EFFICIENT IMPLEMENTATION OF AN ENTERPRISE RESOURCE PLANNING SYSTEM IN A LARGE COMPANY

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>TABLE OF FIGURES AND TABLES</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>2</td>
</tr>
<tr>
<td>1 PROBLEM STATEMENT</td>
<td>4</td>
</tr>
<tr>
<td>2 BACKGROUND OF COMPANY X ERP IMPLEMENTATION</td>
<td>7</td>
</tr>
<tr>
<td>2.1 OVERVIEW OF INDUSTRY</td>
<td>7</td>
</tr>
<tr>
<td>2.2 COMPANY</td>
<td>8</td>
</tr>
<tr>
<td>2.3 BAY AREA DIVISION</td>
<td>10</td>
</tr>
<tr>
<td>2.4 CORPORATE JUSTIFICATION</td>
<td>10</td>
</tr>
<tr>
<td>3 LOST STRATEGY THROUGH OUTSOURCING</td>
<td>14</td>
</tr>
<tr>
<td>3.1 OPTIMIZATION OF RESOURCES</td>
<td>16</td>
</tr>
<tr>
<td>4 PROPOSED NEW DIVISION OF COMPANY X</td>
<td>19</td>
</tr>
<tr>
<td>4.1 TRADITIONAL TEAM DESCRIPTION AND EXPERIENCE</td>
<td>19</td>
</tr>
<tr>
<td>4.2 JUSTIFICATION FOR DIVISION CREATION</td>
<td>21</td>
</tr>
<tr>
<td>4.3 DIVISIONAL VS. INTRA-COMPANY WORK TRANSFER</td>
<td>22</td>
</tr>
<tr>
<td>4.4 MANAGEMENT STRUCTURE</td>
<td>23</td>
</tr>
<tr>
<td>4.5 ECONOMIC BACKGROUND AND JUSTIFICATION</td>
<td>24</td>
</tr>
<tr>
<td>4.5.1 Indirect Burden</td>
<td>25</td>
</tr>
<tr>
<td>4.5.2 Cost Reduction</td>
<td>27</td>
</tr>
<tr>
<td>4.5.3 Strategic Alliance</td>
<td>28</td>
</tr>
<tr>
<td>4.5.4 Learning Curve</td>
<td>30</td>
</tr>
<tr>
<td>4.6 FINANCIAL BENEFITS OF REUSABILITY</td>
<td>31</td>
</tr>
<tr>
<td>4.7 BREAKEVEN ANALYSIS</td>
<td>32</td>
</tr>
<tr>
<td>4.8 TIME EFFICIENCY GAINED</td>
<td>34</td>
</tr>
<tr>
<td>4.8.1 Existing Middleware</td>
<td>35</td>
</tr>
<tr>
<td>4.8.2 Potential Cash flow</td>
<td>36</td>
</tr>
<tr>
<td>5 ASSESSMENT OF CORE COMPETENCIES AND STRATEGY</td>
<td>39</td>
</tr>
<tr>
<td>5.1 PHASE 1 – PRE-XSS IMPLEMENTATION COMPLETION</td>
<td>39</td>
</tr>
<tr>
<td>5.1.1 Technical Resources.</td>
<td>40</td>
</tr>
<tr>
<td>5.1.2 Operations Resources.</td>
<td>40</td>
</tr>
<tr>
<td>5.2 PHASE 2 – POST-XSS IMPLEMENTATION COMPLETION</td>
<td>41</td>
</tr>
<tr>
<td>5.2.1 Technical Resource</td>
<td>41</td>
</tr>
<tr>
<td>5.2.2 Operations Resources.</td>
<td>41</td>
</tr>
<tr>
<td>5.2.3 Knowledge.</td>
<td>41</td>
</tr>
<tr>
<td>5.3 MARKET POSITION AS A STRATEGIC ADVANTAGE</td>
<td>42</td>
</tr>
<tr>
<td>5.4 NETWORK COMPATIBILITY</td>
<td>43</td>
</tr>
<tr>
<td>6 MAXIMIZATION OF KNOWLEDGE TRANSFER</td>
<td>43</td>
</tr>
</tbody>
</table>
Table of Figures and Tables

FIGURE 1: COMPANY X CORPORATE STRUCTURE.................................................................10
FIGURE 2: BREAKEVEN ANALYSIS: LEGACY SYSTEM MAINTENANCE ALONE.................11
FIGURE 3: FINANCIAL BREAKDOWN OF IMPLEMENTATION COSTS.................................12
FIGURE 4: SELLER/BUYER MATRIX OF ERP IMPLEMENTATION PHASES......................15
FIGURE 5: ALLEN C. HAMILTON’S SUCCESSFUL PROJECT PLANNING FLOW (2003)......15
FIGURE 6: COMPANY X NEEDS AND CONSULTANT EXPERIENCE..................................18
FIGURE 7: TRADITIONAL IMPLEMENTATION TEAM COMPANY ORIGIN.........................19
FIGURE 8: COMPARISON OF RATES BETWEEN COMPANY X AND CONSULTING FIRMS 25
FIGURE 9: COMPARISON OF COSTS TO COMPANY X NEW DIVISION LOADED RATE......28
FIGURE 10: PROPOSED PERCENTAGE OF CONSULTANTS TO EMPLOYEES.....................29
FIGURE 11: FINANCIAL BREAKDOWN OF ANNUAL IMPLEMENTATION COSTS AT XSS 30
FIGURE 12: LEGACY SYSTEM MAINTENANCE BREAKEVEN IN TRADITIONAL
IMPLEMENTATION .......................................................................................................................33
FIGURE 13: BREAKEVEN AND LONG TERM SAVINGS FROM NEW DIVISION..............34
FIGURE 14: NORDEN-RAYLEIGH CURVE OF FUNDING PROFILE OVER TIME ...............35
TABLE 1: ESTIMATED SAVINGS DUE TO SAP IMPLEMENTATION DIVISION ......................37
TABLE 2: CAPITAL SAVINGS PROFIT POTENTIAL .................................................................38
FIGURE 15: KNOWLEDGE TRANSFER OF NEW DIVISION PRE-XSS IMPLEMENTATION ..44
FIGURE 16: KNOWLEDGE TRANSFER OF NEW DIVISION DURING XSS .........................45
FIGURE 17: KNOWLEDGE TRANSFER OF NEW DIVISION POST-XSS IMPLEMENTATION46
TABLE 3: LEAN (TOYOTA BASED)-THREE TYPES OF WASTE ............................................51
FIGURE 18: 5SIGMA IMPROVEMENT CYCLE .....................................................................52
TABLE 4: ERP IMPLEMENTATION STRATEGY THROUGH CAPABILITY SUBSTITUTION
..................................................................................................................................................53

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Abstract

Enterprise Resource Planning (ERP) Systems have the potential to streamline business processes. While implementation is difficult and costly in large companies, the promise of an integrated system capable of efficiently flowing data and reporting functions throughout the organization are valuable enough to commit to the cost, schedule, and resource implications of implementing such a system. Cross divisional dataflow and reporting are extremely valuable when analyzing market trends, developing bid integrity on new projects, and standardization of operational platforms.

Even with the promise of efficiency, the reality of streamlined post implementation operations within large companies is often not achieved. Many ERP systems fail during implementation. Of those that are actually implemented, many do not achieve the return on investment (ROI) expected. ERP success or failure in large companies is determined during implementation. Utilizing Design for Manufacturability (DFM) concepts with emphasis on Lean Thinking, an ERP implementation can be accomplished in large companies at a significantly reduced schedule, cost, and risk compared to standard implementation. This project analyzes industry trends with a focus on an actual implementation at Company X. The project analysis reveals that strategic implementation processes can reduce cost and schedule of ERP implementation in large companies while increasing the probability of successful achievement of ROI.
Executive Summary

Company X, a large aerospace and defense company, has chosen its next generation Enterprise Resource Planning Solution (ERP): SAP. SAP is an ERP solution designed to handle all dataflow related to accounting, finance, manufacturing, goods movement, contracts, subcontracts, and procurement. Modern ERPs are new to Company X and the aerospace industry, as most companies and divisions utilize legacy systems that have been in place since the arms race of the 1980’s. Company X’s corporate executives have given the five major U.S. divisions the latitude to pick an implementation schedule that fits into their business. Company X’s Bay Area division, Company X Space Systems (XSS), chose to be the first.

The cost of implementing an ERP is significant. With the immense amount of data and unique customer requirements, considerable time and money was spent training consultants, creating middleware, and training XSS employees how to implement SAP. Now that the transfer of knowledge is almost complete, and XSS is ready to go-live, Company X has the unique opportunity to utilize its own internal resources in a way that significantly reduces the cost of future implementations. This can be achieved through the creation of a new division.

A separate division responsible for the multimillion dollar process of implementing the company’s Enterprise Resource Planning system at sister Company X divisions would significantly reduce cost due to the reduction in the implementation time and reduction of required consultants. It would also eliminate the threat of possible compatibility problems between systems. Based on the legacy systems currently in place across the corporation, this is a very realistic possibility. Finally, it will increase the
cross-functional communication between divisions through the use of the new ERP and through the use of knowledge resources at other divisions.

Ultimately, capital savings resulting from creation of the new division will be over $600 million. Implementation time will be reduced by as much as 50 percent per division, and data-flow and functionality will be improved in the process. The end result will be a system optimized for Company X and streamlined to make Company X’s “One-Company, One Team” initiative a reality.

The structure of this analysis will interweave the above proposed improvements and lean concepts into an overall strategy that improves ERP implementation efficiency at a large company. Examples of efficiencies gained through strategic divisional implementation and utilization of lean principles are suggested. The lean, strategically improved implementation process is then advocated, if implemented would result in significant savings, dramatic schedule improvement, and a more streamlined system to ensure maximum strategic advantage of the integrated ERP.
1 Problem Statement

The cost and schedule associated with implementing an Enterprise Resource Planning System (ERP) is significant. While the cost and schedule can be justified through a return on investment (ROI) analysis, the traditional division-by-division process by which large company implementation occurs is less than optimized. Large company executives implement ERP systems in order to transition multiple data systems into a consolidated system that improves information sharing and allows for strategic data analysis across the corporation.

