Chapter 1

Using the QFD Matrix as a Major Continuous Improvement Tool to Improve Organizational Quality

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EXECUTIVE SUMMARY

This is a case study of an Australian higher education institution (HEI) using quality function deployment (QFD) to identify areas of improvement in serving and meeting the needs of international students enrolled at this university. The composite institution reflects what is currently happening at the time of this writing as part of a process of determining international student needs and ensuring that these are met while meeting academic and institutional requirements (IR). The use of QFD fills a major gap since most methodologies practiced do not focus on either capturing the international students' voice or align these with IRs to enhance the opportunities for successful completion of a degree and meeting student personal and professional expectations. Results are incomplete at this time and thus cannot be reported, but a discussion of the approach is provided, and initial observations are presented to adequately describe the use of QFD and processes and tools used to complete different parts are the central piece of the process, the house of quality (HoQ).

ORGANIZATION BACKGROUND

Composite University (CU) is an independent, multi-campus Australian university, with the main campus located in a suburban setting outside Brisbane in the State of Queensland. It has approximately 30,000 students, with 3000 students alone (10 percent of the total student body population) coming from outside Australia and matriculated as international students. Most of the international students are enrolled in higher degree research (HDR) programs. These students come primarily from China, India, Japan and the Middle East. The University has an annual budget of approximately $350 million AUD and employs approximately 1500 academic and professional staff.

CU, as most Australian universities, actively recruit international students as these are a source of revenue augmenting fees accrued from enrolling domestic students and a mechanism to increase institutional reputation. The University is also keenly interested in pursuing a diversity agenda, believing that international students enhance its learning environment and expose domestic students to different worldviews that will serve them well upon graduation. Student recruitment is centred on attracting students for its applied science, business, nursing, and education programs at the post-graduate level, although about one-third of the international students enrolled are at the undergraduate level. CU does not have a recruitment challenge when it comes to attracting international students because of its reputation as a provider of good educational experience, high employability of graduates, recognised academic staff and research outputs.

SETTING THE STAGE

Higher Education and Internationalisation

Propelled by globalisation and framed by the World Trade Organization's (WTO) legally enforceable set of rules in the *General Agreement on Trade in Services* (GATS – Mishra & Bhatnagar, 2009), learners interested in pursuing vocational and higher education opportunities can consider options outside their country. Learners can consider one of these three options:

- Enrolling at a foreign university in the university's home country,
- Enrolling and attending courses at a foreign university that has a physical presence in the learner's home country as a branch campus or as a partner with a domestic provider or
- Enrolling with a foreign university through an online program.

Learners, i.e., potential students, are able to have these options because of the four modes of trades defined in GATS (Knight, 2003; Tilak, 2011):

- **Mode 1 - Cross-Border Supply:** Concentrates on higher education (as a service) crossing the border, in this case not requiring the learner or the HEI to physically move (e.g., acceptance of the learner in online programs).
- **Mode 2 - Consumption Abroad:** Refers to the learner moving to the HEI's home country to do their course of study as an international student.
- **Mode 3 - Commercial Presence:** When an HEI establishes a facility in another country to teach programs (e.g., branch campus or franchising arrangements).
- **Mode 4 - Presence of Natural Persons:** People travelling to another country on a temporary basis to teach or conduct research (e.g., the flow of academic staff, researchers)

The resulting impact of globalisation and the internationalisation of education has to be understood at the national, sector and institutional levels. This has been defined by Knight (2003) as:

The process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education

According to Tilak (2011), internationalisation is:

a process of integrating international, intercultural, and global dimensions into the goals, functions (teaching, learning, research, and service), and delivery of higher education; it involves a process of interchange of higher education between nations, with partnerships between nations, between national systems of higher education, and between institutions of higher education

Critics of the inclusion of education in GATS point to making higher education into a commodity. Regardless of whether commoditisation is for good or ill on a limited or broader basis or been boosted by GATS itself (Amaral, 2015;Tilak, 2008). Mishra and Bhatnagar (2009) argued that universities from countries actively involved in exporting their institution and programs and/or recruiting for them, see transnational education as a 'huge' opportunity and are doing much to attract students, especially from developing countries. Higher education in particular has been discovered to be 'a lucrative service industry and export commodity, and governments of industrialised countries have actively sought to take advantage of a growing national and international market' (Martens & Starke, 2008). One reason

is that international students are enrolled as full fee paying students and the revenue they provide is used to support the quality of education provided by these HEIs (Larkins & Marshman, 2016).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasises the social responsibility aspects of HEIs and their oversight/regulatory systems. In the *Communiqué* resulting from the *World Conference on Higher Education,* UNESCO (2009) stipulates that:

- Institutions of higher education worldwide have a social responsibility to help bridge the development gap by increasing the transfer of knowledge across borders, especially towards developing countries, and working to find common solutions to foster brain circulation and alleviate the negative impact of brain drain.
- For globalisation of higher education to benefit all, it is critical to ensure equity in access and success, to promote quality and to respect cultural diversity as well as national sovereignty.
- Cross-border provision of higher education can make a significant contribution to higher education provided it offers quality education, promotes academic values, maintains relevance and respects the basic principles of dialogue and cooperation, mutual recognition and respect for human rights, diversity and national sovereignty.

Quality needs to be analysed in the context of access and relevance (Blanco-Ramirez & Berger, 2014). This Communiqué formally links the notions of access and quality and adds the dimension of equity.

- In expanding access, higher education must pursue the goals of equity, relevance and quality simultaneously.
- Expanding access poses challenges to the quality of higher education. Quality assurance is a vital function in contemporary higher education and must involve all stakeholders. Quality requires both establishing quality assurance systems and patterns of evaluation as well as promoting a quality culture within institutions.

Findings from the Organisation for Economic Cooperation and Development (OECD, 2016) indicate the following:

- The proportion of international students enrolled in a program tends to be larger for post-graduate degree programs. International students from Asia accounted for 53 percent of enrolees in OECD countries at the master's and

doctoral or equivalent program levels. China, India and Germany accounted for the highest number of international student enrolees in post-graduate programs. The USA (26 percent), UK (15 percent), France (10 percent), Germany (10 percent) and Australia (8 percent) host the largest number of post-graduate international students.

