MANAGING RISKS IN ENTERPRISE SYSTEMS IMPLEMENTATIONS

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WHAT DETERMINES IF A SYSTEM IMPLEMENTATION WILL BE SUCCESSFUL?

Two companies were at risk. One survived while the other failed after installing an enterprise system (ES), SAP R/3. At the time of its R/3 implementation, beginning in 1995, Dow Corning Incorporated was a $2.5 billion producer of silicone products. The company was facing competitive pressures as well as lawsuits worth $2 billion due to well-publicized problems with silicone breast implants. Existing systems were fragmented and focused on specific departments, making it difficult to present a common face to the customer.The company decided that its survival depended on reengineering its business processes to become a truly global company, an objective it believed could be met only with appropriate information systems. It created Business Processes and Information Technology (BPIT) to support reengineering by incorporating responsibility for business processes and IT within the same organizational unit.

In preparation for its initial implementations—three pilot sites in the U.K.—the company gave up some of its best business practices, and paid little attention to managing change within the organization. It did not train the project team appropriately and did not have the benefit of a consulting partner. Yet the company and the system survived.

This scenario can be compared with FoxMeyer Drug Corporation's R/3 implementation. FoxMeyer's business was wholesale drug distribution, an industry rendered very competitive and relatively unstable by health-care reforms of the early 1990s. Hoping to gain a competitive advantage, FoxMeyer initiated its $65 million R/3 project in 1993. At the same time, FoxMeyer installed extremely ambitious warehouse automation software, which was to be interfaced with R/3 at a new warehouse. FoxMeyer expected to save $40–$50 million dollars annually from the project, as well as to grow rapidly and gain market share [5].

FoxMeyer's plans did not work out. After its major customer, Phar-Mor, went bankrupt in May 1993, FoxMeyer signed a major new customer, University Healthsystem Consortium (UHC). However, the contract required major changes to the project. Costs soared to over $100 million; and in August 1996 FoxMeyer filed for Chapter 11 bankruptcy protection, after taking a charge of $34 million the previous month for inventory and order mix-ups. Following liquidation of its major assets in November 1997, FoxMeyer's trustee sued Andersen Consulting, SAP, and Deloitte for $500 million each in July and August 1998. The case against Deloitte was dismissed in May 1999.

There are many reports of software project failures. In addition to widely publicized figures on system failures in general, The Standish Group International estimates that 90% of R/3 projects run late [12]. Hence these are substantive problems that keep occurring in the industry and that need to be addressed.

Both the Dow Corning and FoxMeyer implementations involve the same software; they took place at similar times (1994–1996) and therefore with similar package capabilities and ES knowledge; and both companies were suffering significant industry pressures. The risks in ES implementations are highlighted here (see the sidebar "Characteristics of ES and ES Projects"), and we seek to answer the questions: Why did Dow Corning's implementation succeed while FoxMeyer's did not?; Which risks are critical?; Are there trade-offs or contingencies among implementation risks? and, What can be done to mitigate the effects of these risks? We do this by presenting a model of risk factors in ES implementation and illustrating the rela-

