

# Development of a Quality Manual for a Research and Educational Centre: A Case Study

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## Abstract

There have been growing concerns about whether proper measures are in place to ensure the delivery of quality services and the operations in research and educational institutions. This paper describes various quality models and discusses their relevance into the total quality concepts and quality management systems (QMS) in education. It then illustrates how a QMS and the accompanied quality manual be developed in a research and educational institution using the Centre for Enterprise Research Integration (ERI) at The University of the West Indies, Trinidad as a case. Through personal interviews with the Centre's personnel, views on the operations and determinants of the QMS were acquired. Results showed that the people's resistance to changes, conflicts on academic freedom, and difficulties on measuring performance were the obstacles to QMS implementation. People involvement and proper communication are determinants of QMS implementation. The system also rests on having a tailored quality manual that entails the documentation of processes and procedures for ascertaining the delivery of quality services and operations in the Centre. The development of quality manual is briefly described in the paper.

**Key Words:** Quality Management System, Quality Manual, Research and Educational Institutions

## 1. Introduction

Quality management is based on an approach of effective management of key processes linked to meeting stakeholder needs (Greenwood and Gaunt, 1994). A quality management system (QMS) that conforms to the requirements of a regional or international standard provides useful guideline and procedures to assure quality goals of these institutions. Two frameworks that have had the most impact on quality management practices worldwide are the U.S. Malcolm Baldrige National Quality Award and the international ISO 9001 certifi-

cation process (NIST, 2005; ISO, 2005). Although both are process-focused, data based, and management-led frameworks, each offer a different emphasis in helping organisations improve performance excellence and increased customer satisfaction.

The Baldrige award focuses on performance excellence for the entire organisation in an overall management framework, identifying and tracking important organisational results (NIST, 2005). The ISO 9001 standard focuses on product and service conformity for guaranteeing equity in the market place, and concentrates on fixing quality systems problems and product service nonconformities (ISO, 2000). The latest revision of ISO 9001 has incorporated many of the principles of the Baldrige criteria. For instance, it provides systematic approaches to the process management that offers more detailed guidance on process and product control as compared to the Baldrige. Thus, for institutions in early stages of developing a quality programme, the standard enforces the discipline of control that is necessary before they can seriously pursue continuous improvement. The requirements of periodic audits reinforce the newly installed quality system until it becomes ingrained in the institution.

With respect to rapid economic development in Trinidad and Tobago, a number of policy efforts have been put into improvement of different aspects of education such as curriculum, language teaching, student guidance, student streaming, management, teacher-student ratio, physical environment, and teacher education. With the efforts aim at improving education quality, there has been growing concerns about the use of quality management practice for directing practices and monitoring performance in research and educational institutions that comprise promoting research, innovation, teaching and training etc.

Would the adoption of QMS facilitate the operation and assure the delivery of quality services in research and educational institutions? This paper addresses this problem statement by reviewing the quality concepts and principles and incorporating a Total Quality approach into the research and educational settings. It presents the main findings of a recent study conducted for the Centre for Enterprise Research Integration (ERI) that is a research and educational centre recently established at The University of the West Indies (UWI), Trinidad. This paper also illustrates how a quality manual be developed based on the ISO 9001:2000 standard that entails the documentation of processes and procedures for ascertaining the delivery of quality services and operations in the Centre.

## **2. Some Models of Quality in Education**

Nowadays, quality has become one of the most important performance measures for both

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consumers and producers and a key element of an organisation's strategy (Raturi and Evans, 2004). Having regards the concerns about achievement of education quality, researchers and practitioners have advocated different models to help understand and achieve quality in research and educational institutions. These models have their own strengths and weaknesses, with emphasis on different aspects of the input, process, and outcome for pursuing quality in education. Six common quality models in education are identified, and their main features are highlighted below:

### **2.1 The Goal Model**

This model sees quality as achievement of stated goals and conformance to given specifications. It assumes that there are clear, enduring, normative and well-accepted goals and specifications as indicators and standards for education institutions or education systems to pursue or conform to. An education institution is deemed to be of good education quality if it has achieved the stated goals or conformed to the specifications listed in the institutional plan or programme plans (Cheng, 1995).

