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Strategic Choices in IS Infrastructure: Corporate Standards Versus "Best of Breed" Systems

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STRATEGIC CHOICES IN IS INFRASTRUCTURE: CORPORATE STANDARDS VERSUS "BEST OF BREED" SYSTEMS

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Abstract

A key IS infrastructure policy decision is whether to let each department select its own "Best of Breed" system solutions, which may be incompatible with each other, or to mandate the adoption of a uniform corporate standard, which may not be deemed suitable by some departments. Our paper examines the salient trade-offs involved in making such critical decisions. We identify cases where installation of disparate systems is preferable from an overall corporate perspective and those where all departments are required to adopt the same system. The paper shows that:

(I) If the organization requires all departments to use the same standard system, then it is always better off delegating this choice of a particular standard to a negotiating process among the departments.

(ii) In certain situations, the organization benefits by letting departments install different systems that are best suited to their needs (Best of Breed).

(iii) Site-licensing may adversely affect the adoption of a standard system as a result of a dysfunctional response which we term *shadow-rider* behavior: departments initially mask their true preferences and do not contribute to the purchase of site licenses, but later try and switch to gain cheap usage of the system once it is licensed.

1. INTRODUCTION

Organizations today have an unprecedented and wide choice of hardware and software systems for each business function, for instance, in large databases (IBM's DB2 versus Oracle), engineering design software (HP's ME10 versus MicroSoft Windows-based VISIOTechnical), basic architecture (open versus closed, mainframe versus client-server), personal computer hardware (PC versus Mac), communication systems (TCP/IP versus Novel IPX), operating systems (Windows NT versus OS/2 Warp), word processing (WordPerfect versus MicroSoft Word), spreadsheets (Lotus 1-2-3 versus MicroSoft Excel), office suites (MicroSoft Office versus Novell PerfectOffice), groupware (Lotus Notes versus Share), e-mail (MicroSoft Mail versus cc:Mail), and presentation software (Aldus Persuasion versus PowerPoint). Given the observed increase in overall IT expenditures (Gurbaxani and Mendelson 1987; Brynjolfsson et al. 1994; Stuart 1994) the current trend of cross-functional integration arising from corporate reengineering and this increased variety, managers are looking for ways to analyze systematically the implications of corporate technological policy choices.

One of the prime considerations facing an organization making these choices is whether to allow users to pick systems that best meet their specific requirements or to mandate a uniform corporate standard that is deemed best overall. Numerous articles in the trade literature provide IS managers with contradictory recommendations about the value of enforcing corporate standards:

> Our economic system rewards genius, and international standards committees are not renowned for that....The future will belong to proprietary systems created by entrepreneurs who refuse to be bound by logicians' schemes. These systems will encompass ideas and functions we can scarcely dream of and no standards architect can prepare for. They will generate wealth that would make Bill Gates blush. [Prince 1993]

In contrast, other authors (Wreden 1995) advocate the use of corporate-wide standards that require departmental managers to put the corporate good ahead of departmental or individual interests: "From an organizational standpoint, it can pay to get all departments running on the same suite so information can be shared more easily."

These apparent contradictions may result from the fact that the desirability of standards depends on various organizational and technological factors. Empirically, one observes that certain corporations mandate strict IS standards while others do not (Brewster and DiPaulo 1995).

The selection of a corporate standard, or of a common information technology, has important economic and organizational implications. This is illustrated by the following example, in which a manufacturing firm evaluates the purchase of a comprehensive production process planning package. The engineering design department prefers to use the *ME10* Computer Aided Design system on Unix-based HP workstations, while the production department prefers using *VISIOTechnical* on MS Windows-based PCS. The first system is perceived as a better tool for solid modeling and kinematic analysis, which are the key activities in engineering; the second has superior process planning and tool path generation capabilities that manufacturing values very highly. Using these two systems requires support and training for both HP (Unix) and PC (Windows) environments. Moreover, file transfers between these systems have to go through pre-and post-processing conversions of drawings since the internal representation of geometric elements differ between most CAD systems (even when they use the same geometric model).

The organization may either require the two departments to use the same system or allow each department to use the system that it prefers. In the former case, the manufacturing firm is said to mandate a standard, while in the latter it is adopting the "Best of Breed" approach. The choice between these two approaches depends on a number of competing cost factors. If the *VISIOTechnical* manufacturer offers steep site licensing discounts, then it may be cheaper to buy many copies of *VISIOTechnical* instead of fewer copies of the two different systems. Further, the organization may develop a beneficial partnership with the vendor of *VISIOTechnical* by which it receives special support and early releases. On the down side, the choice of *VISIOTechnical* will reduce the value of the software to the engineering department since it prefers *ME10.*

Training and support costs are reduced due to shared organizational learning and less variety in user systems. The support staff can become more familiar with the single standard system and provide better help. A larger pool of users makes it easier for them to support each other and it provides management with greater flexibility in employee scheduling and allocation. On the other hand, having to follow a mandated IS standard implies that users give up some decision rights; doing so may adversely affect morale and productivity. Moreover, users may fear that a corporate-wide standard will result in a shift in power from individual departments to the entity picking the standard.

