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## **APPENDICES**

## APPENDIX 1

### THE 1ST QUESTIONNAIRE

#### Questionnaire for Research Study on Quality Management System

This questionnaire is a part of masteral thesis in Engineering Business Management of The Regional Centre for Manufacturing Systems Engineering.

This questionnaire is aimed to get the expert's opinion about criteria to evaluate quality management system in Thai telecommunication company. The purpose of this study is to develop models for this evaluation with references to ISO9000 and the Baldrige Award.

The information collected from this questionnaire will be not only helpful for the research study, but also useful to improve the quality management system for overall telecommunication industry in Thailand.

Please be frank and open with your answers. All materials will be treated with strict confidence by the researcher. Your participation in this study is greatly appreciated.

## INSTRUCTIONS

### 1. Definition

All questions in this questionnaire are in pairwise fashion. You will be asked to compare the relative importance of two elements at a time. The relative importance is measured in scale values ranging from one extreme "9" down towards equality "1" and then again rising to the other extreme "-9."

### 2. Comparison scale

- 9 refers to the first factor is absolutely more important than the second one.
- 7 refers to the first factor is very strongly more important than the second one.
- 5 refers to the first factor is strongly more important than the second one.
- 3 refers to the first factor is weakly more important than the second one.
- 1 refers to the first factor is as important as than the second one.
- 3 refers to the second factor is weakly more important than the first one.
- 5 refers to the second factor is strongly more important than the first one.
- 7 refers to the second factor is very strongly more important than the first one.
- 9 refers to the second factor is absolutely more important than the first one.
- 2 , 4 , 6 , 8 , -2 , -4 , -6 , -8 intermediate values between adjacent scale values.

### 3. Example

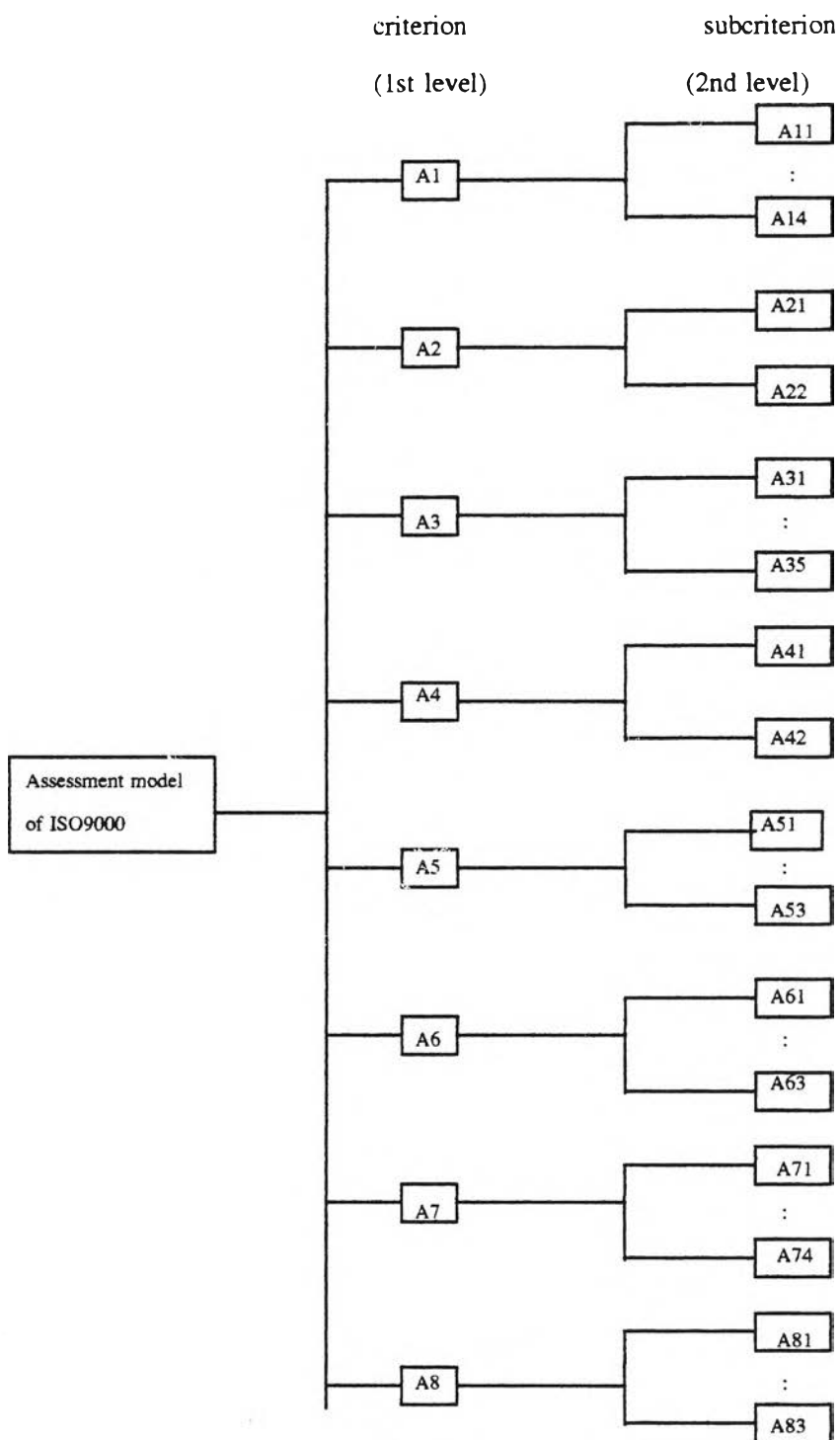
From the given matrix below, if your opinion is that C1 is strongly more important than C2, circle around "+5." On the other hand, if your opinion is that C2 is strongly more important than C1, circle around "-5."

critierion	standard scale for pairwise comparison	critierion
C1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	C2

Section 1: assessment model of ISO9000

The following hierarchical model in figure 1 provides a basis of pairwise comparisons in section 1.

Figure 1



subsection 1.1: pairwise comparisons between the quality criteria with references to ISO9000 when considering the success of quality management system in Thai telecommunication industry.

All quality criteria categorised in this subsection can be identified as follows:

1. Quality management (A1)

Quality management here mainly deals with planning and management of a quality system with high effectiveness and efficiency, and ultimately leads to an achievement of the required product quality.

2. Product definition (A2)

This criterion is concerned with defining the specific products which are or even are expected to be available in an organisation with reference to contract review and design input.

3. Design and development (A3)

This criterion reflects one of product realisation processes; its primary goal is to design and innovate new products.

4. Quality documentation (A4)

Quality documentation is one of the main support processes. It deals with documentation and record keeping of quality procedures and quality records by being limited to the extent being pertinent to the application.



#### 5. Vendor assurance (A5)

Vendor assurance means all activities and function concerning the attainment of quality of the vendors' processes and supplied products. Examples of these are inspection and testing.

#### 6. Handling and delivery (A6)

Handling and delivery should be a supporting process which ensures that only verified conforming products reach customers.

#### 7. Production (A7)

This criterion is one of product realisation processes which focus mainly on producing products being consistent with customer expectations under planned, controlled and documented conditions.

#### 8. Problem identification and correction (A8)

The extent to which problem should be identified and corrected for controlling and improving products can be based on control of a nonconforming product, corrective action and servicing.

critterion	standard scale for pairwise comparison	critterion
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A2
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A3
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A4
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A5
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A6
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A3
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A4
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A5
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A6
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A4
A3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A5
A3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A6
A3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A5
A4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A6

critierion	standard scale for pairwise comparison	critierion
A4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A5	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A6
A5	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A5	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A6	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A7
A6	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8
A7	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A8

subsection 1.2: pairwise comparisons between the quality subcriteria in respect of their importance to quality management when considering the success of quality management system in Thai telecommunication industry.