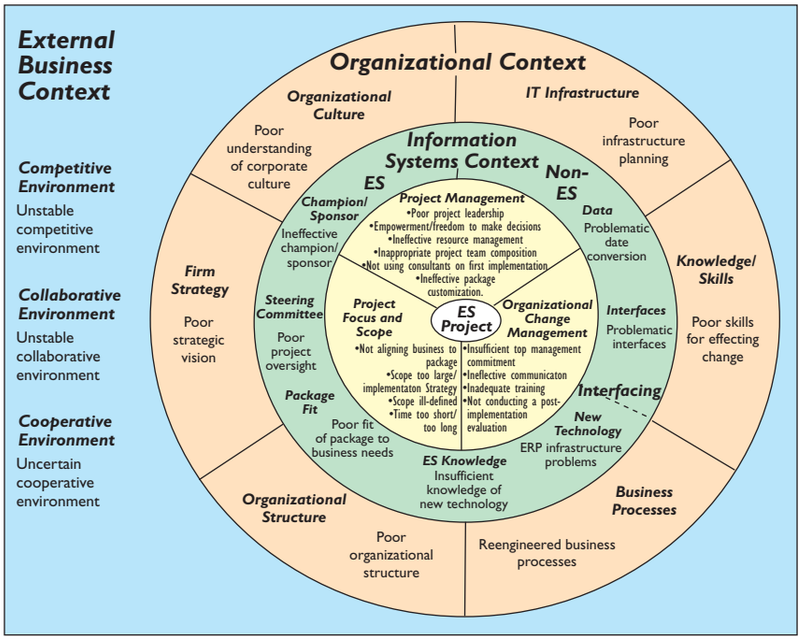

Figure 1. Model of risk factors in ES implementations.

tionships and trade-offs inherent in the model using the Dow Corning and FoxMeyer cases. With our initial understanding, we seek to isolate strong effects, such as company failure, rather than nuances that cause simple cost overruns. Information on Dow Corning's R/3 implementation comes from teaching cases [9] prepared from in-depth interviews. All information reported here on the FoxMeyer implementation is available from online sources.

Model of Risk Factors in ES Implementations

Because the implementation of a cross-functional ES results in major organizational changes, our model is based on forces influencing change. Three kinds of forces, external and/or internal to the company, result in different degrees of change [6]. Those forces result in: movement of the *organization* as a whole; movement of *parts of the organization*; and movement of *individuals and groups*. In our model, because changes due to systems can also be influenced by factors in the business environment, we envisage four levels: external business context, organizational context, information systems context, and ES project (see Figure 1).[1] Figure 1 is depicted as a series of concentric circles representing the different levels of analysis; Figure 2 presents the interrelationships inherent in the model.

Moving from the outer to the inner circles reflects a focus that changes from strategic to tactical. Factors that influence change in the external business context during an ES implementation project may have profound implications for the implementation; that is, the effects are likely to be far-reaching. However, they will occur quite infrequently, depending on the stability of the particular business environment. While factors associated with the project will be less devastating than strategic issues, they will occur much more frequently (Relationship 1 in Figure 2).

We also envisage two further sets of interrelationships based on the interactions among model levels. What we are proposing here are specific types of contingency effects. First, we expect that changes at higher, strategic levels will necessitate responses at lower, tactical levels. For example, it may be possible to overcome a change in the external business context by making changes in project scope and/or project schedule (Relationship 2).

Second, if certain of the more far-reaching strategic factors are handled well, then tactical factors that are handled less well may not endanger the project. Although the implementation would proceed less effectively and efficiently, the ES implementation could still be achieved. However, the reverse would not necessar-

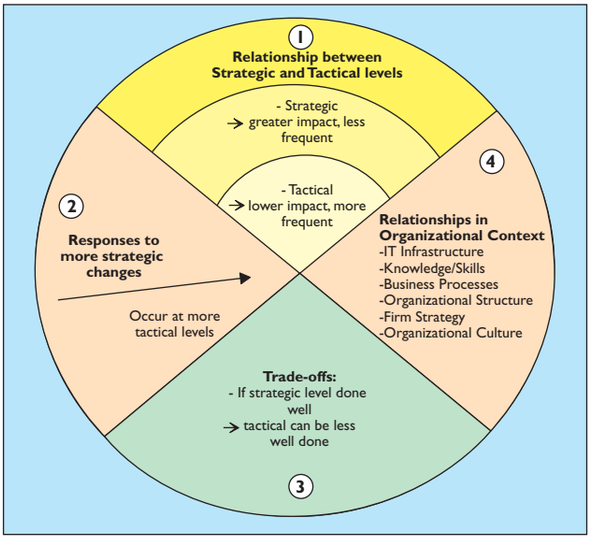

Figure 2. Interrelationships in the risk factor model.

