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Line Managers' Supervision of the Development and Use of Information Systems (IS): Administration Through Planning and Control of IS Effects

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ABSTRACT

The principle of requisite variety requires that an IS evaluation system must reflect the complexity of the information system (IS) innovation process and the interaction between the social and technical aspects of an IS. This may be achieved through paying attention to how people in their own minds define an IS (the IS axis), the questions that should be asked about a particular IS component (the IS issue axis), and people's role in the evaluation as participants in the IS evaluation process and as users of evaluation results (the actor axis.) In the IS innovation idea phase people have thoughts about IS effects, during the creation phase IS effects are analytically defined and partially documented through prototyping, and in the usage phase the real IS effects will emerge - regardless of the IS effects one has thought about or analytically documented. The objective of an appropriate IS evaluation system is to minimize the distance between real IS effects and IS effects thought of and analyzed in the IS development process. The tool to achieving this end is the IS effects worksheet.

INTRODUCTION

For an increasing number of organizations the importance of information has matured to the level where information is regarded as a fundamental business element in addition to men, money, machines, and management (Keen, 1991; Morton, 1991; Larsen, 1993). Yet, harvesting the benefits from IS investments may resemble the dangerous task of walking through a dense mine-field in a pitch dark night without map and torch. Some claim that the users view as much as 80 per cent of IS efforts as partial or complete failures (Mowshowitz, 1976; Harvey and Lesson, 1987; Vowler, 1991).

These reports may exaggerate of the true state-of-affairs. However, as Keen (1991) pointed out, business organizations do not know the true cost of IS since the ratio of known versus hidden costs for in-house developed IS may be as high as 1:4 and for installation of off-the-shelf standard packages as much as 1:7. The introduction of IS also often results in unforeseen social effects, rearrangement of jobs, and knowledge requirements (Zuboff, 1988). Also, IS is often blamed for not delivering the information people need to do their jobs, a problem that is specifically taxing at the managerial level (Wetherbe, 1991).

The problems of not knowing the effects of IS investments may be a challenge to academicians (since there are so many black holes to fill) and troublesome to IS managers (since it is so difficult to argue for and defend the value of IS projects.) However, it is a paramount worry for line managers since they, at the end of the day, are left with the responsibility for the bottom line business results.

Line managers need a coherent framework and a practical approach within which their planning and control of IS can take place. The view presented in this article is that the planning and control of IS effects is an approach that will increase line managers' ability to direct the development as well as use of IS. In the following section the framework for IS effects is developed. Next, the process of developing IS effects are discussed, followed by concluding remarks.

A FRAMEWORK FOR IS EFFECTS

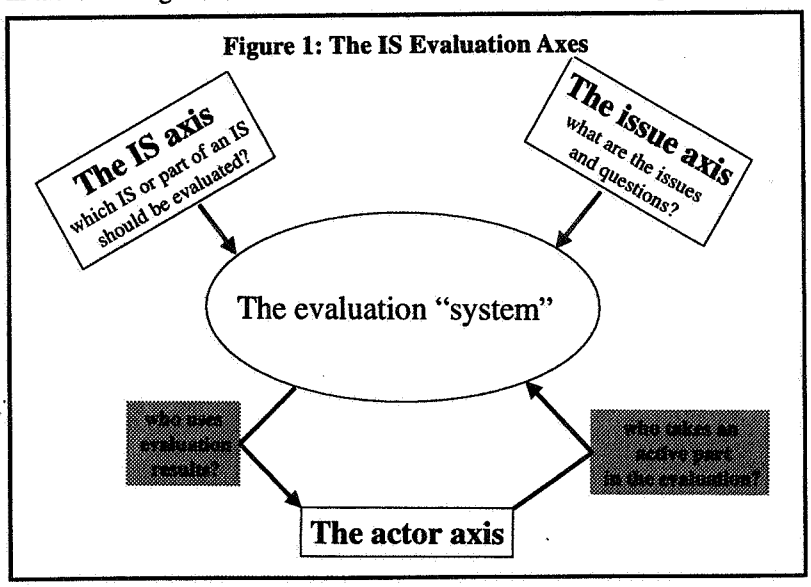
Three questions are discussed; First, which IS or part of an IS should be evaluated? This is labeled the IS evaluation axis. Second, what are the issues and questions? This is called the IS issue axis. Third, who takes an active part in the evaluation and who uses evaluation results? Here the term actor axis is employed, as portrayed in Figure 1.