All quality subcriteria categorised in this subsection can be identified as follows:

1. Management responsibility (A11)

Management basically have to define the company quality policy and execute it through an organisation of people and resources. For example, management must designate a management representative to be responsible for conducting regular, documented management reviews of the quality system.

2. Quality system (A12)

Quality system here is meant the organisation structure, processes and resources which are necessary for quality management implementation.

### 3. Internal quality audit (A13)

Internal quality audits have to be conducted to measure the effectiveness of a quality system designed to achieve stated objectives. A number of crucial areas for internal audit attention include procedures, resources, facilities, measurement systems and results, and so on.

### 4. Training (A14)

Training should be provided to employees under an organisation's documented training plan. In addition, the organisation should provide whatever training is required to enable individual employees to meet the documented qualifications of their posts.

critrion	standard scale for pairwise comparison	critrion
A11	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A12
A11	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A13
A11	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A14
A12	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A13
A12	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A14
A13	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A14

subsection 1.3: pairwise comparisons between the quality subcriteria in respect of their importance to product definition **when considering the success of quality management system in Thai telecommunication industry.**

All quality subcriteria categorised in this subsection can be identified as follows:

1. Contract review (A21)

The standard obliges an organisation to conduct a contract review, that is, procedures for evaluating customer requirements and comparing them with the organisation's capabilities.

2. Design input (A22)

Design input is an input of design processes. A number of sources of design input include design personnel, testing equipment and so on.

critterion	standard scale for pairwise comparison	critterion
A21	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A22

subsection 1.4: pairwise comparisons between the quality subcriteria in respect of their importance to design and development **when considering the success of quality management system in Thai telecommunication industry.**

These subcriteria can be identified below:

1. Design control (A31)

According to the ISO9000 standard, a design process is expected to be planned, controlled and documented with clear and definitive responsibility and authority.

## 2. Design and development planning (A32)

Design and development planning which are generally time-phased should be planned and disciplined, consistent with the application, sophistication and innovation of the product.

## 3. Design output (A33)

In general, an organisation should clearly define its types of design output such as blueprints, design checklists and so on.

## 4. Design verification (A34)

This criterion means confirmation by examination and provision of objective evidence that design meets the specified requirements.

## 5. Design changes (A35)

Design changes are necessary for ensuring the conformity of product to customer expectations. An organisation is required to have procedures for handling such changes which can lead to many problems such as higher development costs, some losses of competitive advantages and more time-consuming tasks and so on.

critterion	standard scale for pairwise comparison	critterion
A31	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A32
A31	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A33
A31	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A34
A31	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A35
A32	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A33
A32	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A34
A32	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A35
A33	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A34
A33	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A35
A34	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A35

subsection 1.5: pairwise comparisons between the quality subcriteria in respect of their importance to quality documentation when considering the success of quality management system in Thai telecommunication industry.

All such subcriteria can be identified as follows:

1. Document control (A41)

This element requires that procedures be established and maintained to control all documents and data that affect the product quality. Examples of documents to be controlled include blueprints, work instructions and test procedures.

2. Quality records (A42)

Quality records are those records used to show whether the required quality be achieved and to verify whether the operation of a quality system is effective and economical. They involves drawings, specifications, blueprints, procedures and many other types of records.

critierion	standard scale for pairwise comparison	critierion
A41	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A42

subsection 1.6: pairwise comparisons between the quality subcriteria in respect of their importance to vendor assurance when considering the success of quality management system in Thai telecommunication industry.

All such subcriteria can be identified as follows:

1. Purchasing (A51)

This element's principal goal is to ensure the achievement of quality of purchased materials or products.

## 2. Customer-supplied product (A52)

It is likely that a customer may also supply the raw material or component parts as input to the production. They should be treated in the same manner as any similar organisation-owned items.

## 3. Receiving inspection and testing (A53)

Receiving inspection and testing are generally utilised to verify the conformity of purchased items to the required standards.

critierion	standard scale for pairwise comparison	critierion
A51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A52
A51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A53
A52	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A53

subsection 1.7: pairwise comparisons between the quality subcriteria in respect of their importance to handling and delivery when considering the success of quality management system in Thai telecommunication industry.

All such subcriteria can be identified as follows:

### 1. Product identification and traceability (A61)

The product identification is to identify products with the use of numbers such as batch numbers and serial numbers. The attainment of these records can lead to the tracing of a product when required.

### 2. Inspection and test status (A62)

The inspection and test status should illustrate whether a product has been (1) inspected and accepted, (2) inspected and rejected, (3) inspected and during decision-making of being accepted or rejected, or (4) not yet inspected.



### 3. Handling, storage, packaging and delivery (A63)

The main goal of these activities is to provide protection for receiving material, work-in-progress and finished product against damage and deterioration.

critierion	standard scale for pairwise comparison	critierion
A61	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A62
A61	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A63
A62	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A63

subsection 1.8: pairwise comparisons between the quality subcriteria in respect of their importance to production **when considering the success of quality management system in Thai telecommunication industry.**

All such subcriteria can be identified as follows:

#### 1. Process control (A71)

Controlling the processes used to produce a product is to ensure the protection from problems and nonconformities. For example, personnel performing the testing of a transmission equipment may be trained and certified in that procedure.

#### 2. Inspection and test (A72)

Whatever procedures an organisation utilises to verify conformance to the required standards reflect inspection and testing. This element addresses three main areas: receiving, in-process and final inspection.

#### 3. Inspection, measuring and test equipment (A73)

These are equipments which are used in inspection and testing. They may include gauges, sensors, special test equipment and more.

#### 4. Statistical techniques (A74)

Statistical techniques should be employed whenever they are suitable and practical for an assessment of process capabilities and product characteristics. Examples of such techniques are analysis of design of experiment, variance analysis and statistical sampling inspection.

critierion	standard scale for pairwise comparison	critierion
A71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A72
A71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A73
A71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A74
A72	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A73
A72	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A74
A73	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A74

subsection 1.9: pairwise comparisons between the quality subcriteria in respect of their importance to problem identification and correction **when considering the success of quality management system in Thai telecommunication industry.**

All such subcriteria can be identified as follows:

##### 1. Control of nonconforming product (A81)

When a nonconforming product is identified, it must be subsequently segregated and disposed in a manner to preclude any inattentional use.

##### 2. Corrective action (A82)

Corrective action initiates with the detection of any suspected nonconformance and ends in taking the appropriate action to correct the deterioration and prevent its recurrence.

