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New Approach in the Design Service Quality Using Axiomatic Design

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Abstract: Improvement of quality service is an important basis for sustainable competitive advantage. The first aim is to determine how important the quality factors are for service firms**.** It is necessary to understand clearly the goals in all points**.** There is only an idea how managers might deal with service quality gaps. The next purpose of this study is to designing organizational service quality using axiomatic design in the university (case study: shahrood university of technology). Axiomatic design is a scientifically based design theory that guides designers through the process of first mapping customer needs into functional requirements, then mapping these requirements into design parameters, and then finally figuring out processes to provide those design parameters. Given that this design is based on customer needs, As a result, the gap between expectations and reality customer needs is at least. The next novelty in this article, we decided to use Design Structure Matrix as tool to reduce the gaps; we show the corresponding matrix equations for minimizing any gaps.

Key words: service quality , axiomatic design , quality of university.

INTRODUCTION

In the growing service sector there is still the most problematic challenge how to deal with service quality. Quality is one of the most expected by customers aspect of almost all service products. High and unique quality is a way to win customers and make them loyal for along time.

During the last few decades, there has been an increasing interest in service quality, based on the assumption that quality offers organizations a competitive and sustainable advantage. Consistent with this idea, some previous research efforts have been devoted to the definition and measurement of service quality. Parasuraman *et al*. [22] proposed a model and designed an instrument (SERVQUAL) to assess service quality. This instrument is the result of several reviews and improvements they have carried out on their model. The SERVQUAL approach has been very influential in the research on service quality. In fact, the vast majority of investigations have used this instrument (or a version of it) in order to assess service quality (e.g. Bigne´ *et al*., 2003; Harline & Jones, 1996; Martin, 1995; Sahney *et al*., 2006; Simon & Woo, 1997; Van Dyke *et al*., 1999) .

Edvardsson *et al*. (2000) define the services concept as a group of various activities whose common characteristic is that they are abstract. In the service sector, the principal object is the people and not machines and products. The production and consumption coincide, and, therefore, the customer is usually present while the service is delivered. This simultaneity is reinforced because the service cannot be demonstrated, stored or moved, and the consumer should be directly involved in materializing the process (Simon & Woo, 1997) .

Quality management proposes that improvement of quality of product/service is an important basis for sustainable competitive advantage. Therefore, most companies across the globe are vigorously pursuing quality as the central customer value.

Deming (1996) claimed that higher quality leads to higher productivity, which in turn leads to long-term competitive strength.

In spite of the fact that the five service quality gaps model is relatively well known, still many researchers propose new frames of service quality gaps. Also there are not too many empirical researches concerning service quality gaps.

We use these principles to design quality factors in service, and claim that this methodology will improve quality operations. We provide a detailed description of the methodology applied to service Process design. Our findings indicate that the methodology works well in improving service Process because it eliminates many non-value-added activities.

Axiomatic design (AD) is a tool that is particularly suited to the design problem because it addresses how to handle cross-functional issues in designing service Process.

In other words, this methodology creates the decomposition process that enables a clear formulation of design objectives.

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MATERIAL AND METHOD

Porter (1985) suggested that a firm could use different strategies to be unique in its industry and to achieve competitive advantage. Since the competitive advantage of being novel on products and retail management styles has almost disappeared, and since price wars alone may not be effective at winning a company sustainable competitive advantage (Dabholkar, Thorpe & Rentz 1996), there has been a call for quality service as a basis for gaining competitive advantage. Because customers appear to demand not simply the products they pay for, but also convenience, respect, caring and integrity during the transaction (Berry 1995), it has been argued that the offering of quality service is a basic retailing strategy for sustaining superior performance (e.g. Parasuraman, Zeithaml & Berry 1985, 1988; Berry 1986; Zeithaml, Parasuraman & Berry 1990; Rust & Oliver 1994; Dabholkar *et al.* 1996; Zeithaml, Berry & Parasuraman 1996).

