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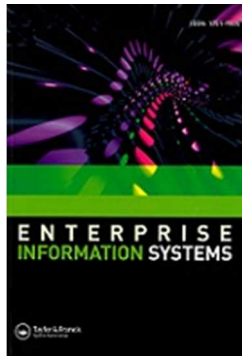
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**Pre-defined and Optional Staging for the Deployment of
Enterprise Systems: A Case Study and a Framework**

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Abstract

The effective deployment of enterprise systems has been a major challenge for many organizations. Customizing the new system, changing business processes, and integrating multiple information sources are all difficult tasks. As such, they are typically done in carefully planned stages in a process known as phased implementation. Using ideas from option theory, this paper critiques aspects of phased implementation. One customer relationship management (CRM) project and its phased implementation are described in detail and ten other enterprise system deployments are summarized as a basis for the observation that almost all deployment stages are pre-defined operational steps rather than decision points. However, option theory suggests that optional stages, to be used only when risk materializes, should be integral parts of project plans. Although such optional stages are often more valuable than pre-defined stages, the evidence presented in this paper shows that they are only rarely utilized. Therefore, a simple framework is presented; it first identifies risks related to the deployment of enterprise systems, then identifies optional stages that can mitigate these risks, and finally compares the costs and benefits of both pre-defined and optional stages.

Keywords: enterprise systems; deployment; staging; real options; risk; CRM

1. Introduction

While cloud computing, social networks, and other new technologies spark the public's imagination, enterprise systems continue to grow and evolve and to capture the attention of chief information officers (CIOs). Enterprise systems are either commercial software packages or self-developed systems that enable the integration of transaction-oriented data and business processes throughout an organization. Vendors report that demand for enterprise systems by both existing and new customers is increasing continuously. SAP reports a 16% increase in software revenue from changes in volume and prices, and that 18% of software orders, about forty-five thousand deals, are attributed to new customers (SAP 2010). Although the incorporation of new technologies such as software as a service into enterprise systems adds to their functionality and facilitates their deployment, many challenges remain in the planning and implementation of enterprise systems. These include the involvement of multiple stakeholders with differing and possibly conflicting interests and the need to integrate across functions and modules, to standardize data and processes, and to rapidly implement new systems such that existing operations are not interrupted (H. M. Beheshti and C. M. Beheshti 2010; Gosain 2004; G. Pan, Hackney, and S. L. Pan 2008; Soh and Sia 2005). To address such challenges, the literature suggests that technical customization and organizational change be carefully choreographed to design, implement, stabilize, improve, and finally transform the organization and its systems (Hong and Kim 2002; Leonard-Barton 1988; Zeng and Skibniewski 2013). In practice, enterprise systems are deployed in stages to reduce the attendant risks and to facilitate learning within project teams and across organizations (Luo and Strong 2004; Motwani, Subramanian, and Gopalakrishna 2005; Wagner and Antonucci 2009). This type of gradual deployment, however, requires the ability to identify risks and stages, to manage the interfaces among sub-projects, and to integrate the knowledge gleaned from these efforts to achieve the overall objectives.

This paper reports on a technique to better identify and evaluate the staging of enterprise system deployment. The findings are based on a critical analysis of the staging decisions made during the deployment of a customer relationship management (CRM) system in a large organization. The detailed case study emphasizes relevance by addressing a critical issue in the contemporary management of enterprise information systems, involving practitioners directly in the research, and developing a feasible solution (Rosemann and Vessey 2008). The applicability of these findings is confirmed through interviews with ten experienced managers, each of whom describes the deployment of an enterprise system.

The suggested technique relies on a simple framework that includes three steps: (1) identification of *pre-defined stages*, rough evaluation of their costs and benefits; (2) identification of risk-items related to the deployment, identification of *optional stages* that mitigate risk, and rough evaluation of their costs and benefits; (3) comparison of pre-defined and optional stages and selection of the staging to be included in the deployment plan (may require return to steps 1 and 2).

The contribution of the current paper is to the literature on both enterprise systems and real options. The refinement of the standard technique of phased implementation should help IT managers to better plan and implement the deployment of enterprise systems. The framework is an enhancement of techniques commonly used by managers, who should therefore find the framework easy to comprehend and apply. The case and framework are also useful in demonstrating the practical implications of thoroughly understanding IT project risk and of systematically managing it. In addition, contributions to the real options literature include a focus on and enhancement of a specific project management technique. In contrast to the broader and more general expositions of real options ideas found in the literature, one type of option, that of staging, is focused upon and specific project management risks are discussed, resulting in a simple framework attuned to deployment. This narrow and detailed

focus has the potential to enhance the practicality of real options thinking for IT project management.

2. Case background

The research site is a large communication service provider with more than two million domestic and business customers. The company, for which the pseudonym iComm is used, is one of the largest communication service providers in Israel. iComm employs several thousand staff within a large engineering division, a domestic customer division, a business customer division, and multiple call centers. The company is characterized by a technological ethos and a culture of careful planning, which have been very useful for the present study. This allows studying a project plan and deployment reasoning that were carefully crafted by experienced IT managers in a technology-savvy organization. This ethos, however, is probably responsible for the formation of an intricate architecture of home-grown systems that makes the deployment of new systems very challenging.

This study focused on the deployment of an enterprise-wide CRM system, which has become a strategic necessity for iComm given the blurring of boundaries between telephone, internet, and cable television and the concomitant need to integrate products and customer service. Motivated by this strategic drive, iComm wanted to enter the “CRM era” as quickly as possible. However, it was burdened not only by its own complexity, but also by that of the CRM system, which included product and service catalogues, sales management, technical help desk management, and a customer preservation module. Indeed, about three hundred interfaces were defined to help the CRM system integrate with iComm’s existing information systems.