Transition of legacy data and processes can easily be underestimated and lead to cost growth (Younossi, Arena, Roll, Jain, Sollinger, 2007). Understanding the systems conversion process and required functionality represents a significant learning curve. Company software engineers and data maintenance personnel often have limited exposure to modern enterprise resource planning systems and therefore require significant training and oversight by external consultants with general modern ERP systems knowledge. In turn, company engineers must train consultants on legacy systems architecture and required data flow. This knowledge exchange is deemed as necessary for successful implementation of the ERP.

Industry data shows that ERP implementation does not typically result in the highly efficient processes expected of an integrated system. While SAP claims that 77-89% of customers that successfully implemented their software suite between 2003 and 2007 have achieved positive return on investment (ROI), independent research found that figure is actually less than 50 percent (Nucleus Research, 2003).
In spite of their benefits, many ERP systems fail (Stratman and Roth, 1999). Once implemented, “many ERP systems face implementation difficulties because of workers’ resistance.” (Al-Mashari and Zairi, 2000). Successful implementation, however, is not a guarantee. Bae, Ph.D and Ashcroft, Ph.D found the typical large company implementation cost averages $100 million per implementation. Of those implementations, only one of every three implementations is successful (Hugos, 2003). “Some 30% fail outright, and another 40% drag on for years, propped up by huge cash infusions until they are finally shut down.” (Hugos, 2003).

With the high failure rate of ERP implementations and lackluster ROI, why do large companies continue to attempt to implement the systems? The result is the foundation of lean thinking: streamlining data transmission and communication. If a company can successfully implement an ERP system, the resulting efficiency of data flow and production planning can reap enormous rewards. Wal-mart attributes early investment in an ERP as a reason for its strong growth over the past two decades (West, 2004).

The uninspiring performance above has sparked a significant amount of research regarding ERP implementations. Researchers and consultants have presented a large volume of proposed “success factors” that are claimed to aid the success of an ERP implementation. These include the following:

1. Closely align systems projects to respond to specific business opportunities or needs.
2. Use systems to change the competitive landscape [and] leverage the strengths of existing systems to build new systems.
3. Use the simplest possible combinations of technology and business processes.
4. Break the design of big systems into smaller subsystems to reduce the overall complexity and lower the risk of building each subsystem.
5. [Do not] try to build a system whose complexity exceeds the organization's capabilities.
6. [Do not] renew a project that has failed once using the same system design and project organization.
7. Focus on business processes and requirements first.
8. Focus on achieving a healthy ERP ROI, including post-implementation performance measurement.
9. Strong project management and resource commitment [is a necessity].
10. Commitment from company executives.
11. Take time to plan up front.
12. Ensure adequate training and change management.
13. Make sure you understand why you're implementing [an] ERP [system].
15. [Ensure the] acceptance by the End-User Community and the Importance of Training.


All of these “helpful hints” are indeed important, but there is an underlying root cause to ERP implementation that has not been addressed.

The approach of this project analyzes the current ERP implementation market and focuses research around an actual in-process ERP implementation at XSS, a division of Company X. Company X is not unique in the way it began its ERP implementation. The ERP implementation is used as a case study to springboard concepts in Lean thinking, Conceptual Systems Design, and designing for operational feasibility through Design for Manufacturability (DFM).

Any large company considering an ERP implementation can utilize the strategy suggested in this project. Because the implementation process utilized by Company X is the standard process used by all large companies when implementing SAP (Mata, 2004), the strategy can be effectively implemented cross-functionally in any large company. The strategy is restricted to large companies because of the associated cost of implementing divisionally. Small to medium size businesses implement enterprise
resource planning systems in a much different fashion and therefore are not aligned to implement a system on such a grand scale.

2 Background of Company X ERP Implementation

The executives at Company X have chosen SAP to be the Enterprise Resource Planning system to replace legacy systems. The ERP modules consist of finance, materials manufacturing/transport, procurement, quality and safety, and contracts modules. Like most large companies, Company X bought the entire suite of SAP’s ERP Software Suite and is customizing it to fit the environment (Betts, 2009). Company X is considered a mature company in a mature industry. Even though Corporate Company X chose the ERP system, each division was given the autonomy to establish a reasonable timeframe for implementation. Each division has its own legacy systems in place that serve the same basic functions as the proposed ERP solution. Each implementation will also duplicate the same knowledge curve incurred by previous divisions because new individuals will have to understand the legacy systems and SAP system in sufficient detail prior to initializing custom views and processes to fit its function.

2.1 Overview of Industry

The Modern Aerospace Industry truly took shape in the 1950’s. In the 1950’s, the government had too many defense related projects to track and follow on a regular basis. Additionally, the projects it had were becoming extremely sophisticated. Because of this, the U.S. Government and defense contractors created sophisticated tracking methods for complex programs. Defense contractors used PERT, CPM and other methods to track the
schedule, cost, and progress of its defense projects (Morse, 2007). Defense contractors utilized super-computers to create systematic tracking and reporting of different programs.

The U.S. Government, impressed by the systematic ability to track, began creating specific systems requirements on large defense programs to track and report schedule and financial progress. As new programs were funded, newer, more sophisticated computerized tracking systems were created (Robinson, 2003). During the arms race of the 1970’s and 1980’s, a compounding number of comprehensive resource tracking systems were created to track material and data, all funded by the U.S. Government as part of the program systems requirements. This trend spread across all “projectized” corporations. An analysis of the commercial Aerospace Industry revealed a similar scenario where tracking mechanisms are a core requirement in large contracts.

2.2 Company

Company X and other aerospace companies created systems to track data and materials of specific programs. As it won program awards, it adapted new tracking systems from existing tracking systems to meet unique program. This was a cost-effective business strategy, because new programs were negotiated with Cost-Plus-Fixed-Fee contracts and new requirements and sufficient funding to implement their own tracking systems. Additionally, the commercial ERP market was still in its infancy, and did not maintain a system robust enough to satisfy unique U.S. Government requirements.
In the mid 1990’s Company X did an analysis of the company’s systems infrastructure, and found immense discontinuity. Each division employed a multitude of unique legacy systems. Very few of the legacy systems were integrated with the other systems. Even the corporate billing system required unique middleware for each division to allow payment of cross-divisional work.

Company X Information Technology (IT) specialists analyzed the market and the alternatives available. They investigated the possibility of a single companywide solution to replace the multitude of disjointed legacy systems currently in use. They found commercial Enterprise Resource Planning solutions now have the capability to track materials and data in a way that satisfies U.S. Government regulations. Most of the Commercial, Off-the-shelf (COTS) ERP systems on the market would require significant customization to satisfy U.S. Government requirements. One ERP solution, SAP, was sufficiently robust enough to track data in a manner that the U.S. Government approved. In fact, some military agencies had already employed SAP as their ERP solution (Flanagan, 2003).

Company X Corporate realized the company needed to create a leaner ERP process than what was currently in use. The cost of maintenance alone on the legacy systems justified the cost of an ERP software suite. Company X Corporate announced a corporate goal to have every division integrate their resource planning systems into SAP. Each division was asked to analyze the current state of its systems, including the number of systems, the data tracked in those systems, and whether those systems could be replaced with SAP.
2.3 Bay Area Division

Company X’s Bay Area division, also known as XSS, is considered a research and technology hub of the corporation. Many successful programs came out of the research from the Bay Area division. Many of these projects also remained in the Bay Area in production areas of the XSS. In terms of its usage of legacy systems, XSS was no different than any of the other divisions (Robinson, 2003).

By the start of the SAP implementation process, XSS was running over 75 different systems related to Manufacturing Resource Planning (MRP). Many of these systems had been storing, moving, and adding data for over 20 years (Robinson, 2003). XSS executives realized implementation of a single ERP solution of any kind would be a massive undertaking. Experienced consultants agreed that the amount of data migration required for an SAP implementation was astronomical (Moore, 2004).

2.4 Corporate Justification

An in-depth analysis of the cost of maintaining the legacy systems showed Company X was spending over $2.5 million per year in maintenance (Lee, 2003). The
cost of the solution itself could be recuperated within three years, even with system maintenance. The total implementation cost, however, extends the “break-even” significantly.

As illustrated by the chart below, the decision to move to SAP is not a short-term solution, but rather an intentional strategic move to become more competitive through increased data flow in the defense environment. If evaluated on the cost alone, it is clear that an ERP solution is not advantageous.

![Graph showing cost over time for legacy system maintenance and a SAP solution comparison.]

**FIGURE 2: BREAK-EVEN ANALYSIS: LEGACY SYSTEM MAINTENANCE ALONE**

Company X believed the streamlining of operations and data through a single system would reduce the cost of business. The single ERP solution would have farther-reaching affects than just cost reduction. The benefits of an ERP are described in detail in the
Lean Analysis section below. The ERP allows data flow between departments and programs that was not possible before. Executives realized the bid and proposal costs could be significantly reduced and accuracy could be improved based on an integrated system’s ability to track financial data of specific requirements (Gupta, 2003). Additionally, planning and tracking materials on large programs would be simplified from multiple manual transactions to automation.

Based on efficiency improvements and legacy system retirement, XSS believes implementation of a modern ERP will reduce business costs by $31 million per year, thereby achieving successful ROI in seven years.