Model of Service Quality Gaps:

There are five major gaps in the service quality concept, which are shown in Figure 1. The model is an extension of Parasuraman .

Gap 1 is the distance between what customers expect and what managers think they expect Clearly survey research is a key way to narrow this gap.

Gap 2 is between management perception and the actual specification of the customer experience - Managers need to make sure the organization is defining the level of service they believe is needed.

Gap 3 is from the experience specification to the delivery of the experience - Managers need to audit the customer experience that their organization currently delivers in order to make sure it lives up to the spec.

Gap 4 is the gap between the delivery of the customer experience and what is communicated to customers - All too often organizations exaggerate what will be provided to customers, or discuss the best case rather than the likely case, raising customer expectations and harming customer perceptions.

Finally, Gap 5 is the gap between a customer's perception of the experience and the customer's expectation of the service - Customers' expectations have been shaped by word of mouth, their personal needs and their own past experiences. Routine transactional surveys after delivering the customer experience are important for an organization to measure customer perceptions of service.

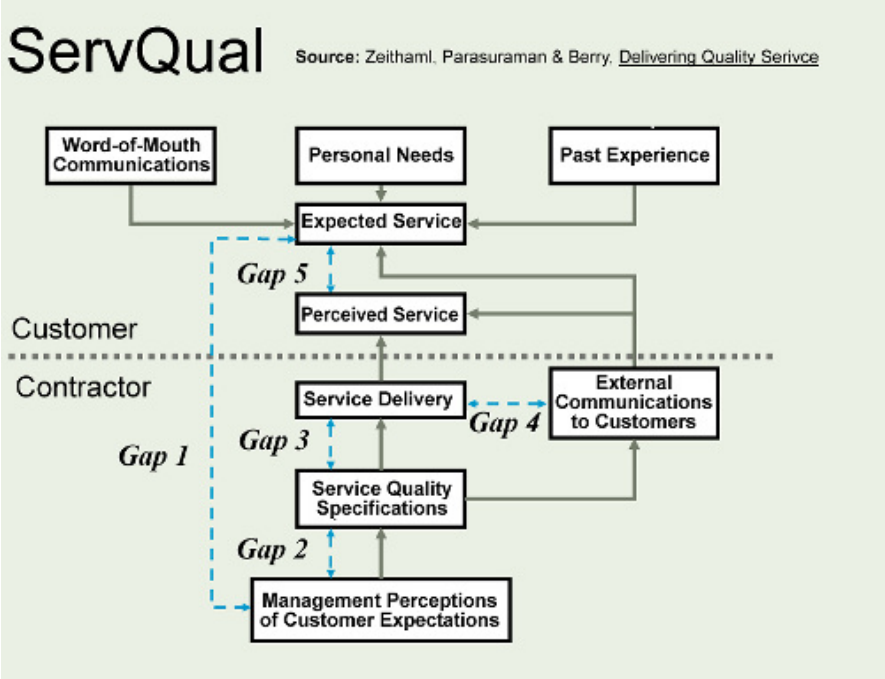

Fig. 1: Model of service quality.

The SERVQUAL Model:

The perception of service quality has been extensively studied during the past three decades. Owing to the intangible, heterogeneous and inseparable nature of services, service quality can be defined as 'the consumer's judgment about a product's overall excellence or superiority' (Zeithaml, 1988, p. 3) , or 'the consumer's overall impression of the relative inferiority/superiority of the organization and its services' (Bitner & Hubbert, 1994, p. 77). Many models have been developed to measure customer perceptions of service quality. The first attempt to

measure service quality was based on Gronroos' (1984) service quality paradigm. He distinguished between technical quality, which refers to the outcome of the service performance, and functional quality, which relates to the subjective perception of how the service is delivered. Rust and Oliver (1994) expanded Gro¨nroos' model (1984) by adding a service environment dimension.

Later, Parasuraman *et al*. (1985) developed the SERVQUAL model which breaks down the notion of service quality into five constructs as follows: tangibles, reliability, responsiveness, assurance and empathy (Parasuraman *et al*., 1988) SERVQUAL represents service quality as the discrepancy between a customer's expectations for a service offering and the customer's perceptions of the service received.