- International enrolment numbers in bachelor's degree programs is relatively low at 5 percent across OECD countries. However, in contrast to the above bullet point, Australia, Canada, Denmark, Japan, New Zealand and Spain show that there were more international students in short-cycle programmes than at the bachelor's or equivalent level.

- International students represent 18 percent or more of total enrolments in Australia, New Zealand and the UK.

- Women account for 48 percent of international students.

- The increase in global demand for tertiary education, reduced transportation and communication costs, and the internationalisation of labour markets for highly skilled people have given students stronger incentives to study abroad as part of their tertiary education.

- The language spoken and used to teach courses is likely to affect choice of potential destination countries. Preference seems to be given to teaching given in English, French, German, Japanese, Russian or Spanish.

Expectations for quality assurance (QA) crosses borders both ways. Although not important to this case study, GATS allows national QA systems to impose oversight requirements to foreign providers. But what is important is that the QA schemes – regardless of whether based on accreditation, assessment, quality audit or regulatory compliance mechanisms – ensures the quality of instruction received by international students the same as that for domestic students.

Australian Higher Education and Internationalisation

International students are an integral aspect of the Australian HEI sector and have been for a long time for reputation enhancement and revenue generation (Hawkins & Bransgrove, 1998). Australia, is presently, the third largest commercial exporter of higher education services after the USA and the UK, enrolling about ten percent of the world's international students and responsible for around $16.8 billion AUD in education-related earnings in 2014 (Ilieva *et al.,* 2017; Larkins & Marshman, 2016). International students comprised 18.8 percent (n=216,298) of Australian university students in 2014, contributing $4.7 billion in student fee revenue or 17.3 percent of the total annual revenue (Department of Education and Training, 2015; Larkins & Marshman, 2016).

In addition to its heavy involvement in international student recruitment, Australia is recognised for strong research co-operation as reflected in the research output with international co-authors (Ilieva *et al.*, 2017). Students gain access to resources and contacts with global experts that enhance both the quality of research and employment prospects. In turn, the Australian HEI sector gets recognition for the calibre of Australian research students and researchers gain expanded opportunities for engaging in the international research arena (Australian Council for Educational Research [ACER], 2015). Australia is also highly rated for its quality assurance schemes, international degree recognition and open infrastructure that facilitates the mobility of students and researchers by facilitating in visa process, opportunity to work during course period and limited time graduate employability schemes (Ilieva *et al.*, 2017). This success has been credited to the commitment and innovation from those working in the sector (International Education Advisory Council [IEAC], 2013).

There are some key quality issues that have to be continuously addressed in order to maintain the recruitment and retention of international students including the quality of their social and academic experiences while studying in Australia. This is perhaps one of the most viable components of the HEI sector (Azmat *et al.*, 2013; International Education Advisory Council [IEAC], 2013).Historically, the practice at Australian universities has been to provide support services that act as an intermediary between international students, their families and the university's learning and teaching communities (Robertson *et al.*, 2000). However, the literature suggests that efforts from these units have not been as successful as they should have been (Slethaug & Manjula, 2012).

Issues Faced by International Students

There are a number of reasons why learners become international students (Kazurnina et al., 2016):

- Quality of education (HEI reputation, approach to teaching, access to more specialised or established programmes),
- Research opportunities for post-graduate students,
- Improved employability opportunity,
- Professional and social status,
- Personal development,
- Appeal of a specific location,
- Value of an international degree.

Yet, many international students from non-native English speaking countries find it difficult to cope when enrolled in HEIs outside their country (face-to-face or online)

or in HEIs from Western-based cultures with a physical presence in their country. One challenge that they find difficult to overcome is the notion of the active learner, even if the international student is looking for this type of experience (Kazurnina et al., 2016; Ringer et al., 2010).Issues of independent learning, assessment practices and the meaning of plagiarism can be and often are barriers that require adjustment. A second challenge is the acculturation issues ranging from language and being understood to cultural (achieving a reciprocal situation of being accepted and accepting of otherness) that must be addressed by all parties involved. Unfortunately, the literature provides few studies addressing specific issues of culturally different subgroups of international students to help guide HEI practice and ensure that a "one size fits all" approach is not taken (Heyn, 2013).

Quality Function Deployment (QFD)

TQM (a.k.a. Quality Management System – QMS) has become an underlying principle of higher education quality assurance and government regulation in broader terms (Farazmand, 2005; Padró & Green, in press). It is a managerial philosophy based on establishing improvement processes and provides a set of tools organisations are able to use to engender improvement (Tague, 2005). The American Society for Quality (2017) defines Total Quality Management (TQM) as:

A management system for a customer-focused organization that involves all employees in continual improvement. It uses strategy, data, and effective communications to integrate the quality discipline into the culture and activities of the organization. Further, TQM is based on eight principles:

1. *Customer-focus (the individuals who ultimately determine the level of quality of what an organisation does),*
2. *Total employee involvement,*
3. *Process centred,*
4. *Integrated system (where micro-processes are interconnected to add up to larger processes),*
5. *Strategic and systematic approach,*
6. *Continual improvement,*
7. *Fact-based decision-making,*
8. *Communications.*

Quality function deployment (QFD) is one of the tools used in the field of quality to identify and understand what customers want from the service or product on offer (Singh et al., 2008). In higher education terms, it is a structured process

for planning a new or redesigning an existing program or service in which student requirements are translated into program or service characteristics (Tague, 2005). The principal aim for QFD is to assure customer satisfaction (CS – Akao, 1990). The "voice of the customer" (VoC) is treated as customer requirements (CR) – the "what" is needed – and then cross-referenced against the technical or institutional requirements (TR or IR) or the "voice of the engineer" (VOE) – the "how" it is formulated and provided (Pitman et al., 1996; Wu & Lin, 2012). HEIs can use QFD for course design and evaluation, educational quality improvement, curriculum quality enhancement, teaching effectiveness evaluation, research and planning (Kamvysi et al., 2014). This case study is a demonstration for another area where HEIs can use QFD: international student recruitment and support services.

