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# Heterogeneity of IT Importance: Implications for Enterprise IT Portfolio Management

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***Various models of strategic IT deployment [McFarlan et al 1983; Henderson & Venkatraman 1993] have explained how firms align IT applications to provide business value. Recent trends in IT spending raise questions about whether IT has largely become a commodity that no longer provides competitive advantage.***

***While prior models allow for variation between firms and over time, we believe that any analysis must also consider the intra-organizational heterogeneity of strategic importance for a firm's IT investments. We present a framework for analyzing four different stages of IT importance: support, mission critical, strategic and laboratory. We show that enterprise IT portfolio management involves administering the lifecycle of applications, and shifting applications over time among the four stages to maintain alignment with their changing strategic importance.***

***We relate this to internal and external forces for change to the IT portfolio, and how these changes affect the allocation and investment of IT resources. We illustrate how the heterogeneity of IT importance influences the tradeoff in IT investment across features, risk and cost among the stages. Finally, we consider the implications of the framework for researching enterprise IT strategies over time, and for IT professionals allocating resources in managing their portfolios.***

Changes in technology provide opportunities for IT buyers to improve capabilities, reduce costs, or both. Such shifts are often treated as one-time industry transformations rather than part of a normal and ongoing process of aligning the IT portfolio to a firm's strategic objectives.

Within an enterprise,[1] different parts of the IT portfolio provide varying opportunities for strategic alignment, both to increase strategic advantage through new technologies or to reduce cost by rightsizing systems design. We develop a multi-stage framework to explain how such enterprise IT portfolios can be managed to maintain the strategic alignment of the disparate information systems within large enterprises. We show how this framework explains the tradeoffs made between features, risk and cost in systems adoption and deployment.

Finally, we conclude with implications for researchers, managers and vendors considering the impact of such portfolio management upon enterprise IT decisions, particularly the impact of non-proprietary hardware and software technologies upon such investment decisions.

## 1. Changes in Organizational IT Use

The two decades from 1980-2000 marked tremendous growth in the organizational adoption of information technologies, through new users, new uses, and new technologies. Some (mainly smaller) firms adopted their first

[1] We use the term enterprise to refer to an organization that has an IS function that is part of the organization's planning process. Usually such organizations have thousands of employees.

computers with the availability of desktop computing, while at larger enterprises, computing shifted from being a back office data processing system to become an integral part of daily operations.

Much of the growth came from innovations developing new technologies, such as RDBMS, RISC-based computing, local area networks, web-based intranets. Some of these technologies enabled new uses, such as web browsing and e-commerce. Other technical developments enabled the further integration of computer technologies into business operations through systems such as supply chain management (SCM), enterprise resource planning (ERP) and customer relationship management (CRM), which required not only alignment of the technology to support business goals, but also a change in business processes to realize the benefits of that technology.

However, this huge growth in technology adoption masked a contrary trend in the declining real cost of computing. Nordhaus [2001] estimated that the cost of computing power has declined in constant dollars at a compounded growth rate of 55% per annum from 1940 to 2001. While adoption spread through businesses and eventually consumers during the last two decades of this period, many of the technologies adopted reflected less expensive ways of solving the same problem, as mainframes were successively supplanted by minicomputers, workstations, client-server and PC computing.

Prices dropped not only due to increasing chip density and increasing manufacturing volumes, but also due to increased competition, reflecting the declining control exerted by proprietary IT vendors over their customers. In the first round, vertically-integrated mainframe vendors lost business to new vertically-integrated "open systems" vendors, which offered lower purchase and switching costs but still used proprietary R&D to keep out new entrants and partially lock in customers [Bresnahan and Saloner, 1997]. The proprietary vendor control was further eroded by a shift to horizontal specialization of component vendors, standardized components and modular systems design that led to the commoditization of once cutting-edge technology [Grove 1996; Bresnahan and Greenstein 1999].

As a result, buyer organizations deployed systems that have similar capabilities but at a lower cost, a process of rightsizing that accelerated after the end of the technology bubble in 2000. This commoditization and associated pervasiveness of IT prompted Carr [2003] to assert "IT doesn't matter" in terms of providing competitive advantage. Even those that disagree with Carr concede that many previously "strategic" information systems are no longer a source of differentiation. Many of the recent IT changes have sought to replace existing capabilities at a lower cost.

The maturation of information technologies had a traumatic impact on IT industry vendors. The rise of commoditized hardware components have reduced proprietary barriers to entry, increasing competition and buyer power, and reducing profit margins. These shifts have been fatal for systems vendors such as Digital Equipment Corporation and have threatened Compaq, HP and Sun Microsystems. More recently, software vendors have faced similar pressures with the increasing popularity and capabilities of open source software.

## 2. Prior Research

From the beginnings of the field of information systems, a key question has been how firms should allocate IT spending to maximize business value. For example, in the first article of the first issue of *MIS Quarterly,* bank president William Dougherty identified a key question for his firm as "How much should we spend and why should we spend it?" [Halbert, 1977: 5].

