Association for Information Systems
AIS Electronic Library (AISeL)

SAIS 2011 Proceedings | Southern (SAIS)

2011

An Experiment For Estimating User Satisfaction

Adarsh Kumar Kakar
University of Alabama, askakar@crimson.ua.edu

AN EXPERIMENT FOR ESTIMATING USER SATISFACTION

Adarsh Kumar Kakar
University of Alabama
askakar@crimson.ua.edu

ABSTRACT

User satisfaction has been found to be an adequate proxy for contribution of Information Systems (IS) to organizational performance (Gelderman, 1998). However, although IS projects plan and estimate cost and schedule, quality, the third leg of the iron triangle, defined as *the degree to which a system, component, or process meets specified requirements and customer/user needs and expectations* (The IEEE Standard 610.12-1990) is seldom estimated. Assessing user satisfaction after the IS product is developed has limited value. Often the situation at this stage is non-remediable resulting in wasted efforts and loss of scarce resources. This paper investigates the feasibility of estimating user satisfaction even before the IS development has commenced. The method developed in the study was tested empirically and can be used in practice to estimate user satisfaction for a given requirement set and to obtain changes in estimates if requirement sub-sets are either included or excluded from it.

Keywords

Estimation, User Satisfaction, Requirement Sets

INTRODUCTION

End- user satisfaction is an important area of IS research because it is considered a significant factor in measuring IS success and use (Ives, Olson, and Baroudi, 1983; Torkzadeh and Doll, 1991; Delone and Mc Lean, 1992; Seddon, 1997). With the boom in e-commerce organizations have to now contend with more and more external users (companies or consumers). To provide superior value to the external customer, it is important that value be added at each point of the value chain. IS departments therefore have a responsibility to provide a high quality product that satisfies the requirements of both internal and external end-users and customers.

But is customer/ user satisfaction given the importance it deserves in development of IS systems? Over the last 50 years, Cost, Time and Quality (The Iron Triangle), have become inextricably linked with measuring the success of project management (Atkinon, 1999). There is a huge body of IS research for estimating cost and schedule resulting in robust models such as such as SLIM (Putnam and Meyer,1992), Checkpoint (Jones,1997), PRICE-S (Park,1988), SEER (Jensen,1983), and COCOMO (Boehm,1981). Yet, there are virtually no theories or models developed for estimating quality, defined as *the degree to which a system, component, or process meets specified requirements and customer/user needs and expectations* (The IEEE Standard 610.12-1990). Quality is generally defined in terms of customer satisfaction (Lilja and Wiklund, 2006). For this paper, customer satisfaction was therefore estimated as a proxy for quality and quality in turn reflects the extent to which the specified user requirements are met by the IS product.

User-satisfaction instruments are currently employed to assess user satisfaction levels after the product is developed or sometimes during the process of product development, to diagnose possible causes of dissatisfaction, and to suggest corrective actions (Baroudi and Orlikowski, 1988). But, while it is important that the past be examined and understood, it is equally important that theories/ models be developed for predicting a priori likely responses of users in advance of system introduction (Melone, 1990). This estimate of user satisfaction can then be used to plan and monitor the achievement of user satisfaction goals of the project similar to planning and tracking the cost and schedule goals of the project.

This paper first discusses the complexities of estimating user satisfaction. Then a simple and easy to use model is developed for estimating satisfaction for a set/ sub-set of user requirements. For greater validity the model is tested for two requirement sets and sub-sets resulting from two most commonly used grouping methods for prioritizing IS requirements. The contribution of this study to practice and its limitations are discussed.

DIFFICULTIES IN ESTIMATING USER SATISFACTION

Assume an ideal or a hypothetical situation where all user requirements have equal importance. Let us also assume that the penalty for not satisfying a requirement is equal to the reward for satisfying a requirement and that each attribute independently and additively contributes to overall satisfaction i.e. there is no interaction effect between them.

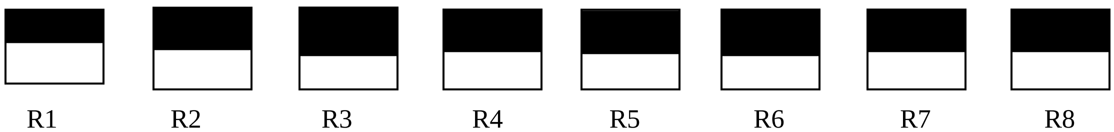

Figure 1

In such a scenario the requirements R1….R8 can be represented by Figure 1. The area of each requirement represents its impact on overall satisfaction; the bottom half (un-shaded portion) represents the quantum of reward for satisfying the requirement and the top half (shaded portion) represents the penalty for non-fulfillment. Estimating user satisfaction in this ideal scenario is simple. Assuming that all user requirements have been captured during requirement elicitation, the overall user satisfaction level can be estimated by the formula:

$$\left[\left\{\sum_{i=1}^{n=8} Si\right\} / n\right] *100$$

Equation 1

where Si is the satisfaction/ dissatisfaction indicator and takes a value 0 if requirement is not fulfilled and 1 if the requirement Ri is fulfilled.