![FIGURE 3: FINANCIAL BREAKDOWN OF IMPLEMENTATION COSTS](image)

<table>
<thead>
<tr>
<th>Financial Breakdown of Costs (in millions)</th>
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<tr>
<td>Year 1 Total Cost (trial)</td>
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<tr>
<td>Year 2 Total Cost</td>
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<tr>
<td>Year 3 Total Cost</td>
</tr>
<tr>
<td>Year 4 Total Cost</td>
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<tr>
<td>Year 5 Total Cost</td>
</tr>
<tr>
<td>Year 6 Total Cost</td>
</tr>
<tr>
<td>Year 7 Total Cost</td>
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<tr>
<td>Total (in Millions):</td>
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XSS management recognized this implementation as a strategic way to refine its processes and procedures, increase its efficiency, and reduce the overall cost of doing business. XSS first elected to implement at its commercial branch. This was due to the comparatively small amount of data migration required, and the less stringent auditing capabilities needed. It would also help train XSS employees the knowledge required to...
implement the system to all of XSS. XSS put together a team of systems and operations engineers and began setting goals for the first successful SAP go-live back in the late 1990’s. During the “trial” implementation, the team gained significant knowledge of the nuances and capabilities of the SAP systems, as well as the XSS legacy systems, which house all of XSS’s data.

The “trial” implementation consisted of 75 percent consultants and 25 percent XSS employees. The “trial” implementation was viewed as marginally successful by XSS executives. Systems were functional, but end-users were outspoken about limited system functionality, difficulty of data entry and analysis, and general systems limitations (Robinson, 2003).

XSS executives, determined to improve the implementation and system functionality at the division, established a larger technical team to implement SAP across the division. Moving from the “trial” implementation to the divisional implementation took time to secure capital funding and perform executive planning.

Two years passed between completion of the “trial” implementation and the start of the divisional implementation. XSS recognized a large portion of the personnel employed to implement the trial implementation were no longer available due to other consulting opportunities. Additionally, only one of the XSS employees actively involved in the trial implementation was still employed by XSS. Others had either been laid off due to economic conditions of the commercial market, or had used ERP implementation experience as a catalyst to move to other companies (Dewar, 2004).
3 Lost Strategy through Outsourcing

The use of consulting firms during the ERP implementation is substantial. In order to confirm the direction and necessity of the business environment, it is first necessary to define the various players and who they represent within a business context. The ERP being implemented can be considered a “product” such that it has a cost to create and maintain, and the expected outcome will be beneficial to the overall organization. Initially, external companies, such as SAP, would serve as the “seller” and Company X would serve as the “buyer”. This, however, is only one transaction of many that will occur during the ERP transaction process. Once the SAP software is sold to Company X, a new transaction begins. This transaction is the process of implementation.

In this second transaction, the Implementation Process is the end-product. Because XSS has accepted the software and responsibility for implementation, XSS’s steering committee is now responsible for choosing the implementation strategy and selling the end product (a useable system) to their customers, the end users.

This is an important distinction. By the point of implementation, the source of the software is irrelevant. Software could be developed in house or purchased. Either way, the company steering committee remains responsible for selling the idea to end-users, who remain the customers. Likely, executives will utilize valuable data that can be obtained through sophisticated ERPs, but that would be a product from the end-users, and thereby a future transaction. In summary, within the context of this research, steering committee executives are considered the sellers, end-users are the buyers, and the implementation process is the product.
Taking this structure into consideration, it is necessary to examine the value added by consultants during the implementation process. The current strategy of implementation at XSS could best be described as outsourced. In the XSS project, consultants comprised the majority of personnel performing programming, data migration, system review, preliminary systems analysis, and initial training.

Using Allen Hamilton’s flow for successful Business Strategy, the process utilized would be described in Section B6: Team Performance Management Plan. This is an
important distinction, because the strategy defined herein advocates a structure to support a Team Performance Management Plan for a large-scale ERP implementation.

At this point, it is important to understand the phase and scope of the project. From the data above, the buyer and seller have been established. The product has been defined as the “Implementation Process.” The purpose strategy within that process should optimize overall company success while minimizing cost and schedule. Within any project, there are several key elements that benefit from optimization. These include optimization of resources, optimization of schedule, and optimization of the process.

3.1 **Optimization of Resources**

By investigating the strategy as primarily outsourced, one must ask how beneficial it is for an outside entity to be implementing a strategic process. Using the statistical data described above, the average large company attempts to implement an ERP three times before it is successful (Hugos, 2003). Large companies do not arbitrarily risk $100 million to implement a system and yet, the success rate of the average implementation is staggeringly poor. Moreover, failure occurs during the implementation phase defined above. Statistically, of these failed projects 60% fail during the “Information Technology (IT) engineering” phase and 40% fail during the end-user implementation phase. Using this information, it is important to determine the causes of failure within these two distinct arenas to provide a framework to minimize failure in these stages.

It has been expressed that the number one reason for IT failures is project complexity (Mitch, 2008). “According to software architect Roger Sessions, the primary cause of software project failures is complexity. Complexity can create delays, cost overruns and
systems that don't meet business needs (Session, Microsoft Press, 2008). [The] goal should be to design the least complex architecture possible that solves the business problem.” (Mitch, 2008).

Understanding the danger of complexity to ERP implementation’s success, it is critical that business units understand the fundamental requirements of a new system. Given the customer is the end-user, and the end-user desires a system that “looks and feels” the same way the old systems felt, the seller is in a difficult situation to optimize a new ERP’s functionality while minimizing complexity of the system architecture. The team management plan shown in Figure 5 is critical to this step.

If the “look & feel” of the system are defined by the consulting firm, which is customary in the ERP implementation process (Mata, 2003), the required system functionality is left to an entity outside the organization with limited experience in the company’s market. In summary, the distinction of required and desired functions is lost if left to consulting groups. While required data may be common among divisions, it is not universal to users of SAP.

Unfortunately, in the case of XSS and most other large companies, the steering committee holding responsibility as the “seller” does not understand the required functions as compared to the desired functions (Bradley, 2005). As executives, they do not participate in adapting program requirements to system functional design. They defer that responsibility to the consulting firms hired to implement the system.
FIGURE 6: COMPANY X NEEDS AND CONSULTANT EXPERIENCE

Figure 6 describes the situation graphically. Consultants understand the requirements common to all ERP implementations. Some additional requirements are unique to certain industries. In the case of Company X, consulting firms boasted “aerospace implementation experience” when offering consultant services (Robinson, 2003). Ultimately, only Company X understands which system requirements are critical to its business processes and strategy. Executives understand the needs philosophically, but lack the practical knowledge of the legacy systems and dataflow requirements. End users hold the practical knowledge, but commonly lack the strategic vision held by executives.

In order for Company X to utilize the dataflow in the ERP to create a technical advantage, they need to create, learn and continuously refine the ERP to become a system that aids the overall company strategy. This is important because an ERP implementation in a large company represents an enormous capital investment to the company. The
perceived process streamlining vision that a modern ERP offers makes that investment worthwhile only if the vision can be carried out.

4 Proposed New Division of Company X

4.1 Traditional Team Description and Experience

The SAP team at Company X consists of approximately 40 employees and 95 consultants. Consultants admitted that they had not seen data tracking requirements and required procedures like Company X’s before (Moore, 2003). Company X did not regard themselves as unique in their data tracking requirements and quickly realized that U.S. Government requirements differentiated them from the commercial industry (Mata, 2004) thereby limiting consultant experience effectiveness. Individuals coming from other defense contractors acknowledged that their systems were equally complex to Company X’s (Wallace, 2003).

![Figure 7: Traditional Implementation Team Company Origin](image)

FIGURE 7: TRADITIONAL IMPLEMENTATION TEAM COMPANY ORIGIN
The lack of aerospace implementation experience contributes to the development and data migration difficulties Company X must overcome to implement SAP successfully. Consultant knowledge within XSS’s implementation team is typical of the industry (Gilman, 2005). Because of the unique data migration requirements, Company X spends a large portion of its time and capital educating consultants on the processes and procedures currently in place, data housing requirements, and appropriate migration techniques into SAP.

This education is time-consuming and expensive. XSS calculated that the first two years of implementation were spent educating consultants and XSS employees, and deciding upon the proposed software solution. Unfortunately for XSS, alternatives are not readily available. There are currently very few SAP experts in the aerospace market. The Company X employees and consultants assisting in the division’s implementation are essentially becoming another set of ERP implementation experts at Company X.

As mentioned previously, the quantity and the breadth of data migration required for implementing SAP at XSS is significant (Moore, 2003). The need for the data retention is based on U.S. Government traceability requirements of related hardware, software and facilities procurement with government funds. This data not only includes materials on-hand, but also materials that were on hand anytime in the last 10 years (FAR 52.213-3).

The loss of skill between implementation phases and large data migration requirements show clear inefficiencies. Consultant expertise in this arena is as varied as companies that implement ERP solutions. Even SAP consultants, who tout an Aerospace “Suite” with their software package, maintain a sophisticated knowledge of systems
requirements, but lack the “tribal knowledge” employees require to be successful in their positions. The technical knowledgebase required by these consultants is described below.

Presently, because the balance of personnel is highly skewed to the consultants, systems integration is largely focused around SAP functionality. XSS strategic initiatives are discounted by consultants. The Business Readiness Group, responsible for integrating systems and end-user required functionality, remains disconnected from system design.

Implementing solely with XSS employees would not resolve the issues described above. Optimization of this mix is critical. As discussed previously, the steering committee executives maintain a strategic vision, which they hope to accomplish by implementing a leaner resource planning system. XSS executives lack the practical knowledge of both legacy and SAP systems and thereby cannot accurately depict the operations required to bring a new system into being. Independent contributors collectively maintain the tribal knowledge and contractual requirements among programs, but lack the strategic vision held by executives. Consultants maintain a basic working knowledge of the system being implemented, but lack both the “tribal knowledge” maintained by independent contributors and the strategic vision maintained by the executives.

4.2 Justification for Division Creation

As mentioned previously, the learning curve of the SAP implementation is steep. Although Company X Corporate realized the costs of maintaining legacy systems, they
may not have fully realized the potential of the first successful SAP go-live. Company X’s implementation process requires each division to employ new resources, such as new consultants and a group of that division’s employees, to implement its ERP solution.

