Despite promises of enterprise integration to reduce costs, save time by integrating similar functionalities into back-end enterprise resource planning (ERP) systems, many projects failed. This is also true for supply-chain management (SCM) and customer relationship management (CRM) systems as front-office functions to manage customer data and automate the supply chain. This article takes a look at statistics, project failure cases, and three solution alternatives, including the software engineering approaches.

**STATISTICS**
The ratio of success to failure rates is rather disappointing, falling below the perceived expectations that the projects would achieve. According to Ulfelder, “fewer than a third of IT projects... are completed on time, on budget and within the promised functionality.” Wilson points out that The Standish Group gives a gloomier picture, stating that “75 percent of the project failure rate [is] due to disappointing results or abandoned projects.”

The Standish Group notes that U.S. companies wasted an estimated $80 to $150 billion per year on enterprise...
projects that eventually failed. For other interesting statistics on project chaos, go to The Standish Group’s Web site at http://www.standish-group.com.

Respected U.S. businesses and enterprises that saw project failures eating up their profits in their quarterly reports include Hershey Foods, W.W. Grainger, and FoxMeyer Drug. Some public agencies met with high cost overruns, lateness, and public outcry. Felter reports that other major companies encountered less serious ERP implementation failures. They include Whirlpool, Dow Chemical, Boeing, Dell Computer, and Apple Computer.

PROJECT FAILURE CASES

As everyone knows, a project succeeds when it is delivered on time, on budget, and within the promised functionality. There are two types of project failures: catastrophic and conditional. A catastrophic failure occurs when the project implementation is late, exceeds budget, and does not work due to defects or deficiencies, causing the once-successful company to completely collapse or file for bankruptcy. A conditional failure happens when the project is delivered beyond the scheduled date, or incurs cost overruns, or causes the product(s) to malfunction, but not all at once. The project implementation may eventually succeed if one of the conditions is corrected. If a company, for example, can correct work defects after completing the project delivered on time, the company may consider the project “successful.”

Now take a look at four cases of project failures. FoxMeyer Drug’s project is a classic example of a catastrophic failure. The Internal Revenue Service, Hershey Foods, and W. W. Grainer first encountered project failures and then successfully implemented the system at a much later date.

Case 1. It took the Internal Revenue Service about ten years to replace the Taxpayer Compliance System (TCS) at an astonishing cost of over $5 billion. While the TCS is not exactly an ERP system, it can be considered an “enterprise” system of great magnitude.

Case 2. Hershey Foods, a candy manufacturer, lost 27 percent of market capitalization after an ERP system implementation failed. In 1996, the company installed three SAP R/3 packages to automate its order-entry systems. The installation was gradual. In 1999, Hershey Foods decided to speed up the automation process and have the system ready for the Halloween and Christmas seasons. As these usually busy seasons rolled around, the system was unable to cope with the usually high demand for its candies. To fix the problem, Hershey Foods hired IBM Global Services as the lead system integrator. In early 2000, the project was implemented successfully.
Case 3. FoxMeyer Drug, once a profitable wholesale drug distributor, fell apart shortly after an ERP system implementation failed, causing the company to file for bankruptcy in 1996. At the same time, it filed lawsuits against SAP and Andersen Consulting for $500 million each. Shortly after, a competitor acquired FoxMeyer for $80 million. Ironically, FoxMeyer Drug was the first distributing company to install the client/server SAP R/3 system on a large scale. FoxMeyer did not receive any help from SAP. SAP was still in its infancy and did not provide help at that time like it did for W.W. Grainger later on. As a result, FoxMeyer Drug hired Andersen Consulting to do the work. The company found the consultant’s work unsatisfactory.

Case 4. W.W. Grainger, the leading North American provider (distributor) of maintenance, repair, and operating (MRO) supplies and services, began the SAP R/3 project and completed it successfully in 1998. Unlike FoxMeyer Drug, W.W. Grainger’s ERP system was initially designed for manufacturers rather than distributors. For two years, however, the company “had to struggle with a number of intractable bugs that threatened to ruin the corporate business.” Although it was a little late turning to SAP for help, it took two years for the company to get the system completely up and running. The company used its own IT staff to implement the system.

ORGANIZATIONAL CULTURE: THE KEY SUCCESS FACTOR

One way of finding out what went wrong at FoxMeyer Drug is to compare this distributor with another. Dow Corning, a $2.5 billion producer of silicone products, successfully implemented a project similar to FoxMeyer Drug. Both companies used the same software, SAP R/3, with similar packaging capabilities. The time to implement the systems was within the range of 1994 to 1996.