The trade-offs in selecting corporate standards policy discussed above are modeled in the following sections.

2. LITERATURE REVIEW

Earlier studies have primarily focused on the evolution of standards in the marketplace. They have examined the influence of various factors on standardization and the benefits of standards (Bensen and Saloner 1994; David and Greenstein 1990; Farrel and Saloner 1986; Greenstein 1992; Katz and Shapiro 1985).

Corporate IT standards involve different trade-offs. A few authors have recently presented examples highlighting the benefits of corporate IT standards and discussed administrative procedures for developing them (Aach 1994; Gordon 1993). Our paper is the first to formulate and rigorously examine the salient trade-offs in mandating infrastructure standards for corporate information systems. Some of the factors that affect the standardization policy have been examined by other IS researchers. These include software development (Banker et al. 1993), systems management (Bakos and Kemerer 1992) and organizational changes (Clemons, Reddi and Row 1993; Brynjolfsson et al. 1994; Malone 1987; Gurbaxani and Whang 1991). In contrast, we provide a comprehensive framework for analyzing the value of corporate standards using non-cooperative game theory with no information asymmetry.

3. ECONOMIC ANALYSIS OF CORPORATE STANDARDS

We define some of the terms and concepts before describing the model. Standards are a set of specifications to which every purchaser or developer of a system must adhere. Most standards have evolved over the years in one of two principal ways. *De jure* standards are mandated by regulatory bodies or governments. In contrast, *de facto* standards arise when a number of entities cooperate or form joint associations to adopt standards voluntarily. We use the term *system* for specific hardware, software or communication equipment or a specific combination of these; *standard* for the use of a common system by various departments; and *infrastructure* for a set of basic installations and facilities such as hardware, software and communication systems.

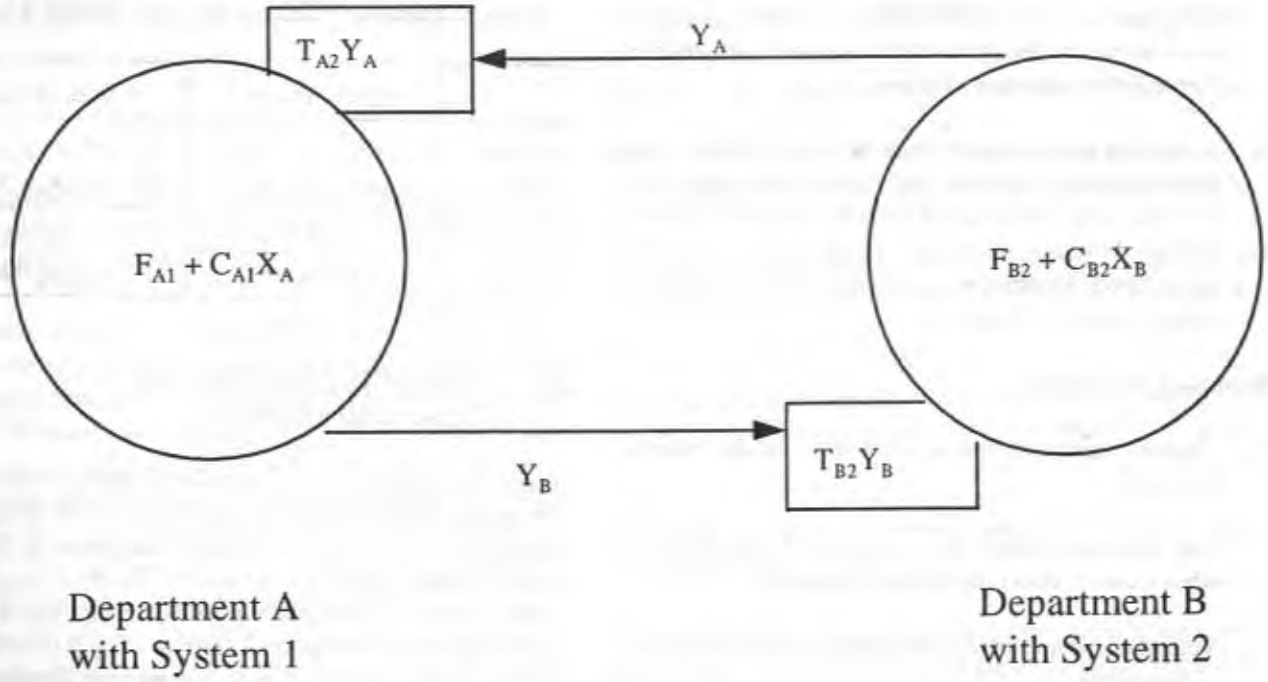

Figure 1. Cost Structure for the Two Departments

We first develop a single-period framework of technology adoption. The framework considers two departments of an organization that may use different systems for their computing needs.[1] In order to examine the evolution of voluntary standards, we assume that the departments operate as profit centers and that they pick the system that is in their best interest. We consider a standard business transaction to be a document preparation and exchange for simplicity. We do not assume that the departments will coordinate ex-ante, but rather that any such coordination is to be determined by the economics and policies of the departments and the corporation. In the following, the subscript *d* refers to departments and the subscript *I* refers to systems. Each department can incur four major cost components:

1. An *acquisition cost*, which represents the cost of purchasing, installing and training the users in operating the information system and other one-time investments. Let F_{di} be the acquisition cost of department *d* acquiring system *I* (dollars). When two or more departments plan to use the same system, it can be centrally ordered and purchasing economies of scale are realized. The benefits of *joint purchase* include volume discounts, site-licensing discounts and other cost savings from processing a joint order. The savings due to joint purchase are shared proportionately. Let W_iF_{di} be this reduction in the acquisition cost of department *d* for system *I* ($0 < W_i < 1$). When one department purchases a product previously acquired by some other department (*delayed purchase*), the acquisition cost incurred by that department may be lower due to previous fixed investments already made by the organization. Let $R_{di}F_{di}$ be this reduction in acquisition cost of delayed purchase by department *d* for system *I* ($0 < R_{di} < 1$).

2. A unit *document processing cost*, which represents the cost of processing a typical business document using the selected information system. This cost includes the cost of users' time in preparing the document and the cost of other resources consumed in processing the document. Let C_{di} be the unit document processing cost of department *d* when it uses system *I* (dollars per document).

3. A unit *translation cost*, which represents the cost of translating and reformatting data of one business document from a foreign format to one accessible by the departmental system. This cost includes the cost of users' time in translating the document and the cost of other resources consumed in this process. The magnitude of this cost depends on the degree of incompatibility across the various file structures and data formats in these information systems. Let T_{di} be the unit translation costs of department *d* for converting documents to system *I* format (dollars per document). To simplify the analysis, we assume that the translation costs are borne by the department for documents that it *receives* in a foreign format.[2] The analysis can be

easily extended for cases where departments incur translation costs based on documents that they *send* and *receive*. Figure 1 shows the cost structure.

4. A *switching cost*, which represents the cost of switching over from one system to another, when system choices are made over time. This switching cost includes the cost of data and software conversion and the cost of retraining. Let S_{di} be the switching cost for department *d* when it moves from another system to system *I* (dollars).

Summary of Notation

F_{di} System acquisition cost of department *d* for system *I* (dollars)

C_{di} Unit document processing cost incurred by department *d* when it uses system *I* (dollars per document)

X_d Volume of documents processed by department *d* (number of documents)

Y_d Volume of documents received by department *d* from the other departments (number of documents)

T_{di} Unit translation cost for department *d* to convert documents from another system to the system *I* format (dollars per document)

W_i Percentage reduction in acquisition cost for system *I* resulting from *joint purchase*

R_{di} Percentage reduction in acquisition cost for department *d* for system *I* resulting from *delayed purchase*

S_{di} Switching cost for department *d* when it moves from another system to system *I* (dollars)

We consider a situation where two departments, A and B, must purchase a new information system. Each department can choose either system 1 or system 2 to meet its business needs. The managers of these two departments pick the systems independently. Since the departments may have different business missions, they might prefer different systems. For specificity, let A pick system 1 and B pick system 2. A's (B's) costs include an acquisition cost F_{A1} (F_{B2}), a processing cost $C_{A1}X_A$ ($C_{B2}X_B$), and a translation cost $T_{A1}Y_A$ ($T_{B2}Y_B$). The costs for departments A and B for these choices and other choices are summarized in Table 1. The costs incurred by departments A and B are separated by a comma. Table 1 represents the normal form of a single-stage game.

Table 1. Summary of Costs for Departments A and B

	B picks System 1	B picks System 2
A picks System 1	$F_{A1} + C_{A1}X_A - W_1F_{A1}$, $F_{B1} + C_{B1}X_B - W_1F_{B1}$	$F_{A1} + C_{A1}X_A + T_{A1}Y_A$, $F_{B2} + C_{B2}X_B + T_{B2}Y_B$
A picks System 2	$F_{A2} + C_{A2}X_A + T_{A2}Y_A$, $F_{B1} + C_{B1}X_B + T_{B1}Y_B$	$F_{A2} + C_{A2}X_A - W_2F_{A2}$, $F_{B2} + C_{B2}X_B - W_2F_{B2}$

3.1 Rise of IS Standards and Externality Effects

If any one system is clearly superior to others, then both the departments will pick that system and it will become the standard. We first look at the case when the departments, left to themselves, make different choices. Given that the two departments make different choices, without loss of generality, assume that A prefers system 1 and B prefers system 2. Define $TC_d(i,j)$ to be the total cost to department d when A picks system I and B picks system j. The following total cost condition states when A will choose 1 if B picks 2:

$$TC_A(1,2) \leq TC_A(2,2)$$

Rearranging the terms in the above inequality, we get:

$$T_{A1}Y_A + W_2F_{A2} \leq \theta_{A1} \qquad (1)$$

where $\theta_{A1} = (F_{A2} - F_{A1}) + (C_{A2} - C_{A1})X_A$. The term θ_{A1} represents the preference of department A for system 1 if it were the only department in the organization. The left-hand side of condition (1) represents department A's *incompatibility costs*, which are the costs that A incurs when it picks a system different from that of B. They include translation costs of converting documents received from B, represented by the term $T_{A1}Y_A$, and the loss of economies of scale, represented by the term W_2F_{A2}. Condition (1) states that department A will pick system 1 if its preference, θ_{A1} exceeds its incompatibility costs. This condition also states why a convergence to a common standard is more likely when the incompatibility costs increase, due to either increased unit translation cost (e.g., due to the complexity of the exchanged documents) or increased flow of documents across departments. Large quantity discounts also push toward a standard system. The direction of information flow across departments also has a significant impact on the choice of information systems. If departments incur translation costs for documents they *receive*, then a department that receives a lot of information is more likely to accept a standard solution than one that sends out more information.