Subsequent researchers have developed the field of I.S. strategy, focusing on the linkage between IT investments and business value. Among the earliest to pioneer such work was McFarlan, whose normative (proscriptive) research offered specific guidance as to how firms could maximize the benefits from IT investments [McFarlan, 1981, 1984; McFarlan et al, 1983]. Meanwhile, causal research in I.S. strategy field has considered how differences in IT business value can be explained by differences within the "focal firm" [Melville et al, 2004].

The study of firm IT investments, returns and strategy is also naturally linked to the study of technology adoption. Because new technologies require both search costs and switching costs, the business justification for incurring such up-front costs is the prospect of reduced ongoing costs or achieving competitive advantage over rivals. Within the I.S. field, technology adoption has been linked to strategic advantage in the study of early technology adopters and the benefits they realized from new technologies [e.g., Kraemer & Dedrick, 2002].

## Factors Explaining I.S. Strategy Success

A major focus of strategic information systems research has been the ongoing attempt to empirically confirm the relationship between IT investment and increased business performance. After early research produced conflicting evidence for a direct relationship between investment and performance, subsequent research has focused on identifying moderating factors for realizing a successful return on IT investment.

Among the earliest such moderators identified is the overall strategic importance for IT for specific firms or for all firms across an industry. In considering the I.S. planning process, McFarlan, McKenney and Pyburn [1983] used a grid to classify firms into four different I.S. environments: support, factory, turnaround and strategic. Their framework allows for different organizational subunits to occupy different quadrants and for the position of a firm [or unit] to change over time. This Strategic Grid model has been validated by various empirical studies including Neumann, Ahitev and Zviran [1992] and Raghunathan and Raghunathan [1990].

A second stream has identified the moderating effect of aligning I.S. strategies to business strategies. Henderson and Venkatraman [1993] argued that such alignment is an essential factor for explaining the impact of IT to a firm's performance — both in terms of the strategic fit from the external to the internal domain of the organization, and the integration between the business and functional domains. Venkatraman [1994] classified the business value received from information systems into five levels of benefits, based on the degree of business transformation that the systems enable and the benefits that have been realized.

The moderating effect of strategic alignment has been one of strongest and most consistent explanations for IT business returns [e.g., Reich & Benbesat, 1996; Chan *et al.,* 1997, Palmer & Markus, 2000]. For example, using the Miles & Snow [1978] typology of prospectors, analyzers and defenders, Sabherwal & Chan [2001] found that I.S. alignment benefited firms in prospectors and analyzers but not defenders. Finally, Tallon et al [2000] found that payoffs were moderated not only by strategic alignment, but also by the degree of importance placed by top executives on the role of IT in firm success.

## Changes Over Time

While perhaps not explicitly identified, implicit in much of the strategic I.S. literature is the assumption that firms utilizing IT investments for strategic advantage will continue to seek such advantage. This is consistent with the Porter's concept of a generic competitive strategy, where firms make a long-term decision to either use above-average investments to achieve differentiation or consistently keep costs low to deliver low prices [Porter 1980].

However, the strategic advantage through differentiation or superior efficiency provided by IT investments can dissipate over time, as IT best practices become broadly diffused throughout an industry or across industries. Once a firm uses an IT investment to gain advantage, competitors may be forced to match that technology to remain competitive [Barua & Lee 1997]. Then a technology that once was essential for providing strategic advantage over competitors becomes a "strategic necessity" even though it no longer provides advantage [Neumann, 1994]. When unable to monopolize their technology, firms may even license it to rivals to monetize their investment and pre-empt development of competing systems, as AMR Corp. did with SABRE and McKesson Drug did with its Economost system [Siau 2003]. Or two firms may enter into a long-term strategic rivalry (as have FedEx and UPS) where one firm uses IT to gain competitive advantage, which turns to strategic necessity (to avoid strategic disadvantage) as each rival matches and then surpasses the technology.

## Managing Portfolios of IT Investments

To more accurately assess the strategic value of information systems, researchers have recommended finer-grained units of analysis than the firm, such as the strategic business unit [Barua et al, 1995]. Other research has disaggregated the analysis even further, considering individual systems and the casual (and normative) explanation of how firms do (or should) successfully manage a portfolio of IT investments. For example, Weill & Vitale [1999] identified key attributes for assessing the success of each information system in a firm's portfolio, considering strategic importance and value, investment, technical quality and level of use.

Ragoowsky *et al.* [2000] showed that the relationship between information systems success and firm benefits is stronger for individual I.S. applications than for the portfolio as a whole.

A few studies have explicitly considered the differences in the strategic objectives among the various information systems required to run a modern IT-enabled enterprise. Considering the procurement of new systems, Saarinen & Vepsäläinen [1994] developed a typology of systems ranging from routine to speculative. They concluded that the most routine systems could be procured off-the-shelf, while those that required investments highly specific to one company entailed the greatest investment, highest risk and enjoyed the highest potential payoff.

## Assessment

The expectations for IT investments are not homogeneous across a given enterprise. Systems differ in their technological composition — in terms of performance, features, complexity, reliability, cost, and support requirements. Systems also differ in how they are used, the degree to which they align with strategic goals, and ultimately how much business value they provide for the resources invested.

