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# A USER CENTRIC TYPOLOGY OF IS REQUIREMENTS

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## ABSTRACT

With a boom in e-commerce, organizations have to contend with fulfilling IS (Information Systems) requirements of rapidly rising numbers of external users in addition to internal users. However, currently there is a gap in IS literature. Virtually no typological scheme (TS) exists for IS user requirements. And a typology is widely acknowledged as the first step towards understanding a phenomenon (Bailey, 1994). Using relevant research findings in the areas of job satisfaction, customer satisfaction and product quality this study explores the possibility of developing a TS of user requirements suitable to the IS context. The aim is to provide researchers with a theoretical foundation for user-centric research in requirements engineering. The outcome of the study, iteratively reached, through literature review and experimentation, is encouraging. The requirement types identified in the suggested TS are found to have both theoretical and empirical support with positive implications for research as well as practice.

## Keywords

Typological Scheme, User Requirements, Implied Requirements, Stated Requirements, Unstated Requirements

## INTRODUCTION

With the boom in e-commerce organizations have to now contend with more and more external users. As a result customer requirements and satisfaction are becoming centre stage of system development activities. Yet, organizations realize that to provide superior value to the external customer it is important that value be added at each point of the value chain that passes through multiple internal users. Therefore satisfying both internal and external users is increasingly becoming a measure of IS success. Aligned with the growing user focus, this study took a user-centric approach to developing a TS for IS requirements, the term user including both internal and external end-users and customers.

Currently there is a gap in IS research. Virtually no typological scheme exists for user requirements, and a typology is widely acknowledged as the first step towards understanding a phenomenon. A well constructed typology is useful for bringing order out of chaos and forms the foundation for both theorizing and empirical research (Bailey, 1994). This paper utilized the unique form of theory building represented by the typology approach (Doty and Glick, 1994) to provide a theoretical basis for future research in requirements engineering. But to develop a reliable user-centric typology of IS requirements the following questions had to be addressed:

Are IS user requirements a homogeneous category? Do users give same importance to all requirements? Is the ratio of reward for fulfillment and the penalty for non-fulfillment the same for all user requirements? What are the widely used requirements grouping methods in literature? Are they empirically supported? Are they based on a strong theoretical foundation? Are these requirement groupings intuitive? Are they relevant in the IS context?

Getting answers to these questions was a long iterative process involving literature study and experimentation. The study began with a search in IS literature for a suitable TS. Not finding substantial success the quest then led to a search in job satisfaction and product quality literature resulting in the discovery of a two factor and a three factor classification of user requirements. The three factor classification also known as Kano (Kano, Seraku, Takahashi and Tsuji, 1984) classification seemed most promising and the most widely used in product development. Although there have been a number of studies in literature, including IS literature, about its potential usefulness, an experiment was nevertheless conducted on potential users of the mobile app to verify the relevance of the three factor classification to IS. The experiment specifically tested the expected characteristics and face validity of the requirements classified using the three factor theory. The results of the

experiment led to a search back in literature for theoretical underpinnings of this three factor classification. It was found that although a number of studies in product quality literature empirically supported the three factor classification a solid theoretical basis for it was not found. However, in a revisit of IS literature, the ISO classification, which was earlier overlooked in favor of the three factor classification, and which has limitations compared to the three factor classification, provided valuable insight? Extending the ISO classification of user requirements, and utilizing the widely accepted Expectancy-Disconfirmation paradigm, a TS was developed that not only has a solid theoretical foundation but a strong empirical support as well.

## LITERATURE REVIEW

### Classifying Needs and Requirements

#### *Frederick Herzberg and the two factor theory*

Investigators of consumer satisfaction have frequently adapted models and techniques from studies of job satisfaction (Pfaff, 1973; Czeipiel, Rosenberg and Akerele, 1974). The adaptations have face validity because the concept of satisfaction is common to both types of studies (Maddox, 1981). Therefore, although the Motivation-Hygiene Theory was developed by Frederick Herzberg (1959) as an alternative to Maslow's theory (1954) for studying job satisfaction, it has contributed to a body of knowledge on customer satisfaction.