The SERVQUAL instrument has been tested for its validity and reliability (Bolton & Drew 1991; Babakus & Boller 1992; Cronin & Taylor 1992) and applied to different industries, such as professional services (Freeman & Dart 1993) , health care (Lam 1997), tourism (Tribe & Snaith 1998) , business schools (Pariseau & McDaniel 1997) and information systems (Kettinger & Lee 1994) .

In summary, the SERVQUAL scale focuses on functional service encounters and only superficially considers other types of service quality dimensions that could be relevant in the service sector. More specifically, tangible dimensions and the relational interaction between the employee and the customer are relatively neglected. Thus, a more integrated conceptualization and measure of service quality are required in order to achieve a comprehensive model of service quality .

Despite the fact that SERVQUAL has been the model most widely used and disseminated by academics, it has also been extensively criticized (Buttle, 1996; Carman, 1990; Karatepe *et al*., 2005) . SERVQUAL's weaknesses led to the development of alternative models to measure customer perceptions of service quality.

Table 1: The five dimensions of the SERVQUAL model.

1. Tangibles: physical facilities, equipment and appearance of personnel
2. Reliability: ability to perform the promised service dependably and accurately
3. Responsiveness: willingness to help customers and provide prompt service
4. Assurance: knowledge and courtesy of employees, and their ability to inspire trust and confidence
5. Empathy: caring, individualized attention the firm provides its customers.

Axiomatic Design Frame Work:

In the Axiomatic Design theory the design process is divided into four domains (fig. 2). The first domain is the customer domain, in which the customer's needs are collected, that is, the input that will affect the design object. The second domain is the functional domain, in which the functional requirements (FRs) are stated. FRs are extracted from the needs that the final product or process must satisfy, that is, the customer needs. The third domain is the physical domain, in which the design parameters (DPs) are stated. Every DP is a concept to fulfill one FR, that is, one DP corresponds to one FR. The fourth domain is the process domain. In the process domain process variables (PVs) are stated. An FR is "the goal to achieve," and a DP is "the means to achieve the goal."

Besides the domain, there is an additional feature that has to be taken into consideration to complete the design process model, and that is the constraints. The constraints are limiting the available solution space. There are two types of constraints: input constraints and system constraints. Input constraints are extracted from the customer domain and are often the result of decisions made outside the current development process. System constraint is the result of earlier decisions made within the current development process, often at higher levels in the design hierarchy.

The design process starts in the identification of customer needs and attributes, and formulating them as FRs and constraints. These FRs are then mapped onto the physical domain by conceiving a design embodiment and identifying the DPs. There may be more than one solution to this mapping. Each DP is then mapped onto a set of PVs that define it.

At a given level of the design object, there exists a set of functional requirements. Before these FRs can be decomposed, the corresponding design parameters must be selected. Once a functional requirement can be satisfied by a corresponding design parameter, that FR can be decomposed into a set of sub-FRs, and the process is repeated. This process, carrying out the decomposition into new layers and mapping between the domains, is called zigzagging. (Cochran 1999; Cochran, Yong Suk, 2000; Satity 1990; Tate and Nordlund, 1996; Yong suk 2003).

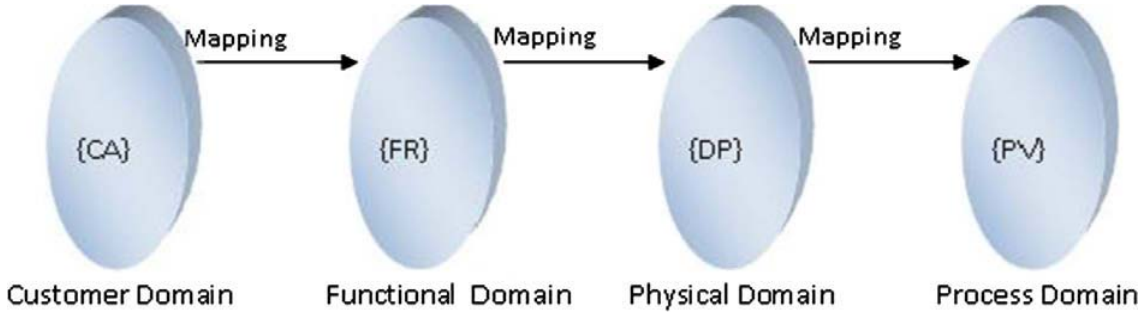

Fig. 2: Design mappings and domains.