The three axes need elaboration.

THE IS AXIS - Which IS or Part of an IS Should be Evaluated?

For the developers of IS the question of what to evaluate may seem redundant. Obviously, the IS to be scrutinized is the computer system they make.

Figure 1: The IS Evaluation Axes



From the line managers' point of view that simple answer is ambiguous. First, managers have a dual relationship to IS. Some systems support the managers' own job. Line managers are also the custodians of organizational interest since they carry responsibility for IS quality on behalf of subordinates and other interest groups with direct or indirect relationship to the managers' area of responsibility.

Second, within most line managers' area of responsibility a host of different IS applications usually are in place. Some are basic organizational systems (for example, order processing, production planning and control, payroll, personnel, accounting, or office automation), others may be labeled decision support (for example, budgeting, customer credit evaluation, or product and customer evaluation), and the line managers may have an executive information system (EIS) available to them.

The recent trend of integrated IS applications illustrates the problem. For example, the quality of an Executive Information System (EIS) cannot be evaluated in isolation since a good EIS is highly dependent upon the quality of the organizational IS applications that deliver information to the EIS. An IS for collaborative work or office automation contains elements from many of the traditional basic IS applications. Last but not least, users may not easily understand the difference between an organization's intranet, extranet, or internet. Users are concerned with how well IS support their jobs. They may not be overtly interested in or know the names IS experts use for IS modules hidden behind menus, screens, and reports. In conclusion, for the user an IS cannot be precisely described technically but is a social construct.

Another integration effect is that users no longer limit their IS concerns to applications strictly within their own organizational unit or area of responsibility. That is, users in marketing may have opinions about the quality of IS in production, and users in production have an increasing need for evaluating the quality of IS in sales and marketing. And everybody has a legitimate interest in the quality of budgeting and accounting systems. The obvious effect of integrated IS is that a particular user is not interested in the total IS, only the *job relevant elements* of it.

However, the question of what is an IS user element remains unclear. In the literature on IS effects the application to be considered is taken for granted. Based on a survey of the most recognized published research within this domain, DeLone and McLean (1992) concluded that an IS success model should contain the elements of system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Seemingly, researchers have not discovered the need for a clear definition of what to evaluate. The focus has been on how to evaluate.

The dangers of unclear definition of the elements of an IS that users take advantage of are two-fold. First, a lack of clear IS definition may result in lumping incompatible IS elements together. An evaluation including several IS different elements may result in averaged data. Second, users may be asked to evaluate IS elements they have no direct need for and/or practical experience with. The negative implications here are lack of user interest, unreliable results, and averaged data. The total end result is data that may not accurately define IS strengths and problems; prerequisites for initiating improvements.

This author suggests that both a top down and a bottom up approach must be used to determine the IS to be evaluated. This is an example of what Van de Ven (1986) has coined the part-whole relationship, that is, the difference between individual employee needs and organizational requirements.

The bottom up approach builds the bridge between the users and the users line manager who carries responsibility for a portfolio of ISs. The basis for defining the elements of an IS that users perceive as an atomic unit is the job tasks employees perform. Job tasks require IS support. Consequently, the definition of an IS user element is: "The user perceived atomic unit of an IS that supports a job task." Examples of job tasks and IS user elements for three employee positions are shown in Table 1.

The elements employees define may be combined to represent larger ISs within a line manager's area of responsibility. A larger IS may represent a traditional functional area (for example, production planning, sales, human resources planning, or managerial accounting.) A larger IS within a manager's area of responsibility is denoted "IS manager element." An IS man-

Table 1. Examples of Employee Positions, Job Tasks, and Required IS User Elements

Employee category	Job tasks	Required IS user elements
Marketing director	Stay informed about competitor activities	IS for competitor intelligence
	Identification of good customers	IS for customer analysis
	Capture market share	IS for competitor intelligence IS for customer analysis IS for order processing IS for inventory control IS for distribution IS for production plans
Sales person	Know if product can be delivered	IS for inventory control IS for production plans IS for sales forecast IS for next week's special campaigns
	Determine order delivery	IS for distribution
Production planner	Determine next week's production requirements	IS for inventory control IS for sales forecast IS for next week's special campaigns IS for production plans
	Allocate work-force	IS for production IS for personnel

ager element is defined as: "(A part of) an IS that supports a particular manager's area of responsibility." Obviously, managers may carry responsibility for several IS manager elements. The concept of the IS manager element allows evaluation within traditional business units (for example, production and marketing) although the IS application is an integrated system. The total evaluation of an IS application would be the sum of evaluation within each IS manager element.