### **2.2 The Resource-Input Model**

This regards quality as the natural result of achievement of quality resources and inputs for the institution. Research education quality is assumed to be the natural result of achievement of scarce resources and inputs for the institution. This model is useful if the connections between quality of inputs and outputs are clear (Cameron and Whetten, 1990). The model redresses the limitation of the goal and specification model, linking education quality to the environmental context and resources input. However, this model emphasises significantly on acquisition of inputs that may reduce the institutional effort put into educational processes and outputs. The acquired resources may become wastage if they cannot be used efficiently to enhance quality of process and outcomes.

### **2.3 The Process Model**

In this model, quality is seen as smooth and healthy internal process and fruitful learning experiences. The process model assumes that an educational institution is of high education quality if its internal functioning is smooth and "healthy". If there is a clear relationship between the process in institutional and educational outcomes, this model should be useful (Caldwell and Spinks, 1992). The process model has its limitations, such as the difficulty in monitoring processes and gathering related data, and the focus on quality of means instead

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of quality of ends.

## **2.4 The Satisfaction Model**

According to this model, quality is defined as the satisfaction of strategic constituencies. It assumes that the satisfaction of strategic constituencies of an educational institution is critical to its survival (Cheng, 1993), and therefore education quality should be determined by the extent to which the performance of a research and educational institution can satisfy the needs and expectations of its powerful constituencies.

## **2.5 The Legitimacy Model**

Quality is regarded as the achievement of an institution's legitimate position or reputation. Individual institutions have to compete seriously for resources and overcome internal barriers, and on the other hand, they have to face the external challenges and demands for accountability and "value for money" (HKG, 1994). In order to gain legitimacy for survival and to acquire critical resource, research/educational institutions have to win the support of the community, build up good public image and show evidence of accountability.

## **2.6 The Organisational Learning Model**

The organisational learning model assumes that quality is a dynamic concept involving continuous improvement and development of members, practices, process, and outcomes of an institution (Fullan, 1993). Quality is thus considered as a means to continuous development and improvement. This model is similar to the process model. The difference is that it emphasises the importance of learning behaviour for ensuring quality in education; whether the internal process is currently smooth is not so critical.

# **3. Quality Concepts and Principles in Education**

Quality in education is a rather vague and controversial concept in research and policy discussion. To different people, the definition may be different and so the indicators used to describe education quality may be different. Some emphasise the quality of inputs to the education systems whereas others emphasise the quality of processes and outcomes. No matter whether referring to input, process, outcome or all of them, the definitions of quality in education are often associated with fitness for use, the satisfaction of the needs of strategic con-

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stituencies or conformance to strategic constituencies' requirements and expectations.

Raturi and Evans (2004) contend that quality management refers to the policies and procedures used to ensure that goods and services are produced with appropriate levels of quality to meet the needs of customers. Quality management in educational institutions offers a more structured approach (Lomas, 2000). Quality management documents firmly address the issues of best practice and the quality of teaching and learning (Lomas, 2000; QAA, 2000). Significant changes will be seen to the external quality assurance context for educational institutions, a change that will have a profound impact upon institutional internal processes.

Quality management is based on an approach of effective management of key processes linked to meeting stakeholder needs. According to Lagrosen (2003), there are six quality concepts for education based on quality management principles. These are:

- *Leadership* - Leaders establish unity of purpose and direction of education. They should create and maintain the internal environment in which people can become fully involved in achieving the school's objectives.
- *Understanding stakeholders* - Research and educational institutions depend on public confidence and therefore should understand current and future community needs, meet student-learning requirements, and exceed the community's expectations.
- *Factual approach to decision making* - Effective decisions and actions are based on the analysis of data and information. The selection of appropriate data in schools needs to be guided by considerations of the breadth and depth of the data collected. Quality-related data should include student and stakeholder needs, process control limits, performance measures, and changed values.
- *Involvement of people* - People at all levels are the essence of education and their full involvement enables their abilities to be used for the organisation's benefit.
- *Process approach* - Learning is achieved more efficiently when related resources and activities are managed as a process.
- *Continual improvement* - Continual improvement in processes and results should be a permanent objective of research and educational institutions.