QFD is developed by involvement of a cross-functional team and provides an interdepartmental approach to communication that creates a common quality focus across all functions/operations in an organisation (Andronikidis et al., 2009). Teams define [1] the learner's wants (the "what") in order to become or remain a student, [2] the mechanisms (programs and services) that are in place to satisfy these wants and [3] the relationships between the "what" and "how", assigning value weights to each using a matrix known as a 'House of Quality' (Pitman et al., 1996). QFD can be referred to as designed-in quality rather than traditional inspected-in quality because it is a tool that concentrates on maximising CS and delivering "value" by discovering spoken and unspoken CR, translating CR into actionable program or service features and communicating them within an HEI and to potential students and stakeholders (Chan & Wu, 2002a; Mazur, 1993). According to Gupta et al. (2012), the three main goals focusing QFD are:

1.   The prioritisation of spoken and unspoken customer wants and needs
2.   Translating these needs into technical characteristics and specifications and
3.   Building and delivering a quality product or service by focusing everybody toward CS

These are done through a four-stage translation process that transfers:

1.   Customer requirements into product/service features;
2.   Product features into design requirements;
3.   Design requirements into process requirements; and
4.   Process requirements into processes/methods (Hwarng & Teo, 2001; Quinn et al., 2009).

The most commonly used structure making up QFD is the house of quality (HoQ – Andronikidis *et al.,* 2009). The HoQ involves the construction of one or

more matrices, called "quality tables" that guide the decisions that must be made throughout the development process (Cohen, 1995). Essentially, HOQ is the central component in constructing QFD (An, 2011). Figure 1 is an example of a typical HoQ (Gharakhani & Eslami, 2012; Russel & Taylor, 2003)

A HoQ contains seven major components (Wu & Lin, 2012):

1. **CR (the "What"):** Can be obtained through a Kano analysis, other market surveys (e.g., focus groups, individual interviews and/or questionnaire surveys) and the use of other quality instruments to provide a fuller, more comprehensive perspective.
2. **TR or IR (the "How"):** What HEI administrators and staff believe is required for learning to happen.
3. **Determination of the Relative Importance of CR:** What the HEI should focus on the most based on CR data collection instruments as above given resource and time restrictions in order to avoid distraction and resource wastage.
4. **Establishing a Relationship Matrix (the "What" vs. the "How"): To** determine if there is a relationship between a CR and TR (or IR) to determine its level (strength) of influence on learner/student choices. "Creating this matrix" is necessary to translate the VOC into the VOE, and the matrix should be analysed carefully by domain experts (engineers or technicians).

Figure 1. General overview of House of quality
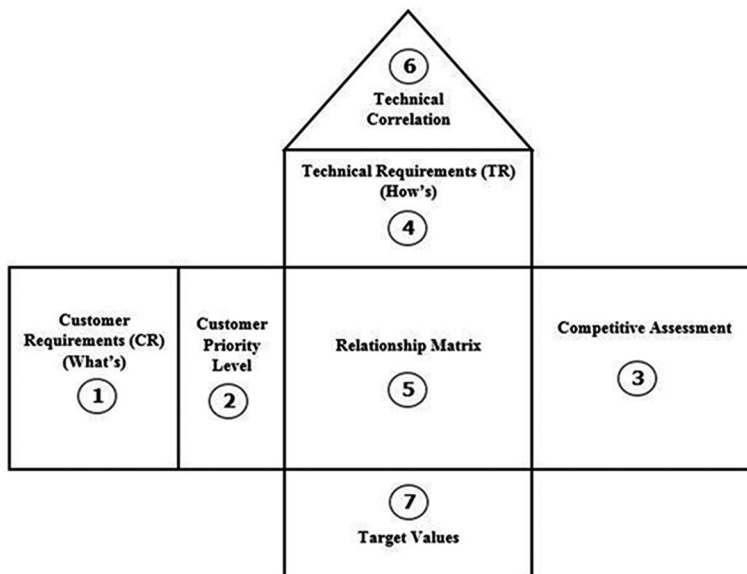
5. **Forming a Planning Matrix/Competitive Analysis:** Comparing with other HEIs to identify market position and determine the strengths and weaknesses of programs and services in terms of CR. Using quality instruments such as a Kano analysis helps evaluate and assign an overall performance value in respect to each CR.

6. **Generating a Technical Correlation Matrix:** Evaluating the dependencies among the TR to determine if they have a positive or negative impact on each other when adjusted based on CR data. A correlation matrix is recommended for HEIs interested in performing a more technical analysis. "The findings generated from a correlation matrix can provide a reference point for determining the trade-offs of various TRs in product design". TRs that may cause quality control (QC) problems and increase the potential for risk will require special attention to avoid additional costs from continuous adaptation until a solution is found or the adaptation abandoned.

7. **Producing a Design Matrix:** Similar to the planning matrix, it is created to help produce the program or service expected or required from learners/students. The relative importance and degree of difficulty of each TR needs to be analysed as part of making comparisons with other HEIs or determining internal priorities related to competing with other HEIs or adapting programs and services to increase satisfaction.

One particular technique typically associated with QFD – and one that is particularly useful for the purposes of this case study – is the Kano Model (Tague, 2005). It is used as a means of identifying CRs through what satisfies them. Created by Noriaki Kano and colleagues in 1984 and based on Herzberg's motivation theory, it is an effective tool for understanding customer needs and their impact on customer satisfaction whose use is expanding in fields such as education (Figure 2 – Witell *et al*., 2013). The technique introduced by Kano focuses on the notion of attractive quality (Chaudha *et al.,* 2011). It is an approach specifically designed to determine CRs and what it takes to exceed expectations coming from the CRs (Hashim & Dawal, 2012).

The Model categorizes different CRs based on how well they are able to achieve customer satisfaction (Figure 3 – Clegg *et al.,* 2010).CRs can be classified into three categories(Bayraktaroğlu & Özgen, 2008; Hashim & Dawal, 2012; Taifa & Desai, 2015; Tan & Shen, 2000; Wang & Ji, 2010; Wu *et al.,* 2010):

1. **Must-Be (Basic) Requirements:** When customers expect certain qualities and will be dissatisfied if the expectations are not fulfilled.