This would allow for differentiation of evaluation among sub-user groups. For example, users in production may want to evaluate the quality of ISs targeted for marketing because production would benefit from having access to these ISs. Likewise, users in marketing may evaluate the quality of relevant production ISs. The main objective is, of course, to avoid a limited and narrow evaluation. That is, although those who are the traditional target users of an IS application may be satisfied with their IS support, users outside the target domain may not be of the same opinion.

An executive officer may ask how his firm can measure its business benefits from detailed IS elements. His argument would be that the most important business value does not stem from one particular but from the synergetic effect of many IS elements. Of course, the executive officer is right.

The answer to the executive officer's critique is the top down approach. In addition to the IS elements that individual employees use, IS should be evaluated for its contribution to business. However, an overall general business evaluation of IS would be too broad in scope and, therefore, imprecise and of little value. An organization must specify business value in regard to identifiable business processes or interest parties. Candidate business processes are product and business administrative processes, product and business technological processes, product and business product innovation, and product and business integration processes (Swanson, 1994). Interest parties may be vendors, customers, competitors, or new entrants (Porter, 1985). Once defined, each of these domains (hereafter called a "IS business domain") can be evaluated separately and the underlying IS applications, IS manager elements and IS user elements can be mapped to them. An example of this is shown in Table 1 where the marketing director's responsibility to capture market share may require support from many IS elements.

Good management practice tells us that a decision body - a group of managers or a particular manager - must be responsible for an IS business domain, otherwise purposeful action cannot be taken (Checkland, 1981). The members of the decision body may not be direct users of the IS elements within a particular IS business domain. They may have vague ideas about the underlying IS applications and IS elements. The inherent danger here is that if the decision body has an unclear perception of what the IS business domain is and what its corresponding IS applications and IS elements are, the evaluation of the IS business domain has no concrete frame of reference. That is why it is important that the IS business domain is given a concrete and good descriptive label and that the contributing IS applications and IS elements are mapped to it.

The enlightened executive officer and, even more probable, the corporate information officer would forward the view that the quality and functionality of IS strategy, common IS rules and regulations, and information technology (IT) infrastructure may not be adequately measured if the evaluation is only based on users' and decision makers' definitions of IS business domains, IS applications, IS manager elements, and IS user elements.

The point raised here is that organizations need guidance structures (hereafter labeled "IS platforms") that may determine IS application quality (Keen. 1991). Therefore, the IS platform is a candidate for evaluation in its own right. The starting point here may be that each part of the IS platform (for example, IS strategy, IS rules and regulations, IT infrastructure) is given a clear name and description. Each part of the IS platform may be broken down into meaningful sub-sets (for example, separate rules and regulations for end-user computing, outsourcing, or IS usage cost allocation). Where appropriate, IS business domains, IS applications, IS manager elements, and IS user elements may be mapped to these sub-sets.

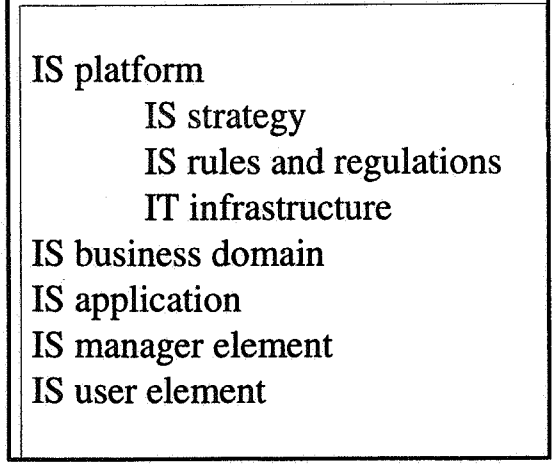
As we have seen, the determination of what IS aspects to evaluate is a complex issue. The principal components may be arranged in a hierarchy, as shown in Figure 2.

