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System Quality, User Satisfaction and End User Development

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Abstract

Organisations rely heavily on user developed applications (UDAs) to support organisational decision making, but for the most part the satisfaction of the user developer is the sole indicator of application success. This study investigated the relationship between system quality and user satisfaction in the UDA domain. The results of the study indicate that although a positive relationship existed between system quality and user satisfaction when the user of the application was not the developer, that relationship was not present when the user was also the developer. Possible implications of these findings are discussed.

Keywords

EI0206.01 System quality, EI0207 User satisfaction, EL0301 Measuring IS success, FA05 User development, FD02 User involvement, GA03 End-user computing, GB0404 End users

INTRODUCTION

UDAs are computer-based applications for which non-information systems professionals assume primary development responsibility. They support decision making and organisational processes in the majority of organisations (McLean, Kappelman, & Thompson 1993). End user development of applications provides users with a valuable and popular alternative to the traditional process of systems development. Perhaps the most important benefit claimed for user development of applications is improvement in employee productivity and performance, resulting from a closer match between applications and user needs since the end user is both the developer and the person who best understands the information requirements.

Despite the potential benefits to an organisation of user development of applications there are many risks associated with it. These risks result from a potential decrease in system quality as individuals who have little or no formal information systems (IS) training take responsibility for developing and implementing their own systems. However, organisations generally undertake little formal evaluation of the nature and quality of applications developed by end users (Bergeron & Berube 1990), and generally do not formulate policies requiring or supporting formal testing and documentation of end user developed software (Cale 1994). This places a heavy reliance on the individual end user's perceptions of the value of the application. In fact in many cases the satisfaction of the user developer is the sole measure of

application success. This raises the important issue of the need to be able to measure the effectiveness and success of UDAs.

The literature on organisational IS success suggests that system quality (as well as information quality) positively influences user satisfaction, and that user satisfaction with an IS is associated with increased individual effectiveness (see DeLone & McLean 1992; Rivard, Poirier, Raymond, & Bergeron 1997; Seddon & Kiew 1996). These relationships are represented in DeLone and McLean's (1992) model of IS success (see Figure 1 below).

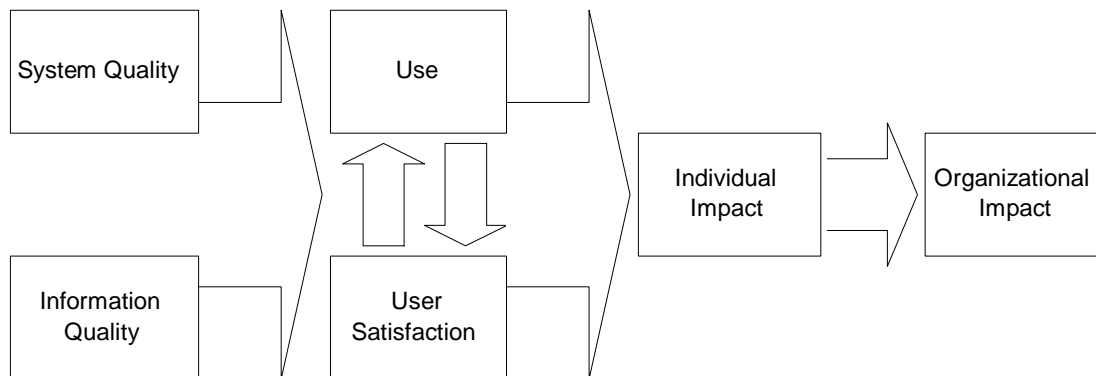


Figure 1: DeLone and McLean's (1992) model of IS success

If these relationships hold true then a user's satisfaction with an application should be a good indicator of its effectiveness or success. However some authors have questioned the role of user satisfaction in IS success (e.g. Etezadi-Amoli & Farhoomand 1996; Melone 1990; Thong & Chee-Sing 1996). Of particular relevance to this study is Melone's (1990) research, which noted that user satisfaction is an attitude, and that attitudes that users hold may play a role in establishing and maintaining a positive image of the self. Melone warns that this can compromise the role of user satisfaction in evaluating systems. Similarly, Hufnagel (1990) suggests that an individual's affective response to a given performance outcome is often highly subjective and in some cases, highly ego-defensive.

Despite the research on IS success in the organisational IS domain little work has been done to examine how IS success models apply in the UDA environment (Shayo, Guthrie, & Igbaria 1999). It is possible that the role of user satisfaction may be more problematic in the UDA domain because end users may be less able to be objective about the applications they have developed than they are about applications developed by others. The presence of a developer 'bias' may be intuitively expected and is consistent with previous research on user involvement. User involvement has been described as a subjective psychological state reflecting the importance and personal relevance of a system to the user (Barki & Hartwick 1989). The role of user involvement in influencing user satisfaction with systems has been investigated for organisational systems and the literature indicates that the more involved a user is with the development process, the more satisfied they will be with the final product (Amoako-Gyampah & White 1993; Barki & Hartwick 1994; Doll & Torkzadeh 1988; Lawrence & Low 1993).

