Rapid E-Business Development Project Management at Intel

Dien D. Phan¹, Douglas R. Vogel²

Department of Information Systems, St. Cloud State University, St. Cloud, MN 56301, U.S.A.
Department of Information Systems, City University of Hong Kong, Kowloon, Hong Kong

¹ddphan@stcloudstate.edu; ²isdoug@cityu.edu.hk

Abstract- The proliferation of e-business development projects in the past decades has facilitated the rapid expansion of e-business. However, the management of e-business development projects remains the major challenge for organizations. Studies find that problems with failure to meet requirements, cost overruns, and schedule delays remain common. Since the emergence of e-commerce, development paradigms have shifted toward a shortened development cycle. Project management strategies, process, and practices have changed to meet emerging needs.

The goals of this study are to gain insights concerning the successful development of e-business systems with the development of the first extranet system at Intel Corp., as a case in point. Lessons learned and critical success factors are discussed.

Key Words- E-business Development; Success Factors; Software Engineering; CMMI; Project Management; Agile Development

I. INTRODUCTION

The history of software development reveals a multitude of problems caused by poor, as well as undisciplined and incomplete development practices. A study made by The Standish Group in 1995 reported that the overall success rate of information technology projects in the U.S. was only 16.2 percent and that over 31 percent of IT projects were canceled before completion [17].

Despite numerous project management studies in this area, very few have taken both total systems thinking and analytical thinking perspectives. From the analytical thinking perspective, tasks and processes are broken into progressively smaller parts that relate to highly specialized disciplines (such as virtual team productivity or impact of diversity on quality). From the systems thinking perspective, project management is viewed as a whole in the context of the entire environment both inside and outside of the organization. Organizations that outsource development projects must incorporate the total systems thinking perspective in managing projects because they often cannot control or dictate their vendors’ specialized practices and techniques.

As information technologies have developed, new business models have emerged, creating turmoil in the business world. For the past decades, entrepreneurs and existing companies have built and expanded their e-business systems to exploit the new e-commerce frontier. Because of time and budget constraints, many had to adopt a quick and agile development methodology.

Intel Corp. is one of the few major brick-and-mortar companies that developed an e-business system in-house during the early days of e-commerce. Mandated from the CEO, Intel development teams completed its first e-business project within a year. It had to depart from the traditional waterfall development model and try a rapid development approach. The development began in early 1998, and by July 1998, a pilot system was deployed. By the end of 1998, the entire e-business system at Intel was completed on time, within schedule, and within budget.

The purpose of this study is to gain insights regarding success factors that contribute to the successful delivery of modern e-business projects. The goals of this study are to determine:

- what are the major issues faced by e-business development projects?
- what are the new insights in e-business software development? What has changed from traditional systems development?
- what are the success factors?

II. E-BUSINESS SYSTEMS DEVELOPMENT

The e-commerce evolution during the past decade has created a plethora of new ways of doing business. Some have worked well while others have been less successful. At the beginning of the evolution, there was an explosive growth of new opportunities and business paradigms in e-commerce that led to the proliferation of numerous e-commerce development projects for startup enterprises. Experts believe that the rapid expansion of e-commerce infrastructure and support services before the year 2000 and the collapse of many dotcoms after that created the excess capacity which fueled the growth of e-business systems today.

A. Modern Information Systems Project Management

The history of software development reveals a multitude of problems caused by poor, undisciplined, and incomplete development practices. Fourteen years after the initial CHAOS report in 1995, the Standish Group noted the project success rate doubled from 16 to 32 percent and project failure rate was reduced from 31 to 24 percent [8]. While the progress in project management has been substantial, there is room for continuous improvement.

Numerous software engineering and project management studies suggest that the major challenge for any development project is the ability to manage and control development resources and environment [12]. With the emergence of new business models such as supply chain management (SCM) and the widespread use of off-the-shelf software, controlling dependence on external resources in the development of e-business software is a major challenge.
There are several reasons for this challenge to exist. First, it is difficult to control and manage end-to-end connectivity worldwide, as much of it falls outside direct control of company’s management. Second, managing dependence on vendor software components is also a daunting task.

As requirements for e-business systems exceed the resource capacity of development projects, managing projects to meet schedules, costs, and requirements becomes more difficult. The typical software engineering phenomena of using limited resources to meet all requirements have been described by Brooks in his well-known book, The Mythical Man-month [2]. Compressed schedules to cut development cycles also create extra demand on limited resources.

