Relative Importance of the Factors under the ISO-10015 Quality Management Guidelines that Influence the Service Quality of Certification Bodies

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This study presents a suitable methodology for evaluating the relative importance of factors under the ISO-10015 standard that influence the service quality of certification bodies. Specifically, this study applied the fuzzy analytic hierarchy process (FAHP) method to select the most appropriate factors influencing the service quality of certification bodies. The key research approaches involved the FAHP method and corresponding questionnaires distributed to experts on the Taiwan Training Quality System.

In the evaluation process, a consistency index (C.I) and consistency ratio (C.R) are used to evaluate the consistency of the assessment process. The C.I and C.R

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values for both objects and criteria were lower than 0.1, indicating satisfactory consistency. According to the overall weights assigned to the objects and criteria, the following three factors most strongly indicated improvement directions for the service quality of certification bodies: customer relationship management processes (weight: 33.18%), human resource quality (weight: 17.00%), and financial performance (weight: 14.88%). According to the results, the FAHP method facilitates evaluating, determining, and ranking factors influencing the service quality of certification bodies according to their weights.

This study provides practical findings regarding the provision of service by certification bodies. Furthermore, the current findings can serve as a reference for future research.

1   Introduction

The top priority of certification bodies is to provide professional-quality services to certified companies. Therefore, this study explored the ISO-10015 Quality Management Guidelines to ascertain the relative importance of factors influencing the service quality of certification bodies.

The ISO-10015 standard is among the ISO-9000 standards, and it defines the training criteria for an organization's human resources. The purpose of these standards is to enable organizations to determine the training operations that promote organizational vision and objectives.

Quality management systems involve compliance auditing conducted by independent third-party certification bodies in accordance with the requirements of the ISO-9000 quality management system. Such requirements include the objectivity and impartiality of the certification services.

The ISO-9000 quality management system has been implemented for approximately 40 years. Organizations use this system to enhance the competitiveness of their management tools, ensuring compliance with customer

requirements and expectations. Thus, such organizations achieve customer satisfaction and realize continued improvements in their management of standards. This has always been the principal emphasis of human resource management, which posits that organizations must meet product requirements, and these consequently affect the implementation of appropriate training and decisions on necessary staff functions (ISO 9001: 2015). Therefore, regardless of the awareness level of the members of a certification body, improving service quality is the only means of enhancing customer respect and competitiveness.

2   Literature Review

In our literature review, we focused on the ISO-10015 Quality Management Guidelines and the perspectives of the audit teams of certification bodies. Accordingly, in the following subsections, we detail the relative importance of relevant factors influencing the service quality of certification bodies.

2.1   ISO-10015 Quality Management Guidelines

Because of the need for an appropriate tool for ensuring the quality of training, the ISO 10015:2005 Quality Management Guidelines were developed, negotiated, and refined by a panel of experts worldwide and issued by the ISO secretariat in 2005. As a member of the ISO 9000 quality management family, ISO 10015 is a guideline for education and training within organizations, and it ensures that employees within an organization are well trained and competent to "meet the organization's commitment to supply products of required quality" (ISO 10015:2005). ISO 10015 requires compliance with a standard process; one of its benefits is that professionals in human resource departments can perform all aspects of a training design process without being asked by management to exclude any steps. Thus, the standard ensures that managers remain committed to best practices in training, and this thus promotes the overall efficiency of organizations. An organization's objectives for continual improvement, including the performance of its personnel, might be affected by numerous internal and external factors that include changes in the market, technology, innovation, and customer and stakeholder requirements. Such

changes may compel an organization to analyze its competence-related needs. An effective means of addressingthese needs is to implement a training process according to the training cycle illustrated in Figure 1 as (ISO 10015:2005).
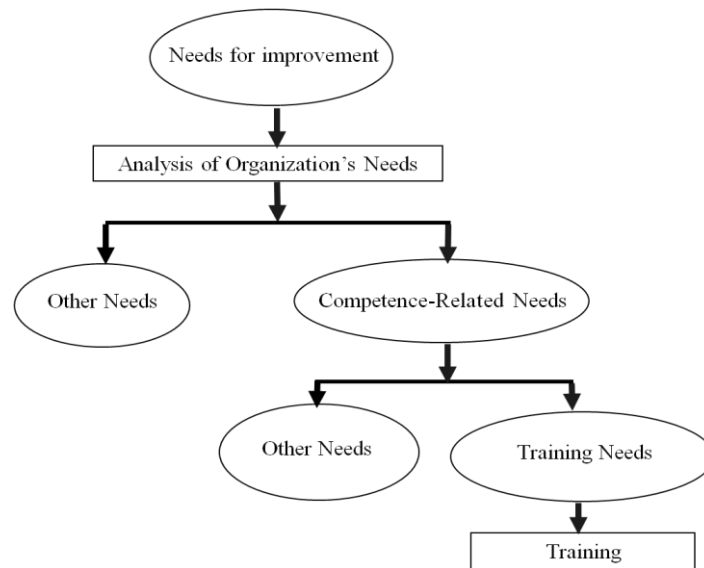

Figure 1. Training Cycle as Presented in ISO 100015:2005 (Source: ISO 100015:2005, Section 1 "Introduction," Figure 1)