[1]The categories within each level were developed by synthesizing literature on software project risks, risks in IT projects, and critical success factors in ES implementations. Scott and Vessey present a complete description of model development in [11].

Phase	Year	Month	Milestone
Prior to initial implementations	1991		Global Order Entry System (GOES) Project Global process consensus difficult
	1994		Need to restructure around processes rather than functions
Pilot implementations	1995	Early	Decision to implement R/3 and Project PRIDE (Process Reengineering through Information Delivery Excellence) 1. Established Process and Information Technology Board (PITB) responsible for setting strategic directions for global information technology 2. Combined IT function with business process reengineering function into a unit called Business Processes and Information Technology (BPIT) 3. Appointed Charlie Lacefield, the then-VP of Manufacturing and Engineering to manage the new organizational unit
		June	Formation of global team of 40 operations and IT specialists from around world
	1996	February	Restructure sub-teams from eight to four to match four key operational processes New project manager, Ralph Reed
		September 30	Three U.K. pilot implementations on time but cut scope and there were communication and change management problems Global Workstation Project—new distributed infrastructure
Follow-up	1997		Formed area teams in Americas, Europe, and Asia Established PRIDE academy in Midland, MI—global team to train area teams Formed think tanks to determine future processes, aid in change management
	1998	December	Full implementation

Table 1. Important milestones in the Dow Corning ES implementation history [9].

ily be true—even if the tactical factors were handled well, inappropriate handling of the strategic factors could doom the project (Relationship 3).

A further set of relationships can be found within the organizational context factors that contribute to implementation risk. The most difficult factor to address, and therefore that for which the risk is highest, is a change in organizational culture, followed by firm strategy, organizational structure, business processes, knowledge/skills, and IT infrastructure [1] (Relationship 4.)

Analysis of the Dow Corning and FoxMeyer R/3 Implementations

What does our model tell us about the risks in the Dow Corning and FoxMeyer implementations? We first outline the similarities in the two implementations followed by the differences. We then use our model to explain the differences: why FoxMeyer did not survive its R/3 implementation and whether Dow Corning might have survived in similar circumstances. In this way, we examine the choices the companies made and the trade-offs that may have made a difference to the outcomes. Tables 1 and 2 present important milestones in the history of the Dow Corning and FoxMeyer implementations, respectively, while Table 3 summarizes the risks associated with the implementations.

Similarities in the Dow Corning and FoxMeyer R/3 Implementations. From the viewpoint of the external business environment, both Dow Corning and FoxMeyer were operating in "threatened" environments leading up to their ES purchase decisions. Dow Corning was facing costly lawsuits and increased competitive pressures, while FoxMeyer was facing decreasing margins and high transaction volumes. From the viewpoint of organizational context, both companies had well-defined business strategies and viewed IT as key to supporting them. Because both companies viewed

Phase	Year	Month	Milestone
Pre-implementation	1993	May	Lost major customer, Phar-Mor Inc.
		July	Planning begins on Delta Project Testing scalability on Digital and HP servers
		September	Contract with SAP
Implementation	1994	January	Contract with Andersen Consulting HP chosen as hardware platform Implementation of Delta Project begins
		July	Contract with UHC Systems
	1995	January to February	UHC warehouses open interface problems result in millions of dollars in inventory losses
		January to April	Implementation proceeds FI and SD live for UHC
		May	Washington Courthouse warehouse scheduled to go live
		August	Washington Courthouse warehouse live; damaged inventory and losses from duplicate shipments cost $15.5 million
Aftermath	1996	February	COO Thomas Anderson asked to resign
		July	$34 million charge for inventory and order mix-ups
		August	Chapter 11
		October	McKesson agrees to pay $80 million for FoxMeyer
	1997	March	Chapter 7
		Fall	Asset liquidation
	1998	July	Sues Andersen Consulting
		August	Sues SAP Sues Deloitte
	1999	May	Case against Deloitte dismissed

Table 2. Important milestones in the FoxMeyer's ES implementation history [2].

integrated business processes as the key to their success, both decided to implement an ES. Both companies restructured their organizations prior to or in the same timeframe as initiating their R/3 implementations.