Raturi and Evans (2004) contend that the customer is the judge of quality. A quality-focused organisation's efforts need to extend well beyond meeting specifications, reducing defects and errors, or resolving complaints. Total Quality is an integration concept. It incorporates different models of quality, particularly the organisational learning model, the sat-

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isfaction model, and the process model as necessary for research and educational environments.

Moreover, total quality has the process perspective that links all necessary activities together and focuses on the entire system. This perspective is supported by continuous improvement, which refers to both incremental and breakthrough improvements in processes. Real improvement depends on learning, which requires feedback and analysis of results to understand why changes are successful and enable better approaches to be adopted. In line with the total quality concepts, research and educational institutions should involve and empower its members in functioning, carry out continuous improvement in different aspects of internal process, and satisfy the requirements, needs, and expectations of their external and internal powerful constituencies even in a changing environment (Bradley, 1993; Greenwood and Gaunt, 1994).

#### **4. Establishing a QMS: A Case of The ERI Centre**

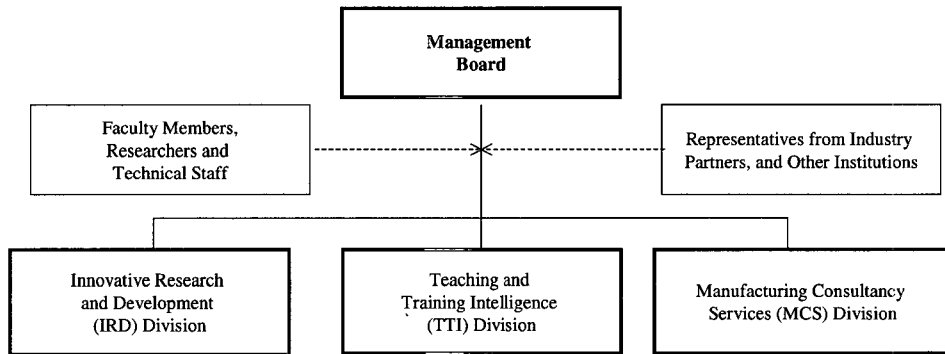
In responding to the growing need of University-Industry collaborations, the Department of Mechanical and Manufacturing Engineering has taken an initiative to establish the Enterprise Research Integration (ERI) Centre under the Faculty of Engineering at The University of the West Indies, Trinidad. The mission of the Centre is to promote research, innovation, teaching and training in manufacturing and to work closely with industry through collaborative projects to disseminate best practices in the region via fostering entrepreneurship and niche enterprises (Pun *et al.*, 2004).

At present, the Centre is in its early stages of development Figure 2 shows the organisational structure of the ERI Centre. The Centre is administrated under the Management Board that consists of Faculty members, the Head of the Department, and representatives from industry partners and other institutions. Headed by the Centre Manager (CM), the Centre has three divisions, looked after the matters related to 1) research and innovation, 2) teaching and training, and 3) outreach and consultancy services. These divisions are:

- Innovative Research and Development (IRD) Division – To promote innovation and a wider development of pure and applied research, individual and collective engineering projects.
  - Teaching and Training Intelligence (TTI) Division – To support research activities and teaching programmes at UWI, and provide specifically designed company courses for in-
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dustry partners.

- Manufacturing Consultancy Services (MCS) Division – To identify and assess the business potential of research projects and technology commercialisation.



**Figure 1.** Organisation Structure of the ERI Centre

**Table 1.** Roles and Functions of the ERI Centre

Division	Roles and Functions
I. Innovative Research and Development	<ul style="list-style-type: none"> <li>• To foster innovation and R&amp;D activities consistent with the Centre’s mission.</li> <li>• To work closely with industry partners and other research institutions within the University and outside.</li> </ul>
II. Teaching and Training Intelligence	<ul style="list-style-type: none"> <li>• To build intelligence bases with focus on human resources development and training.</li> <li>• To support the teaching programmes in the University and offer training courses for industry.</li> <li>• To develop computer-based training and assist industry partners to design in-house programmes that meet the training requirements and needs.</li> </ul>
III. Manufacturing Consultancy Services	<ul style="list-style-type: none"> <li>• To coordinate the expertise and consultancy supports from faculty members.</li> <li>• To assist industry partners to identify and assess the business potentials.</li> <li>• To provide consultancy services by facilitating technology transfer and fostering entrepreneurship and niche enterprises in the country and the Caribbean region.</li> </ul>

Individual divisions are operated with a team of senior development engineers (SDE), development engineers (DE), technicians, research assistants (RA) and students (RS). The Centre serves a wide range of external stakeholders including government, industry partners and other institutions as well as internal users (such as researchers, lecturers and students). The main roles and functions of three divisions are depicted in Table 1. The ERI Centre

Taskforce has realised the need to establish a QMS that would offers a structured approach for the Centre to operate at appropriate levels of quality and meet the needs of both external and internal stakeholders by adhering to the policies and procedures (Pun *et al.*, 2004).