### 3. Servicing (A83)

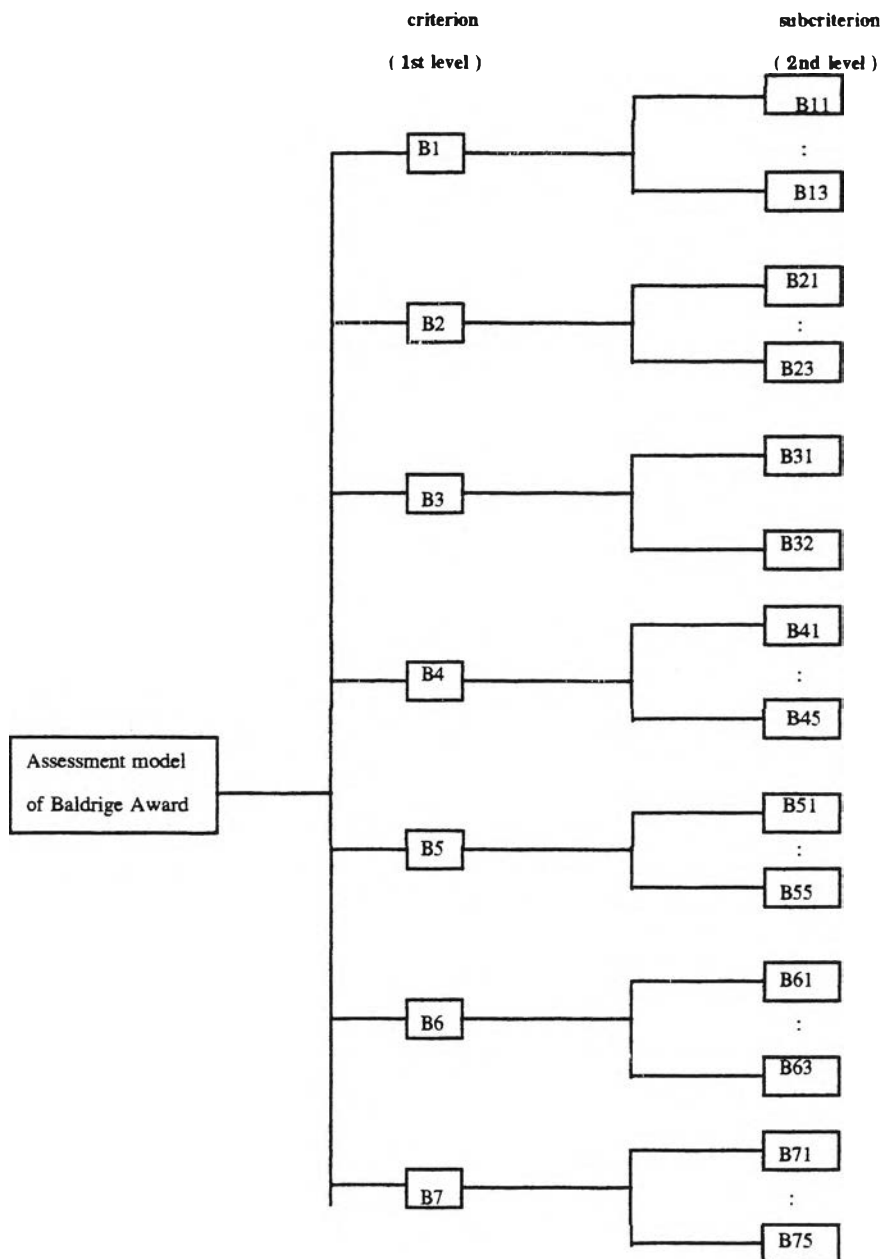
This element requires procedures for performing all contractual service and verifying whether the service meets specified requirements. Examples of service activities are the provision of suitable maintenance instructions and the availability of competent service personnel.

critereon	standard scale for pairwise comparison	critereon
A81	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A82
A81	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A83
A82	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	A83

**section 2: assessment model of the 1992 Malcolm Baldrige National Quality Award**

The following hierarchical model in figure 2 provides a basis for pairwise comparisons in section 2

**Figure 2**



subsection 2.1: pairwise comparisons between the quality criteria with references to the Baldrige award when considering the success of quality management system in Thai telecommunication industry.

All quality criteria categorised in this subsection can be identified as follows:

1. Senior executive leadership (B1)

This element focuses on the role senior executives play personally “in creating and maintaining a customer orientation and clear visible quality values.”

2. Information and analysis (B2)

This category deals mainly with the scope, validity, analysis, management and use of data and information to drive quality excellence and improve competitive performance.

3. Strategic quality planning (B3)

This category places a substantial emphasis on a company's planning process and how to link between all key quality requirements and overall business planning.

4. Human resource development and management (B4)

This criterion focuses on the key elements of how a company realises the full potential of its employees in the pursuit of the company's quality and performance objectives.

5. Management of process quality (B5)

This category means a systematic management of all processes affecting quality and performance requirements. Such processes include from design and introduction of products and services to delivery processes.

### 6. Quality and operational results (B6)

Quality and Operational Results category places an emphasis on the quality levels and improvement trends in quality, operations and suppliers.

### 7. Customer focus and satisfaction (B7)

This category focuses on a company's relationship with customers, and its knowledges of customer requirements and of the key quality factors that consider marketplace competitiveness.

critierion	standard scale for pairwise comparison	critierion
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B2
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B3
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B4
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B5
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B6
B1	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7
B2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B3
B2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B4
B2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B5
B2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B6
B2	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7
B3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B4
B3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B5
B3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B6
B3	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7
B4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B5
B4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B6
B4	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7
B5	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B6
B5	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7
B6	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B7

subsection 2.2: pairwise comparisons between the quality subcriteria in respect of their importance to senior executive leadership when considering the success of quality management system in Thai telecommunication industry.

All these subcriteria can be identified as follows:

1. Senior executive leadership (B11)

This criterion deals with the senior executives' leadership, personal involvement and visibility in developing and maintaining an environment for quality and operational performance excellence.

2. Management for quality (B12)

Management for Quality category deals with the extent to which a company's customer focus and quality values are integrated into day-to-day leadership, management, and supervision of all work units.

3. Public responsibility (B13)

This category requires a company to add its responsibilities to the public in its quality policies and practices.

critrion	standard scale for pairwise comparison	critrion
B11	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B12
B11	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B13
B12	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B13

subsection 2.3: pairwise comparisons between the quality subcriteria in respect of their importance to information and analysis when considering the success of quality management system in Thai telecommunication industry.

All these subcriteria can be identified as follows:

**1. Scope and management of quality and performance data and information (B21)**

A company is required to have procedures for determining and utilising data and information to plan the day-to-day management and evaluation of quality.

**2. Competitive comparisons and benchmarks (B22)**

This criterion principally concerns comparison with a company's competitors and benchmarks with a key world-class company for supporting the quality and performance planning evaluation and improvement.

**3. Analysis and uses of company-level data (B23)**

The focus is on how to collect, analyse and translate quality-and performance-related data into actionable information to support a wide range of activities based on a company's overall operational and quality objectives.

critierion	standard scale for pairwise comparison	critierion
B21	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B22
B21	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B23
B22	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B23



subsection 2.4: pairwise comparisons between the quality subcriteria in respect of their importance to strategic quality planning when considering the success of quality management system in Thai telecommunication industry.

All these subcriteria can be identified as follows:

1. Strategic quality and company performance planning process (B31)

This category places an emphasis on how a company develops short term (about 1-2 years) and longer term (3 years or more) plans and strategies; these strategies need to be interrelated to the overall business planning.

2. Quality and performance plans (B32)

This category deals with the extent of summary of a company's quality and performance plans and goals in short term and longer term for an achievement of the quality and customer satisfaction leadership.

criteria	standard scale for pairwise comparison	criteria
B31	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B32

subsection 2.5: pairwise comparisons between the quality subcriteria in respect of their importance to human resource development and management **when considering the success of quality management system in Thai telecommunication industry.**

All these subcriteria can be identified as follows:

1. Human resource management (B41)

This category concerns a company's overall human resource development and management plans and practices which substantially affect many employee-related activities such as education and training, recruitment, hiring, recognition and so on.

2. Employee involvement (B42)

To achieve a company's quality and performance objectives, it is required to have management practices and specific mechanics for promoting employee contributions, both individually and in groups.

3. Employee education and training (B43)

One main goal of employee education and training is to allow a company's employees to understand the jobs assigned and to perform them correctly.

