SYSTEM DESIGN AND IMPLEMENTATION: A PILOT STUDY

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Abstract

Organizations of all sizes rely heavily on management information systems to function effectively. Over time technological change, organizational growth and changing information requirements necessitate the implementation of new systems and the transition of to new platforms. The success of such implementation efforts depends significantly on the planning, management and execution of the transition. This paper is a pilot study that explores end-user satisfaction with the systems implementation process of a small, independent university located in the southeastern United States.

Keywords: implementation, system design, end user

Introduction

Contemporary organizations rely increasingly on computerized management information systems (MIS) to function effectively. Not only are the traditional accounting, production and inventory programs critical components of contemporary integrated computer systems, but also those involved with customer service, marketing, and human resources.

The organization's stakeholders (customers, employers, investors, regulators, suppliers, community members, etc.) are developing higher and higher expectations concerning the ability of the organization to manage its own information and to interact via management information systems in a rapid, convenient and elegant manner. These rising expectations have created increasing pressure for organizations to implement ever more sophisticated and easy-to-use systems. Responding to these mounting pressures, some organizations have adopted more sophisticated systems design and implementation procedures. Consequently, there is a compelling need to develop instruments and procedures to evaluate the effectiveness of the systems implementation. This paper is a pilot study presenting one such effort.

Evolution of the Theory of Systems Design and Implementation

Many computer information systems are not initially successful and consequently are frequently considered implementation failures (McDonald, 1983). Furthermore, some systems never perform to design specifications, as originally intended. These failures are evidenced in system underutilization, failure to achieve adequate return on investment, inefficiencies in operations, and abandonment of systems by organizations (Allingham and O'Connor, 1992).

Unfortunately, many new management information systems (MIS) fail when implemented. The causes for systems failures are varied. Ewusi-Mensah (1997) identified six primary reasons for system implementation failure. "These factors include the lack of well-articulated project goals; inappropriate staffing of project teams; poor management;

technically weak project teams; a weak or inappropriate technology infrastructure in the organization; lack of senior management involvement; and escalating project costs and time to completion" (Ewusi-Mensah, 1997).

Additional studies suggest that the lack of attention to the human and social factors contribute to MIS failures during system design and implementation. According to Zhang et al. (2005), "just as it is important to understand systems requirements as early as possible, it is important that human technology interaction should be addressed at the beginning and throughout the entire process of SDLC." The Systems Development Life Cycle (SDLC) is a process created for the development and implementation of information technology systems. By responding proactively to the previously identified failure factors issues and Zhang's admonition concerning human/technology interactions, the SDLC provides a useful tool for evaluating the design and implementation of new systems.

Historically, the SDLC evolved from the traditional Waterfall Development Model proposed by Winston Royce in 1970. The Waterfall model, following strictly linear and hierarchical processes, includes the following steps: 1) requirements, 2) analysis, 3) design, 4) coding, 5) testing, and 6) operations. (http://en.wikipedia.org/wiki/Waterfall_model). The Waterfall model is often criticized for its rigidity, lack of iterative processes, and its failure to provide for system evolution (Alexander, 2004). Although the SDLC incorporates many of the Waterfall model steps, it is iterative both within the steps and throughout the model. In addition, the SDLC has the added advantage of emphasizing both formal and informal collaboration between system design experts and end users.

According to Kay (2002), there are a variety of ways to characterize the SDLC stages. He suggests the following steps for the SDLC process (Kay, 2002):

- Project planning, feasibility study
- Systems analysis, requirements definition
- Systems design
- Implementation
- Integration and testing
- Acceptance, installation, deployment
- Maintenance

For the purposes of this study, the framework for developing the end-user satisfaction survey instrument is predicated on the SDLC stages identified and defined by Haag, Cummings and Phillips (2006). The stages of the model are as follows:

1. Planning – Define the system to be developed. Set the project scope. Define high-level system requirements. Develop scope documentation. Develop the project plan defining what, when, and who questions. Establish milestones including tasks, resources, and timeframes, and identify critical success factors. The planning phase requires end users and IT specialists to work together to develop system requirements

2. Analysis – Gather the business requirements for the system. Design the technical architecture required to support the system, design system models. Analysis should involve end users and IT specialists working together to gather, understand and document business requirements.