#### 4.1 Conduct of Personal Interviews

In order to acquire the views on the Centre's operations and the development of a QMS, two series of interviews were conducted with the staff members of the Centre and the Department of Mechanical and Manufacturing Engineering at UWI in February/April 2005. In the development of the QMS, it would be necessary to have empirical knowledge of how individual divisions actually operate. The first series of interviews was concerned with the current operations of the Centre. Two core members of the ERI Centre taskforce who were involved in establishing the ERI Centre were interviewed, one being the Head of the Production Engineering and Management programmes and the other being the Head of the Industrial Engineering programme. A semi-structured questionnaire was designed (see Table 2). The focus of the interview was to determine the operations of individual divisions (such as IRD, TTI and MCS) from the point at which customers would seek for services to the point at which the job would be released to them. The acquired information would be consolidated to determine the work process and instructions for individual divisions and form an integral part of a quality manual for the Centre.

- What are the purposes of each division (i.e. IRD, TTI and MCS) in the ERI Centre?
- Who would be responsible for the jobs assigned and undertaken in individual divisions?
- What are the measures to be put in place to ensure that correct courses of action are being taken for each division?
- How would the Centre monitor the actions implemented for the job undertaken for individual divisions?
- Would payments be settled by customers/clients before or after the job is completed?
- How would the completed jobs be delivered to the customers for each division? For example, if the job involved production of some product, would it be directly delivered to the customer or would the customer return to collect it?

**Figure 2.** An Excerpt of First Series of Interview Questions

The second series interviewed four members of staff, including the present Head, former Head, a Lecturer and the Head of Industrial Engineering programmes in the Department.



They were invited because of their knowledge and involvement in the development of the QMS in the Department. The interviews acquire their views and experiences with establishing and maintaining the QMS in the Department of Mechanical and Manufacturing Engineering. The focal area was on the effectiveness of the QMS on maintaining quality delivery of the services to the stakeholders of the Department. It also explored the factors and the considerations that were pertinent to the evaluation of needs and the development of a quality manual for the ERI Centre. An excerpt of second series of interview questions is depicted in Table 3.

- Should the Department have some means or mechanisms to ensure the delivery of quality services to stakeholders? What are the means and/or mechanisms?
- Does the Department have a quality management system in place?
- What steps has been taken to ensure that the quality system is properly implemented and adhered to?
- Are there obvious and/or not so obvious difficulties encountered in implementing this system in the academic environment as in other institutions such as defects, weaknesses, and dysfunctions?
- To what extent do you agree that the choice of quality management framework and the standard used are important considerations when developing a quality manual for the QMS of an academic institution like the Department and the ERI Centre? Any other considerations?
- To what extent do you agree that the existing quality system serves its purpose to maintain the quality standard and safeguard the proper running of the Department?
- To what extent do you agree the quality system is useful for research and education? In what ways?

**Figure 3.** An Excerpt of Second Series of Interview Questions

## 4.2 Analysis of Findings

### 4.2.1 Highlights of the First Series Interviews

#### *Functions of Individual Divisions*

In general, CM has the overall responsibility of the jobs undertaken while a team led by SDE and DE has more specific responsibilities in carrying out the different projects in individual divisions. CM would consider the available resources and consult with SDE and other personnel if needed and would then formulate a contract. Academic members (such as professors, lecturers and RA) would also be responsible for jobs undertaken depending on the nature of the project. A sample process flow model of the IRD division is derived as in Figure 4. Both TTI and MSC divisions have similar process flow as that of IRD division.