2.2   ISO 10015 Training Cycle

Figure 2 presents the training cycle involved in the ISO 10015 Quality Management Guidelines, indicating that this systematic process comprises four stages: (1) define training needs, (2) design and plan training, (3) provide for training, and (4) evaluate training outcomes. ISO-10015 also requires a monitoring mechanism that documents each step of the process to ensure step-by-step compliance with standardized procedures and performance criteria. The monitoring mechanism examines the outcomes of training programs to determine the effectiveness of such programs. This is an ongoing process that can be considered a cycle for encouraging continual improvement.
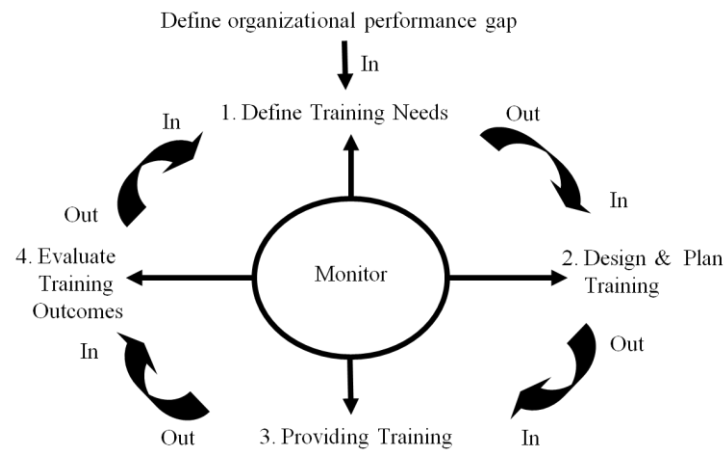
Figure 2. ISO-10015 Training Cycle

2.3   Training System Involved in ISO-10015 Quality Management Guidelines

2.3.1   Human Resource Quality

Human resources, the main component of production forces, engage in production and other economic activities directly and indirectly and ensure that a company's production mechanisms are efficiently used to satisfy its needs (Armstrong, 1995; Blaga *et al.*, 2014).

Enterprises implement training operations with the objective of improving the quality of manpower, thereby improving organizational efficiency. Thus, all departments should have complete access to basic knowledge and skills, and they must particularly promote positive motivation and self-development (Li, 2001).

Human capital is the foundation of organizational improvement and innovation. Accordingly, organizations can integrate ISO 10015 as a planning tool to establish a human capital management framework in order to systemize training processes. Thus, such organizations can easily track the benefits of the training processes (Wang *et al.*, 2007).

Organizations must train their human resources according to changes in internal and external environments, as well as changes in strategies. Therefore, selecting appropriate educational strategies is very crucial for organizations; such strategies can be directed toward organizational goals through improving managers' and employees' knowledge (Mir Sepasi, 2012).

Because knowledge phase-out and update speed are bound to networking and digitalization, companies are compelled to prioritize human resource quality (Zhou, 1996). Upgrading labor education and professional skills can improve productivity and reduce costs (Wu, 1996). Ying (2016) identified the visibility of the training approach as one of the fundamental provisions for improving human resource quality for Tourism in Indonesia.

A profile of best practices provides a useful benchmark for organizations to assess their human resource activities. Bottom-line payoffs for the successful integration of human resource management practices and total quality management are manifested in reduced costs, increased product reliability, greater customer satisfaction, and shorter product development cycles (Blackburn et al., 1993).

2.3.2   Personnel Training Development

Training and development activities enable organizations to adapt, compete, excel, innovate, produce, be safe, improve services, and reach goals. In the United States alone, organizations spend approximately $135 billion per year in training individuals (Patel, 2010; Salas et al., 2012).

Personnel training can be divided into "education" and "training." Education refers to the cultivation of personal knowledge and ability, in addition to professional knowledge and skills (McGhee & Thayer, 1961). Because training is part of a learning process, learning from experience helps employees to develop appropriate habits, skills, knowledge, and attitudes through appropriate thought and action. Training is necessary for both new and existing employees to develop and improve basic skills in both current and future work (Dessler, 1994; Hall, 1986).

Making a clear distinction between education and training is difficult. Nevertheless, integrating the two concepts is crucial (Buckley et al., 1990; Camp et al., 1986; Goldstein, 1974).

Personnel training and development has become a vital strategy for industrial upgrade and development. Enterprises can effectively respond to a rapidly changing economy and society only by implementing vocational training systems that can enhance employee performance continually and systematically (Lin *et al*., 2012).

2.3.3 Training Programs

The procedures involved in training design and planning are outlined as follows: making decisions on the attribution, roles, and responsibilities of the environmental training, training for outsourced employees, and establishing a training program and offering it to all employees of an organization, regardless of their position. (ISO 10015/2001)

Attia *et al*. (2012) provided recommendations for setting standards for evaluating training programs. Knowledge gained was reported to be a vital measure of the effectiveness of a training program. According to the results of a learning evaluation process, trainees considered the value of selling skills, company information, and behavioral training topics to be valuable and the role of the instructor to be crucial.

Regarding the analysis of staff training needs, scholars have proposed various ideas. Front-end analysis, needs assessment, and needs analysis are the most widely used, but they are complex and require clarification (Jian, 1993). Practitioners in the training field evaluate training programs on the basis of the principles of reaction, learning, behavior, and results. Training programs are subject to performance appraisal, and they entail coaching, creative management, presentation skills, supervisory skills, and sales, as well as an outdoor-based program (Kirkpatrick, 1994).

2.4 Operational Process Management of ISO-10015 Quality Management Guidelines

2.4.1 Customer Relationship Management Processes

For a successful implementation of customer relationship, customer relationship

management (CRM) must be integrated into the overall operations of a firm (Piercy, 2009). For example, interactive buyer–seller relationships can be established by implementing strategies that include establishing bonus and loyalty programs, providing dynamic pricing, developing service quality programs, engaging in value offers and deals, and establishing social media websites and Internet blogging platforms (Lo *et al*., 2007; Greenberg, 2009; Peppers *et al*., 2010; Kaplan *et al*., 2010; Nguyen, 2011). Advances in CRM must consider issues related to social media, fairness, and trust (Nguyen *et al*., 2012).

Peppers *et al.* (2010) reported that excessive firms have adopted CRM without appropriate preparation. They maintained that the mechanics of implementing CRM are complex. However, despite the complexity of CRM implementation, sophisticated analyses, concepts, or advanced technologies are not necessarily required for the implementation to be successful (Boulding *et al*., 2005, Nguyen *et al*., 2012).