3. Design – Build a technical blueprint of how the system will function. Technical architecture defines the hardware, software, and telecommunications equipment required to run the system. The design phase uses models, graphical representation of designs including the GUI (developed jointly by end users and IT specialists)

4. Development – During this phase the design is developed into an functional system by developing the technical architecture, database and programs.

5. Testing – This phase involves writing the test conditions, developing detailed steps the system must perform along with the expected results of each step. The system is tested to verify that it actually works and meets all of the requirements defined. End-user acceptance testing is performed to duplicate actual use. Testing should be done under conditions as close to operational as possible.

6. Implementation – Implementation includes making the system operational, writing detailed user documentation, providing training for the systems end users. It includes conversion from the old system to the new system.

7. Maintenance – Monitor system to ensure it continues to function. Establishes a help desk to support system end users and provides an environment to support system changes and upgrades.

The SDLC cycle does not move inexorably from step to step. Within a given step, several iterations may be required to resolve a particular issue. Discoveries made in the later steps of the cycle may send the development team back to earlier ones. This is one of the major improvements over the Waterfall model. End-users involvement is the other major innovation in the SDLC model. The involvement of end users helps ensure that the new technologies will meet business requirements, be user friendly, address Zhang's concern for human/technology interactions, and facilitates development of ownership in the system among end users.

Historically, scholars have proposed numerous instruments for measuring the success of management information systems. These include cost-benefit analysis (King and Schrens, 1978), systems usage measures (Lucas, 1975), information attributes (Epstein, 1982), and user satisfaction with information systems (Bailey and Pearson, 1983). Recent research that is more recent shows that user information-system satisfaction depends on user involvement in the SDLC process. According to Allingham and O'Connor (1992), "MIS success varies between users of the same MIS based on their organizational function and that user involvement in the systems development life cycle has significant positive effect on UIS (user information systems satisfaction)." Baronas and Louis (1988) suggest user involvement in the systems development process is effective because "the active ingredient in user involvement is perceived control; user involvement is effective because it restores or enhances perceived control."

A critical factor in the success of an information system is meeting the information requirements of individual jobs. This is determined by knowledge of those requirements before and during the SDLC process and including those requirements in system design (Allingham and O'Connor, 1992). The satisfaction of the users of an information system is defined as "the extent to which users believe the information system available to them meets their information needs" ((Ives et al, 1983).

According to Hess (2005), this understanding of business process / application relationships is the most significant prerequisite to planning and analysis of legacy system transformation projects. The system's end users are in the best position to understand the business requirements of new systems and should be extensively involved in the SDLC. End user involvement in requirements identification (and other aspects of SDLC) positively affects the job-system fit (Pettingell et al, 1988; Straub and Trower, 1988).

Pilot Study

This paper presents a pilot study evaluation of end-user satisfaction with the transformation of a legacy information system at a small, private university in the southeastern United States. The legacy system consisted of a variety of stand-alone applications, compiled over many years and supplied a verity of vendors. These applications include accounting, admissions, advising, email, Internet access, library services, personnel records, and teaching support. The goal of the new system- development process is a fully integrated management information system that serves the needs of the university's stakeholders.

Work on the transformation of the legacy system initiated in 2005. At the time of the pilot study (late 2006), most of the new systems were operational but not fully integrated. The purpose of the pilot study was to develop a research instrument for measuring and evaluating the transformation of legacy systems. Based on the literature review presented above, the SDLC model appears to provide the soundest theoretical basis for the development of the instrument.

Using the seven steps of the SDLC, a preliminary questionnaire was developed. The questions related to the life cycle steps and used Likert-type scale items. A scale score of "1" was anchored with "Strongly Disagree" and a scale score of "5" was anchored with "Strongly Agree." The questionnaire also asked for data concerning the respondents' job function, length of service, and experience with management information systems.
As part of the questionnaire design process, a number of faculty members, staff, and students completed the preliminary questionnaire. The respondents were de-briefed exposing several areas for improvement. Questions that were too complex or jargon laden were rewritten and questions that required specific knowledge or experience

unavailable to the typical survey respondent were eliminated. Finally, a "Don't Know" response was added for individuals who felt unable to respond to a given question.