4. Employee performance and recognition (B44)

This criterion concerns how a company recognises, promotes, compensates, rewards and provides feedback to employees, based mainly on each employee's achievement of the quality and performance goals.

5. Employee well-being and morale (B45)

This criteria deals with well-being and morale factors such as health, safety, satisfaction and ergonomics to be included in the quality improvement activities.

critierion	standard scale for pairwise comparison	critierion
B41	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B42
B41	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B43
B41	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B44
B41	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B45
B42	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B43
B42	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B44
B42	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B45
B43	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B44
B43	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B45
B44	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B45

subsection 2.6: pairwise comparisons between the quality subcriteria in respect of their importance to management of process quality **when considering the success of quality management system in Thai telecommunication industry .**

All these subcriteria can be identified as follows:

1. Design and introduction of quality products and services (B51)

As very first processes, new and/or improved products and services are to be designed and introduced to meet key product and service quality, and company performance requirements.

2. Process management or process quality control (B52)

This category focuses on how a company manage and maintain the quality of production and delivery processes in accordance with product and service design requirements. One example of these activities is handling out-of-control occurrences.

### 3. Business process and support services (B53)

This element deals with the processes and services that support a company's production and service activities. Examples of these processes are finance accounting, software services, sales and marketing, purchasing and administrative services.

### 4. Supplier quality (B54)

Like the company quality, a company also needs to ensure the quality of materials, components and services provided by its suppliers. This can be done by a variety of methods such as audits and receiving inspection.

### 5. Quality assessment (B55)

Quality assessment have means how to assess a company's process, and product and service quality results.

critierion	standard scale for pairwise comparison	critierion
B51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B52
B51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B53
B51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B54
B51	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B55
B52	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B53
B52	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B54
B52	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B55
B53	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B54
B53	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B55
B54	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B55

subsection 2.7: pairwise comparisons between the quality subcriteria in respect of their importance to quality and operational results **when considering the success of quality management system in Thai telecommunication industry.**

All these subcriteria can be identified as follows:

1. Product and service quality results (B61)

This category means current trends and levels for all key measures of product and service quality. Examples of these measures include accuracy, precision, timeliness and after-sales services.

2. Company operational results (B62)

This category means current trends and levels for all key measures of overall company operational performance could address productivity index, waste reduction, cycle time reduction, environmental improvement and more.

3. Business process and support service results (B63)

This criterion deals with current trends and levels for key measures of the quality and performance of business processes and support services.

4. Supplier quality results (B64)

This category deals with current levels and trends for key measures of the quality of suppliers.

critierion	standard scale for pairwise comparison	critierion
B61	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B62
B61	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B63
B61	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B64
B62	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B63
B62	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B64
B63	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B64

subsection 2.8: pairwise comparisons between the quality subcriteria in respect of their importance to customer focus and satisfaction **when considering the success of quality management system in Thai telecommunication industry.**

All these subcriteria can be identified as follows:

1. Customer relationship management (B71)

This element places an emphasis on all procedures determining effective management of relationships with a company's customers. The company should have means for providing information and easy access to ensure that its customers be capable of commenting or complaining, for instance.

2. Customer satisfaction determination (B72)

This element focuses on the methods for determining customer satisfaction. Understanding of market segments and various customer groups is the prerequisite.

3. Customer satisfaction results (B73)

This category means current levels and trends for a company's customer satisfaction. Number of customer complaints may represent one example of these results.

4. Customer satisfaction comparison (B74)

The standard requires a company to describe comparison of its customer satisfaction with key competitors.

5. Future requirements and expectations of customers (B75)

This category deals with how a company determines future customer requirements and expectations. For example, it should know which product and service features can satisfy the customers the most.

critierion	standard scale for pairwise comparison	critierion
B71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B72
B71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B73
B71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B74
B71	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B75
B72	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B73
B72	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B74
B72	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B75
B73	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B74
B73	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B75
B74	+9+8+7+6+5+4+3+2 1-2-3-4-5-6-7-8-9	B75

If you would like to have a copy of this complete thesis, please answer the questions below. I am very pleasure to send it to you after the thesis is already finished.

Name ..... Surname .....

Address .....

.....

Tel. ....



**APPENDIX 2****THE 2ND QUESTIONNAIRE**  
**Questionnaire for Research Study on Quality**  
**Management System****Introduction**

This questionnaire is a part of masteral thesis in Engineering Business Management of The Regional Centre for Manufacturing Systems Engineering. This thesis is aimed to self-assessing quality management system for Thai telecommunication company.

**Purpose**

This questionnaire is aimed to get your opinion about your company's quality management system.

**Scope**

The target group should be at least middle management.

Please be frank and open with your answers. All materials will be treated with strict confidence by the researcher. Your participation in this study is greatly appreciated.

## INSTRUCTION

The following questions are established depending on criteria of two international quality standards: ISO9000 (1987) and The Baldrige Award (1992). They are answered by yes-no statement and by circling around a number as follows:

- 1 represents the worst level
- 3 represents the medium level
- 5 represents the best level
- 2 represents the level between level 1 and 3
- 4 represents the level between level 3 and 5

Please answer the questions which are **applicable** or **relevant** to your operations.

## 1. Questions for quality management system with references to ISO9000 (1987)

### 1.1 Questions for criterion 1: **Quality management**

#### Subcriterion 1: **Management responsibility**

a) Management has defined quality policy.	1 2 3 4 5
b) Management has defined responsibilities of people whose work affects quality (eg through an organisation chart or job responsibility).	1 2 3 4 5
c) Management conducts activities to verify effectiveness of design, production, installation and service activities.	1 2 3 4 5
d) A management representative has been designated to be responsible for quality.	1 2 3 4 5
e) Management conducts regular review meetings to discuss the quality system. Records of these meetings are kept.	1 2 3 4 5

#### Subcriterion 2 : **Quality system**

a) Your organisation has prepared procedures to ensure that product conforms to the requirements.	1 2 3 4 5
b) Your organisation has effectively implemented those procedures.	1 2 3 4 5
c) Your organisation documents those procedures.	1 2 3 4 5
d) Your organisation has provided adequate resources needed to meet required quality objectives.	1 2 3 4 5
e) Your organisation's monitoring activities ensure the compatibility of design, production process, inspection and testing, installation, and relevant documentation.	1 2 3 4 5
f) Your organisation identifies acceptance criteria of all specified requirements.	1 2 3 4 5
g) Your organisation develops the measurement requirements.	1 2 3 4 5

### Subcriterion 3: **Internal quality audit**

a) Internal quality audits are planned, conducted and documented.	1 2 3 4 5
b) The internal quality audits are prioritised based on importance of auditing area to the quality system.	1 2 3 4 5
c) Corrective actions arise from the audits.	1 2 3 4 5
d) Management reviews the effectiveness of corrective actions.	1 2 3 4 5

### Subcriterion 4: **Training**

a) Qualifications, in terms of education, training and experience, exist for each employee whose work affects quality.	1 2 3 4 5
b) Training needs are identified.	1 2 3 4 5
c) Your organisation provides such training where needs exist.	1 2 3 4 5
d) Your organisation maintains training records.	1 2 3 4 5
e) Your organisation motivates all employees toward quality performance	1 2 3 4 5

## 1.2 Questions for criterion 2: **Product definition**

### Subcriterion 1: **Contract review**

a) A contract is reviewed with customer.	1 2 3 4 5
b) Customer requirements are fully defined.	1 2 3 4 5
c) The customer requirements are within organisation capabilities.	1 2 3 4 5
d) Differences between customer and organisation are resolved.	1 2 3 4 5
e) The contract and customer requirements records are maintained.	1 2 3 4 5