In response to the need for short development cycle time, many organizations such as Microsoft, Netscape, and Intel began to implement agile development processes in the 1980s [3]. However, not until 2001 did Ken Beck et al. officially declare the Agile Manifesto (http://agilemanifesto.org/). The agile development approach aims to have incremental delivery, informal methods, simplicity, and small teams. The development guidelines stress delivery over analysis, systems modeling, and require continuous user involvement. Furthermore, in an agile development environment highly skilled workers are vital to success.

Phan, Vogel, and Nunamaker [12] and Pfeffer and Salancik [11] argue that limited resources cause projects to become interdependent with other organizational units, as well as with the external environment, for resources that they do not currently have. As a consequence, projects and the environment make more demands on each other and develop internal and external strategies to minimize uncertainties arising from dependence on the environment for resources. These strategies include buffering, coordinating, contracting, and merging.

Numerous studies have been conducted to study successes and failures of software development projects. Key project success factors are:

1) clear goals, directions, and well-defined scope;
2) top management support;
3) client/user participation;
4) good project management and quality control standards;
5) multiple versions available;
6) user/client acceptance;
7) coordination and collaboration efforts;
8) optimal mix of work force;
9) detailed plan and schedule;
10) good management of features and milestones [12, 15].

B. CMMI and Software Development Process Improvement

The Carnegie Mellon University’s Software Engineering Institute (SEI) has developed the Capability Maturity Model Integration (CMMI) that is predicated on a set of software engineering capabilities with a focus on process quality management. The CMM has five levels of maturity with associated Key Process Areas (KPA) as presented in Table I.

<table>
<thead>
<tr>
<th>Maturity Levels</th>
<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Initial</td>
<td>People</td>
<td>Competent people</td>
</tr>
<tr>
<td>Level 2: Repeable</td>
<td>Project Management Processes</td>
<td>Software configuration management, Software quality assurance, Subcontract management, Project tracking and oversight, Project planning, Requirements management</td>
</tr>
<tr>
<td>Level 3: Defined</td>
<td>Engineering processes and organizational support</td>
<td>Peer reviews, Intergroup coordination, Software product engineering, Integrated software management, Training program, Organization process definition, Organization process focus</td>
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<tr>
<td>Level 4: Quantitatively Managed</td>
<td>Product and process quality</td>
<td>Software quality management, Quantitative process management</td>
</tr>
<tr>
<td>Level 5: Optimizing</td>
<td>Continuous process improvement</td>
<td>Defect prevention, Technology change management, Process change management</td>
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Many studies have found that improving process capability and maturity lead to better quality and productivity [5, 9]. Certainly moving up the capability and maturity level in the model requires significant investment, efforts, and discipline, these studies showed that moving up in the CMM level is a good investment.

C. E-business Systems Development

Numerous studies have addressed various challenges in e-business development [3, 9, 14]. Major issues in building E-business systems projects include:

1) Integration of Front, Back Office, and Supply Chain systems:
   On-line applications must be connected and integrated to back office systems, such as ERP and DBMS. Good integration is critical to make sure that customer orders match existing inventory, price, and delivery schedule.

2) Outsourcing:
   Few companies today have the capability and resources to develop an entire e-business system. The majority rely on vendors to supply hardware, software, and expertise to build e-business systems. Companies can select to have servers run on mainframes, mid-range computers, Unix or PC workstations. While mainframes and mid-range computers require more staff to support, they are not vulnerable to the majority of attacks that aimed at Unix or PC workstations. The belief that PC servers require fewer staff to run than those that use mainframe or midrange computers may be false. As mentioned previously, many IT departments lack human resources to install and thoroughly test frequent and numerous patches and updates for PC servers.

3) Software Customization:
   Off-the-shelf e-business packages generally offer enterprises to customize the functionality of the software by developing their own code in Java, C++, HTML, XML, ASP, etc. Dependent on the individual situation, each company
must decide whether to build a proprietary e-business system or use open source software.

4) Rapid Development Methodology:

In today’s business environment, organizations expect project cycle to be short and changes to be adopted quickly. An agile development methodology has become common in e-business projects.

III. METHODOLOGY

In this study, the E-business project at Intel is studied. This is a qualitative study that examines the existence of key success and failure factors, processes, and best practices in managing e-business development projects. In information systems (IS) research, case studies are suitable for theory building when existing theory is limited [1]. Furthermore, IS theory and model development can be based on a single case study [19]. Information from the development of Intel eBusiness system are archived from Intel’s internal project repository and interview of Mr. Phuc Than at Intel.