From the viewpoint of implementing an ES, both companies had a proponent at high levels within their respective corporations. There was some doubt about the fit of the R/3 package to both companies' needs: Dow Corning was unsure whether the software would ultimately support the number of users it anticipated for its global operations, while FoxMeyer was uncertain whether the system could process the required number of daily transactions. FoxMeyer ran simulations and determined that R/3 could, indeed, process the volumes needed; Dow Corning did not address the software's limitations in the implementations reported.

Table 3. Summary of risk factors in Dow Corning's and FoxMeyer's implementations.

Risk Factors	Dow Corning	FoxMeyer
External Business Context Characteristics		
Competitive Environment	Threatened by breast implant lawsuits; competitive pressures	Unstable; cut throat competition; acquisitions and mergers
Collaborative Environment	Relatively stable	Unstable; lost major customer (Phar-Mor). Signed a replacement customer (UHC) during implementation. (Did not react appropriately; see Project Characteristics)
Cooperative Environment	Relatively stable	Relatively stable
Organizational Context Characteristics		
IT Infrastructure	Radical change required	Radical change required
Knowledge/Skills	Lacked needed skills; training on R/2 inappropriate, inadequate; established PRIDE academy	Lacked needed skills
Business Processes	Originally planned to reengineer; in the end, accepted R/3 processes	Originally planned to reengineer; in the end, accepted R/3 processes
Organizational Structure	Centralized prior to R/3 decision; still needed process-oriented approach	Centralized prior to R/3 decision; still needed process-oriented approach
Firm Strategy	High-growth strategy	High-growth strategy
Organizational culture	Established firm; certain changes under way prior to R/3 decision open culture invited communication; loyalty	Established firm; certain changes under way prior to R/3 decision; less open culture; inadequate communication; lack of loyalty; turnover problems
Information Systems Characteristics		
ES		
Champion/Sponsor	Charlie Lacefield: VP and Executive Director of Business Processes and Information Technology (BPIT) realistic expectations of technology; move forward gradually; small wins	Thomas Anderson: Chief Operating Officer; unrealistic expectations of technology
Steering Committee	Process and Information Technology Board (PITB) responsible for setting strategic directions for global IT	If in place, did not play a strong leadership role
Package fit	Concerns with processing large numbers of global users	Attempted to assess transaction volume; in the end, proved to be inadequate
ES Knowledge/Skills	Lacking; minimal use of consultants	Lacking in both FoxMeyer and implementation partner, Andersen Consulting
New Technology	Not used previously for such a large number of global users	Not used previously for distribution; large volumes of transactions
Non-ES		
Data		Conversion problematic; numerous data errors (large $ losses)
Interfaces	Omitted bolt-ons, for example, to bar scanners, and so forth, to meet project deadlines	Problematic; numerous data errors (large $ losses)
ES Project Characteristics		
Project Focus and Scope	Reduced scope when needed	Inappropriate reaction to new customer; compressed schedule; did not test adequately
Project Management	Strong project leadership	Who was in charge? Project leadership inadequate
Organizational Change Management	Formed "think tanks" to determine future processes, aid in change management	Had some exposure to change; needed improvement

Acquiring the necessary ES skills was problematic for both companies. Dow Corning's employees received R/2 (mainframe) training, instead of the client/server R/3 version, because R/3 training was not yet available. Similarly, FoxMeyer's training appears to have been inadequate.

Both companies needed to convert from their existing centralized mainframe infrastructure to a distributed client/server infrastructure. Both companies implemented vanilla versions of the software, although both implemented less than expected due to time pressures: FoxMeyer had intended to make process changes by customizing the system; Dow Corning had intended to add on other software (for example, to automate authorization notices for large purchases).

