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Abstract

An important issue in the area of information systems strategy is the still unresolved problem of how to create an effective feedback loop between the evaluation of information systems implementations and the strategies which the systems were designed to fulfill. Much MIS research is devoted to measuring IS implementation success, but popular dependent variable measures are often incomplete, inaccurate, or inefficient and seem to yield very little analytical information to map back into the ongoing IS strategy development process. This paper discusses three key points: 1) the paper will trace measurement concerns due to historical linkages between the specific implemented information technologies and the associated measure of IS success; 2) second, the paper will explore the rift between the quantitative and qualitative measures of information systems (IS) implementation success; and 3) finally, the paper will conclude by describing an economic theory perspective of IS implementations that may contribute to improved valuations of IS success in the future. Including the use of the reference discipline of economics in the evaluative toolkit permits the design of a more comprehensive framework to use for the analysis of IS success, which may improve the feedback mechanism between information systems strategy and its implementation.

Introduction

There are many studies in the information systems literature that endeavor to measure the success of IS implementations. IS researchers work to establish the bottom line impact of information technology (IT) investments to reaffirm linkages with both IS strategy and fundamental business strategies. At times, the overall impact of information systems may not be measured well. It is possible that our dependent variable measuring techniques may have improved and become more sophisticated over time, just as our information technologies have improved and become more sophisticated over time. Still, the overall impact of how well information systems are being implemented remains a central and very interesting problem for IS researchers. Indeed, this research problem is a critical element of research in IS: to explore the measurement of the success of implementation of information systems in terms of achievement of the information systems strategy, as well as to generate capabilities to better understand how to modify and predict future successful IS behaviors.

IS Success Dependent Variable Flaws

A mapping of the evolution of the techniques by which IS researchers measure success suggests that a history of the popular IS dependent variables are tightly coupled to and limited by the information technology extant at the time (Figure 1). During the personal computer period, subjective measures such as presented in Bailey and Pearson (1983) or Ives, Olson and Baroudi (1983) measure user satisfaction with the installed information system. As an illustration of the dependent variable technological dependency, Ives, et al. (1983) measure user happiness with items such as response time and competition between departments and the EDP center for funding, both issues that are much less relevant today then they were in the early 1980's. Later, Davis (1989) adds the subjective concepts of perceived usefulness and perceived ease of use of the installed system to the measurement of the dependent variable. In 1991, Harris and Katz, writing in a more enterprise wide computing period, evaluate overall firm financial performance as the dependent variable. In 1994, again in the time of enterprise computing, Brynjolfsson and Hitt examine firm return on computer capital investment as compared with other forms of capital investment.

The history of the MIS dependent variables range from the detailed measures of response time, frequency of use, decision quality, dollar value of information generated, user productivity, and user effectiveness, to changes in decision making strategies or in industry structure (DeLone and McLean, 1992). Although the single MIS dependent variable of choice may indeed capture an accurate picture of the effectiveness of the information systems which are implemented, the best *set* of dependent variables should not only measure how well the selected technology is working to meet the needs of the user population, but also include a technologically independent evaluation of how well the information system meets the strategic information needs of the firm.

Further, a categorization of dependent variable measures, using a matrix that modifies the DeLone and McLean (1992) typology, exposes a gap in the center in terms of the degree of analysis of the dependent variable measures which are employed (Figure 2). Qualitative measures such as strategic advantage or innovativeness are more holistic, and ultimately may get at the guts of whether a system is of benefit in an intuitive, inclusive way that quantitative measures may not capture. However,

qualitative measures may be severely lacking in the rigor that senior management needs in order to evaluate competing uses of capital (Dos Santos, 1991). On the other hand, quantitative measures such as return on assets may give IS executives the specific ammunition that is required to obtain top management approval for a technology implementation, but may be so rigorous that only the most obvious of IT implementations will prevail. The best dependent variable selection should also include an analysis which lies somewhere between the extreme qualitative and quantitative ends of the continuum.

An Economic Theory Framework

The economic theory framework which is shown in Figure 3 addresses the combined limitations of technology dependent measuring instruments as well as the restrictions of a discrete (e.g., either fully qualitative or quantitative) degree of analysis. Economic theory as a reference discipline imports an underlying structure and missing element to the stream of IS success valuation research by overcoming the previously described weaknesses in the existing set of measures. The economic theory framework adds a level of analytic strength to the extremes of the highly qualitative and often technologically dependent measures, and the accurate but often too difficult to capture quantitative measures. Examples of current IS work which borrows from economic modeling include an analysis of the effects of price changes on the demand for computing power (Gurbaxani and Mendelson, 1990), a look at the benefits of IS auditing in terms of marginal costs (Westland, 1990), the use of network externalities thinking to assist in the pricing of internal IS services (Westland, 1992), and the application of utility curves to the problem of optimizing database design (Beggs, 1989).