IV. E-BUSINESS PROJECT AT INTEL

Intel Corp., located in Santa Clara, California, is the world’s largest producer of Integrated Circuits Chips in the world today with a total revenue for 2011 at over $54 billion and Net Income close to $13 billion. Founded in 1968 to build semiconductor chips, Intel invented the microprocessor more than 25 years ago. Today, the company has evolved from a processor manufacturer into a supplier of network and server hardware, Internet hosting services, and other e-Business components. Its technological leadership ranges from microprocessor design to advanced manufacturing and packaging, and it maintains production and research facilities around the world.

The early benefits of e-business for Intel were too great to be ignored. With over $25 billion annual sales in 1998 and a world wide network of business partners, resellers, and original equipment manufacturers (OEM), Intel needed to improve its efficiency by automating its business to business (B2B) processes. Current traditional order processes at Intel were too slow and thus a Web-based order management system was needed.

Most of Intel’s business is in the PC market where there is intense competition from other chip makers such as Advanced Micro Devices (AMD), Cyrix (acquired by National Semiconductor in 1997 and then by VIA in 1999), Texas Instruments, Motorola, and IBM. In the past, Intel customized its catalogs and sent them to its potential customers along with product availability information. Until the summer of 1998, Intel’s business process was done entirely via fax and telephone. However, when major buyers such as Dell Computers and Cisco Systems started to use the Web to do their business in 1996, they pressured Intel to do business online quickly. Seeing the coming e-business revolution, Andy Grove, then chairman of Intel, directed his employees to move Intel into Internet quickly: “Within five years, all companies will be Internet companies or they won’t be companies” [13]. The mandate to launch an e-business system within several months sent shockwaves to the newly formed e-business development team: “A lot of people feel overwhelmed by ‘The Task’ ” noted by Sandra Morris, Vice President of Sales and Marketing Group, and director of Internet Marketing and E-commerce at Intel [7].

A. Requirements, Methodology, Project Structure, and Responsibility

In order to establish the project scope, Intel’s e-business customer requirements and market opportunities were studied. At the end of 1997, Intel began building its worldwide e-business team and Intel’s Sales & Marketing Group was assigned to lead the project. These requirements were gathered, grouped and translated into project requirements which the required resources to develop key requirements were estimated.

1) Development Methodology:

With the mandate to have an e-business system online within months, Intel’s initial project team had to agree on a strategy to develop the system quickly. However, by 1998, the agile development methodology was still in its infancy and Intel project team members like those in most manufacturing companies had no experience with this approach. Without a formal agile development approach, they agreed that best methodology available for rapid development at that time was the incremental prototype approach. They decided to go ahead with a pilot project to design and deploy a simple e-business solution that worked with existing business processes, and then grow the system from one version to the next.

2) Project Scope:

In order to rapidly deploy the e-business system within a short time, the project scope was limited. The initial project scope was to build a pilot system that served its middle tier customers which covered 25% of accounts in 35 countries using a one-stop with 240 shopping sites for customers throughout the world. Personalized data and applications were tailored to users’ needs to provide an individualized experience. This system basically was a self-service extranet named “E-Business Program” focusing on procurement and customer support for its supply chain partners. Access to the site was restricted to Intel’s authorized business partners and customers. After the first version, this system grew into a full scale B2B e-business system. “We picked one thing we could build very quickly and deploy to our customers. The thing to do is ask what makes you a strong company and how do you use Internet to make the company stronger,” noted by Sandra Morris [18].

3) Project Organization, Roles and Responsibilities:

After the initial project meeting, the following project organization chart was drafted and accepted (Figure 1).

![Fig. 1 Intel E-Business Initial Project Organization Structure (Source: Intel, [7])](image)

The roles and responsibilities of participants of the initial e-business development teams were defined as follows:

- Project Planning
- Business Analysts
- Sales and Marketing
- IT Department
- Intel E-business project
- P & L Group

a. a planning team which consisted of customer, technical and logistical perspectives to define the scope and objective of the project;
b. business analysts and consultants to help define the business workflow and assess how information is given to customers;
c. sales and marketing staff to determine the best ways to work with customers in the new e-business environment;
d. planning and logistics group to help the IT department build a solution that integrated with existing business systems;
e. the Information Technology (IT) department to act as an "enabler" of business. Its role was to integrate e-business technologies and build the system.