As the previous summary suggests, most of the work on IT adoption and I.S. strategy has focused on differences between organizations. Such differences in IT intensity are certainly important and empirically validated, whether between industries or between leaders and laggards in the same industry. Some of this inter-organizational focus can also be attributed to the use of the individual-centered diffusion of innovations (DOI) frameworks popularized by Rogers [1983] that were later adapted for studying organizational adoption of innovation [e.g. Tornatzky & Fleischer, 1990]. There is also the tendency in analysis (whether journalistic or academic) to highlight "first movers" and other best practices as exemplars for other firms to emulate.

The one place where intra-firm differences in systems requirements have been considered is in the earlier research on IT portfolio strategies. However, such portfolio studies tend to focus on internally developed applications [e.g. McFarlan, 1981; Kirsch, 1997; Weill & Vitale, 1999]. In the past decade, firms have shifted to off-the-shelf applications for some routine needs, while other customized applications are built on top of off-the-shelf enterprise applications (such as offered by Oracle, PeopleSoft or SAP). So consideration of the returns to IT spending of necessity must consider the entire applications stack, from the off-the-shelf network infrastructure and computer systems to packaged middleware and applications — in addition to spending on internal systems development.

Even for an enterprise that uses key information systems as its primary source of competitive advantage, there will likely be other systems of little or no strategic importance, with concomitant lower levels of top management visibility, staffing and investment. Saarinen & Vepsäläinen [1994] termed these as "routine systems".

Therefore, we feel it is important to consider the variation of IT requirements *within* organizations and even organizational subunits, particularly the larger ones. Such research would consider not only decisions between custom and off-the-shelf applications, but also spending on systems infrastructure. It would consider not only spending to obtain new capabilities, but also to obtain the current capabilities at a lower cost. Finally, it would link the decisions made by organizations regarding new technologies to the differences in requirements within the organization, offering insights not only to which organizations will be first to adopt such technologies, but also where and why.

## 3. IT Portfolio – a Stage Framework

Consistent with the definitions of McFarlan, Venkatraman and others, we identify differences in strategic importance between information systems. We use this to build a model of the IT portfolio that allows for heterogeneity of technology requirement, both to explain intra-organizational, inter-organizational and inter-temporal differences in technology decisions, and also to offer a framework for managers to consider how to manage their IT investments.

### What is a Stage

Here we define a "stage" as a category of strategic importance for a given information system. All systems in the same stage share similar strategic importance and (as will be discussed in the next section) face similar trade-offs between competing goals in procuring the system. A given system may be deployed and retired within a given stage, or its categorization may shift over time as the technology and business environment evolve, and the system is modified [or not] to reflect this evolution.

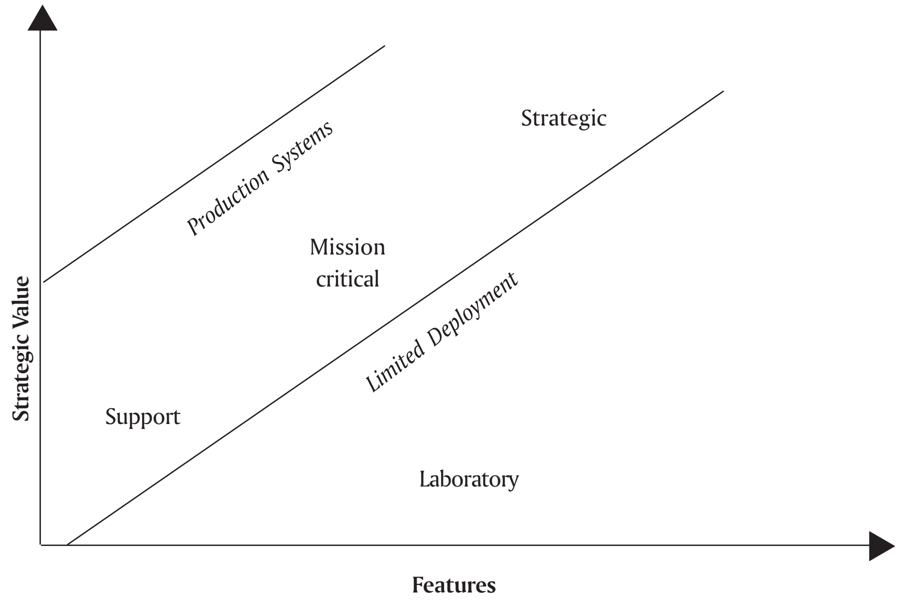
We hypothesize four distinct stages — three involving production systems and a fourth involving experimental or other limited deployment systems. The definitions of these stages are summarized in Table 1. At any given point in time, the stages are distinguished by their goals, strategic alignment and capabilities. However, over time, the typical level of capabilities for each stage would be expected to increase over time. On the supply side, new capabilities become available that are incorporated through the normal replacement cycle. On the demand side, users' increase in sophistication and expectations and upgrades by rivals both raise the minimum expected capabilities for systems at any given stage.