2. **One Dimensional (Normal Performance) Requirements:** When the fulfilment of the quality expectation is positively and linearly related to the level of

Figure 2. Kano Model
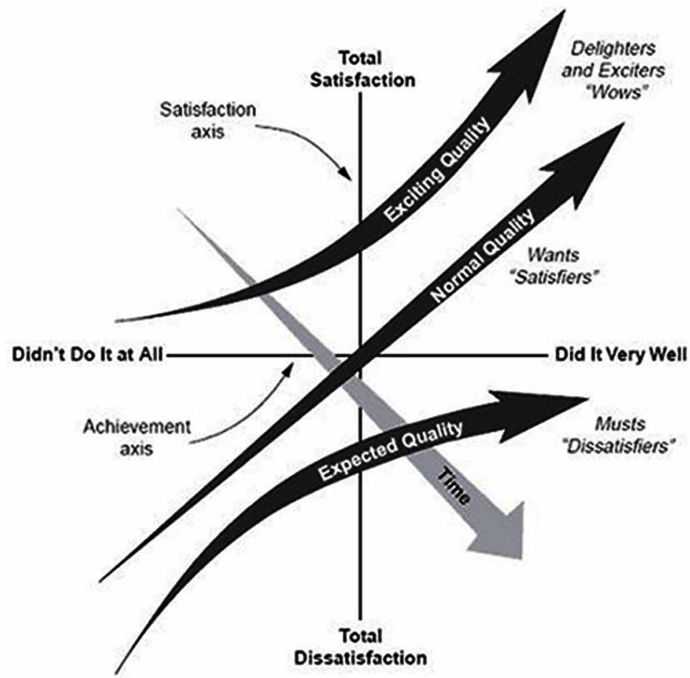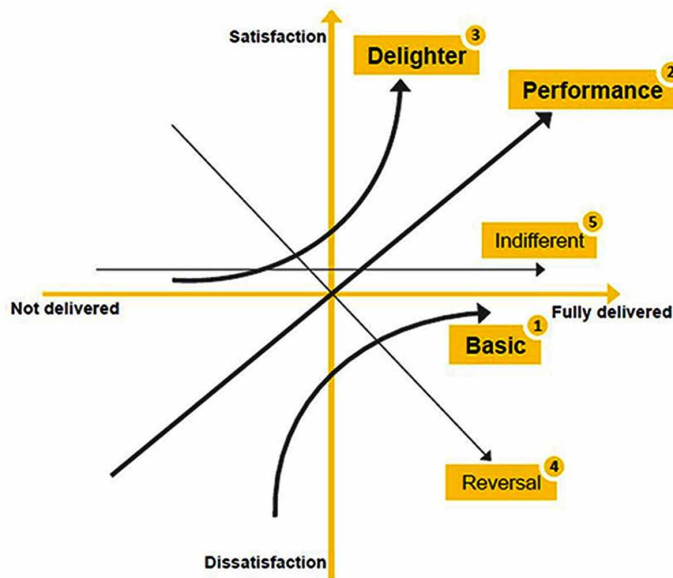*Source: Witell et al., 2013*

Figure 3. Kano Model of customer satisfaction

customer satisfaction. Thus, if the expectation is not fulfilled dissatisfaction occurs. It is what keeps an HEI in the market as a viable competitor.

3. **Attractive (Excitement) Requirements:** What it takes to exceed customer expectation and when that happens a greater than proportional degree of satisfaction will be noted. However, the absence of these requirements dose not result in dissatisfaction because they not expected by customers.

In addition to the three major categories of CRs, there are other classes that may be visible "indifferent", "reverse" and "questionable" outcomes can also appear (Bayraktaroğlu & Özgen, 2008; Chaudha *et al.,* 2011; Clegg *et al.,* 2010; Gupta & Srivastava, 2011; Högström et al., 2010; Sahney, 2011):

4. **Reverse (R):** Meaning that the customer will be satisfied when the current quality requirement is absent. On the contrary, presence of these requirements causes customer dissatisfaction.
5. **Indifferent (I):** Meaning that the customer is not concerned with this requirement and is not much interested whether it is present or not.
6. **Questionable (Q):** Concern with the response to the survey question due to misunderstanding, misinterpretation or incorrectly phrased question.

There are typically four steps to performing a Kano analysis:

● Product requirement(s) identification,
● Constructing the questionnaire,
● Administering follow-up learner and/or student interviews, and
● Evaluation and interpretation (Matzler *et al*., 1996).

The Kano Model identifies and classifies CRs through a questionnaire composed of functional and dysfunctional sets of questions based on CRs the HEI wants to test out. CRs can be initially identified through formal and informal focus groups of learners, students and pertinent staff. Usually – and there are several ways of designing it – the instrument is made up of five sets of paired questions using a Likert 5-point scale (with headers indicating levels of like, dislike, neutrality) based on (Tontini, 2007). Upon completion, results have been represented through special evaluation Table 1.

As previously noted, QFD benefits from applying various tools from the field of quality. These techniques enhance the ability of QFD to fully capture the data needed to make improvements in existing programs and/or services. Below are tools

Table 1. Evaluation grid of functional and dysfunctional Kano questionnaire

CUSTOMER REQUIREMENTS		DYSFUNCTIONAL				
		Like	Must-Be	Neutral	Live With	Dislike
FUNCTIONAL	Like	Q	A	A	A	O
	Must-Be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live With	R	I	I	I	M
	Dislike	R	R	R	R	Q

Note: A=Attractive; O=One Dimensional; M=Must-Be; I=Indifferent; R=Reverse; Q=Questionable

recommended for use as part of a wider QFD study (Andronikidis *et al.,* 2009; Chen, 2013; Sower & Fair, 2005). Figure 4 illustrates where and how these fit within the QFD HoQ. Table 2 explains when and why these tools should be applied as adapted from Shahin *et al.,* 2010).