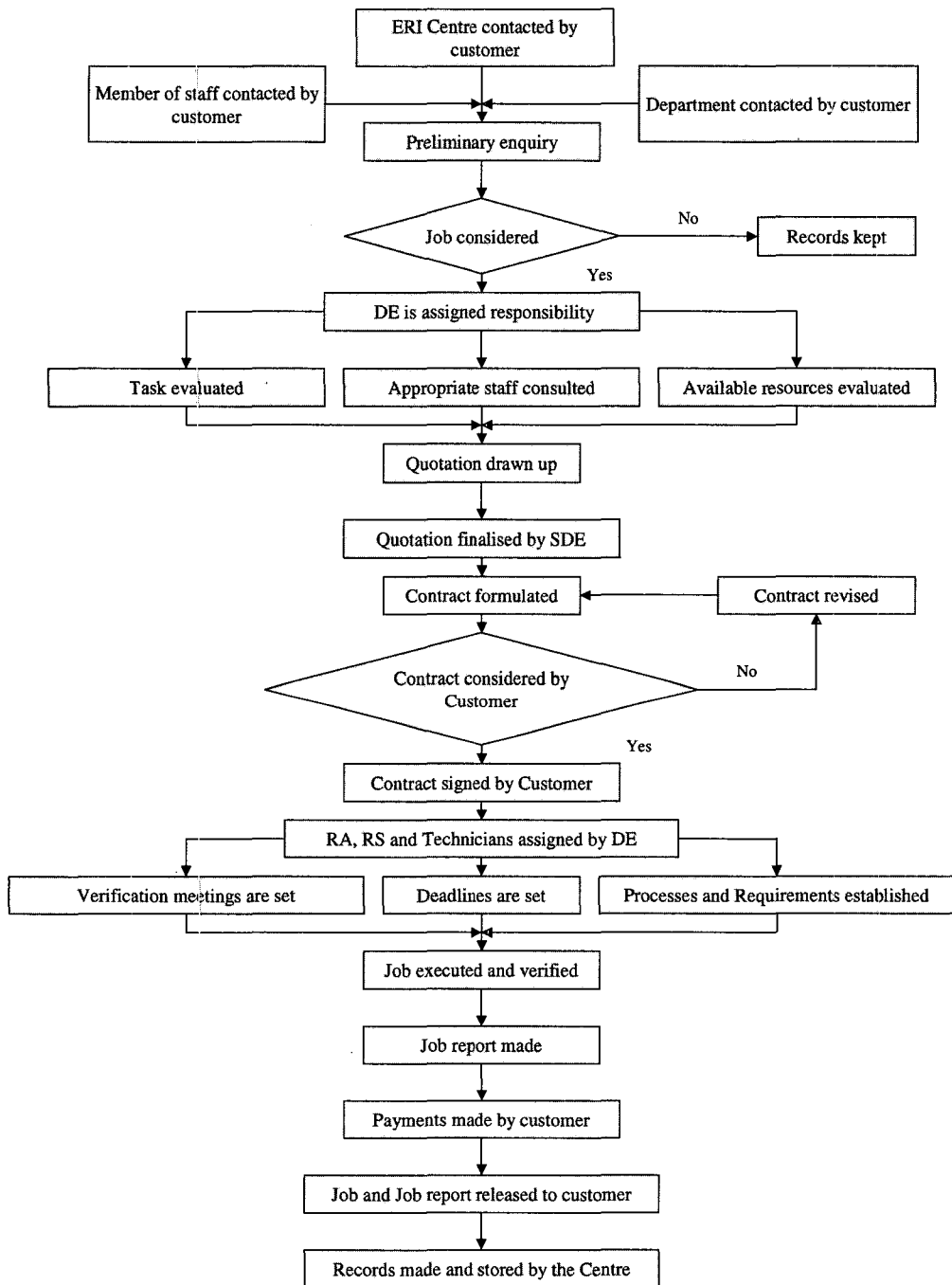


Figure 4. Process Flow Model for the IRD Division

### ***Measures and Monitoring of Operations***

Course of actions taken would be reviewed by the SDE and approved by the CM for all three divisions. This would ensure that appropriate actions and processes were put in place. SDE and CM would monitor the processes through intermittent reviews, verification, and testing where possible for all three divisions. For the IRD Division, the completed job together with a job report would either be delivered directly to the customer, or collected by the customer, depending on the nature of the project. For the TTI Division, teaching/training programme would be executed on campus or on customer's premises and a job report be issued to the customer. For the MCS Division, consultation might be delivered at job site or at the Centre. Payments would be made in full before the job was to be carried out. In some cases, partial payments might be made in phases depending on the how long the job would take for individual divisions.

