A Construction and Empirical Study of Quality Management Evaluation Index System in the Internet of Things Industry

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Abstract: A revised version of the ISO9001:2015 quality management system is an indispensable element for a corporation to survive against the severe competition and maintain sustainable, competitive superiority, as well as a new outlook. With this in mind, the first purpose of this research was to seek customer satisfaction through the continuous improvement of the organization in the IoT industry. Furthermore, it aimed to lay a foundation for a preemptive response and formulate a management strategy regarding the continuity of the business. Simultaneously, we explored whether the scale items of the lower-ranking level resulting from the latent variables in the main provision of the revised edition are the variables that can sufficiently explain the latent variables. Furthermore, the statistical programs of the SPSS22.0 and the AMOS18.0 were utilized for analysis. The results demonstrated that corporations can achieve customer satisfaction through continuous improvements concerning the successful introduction and conversion of the new quality management system. It was confirmed that the core variables of the revised edition sufficiently explained the latent variables. Consequently, it is imperative to understand the latent risks from the internal and external environments surrounding the organization and formulate the short-term and long-term strategies of the organization on the part of a corporation.

Keywords: IoT (Internet of Things); QMS (quality management system); contexts of the organization; continuous improvement; customer satisfaction

1. Introduction

In the era with rapid change, IT technologies have been advancing vigorously in relation to this research because of the 4th industrial revolution. Owing to the spread of new technologies, such as big data, IoT, and 3D printing, the business paradigm has been rapidly shifting. Not only that, in the field of the quality management system (QMS) supervised by the ISO, it has been introduced into all industries and it is spreading quickly following the official announcement of the revised edition of the ISO9001:2015. This research aimed to reflect the changing requirements of the IoT industry in the new era toward a continuous, systematic, and logical approach method as the process approach method of the new QMS and to present a strategy for coping with the risks. Additionally, the basic research needed to materializing a new business was conducted. The definition of ‘quality’, which has been discussed recently, does not simply have only the product or the service as the objects. Its meaning has been interpreted in the broad sense, consisting of the overall qualities of process management and the formulation of a management strategy [1]. This is the core of securing the survival strategy and the competitiveness of a corporation. Each corporation directly confronts the situation, which determines the success or failure of the business and not only the decision-making on the part of the organization according to the collection of the information, the analysis, and the level of the
utilization of the quality. Nor is it limited to products, the definition of “quality” has been extended to include a part of a company’s quality management activities throughout the process of providing products and services. Based on such a concept of ‘quality’, QMS is essential for the assurance of the quality competitiveness in the organization. With the five domains of the purpose, the range of the applications, the management means, the results, and the management of quality management, the quality management system presents the standard needed for the work activities. It is an international quality management standard that effectively documents and enables the receipt of the certification of all sorts of elements of the production process determining the quality of the corporation. Regarding the International Organization for Standardization (ISO), the first edition of the ISO9000 series was published in the year 1987. Later, the revised edition of the ISO9000:1994, the 3rd edition of the ISO9001:2000, and the 4th edition of the ISO9001:2008 were published. The revised version of the ISO9001:2015 (hereafter, ‘the 2015 revised edition’) was publicly announced by taking the decisive action of the important revision (a major change), which drastically reflected the modern requirements in September 2015. The 2015 revised edition can be viewed as an essential change with which the quality performances of the present and the future for the final consumer (end user) can be considered with regard to the process of its provision. It was reported that the influences and the value concerning the QMS of all the organizations can be improved. As a result, the main revision matters which are anticipated with the introduction of the 2015 revision edition must be confirmed. Moreover, it is valuable for confirming what meaning will be conveyed by the revision, and why it matters to the organization and its preparations.

The main requirements of the 2015 revised version have been organized with the 10 provisions of the scope, the references, the definition of the terms, the contexts of the organization, the leadership, the planning of QMS, the support, the operation, the performance valuation, and the improvement. With respect to the need for these revisions, firstly, in the Annex SL (the guidelines related to the development process and the organization of the management system standard), the coincidence of the 10 provisions, which comprise the high-level structure (HLS), had been improved to be commonly used in the management system standard (MSS). Secondly, the integration of the management system standard (MSS) was required. Then, not only sustainable economic growth but also environmental conservation and social responsibility were deemed essential to manage a successful corporation. Thirdly, the system consistent with the many kinds of upper-ranking management system standards (such as ISO9001:2008, ISO14001, ISO18001, ISO26000, ISO27001, and ISO31000), of which the structures of the standards are different according to each provision, was adjusted. The main provisions were compared and presented by ISO management standards, as described in Table 1.

Researchers presented many arguments on the system scheme design related to the quality management system. However, IT technology has entered into a period of vigorous development with the emergence of the 4th industrial revolution era. There are few studies on improving customer satisfaction through quality management in the available literature. Moreover, the specific question of how to improve customer satisfaction through IT technology continuously remains unclear. The influence mechanism is also ambiguous in terms of how the core elements that enterprise organizations introduce into the revised version of the ISO9001:2015 quality management system improve competitive advantages. Therefore, the research questions of this study are as follows:

RQ1: Which core elements of the ISO9001:2015 revised edition can be used as measurement variables of the continuous improvement of quality management?