**Table 1. Definition of stages**

| Stage | Characteristics | Level of Strategic Alignment | Example |
|---|---|---|---|
| Support | Productivity-oriented, cost-effectiveness and operational efficiency are important | Low to non-existent | Desktop computing |
| Mission Critical | Smooth and continuous operations required to fulfill the mission of the enterprise | High, well understood | Airline reservations [2000s]<br>SCM [2000s] |
| Strategic | Vital to competitive success, leading-edge technology, sustainability is important | High, not yet well understood | Airline reservations [1970s]<br>SCM [1990s] |
| Laboratory | Driven by user demand for pilot studies and experimentation with bleeding-edge or cost-saving technology | Low, but rising | RFID product tags [2000s] |

The stages are distinguished in large part by their relative strategic importance; the strategic I.S. issues McFarlan et al [1983] identified entire firms or business units, we believe can be extended to individual systems. Among the production stages, there is an increase in strategic importance from Support to Mission Critical to Strategic, with a parallel increase in features (Figure 1). The Laboratory stage may have more advanced technology, but is not yet strategically important because it contains unproven technology that is not yet deployed.

**Figure 1: Stages in the IT Portfolio**




Each of the stages represent the strategic role of a given information system within an enterprise. That system includes not only the application software, but the underlying infrastructure as well, such as the middleware, computing platform, network infrastructure or support staff. Of particular interest is the computing platform [cf. Bresnahan & Greenstein, 1999] of hardware and operating system, since prior research has shown that when application software choices drive system designs, the entire "stack" of software and hardware are selected (or updated) as part of a holistic design.[2] Quite often, the computing platform and system design are part of a more complex enterprise computing architecture [e.g., see O'Rourke, Fishmand, Selkow 2003].

## Strategic Stage

Systems in the strategic stage are those that, by definition, are strategically important to the business performance by providing actual (not imagined)

2 The term "application" has been used in IT-related writing to talk about the process of applying information technology to solve a particular problem, or for a class of software closest to the user or client. To avoid confusion, in this paper we use "IT application" and "application software" respectively for these related (but distinct) concepts.

competitive advantage over rivals. The Strategic stage in this framework is consistent with the definitions of McFarlan et al [1983] and Venkatraman [1994] for a category of system that has the greatest strategic benefit to the enterprise based on both uniqueness and business value delivered.

Strategic systems are also those that require the greatest change to business processes, consistent with Venkatraman's [1994] 4th and 5th levels of strategic alignment; such systems might be those that link the enterprise to strategic partners and suppliers in the Porter [1980]-style value chain. For example, Broadbent et al [1999] showed that IT resources [both human and technical] were a prerequisite to successful business process realignment.

These systems usually require the largest proportionate share of resources and the greatest top management oversight. In the race to get ahead of rivals, these systems may be developed quickly to take advantage of a window of opportunity; thus, the strategic impact of their deployment may not be well understood or assured ahead of time. In order to sustain the competitive advantage the enterprise will have to devote substantial resources to deployment and to up-keep of the technology requirements.

## Mission Critical Stage

While these systems do not provide competitive advantage, the smooth and reliable operations of the systems in this stage are critical to the fulfillment of the mission of the enterprise. Thus their failure (however temporary) will potentially subject the enterprise to financial exposure, loss of customers, goodwill and brand loyalty.

These may be systems may be systems that once provided strategic advantage, but now, due to imitation by rivals, are in the "strategic necessity" category of Neumann [1994]. Or these may be the systems introduced by rivals who are forced to adopt new technology to avoid ceding permanent advantage to the first mover [cf. Barua & Lee 1997].

The main operational concerns for these systems are the up time, error-rate, security, and system integrity. These systems have very specific features and performance requirements that must be met, and in order to sustain these requirements, an enterprise must provide the resources necessary to support them.

For example, a mission critical application for a particular enterprise might be one that employs a best-in-class software package to process customer orders online. In order to produce the performance required for such an application, the enterprise would have to invest in a reliable and scalable hardware infrastructure to complement the software[3].

### Support Stage

These systems are not crucially important, but provide business value by improving the enterprise's internal efficiency. They include features of both the Support and Factory quadrants of the McFarlan et al [1983] strategic grid, while they share technical characteristics with the "routine systems" identified by Saarinen & Vepsäläinen [1994].

In a typical enterprise, these systems might include desktop, productivity, decision-support, communication, ERP applications, and many infrastructure technologies. However, the actual classification of a system is determined by its business value, not its underlying technology: a word processing system that is "support" in a manufacturing plant might be "mission critical" in a professional services firm [such as a law firm] whose output consists of documents produced and distributed under tight deadlines.

The main concern for operating these systems is cost-efficiency. Often these systems are run like a utility, that is, "turn on the switch and they should run." There is no opportunity for competitive advantage from such systems, and thus are rarely part of the strategic planning process of the enterprise. These systems are usually managed by mid-level managers and do not require top management intervention.

### Laboratory Stage

These systems are not part of the operations of the enterprise, but are developed in response to user demands for pilot studies and experimentation with new technology.

3 As a matter of fact, the requirements of such systems call for consistency in reliability and other features within the whole system, from hardware through the software "stack."

This category is a temporary stop for systems that are being evaluated for a permanent operational role. Not all IT applications graduate from laboratory to deployment, but those with demonstrated merit and value are deployed as applications in one of the other stages. These applications usually have a low level of management visibility reflecting their low strategic importance. The research, investigation and evaluation of these systems often depend on the availability of slack resources available in the IS function.