The Design Axioms:

Suh [1990] proposed the use of axioms as the scientific foundations of design. Out of the twelve axioms first suggested, Suh introduced the following two basic axioms along with six corollaries that a design needs to satisfy:

• The Independence Axiom (Axiom 1):
Maintain the independence of the functional requirements (FRs).
• The Information Axiom (Axiom 2):
Minimize the information content of the design.

Independence axiom states that, during the mapping process from the FRs in the functional domain to the DPs in the physical domain, a change in a particular DP must affect only its referent FR. According to the information axiom, among all the feasible designs that satisfy the independence axiom, the one with the minimum information content is the best design.

The relation between the functional requirements and the design variables can be expressed by the method of using Design Matrix. In a similar way, by using Design Matrix (DM) the relation between different fields can be shown. The relationship between FRs an DPs can be written as:

$$\{FRs\} = [A]\ \{DPs\} \quad (1)$$

The Design Matrix that satisfies Independence Axiom can be shown in either diagonal matrix or triangular matrix. The diagonal matrix stands for uncoupled matrix (Equation 2) which satisfies complete functional Independence Axiom, is most appropriate. In this case each functional requirement is affected by one design variable and the intended alteration of the design variables is made possible. The triangular matrix is decoupled Design Matrix (Equation 3) and if the design variables are changed according to a specific order, the influences caused by changes in the design does not make trouble very much. Any other matrix (Equation 4) is known as a coupled design. In these equations, an X represents a strong effect by a DP on a FR, while a zero indicates a weak effect, relative to the tolerance associated with the FR .(suh 1990 , suh 2001)

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & 0 \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Uncoupled Design (2)}$$

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & 0 \\ X & X & 0 \\ X & X & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Decoupled Design (3)}$$

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & X \\ X & 0 & 0 \\ 0 & X & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Coupled Design (4)}$$

Designing of Service Quality Using AD Principle:
Decomposition Level 1:

A successful design approach should begin with a definition of what we want to achieve and end with a clear description of how we will achieve them. From an FR in the functional domain, we go to the physical domain to conceptualize a design and determine its corresponding DP at the highest level. . In this research, we just focus on the FRs domain because the design of the service quality is based on FRs.

For the preliminary stage of design, the principles of AD are applied. The first step is to define the FRs of the system at the highest level of its hierarchy in the functional domain. In this work, the following has been selected as the highest FR:

And The following DP has been selected to satisfy the FR provided above:
FR_0 : service quality evaluation & improvement **DP_0:**service quality evaluation strategy

If the DPs proposed for satisfying those FRs defined in the steps above cannot be implemented without further clarification, AD principles recommend returning to the functional domain for decomposing the FRs into their lower FRs set. The following lower FRs set is defined for decomposing the FR determined in Step 1:
FR_1: Tangibles
FR_2: Reliability
FR_3: Assurance
FR_4: Responsiveness
FR_5: Empathy

The following DPs are in response to the FRs listed above:
DP_1: Implementing optimal system strategies
DP_2: Increasing reliability strategies
DP_3: Quality assurance strategies
DP_4: Commitment strategies
DP_5: Collaboration strategies

