8-25-1995

A TQM-Based Systems Development Process

Anthony C. Stylianou
University of North Carolina at Charlotte,

Ram Kumar
University of North Carolina at Charlotte

Moutaz J. Khouja
University of North Carolina at Charlotte

A TQM-Based Systems Development Process

Anthony C. Stylianou, Ram Kumar, Moutaz J. Khouja
Academy for Applied Research in Information Systems, The Belk College of Business Administration,
University of North Carolina at Charlotte, Charlotte, NC 28223. Tel. (704)547-2064

1. Introduction

Similar to manufacturing, a critical requirement to achieving high quality in the production of information systems (IS) is the ability to deploy the customers' desires throughout the systems development process(SDP). The MIS literature has long recognized the importance of user involvement in the SDP (Davis, 1989; Davis, Bagozi, and Warshaw, 1989). The major objective of user involvement is to develop high quality systems with which users are comfortable and satisfied. The specification of requirements and the subsequent conversion of these requirements into a useful system is often a complex process. It is imperative to be able to capture user requirements accurately and in a fashion that is conducive to their transfer to a development methodology. This can result in detailed design specifications that reflect the user quality concerns and can lead to efficient and effective implementation. It is often assumed that the existing systems analysis, design, and implementation methodologies allow developers to document and keep track of the user requirements thus enabling development of an end product with which users are satisfied. Situations where users are dissatisfied with a system are nevertheless not uncommon. This dissatisfaction is the result of the users' perceptions of quality not being met.

Careful attention to details and user involvement in the development process increase the potential for, but do not guarantee, a high-quality system. It is important to realize that the traditional systems development methodologies do not explicitly document user quality attributes. They also make no provisions for ensuring that those quality characteristics are properly and systematically considered throughout the various stages of the development process. It is possible that some user requirements such as ease of use, maintenance, and security are not captured in data and process modeling. It may also be the case that quality features related to hardware or support services and other user requirements are either not explicitly considered or they vanish in the stepwise refinement process, which typically emphasizes software.

This paper highlights limitations of the traditional systems analysis and design methods as they relate to user perceptions and measures of quality, and proposes a method of integrating quality function deployment into the SDP.

2. QFD and IS

Quality Function Deployment (QFD) is a design tool of TQM that was originally used by manufacturing firms to bring new products to the market sooner than the competition, with lower cost, and improved quality (Sullivan, 1986). In its most basic form, QFD is a design tool that translates customer requirements into the appropriate technical requirements at each stage of the production process. A brief outline of the steps involved in QFD is:

1. Identify the customers
2. Establish customer requirements for the product/service and their relative importance in the customer's terms.
3. Identify the characteristics of your product/service.
4. Understand the relationship between product/service characteristics and customer attributes and then identify the ideal product/service characteristics.
5. Compare your product characteristics to those of the competition.
6. Identify the selling points of your product/service relative to the competition.
7. Develop target values for final product/service characteristics based on customer importance, selling points and competitive evaluations.

Since improving the quality of software development has been identified as one of the ten key issues in IS management (Nlederman, Brancheau, and Wetherbe, 1991), the application of QFD to the design of IS may prove to be critical.

An important aspect of QFD is that quality is defined by the customers and using their own terms. In spite of its simplicity, this aspect may be critical in the production of high quality IS. Traditionally, quality of software and systems in general has been defined in technical terms that may mean little, if anything, to the users/customers. Such quality attributes are frequently of little or no importance to the users/customers.

Integrating QFD into the Systems Development Process

In the IS context, the QFD methodology could be used for the following purposes:

1. Document the users' (customers') quality requirements.
2. Translate the users' quality requirements to characteristics of the components of the system (software, hardware, service, etc.).
3. Relate component characteristics to sub-component characteristics. This is analogous to stepwise refinement in traditional systems analysis and design methodologies. However, sub-components are not restricted to software modules, but include hardware and service modules. Also, the impact of each sub-component on the overall system quality attributes is explicitly documented and tracked throughout the analysis, design, and implementation process.
4. Identify conflicting user requirements that would affect design requirements. For example, there may be conflicts between ease of use, and fast response. These conflicts can be explicitly documented and considered during design decisions.
5. Identify production (development) processes and quality checkpoints that help to achieve the required system quality characteristics.

While QFD provides means for translating end-user requirements into detailed sub-component requirements, it is not specific to software design and development. Hence, it does not provide the data and process modeling constructs supported by traditional systems analysis and design methodologies. Thus, QFD and the traditional systems analysis methods are complementary in some ways. We therefore propose a framework for integrating QFD into the systems analysis and design process, in order to increase the likelihood of developing high-quality systems.