These new “teams” will once again learn the nuances of the market prior to implementing the ERP solution. The same issues will arise with data migration and maintenance. Training will have to be provided for the new group of consultants whose familiarity will be in the system architecture, but not particularly the industry.

4.3 Divisional vs. Intra-Company Work Transfer

By utilizing the same Company X resources that lead the first successful implementation, Company X can introduce a successful, tested, approved process to other divisions. The success, of course, is based on the success of the knowledge transfer that occurs during the initial implementation. This can be accomplished through the creation of a new division, especially designed to implement the ERP solution across the company.

The actual creation of a separate division is essential for several reasons. The creation of a division will allow the easy creation of long-term labor contracts with the team members without unnecessary bureaucratic intervention. This will ensure low turnover in the future and retention of the required knowledgebase throughout the implementation process. It will also allow maintenance of overhead rates through corporate oversight of overhead and indirect rates. This was successful in the past (Charest, 2002), and can be successfully used in the future to control costs and maintain
lower turnover. Indirect rate advantages are discussed in detail in the financial section below.

In the current company structure, XSS maintains a high profit margin due to the scope of work they typically undertake. As stated above, knowledge transfer is essential. Only XSS employees will have the unique knowledge required to implement the ERP solution successfully in other divisions with a minimal learning curve. By requiring XSS to transfer employees through intra-company transfer; it would have to use a lower profit margin to remain in compliance with company policy. Traditional intra-company work transfers are done at cost. Based on this structure, XSS would appear to be losing margin by internally outsourcing XSS employees, and executives would not want to support a business segment that has a lower margin than XSS. Therefore, it is in the company’s best interest to create a separate division to ensure adequate support of the members of that division.

4.4 Management Structure

Due to the projectized structure of the company, the management structure currently in place is reflective of the management structure in the new division. One unique feature of the division that is currently not in place at XSS is the introduction of long-term (seven year) contracts to individuals in the division. Because the knowledgebase is essential to successful SAP implementations, there needs to be a structure in place to minimize turnover. Currently, the bureaucracy at XSS makes approval of long-term contracts exceedingly difficult. The new division can employ long-term contracts as a means of retention. Based on the current market conditions and
history of employee loyalty, long-term contracts will minimize any turnover that may occur. Additionally, it will allow sustained growth of the knowledgebase as the ERP division implements at other Company X divisions.

4.5 Economic Background and Justification

By completion of the XSS implementation, XSS estimates the total cost of the SAP implementation will be $120 million. The implementation process is expected to last seven years total, including a “test” implementation using the commercial space division described above. The XSS implementation process is approximately five years. As stated previously, a ratio of approximately 75 percent consultants and 25 percent Company X employees has been utilized.

The use of consultants is necessary due to Company X’s unfamiliarity with SAP. Company X employees are utilized for their knowledge of legacy systems, existing data, government requirements, and knowledge of programming. They are slowly taught the functionality and programming behind SAP. A comparison of the delta between the consulting rates is listed below.

NOTE:

*Because the financial analysis is specific to Company X and the SWOT analysis is general to the strategy, it was included at the end of the report.*
FIGURE 8: COMPARISON OF RATES BETWEEN COMPANY X AND CONSULTING FIRMS

The positive deltas between the negotiated consultant rates and Company X’s internal rates are significant. Therefore, on a purely financial basis, there is significant justification to reduce consultant headcount wherever possible and replace it with Company X employees’ hourly rates.

Based on the removal of most consultants alone, the cost reduction of an implementation would be over $50 million. Before assuming the rate delta will result in savings, indirect rates, learning curve, existing middleware, ROI, and possible post-implementation usage must also be taken into consideration.

4.5.1 Indirect Burden.

Indirect or burdened rates between divisions vary significantly. XSS has a significant burdened rate due to its location in the Bay Area, the age of its buildings and equipment, and other significant infrastructure costs. These indirect costs create a burdened rate of over 300 percent. Because of this, an XSS employee’s impact to capital
actually exceeds the consulting rates above. Other XSS divisions have achieved overhead rates of less than 200 percent in order to maintain consulting relationships with the U.S. Government for specific projects (Charest, 2002).

The consulting firms employed by XSS significantly reduce burdened rates by avoiding facilities expenses. Consultants travel from across the world weekly and meet physically in the XSS division. They charge XSS directly for travel expenses and overhead costs are once again avoided. An evaluation of the above consulting firms’ travel expenses revealed a total cost 1.6 times the direct rate (Robinson, 2003).

This is because consultants are dispersed globally, and can seek reimbursement for rates deemed reasonable by the U.S. Department of Transportation. Reasonable rates include a coach class seat on most U.S. airlines, up to $52 per day in meals and incidentals, and lodging reimbursement up to $140 per night legal, finance, and administrative functions. A study of consulting travel expenses revealed an average roundtrip cost of $590 per consultant during the implementation at XSS. Combined, this totals an additional $782 per consultant per week. This can quickly escalate what seems to be a reasonable consulting rate into an excessive cost.

Creation of an implementation division would create significant costs savings in this area. As stated previously, Company X’s indirect rates have been reduced to less than 200 percent. These rates still require building and facilities maintenance. The new division would be able to establish its “home base” at the division in which the implementation is being administered, just as consulting firms do. This would help enable additional overhead reduction. The new division’s indirect costs would only consist of retirement (401k), benefits, and large company double taxation, all of which
amount to 82% of direct wages. Additional costs, including legal, finance, and administrative functions, have been centralized and are not charged to other divisions during intra-company work transfers.

4.5.2 Cost Reduction.

The positive delta in costs between Company X and consulting rates is significant. By utilizing the Company X new divisional burdened rate of 182 percent, this would reduce the hourly cost to Company X by 52 percent compared to SAP consultants and 5 percent as compared to Deloitte and Touche. Company X would initially require some consulting resources to assist in the implementation processes that are core to every implementation. During the second ERP implementation, if only Company X employees are utilized, an instant cost reduction of 28 percent, or $33.6 million will be realized.
4.5.3 Strategic Alliance.

While elimination of consultants is financially advantageous, it is not realistic nor in the best interest of Company X’s strategy. Instead, it is best to optimize the consulting assistance utilized. As shown in Figure 6, there is a portion of ERP implementation that is common to all implementations. This is disjointed from the company strategy and involves a highly technical task team to refine code and streamline that code to fit Company X’s strategy.

Based on the XSS implementation, this conservatively reflects 25 percent of the employees, and the overwhelming majority are employed by SAP. Regardless of the experience a Company X employee gains by working with the implementation team, an SAP consultant will have broad applications knowledge that will assist in situations that a Company X employee may not be able to address. Company X executives estimated a
Company X employee can gain 80 percent of the required knowledge prior to completion of the XSS implementation (Lee, 2003). Therefore, it is sufficient to have a 25 percent buffer.

Using the analysis above with the added assumption that 25 percent of SAP consultants will be maintained for highly complex data migration and programming, a cost reduction of 12 percent, or $14.4 million would be realized.

The use of SAP consultants is expected to continuously decrease as Company X’s new division gains the applications-based experience currently held by a select number of SAP consultants. Over the proposed implementation period, Company X could continuously reduce critical consultants by a conservative estimation of 10 percent per annum due to knowledge transfer that would continuously occur during the ERP implementation.

![FIGURE 10: PROPOSED PERCENTAGE OF CONSULTANTS TO EMPLOYEES](image-url)
4.5.4 Learning Curve.

The learning curve represents a significant portion of money, time and effort on the ERP implementation. The quantity and quality of data being migrated represents an immense hurdle. Even the ERP project manager did not realize the “miserable state of the data” (Lee, 2004). Therefore, even after the Company X implementation team learned the intricacies of SAP, Company X had to develop unique ways of categorizing data in such a way that it could be migrated by middleware.

As described previously, the first two years of the XSS implementation were spent as a trial implementation at XSS’s commercial segment. The proposed division would eliminate the need for trial implementations completely thereby reducing the implementation cost by $10 million.

Assuming there is some learning curve required for each site’s legacy systems, the first year required for implementation at a new division will be spent adapting existing middleware from previous implementations to be sufficient to move legacy data into SAP. The annual implementation cost would then be eliminated from the first two years in the chart below.

<table>
<thead>
<tr>
<th>Financial Breakdown of Costs (Millions)</th>
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</thead>
<tbody>
<tr>
<td>Year 1 Total Cost (trial)</td>
</tr>
<tr>
<td>Year 2 Total Cost</td>
</tr>
<tr>
<td>Year 3 Total Cost</td>
</tr>
<tr>
<td>Year 4 Total Cost</td>
</tr>
<tr>
<td>Year 5 Total Cost</td>
</tr>
<tr>
<td>Year 6 Total Cost</td>
</tr>
<tr>
<td>Year 7 Total Cost</td>
</tr>
<tr>
<td>Total (in Millions)</td>
</tr>
</tbody>
</table>

FIGURE 11: FINANCIAL BREAKDOWN OF ANNUAL IMPLEMENTATION COSTS AT XSS
SAP will replace 72 legacy systems at XSS. Of those systems, 30 are end-user applications, and 42 are intermediary applications used to connect end-user systems to other end user systems. A discussion with an individual from a sister division showed that other divisions had similar circumstances (Elimen, 2004). That retirement will save Company X approximately $2 million annually upon retirement of these systems (Gupta, 2003). By reducing implementation by two years, the new division will save Company X an additional $4 million by retiring legacy systems two years sooner than under the existing 7 year implementation strategy.

4.6 Financial Benefits of Reusability

Using one of the philosophies of Design for Manufacturability (DFM), software “reuse” can create a tremendous advantage to the implementation process. Because the conversion middleware is adaptable, additional savings will come through the reuse of middleware as opposed to re-creation. Consulting software engineers working on creation of XSS middleware and data migration revealed that approximately 40 percent of the middleware created for data transfer could be re-used within other divisions (Mata and Ferrario, 2004). The remainder is so highly customized for legacy applications, that it would be simpler to create new middleware to convert the data.