The proposed conceptualization of IS measurement suggests that the application of economics to the evaluation framework may generate new abstract ways of thinking about the IS measurement problem. For example, the use of isocost curves which show ever increasing improvements derived from information technology (IT) capital dollars as compared to other kinds of capital dollars may reveal an inherent bias to IT capital selection to a senior executive. An analysis based on a long run average total cost curve for all technologies may reveal that the firm is overinvested into diseconomies to scale for technology applications, which was disguised by the cost versus productivity of a series of short run average total cost curves for individual technology investments. A mapping of the price versus quantity demanded for several IT products will show the various elasticities of demand by product, indicating which kinds of IT products are perceived to be more vital than others. If the change in demand for a product such as a new operating system is high for small changes in price, that system has high elasticity, meaning information systems managers view it as being less critical to own.

The use of a more comprehensive framework, which includes a set of traditional IS qualitative and quantitative measures as well as new, creative and analytical economic measures of IS implementation success, may contribute to improving the feedback mechanism to the IS strategy development process.

	1960's-1970's Early IT Period	1980's Personal Computer Period	1990's Enterprise Period
IT Literature of Times	Information Processing View of Corporate Organization, Galbraith (1974), Cyert and March, (1963): Information technology can automate repetitive processes. Cognitive Styles, Bariff and Lusk, (1977). Individuals learn and adapt to IT in different ways.	IS for Competitive Advantage, Cash and Konsynski (1985), Porter and Millar (1985): Info. gives competitive advantage over the competition. Centralization vs. Decentralization Debate, Managing PC's, Henderson and Treacy (1986), Rockart and Flannery (1983).	Interorganizational structures, enterprise wide orientation, IT can be used across organizations to improve business processes, team and group work: Learning Organization, Senge (1990), Business Process Reengineering, Davenport (1992), Hammer and Champy (1992).
Typical IS Dependent Variable	Poor Cost Control Issues: Brooks (1975), Large scale Implementation Issues: Argyris (1970), Overall Questionable IS Effectiveness: Ackoff (1967), Dearden (1972)	User Satisfaction: Bailey and Pearson (1983), Ives, Olson and Baroudi (1983) End User Computing: Doll and Torkzadeh, (1988)	Macroeconomic level measures: Brynjolfsson (1993), Hitt and Brynjolfsson (1994), Enterprise level measures: Weill (1992), Harris and Katz (1991), Dos Santos (1991), Strassman (1990)
Characterization of IT	Mainframes, large centralized databases, centralized DP hierarchy of control, backlog of projects, cost overruns, major transactions processing installations, custom programming	PC's introduced and spread at exponential rate, cracks emerge in centralized DP, DP has difficulty monitoring applications and hardware at end user level, PC applications uncoordinated with mainframe activities	Client/Server, distributed databases, Lotus notes for workgroups, Internet, World Wide Web, Object Oriented programming, wireless, cellular, networking cheap and available

Figure 1. History of IS Success Valuation

	Qualitative (Perceptual, intentions, and opinion)	**Quantitative** (hard, typically financial valuations)
Organizational, firm level, industry level	Strategic, Competitive Advantage, Barriers to Entry, etc.: Cash and Konsynski (1985), Ives and Learmonth (1984), Porter and Millar (1985); Innovativeness: Keen (1988); Indirect Benefits: Dos Santos (1991)	Return on Assets, Sales Growth, Labor Productivity: Weill, (1992); Market Value Changes in Response to IT: Dos Santos, et al., (1993); Impact of IS intangibles on firm market value: Grove, et al., (1990); Firm Performance in terms of IT impact on cost efficiency, income of firm: Harris and Katz, (1991)
User, process, operational or unit level	User Satisfaction: Bailey and Pearson (1983), Ives, Olson and Baroudi (1983); End User Computing: Doll, Torkzadeh, (1988)	Technical benefits such as information simplicity, legibility: Westland, (1990); Direct Benefits: Dos Santos, et al., (1993); Operational Cost Savings Benefits, such as return on management: Strassman, (1990).

Figure 2. Dependent Variable Qualitative Versus Quantitative Gap by Organizational Level

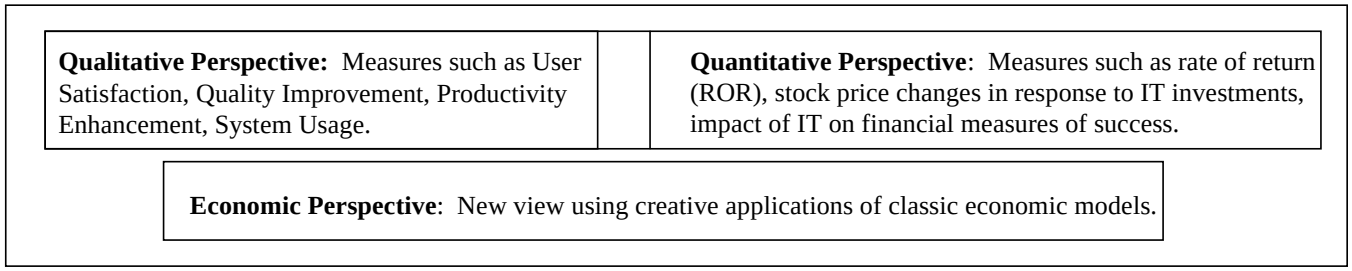

Figure 3. An Economic Theory Perspective on Valuations of IS Implementation Success

References

References available upon request (kleist@vms.cis.pitt.edu).