However, as financial and competitive pressure increase in the enterprise's environment, the strategic impact of these applications will also increase and thus require allocation of resources; an example of such would be when an enterprise deployed Wi-Fi technology on its R&D campus to evaluate its suitability for deployment throughout the enterprise. The laboratory stage can also be used to evaluate new cost-saving technologies, such as the replacement of RISC-based Unix systems with commodity PC Linux servers.

## 4. Tradeoffs Among Features, Risk and Cost

While enterprises procure systems of differing levels of strategic importance, there are other differences as well. In allocating resources for each system, firms must make tradeoffs between competing product attributes.

For systems intended to deliver competitive advantage, enterprises have sought the most advanced technologies in most strategically important systems — those in the strategic stage.

But in our interviews with MIS buyers [cf. Dedrick & West, 2004], we found two important categories of attributes driving recent buying decisions:

- a desire for lower costs thus motivating the adoption of lower cost solutions to existing problems;
- a recognition that achieving lower costs requires either giving up features or accepting higher risk.

Not surprisingly, the only systems that justify the highest costs are those that generate the greatest strategic value. So thus the trade-offs between features, risk and cost made by IS managers in procuring new would be expected to vary based on the strategic importance of the systems. Of course, the feasible region of the tradeoff space is determined by the availability of products[4].

The decisions made regarding the different levels of the systems stack will also have to make trade-offs between feature, risks and costs — both between systems and within systems

Therefore, we expect to be able to make three type of predictions:

- within systems of similar strategic importance, the relative importance between features, risk and costs;
- between systems of different strategic importance, the differences in the importance of these three attributes based on differences in strategic importance; and
- within the same system, the relationship for features, risks and costs among different layers of the systems stack.

### Features

The features of information systems are all the attributes that are customarily used to measure what is good, valuable or new about an information systems. Vendors of new products often seek to distinguish their products in terms of features, while sales of upgraded hardware and software products are driven by such features.

If features are what deliver innovation and new capabilities, then competitive advantage — through highly strategic systems — is driven by the availability of features. For an entire system, the features that provide the most competitive advantage are typically those at the highest levels of the stack, i.e. closest to users.

Therefore, we would expect:

Proposition 1*A: The importance of features in purchasing information systems will be higher for systems of higher strategic importance.*

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4 We use the term product here to represent something that can be purchased. It includes systems, components and "solutions."

*Proposition 1B: The importance of features is greater for higher levels of the stack than lower levels of the stack.*

## Risk

One of the key issues facing IS managers is the degree of risk that is acceptable in operating systems. For some systems, the risk is an issue of reliability — such as might be measured by time between crashes, restarts or failures.

In other cases, the difference may not be in the technical quality of the system, but the other attributes of the entire product offering. For systems with low risk tolerance, this includes support capabilities like 7/24 support, on-site or telephone support. Or it might include indirectly measured intangibles, such as credibility or brand name reputation.

However measured, we would expect:

*Proposition 2A: Firms will accept more risk in systems of low strategic importance.*

Firms also need to make risk choices about the various components of an information system. Based on the principle that "a chain is only as strong as its weakest link", we would expect that paying for low risk at one layer will not be generally valuable if the other layers of the system entail high risk.

*Proposition 2B:Firms will make similar risk choices for all layers of the stack.*

## Cost

IS managers make a variety of decisions regarding costs. In some cases the decisions are driven by the initial cost of the good, such as the purchase price for software or hardware. In other cases, the decisions may be driven by the initial costs of related goods — as when the hardware for Lintel is cheaper than for RISC-based Unix.

In other cases, cost considerations may encompass ongoing costs — whether renewal/maintenance/support costs, staffing costs. In a few cases — although not as often as hypothesized in management studies — firms will attempt co estimate a total cost of ownership (TCO) which subsumes both initial and recurring costs.

The amount firms are willing to pay is a direct reflection of the strategic value of a system. Therefore, we would expect:

*Proposition 3A: Cost is less important for systems of higher strategic importance.*

*Proposition 3B: Cost is the highest priority for systems of low strategic importance.*

At the same time, the cost decisions made for multiple layers of the stack will be driven more by the features and risk than cost. So we would expect:

*Proposition 3C: Correlations in the importance of costs between layers of an information system will be mediated by correlations in the features and risks between these layers.*

## Links to the Stages Framework

Given the ranking of the three production stages according to strategic importance, we would expect that importance to drive differences in features, risk and cost importance. So, for example, the importance of cost would be higher for the support stage than mission critical stage, and for mission critical stage than the strategic stage.

As noted earlier, the one stage not directly characterized by differences in strategic importance is the laboratory stage. Previously, the laboratory stage might have been used only to introduce new cutting edge features which provide sources of competitive advantage for the strategic stage. However, since the collapse of IT spending after 2001, today laboratory evaluations are also often driven by a desire to deliver similar capabilities at a lower cost, thus having features reflecting the stage of intended deployment.

The per unit cost of laboratory systems will be lower than for comparable production systems if vendors provide evaluation hardware and software, but higher in terms of staffing costs to set up and evaluate a brand new application. Even if these two effects cancel out, a limited sc ale test deployment is likely to be less expensive than a full production deployment — assuming that that production deployment is at scale (rather than a single system, such as a CEO decision support system).