According to the Motivation-Hygiene theory (Herzberg and Synderman, 1967) job satisfaction and dissatisfaction must be separated into two different continua, and are determined by two different sets of factors. Factors found to affect job satisfaction (recognition, achievement, work itself, advancement, and responsibility) are called "motivation factors." Factors found to affect job dissatisfaction (salary, company policies, technical competence, interpersonal relations and working conditions), called "hygiene factors" (Brenner and Carmack, 1971). By implication, customer requirements can be classified into two categories, those that cause customer dissatisfaction if not fulfilled but no significant satisfaction if fulfilled and those that cause customer satisfaction if fulfilled but no dissatisfaction if not fulfilled. "Hygeine" factors are also called "Dissatisfiers" and "Motivation" factors are called "Satisfiers".

#### *The Three factor theory*

Earlier empirical studies (Swan and Combs,1976; Maddox 1981; Cadotte and Turgeon, 1988; Johnston and Selvestro, 1990) of customer requirements found support for Herzberg's (Herzberg and Synderman,1967) two factors classification. However, later studies (Brandt, 1987; Brandt and Reffet, 1989; Stauss and Hentschel,1992; Johnston,1993; Anderson and Mittal,2000) found empirical support for a three-factor theory, the third factor leading to dissatisfaction as well as satisfaction. Today the three factor theory is widely accepted. The three factor theory is popular in quality literature as the "theory of attractive quality" (Kano et al, 1993) and is based on Herzberg's two factor theory. The three factors in the three factor theory are:

**Basic factors:** They are prerequisites and must be satisfied first at least at threshold levels for the product to be accepted. The fulfillment of basic requirements is a necessary but not a sufficient condition for satisfaction. The customer takes Basic requirements for granted, and therefore does not explicitly ask for them. They are similar to Herzberg's "Hygiene factors" or "Dissatisfiers". The other names used for Basic factors are Minimum Requirements (Brandt, 1988), Must-be requirements (Kano et al, 1993), Implied requirements (ISO/IEC 9126-1, 2001).

**Performance factors:** These are requirements that the customer deliberately seeks to fulfill. They are uppermost in her consciousness. Fulfilling these requirements leads to customer satisfaction and not fulfilling them leads to dissatisfaction. The other names for Performance factors are One-dimensional requirements (Kano et al, 1993), Stated requirements (ISO/IEC 9126-1,2001).

**Excitement factors:** Excitement requirements are those that the customer did not expect. They surprise the user by adding unexpected value to the product thereby delighting her. The Excitement factors are similar to Herzberg's "Motivation factors" or "Satisfiers". The other names for Excitement requirements are Attractive requirements (Kano et al, 1993), Value enhancing requirements (Brandt, 1988).

Extant research (Robertshaw,1995; Mazler and Sauerwein,2002) has suggested that amongst the three categories of requirements, Excitement factors should be given the least priority, Performance factors should be given the next higher priority and Implied needs should be given the highest priority from the user perspective. The main reason for the suggested priority is that user dissatisfaction should be precluded first before aiming for customer satisfaction and delight.

### **Requirement Classification from IS literature**

A review of IS literature shows that it is sparse on classifying user requirements. Most commonly used is the ISO (ISO/IEC 9126-1,2001) definition of quality, which is derived from ISO 8402 (1984) as the totality of characteristics of an entity that bear on its ability to satisfy Stated and Implied needs. Implied needs are the Basic factors of the three factor theory while the Stated needs are the Performance factors. However unlike Basic factors and Performance factors there is no equivalent of Excitement factors in ISO (ISO/IEC 9126-1,2001) definition. Extant research (Mazler, 2004) has shown that it is by discovering and meeting the Excitement requirements that organizations differentiate themselves from others.

### **Expectancy-Disconfirmation Theory**

The expectancy-disconfirmation theory is widely used in the consumer behavior literature to study consumer satisfaction (Bhattacharjee,2001). The predictive ability of disconfirmation theory has been strongly demonstrated in “Customer Satisfaction: A Meta-Analysis of Empirical Evidence” (Szymanski and Henard,2001). According to this theory, customer satisfaction has three main antecedents: expectation, disconfirmation and perceived performance outcomes. Customers are said to be satisfied when the outcomes exceed expectations (positive disconfirmation), dissatisfied when expectations exceed outcomes (negative disconfirmation) and just satisfied when outcomes match expectations (Oliver,1981). Delight results from a high level of surprising positive disconfirmation (Rust and Oliver, 2000). This theory will be used to provide the theoretical foundation for the typological scheme proposed in this paper.