The enterprise-wide CRM system replaced several home-grown systems with limited CRM functionalities. The latter included two sales management systems that were

specifically developed and operated independently by each of the main business units and two technical help desk management systems that were also separately developed and operated by the two units. In addition, the new CRM system replaced some functionality of the billing system, a technician assignment and scheduling system, and an order management fulfillment system. Figure 1 presents this study’s main activities as related to iComm’s CRM project.

[Insert Figure 1 about here]

Full access to the project planning documentation and to the CRM Project Office manager (hereinafter “project manager”) were given to us (step 2a in Figure 1). About ten interviews of two hours each with the project manager were conducted, mostly to gain an understanding of company documentation, to identify and prioritize risks, to calculate costs and benefits of the project, and to discuss pre-defined and optional staging. In preparing material for the interviews, the project manager consulted several members of his staff. Other managers, including the CIO, a financial analyst, and a senior IT architect were interviewed as well (step 2b in Figure 1).

The complexity of organization and system, and the need to convert iComm’s data architecture from a billing-centered to a CRM-centered structure, highlighted the issue of deployment policy in the early planning stages of the project. On the one hand, the business units and the chief executive officer (CEO) advocated making a “clean break,” in contrast to a gradual transition from the old systems to the new CRM system. Such a sharp change would confine operational glitches to a short period of time and eliminate the need to operate the old and new systems in parallel. On the other hand, iComm’s IT department considered gradual deployment an effective means of obtaining a stable system whose operation can be learned before full deployment. The gradual approach contained several variations, including a pilot confined to a specific geographical area and to a small number of customers, staged

deployment of the system first in one business unit and then in the others, and scaled-down deployment of most CRM functionality.

Several top management discussions about the deployment principles were held (step 1b in Figure 1). At the same time, the IT department and the project office studied several deployment alternatives and assessed the constraints and risks associated with each. This process led to the decision to deploy the system gradually. The project was divided into eight main modules or sub-projects, including the product and services catalogue, sales management, technical help desk management, customer preservation, and data conversion, as detailed in the next section.

3. Pre-defined staging

Organizational learning is the process through which organizations enhance their knowledge and improve their actions and performance (March and Olsen 1975). Module-by-module implementation of enterprise systems is a viable alternative to full deployment because it promotes a gradual learning process by the organization, its vendors, and the respective teams involved in the implementation (Luo and Strong 2004; Motwani, Subramanian, and Gopalakrishna 2005). Organization-specific learning is needed because organizations typically have different experiences with technology, processes, and ways of dealing with change and outsourcing management. Therefore, pre-defined staging is used to allow learning and reduce the risks inherent in the implementation of enterprise systems. This approach involves implementation in planned stages to reduce the probability of unwanted outcomes, such as cost overruns, missing functionality, or project failure. In addition, pre-defined stages are often used when resources are limited; for example, if the number of available deployment experts is limited, the system can be deployed gradually, one department at a

time, thus ensuring that experts are on-hand during the deployment period in each department.

iComm’s CRM project included several levels of pre-defined staging, the highest of which was related to a strategic transformation of iComm’s focus from technology to marketing, as noted by the CIO:

“Since 1997, when the strategic focus was changed, information systems were gradually transformed from home-grown, efficiency-focused systems into off-the-shelf enterprise systems that should enable market agility. This transformation spanned more than ten years. The new systems were considered a strategic imperative, thus the focus of the decision process was not on return on investment, but on reducing operational problems. Thus, staging of both major investments and within-project deployment was the norm.”

The two central types of staging used by iComm were functionality staging and customer staging. Namely, gradual deployment of major functions and addressing different customer groups gradually. Both may be seen as generalizations of the module-by-module deployment reported for enterprise resource planning (ERP) systems as each module addresses different functionality and different users. The CIO explained:

“Our thinking about CRM deployment, already in the initial presentation to the board of directors, was to start with our business customers rather than with domestic customers, because we expected competition in this segment....Our legacy systems were divided into two main functional areas, technical-support and marketing. So, we initially suggested four stages: business marketing, business technical-support, domestic marketing, and domestic technical-support. There were other staging possibilities, for example geographic area-by-area

1
2
3 *staging, but we decided on customer and functional staging starting with the most*
4
5 *contested segment and function.”*
6

7 The CIO's reasoning focused on an anticipated benefit: the new system was essential to
8 ensure market agility, which was urgently needed in the business segment and for marketing.
9 But from the learning perspective, this reasoning may be problematic as the focus is on the
10 benefit and not on learning. The order of staging, indeed, was reversed in later discussions, as
11 noted by the project manager:
12
13

14 *“We considered starting with domestic customers because the functionality was*
15 *simpler. Business-customer needs and thus products were more complex, reflected*
16 *in the number and complexity of interfaces to other systems. So, we preferred to*
17 *deploy first with the easier customer segment, functionality, and interfaces.”*
18

19 This reversal of priorities is consistent with learning and risk mitigation. The project
20 addresses the easier challenges first and postpones the most complex ones until later, when
21 the deployment experts understand the new system better and have acquired personal
22 experience with the customization and deployment teams. However, staging and learning
23 have their costs. First, partial system deployments characteristic of modular approaches
24 require the construction of interfaces to the legacy systems, which will gradually become
25 redundant as more functionality is deployed. Second, partial deployment involves
26 organizational costs. For example, in iComm, a staging possibility was rejected because it
27 undermined immediate value creation and endangered the change management process that
28 was trying to achieve quick wins (Kotter 1995). The project manager elaborated:
29
30

31 *“We also discussed the possibility to deploy most but not all functionality for the*
32 *domestic customers. Marketing functionality is relatively complex; should we*
33 *delay it to a second stage? We decided not to do so, because marketing is central*
34 *in materializing the value of the system.”*
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In parallel to these discussions, the possibility of geographical staging was considered. As iComm was spread across several geographical areas, it seemed logical to experiment in one area and then to deploy, possibly gradually, in other areas. The project manager explained why geographical staging was eventually deemed inappropriate:

“A previous system, a technician scheduling system, was deployed gradually area by area. It made sense because technicians were managed via forty-two local centers. However, area by area deployment does not make sense for CRM because we operate call centers uniformly with virtual customer queues, and representative assignment is managed by availability and skill, not by location.”