A similar analysis can be done for department B's preference for system 2. The equation is given by

$$T_{B2}Y_B + W_1F_{B1} \leq \theta_{B2} \qquad (2)$$

where $\theta_{B2} = (F_{B1} - F_{B2}) + (C_{B1} - C_{B2})X_B$ represents the preference of B for system 2 over system 1, and the incompatibility costs imposed on B are given by $T_{B2}Y_B + W_1F_{B1}$.

Now consider the welfare of the organization as whole. Assume that the costs are such that the unique outcome for the above game is for the departments, left to themselves, to choose different systems.[3] Without loss of generality, let this outcome be such that A picks system 1 and B picks system 2. Although these choices represent the least-cost alternatives for each department, it may not be the most cost-efficient choice for the organization as a whole. The cost for the whole organization of picking disparate systems over a system-1 standard is given by $\Phi_1 = TC_A(1,2) + TC_B(1,2) - (TC_A(1,1) + TC_B(1,1))$, and the corresponding cost for a system-2 standard by $\Phi_2 = TC_A(1,2) + TC_B(1,2) - (TC_A(2,2) + TC_B(2,2))$. These may be rewritten as:

$$\Phi_1 = T_{A1}Y_A + W_1F_{A1} - (\theta_{B2} - (T_{B2}Y_B + W_1F_{B1})) \qquad (3)$$

$$\Phi_2 = T_{B2}Y_B + W_2F_{B2} - (\theta_{A1} - (T_{A1}Y_A + W_2F_{A2})) \qquad (4)$$

The *externality cost* is the cost that a department imposes on the other department by choosing a different system; this includes the translation cost and lost economies of scale. In expression (3), the term $T_{A1}Y_A + W_1F_{A1}$ represents the *externality costs* imposed on A by B in its choice of a different system, and $T_{B2}Y_B + W_1F_{B1}$ represents the incompatibility costs of B. The *marginal cost* of forcing a department to change its choice of a system is the difference between its preference for the system and its incompatibility costs. Expressions Φ_1 and Φ_2 represent the organizational cost savings or the value of standards and are expressed as the difference between the externality costs and the marginal costs of forcing a department to switch to a standard system. A standard will arise if Φ_1 or Φ_2 is positive, as the organization will prefer it over incompatible systems. The following proposition summarizes this idea.

Proposition 1: From an overall organizational standpoint, a department may be forced to reverse its original choice of information system, thereby conforming to a *de jure* standard, if conditions (1) *and* (2) hold and either of Φ_1 or Φ_2 is positive.

Proofs of all the propositions are given in our working paper (Dewan, Seidmann and Sundaresan 1995). These conditions state that it is individually optimal for the two departments to select different systems and it may well be that the net organizational savings realized by converting to a standard exceed the costs imposed on a department forced to reverse its original choice.

Proposition 2: If it is optimal to have an involuntary standard (conditions of proposition 1), one of three situations may evolve:

1. Department B moves from its system (system 2) to department A's system (system 1). Formally, $\Phi_1 > 0$ and $\Phi_2 \leq 0$.

2. Department A moves from its system (system 1) to department B's system (system 2). Formally, $\Phi_1 \leq 0$ and $\Phi_2 > 0$.

3. Either one of the departments adopts the other's system. Formally, $\Phi_1 > 0$ and $\Phi_2 > 0$.

Figure 2 illustrates the managerial implications of these two propositions. It shows the impact of the departments' individual preferences on their eventual choice of information systems. The positive direction of the horizontal axis depicts A's preference for system 1 (θ_{A1}); the negative direction depicts A's preference for system 2 (θ_{A2}). Similarly, the vertical axis shows B's preferences (θ_{B1}, θ_{B2}). When neither department has a strong preference, a dual standard emerges: both departments are likely to choose the same system voluntarily. On the other hand, when both departments have strong preferences, we witness best of breed choices. When the departments' preferences are in conflict, it may be possible for the one with the stronger preference to persuade the other to adopt its system by providing a subsidy. The cross-hatched area in the lower right quadrant illustrates these possibilities: at P1 department A will subsidize B's choice of system 1, at P2 department B will subsidize A's choice of system 2, and at P3 either department will be willing to subsidize standardization to eliminate its incompatibility costs. The length of the arrows emanating from these points represents the minimal subsidy provided to the department changing its original selection. It is clear from Figure 2 and from Proposition 1 that the subsidies will be less than the subsidizing department's savings. These issues are further studied in the following section.