Based on the debriefing, the authors reduced the 40-item questionnaire to 30 items. The first 23 questions relate to the seven steps of the SDLC model. The revised items now reflect more simplified terminology and a narrower focus. The remaining seven questions collect demographic and organizational data. Since the debriefing also found that the job title and experience categories were inapplicable to student respondents, those items were revised as well. The revised questionnaire is the basis for the data and results reported in this paper.

Preliminary Survey Results

The survey was given to 87 individuals and the results were entered into MINITAB for analysis. "Don't Know" responses were excluded from the analysis. In the interest of brevity, the questions are compressed by category and the weighted mean is calculated for each. These results are summarized in the following table:

Table 1: Results Summary

Category	Questions	Total Number of Responses	Weighted Mean
Planning	1 - 4	286	1.84
Analysis	5 - 7	189	2.06
Design	8 - 9	117	2.27
Development	10 - 11	120	1.77
Testing	12 – 13	116	1.75
Implementation	14 – 17	311	1.71
Maintenance	18 – 23	372	2.52

Conclusion

These weighted averages reveal considerable dissatisfaction with the new system. The means are surprisingly low, given the amount of time and resources devoted to the transformation of the legacy system. However, based on the comments made by respondents in the free-form response area of the survey, the scores appear appropriate. There was particular dissatisfaction about the piecemeal implementation of system components. Additionally, the implementation occurred at a time inconvenient for the users, with little advance notice. A possible mitigating factor is that the system has not yet been fully implemented.

Continued Research

The follow-up to this pilot study will occur after full implementation when the full benefits of the new system may be realized. This follow-up study will employ a larger and more representative sample, allowing for statistical tests among the different groups of end users. A component of this continued research will be to determine if there is an association between end-user involvement in the development process and end-user satisfaction with the system implementation.

References

Alexander, I. & Maiden, N. (2004) Scenarios, Stories, and Use Cases: the Basis. *IEE Computing & Control Engineering*, October, 24-29.

Allingham, P. & O'Connor, M. (1992) MIS success: why does it vary among users?. *Journal of Information Technology*, 7, 160-168.

Bailey, J. & Pearson, S. (1983) Development of a tool for measuring and analyzing computer user satisfaction. Management Science, 29(5), 503-545

Baronas, A. & Louis, M. (1988) Restoring a sense of control during implementation: how user involvement leads to system acceptance. *MIS Quarterly*, 12(1), 111-123.

Epstein, B. & King, W. (1982) An experimental study of the value of information. *Omega*, 10(3), 249-258.

Ewusi-Mensah, K. (1997) Critical issues in abandond information systems development projects. *Communications of the ACM*, 40(9), 74-80.

Haag, S., Cummings, M. & Phillips, A. (2006) *Management Information Systems for the Information Age.* Boston: McGraw Hill.

Hess, H. (2005) Aligning technology and business: Applying patterns for legacy transformation. *IBM Systems Journal*. 44(1), 25-45.

Ives, B. Olson, M. & Baroudi, J. (1983) The measurement of user information satisfaction. *Communication of the ACM*, 26(10), 786-805.

Kay, R. (2002) QuickStudy: System Development Life Cycle. *Computerworld Development.*

King, W. & Schrems, E. (1978) Cost-benefits analysis in IS development and operation. *Computing Surveys*, 10(1), 19-34.

Lucas, H. (1974) *Toward Creative Systems Design*. New York: Columbia University Press.

McDonald, T. (1983) Psychtech: understanding the user. EDP Performance Review, 11(11), 1-5.

Oliver, I. (1988) Organizational power: computing specialists do have it. *Proceedings of Joint International Symposium*, Sydney, Australia, 205-226.

Straub, D. & Trower, J. (1988) The importance of user involvement in successful systems. Minneapolis: Working Paper Series Carlson School of Management.

Wikepedia (2006) *Waterfall Model*, retrieved November 2006 from http://en.wikipedia.org/wiki/Waterfall_model.

Zhang, P., Carey, J., Te'eni, D., & Tremaine, M. (2005) Integrating Human-Computer interaction Development into the systems Development Life Cycle: a Methodology. *Communications of the Association for Information Systems*, 15, 512-542.