#### **4.2.2 Highlights of the Second Series Interviews**

##### ***Difficulties Encountered in QMS Implementation***

The initiative of establishing the Departmental QMS was to meet the requirements of the external accreditation body, the Institution of Mechanical Engineers in the UK and the Internal Quality Assurance Committee of the University. It was found that there was no explicit mechanism to maintain the QMS and the Department adhered to the system mainly on the areas of curriculum planning and development. These were attributable to:

- Lack of human resources that put the QMS in place.
- Lack of involvement of staff.
- Resistance by staff to adopt changes in their teaching styles.
- Resistance to the level of control imposed by the QMS as to academic freedom.
- Difficulties to measure and monitor the results of QMS implementation.

##### ***Factors Affecting QMS Implementation***

All interviewees commented that the establishment of the QMS as a must for the Department to meet the requirements of external accreditation and internal quality assurance bodies. Although it has been difficult to measure and monitor its effectiveness, the QMS stressed the consistency of processes and procedures that would help assure the delivery of quality services. Some interviewees argued that intellectual freedom would need some kind of guidelines that the QMS might provide. It would be important to adopt an appropriate quality management framework and use the compliance requirements of some recognised

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standards to establish, develop and maintain the QMS. Moreover, several factors that would affect the success of QMS implementation were identified as follows:

- **People Involvement** - if the members of staff are involved in the development and implementation of the QMS, they would feel empowered and take a more active role at upholding the system;
- **Internal Communication** - if the members of staff are able to better understand the importance and need for the system, they would be more willing to accept it.
- **Tailored quality manual** - The manual outlines the processes and procedures that guide the operations and provides a platform upon which continuous improvement of these operations can be achieved.
- **Performance measurement** - This enables the Department to know whether the system being implemented is effective and fit for purposes.
- **Continual review and improvement** - This enables the Department to maintain concurrence with both internal and external environments.

### **4.3 Development of a Quality Manual**

The establishment of the ERI Centre served as extended arm of the Department in the areas of research, training and consultancy. The Centre has strong link with the Department, but operated separately with own organisational entity. Many sections of the existing quality manual of the Departmental QMS were inapplicable and the revision/extension of them would not suit well with the operations of the Centre. The ERI Centre Taskforce has realised the need to develop a new quality manual for the Centre.

Incorporated the findings of personal interviews into the operations of the ERI Centre, a draft quality manual was being developed. In order to assure the quality of its services, it was proposed for the ERI Centre to adopt a total quality approach and tailor the quality manual with respect to the compliance requirements of ISO 9001:2000.

#### **4.3.1 Basic Structure of the Manual**

The new quality manual is made up of four levels that enable a more thorough and comprehensive documentation of the operations of the Centre. Level I is introductory and describes the administration of the manual, the overall quality sequence and quality policy; and is made up of eight clauses, namely: 1) Scope; 2) Normative reference; 3) Terms and definitions; 4) Quality management system; 5) Management responsibility; 6) Resource management; 7) Product realisation; and 8) Measurement, analysis and improvement.

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Level II describes the overall procedures and responsibilities for operating the QMS for the three divisions of the Centre. It is made up of the six compulsory operating procedures, with respect to the ISO 9001:2000 standard. These are:

- Clause 4.2.3: Control of Documents;
- Clause 4.2.4: Control of Records;
- Clause 8.2.2: Internal Audits;
- Clause 8.3: Control of Nonconforming Product;
- Clause 8.5.2: Corrective Action;
- Clause 8.5.3: Preventative Action.

Level III contains the specific work procedures relevant for each specific division within the organisation. These work procedures are generated from the procedures of Level II, and refers to the Forms of Level IV. The information contained in first level of the manual is freely available. The information contained within Levels II, III and IV of the manual is strictly confidential and may not be disclosed or copied in any part, without prior approval.