From the viewpoint of the project itself, neither company appeared to have very good project planning in place. Further, neither company appeared to expend a great deal of effort on organizational change management. Dow Corning focused on reducing the length of the transition period out of concern for the project team, while FoxMeyer had problems with personnel at its warehouses.

Differences in the Dow Corning and FoxMeyer R/3 Implementations. Although both companies faced pressures in their respective industries, FoxMeyer's situation changed during the proj-

ect while Dow Corning's remained stable. FoxMeyer therefore needed to make adjustments to factors at lower levels in the model to ensure a successful implementation (Relationship 2). The major difference between the two companies at the organizational context level was in their organizational culture, which, according to our model, has the greatest influence on bringing about organizational change. Dow Corning had an open culture that invited communication. In fact, Dow Corning's value statement: "articulated its commitment to an open and creative culture that recognized employees as the primary source of ideas, actions, and delivery of performance. Dow Corning's consistent growth performance had resulted in a stable work environment that reinforced the loyalty of its employees" [9, part A].

FoxMeyer's organizational culture was less open. When FoxMeyer brought forward its implementation in 90 days as a result of its contract with UHC, employees did not voice their concerns to management. The lack of open communication meant employees were not particularly loyal to FoxMeyer, which cost the company substantially. For example, project personnel thought they could obtain much higher salaries with their newly gained R/3 knowledge; and employees at existing warehouses, knowing they were going to be out of work, left in droves prior to the implementation of the automated warehouse.

A further difference between the two implementations lies in the use of consultants. FoxMeyer engaged Andersen Consulting as its implementation partner, while Dow Corning decided not to use consultants because its culture encouraged employees to try new things. Dow Corning's employees therefore: "... struggled to understand the methodology for simultaneously learning the software, designing processes, and configuring the system. They were particularly challenged by the highly integrated nature of the software, which they cited as its greatest strength and its greatest weakness. ... They spent much time hands-on with the SAP/R3 software exploring what it could and could not do" [9, part B].

There were also marked differences in the way the two companies viewed technology. FoxMeyer had unrealistic expectations of what R/3 could do for it (see [8]): "Insiders say top management was so overoptimistic about computerization that it recklessly underbid contracts, expecting electronic efficiencies to lower costs enough to make the deal profitable" [2].

Dow Corning, on the other hand, was prepared to move forward gradually, foregoing its business process reengineering vision to get the system up and running to reap the benefits of a common, global system prior to seeking more sophisticated processes. The notion of pursuing "small wins" is regarded as a critical success factor in process reengineering [7].

At the information systems level, FoxMeyer's project leadership appears to have been weak. Although they had a project champion (COO, Anderson), the project did not appear to have an influential steering committee nor a strong project manager. Dow Corning, on the other hand, had a very strong leader (VP and Executive

Characteristics of ES and ES Projects

Enterprise systems have been in vogue since the early to mid-1990s when a number of vendors developed cross-functional integrated systems on client/server platforms. Many companies seized the opportunity to implement such systems, which provided them with both business and technology advantages. Such systems permit companies to reorganize their business processes to support the new organizational paradigm, for example, of lean production, or just-in-time manufacturing. They also support common, global business processes, and therefore facilitate data integration across the enterprise. Further, the client/server-based IT infrastructure is more flexible and scalable than mainframe systems.

Implementing an ES is a major undertaking. The size and complexity of the endeavor is influenced by whether the implementation is focused on the value chain, and therefore involves sales and distribution, materials management, and production planning modules; or whether it is focused on supporting the value chain, and therefore involves financials and/or human resources modules. The size and complexity of the implementation is further influenced by the strategy chosen to roll out the modules (for example, Big Bang, phased, pilot, or some combination thereof).

Contrary to traditional wisdom, current recommendations are that companies accept the processes embedded in the package [3]. Because of their cross-functional nature, ES implementations have significant impacts on business processes and therefore on employees' work lives. Hence, ES implementations impact and are impacted by organizational factors such as the climate for change. C

The majority of project failures do not stem from technology issues per se but from management issues surrounding the implementation.