3.2 Subsidizing Standard Choices

We consider the problem of achieving the organizationally optimal standard. In some cases, even when it is organizationally optimal to have a standard, the departments may pick different systems. This occurs because the departments ignore the externalities in making choices.

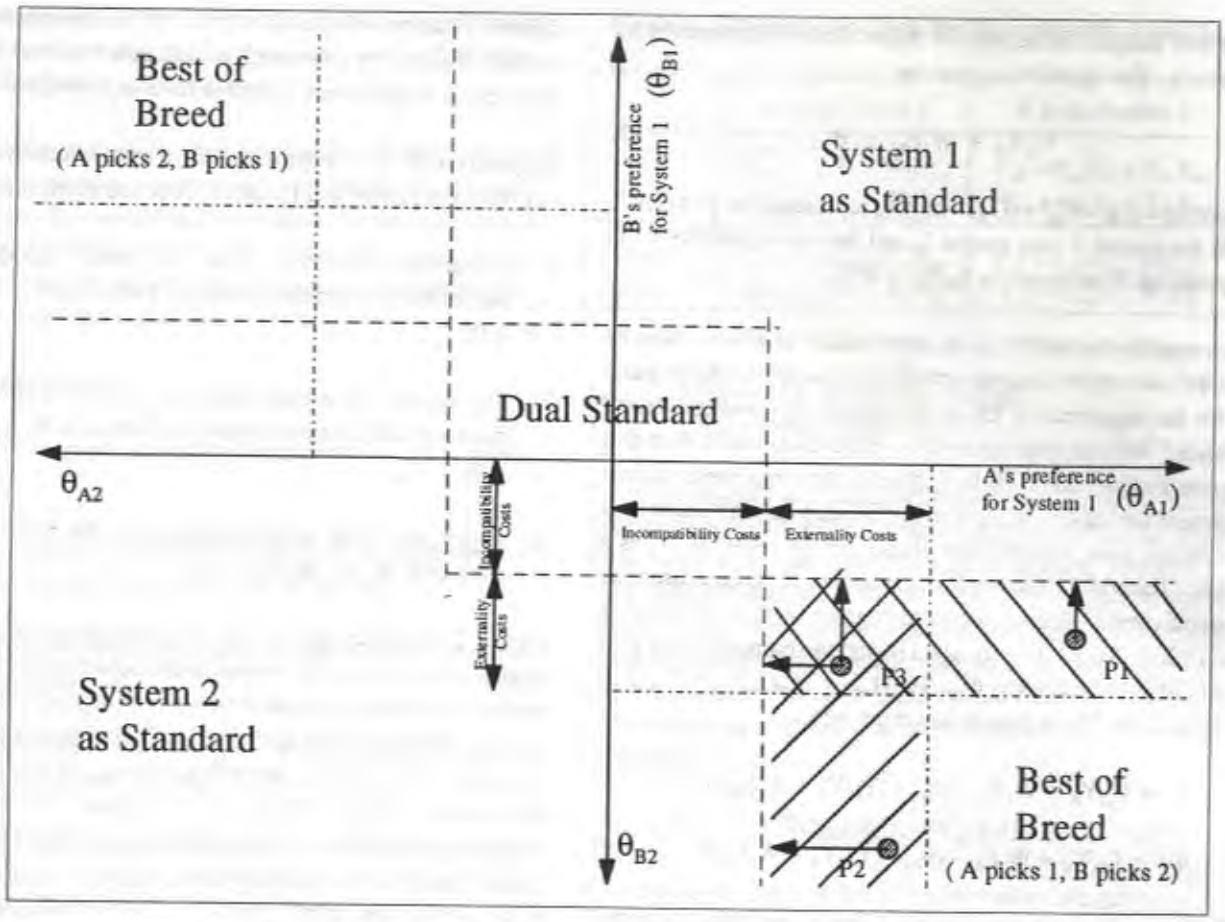

Figure 2. The Preference Space and Different Outcomes

Consider the case when both departments choosing system 1 is the socially optimal solution and the departments choose different systems (department A picks system 1 and department B picks system 2) when there is no coordination. Conditions (1) and (2) are satisfied, and $\Phi_1 > 0$. The socially optimal result can be achieved by providing a subsidy to B to switch to system 1. It is interesting to note that the cost of the subsidy is smaller than the externalities because of significant incompatibility costs. The minimal subsidy required by B is given by $\theta_{B2} - (T_{B2}Y_B + W_1F_{B1})$. The subsidy equals the preference of B for system 2 over 1 less its own incompatibility costs. Since $\Phi_1 > 0$, it can be seen from equation (3) that $T_{A1}Y_A + W_1F_{A1} > (\theta_{B2} - (T_{B2}Y_B + W_1F_{B1}))$. Even after issuing the subsidy, the organization can still attain a savings of Φ_1 over the uncoordinated result of different systems, as the savings in externality costs imposed on A are greater than the subsidy to B. In this case, since A gets the net savings, A will be prepared to provide the subsidy. This interesting phenomenon is highlighted by the following proposition.