However, the one clear difference is in the tolerance for risk. The laboratory stage is used for evaluating new, unproven technologies — or for internal systems development, to develop them in house. The new is always initially riskier than the existing and known. We would expect that new technologies that are evaluated through the laboratory stage — rather than directly installed into production — would be the riskiest of the new technologies. Thus, we predict:

*Proposition 4: Firms will accept more risk in the laboratory stage than in the support, mission critical or strategic stages.*

Using these propositions, Table 2 summarizes the relationship between the features, risk and cost tradeoffs between the four stages. The tradeoffs reflect the decision maker's response to the external and internal forces that are exerted on the organization as described earlier.

**Table 2: Hypothesized Tradeoffs between Stages**

| Stage | Features | Risk | Cost |
|---|---|---|---|
| Support | Minimal | Moderate | Low |
| Mission Critical | Standard | Little or none | Moderate |
| Strategic | High | Low | High |
| Laboratory | *Varies* | High | Medium |

## 5. Forces for Change Between Stages

For any enterprise, the portfolio of IT systems will change over time. In some cases, systems will be added or deleted. In other cases, existing systems will change in strategic importance and thus shift between stages. Such shifts will be caused by some combination of internal and external forces on the organization.

### External Forces

An enterprise faces a number of external pressures that shape its IS strategy. First and foremost is the level of customer demand, driven by the overall economy and the health of customer industries. The enterprise also must worry about existing competitors, potential new entrants and substitutes, and pressure from its suppliers [Porter 1980]. Such environmental factors are largely beyond the control of the enterprise.

Other than the changes in economic conditions, two types of pressure have a major impact on the use of IT to improve the competitive position of the enterprise. The first type of pressure is from increasingly capable rivals, which either match the IS strategy of the focal enterprise or surpass it. The IS shop is constantly searching for new applications that can provide a competitive edge, or to upgrade and enhance existing applications.

The enterprise also faces ongoing pressure from customers to reduce prices, which force the enterprise to reduce IT and other operational costs. For some enterprises, this has meant integration with customers' information systems to ease transfer and sharing of information. Such pressure lead to a constant push for EAI (Enterprise Applications Integration) solutions, ERP's integrated with back-office support and CRM solutions.

The typical enterprise has a mixed relationship with its IT vendors. On the one hand, the vendors may offer new products and services that make it easier to implement the IS strategy. On the other hand, some vendors still attempt to pursue unpopular tactics of planned obsolescence[5], licensing and upgrade agreements that leave little flexibility for customers. Meanwhile, enterprises must either manage disparate and incompatible hardware and software, or turn over control to another vendor as part of an outsourcing arrangement.

Such vendor power has been reduced by two recent developments in the IT market place — the proliferation of commodity hardware and non-proprietary software — that potentially reduce the lock-in of proprietary IT vendors, offering more choices and lower costs. We will discuss later how the enterprise trades off such lower cost alternatives in its IT purchase decisions.

## Internal Forces

Those managing the IT portfolio face two general types of internal pressures. First, are the systems delivering business value aligned to the enterprise's overall strategic goals? Secondly, are they doing so in a cost effective fashion? Although Bresnahan and Saloner [1997] did not find cost as a main factor in enterprise IT

5 Software vendors often set timetables for phasing out support for products to force customers to upgrade to new versions of the software with new licensing fees and agreements. This also provides vendors opportunities to sell new features and add-ons which were not available in older versions.

purchasing decisions, it has become a significant concern under recent economic conditions that require IS function to do more with less. These pressure work at cross-purposes, and each may have greater influence on different parts of the portfolio — business value from strategic systems (accepting that it will be expensive) and minimal cost for support systems (accepting commoditization of the technology).

Finally, like other functions the IS managers must demonstrate effectiveness of investment decisions, both generally and via specific financial measures such as ROI. This requires accurate assessment of strategic importance, value delivered and total cost of ownership.

## 6. Managing the IT Portfolio

Enterprises will add, delete or update their portfolio of IT applications to respond to external and internal pressures and maintain alignment with corporate strategic goals. In some cases, this will shift the applications between stages, while in other cases the applications will be updated within the same stage.

### New Applications

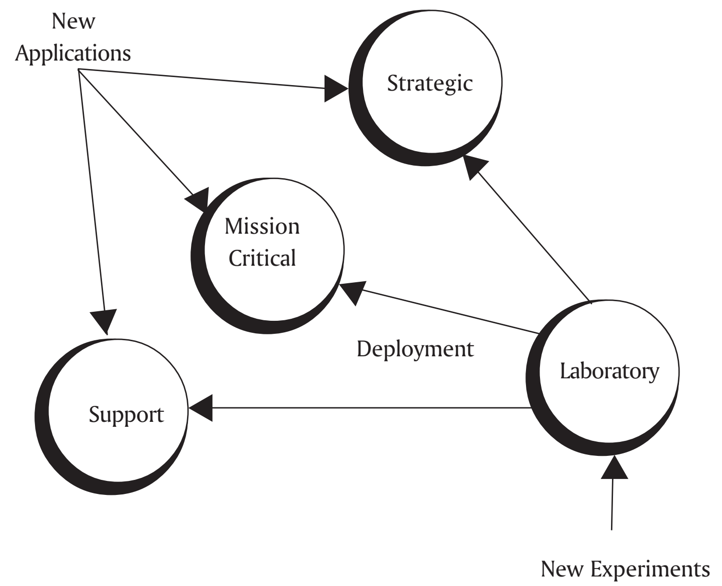
Figure 2 shows how new IT applications are introduced into the portfolio represented by each stage. Applications are introduced into each stage as new requirements come into place. Those introduced into the Laboratory stage are usually from user demands for prototypes and experimentation with new bleeding-edge technology, some of which will graduate to deployment in the other stages.