Director of BPIT, Lacefield), as well as a planning committee. Further, although neither company managed organizational change well, Dow Corning's culture was more conducive to acceptance of change than was FoxMeyer's.

A further difference between the two implementations is that FoxMeyer's difficulties with interfacing systems forced it to take a $34 million charge to cover uncollectible costs related to shipping and inventory problems [2]. There are no reports of such problems at Dow Corning.

Model-based Analysis of FoxMeyer's Reaction to Environmental Change. By far the most crucial change that either company experienced was FoxMeyer's loss of a substantial customer early in its R/3 implementation. Because it needed to maintain high transaction volumes, FoxMeyer signed a contract with UHC, whose business at that time was not a good fit with FoxMeyer's. According to our model, this is a strategic change, which has a major impact on the firm, but which occurs infrequently (Relationship 1).

To handle such a change effectively requires adjustments at lower levels of the model (Relationship 2). Were appropriate adjustments made? The answer appears to be no. The response to the increased complexity resulting from FoxMeyer's UHC contract was to shorten the implementation schedule by 90 days, with the result that there was no time to reengineer business processes. Even more significantly, the team tested only those parts of R/3 that had been configured, apparently without realizing the integrated nature of the software could, and did, lead to errors in the rest of the system, errors that proved costly to the company.

What should have happened? One of two approaches could have been taken to address FoxMeyer's changed circumstances, both of which represent corrections at the lower project level (Relationship 2). First, the scope of the project could have been reduced. A decision could have been made, for example, not to roll out the package to the UHC warehouses in the initial implementation, or to postpone the automated warehouse system until the ES implementation was complete. Second, the implementation time could have been extended to ensure the system was working effectively prior to rollout.

Why were the appropriate steps not taken? There appear to be two major reasons. The first, and most obvious, reason is that project oversight, project management, and the project methodology appear to have been ineffective. It is unclear whether there was an appropriate oversight body at a sufficiently high level within the firm monitoring project performance. Further, it is interesting to note that we could find no mention in our information sources of who actually managed the project, which may indicate that the responsibilities were unclear. No matter who was responsible, project leadership was apparently lacking, and management of the project was questionable.

The second reason lies in FoxMeyer's culture, which did not invite open communication and therefore information sharing. Even when IS employees believed that incorrect decisions were being made, they were not forthcoming. Management's belief, as evidenced in statements from the project champion/sponsor, Anderson, that technology could solve any problem, may have deterred employees from presenting a realistic view to management, which, in turn, may have precluded FoxMeyer from addressing implementation issues more effectively. "We were given an assignment to find any gaps in the SAP system," recalls one FoxMeyer information systems manager. But systems people found they were encouraged to minimize problems. It wasn't appropriate to criticize SAP," the manager says. Adds a consultant who worked on the project: "Every time we showed something that didn't work, they'd say, 'Is this a deal-breaker?' Well, no one was a deal-breaker. But if you put enough cinder blocks in a rowboat, it's going to sink" [2].

A question that inevitably arises from this case is whether the FoxMeyer debacle was a failure of technology or of management [10]. R/3 had not, at the time, been used for large volumes of transactions, and when implemented succeeded in handling only 10,000 transactions per day, compared with the 420,000 transactions that FoxMeyer was processing on its mainframes. Hence the implementation could be seen as a failure of technology. However, this technology faux pas was the result of a management error: simulations were run with insufficient data [2]. Further, decisions regarding technology are made at quite low levels in the "organizational change" structure of the firm as depicted in Figure 1, demonstrating that management had ample opportunity to make appropriate decisions regarding its use. Hence, the error with regard to the choice of tech-

nology is one of many management errors. As an external validity check of the basic structure and implications of our model, we offer the fact that the majority of project failures do not stem from technology issues per se but from management issues surrounding the implementation (see, for example, [4]).