### Subcriterion 2 : Design input

a) Do your organisation design any products (including services)? ( ) Yes                      ( ) No  <i>Note</i> If an answer is no, please go to questions for criterion 4	
b) Sources of design input (eg design personnel, test equipment, etc.) are identified.	1 2 3 4 5
c) They are documented.	1 2 3 4 5

### 1.3 Questions for criterion 3: Design and development

#### Subcriterion 1: Design control

a) Your organisation has procedures for controlling and verifying product design.	1 2 3 4 5
b) Such design satisfies customer requirements.	1 2 3 4 5
c) Relationships among functions involved in the design process as well as interfaces between the design process and other process elements are identified.	1 2 3 4 5

#### Subcriterion 2: Design and development planning

a) Your organisation has procedures for design planning and development process	1 2 3 4 5
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#### Subcriterion 3 : Design output

a) Your organisation has defined its types of design output (eg blueprints, design checklists, etc.).	1 2 3 4 5
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**Subcriterion 4 : Design verification**

a) Your organisation has procedures to verify the achievement of input requirements. At least two of the following methods (design reviews, qualification tests, alternative calculations or comparison with proven designs) should be incorporated	1 2 3 4 5
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**Subcriterion 5: Design changes**

a) Design changes are verified depending on their own causes.	1 2 3 4 5
b) They are approved.	1 2 3 4 5

**1.4 Questions for criterion 4: Quality documentation****Subcriterion 1: Document control**

a) Your organisation has procedures to create quality-related documents.	1 2 3 4 5
b) Types of such documents have been identified.	1 2 3 4 5
c) All documents are available where needed.	1 2 3 4 5
d) Your organisation has procedures to discard outdated documents.	1 2 3 4 5

**Subcriterion 2: Quality records**

a) Your organisation has procedures to create quality records.	1 2 3 4 5
b) The quality records present effective operation of the quality system.	1 2 3 4 5
c) The quality records report status of the required quality levels and actions taken corresponding to nonconformances.	1 2 3 4 5
d) All records are readily retrievable by all concerned to use them.	1 2 3 4 5
e) Your organisation has procedures for discarding obsolete records.	1 2 3 4 5

1.5 Questions for criterion 5: **Vendor assurance****Subcriterion 1: Purchasing**

<p>a) Do your organisation purchase any materials, products or equipment?</p> <p><input type="checkbox"/> Yes                      <input type="checkbox"/> No</p> <p><i>Note. If your answer is no, please go to subcriterion 2: Customer-supplied product</i></p>	
b) There are procedures for planning, controlling and documenting the procurement of materials.	1 2 3 4 5
c) There are procedures for communicating to suppliers in an unambiguous way.	1 2 3 4 5
d) There are procedures for verifying the conformity of purchased materials.	1 2 3 4 5
e) Appropriate supplier records are monitored.	1 2 3 4 5

**Subcriterion 2 : Customer - supplied products**

<p>a) Has your organisation got any materials or products supplied by its customers?</p> <p><input type="checkbox"/> Yes                      <input type="checkbox"/> No</p> <p><i>Note. If answer is no, please go to questions for subcriterion 3</i></p>	
b) Your organisation has procedures for verifying incoming customer-supplied materials or products to determine conformance with respect to features, quantity and condition.	1 2 3 4 5
c) Your organisation keeps customer-supplied products or materials safe.	1 2 3 4 5
d) Your organisation reports to the customer any occurrences of nonconformance, shrinkage, damage, etc., affecting the customer-supplied products or materials.	1 2 3 4 5

**Subcriterion 3: Receiving inspection and testing**

a) Your organisation has procedures for verification of receiving materials.	1 2 3 4 5
b) Verification methods are documented. Results are recorded.	1 2 3 4 5
c) Output exempted from this receiving verification should be traceable in case of recall .	1 2 3 4 5

## 1.6 Questions for criterion 6: **Handling and delivery**

### Subcriterion 1: **Product identification and traceability**

a) If appropriate and/or if required by customer contract, legal requirement or regulatory requirement, your organisation has a documented system for identified products.	1 2 3 4 5
b) If appropriate and/or if required by customer contract, legal requirement or regulatory requirement, your organisation has a documented system for tracing the origin, application and/or location of the products.	1 2 3 4 5

### Subcriterion 2: **Inspection and test status**

a) Organisation has procedures to identify inspection and test status of products.	1 2 3 4 5
b) Such procedures provide traceability to verification activity.	1 2 3 4 5

### Subcriterion 3: **Handling, storage, packing and delivery**

a) Your organisation has means for handling of products to prevent damage or deterioration.	1 2 3 4 5
b) Your organisation has means for storage of the products to prevent damage or deterioration.	1 2 3 4 5
c) Packaging does protects the products.	1 2 3 4 5
d) Final products are controlled from final inspection to acceptance by customers.	1 2 3 4 5

## 1.7 Questions for criterion 7: **Production**

### Subcriterion 1: **Process control**

a) Process areas affecting quality have been clearly stated.	1 2 3 4 5
b) Quality-related processes are in control and capable.	1 2 3 4 5
c) Special processes which are of high importance to quality are implemented.	1 2 3 4 5
d) Documentation exists for normal and special processes.	1 2 3 4 5



**Subcriterion 2: Inspection and test**

a) Your organisation has procedures for verifying conformance to requirements at each critical process points including input, in-process and output.	1 2 3 4 5
b) Verification methods are documented. Results are recorded.	1 2 3 4 5
c) Products exempted from such verification should be traceable in case of recall.	1 2 3 4 5

**Subcriterion 3: Inspection, measuring and test equipment**

a) Your organisation has procedures for selecting equipment capable of required accuracy and precision.	1 2 3 4 5
b) The equipment is calibrated against national standards or equivalent at prescribed intervals.	1 2 3 4 5
c) Your organisation fully reports calibration procedures and results.	1 2 3 4 5
d) Your organisation has procedures for verifying such results when pieces of the equipment are non-conforming.	1 2 3 4 5
e) Your organisation has procedures for preserving accuracy and fitness for use of equipment.	1 2 3 4 5

**Subcriterion 4: Statistical techniques**

a) Are the statistical techniques used in your organisation? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>Note</i> If your answer is no, please go to questions for criterion 8	
b) Your organisation has procedures for identifying the statistical techniques used in assessing process capability and product characteristics.	1 2 3 4 5

### 1.8 Questions for criterion 8: **Problem identification and correction**

#### Subcriterion 1: **Control of non-conforming product**

a) Your organisation has procedures for segregating and disposing nonconforming products to prevent from reaching its customers.	1 2 3 4 5
b) Your organisation has procedures for reworking, acceptance, rejection and re-grade of products.	1 2 3 4 5
c) Your organisation documents all of the above.	1 2 3 4 5

#### Subcriterion 2: **Corrective action**

a) Corrective action procedures are established and consistently followed.	1 2 3 4 5
b) Postaudits are conducted to determine the effectiveness of corrective action.	1 2 3 4 5

#### Subcriterion 3: **Servicing**

<p>a) Are there aftersale servicing requirements in a customer contract?</p> <p style="text-align: center;"><input type="checkbox"/> Yes                      <input type="checkbox"/> No</p> <p><i>Note. If your answer is no, please go to Questions for criterion 1: Senior executive leadership</i></p>	
b) Your organisation has procedures for performing contractual required services.	1 2 3 4 5
c) Your organisation has procedures for verifying that such services meet established customer requirements.	1 2 3 4 5