Customer communication must include (1) providing information related to products and services; (2) handling enquiries, contracts, and orders, including changes in orders; (3) obtaining customer feedback related to products and services, including customer complaints; (4) handling or controlling customer property; and (5) establishing specific requirements for contingency actions. When determining the requirements for products and services that are to be offered to customers, an organization must ensure the following: (1) The organization must ensure that the requirements for the products and services are defined, with such requirements including any applicable statutory and regulatory conditions as well as conditions that are considered to be necessary by the organization; and (2) the organization must ensure that it can meet the claims for the offered products and services (ISO 9001:2015).

CRM includes the following processes: (1) analysis and refinement, (2) knowledge discovery, (3) marketing planning, and (4) customer interaction. Therefore, these processes constitute a management process cycle is shown in equation (3) (Swift, 2001).
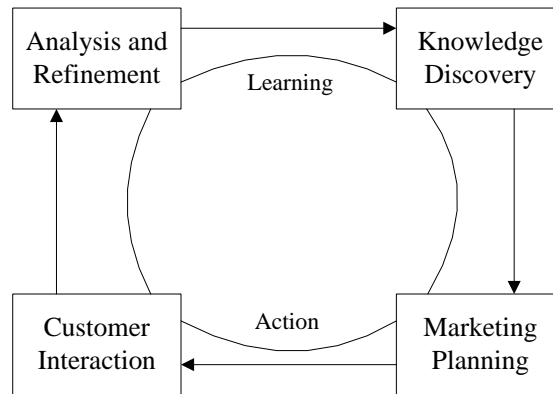
Figure 3. Customer Relationship Cycle (Swift, 2001)

2.4.2 Career Development Plan

Kuijpers *et al.* (2012) explained that the choice of occupation is engendered by an interaction among career-oriented self-efficacy, outcome expectations, and goals. Confidence in efficacy and expectations about the outcomes of actions are considered to be the result of two learning processes: positive or negative reinforcement that results from successful or failed learning experiences, respectively, and "vicarious learning," which is essentially the imitation of behavior that is valued positively by the group one wants to be a part of. Self-confidence in addition to positive expectations about one's actions generates occupational desires.

The first major step in the direction of service operations management is taken at Harvard Business School and led to an experiment that involved an academic course combining service operations and service marketing (Ghobadian *et al.*, 1994). A specific definition of service quality is provided for measuring the extent to which a delivered service meets customer expectations. The perception of quality is influenced not only by the service outcome but also by the service process (Sasser *et a.*, 1978).

The improvement in the ability to perform a job effectively and attain both job satisfaction and customer satisfaction varies with employee tenure, as demonstrated by Schlesinger and Zornitsky (1991). To improve service delivery and output to meet the expectations of internal customers, internal service providers must be

appropriately trained to enhance their skills in executing practical operations and establishing relationships with customers (Jones, 1996).

Regarding internal business processes, measures such as service errors, response to complaints, and employee turnover have been actively assessed by hotels. Innovation and learning have also been assessed in numerous new markets in terms of the following measures: staff appraisals and targets, courses completed, and new improvements. The application of a balanced scorecard in hotels is appropriate because hotels involve various activities such as food services (restaurants), maintenance (housekeeping), point-of sales (front office), and receiving (store room), which have different cost structures (Paraskevas, 2001).

In general, the findings and suggestions of the described studies help confirm Hall's (1996) insight that interpersonal relationships would become an effective and increasingly important informal source of career development support in organizations (Kraimer *et al*., 2011).

2.4.3   Enterprise Resource Planning

Enterprise resource planning (ERP) is a vital organizational tool that integrates different organizational systems and facilitates error-free transactions and production. Nevertheless, ERP system development differs from traditional system development (Shaul *et al*., 2012).

ERP is generally described as an "information system package that integrates information and information-based processes within and across functional areas in an organization." Currently, ERP has been supplemented with new functions such as supply chain management, product data management, and electronic commerce and warehouse management. Thus, ERP provides an avenue of opportunity to enable enterprises to compete globally, respond to competitive pressures, and increase revenue (Gronau, 2010).

ERP is a category of business management systems—typically a suite of integrated applications—that can be used by an organization to collect, store, manage, and interpret data from many business activities. Such activities include (1) product planning and purchasing, (2) manufacturing or service delivery, (3) marketing and sales, (4) inventory management, and (5) shipping and payment.

ERP affords an integrated view of core business processes, often in real time, through common databases maintained by a database management system. ERP systems track business resources—cash, raw materials, and production capacity—and the status of business commitments involving orders, purchase orders, and payroll. Applications constituting such systems share data across various departments (e.g., manufacturing, purchasing, sales, and accounting) that provide the data (Rouse, 2015). Furthermore, ERP facilitates information flow among all business functions, in addition to managing connections to outside stakeholders (Bidgoli, 2004).

2.5 Performance Measurement of ISO-10015 Quality Management Guidelines

Numerous authors have extensively discussed the importance of maintenance performance measures (Arts, 1998; Tsang, 1999; Visser, 2003; Weber, 2006; Parida, 2007; Muchiri *et al.*, 2010). Maintenance managers require performance information to monitor and control maintenance processes and results, ultimately enabling them to provide indication toward improvement. Performance measures facilitate the task of establishing actions necessary to attain equipment performance as required by strategic goals. Managers are typically interested in measuring the efficiency and effectiveness of maintenance processes, establishing the relationship between maintenance inputs and outputs, and thus justifying maintenance investments (Parida, 2007). In addition to the provision of information, performance measures influence the processes people perform and thereby serve as a motivational tool that drives decisions and actions that are consistent with the strategy of an organization (Muchiri *et al.*, 2010).

