
Financial resources	• Adequate financial resources from the venture capital firms
Physical resources	• Adequate physical resources & appropriate conditions
Technological resources	• New and standard software development technologies • The company heavily invests in training and development to master new technologies
Managerial resources	• Advanced knowledge and experience of management and their company loyalty • Strong with engineering, management and marketing
Knowledge management skills	• Considers software development knowledge as strategic asset • Shares and makes knowledge available through face-to-face meeting and distribution of documents
Company culture towards adopting new technology	• The company culture is open to new technologies • Encourages and facilitates continuous individual and organizational learning and improvement

The above-mentioned internal unique resources help Company X to develop differentiated software products for the wireless telecom software and to compete in the world markets. This findings support the resource-based theory. This is in accordance with the internal resource view that IT infrastructures, technical IT skills, financial resources, and managerial resources can all improve an organization's performance.

5.5. Global supply chain integrated software product development

Company X's global supply chain integrated software product development includes the following key issues:

- It reaches out and partners with key customers
- The company emphasizes on high understanding of customer needs

- Utilization of high quality and low cost outsourcing service providers
- Outsourcing service providers are tightly integrated in the development processes
- Improves speed, increases capacity and improves cost competitiveness

5.6. Cross-functional, autonomous teams supported software product development

The company systematically deploys and use tightly integrated cross-functional teams to execute the software project, and develop effectively and efficiently new software products.

5.7. Offers the team decision powers

The company rewards team based on performance and inputs from multiple professionals improve the quality and speed, and satisfy customer needs.

5.8. International software project management

Project management refers to the set of people, tools, techniques and processes used to: a) define the project's goal, b) plan all the work necessary to reach that goal, c) lead the project and support teams, d) monitor progress, and e) ensure that the project is completed in a satisfactory way. Some of the Company X's employees have long experience in large-scale software project management that enables it to manage international software project effectively. Both the top-level executives and other employees of this company have many years of work experience in this area, as they worked in other software companies for more than 10 years.

5.9. Project leader

Many of the Company X's employees have long experience in leading international software projects. Its project leader a) takes into consideration of above mentioned issues of international software production, b) leads all the project participants to motivate and

achieve the goals, c) is responsible for ensuring that milestones and deliverables are achieved and that resources are utilized effectively, and d) is responsible for managing a new product development project through to completion.

The company has been able to develop high quality and appropriate software which the wireless telecom market needs due to the alignment of software product strategy to:
- Business strategy
- Major environmental & software industry trends
- Software company's core competences, other internal capabilities and resources
- Partners' capabilities and resources

The company has improved speed of software development due to a) highly experienced global project leader and managers, b) efficient international software project management, c) customers', subcontractors' and alliance partners' involvement in global supply chain, d) effective cross-functional teams, and e) effective knowledge management and supporting company culture towards adopting new technologies.

6. Collaborative Software Development Processes of Company X

This section deals with the investigation and analysis of the international software product development processes of Company X.

6.1. Major participants of international software product development

The study reveals that for the software product development, the Indian team, the USA team, other teams in Europe & Asia, the venture capital firms, and the subcontractors collaborate internationally. We refer to them here as participants and these participants have been shown in rectangular boxes surrounding the "software product development project" (enclosed in the oval box, see Figure 2).

The Indian office intensively and simultaneously interacts with all participants through the software product development project. The US office mainly interacts with the Indian office. It is also necessary for each participant to interact with the "software product development project". The overall aim is to produce high quality software products very quickly and with a lower cost that satisfy the global customers. These interactions are depicted in Figure 2 with the help of arrows. A single-headed arrow demonstrates a one-way information flow whereas two-way arrows demonstrate a two-way information flow in the process of the interaction. When interaction between the two teams of India and USA is through the software product development project, then the interaction arrows similarly pass through the "software product development project" continued as a dotted line. Further elaboration of the items in Figure 2 is described below.

In this study a venture capital firm is an organizational (business) that provides financial resources to companies for developing software products & related services.

The product ideas for software development mainly come from the USA office, USA advisors & lead customers of USA, Europe & Asia. Prototypes are developed in India on the basis of the product ideas and then these prototypes are demonstrated mainly to US office and leading customers of the above-mentioned countries. Final product is developed through several iterations and delivered to USA office as well as to the customers of USA, Europe & Asia.