The corresponding Design Matrix provides the relationships between the FR and DP elements (Matrix 1). These FR and DP yield the design matrix for this level as:

$$\begin{bmatrix} FR_1 \\ FR_2 \\ FR_3 \\ FR_4 \\ FR_5 \end{bmatrix} = \begin{pmatrix} X & 0 & 0 & 0 & 0 \\ 0 & X & X & X & 0 \\ 0 & 0 & X & X & 0 \\ 0 & 0 & 0 & X & X \\ 0 & 0 & 0 & 0 & X \end{pmatrix} \begin{bmatrix} DP_1 \\ DP_2 \\ DP_3 \\ DP_4 \\ DP_5 \end{bmatrix} \quad (1)$$

The design given in Matrix1 is an uncoupled design and satisfies the Independence Axiom completely. It shows that satisfying customers(student) to the organization (university) can be done in five independent ways. To remove the gap of service quality just be followed all condition as mentioned up.

Decomposition Level 2:

Level 2 includes decomposition of the tangibles, reliability, responsiveness, assurance and empathy. We can decompose FR1 into four sections as FR_{11}, FR12, FR_{13} and FR_{14}:
FR_{11}: Visually appealing facilities.
$FR_{12:}$ Modern equipment.
FR_{13}: Employees who have a neat, professional appearance.
FR_{14}: Visually appealing materials associated with the service.

In satisfying the four FRs defined above, we move from the functional domain to the physical domain. The following DPs are in response to the FRs listed above:
DP_{11}: Comfortable seating, proper heating and cooling system.
DP_{12}: Equipped library, proper center computer.
DP_{13}: Respect the customer perspective
DP_{14}: strong public relationship.

The design matrix for this level is:

$$\begin{bmatrix} FR_{11} \\ FR_{12} \\ FR_{13} \\ FR_{14} \end{bmatrix} = \begin{pmatrix} X & X & 0 & 0 \\ X & X & 0 & 0 \\ 0 & 0 & X & 0 \\ 0 & 0 & 0 & X \end{pmatrix} \begin{bmatrix} DP_{11} \\ DP_{12} \\ DP_{13} \\ DP_{14} \end{bmatrix} \quad (2)$$

The design (Matrix2) at this level is also an uncoupled design. therefore solved the gap 2and remove the discrepancy between management perception- service quality specification .

Reliability is referring to ability to perform the promised service dependably and accurately. Decomposition of FR_2 is described below:

FR_{21}: Providing services as promised
FR_{22}: Dependability in handling customers' service problems
FR_{23}: Performing services right the first time
FR_{24}: Providing services at the promised time
FR_{25}: Keeping customers informed about when services will be performed

The corresponding DPs may be stated as follows:
DP_{21}: determine job description.
DP_{22}:providing suitable condition for staff
DP_{23}:create a sense of responsibility at staff
DP_{24}:using the timing system
DP_{25}: using the document classification system

And the design matrix is:

$$\begin{bmatrix} FR_{21} \\ FR_{22} \\ FR_{23} \\ FR_{24} \\ FR_{25} \end{bmatrix} = \begin{pmatrix} X & 0 & X & 0 & 0 \\ 0 & X & X & 0 & 0 \\ X & 0 & X & 0 & 0 \\ 0 & 0 & X & X & 0 \\ 0 & 0 & 0 & 0 & X \end{pmatrix} \begin{bmatrix} DP_{21} \\ DP_{22} \\ DP_{23} \\ DP_{24} \\ DP_{25} \end{bmatrix} \quad (3)$$

The design (Matrix3) at this level is decoupled design. many organization create a sense of responsibility at staff for improvement service quality. there for it is the important factor is reliability .so that attention to this matter, solved the gap 4 and remove the discrepancy between service delivery – external combinations to customer.