THE ISSUE AXIS - What Are the Issues and Questions?

Managers have always controlled the development of IS features through the development and control of conceptual and concrete goals, objectives, and benefits (Cortada, 1980; Farbey, Land, and Targett, 1993; Remenyi, Sherwood-Smith, and White, 1997). The usual practice is to develop goals and objectives for the positive aspects of an IS, a perception of IS innovation outcome that the term "benefits" bluntly expresses. Seemingly, when an implemented IS functions in unpredicted or undesirable ways the term negative effects is employed. In hindsight, many claim, the problematic areas should have been controlled for in the development process. Impacts that strong interest groups may view as negative - reduction in staff or radical changes in work practice – are often not explicitly addressed or for political reasons treated as a hidden agenda, frequently in an intuitive manner (Weinberg, 1992, 1993, 1994). As shown in Figure 3, these concepts can be arranged within the two dimensions of "positive versus negative IS outcome" and "planned versus emerging IS outcome."

The proposition made here is simple. The more issues that are included in the planning of an IS development the higher the probability of implementation and usage success. It seems dysfunctional to differentiate between goals, objectives, benefits, and effects, since each of these terms denote areas that need attention to ensure the best outcome. Because it is time to avoid the limitation of focus that often is inherent in "goals" and "objectives" and evade the naïve IS view inherent in the term "benefits", the term "IS-effects" is preferred. A simple for this choice, but of critical importance, is that managers must consider all aspects of the IS innovation. Since undesired results are so common, and since the term "effects" more often is used in this respect, effects denotes more effectively the positive as well as negative aspects of an

Figure 2: Hierarchy of Components

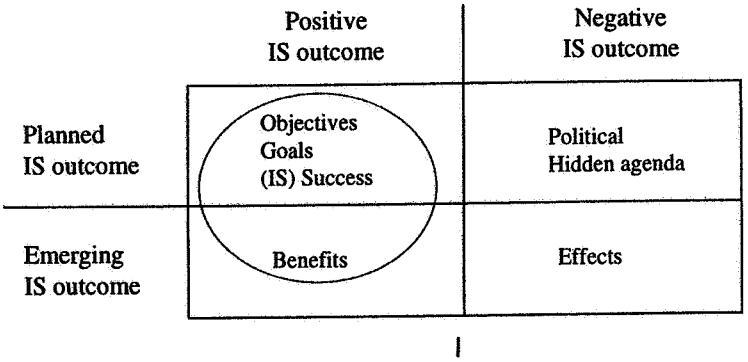


IS innovation.

The most taxing challenge is that any dependent construct/variable may be viewed as an effect and any independent construct/variable may be seen as an effect trigger. In research, the focus is frequently on detailed aspects, and justly so since the aim is to understand the meaning of constructs/variables and their interdependencies in depth. The relatively recently established IS World Catalogue on research aid and tools clearly reflects this research scope (see http://www.umich.edu/~isworld/reshome.html.) However, a manager must understand IS-effects in its totality. Since research more often than not explains IS-effects fragmentally mangers must use judgement. Obviously IS frameworks are forwarded (for example, Morton, 1991; DeLone and McLean, 1992; Olaisen, 1993; Allen and Morton, 1994). Most frameworks do not describe IS-effects and cannot be directly or easily used as the basis for practical IS effects planning and control.

Figure 3: A taxonomy for IS outcome terms

Note: Benefits are occasionally used interchangeably with objectives and goals, indicated here by the stippled circle.



However, IS-effects is a popular theme in its own right. The shortcoming of early contributions is the limited focus on economical issues (Cortada, 1980). Researchers and practitioners have recognized the need for a broader definition of areas where IS-effects occur and that some of these effects, although critical to the organization, cannot be expressed in dollars and cents. Although making progress, some recent contributions do not succeed in bridging theory with practice (see, for example, Remenyi, Sherwood-Smith, and White, 1997).