Finally, simple, resource-related staging, in which customer representatives were trained in batches of 30 per week and technical call center representatives were trained in batches of 20 per week, was exploited at the research site. One of the goals of the employee training was to alleviate the pressure on iComm’s customer-facing employees by reducing availability and quality problems at the call centers while training for the new system and by reducing overtime costs. In addition, this staging aimed to improve the training material, to enhance training staff skills, and to increase the number of trainees that could participate in subsequent training sessions.

Decisions about deployment were finalized by the CEO in a forum of IT and business division managers. Project duration, including customization, data conversion, testing, training, and deployment, would be 18 months. Deployment would begin with a pilot in the domestic customer division that was scheduled to last about two months and expected to convert¹ about 100,000 customers and 100 representatives to the new system. Full functionality would then be available and customers and representatives would be converted

¹ Conversion represented the transformation of a customer record from the legacy systems into the new CRM system; namely, the information about the customer, product and services purchased, payment and so on was converted into the new system. Call center representatives who were trained to use the new system were also labeled as being part of the conversion.

in six phases, each of which would last four weeks and cover up to 400,000 customers. The initial deployment phases were planned at the domestic customer level and the final phases were aimed at the business customer segment. Table 1 shows the main implementation and deployment stages.

[Insert Table 1 about here]

To summarize, pre-defined staging of enterprise system deployment is the norm at the research site, whose managers reason confidently, although in approximate terms, about the costs and benefits of various staging possibilities. These include staging related to customer segments, functionality, geography, and resources.

4. Optional staging

The staged deployment of enterprise systems – as described in the literature and exercised at iComm – is common and has received considerable managerial attention. However, the literature on real options shows that this type of pre-defined staging is often not optimal.

Real options theory estimates the value of *managerial control* in the progress of an investment project. Managerial control refers to the ability of managers to affect the course of a project by responding to uncertainty over time. The term *real options*, coined by Myers (1977), reflects the notion that managerial control is merely a description of the options made available to managers as part of a project and that it is contingent on the real assets underlying the project rather than on financial instruments. Therefore, real options are rights to future choices embedded within an investment in real assets. A significant stream of research has applied real options theory to study IT investments (Ullrich 2013). This literature has identified several types of real options, including deferral, staging, scaling up or down, abandonment, growth or follow-up projects, and resource switching. However, the main relevance of this literature to the current study is the realization that real options are not

inherent in IT projects and, therefore, there is a need for an explicit risk identification mechanism and an ability to embed in the deployment process the corresponding options required to mitigate risk (Benaroch 2002). Specifically, the decision to initiate a deployment stage should be contingent on the anticipated costs, benefits, and risks at the time the stage is reached, similar to any sequential investment decision (Benaroch et al. 2007; Fichman, Keil, and Tiwana 2005).

This line of thinking was applied to the iComm case in two steps: (1) risk identification and costing, and (2) option identification and evaluation. The first step typically includes the identification of risk items, evaluation of the likelihood and potential loss of each risk item, planning risk mitigation techniques for each risk item, and monitoring the risks and implementing the corresponding mitigations (Boehm 1991; ITIL 2011). The second step systematically links options to risks. It is based on the logic of simply identifying staging opportunities that reduce the consequences of materialized risk. The general approach to pre-defined and optional staging is illustrated in Figure 2.

[Insert Figure 2 about here]

Thus, the process started by analyzing risks systematically. Although risks were discussed by project managers and mentioned frequently in project documents, neither their likelihood nor the magnitude of the potential loss was evaluated systematically. To fill this gap, the main risks as mentioned in the project documents were written down, each risk was discussed with the project manager (who consulted other managers of the project), and an agreed upon likelihood and a potential loss for each risk item were recorded. An initial list of about three dozen risks was reduced to ten main risk items that included: a schedule slip of up to three months of the customization work, acceptance testing, or data conversion; missing system functionality found during the testing stage; longer-than-expected service times for customer problem solving, discovered during the pilot stage; lack of CRM expertise among

the members of the deployment team; and overall failure of the pilot stage. These items were consistent with previous reports about risks in IT projects and included project planning and control risks, requirement related risks, and expertise or team related risks (Wallace, Keil, and Rai 2004).

After determining the risks, they were linked with options. Several options reported in the literature (Benaroch 2002) were considered, including the option to explore through pilots or prototypes, the option to expand or reduce scale according to consequences, and the option to stage (stop-resume). Less relevant to this study were options to defer an investment to learn about its outcomes before committing, the option to abandon, options to lease or outsource the project, and growth options that consider future investment opportunities generated by the new system. These options were considered less applicable to the project because the project office was tasked with deploying the system, while the commitments to the system and to the outsourcing vendor were already made and were beyond the project office's prerogative, as were issues related to future investment or growth options.

The potential threat engendered in the list of risks is easily demonstrated by considering the highest item on the risk list, a schedule slip of three months in the customization work. Given that the planned duration of the project was 18 months and that the customization phase was scheduled to last four months, such a schedule slip was considered disastrous. Indeed, its occurrence would imply the existence of significant, fundamental problems in requirement engineering, in the interaction between the vendor and client teams, and possibly in project planning and control at the customization team level.

Table 2 summarizes the main points of the discussion with the project office about their options in the event of such a schedule slip. The options were each assigned a cost, which was roughly estimated according to two measures, the additional effort needed (for example, to build temporary interfaces to legacy systems) and the savings lost due to late deployment.

