Evaluation of ITEM for proactive development

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Abstract

Evaluation will be the key to effective and efficient implementation and use of information technology in education management. As hardware, software and the needs of users develop and change, such evaluation will need to be both proactive and dynamic in that it must continually inform how the systems need to be modified to allow the potential to be fully realised. Dynamic evaluation can then be used to inform the system design, training, support and documentation to ensure end-user acceptance of the systems and provide administration support and information relevant to enhanced decision making processes. Findings from a preliminary study in early 1995 of the Hong Kong School Administration and Management System (SAMS) will be used to illustrate the problems which can occur without carefully planned and contextualised evaluation.

Keywords

Management information systems, schools, evaluation, user-acceptability

1 INTRODUCTION

Institutional organisations are dynamic. This has been particularly the case for education in many countries in recent years as many governments have implemented new education policies over short time scales. Such changes have occurred in parallel with information technology advances which have brought computerised information systems into the scope and affordability of schools. However, most, if not all, commercial

information systems which have been developed for schools have fundamental problems as perceived by users. Any conversation with system managers and users inevitably revolve around the inability of the software to do what the user wants in a way that they want it. "It will not print out particular lists", "it will not allow additional fields", "no additional relational modules can be added to meet the needs of the autonomous institutions" are but a small sample of the many reported shortcomings. Much of this is due to innate inflexibility of the software from the early design process resulting from a 'we know what you want' approach rather than really analysing what was needed and what the new information technologies could offer. In addition, the lack of any properly constituted and planned post-implementation evaluation of the systems, either objective or subjective, has meant that such problems have continued into later versions of the same packages.

In their paper titled 'A two-dimensional approach to systems development', Henson & Hughes (1991) discuss the weakness and waste of resources in the traditional linear SDLC (System Development Life Cycle) approach to the five phases of problem definition, analysis, design, production, and implementation. These writers have suggested the need to have foresight, i.e. anticipation of the impact of the current phase on a later one in the SDLC. Their two-dimensional model of SDLC provides for "the expression of an alternative approach that accommodates the integration of phases. emphasizes the inherent, direct relationships between phases that the traditional approach ignores" (Henson & Hughes, 1991, pp. 43). This need for the integration of phases has also been referred to as "the intertwining of specification and implementation" by Swartout & Balzer (1982).

The evaluation methodologies considered in this paper do not include an analysis of the impact of ITEM systems on the fundamental working of the institutions. This is not to ignore the importance of such studies when the investment is so large. However, the evaluation of the system that is implemented as a result of the investment in a proactive and cyclical way will help to ensure that the design and use are the best possible for the level of investment, with a greatly improved chance that the investment gives value for money in terms of positive effects on the management and success of the schools.

Wild (1995) highlights the importance of user participation for successful school information systems (SISs) development and implementation. A major reason for many failures in SISs is the lack of formative evaluation which could feedback valuable information during the innovation process. The UAA (User Acceptance Audit) recommended by Wild as an evaluation tool is not only a summative instrument to be applied at the end of the implementation process but incorporates formative evaluation throughout the whole SIS-development and implementation process. Information and feedback collected with the UAA would provide timely feedback both to the SIS-users and developers for necessary adaptations and modifications. The UAA thus formalises the evaluation process for both objective and subjective measures of system functionality and usability. Resulting from a preliminary study of the Hong Kong SAMS, a possible cyclical model of evaluation (Figure 1) has been proposed which could impinge on, and enhance, many aspects of the implementation and is a further development of the initial application of the UAA in the education context in the UK (Wild et al, 1992). Various issues of user concern have been identified through initial focused questions and discussion which can be used to develop a more structured analysis process in schools already using the systems (phase 1). Results from this would then be used to review the issues and feedback the results to the relevant point in the development chain. It is likely that such an analysis would identify both barriers and promoters of the system being developed and implemented. Barriers can then be removed and promoters can be used to encourage increased acceptance of the system. The same evaluation process would then be used for the next phase of implementations, hopefully with less barriers and more promoters being identified.

Figure 1 A cyclical User Acceptance Evaluation.