6.2. International software product development processes

Company X meets the rapid product development cycle as the market environment changes very rapidly. If the U.S. team has a preliminary idea, within 2-3 months Company X needs to deliver the ready product. One interviewee stated:

"We cannot go by theoretical models like waterfall model, and so on. We cannot do process for process sake. We need to do several activities in parallel. We have some amount of processing placed to keep the whole product project under control" (Vice President of Product & Technology Development, India, 2002).

The same interviewee broadened his views regarding the above statement in the following way:

"Having evaluated the product idea, we assign an architect who holds the whole product model. He produces high-level design documents. He partitions the architecture into modules and gives it to next level of senior people. Then they work on detail design of their modules and they interact with the architect on the architecture".

At the same time they have a QA team, participating from day 1. They are reading up the architecture documents and designing documents. They are preparing QA, automated test ventures and so on. They start surveying the tools that they can use for automation. They are building the framework for automation.

The company follows the following disciplined tasks and steps (which spread over the U.S. and India) by which repetitively converts products ideas to salable products. Many of these activities are done concurrently.

Phase 1: Product concept creation. The US team generates the preliminary product idea by consulting with the board of advisors who are telecom industry experts, by visiting telecom conferences, seminars, trade shows, and talking to current and future prospective clients and partners.

Phase 2: Product concept evaluation. The product concept idea is sent from the US team to Indian office. Meetings with VP of product and technology development, VP of operations and project manager are conducted at Indian office to discuss feasibility with respect to resources and other issues. The interviewees stated how the product concept idea is evaluated.
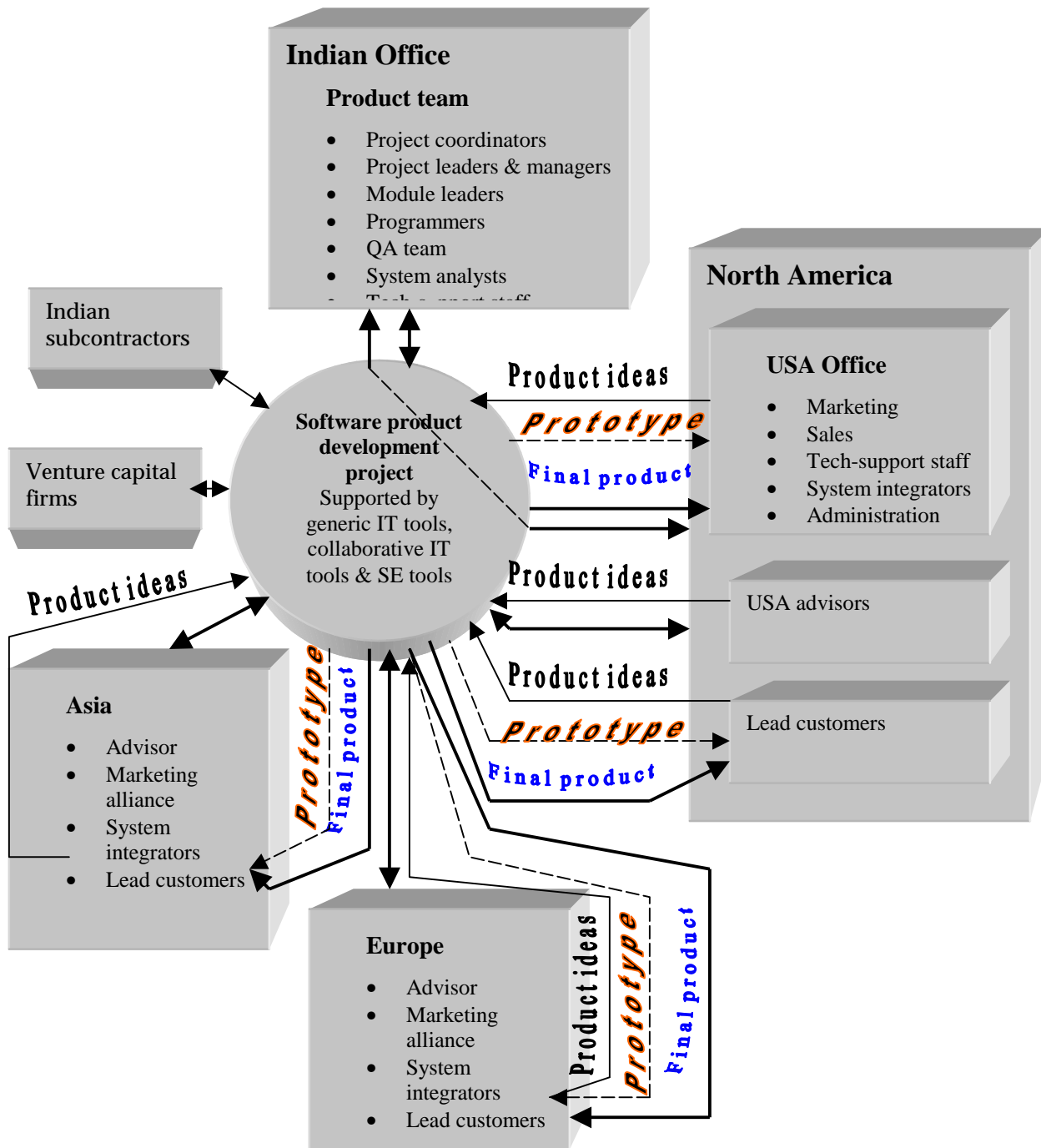
Figure 2: Major participants of international software product development