The numbers in the column for additional effort refer to the investment required, in USD, for extra person months of system-analysts, developers, testing-engineers, training-personnel, and CRM-experts (or champions) in the end-user departments. Lost savings are based on the anticipated operational savings, mostly at the call centres, as a result of CRM deployment. The loss of new opportunities that the system was expected to create was not taken into account because of their high uncertainty. The option to abandon the project was added to illustrate the cost ceiling.

Each of the optional staging entries in Table 2 was also assigned a qualitative benefit. It was found that these were adequate descriptions for promoting the identification of viable options and the subsequent discussions about them to select the best alternative. Detailed option value calculations were performed for the main options, and one such calculation is included in the Appendix. However, it was found that the complexity of modeling was not matched by its benefit to the decision makers. This finding supports the notion that option thinking is highly useful for IT project management, even in the absence of explicit modeling and value calculation (Fichman, Keil, and Tiwana 2005).

[Insert Table 2 about here]

The discussion with the project manager led to the agreement that several of the options should have been included in the project plan. In particular, the option to delay CRM deployment in the business segment by either three or six months was considered prudent in the event that the customization schedule slip were to materialize. Although this type of staging was rejected in iComm’s management discussions about pre-defined staging, in the context of active risk management (and of this research), it was readily agreed that this option is highly efficient.

To summarize, prior to enterprise system deployment, its main risks should be considered. For each risk item, options that minimize the loss if the risk occurs should be

identified, and the estimated cost and anticipated benefit of each option discussed. Options that represent efficient measures for minimizing loss can then be included in the deployment project plan.

Figure 3 illustrates the proposed framework for staging the deployment of enterprise systems. The more elaborate steps in the analytical process described in the framework involve the consideration of risks and their corresponding options. Once options are linked to risks, the process goes through the comparison and selection of pre-defined and optional stages. This process is iterative in the sense that the identification of pre-defined stages should be revisited upon making staging decisions. This iterative process was found to be intuitive to the managers at iComm.

[Insert Figure 3 about here]

5. Validation

Following the case study at iComm, the common staging techniques used in the local industry were examined (step 2c in Figure 1). For this preliminary examination, ten experienced IT managers were selected from ten large organizations in multiple sectors of the Israeli economy. These organizations included five government departments, one large municipality, and one commercial organization each from the healthcare, banking, chemical, and aircraft/defense industries. The senior managers, who all had between 20 and 30 years of experience, were asked to identify and briefly describe a major enterprise system deployed in their respective organizations during the last five years. The discussion with each manager inquired about the staging techniques in terms of pre-defined and optional staging used to deploy the enterprise system. Specifically, each manager was asked first to describe the deployment planning for the selected enterprise system. Then, the terms pre-defined staging and optional staging were explained to the manager, who was subsequently asked to describe

the deployment plan again using the classification of stages as either pre-defined or optional. The interviews were face to face (with one of the authors) and lasted between two to three hours. The interviews were conducted at the headquarters of the respective organizations in the Tel-Aviv area from November 2011 to March 2012. Table 3 describes the question protocol that guided the interviews, Table 4 summarizes the resulting project descriptions, and Table 5 presents the approach of these projects to pre-defined and optional staging.

[Insert Table 3 about here]

[Insert Table 4 about here]

[Insert Table 5 about here]

These interviews confirmed that while pre-defined staging is common, optional staging is only seldom used. All respondents described some level of pre-defined staging related to learning, resource constraints, or risk mitigation. Most projects included pre-defined staging by function, some by geography, business unit, or company, and others used major project tasks, such as development, customization, data improvement, and conversion, around which to organize staging.

In contrast, as can be seen in Table 5, only four of the ten projects included some type of optional staging; two projects included optional functionality or content that was planned to be developed contingent on the successful deployment of the essential functionality or content. One project included escalation procedures that comprised the optional involvement of top executives and optional resources to handle schedule slip. Interestingly, many of the managers that were interviewed recognized optional thinking as a common project management technique. Specifically, the deployment of an initial system – a pilot – before finalizing the full deployment plan was described in four of the ten projects. Rollback – the option to revert to the previous system in case of failure of the development or of the

deployment project – was also included in four projects. However, although option-thinking was often incorporated at the beginnings and ends of projects, it was neither common nor systematically employed in the planning of intermediate project stages. The validation step confirmed the external validity of the case study (steps 2a and 2b in Figure 1) by showing that the staging and risk management techniques used at iComm are standard practices in the industry.

6. Lessons learned

Four important lessons for staging the deployment of enterprise systems may be learned from this study.

6.1. Project managers should consider multiple types of pre-defined staging

To consider all possible stages, it is helpful to begin with a checklist of staging types that includes:

Customer-segment staging: Often it is useful to start with customers who have simple needs, an approach that fosters learning by the project managers before they are obligated to contend with customers with more complex needs.

Functional staging: Start with simple functionality to learn the new system, its customization issues, and the vendor team. This type of learning will help when addressing complex functionality in later stages.

Geographical staging: Used mostly to reduce costs and risk exposure by focusing on a specific locality; it is useful when each locality has only limited types of customers and internal users and when each locality requires limited functionality.

Organizational staging: Starting with cooperative business units promotes conditions favorable for learning how to resolve problems and to achieve quick wins. The lessons

learned and expertise developed during the first stages will help project managers address business units that present more challenges.

Infrastructure staging: Building the infrastructure first facilitates the resolution of problems related to hardware, networks, and foundation software. This approach enables demanding organizational problems typical of enterprise systems to be tackled when the technological ‘ground’ is stable.

Resource-based staging: Learn by using a small amount of a specific resource – for example, programming and customization personnel. Later customization and deployment under full resource conditions is subsequently easier.

While managers at iComm considered different staging possibilities, they did not do so systematically. The ten experienced IT managers with whom staging was discussed confirmed that although staging was common, none of them used a formal tool or process to systematically compare different staging possibilities. Therefore, a checklist such as that described above could facilitate such a comparison. Managers should ask, for example, “what organizational staging can we do?” For each staging possibility, the benefits in terms of learning and risk reduction should be discussed and rough costs should be estimated. Repeating this exercise for each staging type should help reveal a variety of opportunities to facilitate learning and reduce the incidence of risk using pre-defined stages.