Another major software development savings comes from the lack of customization to SAP. Once it has been established at XSS, the same system can be used in other divisions. The reason this can be assured is due to the similarity between different defense customers. The customization currently being done to SAP is based on U.S. Government prime contract requirements. Those requirements are similar across the...
company. For example, every Navy contract contains similar financial reporting requirements. Because XSS has already customized SAP for XSS and will require approval of the Defense Contract Management Agency (DCMA) prior to implementation completion, no additional development is needed for the end product. This will be discussed further in the Lean section below. This has additional opportunities in the global aerospace and defense market, which will be discussed in the SWOT analysis section.

4.7 Breakeven Analysis

Ultimately, executives are responsible for improved efficiency through utilization of the new systems. Efficiency alone is not enough to sway a company to spend hundreds of millions on capital. As described above, Company X estimates $120 million in capital will be expended upon implementation of SAP to division XSS. Using the standard implementation process, XSS will break even in seven years based on efficiency estimates by XSS executives.

Company X, on the other hand, must continue to allocate $120 million per implementation, similar to their first implementation when implementing SAP at the four other divisions. Continuing the seven year implementation span, a total of $240 million, plus inflation, will be expended by completion of the second implementation. Upon implementation at the third division, this cycle once again repeats itself. Implementation at all divisions would take 35 years due to repetitive seven year implementation spans using the standard process. Multiple implementations can occur simultaneously, but
costs would simply be incurred more rapidly, and risk of connectivity loss between divisions would increase.

Costs rises exponentially as additional divisions implement. Costs of legacy system maintenance eventually drops below the cost of implementation, but additional legacy systems are introduced as soon as one division completes implementation and the next division begins implementation.

![Graph showing the relationship between ROI, ERP Cost (SAP), and Legacy System Efficiency & Maintenance over years.](image)

**FIGURE 12: LEGACY SYSTEM MAINTENANCE BREAKEVEN IN TRADITIONAL IMPLEMENTATION**

Over the implementation life of SAP, a break-even is expected to occur 13 years after XSS implements SAP.
4.8 Time Efficiency Gained

From an efficiency perspective, a 35 year implementation on a lean process is not optimal. Company X wants to implement SAP as quickly and efficiently as possible. Implementation of a new division is critical in reducing implementation spans and maintaining strategic knowledge transfer. Utilizing knowledge gained, the first two years of implementation are cut out of the implementation schedule due to elimination of redundancy at project start. By utilizing EASDEC and Lean processes described below, standard spans can be further reduced by implementing efficiencies such as learning curve reduction within the implementation process.

Removing two years from an implementation span is only a small part of EASDEC and Lean philosophies. The re-education and reevaluation of the product is waste in the lean perspective. Utilization of a dedicated division will ensure the learning curve effect is not present during the second implementation. Additionally, the software standard will be established by the division, ensuring that reevaluation of a software solution is unnecessary.

FIGURE 13: BREAK-EVEN AND LONG TERM SAVINGS FROM NEW DIVISION
FIGURE 14: NORDEN-RAYLEIGH CURVE OF FUNDING PROFILE OVER TIME

By reducing the implementation time to five years per division, the overall implementation at Company X is reduced by ten years. Upon implementation, the ERP efficiencies are realized thereby creating positive gains on capital expenditures. This continues into the second year and accumulates as added gains are made to reduction in capital expenditures. By utilizing the same core team of individuals, the knowledge base is maintained, and the strategic company initiative is maintained by employees that have “bought into” the company strategy and understand the environment in which the company thrives.

Using Lean and EASDEC philosophies, implementation time can be further reduced. An analysis of the efficiencies gained through Lean and EASDEC suggest that the final division would actually have an ERP implemented in less than three years.

4.8.1 Existing Middleware.

As mentioned earlier, the usage of custom middleware for data migration is extensive. Additionally, a large amount of middleware remains in existence after implementation is complete. The main intent of the middleware is to create a medium by
which critical data can be extracted from legacy systems and automatically categorized and transported into SAP. Because the fields are not identical, the conversions are not simply “one for one”. Commonly, legacy system data is transferred into a text file, commonly referred to as a “flat file” by data programmers. The flat file is then reformatted into columns and rows that can be transferred into SAP. These unique programs perform the functions above in order to lessen the manual data entry required.

While many systems are customized for XSS programs, Company X Corporate has determined solutions for several lines of business, including Human Resources and Accounts Payable that are common across all divisions. Like all other databases, middleware is required to establish trigger functions in SAP that flags actions in the Corporate systems. By using the proposed strategy of creating a new division, middleware and trigger solutions can be reused in every implementation. The use of a single division to implement future implementations will reuse existing middleware wherever possible, which will lower the cost. Middleware code development cost XSS approximately $15 million (Lee, 2004). By eliminating 40 percent of the middleware development in the subsequent divisions, company X will save $6 million per implementation in middleware development costs.

4.8.2 Potential Cash flow.

The resulting savings from the ERP Implementation Division are $78 million.
TABLE 1: ESTIMATED SAVINGS DUE TO SAP IMPLEMENTATION DIVISION

In order to calculate the true benefit of the new division, it is necessary to analyze Company X’s financial performance during 2003. Because the implementation is being treated as a capital expense, it is depreciated over a ten year period. A decrease in Capital Expense by $34.4 million brings about the following results to Company X financial data:

a. If the additional $34 million bi-annual savings (assuming a two year implementation reduction) was reinvested in the company, it would have the following effects on the financial statements:
   
i. Capital Expenditures decreases from $687 million to $653 million
   
   ii. The savings could increase equity by 11.82 percent. This could be distributed to the shareholders to increase the value of the stock.

   iii. It is assumed that the retained earnings will be used to increase income. Because Company X’s current ROI is 4.02 percent, the additional retained earnings could potentially produce additional revenue for Company X. Based on the $34.4 million reinvested in profitable ventures, the additional revenue Company X could compound is over $205 million.
<table>
<thead>
<tr>
<th>Year</th>
<th>Capital Savings reinvested (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$6.88</td>
</tr>
<tr>
<td>2</td>
<td>$7.16</td>
</tr>
<tr>
<td>3</td>
<td>$7.44</td>
</tr>
<tr>
<td>4</td>
<td>$7.74</td>
</tr>
<tr>
<td>5</td>
<td>$8.05</td>
</tr>
<tr>
<td>6</td>
<td>$8.37</td>
</tr>
<tr>
<td>7</td>
<td>$8.71</td>
</tr>
<tr>
<td>8</td>
<td>$9.05</td>
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<tr>
<td>9</td>
<td>$9.42</td>
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<tr>
<td>10</td>
<td>$9.79</td>
</tr>
<tr>
<td>11</td>
<td>$10.18</td>
</tr>
<tr>
<td>12</td>
<td>$10.59</td>
</tr>
<tr>
<td>13</td>
<td>$11.02</td>
</tr>
<tr>
<td>14</td>
<td>$11.46</td>
</tr>
<tr>
<td>15</td>
<td>$11.91</td>
</tr>
<tr>
<td>16</td>
<td>$12.39</td>
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<td>17</td>
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<tr>
<td>18</td>
<td>$13.40</td>
</tr>
<tr>
<td>19</td>
<td>$13.94</td>
</tr>
<tr>
<td>20</td>
<td>$14.50</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$205</strong></td>
</tr>
</tbody>
</table>

TABLE 2: CAPITAL SAVINGS PROFIT POTENTIAL

There are a myriad of ways the financial structure can be modified. For example, it could be assumed Company X’s intangible assets could increase by the cost savings that would occur as a result of the division creation. In order to provide an example of potential effects to the overall value to shareholders, the most conservative methods were used when calculating changes in value of the corporation.

Based on the information above, a single implementation using the proposed strategy will save the corporation significant capital. Over the five implementations, the potential savings to Company X is significant. Taking the time value of money into consideration, a new division creates huge potential for extra capital over a 20-year period.
5 Assessment of Core Competencies and Strategy

Company X’s core competencies are vast in the areas of defense and data tracking, but not in the modern ERP arena. Company X employs hundreds of software engineers with the ability to program and modify almost any system in existence. Company X’s core competencies truly lay in designing state-of-the-art aerospace technology and establishing the systems integration required to put cutting edge ideas into production.

The strategy described above can be used advantageously at XSS during the first implementation. The subsequent sections describe the specific aspects of the implementation at XSS and how the proposed new division would interact with the implementation process to maximize efficiency. Because XSS is in the midst of implementation, the subsequent sections are hypothetical. Utilization of the proposed strategy describes how the implementation would have been if the strategy had been implemented. Because there are two separate instances on which this strategy is based, it is important to address the two “phases” separately.

5.1 Phase 1 – Pre-XSS Implementation Completion

Prior to XSS implementation completion, the knowledge-based resources Company X employs are limited. The physical resources are more than sufficient. In essence, the knowledge required to implement SAP is being transferred during the XSS implementation process. While the intent of this strategy is not to pinpoint the specific resources needed, it is important to address the areas of knowledge and knowledge retention required to successfully implement SAP.
5.1.1 Technical Resources.

The technical knowledge required for implementation includes understanding of the code, table structure, and required flow that is standard in SAP. The core of the technical understanding of SAP is referred to as ABAP. ABAP maintains the table code and structure that runs the graphical user interfaces and dataflow through the system. As Information Systems individuals gain expertise in ABAP editing and integration, they will be able to customize SAP to the requirements of each division. Additionally, since many of the nuances required in the defense arena will be repeated across divisions, the learning curve even for trained Company X employees will be reduced due to what is essentially a repetition of software modification that has already occurred. Initially, this is where the greatest percentage of SAP consultants will be maintained, as the ABAP programming language is common to all SAP implementations.