4) Project Development Methodology:
Because there were few people with adequate knowledge and experience in the rapid development of a B2B E-commerce systems, the Intel development team was extremely cautious. Rather than attempt to build the entire business infrastructure from ground zero, Intel’s development group decided to implement an incremental approach to build the system. This incremental approach used at Intel is similar to the “grow rather than build from scratch” and “frequent synchronization and stabilization” approaches used at Microsoft and Netscape. One of the early incremental development efforts at Intel after the launch of its e-business website was an Access Manager application that automated the creation of account user IDs and passwords to access the unified environment known as the “Landing Zone.” Another incremental development was adding the encryption function that started with the domestic encryption technology that was available for companies in the U.S. and later to work with imported encryption technology developed outside the U.S.

B. Project Communications and Stakeholder Involvement
Because many Intel customers overseas had little or no knowledge of e-commerce and had no e-commerce infrastructure, Intel initially made a great effort to educate customers in basic e-commerce and Internet applications. Information on individual customer Internet and network structure, e-commerce background, and customer supply chain and workflow management was collected so that the new e-commerce systems would be able to fit into existing customer information systems.

Once Intel had a grasp of the overall Internet infrastructure and e-commerce background of its customers, development team members contacted customers and provided basic e-commerce training for those who needed it and performed assessments on their e-commerce system needs. Thus, through customer input and feedback, real user requirements were gathered.

International input is proved to be crucial. “It is absolutely amazing the amount of work we did with customers overseas to make e-business program a success for them, I remember one time our technical team traced a connectivity issue back from a Customer in Asia, through their ISP, and out across the Net to a bad router board in San Francisco owned by yet another ISP who hadn’t realized they had a problem,” noted an e-Business Customer Marketing Manager at Intel.

Other customer involvement activities included:
1. formation of a team specially focused on customer deployment;
2. running concurrent project tasks so that deployment related activities such as account ids and passwords took place while the system was under development;
3. education, training, and project promotion for customers and users worldwide;
4. upgrading project priority by positioning e-business as strategic imperative for Intel and its customers;
5. ensure responsive Internet access by working with customers, ISP, and other related organizations in customer site countries.

In recognizing the importance of customer’s input in this project, a team leader noted: “We worked with a deeply committed team of world wide contributors. The inputs on design, deployment, and training came from people who were in those countries around the world. We like to say that the sun never sets on our e-business development, because we have people working on it around the world in every time zone.”

C. Quality Assurance
During development, codes were frequently inspected and tested. Intel’s development groups anticipated frequent changes in both internal and external design and processes. Its development process was an iterative one that relied on continuous improvement and frequent synchronization testing. Customers played a major role in quality control via the online feedback and Intel’s site visit. Like Microsoft and Netscape, Intel put beta versions of new features out for customers to use and test, then continued to upgrade its e-business system based on the feedback. This is the modern software engineering “upgrade often, test often, and release often” approach. Critics of this process argue that due to a short development cycle, “release-often” software does not go through the rigorous of the traditional development process. The counter quality assurance argument for this approach is the exposure of Beta versions to thousands of users worldwide, allowing bugs to be identified faster and fixed sooner.

D. Results
On July 1, 1998, Intel officially began taking orders from OEM and distribution customers using a new series of personalized Web sites. The new e-business system enabled approximately 200 Intel’s customers in almost thirty countries to place orders for Intel products, check product availability and inventory status, receive marketing and sales information, and obtain customer support - all in real time, 24 hours a day, 7 days a week. The major successes of this project are summarized below [13].

1) Wave after wave of orders, worth $1 Billion, were booked on its online e-business system in the first 15 days of deployment, surpassing the company’s initial launch goal of moving $1 Billion in the first three months.

2) The company was able to eliminate most faxes to and from its customers worldwide. For Taiwan partners alone, it eliminated 45,000 faxes per quarter.
The company continued to receive approximate $1 Billion of online orders per month for the rest of 1998.

Customer survey rated Intel's e-business site at 94% for overall value.

By June, 1999, over 560 companies in 46 countries were using Intel’s e-business system.

The time to complete a transaction was reduced by an average of 70%.

Many of Intel’s employees who participated in the development of the e-business program received promotions after its successful deployment. Sandra Morris was promoted to the CIO position.

By August 2000, Intel’s stock value peaked at close to $75 per share, its market capitalization passed the $500 billion mark that only a few major companies such as Microsoft, GE, Exxon Mobil, Cisco, and Apple Computers could achieve [6].