6.2. Project managers should tie optional staging to risks

The common practice of implementing pre-defined staging misses significant opportunities to minimize loss when risks materialize. Although pre-defined staging assumes that there are constraints and risks and that dealing with them entails a staged learning process, only the inclusion of an explicit, systematic process for identifying and assessing the risks and their corresponding optional stages will ensure that all staging possibilities are fully considered.

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2
3 As an example, consider organizational staging at iComm. A marked disparity existed
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5 between the domestic and business customer divisions. Management estimated that the
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7 products and processes of the business division possessed much higher complexity and risk
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9 than those of the domestic division. The pilot system was thus planned to be deployed only in
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11 the domestic customer division, on the basis of the assumption that uncertainties would be
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13 resolved by this pilot deployment. But because iComm wanted to supply its business
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15 customers with CRM functionality as soon as possible, actual deployment was planned to be
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17 roughly at the same time in the two divisions.
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21 Thus, although risk was understood and an effort was made to reduce the likelihood and
22
23 potential loss of unwanted outcomes, project managers had little planned in the event that
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25 something went awry. One effective protective measure could be to delay the start of the
26
27 more complex parts of the project. For example, the project manager was asked to consider
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29 the possibility that customization work would slip by a few months. He agreed that this was
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31 the top risk item, and indeed he considered its occurrence to be plausible. Were this risk
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33 actualized in the midst of the project with no optional staging, the possible reactions would be
34
35 limited – either continue with the original plan, in the process probably putting a lot of
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37 pressure on the vendor and on iComm's project team, or abandon the project. Therefore,
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39 options to delay the sales module for the business customer division or the full functionality
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41 for this division must be included as staging options to enable a systematic reaction to the
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43 materialization of risk.
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47 The lesson here is simple – if the potential for a major risk being realized has been
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49 identified, one should try to reduce it. However, failure to completely neutralize the risk
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51 mandates the consideration of options – to delay, to stage – ready for implementation should
52
53 the risk materialize.
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6.3. Pre-defined and optional staging often complement each other

There are several reasons why the two types of staging complement each other. As the previous lesson shows, pre-defined stages are often included to reduce risk while optional stages should be included to reduce the consequences of risk when it materializes. It is therefore advisable to plan stages that reduce the probabilities of unwanted outcomes and their potential losses. Managers should then complement their project planning by considering their potential actions if risk materializes, often by planning optional staging.

Another explanation of the complementarity of pre-defined and optional staging is related to a difference between learning and risk management. The logic of learning, which is central to pre-defined stages, is that starting with simple tasks, or slow rates of deployment, contributes to learning how to handle subsequently complex tasks or high rates of deployment. The logic behind risk management, which underlies optional staging, dictates that the riskiest steps be dealt with and resolved as early in the process as possible.² Using both types of logic should allow project managers to consider a large number and variety of staging possibilities. However, the iComm research site and interviewees did not provide examples of “risk first” staging. While “risk first” staging is probably relevant in projects where technological risk is central and it is often resolved in a prototype or other early optional staging, it is less relevant in the current context of enterprise systems where organizational risks are paramount.

6.4. Optional staging is often much more valuable than pre-defined staging

Pre-defined stages focus on a normal, uneventful deployment. As such, their value is related to improving the efficiency of the deployment process. Risk-related optional staging,

² In general, stages can be performed nonlinearly, with the most risky shifted to as early or as late in the process as possible (Benaroch 2002); pre-defined and optional staging complement each other when early risk resolution is preferred.

however, considers the occurrence of significant deployment problems, including even disastrous events. Under such circumstances, therefore, the value of reducing loss is often significant.

For example, consider the CRM deployment case. Managers at iComm considered six- and nine-cycle deployments. A nine-cycle model was considered to allow for slower and better learning of the deployment procedures and training of the call center representatives. Moreover, it was also seen as a way to reduce the risks of schedule slips, poor training, and poor representative knowledge of the new system. A six-cycle model was considered to reduce the deployment work and the related organizational uncertainty. A rough estimate of the added value of preferring the nine-cycle over the six-cycle model, as reasoned by the project manager, was in the tens of thousands of dollars. In comparison, a conservative estimate of the value of the option to delay CRM deployment at the business customer level was USD 148,000 (see the Appendix).

7. Conclusion

Based on discussions with experienced IT managers and on ideas borrowed from option theory, this paper identifies a weakness in the practice of staging the deployment of enterprise systems. Therefore, a simple framework is suggested to improve this practice by adding to the commonly used pre-defined stages the element of optional staging. Using data from a large CRM deployment project, this paper showed how optional staging was related to risk management and how it complemented pre-defined staging. The analysis also demonstrates the usefulness of option theory thinking to practitioners, who find explicit modeling and value calculation impractical. The suggested improvement seems practical, simple to implement, and highly valuable in the deployment of enterprise systems.

Appendix. Calculation of the value of an optional staging example

The staging option of deploying the CRM system at iComm first in the domestic customer division and only much later in the business customer division was evaluated. This option is to be exercised if a considerable slip in the customization work schedule is detected. The evaluation was done using an Excel worksheet and a very simple modeling approach. Costs and benefits were calculated per year, and benefits were either realized immediately (the good scenario) or gradually over the course of four years (the scenario in which risk materializes). Value was calculated for a ten-year horizon. The calculation, contained in a single page, assumes acquaintance with basic finance techniques. The only non-trivial calculation was of the implied volatility, which was easily done using an Excel macro contained in John Hull’s book *Options, Futures and Other Derivatives*.