### **EMPRICAL SUPPORT FOR THE THREE FACTOR THEORY**

Of the three user classification systems investigated in the study i.e. Herzberg’s two factor theory, the three factor theory or the theory of attractive quality (Kano et al,1993) and the ISO classification, the three factor theory is the most widely accepted in product quality literature. An empirical test was therefore conducted to determine if it can be applied in the context of IS products. The empirical test involving users and potential users of a popular Mobile app. sought to validate whether the classified requirements made intuitive sense and whether they matched the distinctive properties specified in literature.

Using the widely accepted Kano survey method (Kano et al,1993) for classifying requirements, 23 respondents answered both, a functional survey (questions were asked to get participant response if requirements are met) and a dysfunctional survey (questions were asked to get participant response if requirements are not met), for grouping 15 randomly chosen user feature requests into the three categories. The requirements so classified were then evaluated for their face validity in accordance with the three factor theory. Simultaneously 30 other respondents assigned priorities (High, Medium and Low) to each of the 15 feature requests for their implementation into the product. This was done to explore the match between the criticality of feature requests as suggested by the three factor classification and their actual importance rating assigned by the users. All the respondents were senior undergraduate MIS students familiar with the Mobile app.

Analysis of the experiment results showed that the users classified the following three of the fifteen requirements of the Mobile app as Basic requirements:

1. Choose date from a calendar – currently users enter the date manually
2. Purging completed tasks - currently tasks have to be purged one by one
3. Create tasks that repeat yearly - presently system allows creation of daily, weekly and monthly tasks only

Intuitively it makes sense to classify these three requirements in the Basic category since the features are so basic that they may be entirely taken for granted by the users that the developer will provide for them in the application. For example ‘choosing date from a calendar’ is now a commonly available feature across applications and users do not expect to enter date manually. The user may therefore not articulate this requirement. Further, in accordance with the characteristics of Basic requirements, providing a calendar feature is not expected to increase her satisfaction, because it will go unnoticed by the

user as it is basic to the product. But not providing a calendar feature will cause dissatisfaction as the Implied requirement will now become manifest to the user by its absence in the product.

The Requirements 1 and 2 were accorded High priority by the second set of respondents while Requirement 3 was accorded Medium priority, broadly confirming the tenets of three factor theory and extant research that meeting Basic requirements is critical for the user (Robertshaw,1995; Mazler and Sauerwein,2002).

The following sets of three features out of fifteen were classified by respondents under the Performance requirements Category:

4. Auto color Tasks – to indicate to the users how far it is from due date
5. Shortcut to create tasks – currently it requires 3 clicks to go to the task creation option
6. Color tasks based on priority – to enable users to visually see task priority

This classification also made sense because these are user specific requirements that are not basic to this product (a task tracking system) or even this class of products. Satisfying them will enhance user satisfaction while not satisfying them will result in user disappointment. All three requirements were assigned medium priority. This is in line with the three factor theory and extant research (Robertshaw,1995; Mazler et al,2002) which states that amongst the categorized requirements Basic requirements should be fulfilled first to preclude dissatisfaction and that meeting Stated requirements are next in importance (Robertshaw,1995)

One requirement was classified in the Excitement (Unstated) category:

7. Grocery shopping list – to enable users to create and update a regular grocery shopping list that will enable them to check and tick off the items purchased from the store.

This is an innovative feature which a typical user would not normally articulate, but would be thrilled to have if provided. However, in line with literature, it was expected that this feature would be accorded a lower priority. Yet, users accorded it high priority.

Overall the results of the experiment confirmed that the categorized feature requests conformed to their respective category traits as described in the TS. In addition, the relative importance of feature requests seemed to have broadly inherited the relative importance of their categories as propounded by the TS.