Using Equation 1, if all requirements of the user (Figure 1) are fulfilled as attributes in the final product, then the estimate of user satisfaction will be (8÷8)×100=100%. If only six of these requirements are planned to be addressed in the final product, say due to budget or schedule constraints, then the estimate of user satisfaction level will be (6÷8)×100=75%. In this simplistic model there is no need to take inputs from the user for estimating user satisfaction.

However, in reality, each of the assumptions stated above is not valid. A typical requirement set is more likely to represent Figure 2 below than Figure 1:

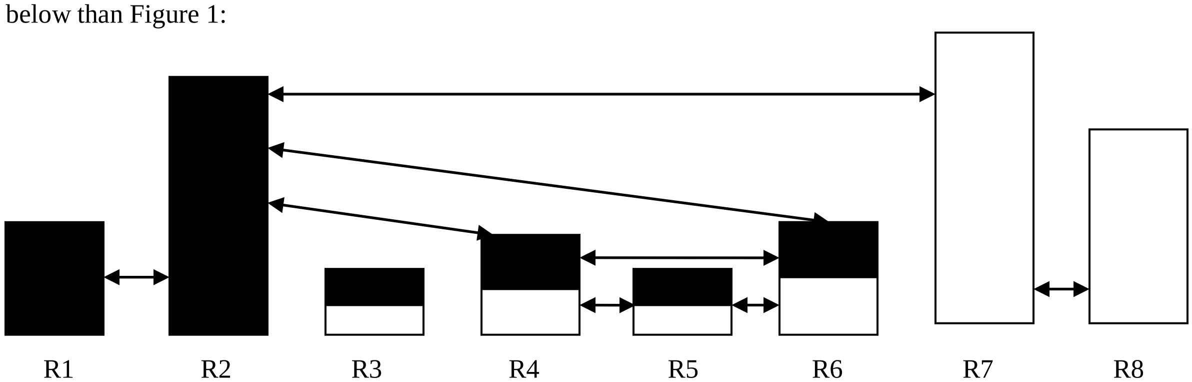

Figure 2

Users typically give more importance to certain requirements than others. In addition, user requirements in practice are not a homogeneous category. The quantum of penalty versus the quantum of reward varies for different types of requirements. For example the penalty for not fulfilling a “hygiene” (Herzberg, 1966, Zhang, Von Dran, Small, and Barcellos, 2000) type requirement, such as providing a drop down menu for selecting a country name instead of users having to enter it manually will be much higher than the reward for fulfilling it. Conversely the reward for fulfilling a “motivational” (Herzberg, 1966; Zhang et al., 2000) type requirement such an elegant screen design, will be much more then the penalty for not fulfilling it. In addition, there is interaction effect between requirements (represented by arrows in Figure 2). The overall user satisfaction level of fulfilling two or more individual requirements may not be additive i.e. a sum of their individual contributions. For example, if the developers of a task tracking system decide to provide features for managing (create, modify and delete) daily, weekly, monthly and yearly tasks in the current release but provide the calendar feature for entering dates only in the next release, then the individual contributions to overall satisfaction, of providing these features in different releases may not be the same as the combined satisfaction of providing both the features in the same release.

To comprehensively model the main and interaction effects at individual requirement level for only eight requirements will require seeking satisfaction feedback from users/ customers on $n + 2^{n-1} = 8 + 2^{8-1} = 134$ scenarios where in each scenario a different requirement set is presented to the user for feedback. This will require a very large sample size if one considers the norm of having the number of observations at least 10 to 20 times the number of variables. Such large data sets may not be available. In addition, to get the relative importance for just 8 requirements using say pair-wise comparison technique would require the user to make $n \times \frac{n-1}{2} = 8 \times (8-1) \div 2 = 28$ comparisons. Taking these inputs from the users is expected to fatigue them immensely. In a research study (Lehtola and Kauppinen, 2006) it was found that after working for half an hour with 20 requirements using pair-wise comparison, their first user became so irritated that she was not able to really concentrate on comparing the requirements. All she wanted was to finish the task quickly. The experiment with other two users had to be abandoned.