Figure 4. TQM tools that can be used within the QFD matrix
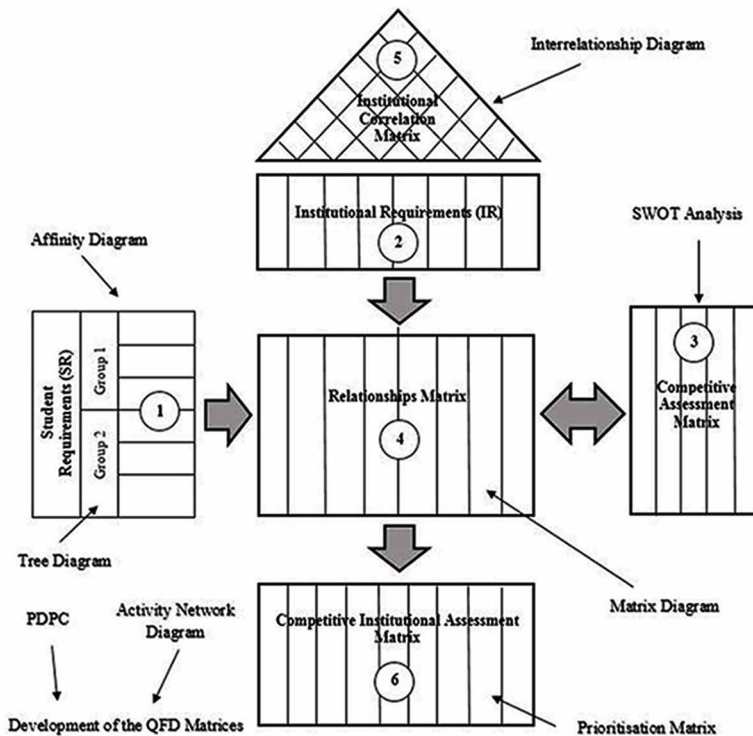
Table 2. When and why the quality tools should be used in performing a QFD exercise

No.	Quality tools & techniques	Why use?	When to use?
1.	Affinity diagram	• A proper way to creative work for explaining the tough results • For collecting linguistic data • For collecting different ideas	• Winnowing a large amount of data • Encouraging new patterns of thinking
2.	Interrelationship Digraph	• For demonstrating logical relationships between items • For determining the logical sequences of phases of the plan • For identifying components that have greater effects on others	• When we want to identify ideas and their interrelationship • When a complicated solution has been implemented • When we want to analyse a complicated result
3.	Tree diagram	• For breaking large categories into detail • For displaying components of actions that should be done to achieve the goal	• When we analyse a process in detail • When we investigate a root cause of a problem • When we want to develop actions for implementing the plan
4.	Matrix diagram	• For explaining the relationship of ideas in a form of a matrix	• When we want to investigate a large number of data for investigate their relationships • When we want to identify the severity of data
5.	Prioritisation Matrix	• For judging about importance of one topic into another by weighting them	• When we want to evaluate different strategies
6.	PDPC	• For identifying potential and counteracting • For preventing happenstance and planning for them	• When we want to have a plan for identifying potential risks • When we want to avoid risk • When we want to counteract
7.	Activity Network Diagram	• For scheduling of a work	• When we have parallel activities
8.	SWOT Analysis	• For indicating the significance of external and internal forces of organisation • For understanding the sources of competitive advantage • For helping to make a decision whether the problems faced by organisation rotate around a need to improve its strategy	• When we want to assess an external and internal environments of organisations to adopt its strategy • For recognizing the organization's current performance (strengths and weaknesses) and the organization's future (opportunities and threats) by accounting for the factors that exist in the external background

Activity Network Diagram (AND) or Arrow Diagram

Construction planners have used activity network diagrams for years in the form of critical path method (CPM) and program evaluation and review techniques (PERT) as part of project planning. It is a planning and communication tool used to ensure the most suitable time planning for a certain task and to facilitate control through the course of sequential steps of QFD technique (Shahin *et al.,* 2010). AND's work well when the steps of the project, their sequence and how long each step will take are known factors (Tague, 2005).

Affinity Diagram

This is a technique for gathering and organising a large number of ideas, opinions, and information relating to a broad problem or subject area (Evans, 2008). It is used to promote creative thinking. It can be very helpful in breaking down barriers created by past failures and getting people to give up ingrained paradigms that mitigate against finding new and different approaches. The affinity diagram helps individuals in better understanding the essential parts of the problems and penetration solution alternatives, making requirements more easily arranged so they can be directly entered into the House of Quality. After constructing an affinity diagram, the learner and/or students requirements portion are entered into the House of Quality matrix (Al-Bashir, 2016).

Interrelationship Digraph

The purpose of an interrelationship digraph is to take a central idea and map out logical or sequential links among related categories (Evans, 2008). It is a graphical cause-effect analysing tool used in the problem identification and description phase of strategic quality planning when there is a need to clarify and understand different relationships. The technical correlation portion in the QFD matrix is a good example of where this tool is used (Shahin, et al.,2010).

Matrix Diagram

The matrix diagram is the most widely used of the QFD tools. A matrix is a structure that provides rows and columns that represent the variables under investigation (Aikens, 2011). Using a matrix is helpful for identifying and displaying connections among responsibilities, tasks and functions (Goetsch & Davis, 2010). Basically, a matrix diagram shows the relationship between two or more sets of factors. The heart of QFD matrix is an example of one of the many matrix diagrams now used for planning reasons and quality improvement as a means of facilitating the identification of the relationships between the identified factors (Evans, 2008; Shahin et al., 2010).

Prioritisation Matrix

A prioritisation matrix (sometimes called matrix data analysis) takes data from a matrix diagram and seeks to arrange it quantitatively to display the strength of relationships among variables in an easily understood format. It is a rigorous,

statistically based (factors analysis) technique (Evans, 2008). It is the only one of the quality tools that analyses numerical data to quantify the degree of the relationships between the various factors (Shahin *et al*., 2010). This is useful in the competitive technical assessment portion of the QFD.

Process Decision Program Chart (PDPC)

This is a method for mapping out every conceivable event and contingency that can occur when moving from a problem statement to a possible solution(s). It can be used to plan for each possible chain of events that could occur when a problem or goal is unfamiliar (Evans, 2008; Shahin et al., 2010). The PDPC chart is a planning tool used to evaluate or assess process alternatives in the initial definition and development of processes in order to develop the best process of applying the QFD matrix (Shahinet al., 2010).

Strength-Weakness-Opportunities-Threat (SWOT) Analysis

The SWOT analysis technique can be used to help the decision makers and the QFD team when they are building the QFD matrix, especially the portion of the competitive assessment matrix. The results of the QFD project starts to become apparent once the team begins to utilize SWOT analysis to advise a set of strategies, through analysing strengths, weaknesses, opportunities and threats of internal and external assessment of university for better interpretation of available information for effective decision making (Sharma & Rawani, 2008). Using SWOT can also link QFD into a risk register set-up to help further define alternative solutions to enhance the planning dimension and mitigate potential distortions arising from utilising these calculative tools (Downer, 2011; Padró, 2014; Padró & Winwood, 2015).