Scholars have proposed four possible types of performance measures: (1) human resource outcomes (e.g., turnover, absenteeism, and job satisfaction), (2) organizational outcomes (e.g., productivity, quality, and service), (3) financial accounting outcomes (ROA and profitability), and (4) capital market outcomes (e.g., stock price, growth, and returns) (Dyer *et al.*, 1995).

Corporate performance measures provide a more complete assessment of the following dimensions: (1) financial performance, which typically involves using

indicators such as ROI and the sales growth rate; (2) operational performance, which, in addition to financial performance, is coupled with the market share of the nonfinancial indicators of product quality, new product introduction, and added value; and (3) organizational effectiveness, which refers to nonfinancial and human-related indicators such as employee morale (Venkatraman *et al.*, 1986).

3   Methodology

3.1   Methodology Choice

The analytic hierarchy process (AHP), which was first introduced by Saaty (1980, 1996), is a method used for addressing complex systems with several alternatives and then comparing the corresponding results. The main objective of this study was to use a fuzzy AHP (FAHP) as an effective approach to determine the relative importance of factors influencing the service quality of certification bodies.

In the FAHP, expert opinions are compared and represented as fuzzy variables that are used to determine the final weights of indices. Various researchers have proposed many FAHP methods and applications in the literature. Van *et al.* (1983) were the first to introduce the application of fuzzy logic principles to the AHP (i.e., the use of triangular fuzzy numbers (TFNs)). To reflect a decision-maker's opinion toward each criterion, Buckley (1985) first used fuzzy numbers. Chang (1996) presented a new approach that entails the use of TFNs for a pairwise comparison scale of the FAHP. In addition, Leung *et al.* (2000) proposed a strategy that involves formulating fuzzy ratios of relative importance as constraints on the membership values of local priorities. Bozdag *et al.* (2003) also applied the FAHP as one of four group decision-making methods, based on fuzzy multiple attributes, to select the best computer-integrated manufacturing system. Moreover, the concepts of fuzzy set theory have been integrated with the AHP to realize the FAHP (Beynon *et al.*, 2004). In study by Tolga *et al.* (2005), the FAHP approach is used to combine noneconomic factors and financial figures. Ayag *et al.* (2006) first used the FAHP to weigh alternatives under multiple attributes, and they subsequently conducted a benefit/cost ratio analysis. Chan *et al.* (2007) used a fuzzy extended AHP to select global suppliers. Furthermore, in another study, the FAHP enabled executing group

decision-making (Tang *et al*., 2009) to derive priorities based on pairwise comparisons. Jaskowski *et al.* (2010) proposed an FAHP method and reported that the proposed method is superior to the traditional AHP in terms of the quality of criteria prioritization. The FAHP has been increasingly used in multicriteria decision-making because of its simplicity and similarity to human reasoning. Hence, considering the success of this method thus far, it has been deduced to be suitable for evaluating proposed policies (as well as in assessing tangible and intangible information) (Wu *et al*., 2013)

Cho *et al.* (2013) applied the FAHP to 111 business and research and development experts employed in the machinery industry; they developed a commercialization assessment model by using the priorities of success factors derived by the FAHP. Their study could drive the assessment initiatives of new product development in manufacturers and could provide them with practical implications about the commercialization of new technology products.

Fu *et al.* (2006) conducted an FAHP analysis to investigate the relative weightings assigned to various factors by two industries to determine the influence of such factors on entry to an electronic marketplace (EM). They compared the weightings of each factor in the respective industries and the different factor routes involved in adopting EMs.

Aggarwal *et al.* (2012) reported that organizations need information technology to help them make quick, appropriate, and accurate decisions and more effective management. They thus implemented a supplier selection system; they validated the design of the selection system and its underlying fuzzy AHP model in a hospital.

According to Yang *et al.* (2004), the pure AHP model has some shortcomings. They reported that the AHP (1) is mainly used in nearly crisp-information decision applications; (2) inherently involves a very unbalanced scale of judgment; (3) lacks consideration of the uncertainty associated mapping human judgment to a number through natural language; (4) involves a rather imprecise ranking system; and (5) involves subjective judgments by perception, evaluation, improvement, and selection based on the preferences of decision-makers, which considerably influence its results. To resolve these problems, several researchers have integrated fuzzy theory with the AHP in an attempt to ameliorate the uncertainty involved in the

process. Accordingly, Buckley (1985) and Csutora *et al.* (2001) have used evolutionary algorithms to calculate weights with trapezoidal fuzzy numbers.

In recent years, numerous researchers have applied consistent fuzzy preference relations to many different fields. For example, Wang and Chang (2007) applied this method to forecast the probability of successful knowledge management, as well as to predict the success of knowledge management implementation. Moreover, Wang and Chen (2006) adopted this method to select a multimedia authoring system (MAS). Wang and Chen (2007) also applied consistent fuzzy preference relations to partnership selection (Wang *et al.*, 2011).

3.2   FAHP Calculation Formula

This study employed the FAHP method to conduct a fuzzy hierarchical analysis through fuzzy numbers in order to achieve pairwise comparisons and determine fuzzy preference weights. In this section, we briefly review the concepts of fuzzy hierarchical evaluation. The subsequent sections detail the computational processes of the FAHP.