The Vice President of Product & Technology Development expressed his views regarding the product concept evaluation in the following way:

"I think strategic fit is very important because this company comes into existence because of the identification of a problem that has a market value and that we could solve. Some of our

founding fathers were in the telecom industry. They were able to identify their shortfalls and tried to do things in a better way – that is better easier and faster way. And also since our initial phase of the company is very dependent on good partnerships and those kinds of things, I would rate strategic fit as a very important attribute" (India, 2002).

Both the Vice President of Product & Technology Development and Vice President of Operations came to the following idea after an in-dept discussion.

"That is why we have marked here a) strategic fit, b) technical feasibility of the product, c) company needs, d) the capability of our team, and e) the execution capability of our team. Our personal feeling would be that technical feasibility, market scope, and product cost would be normally required things for any company for any particular product. You have to be technically feasible to be able to be successful. Otherwise you would not succeed. Those are normal concept evaluation attributes" (India, 2002).

Meetings are conducted with team leaders/ managers of product development, project management, quality assurance, release, deployment and support to discuss the scope of work with them and to assess the extent of involvement of each of the above groups in that particular project. These meetings are also used to generate any special IT / resource requirements from any of the concerned teams.

Phase 3: Creation of requirement documents. The project business analyst creates documents for requirements. Requirements are discussed internally with the VP of product & technology development, VP of operations, project manager and other experts to understand how this project will help in defining and refining the product.

Phase 4: Development and approval of the project plan. Project plan is created and discussed with the team leaders / managers again to validate authenticity and validity of each groups' involvement and effort. This project plan will have everything but the start and hence the finish dates.

Project plan is submitted to the US team for review and approval. If any adjustments are to be done again the team leaders / managers will meet to discuss the options.

Once this iteration is over, the project plan and the requirements document are approved and signed off by the US team. The start date will be assigned and hence the end date will be apparent. Once again the US team approves this end date. An email distribution list has been created to facilitate easy and smooth communication so that everybody concerned with the project is made aware of things he / she should know.

Each team leader gets the project plan and if necessary they create their own plans to be able to deliver their part according to the plan. The plan includes dependencies, risks and fail-over strategies of their own efforts.

Phase 5: Establishment of the frequency of the progress review. The frequency of the progress review is established depending on the duration and the complexity of the project. The VP of product & technology development, VP of operations and project manager decide it. The team leaders / managers can then plan their group's reviews accordingly.

Phase 6: Development of high-level project design. The technical architect for the project creates a high-level design document. This document is taken and discussed in a meeting with the team leaders / managers for everybody to have an understanding of the project design, which would help them, plan / estimate their group's effort.

The technical architect creates the detailed design document and the developers receive specifications for their modules. The developers create their own design document and have it validated with the technical architect. This document would include some information on the inputs and outputs of their own modules.

Henceforth any change to be made in any of the aspect of the project to be broadcasted

to the distribution list and anybody having any concern / issues can call for a meeting.

Phase 7: Implementation of the time sheet. The team leaders / managers are responsible for obtaining the progress of their group's effort and they would have a format, which would need to be submitted to the project manager by each team leader. In case the team leader wants a time sheet can be implemented. It is recommended that the implementation of the time sheet for the critical projects for everybody by default. This progress monitoring can also be done ad-hoc by either the VP of product & technology development or VP of operations or project manager.