## **THE TYPOLOGICAL SCHEME**

Although the three factor theory enables the classification and identification of requirements into three categories it has not been able to satisfactorily explain the reasons for their distinctive characteristics. For example why do fulfilling basic requirements not increase user satisfaction or why do some requirements cause delight when fulfilled while others do not is not explained by the three factor theory; thus justifying the demand by researchers (Mittal, Ross and Baldasare,1998; Lilja and Wiklund,2006) for the development of a theoretically driven typology. Although the three factor theory is based on Herzberg's two factor theory, Herzberg's two factor theory is itself not grounded in theory although there is strong empirical support for it

The search for theoretical support led this investigation perchance to the ISO classification of user requirements. The ISO terminology has a limitation. It classifies requirements into only two types – Implied and Stated which are the same as Basic and Performance requirements of the three factor theory. There is no equivalent of Excitement factors of the three factor theory, in the ISO (ISO/IEC 9126-1,2001) classification. This limits its relevance to product development as fulfilling Excitement requirements are known to cause customer delight. However the terminology it uses is attractive because it is easy to understand, mirrors the user perspective on their product requirements and as it turned out proved vital for developing a theoretical basis for the TS. Therefore extending the ISO terminology (ISO/IEC 9126-1,2001), this paper classifies user requirements into three main types – Implied, Stated and Unstated - with the three categories reflecting the user articulation and user expectation for a given requirement as shown in Table 1 on the next page:

<b>Articulated</b> <b>Expected</b>	yes	no
yes	<b>Stated</b>	<b>Implied</b>
no	<b>*Reverse</b> (customer explicitly does not want them in the product)	<b>Unstated</b> (adds value) <b>*Indifferent</b> (does not add value)

Table 1

\* The reverse and indifferent requirements are not part of the user-centric TS as they do not reflect user needs

The Stated requirements are upper most in the consciousness of the customer and they are both expected and explicitly articulated by the customer (Table 1). The difference between Implied and Stated requirements is that although Implied needs and Unstated needs are both unarticulated by the user, she expects the Implied needs to be fulfilled. But since they are so basic in nature it does not occur to her to articulate them. On the other hand the user does not expect the Unstated needs to be fulfilled as she is not aware of them, but is surprised and delighted when they are implemented in the product as they provide her with unexpected value.

Requirement gatherers can intuitively understand what Implied, Stated and Unstated requirements mean because they are unambiguous in their interpretation, making requirements easier to classify, interpret and analyze. This is unlike the terminology of Basic, Performance and Excitement factors used in the three factor theory which can have multiple interpretations. For example the concept of “attractive” quality, or Excitement factor, is given a number of very different meanings resulting in confusion (Lilja and Wiklund, 2006). Some descriptions share similarities with competitive advantage and differentiation (e.g. Ishikawa, 1990; Kano, 2001), stressing the importance of being superior to, or discernible from, other products. Other descriptions refer to the ability to surprise and delight the customer (e.g. Edvardsson, 2000), and still others to the satisfaction of a specific type of need (Bergman and Klefsjo, 2003). In the TS adopted by this study an “attractive” requirement, rechristened as Unstated requirements, is simply and unambiguously defined as any requirement which is unarticulated and unexpected but which adds value to the customer when implemented in the product (see Table 1).

## THEORETICAL SUPPORT FOR THE TYPOLOGICAL SCHEME

### Implied Requirements

As discussed earlier, Implied requirements are taken for granted by the user. They become manifest to the customer only when they are not fulfilled but they go unnoticed when fulfilled. For example, if the client has asked for a Shopping site, the analyst should include requirements for the Shopping cart such as the View cart, Checkout and Delete from Cart. If the View cart, Checkout and Delete from Cart options are not provided the customer will point out this deficiency to the developer even though the customer may not have explicitly articulated this requirement. In accordance with the expectancy-disconfirmation paradigm, since Implied requirements do not form part of the initial expectation set they do not increase customer satisfaction when fulfilled. However since Implied requirements become part of the expectation set when unfulfilled they cause customer dissatisfaction because outcomes now fall short of her expectations.