Tree Diagram

A tree diagram maps out the paths and tasks that need to be undertaken to complete a specific project or to reach a specified goal (Evans, 2008). It is used to communicate a logical relationship that is hierarchal between events and, in a top-down manner, to break down a topic into successive levels of detail until implementation.

CASE DESCRIPTION

Astin (1993) identified HEI environmental variables impacting retention:

- HEI characteristics,
- Academic staff teaching the curriculum and the student peer group,
- Residence,
- Academic major and financial aid, and
- Student involvement (academic, with academic staff and student peers).

The lens is one of looking at student engagement in terms of achieving learning outcomes; yet, the literature also suggests more person-centred concerns such as inter-relational engagement, engagement as autonomy, emotional engagment and engagement as connection and disjunction that go beyond the traditional academic perspective (Wimpenny & Savin-Baden, 2013).These suggest the complexity of engagement that concern student motivation and agency, how they engage with academic staff and other students, how conducive the learning environment is and active citizenship concerning the students' and HEIs' ability to work togetgher to enable challenges to social beliefs and practices (Zepke & Leach, 2010). These environmental and personal variables guide the direction of the QFD analysis. Figure 5 illustrates the process that was used for this case. Methodologically, the QFD exercise described was based on a mixed methods approach toward constructing the HoQ. The qualitative component of the process was in collecting the information related to the identification of CRs (needs and wants) while the quantitative aspects involved the creation of the matrices within the HoQ.

Steps in Implementing QFD

There were six steps in the process used for this case. Figure 6 illustrates what the finished HoQ elements looked like once the steps were completed (Talib & Maguad, 2011):

1. Capturing the needs of the students to determine CR/SR.
   a. Set up a Kano style analysis based on focus groups helping identify issues that became the basis of the Kano functional-dysfunctional sets of items for the questionnaire.
   b. Identified international student population who were asked to answer the questionnaire. Consent was requester prior to completing the survey.

Figure 5. QFD application framework
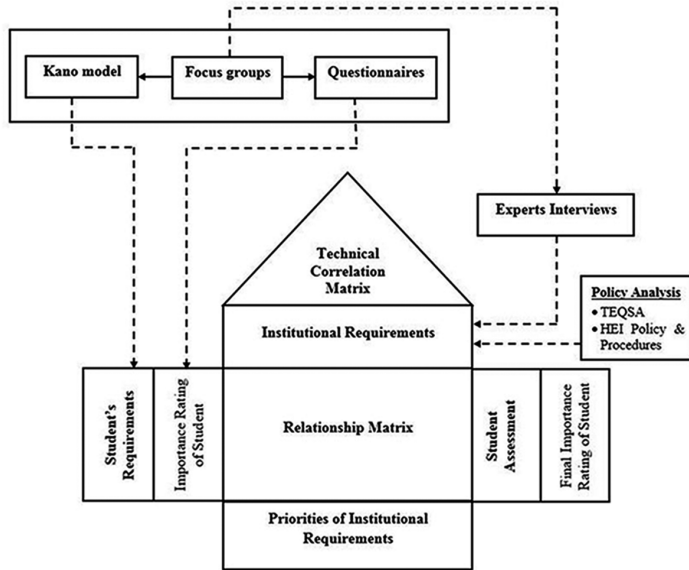
Figure 6. House of Quality (HoQ) elements upon completion of the six steps
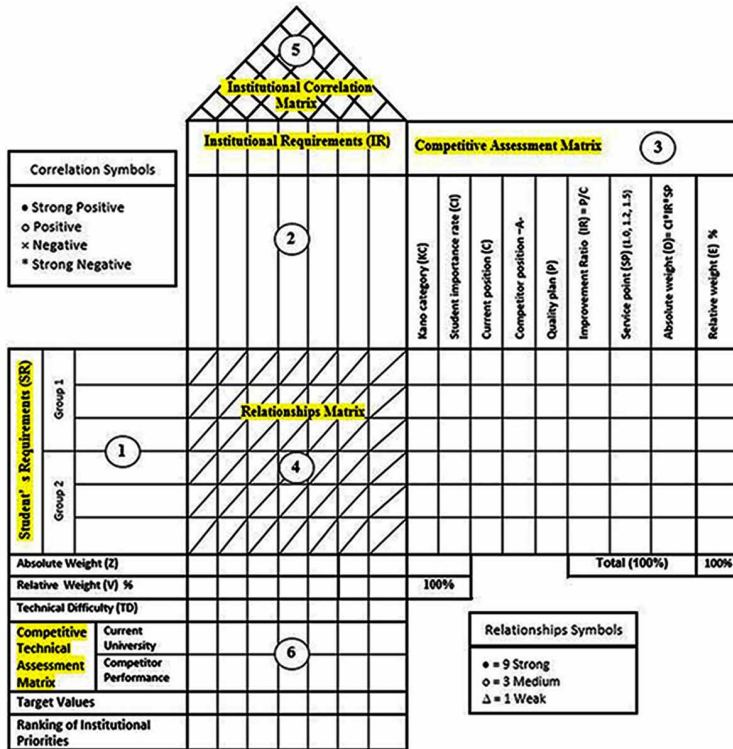
    c.   Follow-up focus groups and individual interviews with different "demographic groups" (e.g., graduate and undergraduate students; married, single, with children or no children; family with student or back in home country, etc.) to further understand international student needs and wants.

2.   Identifying TR/IR by interviewing relevant staff and other key stakeholder representatives via focus groups and individuals when time was an issue.

3.   Developing the relationship matrix. The matrix showed the level of association/influence between each student need and each TR/IR.

    a.   The relationship matrix was completed by the QFD team as per the literature recommendations (Mukaddes *et al.,* 2012).

    b.   Relationships coefficients were calculated and represented in the form of symbols. These were further quantified to show the strength of association (Talib & Maguad, 2011).

4.   Forming the "roof" of the HoQ.

    a.   Prepared by the QFD team based on Kano analysis and TR/IR focus group and interviews (Chin *et al*., 2001; Mukaddes *et al*., 2012; Talib & Maguad, 2011).

    b.   Calculated inter-correlations to show whether there was association, supporting behaviour or conflict, between each TR/IR.

    c.   Correlation coefficients calculated and represented in the form of symbols and numbers to show the direction and the strength of association.