A Quality-Driven Development Process

The proposed quality driven development process integrates the traditional systems development methodology with the following QFD steps:

1. Interaction with different customer groups leads to the identification of overall required system quality characteristics. These are initially expressed in customer terms and are subsequently linked to technical/engineering features of the system. Customers also specify the relative importance of different features. For example, high system availability may be a critical requirement. This could be linked to hardware specifications, software features, backup and recovery procedures, availability of support personnel, etc.
2. From the set of final system quality characteristics, critical subsystem characteristics are determined. For example, hardware specifications would be linked to specifications for computers, telecommunication components, etc.
3. The customer's quality requirements and critical subsystem characteristics lead to the Process and Quality Control (P&QC) plan which specifies the development process to be used. For example, detailed steps in installing a telecommunication network and associated software might be specified. In addition, checks to ensure critical quality requirements specified in earlier steps could be detailed.
4. Operating instructions are then derived from the P&QC plan and can include backup and recovery procedures that are needed to ensure that the system availability requirements are met.

Integrating these QFD-based steps into the development process increases the likelihood that customer requirements will be explicitly recognized and incorporated into the SDP. This in turn is likely to increase the probability of delivering higher quality systems as perceived by the users.

3. A Case Study of the use of QFD in Systems Development

Description of the System

Consider the development of an order entry system (OES) that is used by customers in catalog order stores. The objective of this OES is to improve customer service, by reducing the time required for a customer to order an item, receive it, and pay for it. The customer looks up the required item from a catalog placed near a terminal. S/he then keys in the item number. The system checks availability, and if available asks if s/he would

like to place an order. If an order is to be placed and payment is by credit card, the customer can enter credit card details. Details regarding the item requested are made available by the system to warehouse personnel, who locate the requested item, and send it through a conveyor to customer pickup. Meanwhile, the credit card information entered by the customer is used to get credit approval. The customer shows his/her credit card for physical verification, signs the credit card slip, and picks up the item that s/he requested.

Defining System Quality from the Customers' Point of View

The ultimate users of the system will care little for portability, efficiency, testability, understandability, and modifiability. Reliability, from the customers' point of view is a requirement. A system that is reliable is not a high quality system from the customers' point of view, but rather delivers the basic function for which it was designed. Human engineering (the ability of the system to be easily understood and used by human users) is the only important attribute to the users/customers. In addition, different users of the system may have different defintions of quality. For customers using the system to buy items in the showroom, their definition of quality is likely to include attributes 1 through 11 below. For workers using the system to send the ordered items from the storage room to the checkout counter, their defintion of quality is likely to include attributes 12 through 15.

1. Availability of catalog next to computer
2. Availability of catalog on screen
3. Availability of terminals
4. Easily accessible terminals
5. Fast checkout
6. Magnetic read of credit card
7. Manual card number entry
8. Short authorization time
9. Clear instruction/messages
10. Easily readable screen
11. Easy to use
12. Provide information about each item location
13. Group orders by item location
14. Hooks into inventory control system
15. Provide proof of delivery to customer

4. Summary and Conclusions

We have examined the SDP from the standpoint of user perceptions of system quality. Limitations of the traditional SDP in ensuring high quality systems have been identified. A new systems development approach that integrates established systems development methodologies with QFD has been proposed.

We are currently applying this methodology to several systems development projects. Once experiences are gained from those applications, future research will include

presentation of case studies using the proposed methodology and a more detailed presentation of the pros and cons of this approach.

References

Coad, P., and Yourdon, E. (1991) *Object-Oriented Analysis*, Prentice Hall, Englewood Cliffs, N.J.

Davis, F. (1989) "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", *MIS Quarterly*, Vol. 13, No. 3, 318-339.

Davis, F., Bagozi, R., and Warshaw, P. (1989) "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science*, vol.35, No. 8, 982-1003.

Glass, R. L. (1992) *Building Quality Software*, Prentice Hall, Englewood Cliffs, N.J.

Inmon, W.H. (1988) *Information Engineering for the Practitioner: Putting Theory Into Practice*, Prentice Hall, Englewood Cliffs, N.J.

Nlederman, F., Brancheau, J. C., and Wetherbe, J.C. (1991) "Information Systems Management Issues for the 1990s," *MIS Quarterly* , 474-500.

Yourdon, E., and Constantine, L.L. (1979) *Structured Design: Fundamentals of a Discipline of Computer Program and Systems Design* , Prentice Hall, Englewood Cliffs, N.J.

Zultner, R. E. (1993) "TQM for Technical Teams," *Communications of the ACM*, 36,10, 79-91. 5

The authors' names are listed in random order. Each author has contributed equally to this research.