System benefits were calculated according to the call center cost reductions, better marketing procedures, back-office cost savings, and a reduction in IT maintenance that together totaled \$2.9m in the domestic division and \$526k in the business division (figures are in US Dollars, at a rate of NIS 3.8 per USD). The setup costs, which included client and vendor personnel, hardware, and software licenses, were \$7.4m in iComm’s domestic division and \$1.6m in the business division. Annual costs (similar items to the setup costs) were \$790k and \$526k in the domestic and business divisions, respectively.

To calculate the value of the staging option, two possible states, good and bad, of nature (i.e., the project) were considered, such that the latter corresponded to the materialization of risk. In the good state, benefits were realized immediately, whereas in the bad state, benefits were only gradually realized. Two managerial decisions were also modeled: deployment was either immediate in both divisions or it was staged, such that it was immediate in the domestic division and late in the business division. To simplify the calculation, a one-year delay was assumed.

The benefits of deployment without staging included the immediate realization of benefits, with the net present value (NPV) calculated at \$1.5m. Under the scenario of gradual realization (0% during the first year, 30% during the second year, 75% during the third year, and 100% during fourth and subsequent years), the NPV was \$450k.

The NPV with staging was then considered, but only in the bad state. There is no reason to resort to staging if the risk does not materialize. The benefits of delaying deployment in the business division by one year were expressed in an NPV of \$746k.

To calculate the option value, for simplicity it was assumed that the probability of each of the states of nature was 50%, so the option value was half (the probability of the bad state) the difference between NPVs for immediate and staged deployment, namely: $0.5 \times (\$746k - \$450k) = \$148k$. In other words, the option was worth USD 148,000.

It is useful to understand the magnitude of risk the model represents. For simplicity, the Black-Scholes formula was used with the assumptions that the stock was the full benefits realized immediately, the option type was an American Call, and the exercise time was one year. In other words, the second stage of deployment was allowed to start anytime during the first year, including the project manager's suggestion to include an option for a half year delay. It was further assumed that the exercise price was the business division setup costs (\$1,580k). A risk free rate of 10% was used because of the project's considerable risk, and the implied volatility was 21%. At almost twice the volatility of iComm's stock during the time this project was planned and contracted, the implied volatility thus represented technological risk in addition to the underlying commercial risk.

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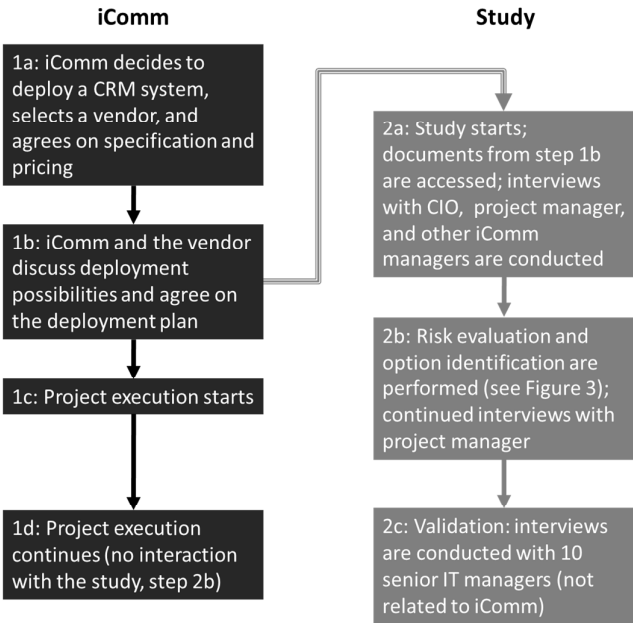