## **2. Questions for quality management system with references to the Baldrige Award**

### **2.1 Questions for criterion 1: Senior executive leadership**

#### **Subcriterion 1: Senior executive leadership**

a) Level of senior executives' leadership, personal involvement and visibility in quality related activities.	1 2 3 4 5
b) The senior executives communicate and reinforce customer focus and quality values with manager, supervisors and all employees.	1 2 3 4 5
c) The senior executives evaluate and improve the effectiveness of their personal leadership and improvement.	1 2 3 4 5

#### **Subcriterion 2: Management for quality**

a) Your organisation's customer focus and quality values are translated into requirements for all managers and supervisors, including their principal roles and responsibilities within their units and those with other units.	1 2 3 4 5
b) Overall organisation and work units quality and operational performance are reviewed. Your organisation assists units that are not performing according to plans.	1 2 3 4 5
c) Your organisation evaluates and improves managers' and supervisors' effectiveness in fostering the customer focus and quality values.	1 2 3 4 5

#### **Subcriterion 3: Public responsibility**

a) Organisation adds its public responsibilities into its quality values and practices.	1 2 3 4 5
b) Organisation anticipates public concerns, and assess potential impacts on society of its products, services and operations.	1 2 3 4 5

## 2.2 Questions for criterion 2: **Information and analysis**

### Subcriterion 1: **Scope and management of quality and performance data and information**

a) Your organisation has criteria for selecting types of data and information used for planning, day-to-day management and evaluation of quality.	1 2 3 4 5
b) The types of data and information include: (1) customer-related, (2) internal operations, (3) company performance and (4) cost and financial.	1 2 3 4 5
c) Each of such types supports quality improvement.	1 2 3 4 5
d) Your organisation has an approach for ensuring that data and information get more reliable, quicker and accessible.	1 2 3 4 5
e) Your organisation evaluates and improves the scope and quality of its data and information.	1 2 3 4 5

### Subcriterion 2: **Competitive comparisons and benchmarks**

a) Your organisation has criteria for selecting data and information for competitive comparisons and benchmarks.	1 2 3 4 5
b) Types of such data and information include: (1) product and service quality, (2) customer satisfaction, (3) internal operations and (4) supplier performance.	1 2 3 4 5
c) Competitive and benchmark data are used to encourage new ideas and improve understanding of processes.	1 2 3 4 5
d) Your organisation evaluates and improves the scope, sources and uses of the competitive and benchmark data.	1 2 3 4 5

### Subcriterion 3: Analysis and uses of company-level data

a) Organisation customer related data are aggregated, analysed and translated into actionable information for quality improvement.	1 2 3 4 5
b) Organisation internal operation performance data are aggregated, analysed and translated into actionable information for quality improvement.	1 2 3 4 5
c) Organisation cost, financial and market data are aggregated, analysed and translated into actionable information for quality improvement.	1 2 3 4 5
d) Your organisation evaluates and improves the effectiveness of analysis.	1 2 3 4 5

### 2.3 Questions for criterion 3: Strategic quality planning

#### Subcriterion 1: Strategic quality and company performance planning process

a) Your organisation develops the short-term (1-2 years) and long - term ( 3 years or more) strategies and business plans for achievement of quality and performance requirements.	1 2 3 4 5
b) This planning process consider: (1) customer requirements , (2) financial , marketing, technical and societal risks, (3) company capabilities, (4) competitor capabilities, and (5) supplier capabilities.	1 2 3 4 5
c) Your organisation evaluates and improves its planning process.	1 2 3 4 5

#### Subcriterion 2: Quality and performance plans

a) Your organisation summarises its key short-term quality and company performance plans and goals.	1 2 3 4 5
b) Your organisation summarises its key long-term quality and company performance plans and goals.	1 2 3 4 5

## 2.4 Questions for criterion 4: **Human resource development and management**

### Subcriterion 1: **Human resource management**

a) Human resource plans supports your organisation 's quality and performance plans.	1 2 3 4 5
b) Such plans include: (1) education, training and related skill development, (2) recruitment, (3) involvement, (4) empowerment and (5) recognition.	1 2 3 4 5
c) Different training and development needs are clearly defined for different types of employees.	1 2 3 4 5
d) Your organisation evaluates and improves the effectiveness of the entire work force by using all employee-related data.	1 2 3 4 5

### Subcriterion 2: **Employee involvement**

a) Your organisation has mechanisms to promote employee contributions, empowerment, responsibility and innovation.	1 2 3 4 5
b) Your organisation evaluates and improves the effectiveness of involvement of all types of employees.	1 2 3 4 5

### Subcriterion 3: **Employee education and training**

a) Different needs for the types and amounts of quality and related education and training are contributed to different types of employees.	1 2 3 4 5
b) Your organisation conducts summary and trends in quality and related education and training received by the employees.	1 2 3 4 5
c) The summary and trends address: (1) quality focus of new employees, (2) percent of employees receiving such education and training per employee annually.	1 2 3 4 5
d) Your organisation evaluates and improves the effectiveness of such education and training.	1 2 3 4 5

#### Subcriterion 4: Employee performance and recognition

a) Your organisation recognises, promotes, compensates, rewards and provides feedbacks to employees.	1 2 3 4 5
b) The employees contribute to the approaches above.	1 2 3 4 5
c) The actual performance and recognition trend data are considered.	1 2 3 4 5
d) Organisation evaluates and improves its performance and recognition processes	1 2 3 4 5

#### Subcriterion 5: Employee well-being and morale

a) Employee well-being and morale factors such as health, safety, satisfaction and ergonomics are considered in quality improvement activities.	1 2 3 4 5
b) Your organisation has procedures for mobility, flexibility, and retraining in job assignments to support employee development.	1 2 3 4 5
c) Organisation offers special services, facilities and opportunities to employees. These might include counseling, assistance, recreational education and more.	1 2 3 4 5
d) Trends in key indicators of the well-being and morale are considered. This should address, as appropriate; satisfaction, safety, absenteeism, turnover, strikes and worker compensation.	1 2 3 4 5

### 2.5 Questions for criterion 5: Management of process quality

#### Subcriterion 1: Design and introduction of quality products and services

a) Do your organisation conduct any product designs by itself? ( ) Yes                      ( ) No <i>Note. If your answer is no, please go to question e).</i>	
b) Your organisation develops the designs of products, services and processes.	1 2 3 4 5
c) Customer requirements are translated into design requirements.	1 2 3 4 5
d) All quality requirements are addressed early in the overall design process as appropriate.	1 2 3 4 5

e) The design requirements are expected to be translated into production and delivery requirements.	1 2 3 4 5
f) A plan for selecting , setting and monitoring key process characteristics is developed.	1 2 3 4 5
g) Your organisation evaluates and improves the effectiveness of its designs and design processes.	1 2 3 4 5

### Subcriterion 2: Process management or process quality control

a) Your organisation maintains the quality of processes in accordance with design requirements. This should address types and frequencies of measurements, and how to handle out-of-control occurrences.	1 2 3 4 5
b) Your organisation evaluates and improves the effectiveness of processes. This should address, as appropriate: process simplification, waste reduction, process research and testing and use of alternative technologies.	1 2 3 4 5

### Subcriterion 3: Business process and support services

(Include activities and operations involving finance and accounting, software services, sales, marketing, information services, purchasing, personnel, legal services, plants and facilities management, basic research and development, secretarial, administrative services and so on)

a) Your organisation manages its business processes and support services.	1 2 3 4 5
b) The following are considered: process performance data, process and organisational simplification, use of alternative technologies, benchmark information , information from customers of business processes and support services and challenging goals.	1 2 3 4 5