Doll and Torkzadeh (1989) speculated on the 'bias' of end user developers but didn't empirically investigate it. McGill et al. (1998) provided preliminary evidence of this 'bias' in the UDA domain in showing that end users exhibited an increased degree of satisfaction with

a spreadsheet application that they had developed themselves compared with another end user using the same application. The actual development of an application, which may involve a significant investment of time and creative energy, may be satisfying other needs beyond the immediate task. User satisfaction with a UDA could therefore reflect satisfaction with the (highly personal) development process as much as with the application itself (Barki & Hartwick 1989). If user satisfaction is to continue to be commonly used as the sole organisational indicator of the effectiveness of UDAs more must be known about its relationship to system quality and to individual performance.

RESEARCH QUESTIONS

This study investigates the relationship between system quality and user satisfaction in the UDA domain. The first research question investigated was: ‘Does the positive relationship between system quality and user satisfaction discussed in the organisational IS literature hold in the end user development domain?’

Given the support for a positive relationship between system quality and user satisfaction in the organisational IS literature it was hypothesised that:

H1: System quality is positively correlated to user satisfaction when the user is not the developer.

The second research question investigated was: ‘Does being an end user developer influence the relationship between system quality and user satisfaction?’

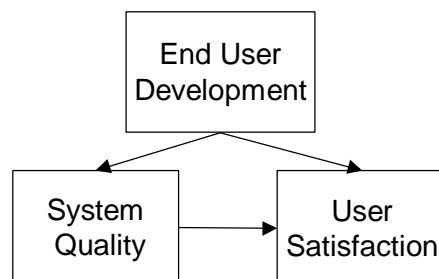


Figure 2: End user development may influence the relationship between system quality and user satisfaction.

Based on the findings in the user involvement literature it is likely that an end user developer will have high levels of user satisfaction as they are not only involved in every phase of development, but also often carry out every phase of development by themselves (Amoako-Gyampah & White 1993; Barki & Hartwick 1994; Doll & Torkzadeh 1988; Lawrence & Low 1993). It was hypothesised that:

H2: The relationship between system quality and user satisfaction changes when the user of the application is also the developer.

METHOD

Subjects

This study is an extension of the examination of user satisfaction with UDAs undertaken by McGill et al. (1998). The study was conducted with a group of 39 Business students (14 males and 25 females) enrolled in a second year university IS service course. The course was designed to prepare students to participate in end user computing activities in organisations

once they graduate and join the workforce, rather than to become IS professionals. Students in the course had already completed an introductory first year course that included basic spreadsheet skills.

The general applicability of research findings derived from student samples is an issue of concern (Cunningham, Anderson, & Murphy 1974). Whilst there is some evidence that graduate business students are good surrogates in studies relating to the use and evaluation of technology (Briggs, Balthazard, & Dennis 1996), it is not clear whether this also applies to undergraduate business students. However, the constrained nature of the exercise undertaken by the students provided a valuable opportunity to address the research questions, and the students who participated in the present study can be considered as typical of professionals who will be involved in user development of applications in the future.

User Developed Applications

Prior to the study, each of the subjects had completed a case that required them to design and develop a spreadsheet application to provide financial reporting to, and aid financial planning by, a small business (Starlight Expeditions Case, Kroenke & Dewitz 1994). The case was selected because it represented a realistic problem for an end user to analyse, and the scope and complexities were typical of the type of applications that end users would be likely to tackle in a 'real' work situation. The case description was approximately 4 pages long and the finished spreadsheet required at least 4 linked worksheets. It was anticipated that it would take the subjects at least 3 days to plan and develop the application. This case constituted 10% of each student's overall course grade.

All the subjects developed the same application. This provided an excellent opportunity to study the relationship between system quality and user satisfaction, without the subjects' perceptions being influenced by the nature of the application itself. It would be difficult to obtain this level of control in a field study in an organisational setting.

Instruments

User satisfaction refers to the attitude or response of an end user towards an IS. It has been defined as 'the affective attitude towards a particular computer application by an end user who interacts with the application directly' (Doll & Torkzadeh 1988). User satisfaction was measured using the 12 item scale developed by Doll and Torkzadeh (1988) as this end user computing satisfaction (EUCS) instrument has been commonly used in the end user computing domain (e.g. Gelderman 1998; Igbaria 1990; Rahman & Abdul-Gader 1993). Each item was measured on a 5 point Likert scale ranging from (1) 'almost never' to (5) 'almost always' (see Appendix for a list of the items). The instrument was shown to be reliable with a Cronbach's alpha of 0.94.