Assurance is referring to knowledge and courtesy of employees, and their ability to inspire trust and confidence and decomposition of FR_3 is described below:
FR_{31}: Employees who instill confidence in customers.
FR_{32}: Making customers feel safe in their transactions.
FR_{33}: Employees who are consistently courteous.
FR_{34}: Employees who have the knowledge to answer customer questions.
The corresponding DPs may be stated as follows:
DP_{31}: Establishing course for staff
DP_{32}: behavior appropriator's staff with student.
DP_{33}: behavior appropriator's staff with student.
DP_{34}: recruiting and establishing staff with specialist skills for job .
The design matrix is:

$$\begin{bmatrix} FR_{31} \\ FR_{32} \\ FR_{33} \\ FR_{34} \end{bmatrix} = \begin{pmatrix} X & X & X & 0 \\ 0 & X & X & X \\ X & X & X & 0 \\ X & 0 & 0 & X \end{pmatrix} \begin{bmatrix} DP_{31} \\ DP_{32} \\ DP_{33} \\ DP_{34} \end{bmatrix} \quad (4)$$

The design at this level is decoupled design . the matrix 4 shows that establishing course for staff, behavior appropriator's staff with student and recruiting and establishing staff with specialist skills for job are the most important factors in assurance. in other word, the university pay attention to these factors in recruiting employees at first stage . so that attention to this matter , solved the gap 3 and remove the discrepancy between service delivery – service quality specifications .

Responsiveness is referring to willingness to help service and decomposition of FR_4 is described below:
FR_{41}: Prompt service to customer
FR_{42}: willingness to help customer.

FR_{43}:readingness to respond to customers 'requests

The corresponding DPs may be stated as follows:
DP $_{41}$: using the timing system
DP $_{42}$: Establishing course for staff
DP $_{43}$: Establishing course for staff
The design matrix is below :

$$\begin{bmatrix} FR_{41} \\ FR_{42} \\ FR_{43} \end{bmatrix} = \begin{pmatrix} X & 0 & 0 \\ 0 & X & X \\ 0 & X & X \end{pmatrix} \begin{bmatrix} DP_{41} \\ DP_{42} \\ DP_{43} \end{bmatrix} \quad (5)$$

The design at this level is a decoupled design. as mentioned in the before section, establishing course for staff is the most important factor in selection and recruiting employees process . so that attention to this matter, solved the gap 5and remove the discrepancy between service delivery – external combinations to customer.

Empathy is referring to caring, individualized attention the firm provides its customers and decomposition of FR_5 is described below:
FR $_{51}$: Giving students individual attention.
FR $_{52:}$ allocation optimum time of work for student .
FR $_{53}$: Having the student's best interest at heart.
FR $_{54}$: Employees who seek the best interest for student.
The corresponding DPs may be stated as follows:

DP_{51}: Establish answer and question session between executive and student.
DP_{52}: accurate planning for professor
$DP_{53:}$ identifying needs of student and solved theirs.
DP_{54}: implementing expert's professor.

The design matrix is below:

$$\begin{bmatrix} FR_{51} \\ FR_{52} \\ FR_{53} \\ FR_{54} \end{bmatrix} = \begin{pmatrix} X & X & 0 & 0 \\ 0 & X & 0 & 0 \\ 0 & 0 & X & X \\ 0 & 0 & 0 & X \end{pmatrix} \begin{bmatrix} DP_{51} \\ DP_{52} \\ DP_{53} \\ DP_{54} \end{bmatrix} \quad (6)$$

The design matrix is uncoupled

It shows that removing the gap 1 (expected service – management perceptions of customer expectations) of service quality just be followed all condition as mentioned up.

Design Structure Matrix as Tool to Reduce the Gaps:

A Design Structure Matrix (DSM) is easy to understand tool for analysis and the management of complex systems. It helps analyze dependencies among system elements and derive suggestions for structuring. DSM has a wide range of applications, Ranging from task planning to analysis of system interactions. A design structure matrix DSM provides a simple , compact and visual representations of a complex system that supports innovative solutions to decompositions and integration problems.

DSM can then be used to determine the sequence minimizing gaps and the need for feedback loops. It is a good tool representing interactions among design objectives and facilitating analysis of these interactions.

Based on the complementarities between AD and DSM, it is proposed to enhance the AD method with DSM. The underlying logic is transforming the AD's design matrix into corresponding DSM for system interaction evaluation, thereby improving the feasibility of AD result.