RQ2: Which variables in the core elements of the ISO9001:2015 revised edition have a more influential role in promoting the competitiveness of enterprises?
Table 1. A comparison table of the main provisions by ISO management standard.

| HLS Structure | ISO9001:2008 | ISO14001 | ISO18001 | ISO26000 | ISO27001 |
|---------------|-------------|----------|----------|----------|----------|
| 1 Scope       | •           | •        | •        | •        | Information security policy |
| 2 References  | •           | •        | References | •        | Risk assessment |
| 3 Definition of terms | Quality management | Environmental management | Safety and health | Definitions of terms | Social responsibility The principle of the social responsibility |
| 4 Contexts of organization | Responsibility of the manager | - | - | - | The establishment of the security organization Assets classification and control |
| 5 Leadership | - | - | - | - | Personnel affairs security |
| 6 Planning | Resources management | - | - | - | - |
| 7 Support | Product realization | - | - | - | - |
| 8 Operation | Measurement and analysis | - | - | - | - |
| 9 Performance evaluation | - | - | - | - | - |
| 10 Improvements | - | - | - | - | - |

“•” is a mark for the HLS application provisions by the management standard.

2. Theoretical Background

2.1. Contexts of the Organizations

Quality management has been considered necessary as a strategic base for securing the competition superiority for an organization, which must be utilized in improving the internal and external revolution management of the organizational operation and in the formation of the mutually organic relationships between the parties concerned [2]. Given the situation of the organization, the domains of management responsibility, the process approach method, customer satisfaction, and continuous improvements must be subdivided and applied to operate effective quality management [3]. Thus, the ACDP (Analyze, Change, Do, and Prosper) technique has been proposed for process management and efficient and continuous improvements through the ACDP management technique to effectively manage the present situation [4].

2.2. Leadership

Leadership has been defined as the ability to pursue change management [5]. According to the requirements of the quality management system, continuous support from the top management level must contribute to performance improvement [6]. The leadership of a CEO must induce process innovation and improvement based on the cooperation and the activities of the organization [7]. This means that the leadership of the top management can continuously manage the atmosphere and the culture of the organization, executing whole-company quality management activities [8]. Particularly when introducing the quality management system, the improvement of the internal capabilities, such as the leadership, the resources, and the management activities, can reach the spreading of the results through the improvements of the external capabilities, facilitating management performance [9].

2.3. Planning of the QMS

Strategic planning is advanced by setting up the management of the goal, which is operated by the short-term and long-term plans realized by the improvements and innovations [6]. Planning is also a design with the purpose of pursuing the change regarding the object of the long-term plan for the strategic management for the differentiation on the part of the corporation [10,11]. Then, the system evaluation and the continuous improvements can be executed through the short-term and long-term strategic approach methods by the execution and the strategic management of the project. Hence, setting up goal management
related to quality must become the precondition of the quality planning activity to satisfy the customers’ requirements through a differentiated strategy.

2.4. Support

Strategic support is more critical than anything else to bring about the synergy effects before and after the introduction of the quality management system [5]. Among the resources of a corporation, human resources are imperative, and the innovation from within a corporation eventually comes from an excellent person of talent [12]. Therefore, the human resources of a corporation, as one main factor that determines organizational performance, have come to be the crucial means of proactively coping with the changes in the technologies and the environmental changes in the market [13]. In addition to human resources, the development of new-generation digital technology is also considered helpful to promote the effectiveness of total quality management. Moreover, the deficiency of immutability and traceability in the theory and practices can be overcome to make ISO 9001:2015 standard-based QMS more effective when blockchain technology is adopted [14]. Other strategic supports, such as the investment activities regarding the material, financial, and information resources, are the core elements exerting direct influences on the execution results, which is pursued by the corporation [15,16].

2.5. Operation

The operation of the process, along with the support from the top management level, the feedback of the information, and the performance evaluation, are regarded as the core elements for the successful execution of the quality management system [6]. Against the background of Industry 4.0, Quality 4.0 has been proposed. It refers to the digitalization of TQM and can be measured by soft dimensions (such as top management commitment, customer focus, training and learning, and quality of big data and analysis) and hard dimensions (such as process management, continuous improvement, and product/service design) to reveal the effective implementation of quality management [17].

Operational management of a corporation is defined as the organizational activity of supplying products and services at the right time through the establishment and improvement of the quality management system and the whole-company quality management activities [18]. Similarly, operational capability has been defined as the capability that can provide products and services [11] and execute continuous innovation activities through technological development and strategic management [19]. It is imperative to put the related activities into practice through the materialization of the products and services [18], the synergies through the innovation activities, and the continuous improvement activities [20] when the quality management system is introduced to continuously seek the efficient management of the process and the improvement of the management performances of a corporation.