According to Wilson (1993), IS-effects can thematically be divided into the seven areas of functional productivity, user utility, impact on the value system and chain, comparative performance, business alignment, targeting assessment, and management vision. The division into effect areas is a valuable contribution. The problem is that the author does not present arguments that proves that these are clearly separated and not overlapping IS-effect areas. Nor does the approach guarantee that the areas included cover the business domains where experience tells us IS-effects will certainly occur.

Using DeLone and McLean (1992) as their conceptual basis, the contributors in Garrity and Sanders (1998) present comprehensive approaches to IS success. Yet, the book contains variations of the original DeLone and McLean IS success model - telling us that in the minds of the contributors this model is not stable or complete. Also, the book focuses on research instruments rather than on line management IS-effects issues. Perhaps this is why key line management concerns such as business value (Hitt and Brynjolfsson, 1996) is not explicitly included in the DeLone and McLean model.

The suggestion forwarded here is that the basis for defining IS effects is the concept of the IS artifact (Larsen, 1998). An artifact is a phenomenon or object created through a human activity system (Checkland, 1981; Checkland and Scholes, 1990). The artifact spans the core business activity level, the information needs and requirements level, the IS/IT expert level, the IS level, and the database level. The levels correspond with established views on the development of IS s; business issues as the basis for information definition, which determines the design of the IS framework and applications, that decide the database design and functionality. The addition is the IS/IT expert level which reflects the experience that IS/IT experts more often than not are integrators between the business environment and the IT.

Within each of the five levels effects might occur; business activity effects, information needs and requirements effects, IS/IT expert effects, IS level effects, and database effects. Adopting the principle in DeLone and McLean that technology effects explains organizational effects, the causal chain would be from database effects to business activity effects.

The five effect areas do not explicitly include the "human factor." At a minimum human activity is the combination of organizational structure and networks, formal groups, informal groups, and individual actors (Larsen, 1998). Effects occur among IS/IT experts and among line employees. Thus, IS/IT effects include IS/IT organizational structure and networks, IS/IT formal groups, IS/IT informal groups, and IS/IT individual actors. Conversely, within the "line" effects occur in the line organizational structure and networks, line formal groups, line informal groups, and among line individual actors.

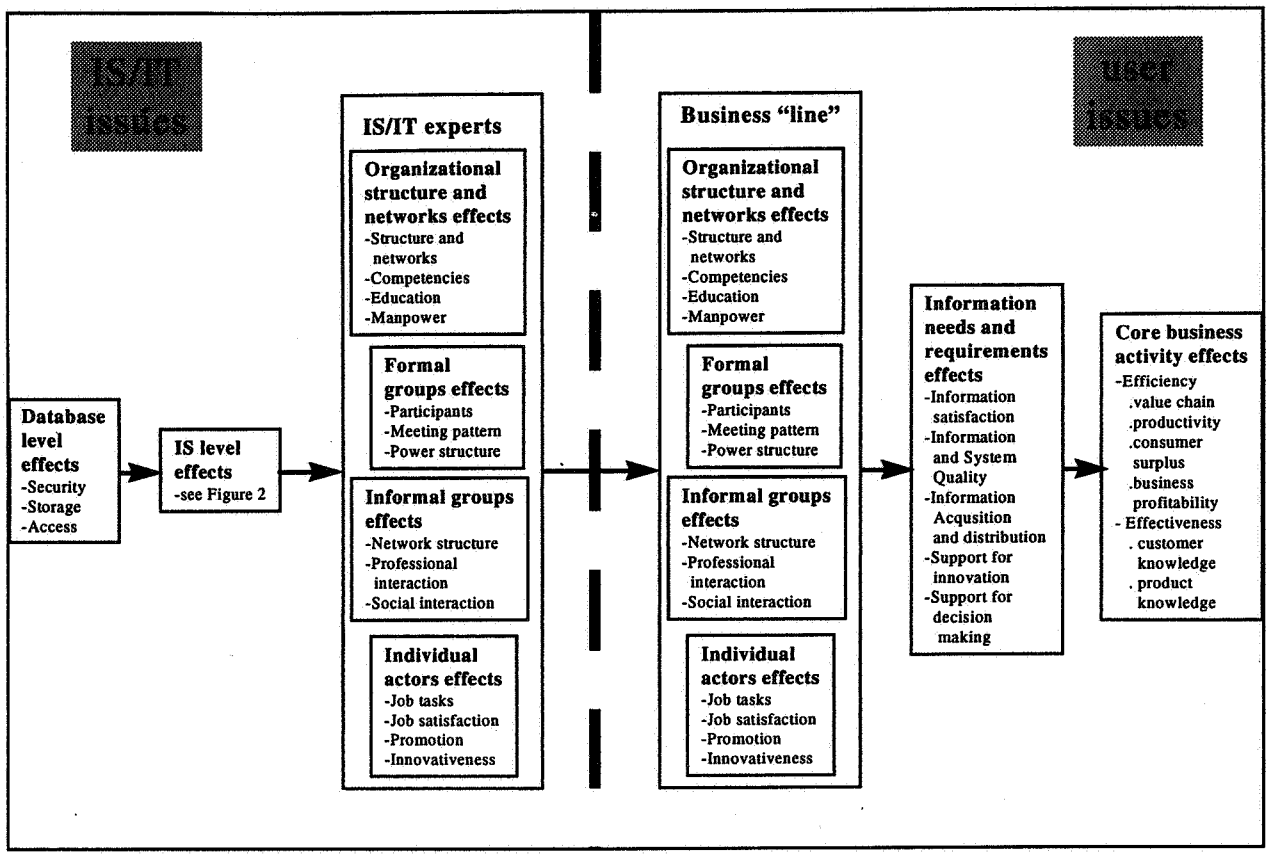
The placement of line effects is made on the two observations that by and large IS/IT determines line effects (in musical terms, it is the theme that the line uses to make their own variations) and the line effects mostly determine information needs and requirements effects. The effect areas are shown in Figure 4.