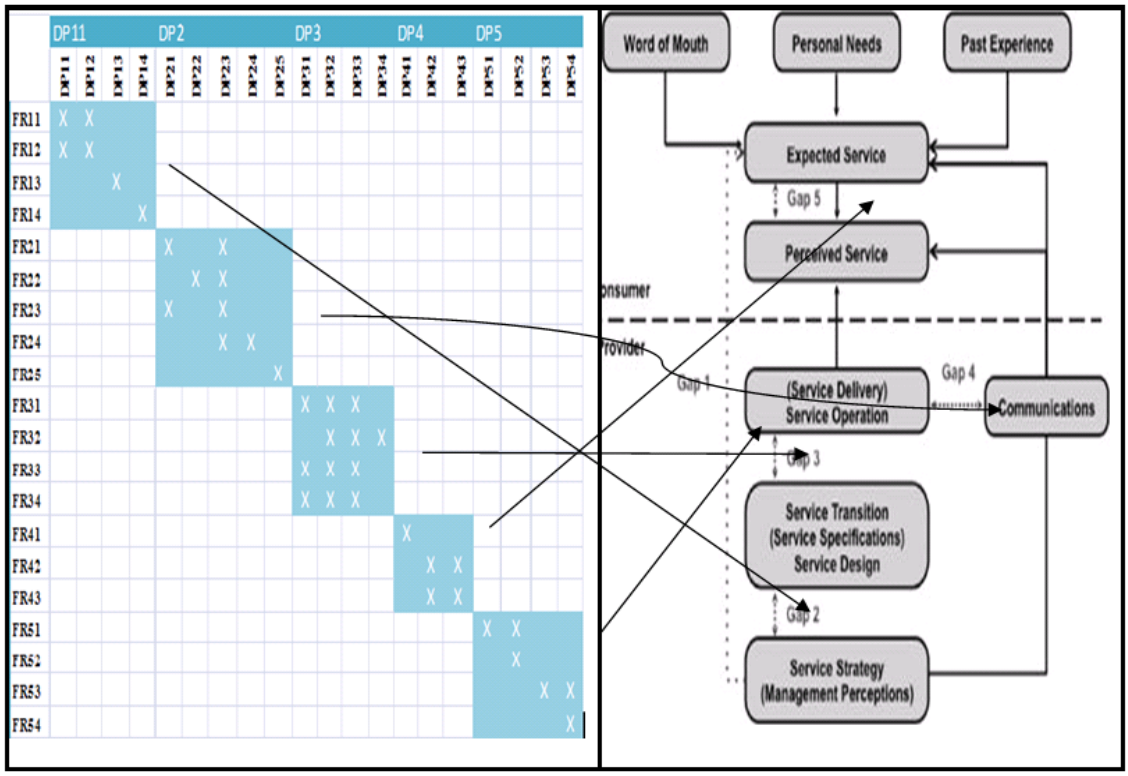

Fig. 3: Axiomatic design for service quality and relationship with design matrix.

Conclusion:

Although functional elements are critical, emotional or relational aspects are also relevant in service quality, especially when services require the physical presence of customers and/or a great proximity between the customer and the contact employee (Price *et al*., 1995).

It appears as the main quality gap which firmly causes quality losses. But also it should be concluded that each service organization needs to analyze carefully their own specific quality gaps, preferably beginning from customers' expectations and customers' complaints.

This paper presents a systematic road map for designing quality Process using axiomatic design principles. An application of the independence axiom was proposed throughout the design process to develop a road map for university quality Process. Axiomatic Design gives us this ability to identify the most detailed factors and their relationships by independence axiom and decomposition.

This is a new approach to development and formulation in quality Process, with the decomposition of Functional Requirements and Design Parameters using Axiomatic Design. This structured design and decomposition method assures that the decisions made in the design are made in proper sequence. It assures that "What to do" is answered before "How to do it";

Finally, we decided to use Design Structure Matrix as tool to reduce the gaps; we show the corresponding matrix equations for minimizing any gaps.

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