2.6. Performance Evaluation

The performance evaluation activity should be continued by improvement activities of the organization in which the performance evaluation takes place through the specific establishment of the goal and the approach method through the participation of the CEO [21]. Process management and performance management through the management of the data of the employees are required to evaluate the performance of an organization [22,23]. After the introduction and the spreading of the quality system, the activities of the evaluation of the performance management can be continued by the growth and the success factor of the corporation [6]. Moreover, the performance evaluation can be executed by regular and irregular performance evaluation activities regarding the quality system to evaluate financial performance and customer satisfaction [24].
2.7. The Relationship between Quality Management Activity and Customer Satisfaction

The improvement activity through quality management activity based on strategic thinking and behavioral policy can satisfy customers [25]. In other words, the whole-company quality management activity can draw continuous improvements and customer satisfaction when the activities are continuously put into practice in the field [24]. Customer satisfaction hangs on the level of the expectation of the customer rather than the qualitative level of the product, followed by an overall evaluation and not a simple product purchase evaluation that relies on a specific product or the experience of having purchased a product only [26]. Satisfaction or dissatisfaction can be felt by comparing what the customer expects with what is actually served [27]. Therefore, the organization must continuously seek improvements and innovations to improve the matters related to customer dissatisfaction. Customer satisfaction can only be derived when the effective operation of the quality system and improvement activities are embodied in the company-wide management system, or when a customer’s experience is higher than their expectation [10]. Additionally, quality improvement activities must occur continuously with the participation of the top management level in pursuing the efficiency of corporate management [28].

2.8. The Research Model and the Hypothesis

The ISO 9000:2000 standard is adopted to systematically measure customer satisfaction. Although ISO9000 has no direct positive correlation with customer satisfaction, it can lead to quality improvement and cost reduction, contributing to the achievement of customer satisfaction [29]. The implementation of standards will stabilize the expected quality of products and services. The reduction of customer complaints and inconsistent products and the improvement in customer satisfaction are other impacts of the implementation of the standard [30]. Factors affecting customer satisfaction with wood products were investigated based on data collected from furniture buyers in online shopping malls. It was revealed that the diversity of product service quality with tangibility, responsiveness, interactivity, stability, and customer satisfaction are significant factors influencing customer loyalty to online shopping centers [31]. The review of the relevant literature suggests that the current research has presented many arguments on the role of ISO9001 in improving customer satisfaction. However, there is still little research on the revised version of ISO9001:2015, especially for Internet of Things enterprises.

In this research, leadership is defined as the thing that advances by pursuing changes under the responsibility of the CEO. Concerning pushing ahead with the management activities and the performance evaluation activities through short-term and long-term planning, the support and the improvement activities of the management level have positive influences on the management performances of the corporation, and they can be followed with customer satisfaction [3,5,8]. Moreover, the activities of the performance accomplishment can be improved through the efficient quality system, continuously bringing about higher customer satisfaction [10,25,27]. Based on such precedent research, Hypothesis 1 was established as follows:

**Hypothesis 1:** The continuous improvement activity of an organization will have a positive (+) influence on customer satisfaction.

3. Research Design

3.1. Methodology

After the research frontier achievements around the world were summarized, the content and description of the initial questionnaire were modified in this study by combining qualitative and quantitative analysis. Then, the evaluation system of the revised version of ISO9001:2015 was determined.

This study searched, collected, and analyzed relevant academic literature on quality management and the IOS9001 index evaluation system through the WOS database, Korean KCI database, and other channels to understand, review, and summarize the existing
literature research. On this basis, the core concept of the research was clarified, and the measurement scale of this study was determined. Concerning qualitative research, the interview method was mainly adopted to provide practical support for the construction of the indicator system. Semi-structured interviews were conducted with five researchers in the field of operation management from Yeungnam University, Kyungpook National University, and Daegu University in South Korea, and three experts from the Korean Institute of Quality Management with the theme of “Research on the Construction of IOS 9001 (2015) Index Evaluation System”. The main contents were the connotations, components, and promotion strategies of context of the organization (ORG), leadership (LED), QMS planning (PLN), support (SUP), operation (OPR), performance evaluation (PER), improvements (IMP), and customer satisfaction (SAT). According to the preliminary indicator system constructed, an expert consultation table was formed through two rounds of expert surveys. In the first round, the scores of each expert were inconsistent in the comparison of individual indicators. Then, the results were fed back to each expert for correction, and the final scores were consistent. Finally, the classification, naming, and interpretation of the dimensions of the indicator system were determined, and the indicator design was adjusted, modified, and improved following the expert survey suggestions to form 24 evaluation indicators.

Before issuing the formal questionnaire, the pre-test questionnaire was distributed in a small scope to discover and modify the loopholes in the questionnaire design while guaranteeing the scientific nature of the data. During the data analysis process, a few principal components were refined from multiple correlated indicators to reveal the internal structure of multiple variables through the idea of dimension reduction and principal component analysis. The determined principal components were the dimensions in this study. With this data analysis method, each dimension can not only retain as much original variable information as possible but also ensure independence among them. Finally, the normalized standard path coefficients and factor loading coefficients in the structural equation model were adopted as the weight of each dimension and index as the basis for the subsequent calculation of evaluation scores.