System quality relates to the quality of the application itself and is concerned with matters such as whether or not there are 'bugs' in the system, the consistency of the user interface, ease of use and maintainability of the system. In this study system quality was operationalised based upon the instrument developed by Rivard and her colleagues to assess the quality of UDAs (Rivard et al. 1997). Rivard's instrument also addresses elements of information quality which they consider to be part of system quality. A number of items were not included because they were not appropriate for the applications under consideration (e.g. specific to database applications) or because they were not amenable to independent assessment (e.g. required access to the hardware configurations on which the spreadsheets were originally used) or because the processes being examined in the items were not applicable to the environment in which the development was done. Minor adaptations to wording were also

made to reflect the terminology used in the case and the environment in which application development and use occurred.

The resulting system quality scale consisted of 35 items, each scored on a Likert scale of 1 to 7 where (1) was labelled ‘strongly agree’ and (7) was labelled ‘strongly disagree’ (see Appendix for a list of the items). An overall quality score for each application was calculated by averaging the scores for 7 quality dimensions. This is consistent with the approach used by Rivard et al. The instrument had a Cronbach’s alpha of 0.90.

Procedure

Each subject was given 2 labelled disks, one containing his/her own spreadsheet application and the other containing another subject’s application (labelled only by research number). Assignment of the second application (the one developed by some other end user) was done on a random basis, so that the subjects were not aware of whose application they were assessing. As an extra precaution, anything that would identify the developer, such as the name of the developer being embedded in the spreadsheet, was removed.

Each subject was asked to use each application to undertake analyses typical of those involved in the case and then to complete a questionnaire. The questionnaire consisted of 3 sections. The first section requested details about the subjects and their experience with spreadsheets and their perceived skill with spreadsheets. The second and third parts of the questionnaire measured EUCS with each of the applications.

Each UDA was also assessed on each quality dimension by two independent assessors. The independent assessors were Information Technology graduates. Before assessing the study sample, the assessors completed four pilot evaluations to ensure consistency between the assessors. The two ratings were averaged to give average system quality.

RESULTS

Table 1 provides descriptive statistics about the quality of the UDAs and the end users’ satisfaction with them. System quality had an average value of 3.47 and ranged from 1.8 to 5.1. The average EUCS rating of the UDAs given by the user developers was higher than that given by the non-developers (45.81 versus 40.64; see McGill et al. (1998) for a discussion of this result).

	<i>Mean*</i>	<i>Std. dev.</i>	<i>Min</i>	<i>Max</i>
System Quality	3.47	0.70	1.8	5.1
EUCS – independent user rating	40.64	7.57	24.0	54.0
EUCS – developer rating	45.81	7.70	28.0	60.0
Difference between EUCS ratings	5.17	10.97	-20.0	28.0

Table 1: Summary information about system quality and EUCS with the UDAs

*Four outliers were detected using the SPSS Outliers procedure and were excluded from further analysis

The first research question considered the relationship between system quality and EUCS when the users are not also the developers of the application. To address this question, the Pearson correlation coefficient was calculated between the system quality rating and the

EUCS rating of the non-developer end user for each application (see Table 2). There was a significant positive correlation between the system quality and EUCS ($r = 0.386$, $p = 0.022$). Thus the study provided support for the first hypothesis.

The second research question considered whether being an end user developer influences the relationship between system quality and EUCS. To address this question the Pearson correlation coefficient between system quality and EUCS of the developer was calculated (see Table 2). There was no significant correlation between the system quality and EUCS of the end user developer ($r = -0.183$, $p = 0.292$). As the significant positive relationship observed previously (when the user was not the developer) was no longer present support was provided for the second hypothesis.

	<i>System Quality</i>	
	Correlation	Significance
EUCS – independent user rating	0.386	0.022
EUCS – developer rating	-0.183	0.292
Difference between developer and independent EUCS ratings	-0.396	0.018

Table 2: Correlations between system quality and EUCS

To further investigate the nature of the change in relationship between system quality and user satisfaction the difference between developer EUCS and independent user EUCS was calculated for each application. The difference scores were correlated with system quality using a Pearson correlation (see Table 2). There was a significant negative correlation between system quality and the difference between EUCS of the end user developer and EUCS of the independent user ($r = -0.396$, $p = 0.018$). This suggests that as the quality of the applications decreases the gap in user satisfaction increases, with the developers of lower quality applications feeling a satisfaction with their applications that may be incommensurate with system quality.

DISCUSSION

The results of this study indicate that although a positive relationship appears to exist between system quality and user satisfaction when the user of the application is not the developer, that relationship may not be present when the user is also the developer. Whilst the findings should be considered preliminary because of the artificial nature of the spreadsheet task and the use of student subjects, the results raise concerns about the heavy reliance of organisations on users' perceptions of their own applications.