The FAHP is based on fuzzy interval arithmetic with TFNs (Figure 4 and Table 1) and a confidence index with an interval mean approach to determine the weights for evaluative elements; therefore, this method is suitable for analyzing small samples of questionnaire feedback provided by a Taiwan Training Quality System (TTQS) expert team.
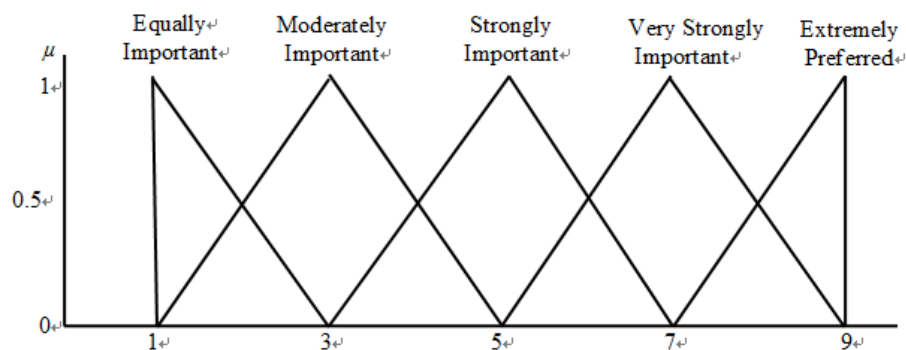

Figure 4. Linguistic Variables for the Importance Weight of Each Criterion (Chang, 1996)

Table1. Fuzzy Linguistic Scale of Fuzzy Numbers (example) (Gumus, 2009)

Fuzzy number	Linguistic	Scale of fuzzy number
9	Perfect	(8, 9,10)
8	Absolute	(7, 8, 9)
7	Very good	(6, 7, 8)
6	Fairly good	(5, 6, 7)
5	Good	(4, 5, 6)
4	Preferable	(3, 4, 5)
3	Not bad	(2, 3, 4)
2	Weak advantage	(1, 2, 3)
1	Equal	(1, 1, 1)

The procedures involved in executing the FAHP method are outlined as follows.

Step 1: Construct pairwise comparison matrices among all the criteria in the dimensions of the hierarchical system. Assign linguistic terms to the pairwise comparisons by determining which is the more important of every two dimensions, as indicated in the following matrix $\tilde{A}$ (equation (1)):

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{\alpha}_{12} & \cdots & \tilde{\alpha}_{1n} \\ \tilde{\alpha}_{21} & 1 & \cdots & \tilde{\alpha}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\alpha}_{n1} & \tilde{\alpha}_{n2} & \cdots & 1 \end{bmatrix} = \begin{bmatrix} 1 & \tilde{\alpha}_{12} & \cdots & \tilde{\alpha}_{1n} \\ 1/\tilde{\alpha}_{12} & 1 & \cdots & \tilde{\alpha}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{\alpha}_{1n} & 1/\tilde{\alpha}_{1n} & \cdots & 1 \end{bmatrix}. \tag{1}$$

Where:

$$\tilde{\alpha}_{ij} = \begin{cases} \tilde{9}^{-1}, \tilde{8}^{-1}, \tilde{7}^{-1}, \tilde{6}^{-1}, \tilde{5}^{-1}, \tilde{4}^{-1}, \tilde{3}^{-1}, \tilde{2}^{-1}, \tilde{1}^{-1}, \tilde{1}, \tilde{2}, \tilde{3}, \tilde{4}, \tilde{5}, \tilde{6}, \tilde{7}, \tilde{8}, \tilde{9}, & 1, i \neq j \\ 1 & i = j \end{cases}$$

Step 2: Apply the geometric mean technique to define the fuzzy geometric mean and fuzzy weights of each criterion, as demonstrated by Hsieh *et al.* (2004):

$$\tilde{\gamma}_i = \left(\tilde{\alpha}_{i1} \otimes \cdots \otimes \tilde{\alpha}_{ij} \otimes \cdots \otimes \tilde{\alpha}_{in} \right)^{1/n},$$
$$\tilde{w}_i = \tilde{\gamma}_i \otimes [\tilde{\gamma}_1 \otimes \cdots \otimes \tilde{\gamma}_i \otimes \cdots \otimes \tilde{\gamma}_n]^{-1}. \tag{2}$$

In this equation, $\tilde{\alpha}_{ij}$ is the fuzzy comparison value of dimension i with criterion j ; thus, $\tilde{\gamma}_i$ is the geometric mean of the fuzzy comparison values of criterion i with each other criterion. In addition, w_i is the fuzzy weight of the ith criterion, and it can be indicated by a TFN; $w_i = (lw_i, mw_i, uw_i)$, where lw_i, mw_i, and uw_i represent the lower, middle, and upper values of the fuzzy weight of the ith dimension, respectively (Sun, 2010).

The FAHP framework is constructed in the form of a matrix, and a local priority vector can be derived as an estimate of relative importance associated with the components being compared by solving the equation (3):

$$A\bar{w} = \lambda_{\max}\bar{w}, \tag{3}$$

where A is the matrix of the pair-wise comparison, $\bar{w}$ is the eigenvector, and $\lambda_{\max}$ is the maximum eigenvalue. Saaty (1996) suggested the use of a consistency index (C.I) for executing test procedures (C.I $<$ 0.1, permissible errors range). A consistency ratio (C.R) can also be used for consistency determination; if C.R $<$ 0.1, then the consistency level of the matrix already exceeds the allowed error range and decision-makers should reconsider their decision-making relationship. The C.I and C.R are calculated using equations (4) and (5):

$$C.I = \frac{\lambda_{\max} - n}{n-1}, \tag{4}$$

$$C.R = \frac{C.I}{R.I}. \tag{5}$$

where R.I represents the average CI obtained from numerous simulation runs, and it varies according to the matrix order (Table 2).

Table 2. Reference Values of the R.I. for Different n Values

n	1	2	3	4	5	6	7	8	9	10
R.I.	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Enyinda *et al.* (2010); Developed by Saaty

Overall hierarchy consistency can be tested according to equation (6):

$$C.R.H = \frac{C.I.H}{R.I.H}, \tag{6}$$

$$C.I.H = \sum_{j=1}^{n}\sum_{i=1}^{n} W_{ij} C.I_{i,j+1},$$

$$R.I.H = \sum_{j=1}^{n}\sum_{i=1}^{n} W_{ij} R.I_{i,j+1},$$

W_{ij} = the total weight of the ith element of Layer j

$C.I_{i,j+1}$ = the C.I of all elements of Layer $_{j+1}$ against the i th element of Layer j .