5.   Formulating the desires/priority based student requirements. Desires were categorised into columns within the HOQ in order of importance to the student (as participants were already enrolled students), with columns based on the following:

    a.   Importance to students (students' focus group rated the importance of each CR/SR from 1 through 5, with 1 indicating the least importance to students and 5 being very essential to students – Talib & Maguad, (2011);

    b.   Target value (also on a 1-5 scale, with 1 indicating "no change", 3 "improvement is needed" and 5 "make it better than a "competing" HEI);

    c.   Scale-up factor (the ratio of the target value to the service rating given in the customer competitive assessment, explaining whether the difference between the current level of service and the target rating can be achieved. – Mukaddes *et al*., (2012);

    d.   Service (sales) point (how well a CR will contribute to service improvement, with the service point value being between 1.0 and 2.0 – (Mukaddes et al., 2012);

    e.   Absolute weight (calculated by multiplying the importance to customer, scale-up factor and the service point – (Aghlmand *et al.*, 2010; Mukaddes *et al.,* 2012; Talib & Maguad, 2011);

Absolute weight (Di) = (importance to customer (C_i) × scale-up factor (SF_i) × service point (SP_i)); and

f.   Relative weight (based on the strength of the correlation between program attributes and CRs, and the relative importance of the CRs – Tontini, 2007).

6.   The QFD team identified TRs/IRs most needed to fulfil CRs/SRs and require further improvement.

a.   The prioritised technical descriptors contain degree of technical difficulty, target value, and absolute and relative weights.

b.   The identified descriptors were:

i.   Degree of difficulty (to evaluate the ability to implement techniques to fulfil student's requirements using a 1-5 point scale difficulty rating, calculated for each TR/IR – (Mukaddes *et al*., 2010; Mukaddes *et al.,* 2012);

ii.   Target value (values that must be obtained to achieve the technical descriptor; How much it takes to meet or exceed the students' expectations is answered by evaluating all the information entered into the HOQ and selecting target values);

iii.   Absolute weight(the sum of the products of the relationships between SRs, TRs/IRs and the absolute weight absolute weight of the CRs – (Talib & Maguad, 2011); and

iv.   Relative weight (the relative weight for TRs/IRs are given by replacing the degree of importance for the CR with the absolute weight for the CR).

CURRENT CHALLENGES FACING THE ORGANIZATION

Three principal challenges, one philosophical and two technical in nature, come to the fore when implementing QFD in HEIs. These have to be acknowledged and overcome to ensure successful application and buy-in for performing and utilising the process and results as intended. The most problematic challenge is the philosophical perspective of appropriateness in using notion of "customer" in a higher educational context. From a pragmatic perspective, the next most problematic issue is one of wanting to implement a quantitatively driven methodology. Then there is the issue of integrating QFD with other existing institutional planning, analytics-based data collection and decision-making, CI and regulatory compliance practices. These three challenges reflect the difficulties HEIs face because of the special difficulties faced not typically encountered in other sectors (Asif *et al.,* 2013; Sirvanci, 2004).

Challenge 1: The Notion of Customer in Higher Education

The literature suggests that the notion of customer, a key premise in TQM, is a major barrier in pursuing quality improvement efforts in higher education (Quinn et al., 2009). Further Singh et al. (2008), state that:

The question of "customer" for higher education poses a very sticky problem. Institutions or colleges are not unanimous on a specific definition of customer. There appears to be something inherently ominous about defining a higher education customer as the student. Faculty and administrators tend to hold the belief that they know what the students need, whereas the students may not necessarily be privy to this information at the early stages of their educational development.

Nonetheless, as Ackerman and Schibrowski (2008) observed, "while not everyone will be comfortable applying concepts from business to an issue in education, adapting the customer retention model to student retention is appropriate given the emphasis both place on quality of services".

There is an additional complication as Quinn et al. (2009) pointed out, that different aspects of HEI operations serve different "customers." This makes defining who the "customer" is a complicated and important consideration, especially when performing a QFD exercise. Kanji and Tambi (1999) divided HEI customers based on how they engage with HEIs. Then again, governments can formally define customers for HEIs as they have with students in a number of countries (Bunce et al., 2016).

Challenge 2: HEI Interest and Capacity to Perform Quantitative Studies

The appetite to perform quantitative studies should be determined to ensure appropriate resourcing and use. In the era of high accountability expectations and increasing regulatory compliance oversight for HEIs, reasons to perform more sophisticated data analyses and interpretations range from improved accountability and performance to defending funding and approach toward achieving results (Padró & Kek, 2017).

This challenge comes about due to two issues: lack of staff versed in quantitative-based quality focused methodology and philosophical perspectives on data. First, HEI units working directly with learners (potential students) and enrolled students do not always have the requisite evaluation and research skills, let alone possess a quantitative methodology background required to be interested in or adequately perform a full or even modified form of QFD. While skills to perform evaluation have been identified as important for these types of units for some time, these skills are

deemed to be of lesser importance than working directly with learners and students (Burkard *et al.,* 2005). This is an issue shared with HEIs wanting to establish an analytics framework for themselves either at the institutional or unit levels.

Second, often, when data collection and analysis does happen, student-serving units prefer to use qualitative methods. There is a tendency to believe that qualitative data provides a more student-centric view of their interactions with university programs (Padró & Kek, 2017). The interest is in telling the individual student's story (Jones & Abes, 2013).

A corollary challenge resulting from these two reasons (which also impacts Challenge 3 below) is that of credibility. As Patton (1999) indicated, three elements come to play. These apply here although his focus was on qualitative inquiry:

- Rigorous techniques and methods for gathering high-quality data that are carefully analysed, with attention to issues of validity, reliability, and triangulation;
- The credibility of the researcher, which is dependent on training, experience, track record, status, and presentation of self; and
- Philosophical belief in the value of [the method of] inquiry.