We therefore decided to get user feedback at the group level i.e. requirement sets categorized by users into High (H), Medium (M), Low (L) priorities. Not only would assigning the importance of requirements into these three buckets would be easy for the user but also to model the main and interaction effect users will be required to rate satisfaction for only $3 + 2^{3-1} = 7$ scenarios (only H, only M, only L, H+M, H+L, M+L, H+M+L). However in our pilot experiment we found that even seven scenarios so fatigued the respondents that they were not sure about the accuracy of their responses. We therefore modeled for only interaction between H and M which required presenting them with only 3 scenarios –only H and only M, and H+M requirement sets. This made practical sense too as often developers have to contend with making a decision about whether to include only High priority requirements or both High and Medium priority requirements in their development plan for the next release. Moreover requirement sets, H+L and M+L, do not make logical groupings for development plans of projects and if all (H+M+L) customer requirements are planned to be met there may be no need for estimating user satisfaction.

To provide greater assurance that our model for estimating user satisfaction is valid, we included in our experiment another popular method which groups requirements into Basic (B), Performance (P) and Excitement (E) factors. For this we presented another set of users with 3 scenarios to consider the main effects and interaction effect between B and P, and a fourth scenario to capture the marginal effect of adding one E requirement to B+P. This is because although E requirements have a lower priority compared to B and P (Bayraktaroglu and Özgen, 2007; Robertshaw, 1995), fulfilling them in addition to B+P surprises the customer resulting in customer delight. To make the HML experiment equivalent with this we included a fourth scenario by adding one L requirement to H+M to know the marginal effect on user satisfaction of adding one low level requirement to H+L.

THE EXPERIMENT AND ANALYSIS OF RESULTS

In the first round of experiment 30 potential users of a popular task tracking software classified requirements into High, Medium and Low Categories. Another set of 23 users classified requirements into Basic, Performance and Excitement categories using the widely accepted Kano survey (Kano, Seraku, Takahashi and Tsuji, 1984). In the next round 28 potential users evaluated on a 9 point satisfaction scale the four HML scenarios discussed in the previous section and another 24 potential users evaluated the four BPE scenarios. The potential users in the second round were randomly chosen from among the potential users in the first round and had no way of knowing which method was used for grouping the requirement sets presented to them.

After the requirements were grouped by the participants in the first round, the satisfaction ratings given by the respondents in the second round for the four scenarios were used to estimate the parameters of the regression equation. The intercept term was excluded because if no user requirements are planned to be implemented we expect zero user satisfaction; that is we expect the regression line to pass through origin. We used requirement sub-sets H,M and B,P as dummy variables in their respective models. We included another dummy variable E to estimate the marginal effect of adding an E requirement to B+P requirement set and a dummy variable L to capture the marginal effect of adding an L requirement to H+M requirement set in their respective regression equations. A value 1 assigned to a dummy variable indicated the presence of a sub-set and a value 0 assigned to dummy variable indicated the absence of a sub-set. To capture the interaction effect we include variables HxL and BxP in their respective models.

The results of regression analysis showed that the coefficients for HxM (p=0.343) and the variable L to capture marginal effect of adding an L to H+M (p=0.291) were found individually and jointly insignificant (Fcrit=-4.294 < F*=3.422) in the first regression model. The coefficients for BxP (p=0.051) and the variable E to capture the marginal effect of adding an E to B+P (p=0.148) were also found individually as well as jointly insignificant (Fcrit=-2.480 < F*=3.521) in the second regression model. The final regression models were run only with H and L as dummy variables in the first model and only B and P as dummy variables in the second model. The results are presented in Table 1 and Table 2 below:

Requirement Sets	Regression Coefficients (Predicted User Satisfaction)	Actual User Satisfaction (US) Rating (Average)	H0:Actual US = Predicted US
1. High only	3.619 ***	3.786	p=0.586
2. Medium only	3.869 ***	4.036	p=0.622
3. High + Medium	7.488	7.320	p=0.177

R^2 (adj)=0.918
*** p<.001

Table 1

Requirement Sets	Regression Coefficients (Predicted User Satisfaction)	Actual User Satisfaction (US) Rating (Average)	H0:Actual US =Predicted US
1. Basic only	3.527 ***	3.833	P=0.365
2. Performance only	2.986 ***	3.292	P=0.354
3. Basic + Performance	6.513	6.208	P=0.252

R^2 (adj)=0.890
*** p<.001

Table 2

As can be seen from Table 1 and Table 2 above, both the regression equations accurately predicted user satisfaction, for individual sub-sets as well as their combination, establishing the validity of the method for estimating user satisfaction

CONTRIBUTION AND LIMITATIONS

This study is a pioneering effort at estimating user satisfaction. With user requirements evolving continuously in a competitive market place, developers and product managers have to make product decisions not only by estimating their impact on cost and schedule but also considering their impact on customer satisfaction. By providing additional information, the estimation model developed in this paper will enable managers to make more balanced project and product decisions.