5.1.2 Operations Resources.

Operations resources are necessary to the success of the ERP. They are not only going to be the end-users, they will also relay the requirements of the defense arena to programmers to ensure the requirements of their government contracts are met. Additionally, most of these requirements are based on government requirements that define the way business must be performed in order to be compliant with the government’s standards. Another aspect of operations requirements is feedback and approval of the Defense Contract Audit Agency (DCAA) and the DCMA. Operations employees are responsible for ensuring that the material, cost and schedule accounting in the ERP meet U.S. Government requirements.
5.2 Phase 2 – Post-XSS Implementation Completion

5.2.1 Technical Resource.

The Post-XSS technical resources must understand the ABAP programming technology and its relation to Company X ERP and program requirements. Middleware and transition techniques required to transition data into SAP must be made available for modification and reuse to transition data in other Company X divisions. While Company X legacy systems are unique to the commercial world, they are common to defense programs (Wallace, 2003) (Mata, 2004). Data flow will also remain similar.

5.2.2 Operations Resources.

Company X engineers must organize the tables and workflow in SAP in such a way that the DCMA and DCAA have approved SAP for use at XSS. DCMA and DCAA need only approve the system once, assuming the data structure remains unchanged. For example, if one program governed by the same customer in a different division establishes a material or a process and that material or process is approved, other divisions can easily transition this material or process to meet their program’s requirements. It could be viewed as a legal precedent. Once it is approved in one area by one region of the DCMA and DCAA, it can easily be approved in other regions if the argument is compelling enough that the two systems are the same or similar.

5.2.3 Knowledge.

Transfer of knowledge is not an explicit part of the XSS go-live. Instead, it is implied at best. If knowledge transfer is not an integral part of XSS go-live, a huge demand is instantly created for future consulting. This could be viewed as the “Can’t see
the forest for the Trees” phenomenon. Company X employees can easily become so involved in the current implementation that they will not strive to achieve additional knowledge for future implementations. This translates into continued requirements for consulting services, which ultimately means additional costs. Additionally, there is no requirement for XSS employees to assist in future implementations, nor is there a structure to allow this. XSS employees are therefore unaware of the potential benefit of the knowledge they can gain. The transfer of knowledge is essential, and should be at the core of the XSS go-live. This is best achieved through corporate acceptance of the described strategy.

5.3 Market Position as a Strategic Advantage

If Company X continues its outsourcing strategy, it will inevitably train the consultants to the various nuances of the defense industry. Since Company X is essentially at the forefront of defense contractors with regards to an integrated ERP, it has the ability to create an integrated resource planning system that satisfies its own strategy. Once this is complete, Company X consultants can take “lessons learned” to other companies. They can then use those lessons learned to create an advantage by refining the systems Company X has in place to maximize productivity based on the learning that took place at Company X.

If Company X maintains the knowledge base created during the XSS implementation through the proposed strategy, it will create several strategic advantages. First, it will gain the financial advantage described above. Additionally, it will build its
overall dataflow advantage and reduce the opportunity for dataflow strategies to be “taught” to competitors through consultants.

5.4 Network Compatibility

As described previously, Company X’s systems are extremely disjointed. Additionally, because drastic changes are often resisted (Lethem, 1989), different divisions could easily customize SAP in such a way that other divisional systems become incompatible (Flanagan, 2003). When a particular division creates its own process-flow requirements independent of other divisional inputs or knowledge, this is a very real threat.

If the proposed strategy is not utilized, Company X could choose to implement SAP within multiple divisions simultaneously. As stated previously, this increases risk of customization that prevents cross-divisional dataflow. The enormous capital requirements of multidivisional implementations typically prevents this from occurring (Flanagan), but it remains a real threat if the proposed strategy is not utilized.

6 Maximization of Knowledge Transfer

Knowledge transfer is at the core of the proposed strategy. There are multiple facets of the knowledge transfer that must be recognized. The industry, size, and end-user characteristics are all important factors. The size of the other divisions may make knowledge transfer difficult due to the time required to sway political factions (Liker, 1997) and the short schedule of an implementation. The high levels of bureaucracy in the
defense industry may also play a role, providing additional difficulties in swaying other parties. (Liker)

The dispersion of knowledge will occur in the following manner. Initially, SAP consultants will transfer sufficient knowledge to Company X’s new division employees to allow them to implement SAP in XSS (1.). Following this, Company X employees will transfer knowledge in a similar fashion to the rest of the company, one division at a time (2).

FIGURE 15: KNOWLEDGE TRANSFER OF NEW DIVISION PRE-XSS IMPLEMENTATION

After XSS go-live, the knowledge transfer will involve dispersing the knowledge obtained by XSS to the rest of the company. As stated previously, some SAP consultants will remain under contract for required knowledge that either has not been transferred
prior to XSS go-live, or knowledge that is unique to the ERP environment and not particularly the defense environment that is required for future implementations.

FIGURE 16: KNOWLEDGE TRANSFER OF NEW DIVISION DURING XSS IMPLEMENTATION

6.1 Communication

Communication is essential in every level of the knowledge transfer; in fact, it creates a means for knowledge transfer to occur. High levels of communication must occur constantly to ensure the transfer of knowledge (MacDuffie and Helper, 1997). Once the division has begun implementing SAP at sister divisions, additional communication will be required between the divisions. This will allow the sister divisions to not only feel the impact of the implementation on them, but also observe the implementation at other divisions (Liker, et al). The ultimate result will be increased
FIGURE 17: KNOWLEDGE TRANSFER OF NEW DIVISION POST-XSS IMPLEMENTATION

As stated previously, the initial communication and persuasion to XSS executives has already occurred during the implementation at XSS. They are now responsible for persuading the user community to accept the new process. Techniques on change management are described in a subsequent section, but the core of their message should be a realistic portrayal to users of what the future holds and how they can prepare (Lethem, 1989).

During future implementations, new division executives must relay information to those divisions in a way that assists in the adoption of the ERP. The XSS team must also communicate the benefits witnessed through implementation of the ERP and drawbacks
to ensure lessons learned are identified and corrected. Failure of communication at this level could easily result in failure of the ERP. (Liker)

6.2 Phases of Knowledge Transfer

The transfer of knowledge occurs in four phases. There are several key areas where knowledge transfer must occur during the implementation process. Those areas include pre-implementation knowledge, post-implementation knowledge, review of knowledge and finally knowledge transfer to other divisions. The pattern could be seen as cyclical, in that each implementation could be seen as a separate transaction.

During the Pre-Implementation transfer, new division employees will create a knowledge base consisting of three vital components:

1. Company X requirements to the U.S. Government.

Use or disclosure of the data contained on this sheet is subject to the restrictions on the cover page.
2. SAP functionality, including standard SAP functionality, SAP language, and understanding of middleware required to convert legacy data into SAP data.

3. Company X legacy systems data, including all key functionality of reporting requirements to the U.S. Government.

These components are all critical during the implementation process to ensure knowledge is sufficiently transferred such that continuous learning leads to continuous reduction of the learning curve from one division to the next.

7 Lean Processes

7.1 Application of Lean Processes

In order to improve upon the above strategy, “Lean Thinking” and “Design for Manufacturability (DFM)” concepts are evaluated for use to improve process efficiency. Additionally, utilization of the EASDEC methodology creates a roadmap to reach an unfailing strategy through Lean Thinking and DFM. EASDEC is a Lean thinking tool that stands for Explore, Analyze, Strategize, Decide, Execute and Control. The EASDEC approach drives dimensions of the proposed strategy, which consists of value, core competencies and boundaries. EASDEC identifies tools to pinpoint and identify the competitive advantages of the proposed ERP implementation strategy along with its schedule reduction and cost avoidance.

Lack of DFM concepts and Lean Thinking in an organization can result in lack of optimization. One result from overlooking these key areas is lack of commitment from the top management, which is often experienced when a new strategy/technology is proposed without adequate prior analysis, market research, technology survey and
sufficient backbone to control and maintain the new technology/strategy. This cascades into a series of undesirable events, including inadequate time and resource planning, inadequate scope definition, insufficient functional requirements definition, deficiencies in quality development, and ultimately improper selection of an ERP system as well as its implementation method. All of the above issues can be resolved through application of DFM techniques and Lean Thinking through the EASDEC method.

7.2 EASDEC

7.2.1 Explore

During the “Explore” phase, the focus is on exploration and observation of current market trends (Saeed, 2009). In the case of Company X, it must analyze and identify the nature and the extent of residual uncertainties that large companies are facing when choosing to implement a new ERP system. During this phase, focus is necessary on emergence and obsolescence of the existing capabilities, budget, schedule and performance.

When exploring the operating environments, Company X must consider potential customers’ shifting preferences and retentions, and gain an understanding of competitors’ cost structure. Company X must reflect heavily on their new business model, including focus on new technologies and competing standards.

7.2.2 Analyze

At the Analyze phase, Company X’s primary objective must be to understand the cause-and-effect by answering “how to implement”. Core processes, overall system economics and dynamics involved with large scale ERP implementation are analyzed. Company X must use core process mapping and benchmarking against the existing
implementation strategies practiced in the industry. Utilization of high level core process mapping and benchmarking techniques are advantageous due to relevant dimensions of strategies of the existing processes as well as the relevant system economics and dynamics. It is at this phase where Company X discovers the existing and potential biases. It is also at this phase where change management considerations are made.

Variations exist in decision makers’ willingness to change. This is derived from their levels of uncertainty when trying to adopt a new business model or investing capital in new technologies (De Meyer, 2002). Once the above components are identified and examined in the Explore and Analyze phases, Company X must develop a Lean strategy that would minimize or eliminate the existing problems large companies face when trying to implement an ERP system. Redundancy of implementation processes represent one area where these variations are identified.

7.2.3 Strategize

In the “strategize” phase, Company X generates a set of options based on lessons learned in the Explore and Analyze phases to improve strengths and lessen the weaknesses of the existing implementation strategies. At this stage, Company X must analyze the strengths and weaknesses of ERP implementation strategies practiced by other large companies when SAP consultants are hired to meet all implementation objectives.