Proposition 3: In the two-system case, if it is optimal to have an involuntary standard, cross-subsidy among departments is sufficient to guarantee the standard choice for the departments involved.

The subsidy mechanism described above will result in a standard with which both the organization and the individual departments are better off. The surplus of the departments and the organization is increased. Standardization can be achieved by subsidizing just one department; this subsidy may be provided by the corporation or by the other department.[4]

As an example, consider the following situation. Departments A and B are to pick from two systems. The purchasing costs of systems 1 and 2 are \$1,000 and \$200 respectively. Additional departments can be added to either system at a cost of \$100. The cost of joint purchases is shared. The unit document processing costs for the systems are \$0.01 and \$0.10 per document, respectively. Processing volumes vary significantly between departments A and B: department A processes 20,000 documents, and department B processes only 2,000 documents. In addition, the departments transfer 1,000 documents between themselves, and each department incurs a unit translation cost of \$0.01 for

each document received in an incompatible format. The costs faced by the two departments for different choices are summarized in Table 2. The first entry in each cell represents the cost to department A and the second entry is the cost to department B. For instance, when A picks system 1 and B picks system 2, the cost to A is $1,210. This comprises the purchasing cost of $1,000 for system 1, a processing cost of $200 and a translation cost of $10. For B, the total cost is $410, consisting of the purchase cost of $200 for system 2, a processing cost of $200, and a translation cost of $10. When both departments pick system 1, they share the joint purchase cost of $1,100 for system 1, resulting in a total cost of $750 to A, comprising a purchase cost of $550 and a processing cost of $200 and a total cost of $570 to B, comprising a purchase cost of $550 and a processing cost of $20. Costs for other choices are similarly derived.

Table 2. Summary of Costs

	B picks system 1	B picks system 2
A picks 1	750, 570	1210, 410
A picks 2	2210, 1030	2150, 350

The choice of system 1 by A and system 2 by B is the only Nash equilibrium in this game. That is, if A picks system 1, B finds it optimal to pick system 2, and vice-versa. Do note, however, that the organization, which incurs the sum of the individual department's costs, prefers that they both pick system 1; this choice gives the minimum organizational cost of $1,320, which is $300 less than the cost of non-cooperative choices. Department A also prefers this outcome. In fact, if A provides a subsidy of $160, then B also picks system 1 and A ends up saving $300 even after the subsidy. Note that if the organization mandates system 2 as standard, the overall cost of $2,500 is higher than the total cost of $1,320 achieved by the subsidy mechanism. The important implication of this result is that, when the organization wishes all users to conform to a common standard, letting the users choose the particular standard through a negotiating process among themselves is superior to imposing a management-mandated standard.

Figure 3 addresses the impact of processing volume changes on the departmental choices, when the number of documents received by a department grows in proportion to the other department's processing volume. The lines in the figure demarcate areas in which the choice of systems by the departments changes and these choices are indicated within each region. The figure shows that the optimal choices constitute closely connected sets. Clearly, the processing volume of both departments has a significant effect upon the their willingness to standardize and their choice of information system. As volume increases for both departments, System 1, with its lower processing cost, becomes preferable as a standard. When volume is very low for both departments, System 2's lower acquisition cost outweighs its higher processing costs. The best of breed solutions will be optimal when there is a great disparity in processing volumes.

3.3 Best of Breed Solutions

It may not be the case that a single standard is the best for the organization under all conditions. Departments with different business missions may prefer different information systems. If the inter-departmental communication volume is not significant, the incompatibility and externality costs will be small and a "Best of Breed" solution may also be organizationally optimal. For example, when conditions (1) and (2) are satisfied, $\Phi_1 < 0$ and $\Phi_2 < 0$, the preference of the departments for their chosen system exceeds the incompatibility and externality costs. Further, "Best of Breed" solutions may be preferred in environments with rapid development and technological uncertainty. This variety provides a hedge when there is incomplete information.

4. IMPLICATIONS OF SITE LICENSING ON SYSTEM CHOICE

4.1 Shadow-Rider Behavior

Cost-sharing of joint purchase and site licensing policies in an organization can result in non-cooperative gaming behavior by the departments by which the organization suffers a dead-weight loss. This is illustrated by the example below.

Consider a case where departments A and B have a choice of two systems. Systems 1 and 2 cost $1,000 and $200 to purchase; additional departments can be added to either system for $100 at the time of purchase and $120 at a later point in time.[5] The unit processing costs for the two systems are $0.01 and $0.10 per document respectively. A department that changes its system in the second period incurs a switching cost of $40. Note that, if a department chooses System 1 in a period subsequent to the period during which System 1 is initially brought into the organization, rather than sharing equally in the purchase price with the other department, they incur only the delayed purchase cost of $120 plus the switching costs of $40. Departments A and B process 20,000 and 2000 documents per period respectively. The organizational policy for cost-sharing of joint purchases dictates that the two departments must share costs equally. With a high processing volume, A always picks system 1 because of its lower unit processing cost. Now consider the behavior of B. It can use either system 1 or 2, in either of the two periods, resulting in four potential strategies. The costs of these strategies are summarized in Table 3; costs of both periods are included. For instance, when B uses the (2,1) strategy, in which it picks system 2 in period 1 and system 1 in period 2, the costs are calculated as follows: B's total cost of $580 comprises a first period cost of $400 ($200 in purchase cost and $200 in processing cost) and a second period cost of $180 ($40 in switching cost, $120 in delayed purchase cost, $20 in processing cost).