## Replacement of Applications

Once an IT application has been deployed, it might undergo some form of updating or replacement sometime in its lifespan. The replacement of an application could, in varying degrees, change the features or characteristics of the application. Overall, replacement does not change the strategic value of the IT applications and they stay within the stage.

The first form of replacement is "replacement-in-kind," i.e., the new system is similar to the existing system. The second form of replacement is the upgrading of the technology deployed for an IT application (sometimes called *upsizing*).

**Figure 2: Introduction of New IT Applications into the Stages**




Enterprises upgrade their technology to respond to user demands as well as competitive pressure from the outside. The upgrade could be based on a replacement schedule or on an on-demand basis. Enterprises might even upgrade in order to take advantage of technology advancement or cost reduction opportunities in the market place. An upgrade usually results in an increase in available features.

In contrast to upsizing of applications, enterprises have also been purchasing technology with fewer features to support existing applications. This was demonstrated in the down/rightsizing movement that started in the early 1990's, when the centralized computing model was gradually replaced by the client/ server architecture. We use the term *rightsizing* here to describe the third form of replacement where organizations are replacing existing proprietary hardware and software with commodity hardware and non-proprietary software. In many situations, applications that were implemented with proprietary hardware and software do not necessarily need all the features that are provided. These applications could very well run with "good enough" equipment that is capable of delivering the performance needed.

The adoption of client/server Unix- and PC-based systems studied by Bresnahan & Saloner [1997] demonstrated all forms of replacement. In some cases, organizations solved existing problems using less expensive technologies; in other cases, they used the new technologies to provide improved capabilities. Their interviews with some 75 enterprises suggested, however, that any adoption of new technologies was driven by needs in [to use our stages formulation] either mission critical or strategic stages, because IT managers gave little thought as to how they could perform support functions better.

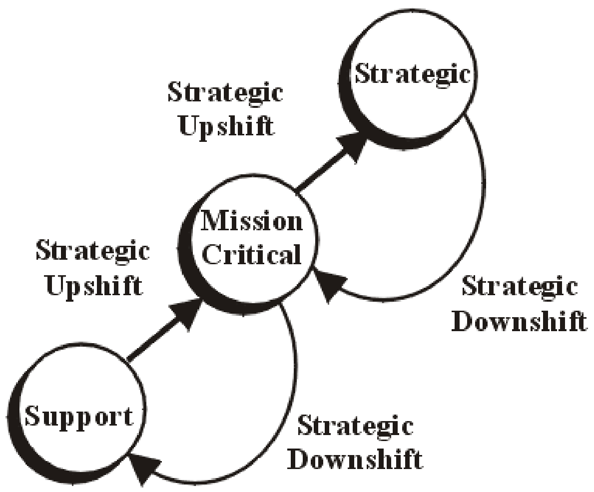
## Strategic Realignment of Applications

Here we use the term Strategic Upshift to describe applications that were in a lower stage become more strategically important and are then classified in a higher stage (see Figure 3). An example of the situation is Enterprise Application Integration (EAI) where disparate support applications are integrated together into a system that has effective and efficient information sharing and interchange[6]. This type of enterprise-level system requires more features than the individual support applications and the strategic importance increases to make it mission critical to the corporation. In this case, an IT application would shift to a higher stage as the result of a strategic realignment.

Another form of Strategic Upshift of applications is when enterprise-level systems are extended to the outside to gain competitive advantage, as with Supply Chain Management (SCM). With this type of application, an enterprise extends its existing logistical support system that is mission critical to connect with its suppliers. A single integrated system is put in place so that all partners in the relationship share information and processing. The usual motivation behind this is to cut operating cost, strengthen the relationship among partners and secure supplier allegiance. When successfully implemented, the applications shift from being mission critical to providing strategic advantage [cf. Porter 1985, Porter

6 Irani et al [2003] proposed a new classification scheme to replace the traditional information systems lifecycle because through EAI, many systems "have extended their identify and lifecycle, making it difficult to evaluate the full impact of the system as it has no definitive start and/or end."

**Figure 3: Strategic Realignment of Applications Between Stages**




and Millar 1985]. Similar examples could be found on the channel/customer side of the value chain with Customer Relationship Management (CRM) applications.

Applications can also be realigned downward in strategic value. As applications become mature, they might be reclassified into a lower stage as a result of a strategic *downshift*. Such a downshift may be deliberate, as when an enterprise decides to reduce investment for applications that no longer provide strategic advantage. More often, this shift goes unnoticed by management. Venkatraman found that many "strategic information systems" later became "no different than best practice in the marketplace" [Venkatraman 1994: 75], as the once cutting-edge technology becomes commoditized and available off-the-shelf from multiple vendors.