$R.I_{i,j+1}$ = the R.I of all elements of Layer $j+1$ against the i th element of Layer j.

In this equation, C.R.H represents the consistency ratio hierarchy, C.I.H represents the consistency index hierarchy, and R.I.H represents the random index hierarchy. An acceptable inconsistency limit should be 0.1 (Saaty, 1980).

3.3   Research Objects

According to the literature review and perspectives of the audit teams of certification bodies, we created a hierarchy regarding the relative importance of the assessed factors (Figure 5). On the basis of the FAHP method, our objectives were to determine the relative importance of factors influencing the service quality of certification bodies and to propose amendments for improving the operation of certification bodies.
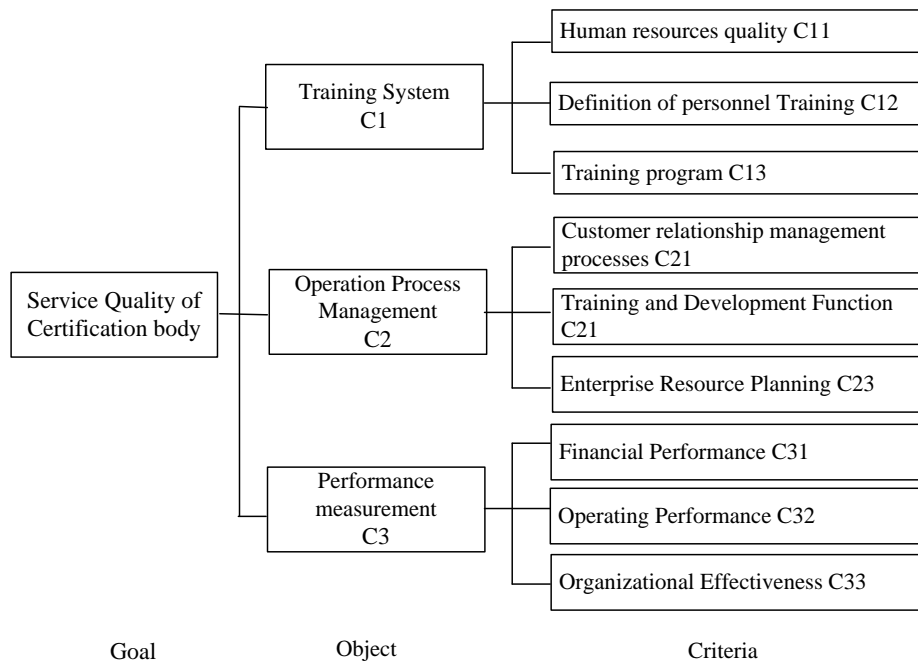

Figure 5. Hierarchy Model of the Relative Importance of Factors

3.4   Sampling

This study used an FAHP questionnaire to collect and analyze the opinions of TTQS experts. The TTQS is an evaluation standard proposed by the Bureau of Employment and Vocational Training of the Ministry of Labor in Taiwan; this system is based on the Service Industry Development Guidelines and Initiative (2004–2008) implemented by the Executive Yuan of Taiwan, and the content concerns a quality accreditation system for the development of a personnel training service industry (Lin *et al*., 2011). The TTQS is an integration of the ISO-10015 Standard, European Foundation for Quality Management model, Investors in People Standard, and other benchmarking projects. Regarding the confirmation of the quality of training in companies, the TTQS can maintain the training quality and performance of staff members as well as enhance the ability of national human resources to accumulate training knowledge (Chen, 2013; Lin *et al*., 2011).

The main concepts of the TTQS include developing the human capital of Taiwan, strengthening the competitiveness of human resources, increasing the performance of vocational training, and measuring the goals and value of vocational training programs (Chuang, 2013). The TTQS can reflect the quality of training plans executed throughout Taiwan, organizational implementation of system conditions, and implementation capability; this can thus ensure that the quality of training in the country to be in line with international standards and for on-the-job training quality to be improved for staff members.

The basic structure of the training quality scorecard of the TTQS is based on the five dimensions of plan–design–do–review–outcome (PDDRO), which is composed of 17 training quality scores (Lin *et al*., 2011). The output of each stage is the input of the next stage, and the five dimensions create a cycle. This system also enables the training of employees to be in line with the visions and goals of the business. Furthermore, this system can identify the gaps among functions to assess all training processes and performance.

In this study, we used quota sampling to select 10 university professors, 10 business consultants, and 10 high-ranking managers to from the TTQS expert team.

4   Results

In this study, of the distributed questionnaires, we collected a total of 17 questionnaires (2 questionnaires were invalid), thus yielding a recovery rate of 56.67%. Five questionnaires were collected from the university professors (29.41%), six from the business consultants (35.29%), and four from the high-ranking managers (23.53%). We used expert choice software to analyze the collected data.

4.1   Object-level Analysis Results

We found that C.R = 0.029 (< 0.1), C.I = 0.017 (< 0.1), and λ_{max} = 3.033, which are acceptable (Table 3). Regarding the derived weights, training system C1 had a weight of 27.00%, service quality C2 had a weight of 40.70%, and organizational performance C3 had a weight of 33.50%. Therefore, operational process management C3 is ranked first, organizational performance C2 second, and the training system C3 third.