3.2. Data Collection

Considering the collection of the data in this research, the questionnaire survey investigation was conducted with the IoT industry as the target group. The Likert, 7-point scale, which is the standardized technique of the ordinal scale, was used for the measurement means regarding the answers to the survey questionnaire. The measurements were performed with the nominal scale for the demographical variables. Concerning the gathering of the samples, the answers were requested and received based on the single survey questionnaire by the corporation. The organization of the questionnaire refers to the existing ISO9001:2008 version, ISO9001:2015 version, and the seven conditions of MB (Malcolm Baldridge), as well as the integrated questionnaire scale. The execution time of the questionnaire survey was from 1 September 2021 to 28 November 2021, lasting about 3 months. The sampling method was convenience sampling.

The study population of this study was managers who lived in Korea and implemented quality management among consumers in industries related to IoT, such as manufacturing industries, service industries, circulation industries, and public institutions. The analysis unit of this study was the management personnel who had a certain understanding of the organization’s implementation of quality management activities and a wide understanding of the satisfaction of their organization’s consumers. The empirical data were collected by questionnaire. Finally, 800 enterprises were selected randomly as samples, including ISO9000 certified and non-certified enterprises. A total of 800 copies were distributed, among which the analyses of the 407 copies, excluding the 3 copies of the insincere survey questionnaires, were performed using the statistical programs of the SPSS22.0 and the AMOS18.0.
3.3. The Measurement Tools

In this research, the scale items were developed based on the theoretical level of the latent variables by the main provision in the revised edition of the ISO9001:2015. Specifically, after comparative analysis, a large-scale project library was established on the basis of the previous research by finding the ISO9001:2008 version of the standard and the same terms. Next, the 7 main provisions of Malcolm Baldridge and the main provisions of the ISO9001:2015 revised edition were compared and analyzed. Subsequently, the final scale items were created following the previous precedent research. Regarding the measurement items, the exploratory factor analysis (EFA) was performed with the entire pool as the objects.

Finally, seven items were not efficient and deleted because the loading value was less than 0.7 (the contexts of the organization (ORG), the LED3 and LED5 of the leadership (LED), the PLN2 and PLN3 of the planning (PLN), the SUP2 of the support (SUP), the OPR4 of the operation (OPR), the PER2 of the performance evaluation (PER), and IMP3 of the improvement (IMP)). A total of the 30 final measurement items were organized by organizing the 4 items of the context of the organization (ORG), the 4 items of the leadership (LED), the 4 items of the planning (PLN), the 4 items of the support (SUP), the 4 items of the operations (OPR), the 3 items of the performance evaluation (PER), the 3 items of the improvement (IMP), and the 4 items of the customer satisfaction (SAT), which is a result variable. Table 2 lists the final measurement tools that organized manipulative definition and measurement method by the organizing element of the QMS.

Table 2. The manipulative definition and the method of the measurement of the elements organizing the quality management.

| Latent Variables               | Manipulative Definition                                                                 | Measurement Method | Related Research         |
|-------------------------------|----------------------------------------------------------------------------------------|--------------------|--------------------------|
| The Contexts of the organization (ORG) | - The management of the customer relationships and the investigation into the level of satisfaction of the customers.  
- The improvement of customer relationships and activity for customer satisfaction.  
- The requirements and the operational form of the QMS.  
- Whether or not it coincides with the regulation (the written procedure) of our company. | 7-point scale      | Based on the ISO9001:2015 |
| Leadership (LED)              | - The vision and the values of the management.  
- The ethical management and the transparent management of the corporation.  
- Whether or not the regulations and the procedures of the management have been abided by.  
- The responsibilities, the rights, and the communication. | 7-point scale      | Based on the ISO9001:2015 |
| The QMS Planning (PLN)        | - The strategy and the goal development of the corporation.  
- The formulation of the quality goal of the management.  
- The activity of the operational planning for the materialization of the products.  
- The work of the design and the development. | 7-point scale      | Based on the ISO9001:2015 |
| The Support (SUP)             | - The work and the designing of the duties of the personnel.  
- The manpower employment and the management that are needed.  
- The strengthening of education, training, and expertise.  
- The support management and the support for the support facilities. | 7-point scale      | Based on the ISO9001:2015 |
| The Operation (OPR)           | - The development of the process needed for QMS management.  
- The activities of the improvement and the innovation of the process.  
- The fluctuations (the changes) management.  
- The formulation and implementation of the production plan. | 7-point scale      | Based on the ISO9001:2015 |
### Table 2. Cont.

| Latent Variables | Manipulative Definition | Measurement Method | Related Research |
|------------------|-------------------------|--------------------|------------------|
| The Performance evaluation (PER) | - The performance measurement, the analysis, and the extent of the utilization of the organization.  
- The internal audit and inspection.  
- The results and the analyses of the performances by work. | 7-point scale | Based on the ISO9001:2015 |
| The Improvements (IMP) | - The measurements of the performances of the organization.  
- The activities of the management and the improvement of the knowledge of the market information and the organization.  
- The management of unsuitable products and the activity of taking the speedy measure. | 7-point scale | Based on ISO9001:2015 |
| Customer satisfaction (SAT) | - The increase in the level of satisfaction of the customers.  
- The reduction of customer dissatisfaction.  
- The improvement of the level of awareness of the corporation.  
- The speedy solutions to the requirements of the customers. | 7-point scale. | Aaker and Day (1978), Oliver [12] |