THE ACTOR AXIS - Participation and the Use of Evaluation

The two most contrasting principles of organizational action that may determine IS innovation participation are mechanistic versus organic (Burns and Stalker, 1994). The characteristics of the mechanistic approach are top-down hierarchical, managerial, and expert oriented. In an IS project the evaluation would more likely than not be carried out by the project manager and the IS/IT experts. In the minds of the decision makers economical benefit and return on investment may dominate.

As Weinberg (1992, 1993, 1994) pointed out, the organic approach builds on the assumptions that the volume and rate of change creates the need for delegation. A small team of top mangers (line as well as IS/IT) cannot fully grasp the social and technical problem content. The knowledge that is required to ensure IS innovation success is dispersed throughout the organization and among customers and vendors. Organic oriented IS projects would put emphasis on the definition of stakeholders, stakeholder participation,

Figure 4: Effect Areas and their Suggested Causal Relationships, with Examples.

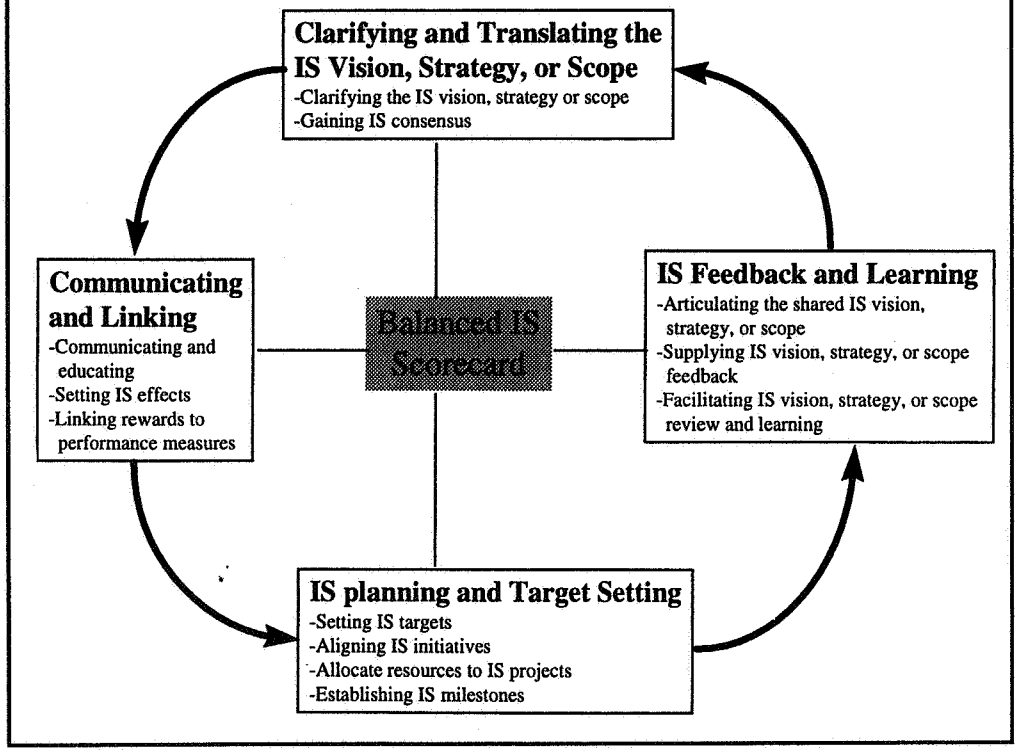


knowledge requirements for participation, and the definition of the broad specter of effects that might occur. Some of these effects may be translated into dollars and cents. Non economical effects are documented to yield a "rich picture" of positive, neutral, and negative change aspects. In essence, decision makers must consider seemingly incomparable IS project effects simultaneously.

It is of critical importance to recognize that we cannot by default say that the organic approach is the best. The organic principles carry the impressions of being democratic and human oriented - virtues highly appraised today and, therefore, perceived as most relevant. However, there is no trustworthy research documentation. Obviously, applying mechanistic principles on highly complex social and technical will increase the failure probability drastically. But the opposite might be equally true, that is, adapting organic principles in situations where top managerial control and top-down principles are correct may also drastically increase the failure probability. In conclusion, the IS innovation characteristics determines the mix of mechanistic and organic principles employed in any IS project. The main prerequisite to ensure organizational learning is that the participation pattern is documented.

Decision makers may not want to use raw evaluation data from detailed effect items.

Figure 5: The IS Balanced Scorecard.
(Adapted from "Figure 1-2 The Balanced Scorecard as a Strategic Framework for Action," Kaplan and Norton (1996). Translating Strategy into Action: The Balanced Scorecard. Boston, MA: Harvard Business School Press, p. 11)



They may want to see key aspects that would help them understand the IS value added. The relatively recent "Balanced Scorecard" approach (Kaplan and Norton, 1996) may be translated into IS issues, as shown in Figure 5.