The obvious limitation of this model is that it considers the effect of adding/ dropping requirements not at an individual requirement level but at the level of requirement sets. In addition this model estimates user satisfaction by considering only the binary states i.e. the requirements are either satisfied or not satisfied. However the project outcomes may also include partially satisfied requirements as well as requirements that have exceeded specified performance levels. The model does not take in account different levels of user satisfaction that may result from providing different levels of performance. Future research may look into the possibility of overcoming these gaps without making the model so complicated that it loses its practical relevance.

REFERENCES

1. Atkinson, R. (1999) Project management: cost, time and quality, two best guesses and a phenomenon. Its time to accept other success criteria, *International Journal of Project Management*, 17, 337–342.
2. Baroudi, J. J., and Orlikowski, W. J., (1988) A Short-Form Measuring of User Information Satisfaction: A Psychometric Evaluation and Notes on Use, *Journal of Management Information Systems*, 4(4), 44-59.
3. Bayraktaroglu, G. and Özgen, Ö. (2007) Integrating the Kano Model, AHP and Planning Matrix: QFD Application in Library Services, *Library Management*, 29, 4/5, 327-351.
4. Boehm, B. (1981), Software Engineering Economics, Prentice Hall.
5. Delone, W. and McLean, E. (1992) Information Systems Success: The Quest for the Dependent Variable, *Information Systems Research,* (3:1), 60-95.
6. Gelderman, M. (1998) The relation between user satisfaction, usage of information systems and performance, *Information & Management*, 34, 11–18.
7. Herzberg, F. (1966). Work and Nature of Man, World Publishing, Cleveland, OH. IEEE Standard 610.12-1990. (1990) Standard Glossary of Software Engineering Terminology.
8. Ives, B., Olson, M., and Baroudi, J. (1983) The measurement of user information satisfaction, *Communications of the ACM* ,26(10), 785-793. Kano, N., Seraku, N., Takahashi, F, and Tsuji, S. (1984) Attractive quality and must-be quality (in Japanese). *Journal of the Japanese Society for Quality Control,* 14, 2, 39-48.
9. Jensen, R.W., (1983) A Comparison of the Jensen and COCOMO Schedule and Cost Estimation Models, *Proceedings of the International Society of Parametric Analysts*, 96-106
10. Jones, C. (1997), Applied Software Measurement, McGraw Hill.
11. Kano, N., Seraku, N., Takahashi, F., and Tsuji, S. (1984) Attractive quality and must-be quality (in Japanese). *Journal of the Japanese Society for Quality Control,* 14, 2, 39-48.
12. Lehtola, L. and Kauppinen, M. (2006) Suitability of Requirements Prioritization Methods for Market Driven Software Product Development, *Software Process Improvement and Practice*, 11, 1, 7-19.
13. Lilja, J. and Wiklund, H. (2006) Obstacles to the creation of attractive quality, *The TQM Magazine*, 18:1, 55-66.
14. Mahmood, M., Burn, J., Gemoets, L., and Jacquez, C. (2000) Variables affecting information technology end-user satisfaction: a meta-analysis of the empirical literature, *International Journal of Human Computer Studies*, 52(4), 751-772.
15. Maarten, G. (1998) The relation between user satisfaction, usage of information systems and performance, *Information & Management*, 34, 11–18.
16. Melone, N.P., (1990) A Theoretical Assessment of the User-Satisfaction Construct in Information Systems Research, *Management Science,* (36:1), 76-91.
17. Park, R. (1988) The Central Equations of the PRICE Software Cost Model, *4th COCOMO Users' Group Meeting*.
18. Putnam, L.H., and Meyer, W. (1992) Measures for Excellence: Reliable Software on Time within Budget, Prentice-Hall, Englewood Cliffs, New Jersey.
19. Robertshaw, W. (1995) Using an objective sales point measure to incorporate elements of the Kano model into QFD, *Transactions from the 7th Symposium on Quality Function Deployment*, 201-16.
20. Seddon, P. B., (1997) A respecification and extension of the DeLone and McLean model of IS success, *Information Systems Research*, 8, 240-253.
21. Torkzadeh, G. and Doll, W.J., (1991) Test-Retest Reliability of the End-User Computing Satisfaction Instrument, *Decision Sciences*, (22:1), 26-37.
22. Zhang, P. Von Dran, G. Small, R. and Barcellos, S. (2000) A two-factor theory for Web site design, *In Proceedings of the 33d Hawaii International Conference on Systems Science (HICSS 33*). Maui, HI: IEEE Computer Society.