Challenge 3: Integration of QFD With Other HEI Decision Making and Reporting Activity

HEI quality is part of the larger purpose of providing value to learners and other stakeholders based on responding to institutional surroundings influencing relevance, access and investment (Blanco-Ramirez & Berger, 2014). Consequently, as Asif *et al.*, (2013) observed, when HEIs use techniques such as QFD these should draw and expand upon existing institutional knowledge. Moreover, the organisational environment needs to be complementary to quality-related techniques and concepts generally labelled as part of TQM for QFD to be more than marginally successful (Martins & Aspinwall, 2001). QFD works within quality systems that aim to satisfy the customer, in the case of HEIs meaning the learners and students (the learners who are enrolled as students –Mazur (1996).

The problem is a simple one, according to Norman (2003), institutional database systems are designed to support critical day-to-day transactions. This is compounded by a territorialism, a concern over who should access data and participate in data collection and analysis which, in turn, underscores a lack of a comprehensive approach toward decisions or at least funnelling data and recommendations to make campus-wide decisions. Many HEI units have their own internal database, often unknown to other parts of an HEI. They often do not talk to each other to create what Terenzini

(2013) coined issues (T2) and context (T3) intelligence. This is unfortunate because an HEI already has between 30 to 35 percent of useful information within its overall HEI databases and these internal ones (Saunders & Wohlgemuth, 2009).

In sum, HEIs can be described as being enacted rather than objective in overall decision-making activity (Tierney, 2008). Therefore, it is practical to understand the institutional expectations and align activities such as QFD with these institutional expectations as well as other decision-making and reporting requirements (Padró & Kek, 2017). Not doing this decreases the potential of an effective use of QFD, not to mention its possible use to begin with. A unit's vision, as a subset of an HEI's vision and overarching conceptual framework of what it does and what it is looking for requires a unit level strategy on how to bring together existing and new evidence to be able to perform meaningful analyses and interpretation deemed useful and valuable (Padró, 2016). In other words, organisational learning occurs when HEIs recognise the usefulness of the acquired knowledge by its various units (Huber, 1991).

SOLUTIONS AND RECOMMENDATIONS

Results are still being analysed to identify and plan for next steps, thus a full set of solutions cannot be reported at this time. Nevertheless, the frame of reference considers the following:

- Reduction in public funding fuelling the HEI sector need to find additional sources of revenue or find ways to increase existing sources of income,
- Increased competition for international students by HEI "exporting" to countries from within sector and other countries and
- Increased competition and need for a growing revenue stream require HEIs to improve their quality of programs and support – to reinvent themselves – to enhance institutional attractiveness and reputation (Azmat *et al.,* 2013).

The importance of using QFD is that it provides a broader and clearer understanding of the needs of international students beyond what is available in the literature that mainly focused on mental health and psychological concerns with acculturation (Heyn, 2013).The literature on the use of QFD in higher education can be categorised into four major parts: curriculum design, teaching effectiveness, educational service quality, and other applications (Ahmed, 2006; Eftekhar *et al.,* 2012; Hwarng & Teo, 2001; Mukaddes *et al.,* 2012). It has proven to be an effective tool for translating the students' CRs into teaching techniques (Mukaddes et al., 2012). QFD as intended expands its use into student recruitment and support outside the

classroom. Utilising QFD provides a legitimate bridge between HEI marketing and recruitment practices and actual service provision to international students because it formally links practice and promise not only within the confines of academic activity but that of the remaining aspects of the student's HEI experience (service support, living arrangements, managing financial concerns, acculturation issues, community engagement within and outside the campus).

The principal solution emanating from this exercise was the importance of integrating QFD into existing data collection, analysis, interpretation and decision-making processes to ensure legitimacy of recommendations and subsequent actions. Key is the ability to form Terenzini's (2013) issues (T2) and context (T3) intelligence. Additionally, this is a must in order to involve the other HEI units in making the necessary changes. What transpired so far recommends asking the questions framed by Donaldson (2009) to create credible evidence:

- Questions of interest;
- Context;
- Assumptions faced by the from staff, evaluators, stakeholders;
- Theory used to guide practice; and
- Practical, time, resource constraints.

These questions should take the slightly modified sets of queries identified by Padró and Kek (2017):

- Is the unit and/or its programs structured to pursue evidence-based decisions and actions? Is there leadership support within the unit and/or higher up?
- What does the unit and its staff need and want to know? – Is there a reporting or equivalent process that needs to be followed? How does this exercise benefit the unit?
- What is the context for the evidence that has to be provided and the interpretation? Is there an internal and/or external framework influencing your decision on what you need and want to know? How is the unit able to generate the evidence in a way that is credible and is able to meet the unit's needs?
- What assumptions do the unit and their staffs have? [How do they compare to those held by] students, academic staff, senior leadership, and external stakeholders about the LAPs? Are the unit's performance, approach, and values congruent with student expectations and the institutional mission and values?

- What is the theoretical grounding of the unit's practice? How consistent is it with the rest of the institution's mindset? How well does the theoretical framework align with how the university interprets performance?
- What is practical given internal expectations, regulatory compliance requirements, timeliness, and resource limitations?

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KEY TERMS AND DEFINITIONS

Affinity Diagram: A graphical brainstorming of new quality management tools used to promote creative thinking, group facts, breaking down barriers, and arranging ideas and customer desires into categories.

House of Quality: The primary planning tool used part in QFD, a matrix-style chart correlates the identified customer requirements called the "Whats" with the technical characteristics called the "Hows."

Kano Model: Method provides an effective tool to understand customer requirements through classifies three major types of the attributes of products or services which studies the relationship between customer satisfaction and the function of product or service. Method helps to structure customer needs and determine its impact on satisfaction a factor to success.

Matrix Diagram: The most frequent used of the QFD tools, a matrix is a structure that provides rows and columns that represent the variables under investigation. The heart of QFD matrix is an example of one of the many matrix diagrams now used for planning reasons and quality improvement as a means of facilitating the identification of the relationships between the identified factors.

Quality: The features and characteristics of a product or service that bear on its ability to satisfy stated and implied requirements of customer and providing superior value.

Quality Function Deployment: A planning technique which focuses particularly on customer requirements and expectation to assure quality and customer satisfaction, through translating customer needs into appropriate technical requirements for each stage of product or service development and production.

Total Quality Management: A management philosophy which promotes an organization-wide effort—through full involvement of the entire workforce and a focus on continuous improvement—that organizations use to achieve customer satisfaction.