Phase 8: Submission and monitoring of the master progress report. The project manager is responsible to accumulate the progress reports from each group and submit a master progress report at the end of each progress report monitoring round. The days of the monitoring are needed to be worked out by the project manager and the team leaders / managers in such a way that the project manager can be ready with the progress report at the end of the predefined frequency.

Phase 9: Development and delivery of code to the QA team. The developers are needed to confirm to the company standards to write code that should be as self-explanatory and have comments at standard places at least. The norm of maintaining the *source control* system also will need to be followed whenever applicable.

Once the developers deliver code to the QA team - it is accompanied by documents written on the required templates; having adequate information to enable the QA team to create / execute their test plans.

Phase 10: Recording the test plans and fixing the bugs. The QA department performs the quality assurance tests and records the test plans. The bugs found in the initial pass of the QA are reported back to development team through the company's approved bug tracking system Bugzilla. The Bugzilla team is responsible to create the logistics for smooth information flow to facilitate quick turnover times. In case of

unusual circumstances the QA leader can get in touch with the developers directly which have to be approved by the project manager and the development team leader. The QA team invites the deployment team during the last phase of the QA once the stability and functionality of the code is validated. User manuals are created at this stage.

The deployment team works with both the QA team and the release team to be aware of any issues that need to be treated as restrictions or known bugs. The QA team then publishes the test plans with the results and the project director for approval.

Phase 11: Carrying out the final test and release, install and deployment of notes. The code from the QA team is then passed on to the release management group. The delivery performance is benchmarked, released with additional software components as required. In addition, installation test is done if required. At this stage the support team is also involved and made aware of what functionality and what delivery is being made. Release notes, install notes, and deployment notes are created at this stage.

Phase 12. Delivery of the product. The proper updating of *source control* system happens before the package is delivered externally.

The company also uses innovative approaches (software reuse, concurrent) and self-made tools to develop the software product rapidly and introduce the product to markets quickly.

The company uses software components in its product development extensively, which shortens the software development cycle. It uses those software components that are being developed by some very good teams of the world. One interviewee stated regarding this issue in the following way:

"Like we know that some very good team has developed some very good software components and we use them in our product development" (Vice President of Product & Technology Development, India, 2002).

The company is developing new releases of its product continuously and delivering

highly differentiated products on a going basis.

The collaborative software development process exhibits that the US team and Indian team are communicating and collaborating effectively in the international software development process. This findings support the cooperation (Contractor and Lorange 1988; Robinson 1988), network (Håkansson 1990) and relationship (Buckley and Casson 1988) theories. That is, when a network of companies is mobilized, the cooperation is enhanced between partners and this in turn improves working relationships. This reveals that IT improves cooperation among several people and companies that supports, once again, the cooperation-based theory maintaining that IT enhances cooperation between organizations.

7. Conclusions

The software product business has become global. Software companies are increasingly attempting to produce software products for the world markets by using software development resources in various parts of the world. Small software companies often cannot leverage international software product development due to its high complexity.

Limited empirical research has been conducted on international software product development for world markets in start-up software companies. This study contributes in terms of theory and practice. At the theoretical level, the study introduces a framework of international software product development process for world markets. It can be used as a basis for further research. The study presents an empirical case analysis of international software product development of a start-up company, which is using innovative technologies to develop software for wireless telecommunications industry. Their software product development spreads over two continents (i.e., USA and India) and targets world markets from the outset. At the practical level, the research results will help small software companies to avoid the problems and obtain benefits from international software product development.

Companies must deploy a systematic software development approach to develop their software products. The software production approach presented through the case company takes into account several issues systematically. Management must take into consideration these issues when developing new software products for global markets.

We are continuing the investigation of software product development in software businesses in different parts of the world. Further research is needed to refine the framework for the international software product development. Various aspects of the framework can also be investigated in depth. For example, research is needed on how to educate and manage professionals for global software product development. The potentials and ways of reusing software platforms and components in start-ups also need to be explored in order to develop complex products rapidly. Due to the lack of money, start-ups cannot afford CASE tools - research is needed to help start-ups overcome this barrier.

References

Barney, J.B. 1991a. Firm Resources and Sustained Competitive Advantage. Journal of Management, 17, 771-792.

Barney, J.B. 1991b. Special Theory Forum: The Resource-Based Model of the Firm: Origins, Implications and Prospects. Journal of Management, 17, 1, 97- 98.

Battin, R.C., Crocker, R., Kreidler, J. and Subramanian, K. 2001. Leveraging Resources in Global Software Development. IEEE SOFTWARE, Vol. 18, No. 2, pp.70-77, March/April.