Table 3. Object-Level Matrix Analysis Sheet

Comparison of the relative importance with respect to Goal: service quality of certification body

	Synthetic pairwise comparison matrices (integrated fuzzy numbers) with geometric means			Geometric means of rows	Fuzzy weight of each dimension	Crisp weights	Ranking
	Training System C1	Operation Process Management C2	Organizational Effectiveness C3	r	w	BNP	
C1	(1,1,1)	(0.542, 0.648,0.795)	(0.567,0.661, 0.773)	(0.745, 0.809,0.885)	(0.223,0.266, 0.320)	0.270	3
C2	(1.258,1.543, 1.844)	(1,1,1)	(1.174,1.476, 1.810)	(1.102,1.228, 1.352)	(0.330,0.404, 0.489)	0.407	1
C3	(1.294,1.512, 1.763)	(0.553,0.678,0.852)	(1,1,1)	(0.920,1.006, 1.107)	(0.275,0.331, 0.400)	0.335	2

C.R = 0.029, C.I = 0.017, λmax = 3.033

4.2   Criteria-level Analysis Results

4.2.1   Training System C1

We noted that C.R = 0.065, C.I = 0.0038, and λ_{max} = 3.076, which are acceptable (Table 4). For the derived weights, human resource quality C11 had a weight of 67.80% (ranked first), training program C13 had a weight of 21.11% (ranked second), and definition of personnel training C12 had a weight of 13.10% (ranked third).

Table 4. Criteria-Level (Training System C1) Matrix Analysis Sheet

Comparison of the relative importance with respect to training system C1

	synthetic pairwise comparison matrices (integrated fuzzy numbers) with geometric means			geometric means of rows	fuzzy weight of each dimension	crisp weights	Ranking
	Human resource quality C11	Definition of personnel Training C12	Training program C13	r	w	BNP	
C11	(1, 1, 1)	(3.472,4.114,4.799)	(3.318,4.158, 4.910)	(2.259,2.577, 2.867)	(0.521,0.668, 0.845)	0.678	1
C12	(0.208, 0.243, 0.288)	(1,1,1)	(0.404,0.484, 0.605)	(0.438,0.490, 0.558)	(0.101,0.127, 0.165)	0.131	3
C13	(0.204,0.240,0.301)	(1.654,2.066,2.477)	(1,1,1)	(0.696,0.792, 0.907)	(0.161,0.205, 0.267)	0.211	2

C.R= 0.065, C.I =0.038, λmax =3.076

4.2.2 Operational Process Management

We observed that C.R = 0.078, C.I = 0.045, and λ_{max} = 3.091, which are acceptable (Table 5). Regarding the weights, CRM processes C21 had a weight of 76.2% (ranked first), enterprise resource planning C23 had a weight of 15.3% (ranked second), and training and development function C22 had a weight of 10.4% (ranked third).

Table 5. Criteria-Level (Operational Process Management C2) Matrix Analysis Sheet

Comparison of the relative importance with respect to operational process management C2

	synthetic pairwise comparison matrices (integrated fuzzy numbers) with geometric means			geometric means of rows	fuzzy weight of each dimension	crisp weights	Ranking
	Customer relationship management processes C21	Training and Development Function C22	Enterprise Resource Planning C23	r	w	BNP	
C21	(1,1,1)	(4.747,5.770,6.785)	(5.500,6.525,7.543)	(2.967,3.352,3.713)	(0.592,0.750,0.945)	0.762	1
C22	(0.147,0.173,0.211)	(1,1,1)	(0.407,0.512,0.704)	(0.391,0.446,0.529)	(0.078,0.100,0.135)	0.104	3
C23	(0.133,0.153,0.182)	(1.420,1.954,2.460)	(1,1,1)	(0.573,0.669,0.765)	(0.114,0.150,0.195)	0.153	2

C.R= 0.078, C.I =0.045, λmax =3.091

4.2.3   Performance Measurement

We found that C.R = 0.029, C.I = 0.017, and λ_{max} = 3.035, which are acceptable (Table 6). Regarding the weights, financial performance C31 had a weight of 44.40% (ranked first), organizational effectiveness C33 had a weight of 29.90% (ranked second), and operating performance C32 had a weight of 27.10% (ranked third).

Table 6. Criteria-Level (Performance Measurement C3) Matrix Analysis Sheet

Comparison of the relative importance with respect to performance measurement C3

	synthetic pairwise comparison matrices (integrated fuzzy numbers) with geometric means			geometric means of rows	fuzzy weight of each dimension	crisp weights	Ranking
	Financial Performance C31	Operating Performance C32	Organizational Performance C33	r	w	BNP	
C31	(1,1,1)	(1.220,1.408,1.614)	(1.416,1.750,2.064)	(1.200,1.351,1.493)	(0.354,0.439,0.537)	0.444	1
C32	(0.620,0.710,0.819)	(1,1,1)	(0.708,0.776,0.	(0.760,0.820,0.894)	(0.224,0.267,0.321)	0.271	3
C33	(0.485,0.571,0.706)	(1.149,1.288,1.413)	(1,1,1)	(0.823,0.903,0.999)	(0.243,0.294,0.359)	0.299	2

C.R=0.029, C.I =0.017, λmax =3.035

4.2.4 Overall Object and Criteria Weights and Ranking Analysis Results

According to the empirical analysis of the FAHP questionnaire results, C.R.H = 0.053 < 0.1, which is acceptable (Table 7). We observed that the first-ranked factor of this object was operational process management, the second-ranked was performance measurement, and the third-ranked was training system.

Regarding all objects and criteria, we determined that the top three were (1) CRM processes (33.18%), (2) human resource quality (17.00%), and (3) financial performance (14.88%).

5   Discussion

According to the empirical results (Figure 6), the first-ranked importance factor is CRM processes C21 (33.18%), and the most significant feature is the continued learning of customer knowledge to achieve the business target of increasing long-term profits.