### 4. Analysis Result

#### 4.1. Demographic Characteristics

The special demographic characteristics of the 407 employee responses to this questionnaire are described as follows. First, men and women occupied 76.7% and 23.3%, respectively. Specifically, 2.2% were under 20 years old, 23.6% were in their 20s, 29.2% were in their 30s, 29.7% were in their 40s, and 15.2% were in their 50s and above. Therefore, the answers by those who were in their 30's and 40's were high. With respect to the amounts of the sales, 43.5% are below 10 billion KRW, 23.8% are below 50 billion KRW, 8.8% are below 100 billion KRW, 10.1% are below 500 billion KRW, and 13.8% are above 500 billion KRW. Furthermore, the ISO-certified corporations and the ISO-non-certified corporations occupied 61.7% and 38.3%, respectively. The electric and electronic type of business was the highest at 35.14%. Next, it was 26.54% for the service industry, 13.02% for the distribution business, 14.74% for public organizations, and 10.57% for the others. Concerning the business ages, less than 10 years and 10 years or higher had the highest percentages at 8.8% and 40.5%, respectively. It was 32.7% for 20 years or higher, 16.2% for 30 years or higher, and 1.7% for 40 years or higher. In terms of employees, 13.76% have less than 50 employees, 39.80% have fewer than 100 employees, 21.87% have fewer than 300 employees, 15.72% have fewer than 600 employees, 6.63% have fewer than 1000 employees, and 2.21% have 1000 or more employees. The special characteristics of the samples are detailed in Table 3.

#### 4.2. The Factor Analysis

In this research, the factor analysis [7] with the standard (>0.70) was performed using the Varimax rotation method to measure the feasibility of the variables. The results revealed that the factor loadings of all questions of the questionnaire survey were 0.70 or higher, verifying the feasibility of each factor. Table 4 presents the rotated component line from the factor analysis.
Table 3. Demographic characteristics.

| Classification | Item               | Frequency | Ratio (%) | Classification | Item               | Frequency | Ratio (%) |
|----------------|--------------------|-----------|-----------|----------------|--------------------|-----------|-----------|
| GENDER         | Male               | 312       | 76.7      | Electric and electronic | 143       | 35.14     |
|                | Female             | 95        | 23.3      | Service business | 108       | 26.54     |
|                | Total              | 407       | 100.0     | Distribution business | 53        | 13.02     |
|                | Less than 20       | 9         | 2.2       | Public organization | 60        | 14.74     |
|                | 20's               | 96        | 23.6      | Others          | 43        | 10.57     |
|                | 30's               | 119       | 29.2      | Type of business |                      |           |           |
|                | 40's               | 121       | 29.7      | Total           | 407       | 100.0     |
|                | 50's or higher     | 62        | 15.2      | Distribution business | 53        | 13.02     |
|                | Total              | 407       | 100.0     | Electric and electronic | 143       | 35.14     |
| AGE            | Less than 20       | 9         | 2.2       |                     |           |           |
|                | 20's               | 96        | 23.6      |                     |           |           |
|                | 30's               | 119       | 29.2      |                     |           |           |
|                | 40's               | 121       | 29.7      | Type of business   |                      |           |           |
|                | 50's or higher     | 62        | 15.2      | Total             | 407       | 100.0     |
|                | Total              | 407       | 100.0     | Electric and electronic | 143       | 35.14     |
| SALES          | Less than 10 billion KRW | 177 | 43.5     | 30 years or older | 66       | 16.2     |
|                | Less than 50 billion KRW | 97 | 23.8     | 40 years or older | 7 | 1.7 |
|                | Less than 100 billion KRW | 36 | 8.8     | Total             | 407       | 100.0     |
|                | Less than 500 billion KRW | 41 | 10.1     |                     |           |           |
|                | Over 500 billion KRW | 56 | 13.8     |                     |           |           |
|                | Total              | 407       | 100.0     |                     |           |           |
| AMOUNT         | ISO-certified      | 251       | 61.7      | 300–less than 600 persons | 64 | 15.72 |
|                | ISO non-certified  | 156       | 38.3      | 600–less than 1000 persons | 27 | 6.63 |
|                | Total              | 407       | 100.0     | 1000 persons or more. | 9 | 2.21 |
|                | -                  | -         | -         | Total             | 407       | 100.0     |

Table 4. The results of the rotated component line from the factor analysis.