Through strength and weakness brainstorming initiatives, options are identified and change management strategies are developed (Saeed, 2009). The SWOT analysis is a tool Company X can use to identify the involvement of the appropriate individuals
required to develop and communicate ideas, ensure change management issues are resolved, and pursue the new strategy.

7.2.4 Decide

Through the Explore, Analyze and Strategize phase, operating environment, market, existing technologies and strategies were analyzed. In Table 3 below, the Lean concept addresses waste at three levels required in implementation of ERP systems:

<table>
<thead>
<tr>
<th>Waste</th>
<th>Translation</th>
<th>Stage</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muri</td>
<td>Overburden</td>
<td>Design</td>
<td>Work that can be proactively avoided</td>
</tr>
<tr>
<td></td>
<td>Unevenness</td>
<td>Implementation</td>
<td>Fluctuations in volume, quality, delivery, etc.</td>
</tr>
<tr>
<td>Mura</td>
<td>Activity that is not useful</td>
<td>Execution</td>
<td>Work that can be eliminated reactively</td>
</tr>
</tbody>
</table>

TABLE 3: LEAN (TOYOTA BASED)-THREE TYPES OF WASTE

By eliminating many of the redundancies (Mura and Muda based wastes) in the existing implementation methods, both the implementation cost and schedule can be reduced. As discussed previously, the effect of eliminating redundancies in a typical ERP implementation reduces additional waste. Nevertheless, it is important to note that the concept of Lean and DFM techniques are intertwined in this case and both are necessary to reduce implementation cost and schedule.

Reusability and Recycling are examples of Lean and DFM concepts. These concepts look to minimize and eliminate waste through design for reusability and recycling. As stated previously, Company X can reuse 40 percent of the middleware created during XSS's implementation on future implementations.
DFM leverages mass customization. Through mass customization of the ERP solution across multiple divisions, companies can sway the new division for a customized yet standardized solution that will work for all divisions.

The 5S model in ERP implementation is another effective Lean tool that identifies and eliminates non-value added activities and wastes.

FIGURE 18: 5SIGMA IMPROVEMENT CYCLE

In the first step, Simplify, 1S simplifies the process by avoiding wasted tasks. Examples of wasted tasks include retraining and redundant implementation phases.

Straighten, 2S, aligns ERP strategy to key corporate objectives. It is used to analyze requirements and legacy data to determine necessary migration through 3S. 4S assists in the systematization of the organization at which the ERP is going to be implemented. It addresses the necessity of organization and orderliness in the working environment. It highlights sharing the knowledge and the lessons learned in the most efficient and effective manner, which impacts redundant training for future implementations and system maintenance.

5S offers a set of guidelines to standardize processes. It is necessary to standardize the ERP implementation across the company thereby eliminating redundant
efforts and maximizing company values and strategy. Through definition of the strategy, clear objectives need to be defined to execute the new strategy. This is accomplished in the Execute phase.

7.2.5 Execute

In the Execute phase, the initiatives are implemented using previously defined methodologies. This maximizes the probabilities of being on-time, within budget and within specification (Saeed, 2009). Once the appropriate methodologies are selected, effective management of each initiative is necessary to ensure initiatives are implemented.

<table>
<thead>
<tr>
<th>Effect</th>
<th>New Capability</th>
</tr>
</thead>
</table>
| Significantly Lower Cost with Minimal Time to Implement | • A Lean ERP Implementation Strategy  
• Updating Existing Legacy Systems while ensuring compliance with the New System  
• Maintaining the Functionalities of the Existing System Throughout |
<table>
<thead>
<tr>
<th>Capability Substitution</th>
<th>Methodology</th>
<th>Locus</th>
<th>Improvement</th>
</tr>
</thead>
</table>
| • BUY (Make vs. Buy)  
• Maximize the use of in-house resources for implementation process following the new strategy | • Corporate executives  
• Business Managers  
• Process Improvement Teams | Structural |

TABLE 4: ERP IMPLEMENTATION STRATEGY THROUGH CAPABILITY SUBSTITUTION

Execution is critical to post-implementation process maintenance. Company X needs to maintain its strategy and processes so that future divisions can continuously reduce cost and schedule of their respective implementations. In addition, the employee
training must consist of the necessary functions to maintain the systems and processes throughout system life.

Continuous utilization of EASDEC, DFM and Lean-thinking will result in the following benefits:

1. All non-value added activities within implementation steps will be eliminated
2. Legacy data maintenance will be reduced
3. Need for outsourcing will be minimized
4. Redundant post-implementation activities will be prevented
5. Continued optimization of in-house labor will be maintained

7.2.6 Control

The Control phase focuses on ensuring improvements are maintained and environmental changes are detected. Control results in effective risk management and proactive reduction. In such events, appropriate countermeasures are put into place to address company risk management issues. Some necessary control mechanisms incorporated upon implementation of the new ERP system vary based on the parameters that would need to be controlled. Variance analysis, balanced scorecards, enterprise risk management training and control mechanism choice frameworks are all necessary tools that Company X should utilize in the control phase (Saeed, 2009).

7.3 Change Management

Studies of change management are vast. For the purposes of the new division, it is most important for other divisions’ executives to understand the importance of change management. Executives should begin with a lenient approach where they provide as much information as possible regarding the change and attempt to persuade the user community to accept the change. For those who are still reluctant, the hammer approach
should be taken whereby management forces the user to either accept or find another place of employment (Lethem, 1989).

7.3.1 Resistance

There are two major types of resistance: Active and Passive. An active resistor will refuse the change actively, by voicing negative opinions about the project, complaining about lost productivity regarding the change, and attempting to persuade others to follow suit. Passive resistors will not directly resist the change, but will avoid the change in such a way that it affects the change’s ability to be successful. Actions can include “forgetting” to attend critical meetings, continuing to use a legacy system whenever possible, and avoiding any training related to the new system (Struckman, 2003).

One of the best ways to minimize resistance is through communication. XSS can minimize resistance through a classical “train the trainer” process. Within this process, each division selects individuals from each user group and trains them on the functionality of SAP in advance. These user-communities then return to their respective groups and pass on that knowledge. This has not only increased the awareness and usability of the system, but also allows users to feel like they are contributing immediately upon implementation completion.

In addition, the new division can hold periodic “lessons learned” sessions whereby knowledge transfer can continue cross divisionally. Divisions currently undergoing implementation can speak directly with divisions utilizing the implemented system and discuss functionality improvements and potential roadblocks that may be encountered upon end-user training.
7.3.2 Chaos and How to Control It

Change management, when not executed properly, leads to chaos in organizations. Existence of uncertainties is natural in new strategic developments. Employee flexibility is critical to enable companies to identify and optimize the approach and timing in order to counter this potential chaos (Stanley, 2006). Different management styles are required to meet these objectives.

During implementation of the described strategy at Company X, utilizing the following steps can minimize potential chaos. First, the new division executives need to ensure that aspects of the future activities are strategically aligned with Company X strategic plans by reviewing lessons learned from previous projects and the climate of the current market. Next, Company X executives and new division executives must establish a culture within the organization to support an environment of change.

Once these two objectives are met, “strategic project management best practices” can be implemented, leading to an effective strategic project management system. This system aids Company X executives in maintenance control of the organization, as well as promoting a culture of change, and building confidence in the organization.

7.3.3 Unique Configuration

Custom middleware will always be required when migrating data from the legacy systems into SAP. The use of existing middleware will allow Company X to minimize the amount of configuration, but some customization is inevitable. If certain programs require customization that is not feasible with SAP, Company X has the option to retain existing legacy systems or develop new customized systems separate from SAP to accommodate these requirements.

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7.4 Data Redundancy Possibilities

There are a myriad of ways to backup legacy data without maintaining the systems. The current strategy is to maintain legacy systems until a date when XSS feels sufficiently convinced that the data in SAP is complete. This process may take years. If other divisions share a common strategy, they reduce the risk of losing data and therefore can retire legacy systems sooner. Since the estimated upkeep of legacy systems is $2 million per year, this can add to the substantial savings already being made through the creation of the proposed new division.

8 SWOT Analysis

8.1 Strengths

The biggest strengths of the proposed ERP implementation strategy are the cost, schedule, and maximization of strategic advantage through optimization of data flow. Because large companies assume significant capital expenditures upon implementation of an ERP, assurance of success through a superior strategy will give confidence to corporate and divisional executives.

Assuming knowledge transfer has occurred successfully as discussed above, knowledge of SAP and the defense market will also be major strengths. These are the primary strengths required for future implementations, so they are a perfect fit with the division. Additionally, Company X gains a strategic knowledgebase, financial strength, and competent labor pool to support the creation of the ERP Implementation Division.
8.2 Weaknesses

The biggest weakness of the proposed strategy is the necessity of a company to commit to the strategy from initiation of the first implementation. Creation of a new division is unnecessary if the company is not willing to commit specific financial resources to the implementation process. Therefore, if the company is not absolutely sure it wants to improve its processes through utilization of a modern ERP, creation of a separate division to implement the ERP is wasteful.

The second major weakness is the bureaucracy within a large company. Even though capital expenditures will equal other divisions, the proposed strategy is new. Just as a large company may be hesitant to commit to the investment in a new division, executives will likely be hesitant to spend the time and effort required to establish the division, regardless of its strategic advantage to the company.

8.3 Opportunities

As stated above, the financial, schedule, and strategic transfer of knowledge are advantageous. In the same way that they enhance company performance internally, they also externally affect the company’s business performance. Company X hopes that implementation of SAP will improve their ability to accurately respond to Request For Proposals (RFPs) from their customers. If the proposed solution is utilized, it will ensure dataflow across the company improving accuracy of proposal work.

Another opportunity, which will be discussed in the “Other Strategies” section below, is utilization of the division for consulting work. Because the division focuses on
a U.S. Government based market, Company X can easily partner with their customers (NASA, Armed Forces, Dept of Energy, and Department of Defense). Company X can assist with implementation. They can even branch out into other Government sectors, such as Dept of Education, to assist in implementation of ERPs or strategy of improving nominally successful ERPs already in place.