Model-based Analysis of Dow Corning's Ability to Withstand Environmental Change. Having addressed the biggest "change" in these two cases, that of a change in FoxMeyer's external business environment, which occurred when its R/3 project was already under way, and having attributed the problems in addressing it to lack of effective project management (Relationship 2), let us examine whether the same problems were likely to have resulted had the environmental change occurred at Dow Corning rather than FoxMeyer.

First, in terms of our hierarchy of organizational context effects, we again note the importance of organizational culture to these two implementations. With Dow Corning's open culture, employees would most likely have alerted management to the possibilities of failure if the company had decided to forego system testing. Contrast this situation with that at FoxMeyer, in which employees were reluctant to approach management.

Second, we have seen that both Dow Corning and FoxMeyer engaged in very little project planning, did not have good project methodologies, and were driven by deadlines. However, there is a major distinction in the way that Dow Corning and FoxMeyer treated deadlines. When it appeared that Dow Corning would not meet its deadlines for its U.K. pilots, it used a different strategy from that used at FoxMeyer: the company cut the scope, rather than compromising testing.

Third, Dow Corning had an excellent business vision, supported by well-defined, long-term projected outcomes. Despite a questionable approach to the project, the implementation remained on track because the company remained in control. This is an example of Relationship 3 in Figure 2, the fact that if certain high-level aspects of the project are handled well, the project will not be jeopardized if certain lower-level aspects are handled less well.

Fourth, Dow Corning had strong leadership from the project champion (Lacefield), something that appeared to be lacking in the FoxMeyer implementation.

Fifth, a further characteristic of Dow Corning, which would have stood the company in good stead had it been in FoxMeyer's situation, is that it demonstrated an ability to react to adverse circumstances. For example: when the project was losing momentum in February 1996, it reduced the number of teams working on the project from eight to four to regain focus; when it realized that local knowledge was needed for regional implementations, the company formed area teams; when area teams could not address R/3 issues effectively, it established the PRIDE Academy to train local members; and the company eventually addressed change management as a side effect of the think tanks set up to address future business processes.

We note, however, that there is a downside to being reactive rather than proactive. An issue for Dow Corning is whether the company ultimately would have been better off not to have had to learn everything for itself, but instead had learned from consultants. Nonetheless, Dow Corning's global R/3 project was completed in December 1998, on time and within budget [9, part C]—see the sidebar "Lessons Learned."

Lessons Learned

What are the lessons to be learned from our model and its application to these two cases?

- Respond to environmental and strategic changes at more tactical (project) levels.
- Ensure you have a well-defined business vision and a strategy by which to achieve it; this may compensate for not doing other things quite so well.
- Recognize the importance of organizational culture; foster an open culture and encourage open communications.
- Take a realistic view of the role technology can play in supporting your firm's strategy; engage in a strategy of "small wins" to leverage knowledge gained.
- Manage the project; employ a strong project leader and a well-defined methodology, so that changes during the project are addressed appropriately.
- Do not underestimate the complexity of converting data and creating interfaces to other systems.
- Be flexible in adjusting to unforeseen complexities; compensate at the project level by deferring the Go Live date, reducing the project scope, changing the number/composition of teams, organizing training, think tanks, and so forth.
- Manage implementation risks; develop contingency plans and measures to assess when to invoke. C

Conclusion

Here, we evaluated the utility of a model of risk factors in ES implementations by applying it to SAP R/3 implementations at Dow Corning Incorporated and FoxMeyer Drug Corporation. We used the model to suggest why Dow Corning's implementation suc-

ceeded while FoxMeyer's implementation failed. A complete description of our model, which applies to ES implementations in general, can be found in [11].

Inherent in our model is the fact that no one risk, on its own, may be responsible for system failure, but that certain risks can be overcome if certain other risks are treated particularly well. We have taken a first step in articulating the relationships among certain risk factors that lead to effective trade-offs. Investigation of further implementations will enrich this knowledge. Further, we expect that, as we improve our knowledge of factors influencing the successful implementation of such ES packages, we will be able to identify critical risks not only from the adverse viewpoint of failure, but also of time and cost overruns. C

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