**Subcriterion 4: Supplier quality**

a) Your organisation has procedures to define and communicate its quality requirements to suppliers.	1 2 3 4 5
b) Your organisation has methods to ensure the suppliers' achievement of quality requirements. Such methods may include audits, process reviews, receiving inspection, certification, testing and rating systems.	1 2 3 4 5
c) Your organisation has current strategies and actions to improve the quality and timeliness of suppliers. These may include partnerships, training, incentives and recognition, and supplier selection.	1 2 3 4 5

**Subcriterion 5: Quality assessment**

a) Your organisation has procedures for assessing and improving its systems, processes, practices, and products and services.	1 2 3 4 5
---	-----------

**2.6 Questions for criterion 6: Quality and operational results****Subcriterion 1: Product and service quality results**

a) Your organisation has trends and current levels for all key measures of product and service quality. Such measures may include accuracy, reliability, timeliness, performance, behaviour, after-sales services, documentation and appearance.	1 2 3 4 5
b) Your organisation has current quality level comparisons with its key competitors. Basis for such comparisons includes independent surveys or studies, benchmarks, and factory evaluation and testing.	1 2 3 4 5

**Subcriterion 2: Company operational results**

a) Your organisation has trends and current levels for key measures of operational performance.	1 2 3 4 5
b) Organisation conducts comparisons with competitors and key benchmarks with the world-class ones.	1 2 3 4 5

**Subcriterion 3: Business process and support services results**

a) Your organisation has trends and current levels for key measures of business process and support services performance.	1 2 3 4 5
b) Your organisation conducts comparisons with competitors and key benchmarks with the world-class ones.	1 2 3 4 5

**Subcriterion 4: Supplier quality results**

a) Your organisation has trends in quality levels of suppliers.	1 2 3 4 5
---	-----------

**2.7 Questions for criterion 7: Customer focus****Subcriterion 1: Customer relationship management**

a) Your organisation develops the strategies and plans to maintain and build relationships with customers.	1 2 3 4 5
b) The most important factors to be taken into account for achieving this are fulfillment of basic customer needs, provision of information to the customers and roles of all customer-contact employees.	1 2 3 4 5
c) Your organisation ensures that complaints and feedback received by all organisation units are resolved promptly and effectively.	1 2 3 4 5
d) Your organisation evaluates and improves its customer relationship management	1 2 3 4 5

**Subcriterion 2: Customer satisfaction determination**

a) Your organisation has methods for determining customer requirements, satisfaction and dissatisfaction. <u>Note</u> Customer dissatisfaction indicators include complains, claims, refunds, repairs, warranty work, warranty costs, incomplete orders.	1 2 3 4 5
b) Your organisation determines customer satisfaction relative to its competitors.	1 2 3 4 5
c) Organisation evaluates and improves such methods above.	1 2 3 4 5

**Subcriterion 3: Customer satisfaction results**

a) Your organisation has trends and levels of its customer satisfaction.	1 2 3 4 5
b) Your organisation has trends and levels of its customer dissatisfaction.	1 2 3 4 5

**Subcriterion 4: Customer satisfaction comparison**

a) Your organisation has trends and levels of its customer satisfaction relative to competitors.	1 2 3 4 5
b) Your organisation has trends and levels of its customer dissatisfaction relative to the competitors.	1 2 3 4 5

**Subcriterion 5: Future requirements and Expectations of customers**

a) Your organisation has procedures for determining future requirements and expectations of customers. <u>Note</u> Examples of the determination of them are the approaches for getting customer-related information and improvement of survey design.	1 2 3 4 5
b) Your organisation projects key product and service features and relative importance of these features to the customers and potential customers.	1 2 3 4 5

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## APPENDIX 3

## AN EXAMPLE OF AHP RESULTS

Full pairwise comparisons (by expert no. 1) between subcriteria under vendor assurance A5 criterion

A5	A51	A52	A53
A51	1	3	2
A52	1/3	1	1/2
A53	1/2	2	1

Original pairwise-comparison matrix (in decimal form)

A5	A51	A52	A53
A51	1.000	3.000	2.000
A52	0.333	1.000	0.500
A53	0.500	2.000	1.000

Summing the entries in each column of the pairwise-comparison matrix

A5	A51	A52	A53
A51	1.000	3.000	2.000
A52	0.333	1.000	0.500
A53	0.500	2.000	1.000
Column totals	1.833	6.000	3.500

Computing the normalised matrix (each element is divided by its column total)

A5	A51	A52	A53
A51	0.546	0.500	0.571
A52	0.182	0.167	0.143
A53	0.273	0.333	0.286
Column totals	1.000	1.000	1.000

Computing the row averages or **relative weights**

A5	Row Average
A51	<b>0.539</b>
A52	<b>0.164</b>
A53	<b>0.297</b>

Original pairwise-comparison matrix (in decimal form) again

A5	A51(.539)	A52(.164)	A53(.297)
A51	1.000	3.000	2.000
A52	0.333	1.000	0.500
A53	0.500	2.000	1.000

Matrix column entries multiplied by relative weights

A5	A51	A52	A53
A51	0.539	0.491	0.595
A52	0.179	0.164	0.149
A53	0.269	0.727	0.297

Summing the row elements

---

A51	3.014
A52	3.004
A53	3.008

---

$$\lambda_{\max} = 3.009$$

$$CI = 0.004 \text{ (RI} = 0.580)$$

$$CR = \mathbf{0.008}$$

## APPENDIX 4

## AN EXAMPLE OF RESULT OF SENSIVITY ANALYSIS

## -Deviation on weight of quality management criterion

Base case

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .331 )	A11 ( .597 )	3.733	3.792	1.255 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .052 )	A21 ( .675 )	3.835	4.051	.135 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .077 )	A31 ( .483 )	3.830	3.856	.297 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		



criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .057 )	A41 ( .675 )	3.887	3.865	.220 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .106 )	A51 ( .663 )	3.375	3.519	.373 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .035 )	A61 ( .176 )	3.423	3.478	.122 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .186 )	A71 ( .460 )	3.997	4.062	.755 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .156 )	A81 ( .222 )	3.567	3.661	.571 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

-10%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .298 )	A11 ( .597 )	3.733	3.792	1.130 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .055 )	A21 ( .675 )	3.835	4.051	.223 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .081 )	A31 ( .483 )	3.830	3.856	.312 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .059 )	A41 ( .675 )	3.887	3.865	.228 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .111 )	A51 ( .663 )	3.375	3.519	.391 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .037 )	A61 ( .176 )	3.423	3.478	.129 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .195 )	A71 ( .460 )	3.997	4.062	.795 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .164 )	A81 ( .222 )	3.567	3.661	.600 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

-20%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .264 )	A11 ( .597 )	3.733	3.792	1.001 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .057 )	A21 ( .675 )	3.835	4.051	.231 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .085 )	A31 ( .483 )	3.830	3.856	.328 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .063 )	A41 ( .675 )	3.887	3.865	.244 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .117 )	A51 ( .663 )	3.375	3.519	.412 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .039 )	A61 ( .176 )	3.423	3.478	.136 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .205 )	A71 ( .460 )	3.997	4.062	.835 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .170 )	A81 ( .222 )	3.567	3.661	.622 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

-30%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .231 )	A11 ( .597 )	3.733	3.792	.876 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .060 )	A21 ( .675 )	3.835	4.051	.243 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .089 )	A31 ( .483 )	3.830	3.856	.343 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .065 )	A41 ( .675 )	3.887	3.865	.251 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .122 )	A51 ( .663 )	3.375	3.519	.429 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .040 )	A61 ( .176 )	3.423	3.478	.149 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .214 )	A71 ( .460 )	3.997	4.062	.872 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .179 )	A81 ( .222 )	3.567	3.661	.655 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