There has been some debate in the evaluation methodology literature about the validity of using 'user satisfaction' as a measure of system success as opposed to more objective measures (see for example Hirschheim and Smithson 1987). However, recently reported research into whether direct user satisfaction is valid as a surrogate measure of information system effectiveness has been carried out by Gatian (1994). She worked from the hypothesis that if an effective system is defined as one that adds value, any measure of system effectiveness should reflect some positive change in user behaviour such as improved productivity, fewer errors and/or better decision making. Extensive questionnaire and statistical analysis focused on direct and indirect users of a college and university information system at thirty nine campuses. The direct users were those who controlled the systems and indirect users were the academic department heads. Conclusions of this extensive research certainly suggest that user satisfaction is an important ingredient for system effectiveness. In another study (Iivari & Ervasti, 1994) the major research question is whether user information satisfaction can be used as a surrogate measure of information system effectiveness through indirect user satisfaction. Again there is extensive research based on twenty one different application information systems in a public organisation and the results suggest that user information satisfaction may, within the well defined limits of the research, have some applicability as a predictor of information system effectiveness and as an indicator of implementability. Such research is adding further credibility to the use of the UAA as an holistic evaluation methodology which could be applied in the education sector ideally as a support to the full process of design and implementation for new systems, but at least as an identifier of barriers to system success and effectiveness at the stage many countries are now at; trying to improve present systems introduced reactively and piecemeal without proper analysis of needs. The small scale pilot projects in the UK also suggest that, through careful contextualisation, the UAA can provide a degree of objectivity to such evaluations (Wild et al, 1992).

2 THE PRELIMINARY STUDY OF SAMS

At this stage in our development of thinking about evaluation methodology, it has been useful to start to apply some of the ideas to a real system. In the crucial issue of user involvement and participation, the SAMS case has revealed two interesting questions: (1) who is the genuine user? and (2) is the involvement genuine, i.e. does the genuine user have a real say?

SAMS stands for 'School Administration & Management System' which is a project started in 1993 by the Hong Kong government. The project aims at providing a standard

SIS for all public-sector primary and secondary schools (about 1,300) in five years time. In the SAMS project, the Education Department of Hong Kong (ED) is technically supported by the Information Technology Services Department (ITSD) of the Hong Kong government. As a policy, ITSD oversees all IT services in Hong Kong government departments and its roles in SAMS thus include the 'expert in control' on the one hand, and the 'service provider' on the other.

Although SAMS is a project to develop an administration and management system for school use, ITSD consider the ED as their client department and user, and not the schools. Although there is a group of user-representatives from schools, formed under the ED to advise on the system development of SAMS, no such member is found on the Project Board. System requirements are therefore not directly collected from nor negotiated with schools by ITSD, but instead through ED. The 'user set', using King and Cleland's (1987) term, is thus differently interpreted by ITSD and by the schools, which consider themselves naturally as the primary users. This omission of 'stakeholder analysis' (Lyytinen, 1987) could be a major factor impeding the future implementation of SAMS in schools.

The second important question, of whether user-involvement is genuine or not, has no easy answer. In the SAMS case, although ED is the sponsor of the project, government policy of ITSD taking both roles of 'expert' and 'service provider' simultaneously has apparently given rise to conflicts of interests. ITSD considers suggestions and requirements from the ED and the user-representatives group but is not required to act on them. Much time and effort were spent on negotiations, yet interviews with the user-representatives indicate strong dissatisfaction with the system functionality finally produced and the support provided during supply and implementation. The answers to questions on specific implementation issues showed that the direct and indirect users were already identifying problems with the system which would have been identified earlier by more careful analysis and formal evaluation:

- The screen input format for pupil data is slow - the Deputy Head quoting 6 minutes per pupil.
- The subject by subject input was slow and did not match the user environment.
- The school is happier with its own system, used for 18 months prior to SAMS.
- The same pupil address has to be entered 3 times.
- The printer was being run through a dedicated computer print server to try to speed up printing - this computer was therefore removed from other uses.
- The school was not happy with the fixed format reports provided with the system.
- The Deputy Head rang the area SAMS support co-ordinator who appeared not to know the system well enough to help.
- The school had the feeling that they had been given the system and "left to get on with it".
- They used their own printer as the one supplied for the system was too slow, especially for Chinese character printing.
- The special data conversion program supplied for entering initial data to be installed into SAMS was very slow and so the school IT co-ordinator had written his own in Access to produce the data in the required format.

In addition some problems were identified which are associated with the bi-lingual nature of the system:

- The system is slow when using Chinese characters.

- There had been insufficient training on the inputting with Chinese characters.

Methodology is therefore one thing, how the methodology is being applied in terms of end-users is another.