Bahri-Ammari *et al.* (2015) found that employees' use of CRM technology leads to higher performance. CRM performance can improve when different CRM

components are used and supported by employees. Exchange of relevant information that provides technology can result in improvements in regaining lost customers, in acquiring new customers, and in enhancing the total return per customer and reducing customer migration.

Table 7. Overall Object and Criteria Weights and Ranking

Object	Weights for Level 2	Criteria	Weights for Level 3	Weights for overall	Ranking for overall
Training System C1	0.2508	Human resource quality C11	0.6780	0.1700	2
		Personnel training development C12	0.1309	0.0328	9
		Training program C13	0.2111	0.0529	7
Operation Process Management C2	0.4352	Customer relationship management processes C21	0.7625	0.3318	1
		Career development plan C22	0.1042	0.0454	8
		Enterprise Resource Planning C23	0.1529	0.0666	6
Performance measurement C3	0.3355	Financial Performance C31	0.4435	0.1488	3
		Operating Performance C32	0.2708	0.0909	5
		Organizational Performance C33	0.2986	0.1002	4

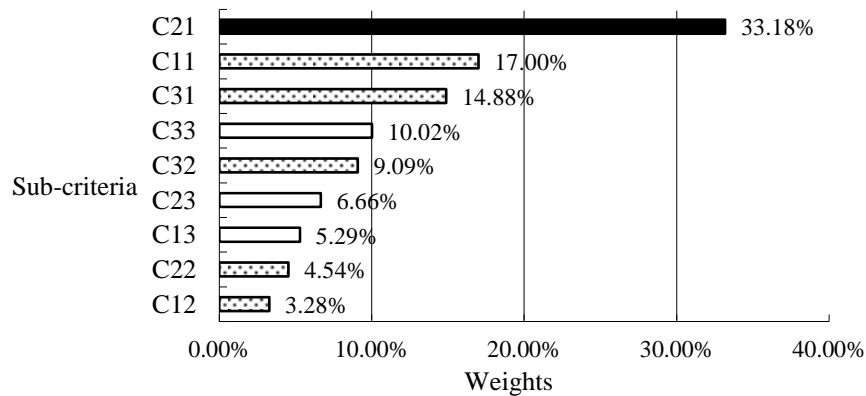C.R.H = C.I.H / R.I.H = 0.053 < 0.

Figure 6. Overall Object and Criteria Weights and Rankings

The second-ranked importance factor is human resource quality C11 (17.00%). Human resource quality refers to worker attitudes, work quality, innovation, the ability to work independently, hands-on problem-solving ability, self-learning ability,

and knowledge level of overall performance; these can be summarized as spiritual, cultural, and skill qualities, which have a profound effect on an organization.

Carayon *et al*. (2014) reported that human factors systems approaches are critical for improving health care quality and patient safety; hence, balancing the work system and encouraging the active and adaptive role of workers are key principles for improving health care quality and patient safety.

The third-ranked importance factor is financial performance C31 (14.88%), which is related to an organization's economic goals such as sales growth, profitability, and earnings per share. Siems *et al.* (1998) worked with Bank of America to explore industrial objects, and the main objective was to understand the effect of the bank's operating efficiency on its financial performance; they used a data envelopment analysis approach for data analysis. The results revealed that the greater the efficiency of the banking business, the lower the cost and profitability and the higher the average return on assets.

The effectiveness of ISO 9001 directly and significantly influences the product/service quality and operational performance of service companies. However, operational performance directly influences financial performance, whereas the effect of ISO 9001 effectiveness is indirect through its significant correlation with operational performance (Psomas *et al*., 2013).

Personnel training development C12 (3.28%) is the lowest-ranked importance factor in this study. Therefore, personnel training development C12 had a nonsignificant impact in this study. Organizational training, education, and development of cognitive connotation are three areas that affect how organizations develop training programs, thereby affecting employee learning orientation and contributing to the involved organization; however, in the ISO-10015 system requirements, organizational training programs are derived from analyzing the performance gaps in the operations of organizations, which can be supplemented through education training strategies. Specifically, ISO-10015 requires implementing education and training programs to complement the staff members in their duties (since a functional gap between executives in the quality management system may directly or indirectly affect compliance with product requirements) and their awareness of the organization's targets so that they can contribute toward reaching the targets, thus enhancing the service performance of certification bodies.

Finally, we found that certification bodies should improve processes, invest in staff training, and implement incentive wage systems to maintain a long-term competitive advantage, which would in turn improve staff members' service willingness and CRM. In addition, the ISO-10015 Quality Management Guidelines can be implemented systemically to define staff training requirements and to improve operating performance further.

Ronald (2005) stated that the ISO-10015 Quality Management Guidelines recommend that companies should choose the most advantageous method of training and assess the appropriateness of the training method to review this decision.

6   Conclusion

This study determined the relative importance of factors under the ISO-10015 Quality Management Guidelines that influence the quality of certification bodies. Certification bodies can use the findings of this study as a reference to implement effective training systems for enhancing the competence of their staff members. Thus, the service quality of certification bodies can be improved, which can in turn enhance the ability of certified companies to improve their organizational performance and contribute toward the sustainable development.

Lin *et al.* (2010) indicated that after executing a sorting process through the FAHP, they derived the vital factors to be enterprise development strategies or strategy maps/blueprints (annual business development plans); the implications for such factors include providing details about human resource development and training plans, themes or directions, and explanations to employees. They suggested that enterprises wishing to engage in humanity can use the presented evaluation model to execute self-evaluation and thus improve their overall human resources.

Taheri *et al.* (2016) also reported that training should empower an organization to resolve any problems it may have. Trainign could be the optimal solution if the organization's problems are engendered by staff incompetence or by discrepancies between staff skill levels and the identified job expectations. When an organization invests in training its staff members, it assures them that it respects the value of their work. Service education is an investment, and the more it is consistent with the

needs of staff members and the goals of the organization, then the greater the impact on the staff members.

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