8.4 Threats

The most notable threat is the existing consulting market. As stated previously, ERP implementations have created an enormous market for consulting services. The proposed strategy suggests minimizing the use of that market. This essentially makes consultants a competitor of the proposed strategy. An interview with an SAP consultant revealed that if the proposed strategy were established, significant resistance with regards to cross-training of Company X employees would be encountered.

Companies such as SAP make a large portion of their profit from service contracts associated with ERP implementations. The proposed strategy directly correlates into loss of revenue for SAP and other consulting firms that offer ERP implementation consultants. An evaluation of revenue earned by SAP for software and software related services in the U.S. reveals that 68 percent of revenue is earned through the traditional implementation process.

The proposed solution for Company X would have reduced SAP revenue by 30 percent at XSS and reduced the need for consulting services consistently over the next decade. It is truly not in competitors’ best interests to assist in the proposed solution.
9 Post-Implementation Usage (Other Strategies)

There are significant opportunities within the Aerospace and Defense community for the proposed division. While the intent of the new division is to implement an optimized companywide ERP solution as efficiently as possible, the knowledge transfer and systems expertise that naturally occurs over a multi-division implementation makes the new division uniquely qualified to assist in other implementations.

The U.S. Government is the largest employer in the U.S. It is public knowledge that NASA and the U.S. Navy have already chosen SAP as an ERP solution. Having a division of employees with a unique set of knowledge that allows system implementation to maintain U.S. Government standards creates a unique opportunity for Government customers.

9.1 Exit Strategy

The proposed post-implementation could be used in lieu of an exit strategy. Because of the lengthy time period required to implement a companywide ERP, an exit strategy is immaterial for 20 years. Upon completion of the last division, the proposed division can be utilized for an overhaul to the proposed SAP ERP solution. There will likely be a new ERP solution available that will improve dataflow beyond what SAP is currently offering in the future. The proposed division will be the logical choice to implement future improvements.
10 Relevance of MSE Coursework

10.1 Engineering 201: Analytical Tools

Engineering 201 provided some fundamental analytical tools that were used in the financial analysis. While Engineering 201 provided the formulas for financial analysis, ISE 200 (Financial Analysis for Engineers) provided a more fundamental interpretation of the financial status of Company X. Because this strategy focuses on cost and schedule efficiencies, it was necessary to use financial analysis tools to depict capital over time.

10.2 Engineering 202: Systems Focus

Engineering 202, Systems Engineering, encompasses all aspects of this project. Systems Engineering is required from inception of the ERP through implementation completion at the last division. While not specifically addressed within the strategy, the Systems Engineering process would require multiple design reviews during the ERP implementation. Systems Engineering efficiencies are discussed in detail within the Lean and DFM sections.

10.3 Engineering 203: Scheduling and Implementation Strategy

Through scheduling and analysis tools defined in Engineering 203, a detailed Gantt Chart was created for tracking project completion over time. Milestones were analyzed and utilized, and the critical path was assessed. Through these scheduling tools, the project team was able to ensure key deliverables were completed over the winter break in preparation for completion of the project within an agreed upon time span.
Within the actual implementation process, management efficiencies could be utilized as well. Classical human needs theories, such as Maslow’s hierarchy and Hertzberg’s Two Factor theory are necessary to assess team needs and reduce turnover.

11 Summary

ERP implementation at a large company requires significant resources to implement. Through the creation of a new division specially designed to implement the ERP solution across the company’s divisions, implementation is greatly improved. Overall cost and schedule are reduced by 30 percent. Data flow is optimized to meet company needs. Customization is common across all divisions ensuring redundant activities are avoided.

Company executives responsible for successful implementation are able to maintain the strategic initiative of a modern ERP without outsourcing that vision. Through the use of Lean practices, utilization of the proposed strategy creates additional schedule and cost savings while reducing waste.
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13 Appendix

13.1 Appendix A: Response to Engineering 298 Questions (Lecture 1)

- **Hypothesis:**
  Utilizing Design for Manufacturability concepts, with emphasis on Lean Thinking and EASDEC, an ERP implementation can be accomplished in large companies at a significantly reduced schedule and cost from standard implementation.

- **What Makes [this] project economically feasible.**
  The cost of an ERP implementation in a large company is significant, but efficiencies within the implementation process are not optimized. The basis for following the proposed strategy maximizes efficiency and knowledge transfer creating significant economic benefits over traditional implementation processes.

- **Definition of the “Pain”, Who needs Pain relief and differentiator.**
  The “pain” being addressed is the traditional way an ERP is implemented within a large company. Because capital savings translate directly into profit, large companies need the “pain relief”. Presently the only “pain relief” providers are consulting firms using traditional inefficient implementation processes.

- **Customer perception of “Pain” and criticality**
  Because the financial and schedule “pains” of traditional ERP implementation is assumed at the start of implementation, customers already plan for the associated “pain” of implementation. As described in the Potential Cash flow section, the proposed strategy can generate $205 million over a five division company’s implementation schedule, equating to $10 million in additional revenue per year. Because a publicly traded company’s number one goal is to maximize the shareholder wealth, customer perception...
of $10 million in revenue per year is in-line with the number one objective and thereby of utmost importance.

- **Cost and investment needed to produce this process:** See Appendix B, Section E.
- **Market Size:** See Appendix B: Section B
- **How much will customers pay for the proposed solution:**

Presently, the market is willing to pay 30 percent more than the proposed solution’s price point. Currently, average large company implementations costs $100 million or more per division (Hugos, 2003)

- **When will the proposed strategy start generating income?**

Because the proposed strategy is a cost reduction and efficiency improvement within a capital project, the proposed strategy begins reducing cost once implemented. The proposed strategy suggests implementation occurs every three to five years, so divisional income generation from the proposed strategy will occur every three to five years. Based on the analysis of Company X, the entire company would see companywide reduction in expenses after 21 years.

- **Cost of Materials, Labor, and Capital:** See Appendix B, Section F
- **Competitors:** See Appendix B, Section G, subsection “Threat”
- **Type of Pain Relief presently offered:**

The traditional ERP implementation described within Company X is a $100-$120 million, seven year per division project.

- **Differentiation from Competitor process:** See Appendix A, Section G.
- **Breakeven Point:**

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Breakeven compared to traditional methods occurs within two years of the initiation of the first implementation. Divisional breakeven ROI occurs within five years of implementation.

- **Market Segmentation:**

This report focuses on the Aerospace and Defense markets, which focus on U.S. Government contracts. In the interest of national security, these companies are incorporated in the U.S. The proposed solution would be geographically independent because the division would physically relocate every three to five years to the ERP implementation site.

13.2 Appendix B: Response to Engineering 298 Questions (Lecture 2)

- **Solution and Value Proposition:**

The “product” being offered is an ERP implementation strategy in a large company. It differentiates from the traditional implementation methodology by minimizing outsourcing and optimizing in-house company resources through creation of an implementation division

- **Market Size:**

The Potential Market Size of the proposed solution is all large companies. This comprises of 30 percent of all businesses. The strategy focuses on the Aerospace and Defense sector, which comprises six to ten percent of U.S. businesses (Aerospace Industries Association of America, Inc. 2009)
• **Competitors:**

Competitors of the proposed strategy are the companies associated with traditional ERP implementation, consisting largely of consultants. In the enclosed report, SAP represents the largest competitor, a global company with customers worldwide and estimated U.S. income of $589 million in software and software service contracts (Non-GAAP, 2007).

• **Customer:**

The customer of the proposed solution is any large company. This report specifically focused on customers within the Aerospace and Defense Market.

• **Cost:**

The cost of the proposed implementation is an artifact of the divisions within the company utilizing the proposed strategy. Savings across the Company X are calculated at $205 million, or $34.4 – $50 million per division. Indirect rates and overhead costs of the proposed division within Company X equate to 82 percent of the direct rate.

• **Price Point**

The cost of the proposed strategy requires an immediate investment of $15 million, a total of $11 million more than a traditional ERP implementation would cost in its first year. This price point includes the differential cost of labor only because the proposed strategy will physically reside at the implementing division’s facility.

• **SWOT Analysis**

Strengths: Cost, schedule, and dataflow optimization represent the strengths of the proposed strategy.

Weakness: Executive reluctance and bureaucratic stalling represent the weaknesses of the proposed strategy.
Opportunities: Company efficiency and strategic use of data represent the weaknesses of the proposed strategy.

Threats:

The existing consulting companies servicing the existing ERP market represent the threat. In this report, SAP consulting services represents the major threat.

- **Investment Capital Requirements:**

  Investment capital requirements are 70 percent of the capital requirements of a traditional ERP implementation within a large company. In this report, Company X’s Capital requirements total $325 million.

- **Personnel Requirements:**

  The proposed strategy requires 105 employees and 30 consultants within Company X.

- **Business and Revenue Model:**

  Because this report emphasizes a strategy to be used by a large company, the strategy would need to be accepted by a company intending to implement an ERP.

- **Strategic Alliance/Partners:**

  The proposed strategy requires teaming with technical experts within the ERP software community at a minimal level to ensure standard ERP functionality is optimized. Within the context of this report, SAP is chosen as a strategic alliance with Company X’s proposed new division.

- **P&L: Norden-Rayleigh Model:**
Based on the risk associated with the proposed strategy, the cumulative assessment of financial cost drivers was set to .02, being slightly more than nominal risk given that the strategy has never been utilized before.

- **Exit Strategy:**

The proposed strategy requires three to five years per division, so an exit will not be feasible for several decades. Upon completion of implementation at the last division, the new division can utilize implementation knowledge to initiate the latest ERP solution.

- **Cost Vs. Price:**

Because the proposed strategy is internal to a large company, cost is the only component analyzed. If consulting is utilized as described in the “Other Strategies” section, traditional rates will be applied. Within Company X, traditional Level of Effort contracts could feasibly fall between 10-16 percent.

### 13.3 Appendix C: Final Presentation