Berry, M. 2002. Strategic Planning in Small High-tech Companies. Long Range Planning, Vol. 31, No. 3, pp.455-466.

Brouthers, K.D., Andriessen, F. and Nicolaes, I. 1998. Driving Blind: Strategic Decision Making in Small Companies. Long Range Planning, Vol. 31, No. 1, pp.130-138.

Brown, N. and Eisenhardt, K.M. 2002. Competing on the Edge: Strategy as

Structured Chaos. Harvard Business School Pr.

Buckley, P.J. & Casson, M. 1988. A Theory of Cooperation in International Business. In F.J. Contractor & P. Lorange (Eds.) Cooperative Strategies in International Business: Lexington, pp.31-53.

Carmel, E. and Agarwal, R. 2001. Tactical Approaches for Alleviating Distance in Global Software Development. IEEE SOFTWARE, Vol. 18, No. 2, pp.22-29, March/April.

Carmel, E. 1999. Global Software Teams: Collaborating Across Borders and Time Zones. Prentice Hall, NJ.

Carlshamre, P., Sandahl, K., Lindvall, M., Regnell, B. and Natt och Dag, J. 2001. An Industrial Study of Requirements Interdependencies in Software Product Release Planning. 5th IEEE International Symposium on Requirements Engineering pp. 84-91.

Chatfield, A.T. & Bjorn-Andersen, N. 1997. The Impact of IOS-Enabled Business Process Change on Business Outcomes: Transformation of the Value Chain of Japan Airlines. Journal of Management Information Systems, Vol.14, No.1, pp.13-40.

Contractor, F.J. and Lorange, P. 1988. Cooperation Strategies in International Business. Lexington Books, Lexington, MA.

Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. 2001. Portfolio Management for New Products, 2nd edition, Perseus Books.

Crawford, C.M. and Benedetto, C.A.D. 2002. The PDMA ToolBook for New Product Development, John Wiley & Sons.

Cusumano, M.A. and Yoffie, D. 1998. Competing on Internet Time: Lessons from Netscape and its Battle with Microsoft. The Free Press.

Ebert, C. and Neve, P.D. 2001. Surviving Global Software Development. IEEE SOFTWARE, Vol.18, No.2, pp.62-69, March/April.

Heeks, R., Krishna, S., Nicholson, B. and Sahay, S. 2001. Synching or Sinking: Global Software Outsourcing Relationships. IEEE SOFTWARE, Vol.18, No.2, pp.54-60, March/April.

Herbsleb, J.D. and Moitra, D. 2001. Guest Editors' Introduction: Global Software Development. IEEE SOFTWARE, Vol.18, No.2, pp.16-20, March/April.

Hoch, D., Roeding, C., Purkert, G., Lindner, S. and Müller, R. 2002, Secrets of Software Success: Management Insights from 100 Software Firms Around the World McKinsey & Co.

Håkansson, H. 1990. Technological Collaboration in Industrial Networks. European Management Journal, September, Vol.8, No.3.

Kalermo, J. & Rissanen, J. 2002. Agile software development in theory and practice. M.Sc. thesis. Software Business Program, University of Jyväskylä, Finland. www.cs.jyu.fi/sb.

Krishnan, V. and Ulrich, K.T. 2001. Product Development Decisions: A Review of the Literature. Journal of Management Science, Vol.47, No.1, pp.1-21.

Käkölä T., 2003. Software Business Models and Contexts for Software Innovation: Key Areas for Software Business Research. Proceedings of the 36th Annual Hawaii International Conference on System Sciences (HICSS), Big Island, Hawaii, USA, January 6-9, 2003. IEEE.

Mata, F.J., Fuerst, W.L. and Barney, J.B. 1995. Information Technology and Sustained Competitive Advantage: A Resource-based Analysis. MIS Quarterly, Vol.19, No.4, pp.487-505.

McGrath, M. 2000. Product Strategy for High Technology Companies. McGraw-Hill.

McGrath, M., Anthony, A. R. and Shapiro 1996. Setting the PACE in Product Development. Butterworth-Heinemann.

Mello, S. 2002. Customer-centric Product Definition - The Key to Great Product Development. American Management Association.

Miles, M.B. and Huberman, A.M. 1994. Qualitative Data Analysis: An Expanded

Sourcebook. 2nd edition, Thousand Oaks, Calif: Sage.