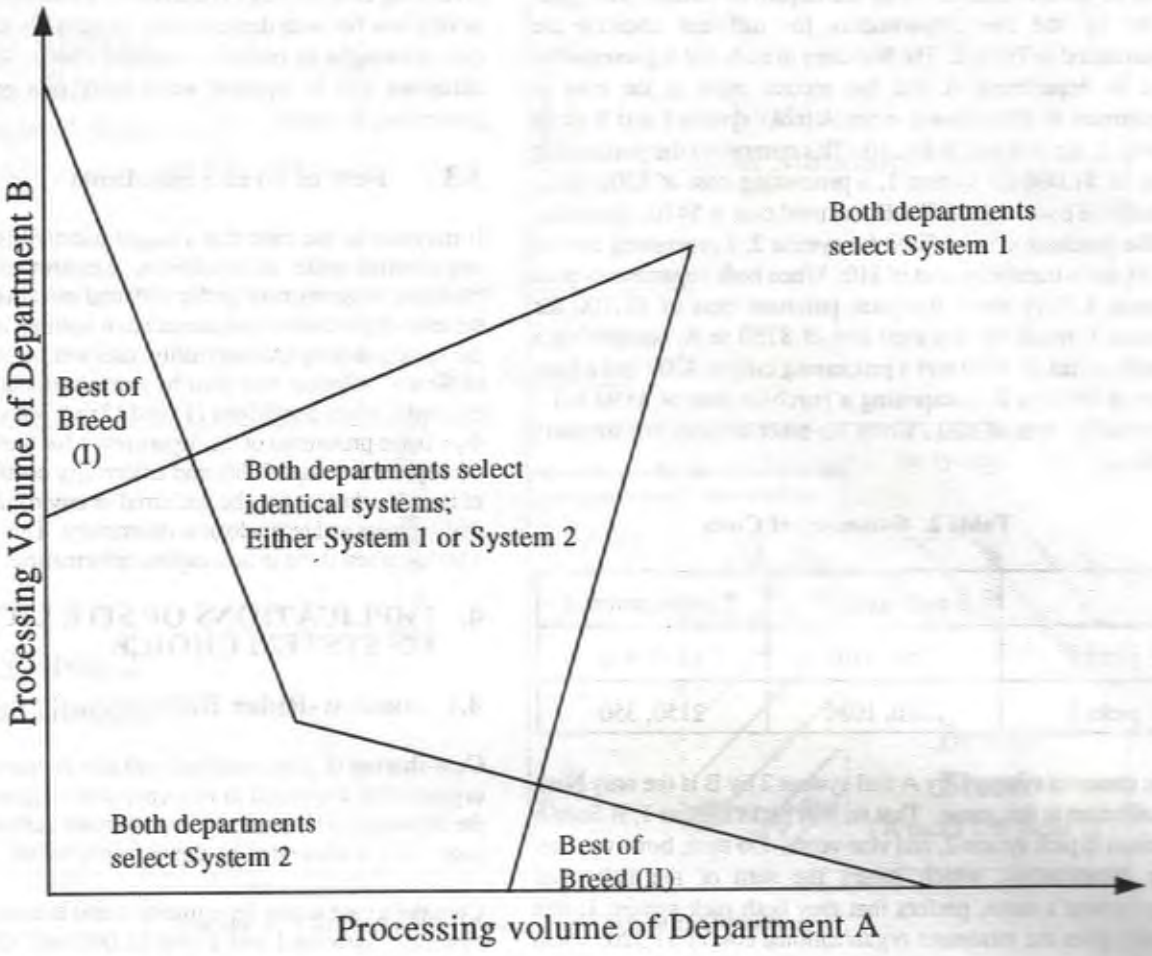

Figure 3. Varying Choices with Processing Volume Changes.
In region (I), department A selects System 1 and department B selects System 2; the choices are reversed in region (II).

Table 3. Summary of Costs: Two Period Analysis

B's Strategy	Costs with no subsidy			Subsidy of $10 from A to B		
	Dept A	Dept B	Organization	Dept A	Dept B	Organization
(1,1)	950	590	1,540	960	580	1,540
(1,2)	950	1,010	1,960	960	1,000	1,960
(2,1)	1,400	580	1,980	1,400	580	1,980
(2,2)	1,400	600	2,000	1,400	600	2,000

Based on these costs (with no subsidy), B chooses the strategy (2,1). This strategy gives it the least cost, which is $10 cheaper than the next best strategy (1,1). The total cost to the organization, the sum of costs faced by the two departments in both periods, is $1,980. If the organization can force B to use system 1 in the first period, the total cost to the organization will be $1,540. If the organization permits B to delay its purchase, then the organization incurs an extra cost of $440 while B saves $10. We term this non-cooperative gaming behavior by departments *shadow-rider* behavior to reflect the combination

of free-rider and delayed purchase behavior; it results in a dead-weight loss for the organization. Table 3 also shows the cost structure when A makes a cross-subsidy payment of $10 to B. With this subsidy, department B is indifferent between picking (1,1) and (2,1). Assuming it picks (1,1), this results in a net saving of $440 ($1,400 - $960) to A and the organization. As switching costs decrease, the organization's loss due to shadow-rider behavior decreases, but the subsidy required to coerce B increases.