-40%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .198 )	A11 ( .597 )	3.733	3.792	.751 ( 2 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .062 )	A21 ( .675 )	3.835	4.051	.251 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .092 )	A31 ( .483 )	3.830	3.856	.355 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		



criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .068 )	A41 ( .675 )	3.887	3.865	.263 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .127 )	A51 ( .663 )	3.375	3.519	.447 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .043 )	A61 ( .176 )	3.423	3.478	.160 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .223 )	A71 ( .460 )	3.997	4.062	.909 ( 1 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .187 )	A81 ( .222 )	3.567	3.661	.685 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

-50%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .165 )	A11 ( .597 )	3.733	3.792	.626 ( 3 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .065 )	A21 ( .675 )	3.835	4.051	.263 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .095 )	A31 ( .483 )	3.830	3.856	.366 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .070 )	A41 ( .675 )	3.887	3.865	.271 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .133 )	A51 ( .663 )	3.375	3.519	.468 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .044 )	A61 ( .176 )	3.423	3.478	.153 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .233 )	A71 ( .460 )	3.997	4.062	.949 ( 1 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .195 )	A81 ( .222 )	3.567	3.661	.714 ( 2 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

+10%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .364 )	A11 ( .597 )	3.733	3.792	1.380 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .049 )	A21 ( .675 )	3.835	4.051	.199 ( 6 )
	A22 ( .325 )	4.500		
A3 ( .073 )	A31 ( .483 )	3.830	3.856	.282 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .054 )	A41 ( .675 )	3.887	3.865	.184 ( 7 )
	A42 ( .325 )	3.820		
A5 ( .102 )	A51 ( .663 )	3.375	3.519	.359 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .033 )	A61 ( .176 )	3.423	3.478	.115 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .177 )	A71 ( .460 )	3.997	4.062	.658 ( 3 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .148 )	A81 ( .222 )	3.567	3.661	.721 ( 2 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

+20%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .398 )	A11 ( .597 )	3.733	3.792	1.380 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .047 )	A21 ( .515 )	3.835	4.051	.190 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .069 )	A31 ( .483 )	3.830	3.856	.266 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .052 )	A41 ( .675 )	3.887	3.865	.201 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .095 )	A51 ( .663 )	3.375	3.519	.334 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .032 )	A61 ( .176 )	3.423	3.478	.111 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .167 )	A71 ( .460 )	3.997	4.062	.681 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .140 )	A81 ( .222 )	3.567	3.661	.512 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

+30%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .432 )	A11 ( .597 )	3.733	3.792	1.638 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .044 )	A21 ( .675 )	3.835	4.051	.178 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .065 )	A31 ( .483 )	3.830	3.856	.251 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		



criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .048 )	A41 ( .675 )	3.887	3.865	.186 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .090 )	A51 ( .663 )	3.375	3.519	.317 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .030 )	A61 ( .176 )	3.423	3.478	.104 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .158 )	A71 ( .460 )	3.997	4.062	.644 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .133 )	A81 ( .222 )	3.567	3.661	.487 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

+40%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .463 )	A11 ( .597 )	3.733	3.792	1.756 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .042 )	A21 ( .675 )	3.835	4.051	.170 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .062 )	A31 ( .483 )	3.830	3.856	.239 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .046 )	A41 ( .675 )	3.887	3.865	.178 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .085 )	A51 ( .663 )	3.375	3.519	.299 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .028 )	A61 ( .176 )	3.423	3.478	.097 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .149 )	A71 ( .460 )	3.997	4.062	.607 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .125 )	A81 ( .222 )	3.567	3.661	.458 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

+50%

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A1 ( .497 )	A11 ( .597 )	3.733	3.792	1.885 ( 1 )
	A12 ( .229 )	3.789		
	A13 ( .073 )	3.816		
	A14 ( .101 )	4.133		
A2 ( .039 )	A21 ( .675 )	3.835	4.051	.158 ( 7 )
	A22 ( .325 )	4.500		
A3 ( .058 )	A31 ( .483 )	3.830	3.856	.224 ( 5 )
	A32 ( .189 )	4.000		
	A33 ( .097 )	4.000		
	A34 ( .123 )	3.500		
	A35 ( .108 )	4.000		

criteria ( weight )	subcriteria ( weight )	score of each subcriterion	value of each criterion	achievement value of each criterion ( rank )
A4 ( .057 )	A41 ( .675 )	3.887	3.865	.220 ( 6 )
	A42 ( .325 )	3.820		
A5 ( .106 )	A51 ( .663 )	3.375	3.519	.373 ( 4 )
	A52 ( .142 )	4.167		
	A53 ( .195 )	3.532		
A6 ( .035 )	A61 ( .176 )	3.423	3.478	.122 ( 8 )
	A62 ( .507 )	3.458		
	A63 ( .317 )	3.542		
A7 ( .186 )	A71 ( .460 )	3.997	4.062	.755 ( 2 )
	A72 ( .125 )	4.030		
	A73 ( .327 )	4.204		
	A74 ( .088 )	-		
A8 ( .156 )	A81 ( .222 )	3.567	3.661	.571 ( 3 )
	A82 ( .518 )	3.777		
	A83 ( .260 )	3.509		

## APPENDIX 5

## LIST OF EXPERTS

Name	Work Position	Address	Reason for Selection
I. Mr. Boonkerd Dhamawasee	Director of Association	Quality Control Promotion Association of Thailand	quality expertise and highly experienced in telecommunications
II. Dr. Ekachai Leelaradsamee	Associate Professor	Faculty of Electrical Engineering(Electronics), Chulalongkom University	expertise in electronics
III. Mr. Phasit Thamrongsiriwat	Director of Research and Development	Telephone Organisation of Thailand	highly experienced in public telephone
IV. Dr. Prasit Prapinmongkolkam	Professor	Faculty of Electrical Engineering(Telecom.) Chulalongkom University	expertise in academic telecommunications
V. Mr. Supin Ungrangsee	Corporate Development Manager & Assistant to the President	ABC Electronic Ltd.	representative of the selected company

## APPENDIX 6

## LIST OF THE 2nd QUESTIONNAIRE'S RESPONDENTS

Name	Work Position	Division
1.Mr.Adijet Wongsaku	Transmission Manager	Network Implementation
2.Mr.Klaharn Rosesukon	Factory Manager	Mobile Phones
3.Mr.Lertrit Sa-Nguanchom	Quality Manager	Manufacturing
4.Mr.Santi Prakkamakul	Telecom System Ser-	System Services
5.Mr.Sarayut Chaiwongkiat	Vice Manager Sales Manager	Telecom Systems
6. A	B	Finance & Administration
7. C	D	Finance & Administration
8. E	F	Finance & Administration
9. G	H	Finance & Administration
10. I	J	Finance & Administration
11. K	L	Human Resource
12. M	N	Marketing Communication
13. O	P	Marketing Communication
14. Q	R	Marketing Communication
15. S	T	Marketing Communication
16. U	V	Marketing Communication
17. W	X	Corporate Development
18. Y	Z	Network Implementation
19. a	b	Business Networks
20. c	d	Logistic Department
21. e	f	Defense Systems

## VITA

Thanagorn Engamornrattana was born on September 4th, 1974 at Pomprab, Bangkok. He has received a bachelor's degree in industrial engineering from Chulalongkorn University since the academic year 1995. Thanagorn has studied for the degree of master of engineering at the Regional Centre for Manufacturing Systems Engineering since 1996.