Figure 1. Methodology flow chart

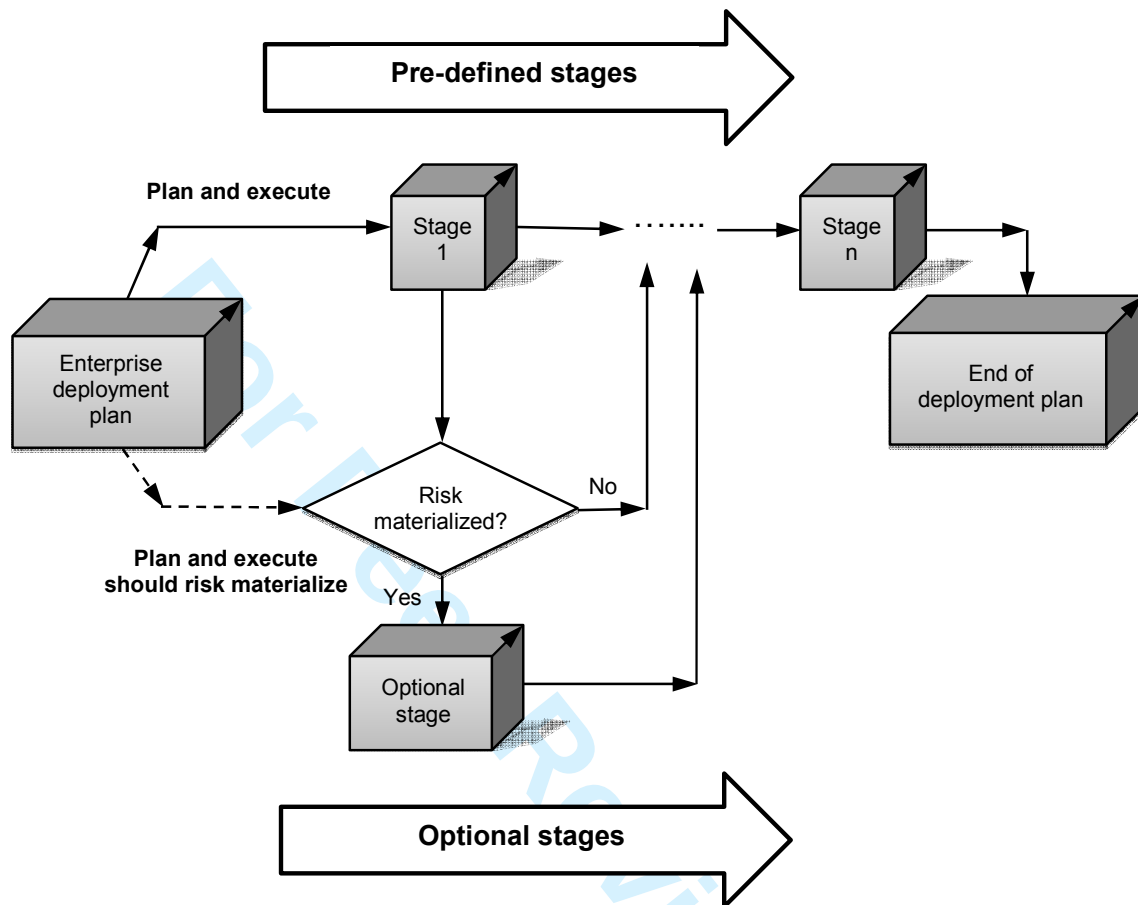


Figure 2. Pre-defined and optional staging

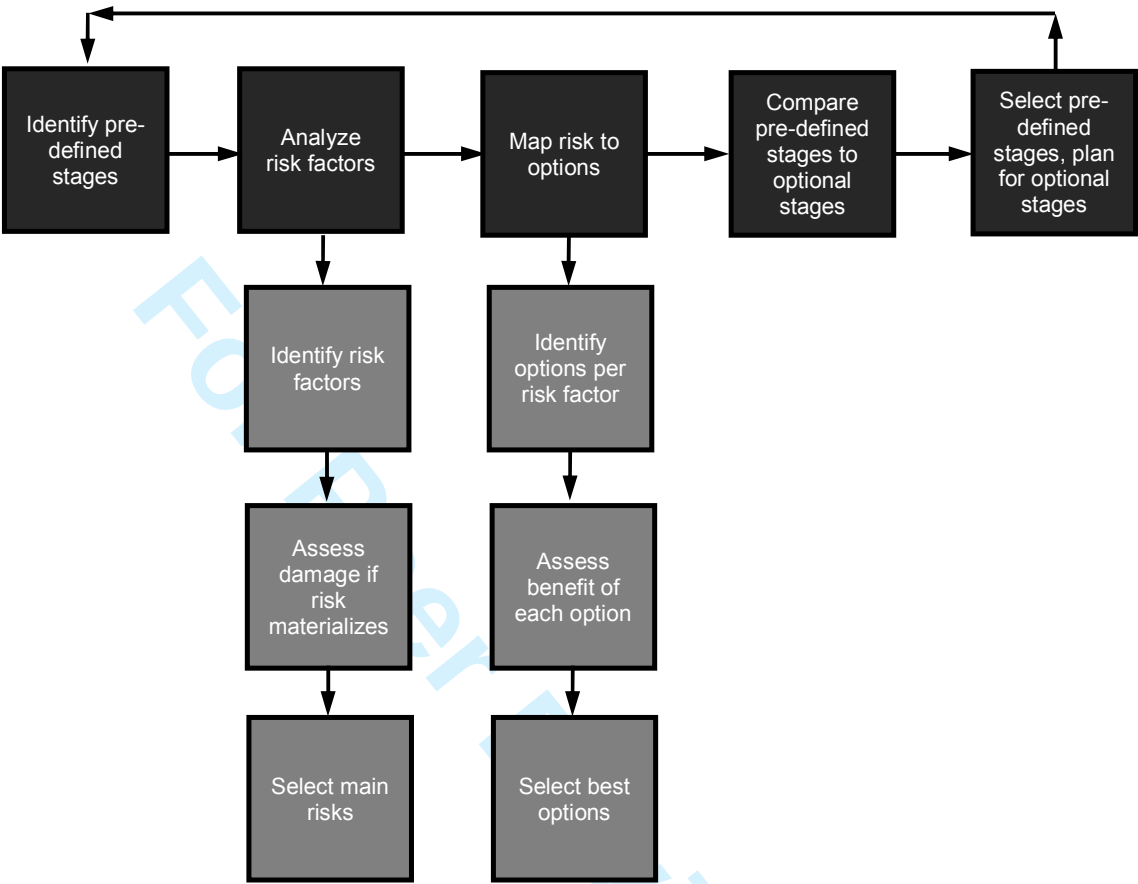


Figure 3. A framework for staging enterprise system deployment

Table 1. Pre-defined stages

	Customiz- ation	Conversion	Pilot	Deployment cycle 1	→	Deployment cycle 6	Total
Duration (weeks)	18	30	3	4.5	→	4.5	78
Customer call center representatives trained	0	0	50	125	→	125	800
Technical call center representatives trained	0	0	60	90	→	90	600
Implementation cost (thousand USD)	3,622	120	262	10	→	10	4,064
Training cost (thousand USD)	0	0	5	11	→	11	71
Converted customers (thousands)	0	0	100	300	→	400	2,250

Table 2. Optional staging related to customization schedule slip of three months

Optional staging	Cost (USD)		Benefit
	Additional effort	Lost savings	
Accelerate client-vendor procedures	Small	None	Handle problems better
Add personnel to customization and testing teams	70,000	None	May help stay on schedule
Delay all CRM deployment in the business segment by six months	Small	270,000	Resolve minor problems before tackling more complex functionality issues
Delay sales module deployment in the business segment by six months	Small	70,000	Resolve minor problems before tackling more complex functionality issues
Delay all subsequent project steps by three months	40,000	70,000	Resolve current problems
Abandon project	225,000	900,000	None

Table 3. Interview protocol (validation phase)

Project description

Describe the main functionality of the system to be deployed and the cost estimated while initiating the project

Describe the required customization work, its scale and timing, and the main roles of the client and vendor

Did the project include software development work beyond customization? If so, describe it, its scale and timing, and the main roles of the client and vendor

What was the deployment scale? How many internal and external users were planned? What were their organizational roles?