Obviously, the issues presented here might not be those of critical concern to IS decision makers. They are introduced to illustrate the difference between documentation of detailed IS effects and managerial issues. The fact that IS innovation still might be a risky investment underlines the need for developing conceptual frameworks for IS evaluation.

THE PROCESS OF DEVELOPING IS EFFECTS

The development of IS effects can be viewed on a macro and micro level. The macro level is defined as the conceptual development of IS effects as a function of the IS innovation (Larsen, 1998). The IS innovation process spans from the birth of the idea that a new IS is needed until the day the IS is disconnected, see Figure 6.

One of the most severe traditional IS evaluation shortcomings is that effects have not been systematically treated throughout the IS innovation process. The most blatant error made is the traditional and obligatory post IS project review that many organizations conduct. Since detailed effects have not been documented as in integrated part of the development process the post review can not be based on good data. This is perhaps why so many post reviews are limited to financial analyses showing wishful bottom line positive return on investment.

IS Innovation Phases

Idea phase		Creation phase		Usage phase		
Idea percolation	Idea molding	Change process definition	Change creation	Change anchoring	Change refinement	Change termination
perceptions about probable effects	socially recognized probable effects	macro effects analytically documented	micro effects analytically documented and prototype verified	recognized effects for freezing IS functionality	recognized effects that may lead to smaller projects that may run trough innovation phases from idea percolation to change anchoring	macro effects that document IS failure

Effect View as a Function of Innovation Phase

Valuable macro analyses depend on the quality of the detailed effect documentation. The development of detailed effect documentation needs a worksheet. The worksheet should contain the effect items. For each item stakeholders should be identified. The degree of importance should be documented. The expected effect level should be included. Building on Gilb's (1976) software metric principle the highest acceptable effect level and the lowest acceptable effect level should be noted for critical effect items. The industry standard performance rate for some of the effect items would allow for benchmarking. The method for measuring the effect should be included together with the cost figure for what it would cost to execute the measurement procedure, the reason being that it may cost more to measure an effect than its worth. Last but not least, each effect should be expressed in financial terms whenever possible. Each IS component would need a separate worksheet. The worksheet is illustrated in Figure 7.