| The Component Line That Was Rotated | The components |
|------------------------------------|----------------|
| 1                                  | 2 | 3 | 4 | 5 | 6 | 7 |
| LED6                               | 0.905 | - | - | - | - | - |
| LED4                               | 0.884 | - | - | - | - | - |
| LED2                               | 0.859 | - | - | - | - | - |
| LED1                               | 0.821 | - | - | - | - | - |
| PLN5                               | - | 0.834 | - | - | - | - |
| PLN6                               | - | 0.800 | - | - | - | - |
| PLN1                               | - | 0.778 | - | - | - | - |
| PLN4                               | - | 0.775 | - | - | - | - |
| OPR3                               | - | - | 0.941 | - | - | - |
| OPR5                               | - | - | 0.928 | - | - | - |
| OPR2                               | - | - | 0.884 | - | - | - |
| OPR1                               | - | - | 0.795 | - | - | - |
| IMP4                               | - | - | - | 0.843 | - | - |
| IMP2                               | - | - | - | 0.799 | - | - |
| IMP1                               | - | - | - | 0.740 | - | - |
| PER3                               | - | - | - | - | 0.820 | - |
| PER1                               | - | - | - | - | 0.816 | - |
| PER4                               | - | - | - | - | 0.805 | - |
| ORG5                               | - | - | - | - | - | 0.822 |
| ORG3                               | - | - | - | - | - | 0.817 |
| ORG4                               | - | - | - | - | - | 0.785 |
| ORG2                               | - | - | - | - | - | 0.780 |
| SUP4                               | - | - | - | - | - | 0.797 |
| SUP3                               | - | - | - | - | - | 0.794 |
| SUP1                               | - | - | - | - | - | 0.792 |
| SUP5                               | - | - | - | - | - | 0.777 |

4.3. An Analysis of the Measurement Model

The measurement model suggests how the latent variables are connected to the observation variables. In the first phase, the measurement model analysis through the confirmative factor analysis was established to analyze the measurement model of the 2015 revision edition and the index of the level of the suitability of the model [15]. The absolute suitability indices were CMIN/df = 1.490 (X² = 414.266, df = 278), GFI = 0.926,
AGFI = 0.907, CFI = 0.981, RMSEA = 0.035, and RMR = 0.039; the increment suitability indices were NFI = 0.944, IFI = 0.981, RFI = 0.935, TLI = 0.978, and NFI = 0.944; the simple suitability indices were PGFI = 0.733, PNFI = 0.808, CFI = 0.981, and PCFI = 0.839. The absolute suitability indices, the increment suitability indices, and the simple suitability indices exceeded the evaluation standards. As a result, suitable results were obtained, as detailed in Table 5. Figure 1 illustrates the measurement model of the 2015 revised edition.

Figure 1. The reflection indicator model.

Table 5. The analysis results of the measurement model.

| Absolute Suitability Index | Increment Suitability Index | Simple Suitability Index |
|---------------------------|----------------------------|-------------------------|
| RMR | RMSEA | GFI | AGFI | NFI | RFI | IFI | CFI | TLI | X²/df | PGFI | PNFI | PCFI |
| Evaluation standard <0.08 | <0.08 | >0.9 | >0.9 | >0.9 | >0.9 | >0.9 | >0.9 | >0.9 | 1 < 3 | >0.5 | >0.5 | >0.5 |
| Suitability index 0.039 | 0.035 | 0.926 | 0.907 | 0.944 | 0.935 | 0.981 | 0.981 | 0.978 | 1.49 | 0.733 | 0.808 | 0.839 |

4.4. The Analysis of the Reflection Indicator

The reflection indicator is adopted to confirm whether the first-level factor reflects the second-level factor well through the relationship between the first-level factor and the second-level factor. In other words, the correlation is high. Thus, the significance test between the first-level factor and the second-level factor was conducted [32]. The
significant result appeared at \( p < 0.001 \). Table 6 provides the non-standardized coefficient, which is the result of the significance test of the first-level factor and the second-level factor.

Table 6. The results of the significance test of the first-level factor and the second-level factor.

| 2nd Level | Estimate | S.E. | C.R. | \( p \) |
|-----------|----------|------|------|-----|
| ORG       | 0.589    | 0.050| 11.768| *** |
| LED       | 0.761    | 0.046| 16.439| *** |
| PLN       | 0.552    | 0.050| 11.102| *** |
| IMP       | 0.782    | 0.047| 16.702| *** |
| SUP       | 0.577    | 0.045| 12.692| *** |
| PER       | 0.666    | 0.044| 15.032| *** |
| OPR       | 0.451    | 0.043| 10.531| *** |

Note: The ISO9001(2015) QMS is 1st level factor; *** \( p < 0.001 \).

Next, the goodness-of-fit index related to the relationship between the first-level factor and the second-level factor of the revised edition was analyzed. The absolute suitability indices were CMIN/df = 1.825 (\( X^2 = 541.412, \) df = 292), GFI = 0.908, AGFI = 0.901, CFI = 0.966, RMSEA = 0.045, and RMR = 0.069; the increment suitability indices were NFI = 0.928, IFI = 0.967, RFI = 0.920, and TLI = 0.962; the simple suitability indices were PGFI = 0.754, PNFI = 0.835, CFI = 0.966, and PCFI = 0.868. The absolute suitability index, the increment suitability index, and the simple suitability index exceeded the evaluation standard. Thus, suitable results were obtained. Table 7 presents the goodness-of-fit index of the revised edition. The reflection indicator model is illuminated in Figure 2. The seven main provisions of the QMS are listed in Table 7. Compared to the evaluation standard, all the results reflected the 2015 revised edition.