According to Scott and Vessey, Dow Corning’s success can be attributed to organizational culture in three areas that FoxMeyer Drug did not provide. They are open communication, empowerment, and realistic expectations. After a brief discussion of each, we use Scott and Vessey’s Model of Risks of ERP Implementation to highlight the degree of some risks each company has taken, as influenced by certain external business factors.

- **Open communication.** Dow Corning’s open culture allowed managers and employees to freely communicate with each other regarding impending failure of the project and solutions to fix the problems. Open communication was lacking at FoxMeyer Drug, as its employees were found not to be loyal to their company. This adversely impacted the communications processes needed to make the project a success.
• Empowerment. Dow Corning’s open culture empowered the employees to try out new ways of doing things to solve problems with ERP system implementation projects. In contrast, FoxMeyer Drug employed Andersen Consulting to do the work as spelled out in a contract. This greatly discourages FoxMeyer Drug employees from opining on the project as it moves from one phase to another in a project life cycle.

• Realistic expectation. Both companies differ in what they expect the SAP R/3 technology can do for the ERP project. FoxMeyer Drug was overly optimistic, having unrealistic expectations on the capabilities of the technology. Dow Corning, on the other hand, was somewhat cautious in proceeding with the project. It gave up its reengineering vision in order to get the system running. The company felt that translating visionary strategies into workable enterprise projects was a bit unrealistic.

MODEL OF RISKS
The Model of Risks in ERP implementation is divided into four levels:

Level 4: External business context
Level 3: Organizational context
Level 2: Information systems context
Level 1: Project context

The three organizational culture factors as discussed in a previous section come under organizational context. It serves as an umbrella for the two lower levels: information systems context and project context. Should this umbrella break (e.g., open communication fails), project implementation at the lower levels may not succeed.

While the umbrella is in good condition, the three external environments — collaborative, competitive, and cooperative — that comprise the external business context level show how stable the organization is. The higher the stability, the greater the chances the umbrella will stay in good condition. This does not mean all three environments must be stable. Dow Corning, for example, was stable in two environment types — collaborative and cooperative — while its competitive environment was not, as it was threatened by lawsuits. FoxMeyer Drug, on the other hand, was unstable in competitive and collaborative environments, while instability characterized its cooperative environment.

Although both companies did not particularly focus on organizational change management, Dow Corning appeared to be more people-oriented at the project level and had concerns about processing a large number of global users it could serve. FoxMeyer Drug, in contrast, was more concerned with assessing transaction volumes.
According to Scott and Vessey,13 “Dow Corning focused on reducing the length of the transaction period out of concern for the project, team, while FoxMeyer Drug had problems with personnel at its warehouse.” Dow Corning shined in project leadership while FoxMeyer Drug showed a weakness for it.

Felter6 reports that BP Amoco (formerly Amoco Corp.) successfully implemented ERP systems in four years. While the company attributes success to adequate time needed to “plan and make the transition,” it is more likely that the organization’s open communication helped the project succeed.

REASONS FOR PROJECT FAILURE
Now take a look at reasons for project failures. CPM Solutions14 gave the ten top reasons as:

1. Lack of user involvement
2. Incomplete requirements
3. Unrealistic expectations
4. Changing requirements and specifications
5. Lack of poor planning
6. Lack of executive support
7. Lack of resources
8. Unclear objectives
9. Unrealistic time frames
10. New technology problems

Ulfelder4 lists six ways an IT project could fail, including:

1. Lack of executive sponsorship
2. Lack of early stakeholder input
3. Poorly defined or changing specs
4. Unrealistic expectations
5. Uncooperative business partners
6. Poor or dishonest communication

Neither CPM Solutions nor Ulfedler discuss the lack of risk management as another failure reason.

Felter6 gives the following ERP system failures:

1. Poor project design
2. Wrong off-the-shelf ERP packages
3. Drastic cost-cutting
4. Very complex and large project
5. Lack of a change management approach
6. Poor communication
7. Assumptions

Although Felter does not consider lack of risk management as a factor in ERP implementation failure, risks of ERP are among several modules in the ERP implementation training program (see section entitled “Solution: Training Program”).

Sumner lists risk factors in enterprisewide projects in seven areas; examples of each are shown below:

1. **Organizational fit**: failure to redesign business processes; lack of data integration
2. **Skill mix**: lack of business analysts with business and technology knowledge; lack of ability to recruit and retain qualified ERP systems developers
3. **Management structure and strategy**: lack of senior management support; lack of a change management strategy
4. **Software systems design**: failure to adhere to standardized specifications that the software supports; failure to effectively integrate “add-on” modules
5. **User involvement and training**: lack of full-time commitment of customers to project management and project activities; lack of sensitivity to user resistance
6. **Technology planning**: attempting to build bridges to legacy applications; inability to avoid technological bottlenecks
7. **Project management**: lack of disciplined, flexible project management; failure to recognize the risk of scope expansion (time, cost)

**SOLUTION: PROJECT MANAGEMENT**

Wilson notes that the Meta Group suggests “the costing, tracking and change of documentation of a PMO [Project Management Office] can reduce project failures by as much as 80 percent.” Wilson presents a PMO project example of nine project management processes and knowledge areas implemented in a three-to-five year time frame (see Exhibit 1).