The positive relationship found between system quality and the user satisfaction of non-developer end users is consistent with IS success models such as DeLone and McLean's (1992). This is encouraging in that it suggests that the satisfaction of end users who make use of applications developed by other end users will not be disproportionate to the quality of the applications, hence allowing them to recognise when use of an application might require caution or be inadvisable. Whilst perhaps not consciously considering the technical quality of applications (Rivard et al. 1997), those end users who make use of applications developed by other end users may nevertheless be prudent users. This finding should provide some reassurance to organisations that rely heavily on UDAs to support decision making and organisational processes.

The second result of this study is however not so encouraging. No significant relationship was found between system quality and the user satisfaction of the developers of those applications. Most organisations place a heavy reliance on the individual end user's perceptions of the value of applications they develop. If the satisfaction of the user developer is the sole measure of application success, and satisfaction does not reflect system quality then the organisations are put at risk. The benefits anticipated from end user development of applications may be compromised.

The lack of relationship between system quality and the user satisfaction of the developers may result from the extreme degree of involvement that many end user developers have with their applications. Cheney, Mann and Amoroso (1986) argued that end user development can be considered as the ultimate user involvement. End user developers are not only the major participants in the development process but also often the primary users of their applications. Applications can come to be viewed as much more than merely problem solving tools. It appears that Melone's (1990) caution that the evaluative function of user satisfaction can be compromised by the role of attitude in maintaining self esteem is particularly relevant in the UDA domain.

In their work on user involvement Doll and Torkzadeh (1989; 1991) describe the situation where an end user's level of involvement with an application and/or the application development process is higher than the end user would wish. In this situation, involvement can have a negative relationship with user satisfaction. So instead of leading to inflated satisfaction, in some cases high involvement can lead to lower satisfaction. If this study included some subjects who had a level of involvement higher than they desired this could also explain the lack of relationship between system quality and user satisfaction for the user developers. Future research should further explore the roles of perceived involvement and desired involvement in user development of applications.

The finding that as the quality of applications decreases, the gap between developer and non-developer satisfaction increases indicates that not surprisingly the major area of concern should be with applications that are of low quality. This problem could be addressed by increasing the levels of training for end user developers, in particular focusing on system development processes and quality assurance.

In conclusion, this study has demonstrated that the relationship between system quality and user satisfaction is different when the user of an application is also its developer. This is of concern to organisations that rely heavily on user perceptions of their own applications.

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APPENDIX

Items Used in the Instruments

User Satisfaction

- Is the spreadsheet accurate?
- Does the spreadsheet provide the precise information you need?
- Is the spreadsheet user friendly?
- Is the information given on the spreadsheet clear?
- Does the spreadsheet provide outputs that seem to be just almost exactly what you need?
- Do you think information is presented in a useful format?
- Is the spreadsheet easy to use?
- Can you get the information you need in a reasonable time?
- Does the spreadsheet provide sufficient information?
- Are you satisfied with the accuracy of the spreadsheet?
- Does the information content in the spreadsheet meet your needs?
- Does the spreadsheet provide up-to-date information?

System Quality

- The application greatly increased my data processing capacity
- The application provides all the information it should
- The application could be used in other similar business situations, without any major modification
- Using the application is easy, even after a long period of non-utilisation
- The application is easy to learn by new users
- The outputs are set out in a logical manner, easy to read and understand
- The terms used in data-entry sections are familiar to users
- Help functions are available throughout the application
- Errors are easy to identify and corrections are easy to make
- This application always issues an informative error message when it detects an error
- The data entry areas provide the capability to easily make corrections to data
- The information contained in the results always matches the actual facts
- Data is labelled so that it can be easily matched with other parts of the system
- All outputs provided by this application are required
- Outputs provided by this application are comprehensive
- The application contains all the information required to produce comprehensive outputs
- The documentation is comprehensive
- Relevant data is easily available
- The application does not destroy any information without asking for a confirmation and getting a positive response

- The application provides default values at the data-entry level where appropriate
- The application never modifies a field without asking for a confirmation and getting a positive response where appropriate
- Unauthorised users could not easily access the whole data files or a part of them
- Unauthorised access is controlled in several parts of the system
- Headings provide information related to the nature of data in the system
- The documentation provides all the information required to use the system
- Meaningful identification is assigned to all data entry sections
- The application is broken up into separate and independent sections
- Each section processes a unique function
- The application is based on a hierarchical processing structure
- Data entry sections are organised in such a way that the data elements are logically grouped together
- The spreadsheet structure is such that queries can be performed easily
- The same terminology is used throughout the system
- The data entry areas clearly show the spaces reserved to record the data
- The format of a given variable is always the same, where ever it is used in the application
- All headings are always at the same place

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