3 THE METHODOLOGY OF SAMS: PRINCE AND SSADM

The PRINCE (Project In a Controlled Environment) methodology has been developed by the Central Computer and Telecommunications Agency (CCTA, 1990) in the United Kingdom as a structured set of procedures designed specifically for managing projects in IS/IT environments. ITSD has adopted PRINCE as the framework within which the SAMS project can be specified, designed and implemented.

PRINCE in essence is a project management and control method with at least two key stages, namely project planning and then implementation of the plan. Each PRINCE stage has five components: Organization, Plans, Controls, Products, and Activities. Following this method, the SAMS project has a 3-tier organization structure with a Project Board (with executive, senior user, and senior technical membership), a Project Management (with a project manager and stage managers), and a Project Assurance Team (with business assurance co-ordinator, user assurance co-ordinator, and technical assurance co-ordinator membership). Plans, and controls based on these plans, are the responsibilities of the respective organization levels:

- For the Project Board -- Project Resource Plan & Project Technical Plan;
- For the Project & Stage Managers -- Stage Resource Plans & Stage Technical Plans;
- For the Stage Teams -- Detailed Resource Plans & Detailed Technical Plans;
- For the Individual -- Individual Work Plan.

Provision is made for an Exception Plan only when a deviation from the plans in terms of cost or elapsed time has exceeded, or will exceed tolerances previously defined by the Project Board.

Without going into details, it is fair to say that PRINCE in SAMS is a methodology intended for quality assurance of the object system production and implementation, with strong user involvement. Participation of users in information systems development is quite well accepted nowadays as one of the most critical factors in implementation success (Mumford & Weir, 1979; Ives & Olson, 1984; Jarvenpaa & Ives, 1991). For instance, ETHICS is a method that specially advocates user participation throughout the systems design stage to produce a socio-technical system (Mumford & Weir, 1979; Mumford, 1983). JAD (Joint Application Design) similarly stresses user-involvement in the systems development process (Wood & Silver, 1989; Kettelhut, 1993). Furthermore, as King & Cleland (1987) have suggested, there is considerable evidence that the lack of involvement of users in different phases of systems development has been a significant factor contributing to the failure of many MIS to perform as expected.

SSADM (structured system analysis and design methodology), according to CCTA (1990), is "a structured set of procedural, technical and documentation standards, designed specifically for analyzing business needs and undertaking software development. It consists of a two-part framework covering business requirements analysis and design - which is sectioned into stages. Taken together these stages provide a complete set of techniques for data modelling, requirements analysis and software design." (pp.17)

ITSD adopted SSADM in May 1988 and it has become a mandatory standard for all systems development by ITSD since November 1991 (ITSD, 1994), and thus SAMS should accordingly be developed with the SSADM methodology. According to the documentation on SSADM (ITSD, 1994), the 'System Development Life Cycle'

(SDLC) of a project development process is divided into the different phases of Project Initiation, Feasibility Study (FS), Systems Analysis & Design (SA&D), Implementation, and Post Implementation Review. The Project Initiation phase defines the area of study, business objectives for the proposed project and the resources available for it. The FS phase marks the beginning of SSADM, which is followed by the SA&D phase (including systems analysis and logical system design stages) and the physical design stage of the Implementation phase. At this end-point of the SSADM application, the major final outcomes are the program specifications and a database or file specification. Subsequently, the four stages in Implementation (program development, system integration & testing, user acceptance test, and system installation & production) are carried out, with the final Post Implementation Review phase concluding the SDLC.

The SSADM structure is thus:

1. Feasibility Study Module (Stage 0: Feasibility)
2. Requirements Analysis Module (Stage 1: Investigation of Current Environment; Stage 2: Business System Options)
3. Requirements Specification Module (Stage 3: Definition of Requirements)
4. Logical System Specification Module (Stage 4: Technical System Options; Stage 5: Logical Design)
5. Physical Design Module (Stage 6: Physical Design)

SSADM should thus be the essential part in the SDLC attending to the systems analysis and design aspects of the 'SAMS' system.