Which project management methodologies were used?

Describe briefly the cost/benefit analysis performed during the initiation of the project

What were the main learning challenges? What did you need to learn during customization and deployment?

What were the main risks relevant to the project?

Pre-defined staging

What were the stages of development, customization, and deployment that you planned for this project?

How did these stages address the learning challenges?

How did these stages address the relevant risks?

Planned optional staging

Did you plan optional stages, including prototypes, responses to risk materialization, rollbacks, etc.?

How did these stages address the learning challenges?

How did these stages address the relevant risks?

Actual, unplanned optional staging

Did you have to stage development, customization, and deployment work in ways that were not planned in advance?

Why were these stages needed? Explain per stage in terms of learning and risk

Results and reflection

Describe the results of the development, customization, and deployment

How successful was the deployment project?

Did you draw any conclusions from your experience in staging the work in this project?

Do you draw any conclusions from the discussion about planned and unplanned optional stages in this project?

Table 4. Project descriptions (validation phase)

No.	Sector	Project	Effort*	Short description
1	Government/ IT infrastructure	Government-wide ERP finance and logistics	2,000 p/y	A comprehensive ERP SAP project across all government ministries. Controlled by the Ministry of Finance to standardize government finance and logistics. Initiated 2001 and completed 2009.
2	Aircraft industry/ industrial	Group-wide ERP	800 p/y including customization, coding, and deployment	An ERP SAP project to support all the Israeli aircraft industry business units. Included finance, procurement, inventory, customers, and suppliers. Initiated 2002 and completed 2006.
3	Government/ mapping	Geographic information system	750 p/y	Creating digital mapping of the state, including geographic maps, road and building databases. Incorporated data from all government departments. Started 1990 and completed 2005. Based on off-the-shelf ESRI software.
4	Public sector	ERP	400 p/y customization and development, 50 p/y deployment	A large public sector organization. Implemented an ERP SAP system to cover finance, budget, suppliers, and later HR and construction. Started 2003 and completed 2008. The project was managed by four levels of steering committees.
5	Municipality	Municipal tax determination	200 p/y customization and deployment	Municipality tax and billing project using SAP ERP Industrial Solution Utility (ISU). Functions included determination, billing, and collecting all tax categories including property, commercial, and water charges. Started 2006; the first version was completed 2009, after narrowing system functionality; full deployment 2011.
6	Chemical	Group-wide ERP	108 p/y customization, 30 p/y deployment	ERP SAP implementation at an international mining and petrochemical group. Modules included finance, cost, procurement, inventory, sales and marketing, and preventive maintenance. The new system replaced multiple mainframe systems, some from the late 1960s. Started 2000 and completed 2008.
7	Banking	Upgrading two costing systems	85 p/y including development and deployment	Major upgrading of two legacy costing systems. The systems were redeveloped to fit new technologies and new functional needs. The project aimed to minimize costs and was executed gradually.
8	Government/ education	Payroll system	60 p/y development, 20 p/y deployment	Replaced a legacy system. Internally developed in stages to cope with budgetary and organizational constraints. Based on .NET and Oracle technology. Started 1999 and completed 2004.
9	Healthcare	Electronic medical records	20 p/y for the pilot only	Proof-of-concept of two competing electronic medical record systems. Full-scale hospital deployment of the two systems. Started 2010.
10	Government/ commerce	Professional training system	15 p/y including development	Internal development of a system to manage professional training, including the training of engineers, technicians, and others.

* The project effort is calculated in person year (p/y) units; the analysis uses a common p/y price in the Israeli software services market of NIS 250,000, which is roughly USD 66,000.

Table 5. Pre-defined and optional staging (validation phase)

No.	Project	Pre-defined staging		Optional staging		Other options
		Stages	Reasons	Stages	Reasons	
1	Government-wide ERP finance and logistics	By departments; smaller modules first	Schedule and budget constraints			
2	Group-wide ERP	By business units	Learning; risk	Escalation resources and procedures were pre-planned for major schedule slips	Criticality of the deployment for operations	Pilot-like pre-deployment simulation and testing
3	Geographic information system	Functional; geographical; content staging	Learning; limited content	Profitable parts were further developed		
4	ERP	Parallel customization but single point deployment				Pilot; roll back
5	Municipal tax determination	Functional; data conversion; hardware purchase; testing	Risk of slow response and schedule slips; learning	Functional stages included essential and optional functionality	Optional go/no-go decision followed the outcome of the essential part	Roll back
6	Group-wide ERP	None – single deployment at all business units; later deployment in additional group companies				Pilot
7	Upgrading two costing systems	By module	Budget minimization			Roll back
8	Payroll system	Development, then functional and geographical deployment	Limited budget; risk			
9	Electronic medical records	By ward, for each of the pilots	Learning	Two competing large-scale deployments	Proof of concept	Roll back
10	Professional training system	Functional modules; data amelioration	Learning; risk			Pilot

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Enterprise Information Systems, Manuscript ID TEIS-2014-0033.R3
"Pre-defined and optional staging for the deployment of enterprise systems: A case study and a framework"

27-May-2015

Dear Professor Ip,

We appreciate the opportunity given to us to publish in *Enterprise Information Systems* and we wish to thank the editorial team for the additional constructive suggestions. We have acted upon these suggestions and we hope that the revised paper can now be formally accepted.

Referee: 2

Comment: *"In validation, interview questions are still missing as well as "when and where" did you conducted it. Please tabulate the sample questions in a table. The time and place you conducted the interview should be mentioned on pages 15-16. After you making these two changes, the paper will be in final form."*

Response: We now include an additional table in the paper (Table 3), which describes the question protocol that guided the interviews in the validation phase. We also include text in the paper itself (p. 16, highlighted in yellow) that describes where and when the interviews were conducted. Thank you for emphasizing the importance of this additional information, which allows readers to better understand the research methodologies leading to our findings.