The worksheet indicates that the evaluation process may be voluminous and elaborate. Obviously, one cannot include every detailed IS effect. The selection of focus and inclusion must be guided through the definition of critical aspects and experience.

CONCLUDING REMARKS

Because most IS innovations are complex interactions among social and technical issues, more attention should be paid to the development of theoretically sound IS evaluation practices and frameworks. The principle of requisite variety says that the complexity within a given system must mirror the complexity in its environment (Van de Ven, 1986). Therefore, the objective to establish valuable IS evaluation requires that the IS evaluation reflects the complexity in our ISs. The means to achieving this end, this article suggests, are paying attention to how actors define IS (the IS axis), the careful development of questions that should be asked (the issue axis), and the two employee roles of participants in the evaluation process and users of IS evaluation results (the actor axis.)

The breadth and depth of an IS evaluation changes as the IS innovation process runs its course. In the idea phase people have thoughts about what the IS effects might be. In the creation phase IS effects are analytically developed and in some cases documented through prototyping. In the usage phase the real IS effects emerge. An IS evaluation system must have the capability to handle these IS evaluation stages. The effects worksheet is an example of a practical tool which also allows for prioritizing among effect issues. Obviously, the number of IS components and corresponding effects that logically may be scrutinized is so vast that choosing IS components and IS effect issues is a critical task in its own right.

The implementation and use of an IS is the moment of truth. When in use IS effects will materialize regardless of effects thought of or analytically developed. Thus, an appropriate IS evaluation approach will minimize the difference between real IS effects and "before implementation" considered IS effects. Achieving this goal would mean the end of ritual post audit IS exercises.

Figure 7: The IS Effect Worksheet

Effect item (examples) \ Effect documentation	Stake-holders	Degree of importance	Effect level: Expected	Highest	Lowest	Benchmark	Real performance	Measurement Method	Cost	Effect in economic terms
Core business activity effects -Efficiency .value chain .productivity .consumer surplus .business profitability - Effectiveness . customer knowledge . product knowledge										
Business "line" Organizational structure and networks effects -Structure and networks -Competencies -Education -Manpower										

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Multimedia Design and Development: A Team-Centered, Collaborative Curriculum

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ABSTRACT

This paper describes a radical new undergraduate curriculum, the BS in Multimedia Design and Development (BS/MMDD). This multidisciplinary, team-centered, collaborative program, developed at American University by the departments of Design, Computer Science and Information Systems, and the School of Communication, focuses on educating practitioners to work in and manage multimedia production teams. The curriculum described here recognizes that those teams are populated by designers, technologists, and communicators who share some core expertise but who differ in some specialization areas. The BS in MMDD meets a growing need in the USA and globally for professionals in the burgeoning field of multimedia design and development. Graduates of this program will help organizations develop and manage their information resources in multimedia environments.

A. BACKGROUND AND MOTIVATION

In recognition of the emerging field of multimedia design, the Departments of Art and Computer Science and Information Systems, together with the School of Communication at American University, created an undergraduate major designed to provide the necessary education and training for this new discipline.

The BS/MMDD blends courses, practices, technologies, and skills from graphic design, computing and communications - it is truly an integration of several disciplines, not a supplement to any existing program.

The goal of the BS/MMDD is to produce graduates who enter the work force as professionals who manage and direct the design and development of multimedia presentations integrating text, graphics, animation, audio, and video. Reflecting the different skills that are required to accomplish this integration, the degree involves a collaboration between three units and offers a blend of design, technology and communication hitherto unknown on most campuses.

The motivations for the creation of this program come from several arenas. Computer scientists are increasingly more involved in the human interface of technology; graphic designers have migrated from the drawing board to an electronic platform; and communications experts in photography, video, audio, and journalism play a critical role in the production of human interfaces to electronic media. Examples of how computer knowledge, design, and communications know how are blending can be seen in a number of emerging technologies:

- The inclusion in the publishing industry of multimedia "texts."
- The proposed delivery of interactive multimedia television to every household in the U.S.