Mintzberg, H., Ahlstrand, B. and Lampel, J. 1998. Strategy Safari: A Guided Tour Through the Wilds of Strategic Management. Simon & Schuster.

Nahar, N. 2001. Information Technology Supported Technology Transfer Process: A Multi-site Case Study of High-tech Enterprises. University of Jyväskylä, Jyväskylä Studies in Computing – 9, Monograph based Dissertation, Jyväskylä University Printing House, Jyväskylä and ER-Paino Ky, Jyväskylä, pp.1-377.

Nahar, N., Käkölä, T. and Huda, N. 2002a. Diffusion of Software Technology Innovations in the Global Context. Proceedings of the Hawaii International Conference on System Sciences. IEEE, January 7-10, Big Island, Hawaii.

Nahar, N., Käkölä, T. and Huda, N. 2002b. Software Production in Developing and Emerging Countries through International Outsourcing. In S. Krishna & S. Madon (Eds) Proceedings of the Information and Communication Technologies and Development: New Opportunities, Perspectives & Challenges. 7th International Working Conference of IFIP, WG 9.4. Indian Institute of Management Bangalore, May 29-31, Bangalore, India, pp.292-310.

Nahar, N., Käkölä, T. and Huda, N. 2001. E-Supply Chain for International Technology Transfer. In D.F. Kocaoglu, T.R. Anderson, D.Z. Milosevic, T.U. Daim, K. Niwa, T.R. Gulledge, C. Kim & H. Tschirky (Eds.) Technology Management in the Knowledge Era (on CD-ROM). IEEE and PICMET, Oregon, USA. PICMET ISBN CD ROM: 1-890843-07-5.

Nahar, N. 2000. Success Factors of IT-Supported International Technology Transfer: An Empirical Study. In L. Svensson, U. Snis, C. Sorensen, H. Fägerlind, T. Lindroth, M. Magnusson & C. Östlund (Eds.) Proceedings of the 23rd Information Systems Research Seminar in Scandinavia: Doing IT Together, 1.

August 12-15, Lingatan, Sweden, pp.181-194.

Nahar, N., Huda, N. and Tepandi, J. 1999. Managing ITT Project through Global Networking Systems: A New Approach. In K.A. Artto, K. Kähkönen & K. Koskinen (Eds.) Managing Business by Projects. PMA Finland and NORDNET, Helsinki, Finland, Vol. 2, pp.1198-1212.

Nahar, N. 1999. IT-enabled Effective and Efficient International Technology Transfer for SMEs. In Evolution and Challenges in System Development, J. Zupancic, W. Wojtkowski, W. G. Wojtkowski and S. Wrycza, Eds. Kluwer Academic/Plenum Publishers, pp.85-98, New York, USA.

Palvia, P 1997. Developing a Model of the Global and Strategic Impact of Information Technology. Information and Management Journal, Vol. 32, No. 5, pp.229-244.

Porter, M.E. 1990. The Competitive Advantage of Nations. Macmillan, Houndmills.

Robinson, R.D. 1988. The International Transfer of Technology: Theory, Issues and Practice. Ballinger Publishing Company, Cambridge, MA.

Ross, J.W., Beath, C.M. and Goodhue, D.L. 1996. Develop Long-term Competitiveness Through IT Assets. Sloan Management Review, Vol.38, No.1, pp.31-45.

Scott, G. M. 2000. Top Priority Management Concerns about New Product Development. IEEE Engineering Management Review, Vol.28, No.1, pp.5-12.

Seppänen, V., Käkölä, T., Pitkänen, O., Sulonen, R., Sääksjärvi, M. 2001. Ohjelmistoalan tutkimustoiminta Yhdysvalloissa (Software Business Research in the USA). Tekes Teknologiakatsaus 109/2001.

Smith, J.A. 1998. Strategies for Start-ups. Long Range Planning, Vol.31, No.6, pp.857-872.

Tersine, R and Harvey, M. 1998. Global Customization of Markets Has Arrived!

European Management Journal, Vol. 16, No. 1, pp.79-90.

Yin, R. 1994. Case Study Research: Design and Methods. 2nd edition, Beverly Hills: Sage Publications, California.

Zahra, S. A. and Bogner, W.C. 1999. Technology Strategy and Software Ventures' Performance: Exploring the Moderating Effect of the Competitive Environment. Journal of Business Venturing, Vol.15, pp.135-173.