Table 7. The goodness-of-fit indices of the 2015 revised edition.

| Classification | Absolute Suitability Index | Increment Suitability Index | Simple Suitability Index |
|----------------|-----------------------------|-----------------------------|--------------------------|
|                | RMR | RMSEA | GFI | AGFI | NFI | IFI | RFI | CFI | TLI | \( X^2/df \) | PGFI | PNFI | PCFI |
| Evaluation standard | <0.08 | <0.08 | >0.9 | >0.9 | >0.9 | >0.9 | >0.9 | >0.9 | 1 << 3 | >0.5 | >0.5 | >0.5 |
| Suitability index | 0.069 | 0.045 | 0.908 | 0.901 | 0.928 | 0.920 | 0.967 | 0.966 | 0.962 | 1.825 | 0.754 | 0.835 | 0.868 |

4.5. The Verification of the Hypothesis of the Research

The relationship between the organizational concept regarding the ISO9001:2015 latent variables and the quality management activity and customer satisfaction was investigated in this research. Table 8 lists the results of the verification of the hypothesis. Since the standardization coefficient \( \beta = 0.612 (t = 15.864, \) \( p < 0.001) \) was observed for the quality management activity, the significant, positive (+) influence on customer satisfaction was demonstrated. Hence, the hypothesis that the quality management activity will have a positive (+) influence on customer satisfaction was adopted.

Table 8. The results of the regression analysis regarding customer satisfaction.

| Dependent/Independent Variable | \( B \) | \( \beta \) | Dependent Variable: Customer satisfaction | T-Value | Significant Probability | Tolerance Limit |
|--------------------------------|-------|--------|--------------------------------------|--------|------------------------|----------------|
| (Constants)                    | 2.513 |        |                                      |        |                        |                |
| ISO9001(2015)                  | 0.554 | 0.612  | 15.864 ***                           | 0.000  | 0.977                  |                |
| BIZ                            | -0.057| -0.096 | -2.376                               | -2.376 | 0.884                  |                |
| PEO                            | 0.082 | 0.088  | 2.145 *                              | 0.033  | 0.866                  |                |
| R                              |        |        |                                      | 0.643  |                        |                |
| R\(^2\)                        |        |        |                                      | 0.413  |                        |                |
| The revised R\(^2\)            |        |        |                                      | 0.409  |                        | 94.610 ***     |
| F                              |        |        |                                      |        |                        |                |

Note: * \( p < 0.05 \), *** \( p < 0.001 \).
5. Discussion

The main purpose of this study was to review the nature of the continuous improvement activity of an organization in the 2015 revision of ISO9001 and its relationship to
customer satisfaction. The data were collected from all the managers of IoT-related enterprises in Korea. Regression analysis results demonstrated that the continuous improvement activity of an organization had a significant positive relationship with customer satisfaction. Customers had expectations of their products and the organizations, and they were dissatisfied when these expectations were not met. Regardless of IT enterprises, manufacturing, or service industries, a company cannot retain customers if it cannot meet customers’ expectations. Therefore, this study provides a crucial reference value for the field of quality management and the theory of customer satisfaction. Through the study of 472 profitable restaurants, Bernhardt [33] reported that the consumer satisfaction data collected were directly related to the profits of restaurants in the later nine months at any point in time. Similarly, through research on a group of different types of companies, Anderson et al. [34] discovered that the perception of high-quality customers was positively correlated with their feedback investment. Eklof and Westlund also [35] pointed out that customer satisfaction played a positive role in quality management and the most imperative role in the implementation of quality management.

6. Conclusions
6.1. Summary of Research Results

In this study, the core elements of the revised version of ISO9001:2015 were explored through empirical analysis. It was concluded that the context of the organization, leadership, QMS planning, support, operation, performance evaluation, and improvements can be used as the measurement indicators of quality management. Additionally, these measurement indicators have a significant impact on customer satisfaction. Among them, the most influential factors are listed in the order of performance evaluation, Improvements, and leadership. This research provoked big changes in new technologies, such as artificial intelligence (AI), big data, IoT, and 3D printing technology, which are representative of the 4th industrial revolution. Concurrently, these technologies spread into the field of the quality management system because the ISO9001:2015 revised edition was issued and was quickly introduced into all industries, such as the public organizations of the nation, the manufacturing industry, and the services. Thus, this research revealed the flows of the changes in the era by introducing new technology and presenting a long-term, systematic, and efficient management method after the introduction. Then, the requirements related to the quality management system of the 2015 revised edition were demonstrated with the IoT industry as the object. Moreover, foundational research was performed into customer satisfaction based on the acceptance and the spread of the new technology [36–38]. The results of this research are summarized below.