In the SAMS case, the Feasibility Study was not done by ITSD but by an external consultancy that carried out the Information Systems Strategy Study (ISSS) for the ED. Government funding was then secured by the ED, with the support of ITSD. The ISSS report subsequently became the blue-print on which negotiations between ED and ITSD were based. Insufficient time and effort, as far as the authors can see, was spent on Systems Analysis and Design. This is evidenced by the fact that ITSD did not spend enough time with schools directly for their requirements analysis. User-representatives and the ED provided the major inputs for this aspect of the SSADM. Davis (1987) has pointed out that "asking users for information requirements may not yield a complete correct set" (pp. 237) but the consequence of asking indirectly has been indicated by the preliminary study. Furthermore, from the products of Modules 3 and 4, one can easily judge that the information systems development perspective is 'datalogical' and not 'infological' (Methlie, 1987). The datalogical perspective takes the information requirements as given by the existing data flows in the organization and the objective of the systems development task is to improve efficiency. On the other hand, the infological perspective looks for an effective information system for the organization that can help support managerial decision-making. Although SAMS is a system named to provide administrative and managerial support for schools, only a datalogical approach has been taken. The information requirements as given by the existing data flows in schools are taken for granted and the objective of the systems development task is to improve efficiency by computerizing manual procedures and data files. There is no trace of the infological approach aiming to develop an effective SIS for the school organization that would support managerial decision-making.

Theoretically, SSADM should be quite comprehensive and detailed in its standards, and should have a number of benefits as proclaimed in the SSADM User Notes (ITSD, 1994). In the SAMS case, these *intended benefits* are considered, in the list below, and observable performance gaps as identified in the preliminary study are noted within square brackets under each item:

1. assure system quality

'The high quality of a project is achieved by viewing the system from three independent viewpoints: Function, Data, and Event which will cross-check one another to minimize omissions and other possible errors.'

[User-representatives and ED staff did not have access to the technical documents developed from the three viewpoints. Such documentation, in any case, could be too technical and complex for lay users. Moreover, quite a number of bugs were identified during the User-Acceptance-Test for the four SAMS modules released to ten pilot schools. Schools also have complaints about the slow speeds in printing out.]

2. better project planning and control

'A checklist for products and a structural framework of procedures can assist planning in terms of minimizing redundant work and providing more accurate estimation of resources requirement.'

[Users found that some data input was needed in triplicate, and printing was slow, with printer specifications not matching the required task. It has also been noted that there was a division of labour among more than ten programmers in producing the different applications in SAMS. Individual programmers might not be fully communicated about what their colleagues were doing.]

3. increase productivity

'Developers do not have to figure out the documentation format and contents from scratch, these are provided in SSADM, as a result much time can be saved.'

[This is assuming that all members in the development team including teacher-representatives are fully conversant with SSADM, which is a matter of doubt.]

4. meet user requirements

'Users will be involved from the earliest stage of the project. Throughout the structure of SSADM, users have opportunities to raise their requirements, walk through and review the deliverables and select the Business System Option. The common language between the users and developers means better communication and hence user requirements can be met more precisely.'

[Much has been said already in this paper on user involvement. The only point to raise here is that users do not generally have a sufficient command of the language in SSADM, even after training for one or two days as in SAMS, to enhance communication with the developers. Moreover, when users were flooded with thick documents of Function Requirements (deliverables), sometimes quite technically written, they often did not know what they really had to agree with. It was only when prototypes in SAMS were available that the users could appreciate whether their requirements were met or not.]

5. avoid reliance on a few key persons

'With the use of a standard and consistent approach, the system development process can be followed easily even by new staff.'

[No information is available for any comment to be made.]

6. increase adaptability

'With a complete specification of a software logical design independent of hardware-specific solutions, the implementation options are kept open for as long as practicable. This can have considerable advantages in large, long duration projects which may be able to take advantage of technological or marketing developments which do not exist at the outset.'

[One system limitation which contradicts this was that the programmers had removed the windowing facility inherent in modern software, leaving a linear DOS type system using only full screen windows. Only time can tell since the SAMS project is only in

its early implementation. One point to note is that the programming language had been decided to be FoxPro for Windows very early on, even before the Logical Design stage.]

7. *reduce maintenance cost*

'Problems can be identified earlier. With fewer omissions from the start, the sound design reduces the chance of logical errors; and there would be less maintenance due to deviation from expectation. It would be easier to implement any changes in data or process even though it has to be performed by a team of new staff because of the adequate and standardized documentation.'

[Since SSADM is a subset within the SDLC, to be concluded before implementation of the product system in user organizations, early identification of problems in design and production is expected. Apparently there were still many problems waiting to be solved when four SAMS modules had already been installed in about 300 schools; and the roll-out plan was due to reach many more by the end of 1996. The user acceptance 'test' used between ED and ITSD is not clearly defined and differs widely from the more formal UAA which is really required to identify problems and match systems to user expectations. In addition, training can be focussed to overcome identified mismatches.]