An example of this phenomenon was during the mid 1990's, when many corporations scrambled to "get online" and developed web pages to "establish their presence on the net." Some of the early adopters of the web technology gained a momentary advantage over their competitors [Dutta et al, 1998]. This advantage was very short-lived because the adoption of the web technology was very rapid and very soon almost every corporation has a web presence.

The deployment of second generation web technology using server-based applications linking customers on the web with back-office database applications have given some corporations a strategic advantage in the late 1990's, but by early 2000's the ubiquity of such applications have all but eliminated the advantage. This is true for many types of technology adoption and once the technology is "built-out," the advantage is lost.

## 7. Discussion

This framework provides a way for considering the decisions made by enterprises in procuring various internal systems, and offers specific propositions about how these decisions are made. As such, we believe it offers both causal predictions for such decisions, a classification system for studying such decisions, as well as a way for managers structure their approach to such decisions.

## Implications for IT Researchers

Previous research on strategic IS has assumed that to produce value, information systems should be highly strategic and aligned to the company's strategy. However, in the past 10 years many organizations have successfully deployed commodity IT solutions in the past years, leading a few commentators to go to the other extreme, concluding that "IT doesn't matter" [Carr, 2003]. We believe that considering the differences of requirements within an organization — allowing for the possibility that some investments are strategic while others are not — more accurately captures the reality of today's IT portfolios.

Prior research has shown how firms have differing levels of strategic alignment for their IT investments, but tended to aggregate all the systems in a large enterprise to the same level of strategic importance (or ignore those systems that are least strategic). Averaging characteristics across a heterogeneous array of systems masks intra-organizational differences that may be as large as the inter-organizational ones. This would tend to obscure (or confound) attempts to explain differences between organizations in the success of their IS strategy.

The stages model developed in this paper provides a framework for analyzing all the systems in an organization, considering their relative importance and alignment to strategic goals, and how such a portfolio evolves over time. Whether subsequent research adopts, extends or rejects the stages presented here, we believe using a portfolio of heterogeneous IT importance is essential to understanding how firms strategically align IT spending to meet corporate goals.

## Implications for IT Buyers

The implications for the IS function within user organizations are:

- Organizations — particularly complex enterprises — need to separately consider the appropriate level of importance and strategic alignment of each of their systems, both between systems and over time. The policies for running and evaluating strategic systems would not apply to support ones, and vice versa. Nor can firms assume that five-year-old policies for mission critical systems are still appropriate today.
- Echoing prior researchers, organizations must consider how the importance of applications change over time. Some systems should be shifted from one stage to another as their strategic importance changes; other systems undergo de facto downshifts that managers tend to ignore until the wasted investment or opportunity is obvious to all. The realignment of IT investments should be considered a fundamental, proactive part of any organization's IS strategy, rather than an episodic reactive exercise when misalignment reaches a crisis point.
- Some IT may no longer matter (because it has become a commodity), but it is dangerous to assume that all IT does not matter. Organizations that ignore the potential benefits of deploying new applications or realigning existing ones may forfeit their competitive position to rivals that carefully evaluate and pursue such benefits.

## Implications for IT Producers

As with IT buyers, vendors of IT products must recognize that the process of rightsizing and realignment is an ongoing and inevitable one, not an occasional earthquake that shakes up an otherwise stable structure. The industry's lack of historical perspective is understandable — it is comparatively young and, for much of that young life, one or a small number of producers has dominated key segments. Nevertheless, modularity and user efficiency pressures assure that cost pressures are now an ongoing feature of the buyer landscape.

The stages framework represents a way of understanding how enterprises manage their IT portfolios, and, in particular, the opportunities for vendors to increase the business value of IT investments and thus the amount buyers are willing to spend. These include:

- *Traditional proprietary approach:* introducing new IT applications that are evaluated on an experimental basis (in the laboratory stage) in hopes of winning widespread deployment.
- *Upsizing and upshifting:* convincing customers to spend more money on existing applications because the buyer can realize greater strategic benefits.
- *Rightsizing and downshifting:* this strategy, epitomized by Dell, involves winning business from competitors by helping buyers deliver existing IT applications at a dramatically lower cost.

## Future Research

As a conceptual framework, this paper offers potential insights based on managerial interviews and prior research. However, the inductive nature of the proposal awaits empirical confirmation. Among the topics that might be studied:

- how the level of minimal features, cost sensitivity and risk tolerance differ between the three operational stages.
- frequency of use of laboratory stage for new IT applications (rather than direct introduction in operational stages) — both between and within organizations — and whether the stage is more likely to be used for the most strategic new IT applications.
- whether firms that more often realign IT applications between stages are more likely to maintain strategic alignment of IT spending to corporate goals.
- the allocation of CIO and top management attention (cognitive resources] between stages, and its effect on cost and risk sensitivity.

More generally, the field needs additional research on how decisions are made regarding the IT portfolio, including trade-offs among features, cost and risk and alignment of each IT application with strategic goals. Of particular interest is how and when organizations recognize than an IT application is no longer providing strategic advantage, and under what conditions they attempt to upgrade such applications to provide continuing advantage.

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