First, the concepts and the properties of each variable are the tools with which the latent variables can be measured accurately because the factors were grouped by the core element, as suggested by the analysis of the rotated component of the 2015 revised edition. Second, how the latent variables and the measurement variables are connected was verified, and the measurement model was investigated through the first-phase confirmatory factor analysis. Regarding the measurement model of the 2015 revised edition, the absolute suitability index was (RMR = 0.039, AGFI = 0.907), the simple suitability index was (X²/df = 1.490), and the increment suitability index was (NFI = 0.944, RFI = 0.935). They all exceeded the evaluation standard, verifying that it was a suitable model. Third, whether the first-level factor reflected the second-level factor was confirmed since the reflection indicator analysis demonstrated a high correlation. Fourth, regarding the relationship between quality management activity and customer satisfaction, the multiple regression analysis uncovered that the revised R² value was around 40.9%, implying the persuasiveness of the entire fluctuations. Fifth, the factors influencing customer satisfaction, consisting of the sales amount, the size of the corporation, and the control variables by industry (namely, the exogenous variables), were controlled. The results further supported that the quality management activities were performed based on customer satisfaction.
6.2. Academic Implications and Empirical Implications

The theoretical suggestions of the results are summarized as follows. First, it was validated that the seven main provisions, which are the core elements, of the 2015 revised edition, were selected as the measurement variables in this research to reveal customer satisfaction for continuous improvements. Second, a questionnaire survey was investigated with the IoT manufacturing corporations and the non-manufacturing corporations in Korea as the objects [19]. This enabled us to flexibly apply the method with which the measurements were possible without any relation to the individual level, the organization, the unit of the corporation, the size of the corporation, or the type of the job. Third, factor analysis was performed to explore the latent variables. The results confirmed that the items as the main provision of the revised edition were the variables for which the correlations were high. Moreover, they were mutually independent variables. Fourth, most of the precedent research on the molding indicator discussed the theoretical aspects primarily. However, the possibility of being able to reach customer satisfaction was validated through the selection of the latent variables that were mistaken as the practical affairs approach method through the reflection indicator.

The following practical suggestions are proposed. First, variables that must be preferentially considered for materializing the new technology developments, the creation of the customers, and customer satisfaction were presented by introducing a new system on the part of the corporations. Second, the situation of the organization, the leadership, and the planning of the QMS were the core provisions of the 2015 revised edition. They are the new variables that can positively influence the quality management activity of the organization and customer satisfaction. Third, the entire quality management system was evaluated and reported to the management by utilizing the measurement tool presented in this research. Fourth, the theoretical background based on the main provisions of the 2015 revised edition demonstrated new variables that allow for the expansion of the participants such as managers. On this basis, the CEO of a corporation can utilize it as an arena for communication with their staff members.

6.3. Limitations and Future Suggestions for Research

The limitations and proposals for future research are summarized from the following perspectives. First, the contents of the core variables that can proactively handle the internal and external opportunities and risks must be organized and provided for the corporations and organizations when establishing and revising the ISO 9001:2015 International Standard or providing the ISO standard. Researchers should conduct empirical studies following the presented core tools. Next, the development of additional tools should be researched considering the fluctuation factors. Second, the empirical research was performed by limiting the independent variables and the dependent variables as the main provisions of the revised edition and customer satisfaction. In the future, follow-up research should be performed to explore the meanings of the main provisions of the revised edition in the relationships between the variables related to the management strategies, including the expansion of the participation of the managers, the leadership, and the corporate performances. Third, the samples of this research were restricted to the IoT industry. Moreover, the research took those corporations which recognized the quality management system based on the manufacturing industry as the objects. Fourth, ISO certified and non-certified companies were not compared. There would be significant differences in quality management between ISO certified and non-certified companies. This study failed to demonstrate the advantages of ISO 9001 certified enterprises over non-certified enterprises. Fifth, common method decentralization cannot be avoided since only one respondent filled in the questionnaire in each enterprise.

Follow-up research considering the diverse kinds of businesses and the samples by industry should be conducted in the future. As this research is a cross-sectional study, there are many limitations to inferring the causal relationships between the variables. Hence, the causal relationship between the improvement of the management performance of the
corporation and customer satisfaction should be disclosed more clearly and definitely, and a longitudinal study should be performed to reveal the changing law of such factors with time.

As suggested, in such an exploratory study, constructive questions for future research can start from a relatively high level of knowledge. Firstly, the replication of this study will contribute to re-examining the effectiveness of its survey results. Data collected from a larger sample size, with greater regional diversity and type diversity can be adopted to validate specific parts of the theoretical model proposed in this study in further empirical research. Secondly, more effective and reliable operations can be included to enrich the research structure and overcome the limitations caused by the data sources used in this research. For example, more categories could be developed to achieve response scores of the leadership level. Data on employee and customer satisfaction should be obtained from employees and customers, not from interviewees. Thirdly, the relationships verified in this study can be tested again in different countries to determine whether they are implemented in the same or different directions. Fourthly, a series of longitudinal studies will be valuable in the time dimension of quality management implementation. Finally, more surveys should be conducted on different types of Internet of Things enterprises to better meet their requirements, so as to constantly improve the quality management system.

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