4 CONCLUSION

The lack of a formal and cyclical evaluation strategy has so far limited the effectiveness of the SAMS implementation. The only formal evaluation, the Post-Implementation Review, will occur too late to identify the problems and user acceptability issues which will already have discouraged many teachers, caused much extra work and infused a lack of confidence in the system as a whole. Our findings show that 'local' school experts are already spending time producing their own data transfer programs and reporting functions, which could have been developed centrally if there had been more emphasis on early analysis of real user needs. The speed of implementation has denied the opportunity for a formal and proactive evaluation of the type proposed in figure 1 to be carried out at the early stages before users find problems. Results from such an evaluation would have overcome many of the identified problems and, at the same time, identified the requirements and content of training courses and better informed design and implementation teams which might have overcome many of the real and perceived problems. Barriers and promoters could then have been dealt with in an organised and structured way so that new users would have felt more confident from the start that the system would help in the administration and management of the school. At the time of the preliminary study, many felt that they wanted to wait "until SAMS was as good as their own" but that striving for a standardised system was a worthy aim.

Preliminary results in the study of SAMS reinforce earlier findings in the UK that a more formal evaluation tool needs to be developed in the context of information systems in the school environment. Such a tool would form a basis for a systematic study from an early stage of development so that schools more quickly and easily gain from the implementation of ITEM. Wide communication of evaluations would help to ensure that new systems learn from the mistakes of earlier systems, which does not seem to be the case at present.

5 REFERENCES

- CCTA (1990) *PRINCE overview: the PRINCE project management method*. Her Majesty's Stationery Office, London.
- Davis, G.B. (1987) Strategies for information requirements determination, in *Information analysis: selected readings* (ed. R. Galliers), Addison-Wesley Publishers, Sydney.
- Gatian, A.W. (1994) Is user satisfaction a valid measure of systems effectiveness. *Information and Management*, **26**(3), 119-131.
- Henson, K.L. and Hughes, C.T. (1991) A two-dimensional approach to systems development. *Systems Development*, **8**(1), 35-43.
- Hirschheim, R. and Smithson, S. (1987) Information systems evaluation: myth and reality, in *Information analysis: Selected readings* (ed. R. Galliers), Addison-Wesley Publishers, Sydney.
- ITSD (1994) *SSADM: end user notes*. Information Technology Services Department, Hong Kong Government, Hong Kong.
- Iivari, J. and Ervasti, I. (1994) User information satisfaction: IS implementability and effectiveness. *Information and Management*, **27**(4), 205-220.
- Ives, B. & Olson, M.H. (1984) User involvement and MIS success: a review of research. *Management Science*, **30**, 586-608.
- Jarvenpaa, S.L. and Ives, B. (1991) Executive involvement and participation in the management of information technology. *MIS Quarterly*, **15**(2), 229-42.
- Kettelhut, M.C. (1993) JAD methodology and group dynamics. *Information Systems Management*, **10**(1), 46-53.
- King, W.R. and Cleland, D.I. (1987) The design of management information systems: an information system analysis approach, in *Information analysis: selected readings* (ed. R. Galliers), Addison-Wesley Publishers, Sydney.
- Lyytinen, K. (1987) A taxonomic perspective of information systems development: theoretical constructs and recommendations, in *Critical Issues in Information Systems Research*, (eds. R.J. Boland Jr. and R.A. Hirschheim), John Wiley & Sons, New York.
- Methlie, L.B. (1987) Systems requirements analysis - methods and models, in *Information analysis: selected readings* (ed. R. Galliers), Addison-Wesley Publishers, Sydney.
- Mumford, E. (1983) *Designing human systems*. Manchester Business School, Manchester.
- Mumford, E. and Weir, M. (1979) *Computer systems in work design - the ETHICS method*. Wiley, New York.
- Swartout, W. and Balzer, R. (1982) On the inevitable intertwining of specification and implementation. *Communications of the ACM*, **25**(7), 438-440.
- Wild, P. (1995) The use of task analysis and user acceptability audits in implementing information technology systems in schools, in *Information technology in educational management* (eds. B. Barta, M. Telem and Y. Gev), Chapman and Hall, London.
- Wild, P., Scivier, J. and Richardson, S. (1992) An evaluation of a LEA's secondary schools IT system for LMS Support. *Education Management and Administration*, **20**(4), 40-48.
- Wood, J. and Silver, D. (1989) *Joint application design*. Wiley Press, New York.

6 BIOGRAPHIES

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