V. SUCCESS FACTORS

Key success factors for this project, ranked by importance, are:

A. Well-defined Goals, Objectives, and Scope

Management was clear and explicit with respect to defining project problems and opportunities, global interfaces, goals, and objectives. To avoid scope creeping, it is important for a project manager to clearly specify not only what should be done but also what should NOT be done. At the beginning, the Intel development team made it clear that the project goal was not to build the entire e-business system from scratch and not to convert the company into an on-line one. Rather, Intel’s early goal was to serve its existing market using Internet technology.

B. Good System Security and Partner Trust

To maintain B2B inter-organization trust and to protect system integrity, e-business systems must strive for the best security scheme available. In this global e-commerce environment, hackers are likely to be ahead of software vendors in finding system vulnerabilities, so the best security is needed. Systems security is a continuous improvement process and will never end. In addition to the best encryption available, the system must be protected by many layers of firewalls, routers, and proxy servers when appropriate.

C. Meeting User Requirements and Personalized Needs

Beyond meeting user requirements in traditional software, web based systems must offer customization and personalization to all levels of users. To meet user requirements, developers must design the system according to what customers need in an e-business system. In web based systems, developers must visit customer sites worldwide to see how the connection works in terms of speed, encryption standards, native language translation, Unicode availability, etc. Because e-business systems development deals with the latest technology, developers must be prepared to learn as a system progresses. Web content must be accurate, current, and appropriate for each individual customer. Because management, procurement, sales and marketing, and engineering functions of value chain partners and customers all have different informational needs, personalized information online allows multiple levels of customers to save time in finding necessary information.

D. Involvement from Stakeholders Especially from the Sponsor

One of the key factors for Intel’s e-business project success was the support from Andy Grove, Intel’s CEO. Top management involvement made it easier for project managers to acquire resources and deploy the e-business system on time. This also facilitated negotiation for resources and headed off delays induced by bureaucracy and lack of inter-departmental cooperation.

E. CMMI Process Maturity

As summarized in Table 2, Intel’s early e-business program development is observed at CMMI level 3. This level is comparable with the level appraised at many other major software companies in the US such as Microsoft, EDS, and Accenture [16]. Like other companies appraised at CMMI level 3, Intel’s process maturity is a major factor for Intel to overcome the challenges in its early e-business project and achieve success.

VI. SUGGESTIONS FOR IMPROVEMENT

Despite the successes mentioned above, there is room for improvement in CMMI and project management areas. In the process maturity areas, Intel can move on to implement the KPAs of Levels 4 and 5. Another area of improvement is the agile development process. Had the agile development approach been more mature in 1997, Intel could have used an agile methodology such as SCRUM to build the Landing Zone, encryption, and most of components. One of the major success in SCRUM at Intel in 2007 is the development of a software for product engineering and development [4]. The success of this project has allowed Intel to expand this methodology to all e-business projects inside Intel. Finally, opportunities also exist for Intel teams to improve project management skills in many areas such as risk management,
outsourcing procurement management, virtual team management, and quality management.

VII. CONCLUSION

With the rapid advance in technology, it is important that companies redesign business processes and systems to handle the shift in the business paradigm. In the development of web based on-line systems, development projects are faced with new issues that may not have existed in traditional software development. These include short development cycles, frequent changes, and global collaboration. Success factors include well-defined goals and objectives, top management support, good user involvement, incremental development, good communications, high CMMI level of maturity, and good security.

This study has provided some new insights into the development of e-business systems and confirmed the validity of new development paradigms for e-commerce systems. As exemplified by the problems faced and the success achieved by Intel’s e-business project, the strategies and success factors discussed in this paper can serve as suggestions and guidance for project managers seeking to improve their e-business project management.

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REFERENCES


Dien D. Phan is Professor of Information Systems at St. Cloud State University, Minnesota, U.S.A. He received his Ph.D. in MIS at the University of Arizona, Tucson in 1990. Professor Phan’s research interests include e-business, project management, Business Intelligence and Customer Relationship Management Systems.

Douglas R. Vogel is Professor of Information Systems in addition to Management Department Acting Head and is an Association for Information Systems (AIS) Fellow as well as AIS President. He received his Ph.D. in Information Systems from the University of Minnesota in 1986. Professor Vogel has published widely and directed extensive research on group support systems, knowledge management and technology support for education. He has recently been recognized as the most cited IS author in Asia-Pacific. He is currently engaged in introducing mobile devices and virtual world support for collaborative applications in educational systems. Detail can be found at http://www.is.cityu.edu.hk/staff/isdoug/cv/.

Dien D. Phan