Let us say we measure, in line with the expectancy-disconfirmation paradigm, the user satisfaction as the ratio of outcomes (user requirements met by the product) and expectations (product requirements of the user). The higher this ratio the greater the user satisfaction and the lower this ratio the lesser is her satisfaction. An unfulfilled Implied requirement will have an effect on both numerator and denominator. The numerator gets reduced as outcomes that would have gone unnoticed are now seen as not being met. In addition the denominator increases as the unfulfilled requirement has now manifested itself to the user, thus increasing her expectation set. This combined effect on both numerator and denominator drastically brings down her satisfaction level; thus explaining the recommendations of extant research that Implied requirements should be accorded highest priority to preclude dissatisfaction with the product.

### **Stated Requirements**

Stated requirements constitute the expectation set of the customer. If the Stated requirement of a system is high availability, then the higher the system availability the more satisfied the customer will be and the lower the system availability the less satisfied the customer will be. This is in accordance with the expectancy-disconfirmation paradigm which states that the customer is just satisfied if the expected requirements such as system availability are met, satisfied when the expected requirements are exceeded and dissatisfied when the Stated requirements are not met. In addition it explains why these requirements should be next in priority after Implied requirements (Robertshaw, 1995; Mazler and Sauerwein,2002). By not fulfilling the Stated requirements the numerator of the user satisfaction equation described in the previous section reduces while denominator has remained the same causing dissatisfaction. However this dissatisfaction is not as acute as not fulfilling an Implied requirements where the numerator gets reduced and denominator increases simultaneously compounding the effect of lowering customer satisfaction.

### **Unstated requirements**

Unstated requirements are entirely unexpected as the customer is not aware of them. In accordance with the expectancy-disconfirmation paradigm, by fulfilling the Unstated requirements of the customer, such an innovative screen design, a novel business process or an efficient workflow, outcomes to expectation ratio is always raised. This is because the denominator of the satisfaction equation remains the same while the numerator increases if Unstated requirements are met causing a high level of satisfaction. Since they never become part of her expectation set even if they are not fulfilled Unstated requirements have no potential to cause dissatisfaction explaining why they are accorded lowest priority in literature (Robertshaw,1995; Mazler and Sauerwein,2002).

The TS is thus supported by theory. The distinct characteristics of each type of IS requirement in the TS could be explained by the expectation-disconfirmation theory.

## **STRENGTHS AND CONTRIBUTION**

This paper is a pioneering effort at developing a user-centric typology of IS requirements. The TS builds on the widely accepted three-factor classification of user requirements. By adopting a suitable nomenclature, the TS scheme is not only able to adapt and empirically validate a popular typology from a non-IS product domain into the IS context but also able to offer a, hitherto missing, theory-based explanation for the unique characteristics of the different types of user requirements. Although, extant research has empirically demonstrated the properties of different types of requirements, it did not offer an explanation for these observations and a need was often expressed for the development of a theoretically driven typology (Mittal, Ross and Baldasare,1998; Lilja and Wiklund,2006). The TS developed in this paper provides a theoretical foundation and user-centric approach for future research in requirements engineering. In addition, it has significant relevance to practice as it is intuitive and offers useful guidance to IS developers on capturing and fulfilling the right set of requirements with the aim of controlling user satisfaction outcomes.

## **PRACTICAL IMPLICATIONS, FUTURE RESEARCH AND LIMITATIONS**

Traditionally developers and requirement gatherers focus efforts and use tools and techniques for discovering the Stated requirements as they are easy to elicit from the customer. However the Stated requirements are only the tip of the iceberg. It is critical to ascertain the "hidden" i.e. Implied and Unstated requirements too; they have a maximum impact on both satisfaction and dissatisfaction levels of the customer respectively. By implication the TS highlights a need for deeper understanding of user requirements and intimacy with the customer because without that her Implied and Unstated needs will not become manifest to the developer of the IS.

The proposed TS can be used as a basis for further research in areas of practical interest such as prioritization of requirements, making trade off decisions, predicting customer satisfaction and developing elicitation tools to discover the Unstated or unarticulated requirements of the customer. Currently the tools available with the requirement gatherers predominantly focus on Stated requirements. In this study, the experiment to validate the TS was conducted for an IS application in a particular domain area and for a particular type of user, that is the potential customers of a popular Mobile app. It may be interesting to investigate the applicability of the TS to other domain areas and other types of users such as internal users of an IS system.



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