#### 4.3.2 Style and Formatting

The choice of wording of the quality manual is adopted in line with the ISO 9001 guideline. The manual is written in the present tense rather than the future tense to reflect what is being done. It is recognised that pagination of the document is important as it identifies how many pages are in a specific section and avoids the need to reissue the entire document every time changes are made. The header which shall appear on every page of the quality manual shall identify the organisation; the document; the section; the revision number; the revision date; authorisation; and pagination. Figure 5 is a sample of the header of the quality manual.

<b>THE ERI CENTRE</b>			
<b>QUALITY MANAGEMENT SYSTEM- Level I</b>			
<b>Procedure # 0: INTRODUCTION</b>			
<b>Rev. No. 0</b>	Rev. Date:	Authorised:	<b>Page 1 of 1</b>

**Figure 5.** Sample Header of the Quality Manual

Identification of the revision status of the document meets the requirements of ISO 9001:2000 Clause 4.2.3: control of documents, and thus shall be applied during the develop-

ment of the quality manual. The section numbering method that shall be used in the quality manual shall correspond to that of ISO 9001. The Level I document shall clearly reflect the numbering system method of ISO 9001, while for the sake of consistency, Levels II, III, and IV shall refer to necessary procedures using the ISO 9001 section numbering as well. In order to ensure the control of documents, the front page of the quality manual shall entail provisions to identify the person whom the document is issued to, who authorised the release of the document, and the date issued. A footer ensuring that each page has been reviewed and approved shall appear on every page of the quality manual. Review and approval of the document shall be performed by the Centre Manager and the Head of Department, respectively. Finally, any terms specific to the ERI Centre shall be properly defined in the quality manual.

## **5. Discussion**

The ERI Centre is a research and educational institution in its early stages of development. It was established in an attempt to bridge the gap between the University and Industry through collaborative projects and by providing quality that meet the needs of Industry, and other stakeholders. The analysis of the interview findings provided empirical accounts on the operations of the Centre and shed lights on the determinants of QMS implementation in research and educational institutions. Complementing the literature base with empirical evidence, several success factors of QMS implementation are identified. These are: people involvement, proper communication, a tailored quality manual, performance measurement and continual review and improvement of QMS.

Change is especially inevitable for the ERI Centre since it is in its early stages of development. Many processes and procedures used in its three divisions (IRD, TTI and MCS) are subject to change. The QMS and the accompanied quality manual must be implemented and adhered to. The clauses and procedures in the manual should be properly communicated to members of staff. In order for the Centre to attain performance and to meet and exceed the expectations of stakeholders, continual revision of the quality manual is needed. A designated member or team of staff should be appointed for ongoing development, maintenance, and update of the quality manual of the QMS.

The Centre should monitor the QMS and assure the operation meets the requirement of the stakeholders. This may be done through the means of periodic audits which identify non-conformances of the QMS at the Centre. Both non-numerical techniques (e.g. affinity di-

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agrams, tree diagrams, benchmarking, brainstorming, cause and effect diagrams, and flow charts) and numerical techniques (e.g. control charts, histograms, paréto diagrams, and scatter diagrams) should be adopted. Once the causes of these non-conformances are identified, corrective and/or improvement actions should be made. It is also suggested that someone be appointed to ensure the control of non-conformances, and to ensure that corrective and preventative actions are properly implemented.

The quality manual is an operational document for QMS implementation. It shall provide a means to maintain the conformity of procedures used, and promote awareness of “good practices” within the ERI Centre as well as the Department of Mechanical and Manufacturing Engineering at UWI. Besides, the quality manual developed may enable the Centre attempting to be certified under the compliance requirements of ISO 9001:2000.

## 6. Conclusion

This paper describes a case study of QMS implementation in a research and educational institution, the ERI Centre. It entails the actual documenting of processes and procedures that are put in place for designing of a quality manual for such an institution. A viable QMS helps to maintain a quality standard and offers guidelines for maintaining consistency of processes and procedures used and maintaining the quality of the services offered in the research and educational environment. Although intellectual freedom is important, some forms of guidelines are required and this could be provided by a QMS. It is anticipated that the QMS would assure the satisfaction of the stakeholders once properly implemented and enforced.

Future work would be put on the evaluation of the efficacy of the QMS and continual revision of the quality manual for the ERI Centre. Besides, the seamless integration of the existing QMS in the Department and the ERI Centre is another research area.

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