We model this behavior by extending the previous analysis to two periods. The departments choose a system in each period. They may switch systems in the second period and incur the cost of purchasing a new system, which may just be the cost of extending the site license acquired by another department. They also incur a switching cost that includes the cost of retraining and the cost of data and software conversion. Refer to our working paper (Dewan, Seidmann and Sundaresan 1995) for details of the model and analysis. Under certain conditions, one department may intentionally choose a different system in period 1 and switch over to the other department's system in period 2. The department will not pick the common standard in the first period itself because it wants to avoid paying large acquisition costs; it does not continue with the disparate system in the second period as it wants to enjoy the benefits of the standard system. The cost savings of adopting a system after some other department has acquired it (typical of site licensing) are large enough to overcome the incompatibility cost of choosing a different system in period 1 and the switching costs in period 2. This dysfunctional shadow-rider behavior imposes additional costs on the organization.

Several other changing scenarios provide interesting insights into what can happen over longer periods. New and revised versions of systems continually emerge that change their functionality and may substantially change the acquisition, processing, translation and switching costs. Vendors maintain backward compatibility of systems to ensure that switching to the new version is easy. Competing systems (Lotus and Excel) build features to translate documents from a rival system easily and may not provide a link the other way. This reduces translation and switching costs from competing systems.

Uncertainty about the functionality of updates may mean that it is better for an organization to have two departments use different systems rather than switching to a standard prematurely. The standard literature is replete with examples of inferior standards being adopted prematurely (e.g., the QWERTY keyboard). Having two systems may be considered a hedge against uncertain market changes, and the organization retains the option of switching over to a standard when better information is available.

5. IMPLICATIONS FOR CORPORATE IS STANDARDS POLICY

We present a rigorous analysis of the salient trade-offs associated with the strategic decision to adopt corporate standards. In general, a company may decide to mandate a certain standard (or a set of standards) to be used by all its business divisions. (Typical examples include various clinics and departments in a hospital, different business divisions of a commercial bank, and different plants and sites of a manufacturing corporation). A company can decide to force all users to use the same standard, but it may leave the actual choice of the particular standard to a negotiating process among users. Our results clearly indicate that, under certain realistic assumptions, users are always better off selecting the shared standard themselves.

In some other cases, the organization may not have a stated standards policy and still we show that all users will voluntarily select the same system. Such voluntary standards evolve under the following conditions:

- User needs are similar and therefore all prefer identical systems.
- There is a high level of interaction among departments.
- Decision options available are so disparate that they result in very high translation costs among them.
- The scale economies in purchase of a standard system is significantly high.

For an organization without a set standards policy, a "best-of-breed" solution, wherein each department independently picks a system that fits its needs best, is optimal for the organization overall under the following conditions:

- Each departments has a unique mission that is best supported by different systems.
- There is minimal transfer of information among departments.
- It is very easy and inexpensive to translate data across systems.
- The discount on uniform adoption is so small that the corporation finds it better to let departments stick to their preferred systems.

The "best-of-breed" approach strategy may lead to disparate system installations by various departments. We identify in the paper interesting situations in which departments, starting with disparate systems, will voluntarily elect at a later point in time to join a corporate standard. The main impetus for this move is

driven by departments trying to exploit corporate site licenses purchased earlier by other departments. This shadow-riding behavior is undesirable from an overall organizational standpoint as it leads to net losses due to switching costs and redundant purchases of systems later to be abandoned. This counter-intuitive behavior has been observed by the authors in numerous organizations which they have visited over the years. We show that cross-subsidy schemes can avoid such dysfunctional behavior.

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7. ENDNOTES

1. This is a simplifying assumption. Although we discuss the choice of standards in terms of departments in an organization, the argument applies to individuals within a department just as well.

For example, the authors of this paper incur a translation cost any time they receive a new version of this jointly-written paper from each other. One of the author's is using MicroSoft Word 6.0 on a Windows NT and sends it to another co-author who uses MicroSoft Word 5.1 on an Apple Macintosh. The recipient of the mail message (or of the floppy diskette) containing a draft of this paper bears the translation and reformatting cost whenever a new version of the paper is sent to him. The third co-author uses a Tex-based system that imposes an even higher translation cost on the other co-authors. We found no way to convert the three figures among the systems.

3. This assumption is made to analyze *de jure* standards. If it does not hold, then we have *de facto* standards. This is examined in section 3.3.

4. A cross-subsidy scheme may not be sufficient when there is a choice among more than two systems. For instance, if A prefers Excel and B prefers Lotus, but the organizationally optimal choice is Quattropro, then it may be necessary to subsidize both A and B.

5. We ignore the time value of money for simplicity.