Like other PMO core areas, life-cycle management starts Year One. Risk management is an ongoing process for three years. An overall picture of the PMO shows that it allows different organizational involvement according to core area. Enterprise management, for example, invites CEO involvement, while program management aligns the PMO with the head of a specific part of the organization.

**SOLUTION: TRAINING STRATEGY**

Felter proposes an ERP implementation training plan addressing training needs on the basis of who needs training, when it is needed, and what
topics should be presented. Five stages comprise the training program: pre-sales, planning and design, build, post rollout, and ongoing.

Although the costs, risks, and benefits of ERP modules are included for each stage of the training program, discussions on the intangible assets (as distinct from the tangible assets) of the risks are lacking. While the training plan gives the appearance of tying in with a project life cycle, it does not refer to risk management from software engineering perspectives.

**SOLUTION: SOFTWARE ENGINEERING**

Risk management is a component of a process model in Model-Based Architecting and Software Engineering (MBASE) developed by Professors Barry Boehm and Daniel Port at the Center for Software Engineering (CSE) at USC in 1998. MBASE focuses on the other three model types — product, property, and success — as a way of ensuring that software architecture meets certain criteria (see Exhibit 2).

According to Myerson,\(^\text{16}\) organizational culture (including open communication, empowerment, realistic expectations) is identified as an intangible asset in risk management. Other examples of intangible assets include vendor support, dependence on suppliers, overlapping scope,
implementation plan direction, organizational changes required, level of change required, user involvement, and training plan. Also included are implementation dates, staff experience, evolving business requirements, business commitment to development, stable development team, complexity of functions, and low team knowledge of business.

It does not matter what software engineering model is used to illustrate how a project should be implemented. Identifying the assets — intangible and tangible — is the first step in risk management. The second step is to identify threats that can harm the system assets, including the organizational culture and other intangible assets. A threat can be a source of several vulnerabilities (e.g., unstable cooperative environment), while several threats may have the same source of vulnerability. All vulnerabilities are susceptible to attacks when exploited.

The next steps are to calculate the ratings of risk impacts upon each asset category, and determine the costs of safeguards needed “to reduce vulnerabilities or to control risks at more acceptable levels.” Next, the values of each asset category are computed according to the level of a risk — before and after the safeguards are implemented. After calculating the return on investments of safeguarding the assets, the final step is to monitor any changes in assets and risks of the system.

CONCLUSION
Many project failures are the result of the failure to identify what intangible assets are, consider how they are susceptible to attacks, and determine what safeguards should be in place. Risk management from
software engineering perspectives is a way of reducing the risks of project failures. One should also explore what other assets are intangible, particularly when a distributed system gets very complex and very large and involves thousands and thousands of global users.

Exhibit 3 shows a sample checklist in which one can check off the appropriate risk level: low, medium, or high. One can also modify it to suit organizational requirements and lifestyle.

Notes
1. An ERP system is, by definition, “any software system designed to support and automate the business processes of medium and large businesses.” Free Online Dictionary of Computing at http://foldoc.doc.ic.ac.uk/foldoc/index.html
2. SCM is “the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer… involves coordinating and integrating these flows both within and among companies.” SearchEBusiness.com at http://www.searchebusiness.com
3. A CRM system is an enterprise-wide system “that allows companies to manage every aspect of their relationship with a customer.” Free Online Dictionary of Computing at http://foldoc.doc.ic.ac.uk/foldoc/index.html.
11. SAP R/3 replaced the older host-based mainframe SAP R/2 system.
14. These knowledge areas are borrowed from the PMI PMBOK (Project Management Book of Knowledge).
17. Examples of major categories of tangible assets include personnel, hardware, and facility.

Bibliography
Read *The Complete Book of Middleware*, which focuses on the essential principles and priorities of system design and emphasizes the new requirements brought forward by the rise of E-commerce and distributed integrated systems. Read *Enterprise Systems Integration, second edition*, to provide yourself with the business insight and the technical know-how that ensures successful systems integration. Learn more about Model-Based Architecting and Software Engineering, ([www.gartner.com](http://www.gartner.com)).

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