

# The study of ISO9001 processes as basis for business explicit knowledge

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## ABSTRACT

Our research invited the electronic and electrical manufacturer as the samplings those owned the ISO9001 certification that was widely recognized as the practical formality and normality of flow in firms. Based on business size, we distinguished the research factors affecting by asset amount, employee number and establishing period. According to the tendency and cross analysis, we found that almost are significantly centered on the product realization knowledge, and the higher amount of asset, the more number of employee that appears then the business flow is more positive influenced by product realization knowledge. It means that firm should pay more treatments on business flows when investing of asset or growing of employee. Against previous work, our contribution has clearly demonstrated that the business practical flow especially on the product realization as explicit knowledge is stronger influenced by business size; also, four propositions were from the nine inferences in the conclusion as well.

*Key words: Knowledge management, Business flows, ISO9001, Electronic and Electrical*

## 1. INTRODUCTION

Many of scholars in management [7], [3], submitted that knowledge is going to replace with land, labor, and asset and machine equipment and is becoming the most important competitive factor ([23]; [18]; [22]; [28]). With the definition of tacit knowledge, explicit knowledge and spiral of knowledge theory by Nonaka ([20]; [21]), the business 'resource-basic theory' was replaced by the 'knowledge-based competition'.

More and more researches submitted knowledge as the core competition of business. But, due to the difference in the industrial types and the operational methods, there are great of difference inside the business flows. Fortunately, the ISO9001 has been widely accepted by all the countries in the world since its publication in 1987. In order to have the research more probably against the general knowledge operation in business, our research abandoned the personal tacit knowledge and centered on the conceptual explicit knowledge. Therefore, what knowledge definition around the business flows as the explicit knowledge according to ISO9001 because it is imported a certified standard for the internal procedure of a qualified

business. Hence, the business flows as knowledge affected by the business size factors could conduct business progress from research propositions.

## 2. RELATED WORKS

### 2.1 Explicit Knowledge

Tan divided the knowledge management issues into nine categories by using the 'process perspective' [24]. He thought knowledge should be stored by a specific method and all the knowledge activities are built on the basis of the proper management culture and business system. Gary pointed out that knowledge creativity is the meaning of 'learning-by-doing' or 'learning-before-doing' is different from the industry characteristics [9]. According to [25], the process of knowledge management should emphasize on the creation of new knowledge, and the new knowledge should come from the internal or external daily works of enterprise. The creation of internal knowledge comes from the research development, experience accumulation and learning-by-doing, whereas that of external knowledge comes from the suppliers, customers and competitors. [5] pointed out that the construction of knowledge includes four elements:

accumulation of experience, basis of the truth, judgment, and intuition. However, whether the business can effectively gain and apply knowledge is deeply linked with the business flows. Drucker thought that knowledge will become the critical key of the business success in the future [7]. Once the business wants to sustain the competition advantages, it should assure that the corresponding speed of the knowledge accumulation is faster than that of other competitors. The first priority to assure is to have the daily work procedure of flow connecting with the knowledge management well done [4]. Toffler announced that knowledge is the resource and critical point of the highest authority rather than the traditional land and labors [27]. The future society will be a competitive environment that is centered on the knowledge economics that the business is fighting for.

The Japanese scholars Nonaka and Takeuchi divided the knowledge into tacit knowledge and explicit knowledge [19] that shown on Table 1. The characteristics of the explicit knowledge can be extracted, repeatedly used and shared. Nonaka and Takeuchi not only classify the knowledge into tacit and explicit, then, but also establish the knowledge spiral model which is divided into four categories: socialization, externalization, embodying and combination.

Table 1 Explicit knowledge vs. tacit knowledge [19]

Objective
vs.
Subjective
Mental- Rational knowledge
vs.
Substantial- Experiential knowledge
Un-real time- Continuous knowledge
vs.
Real time- Synchronize knowledge
Theatrical- Digital knowledge
vs.
Actuality- Analog knowledge

### Related Works

The knowledge that accordance with ISO9001 has been investigated by the academic community for a long time, for example, [6] explored the usage of ISO9001 to reach the knowledge application of the business. Using the practical method to explore the information orientation work of the Taiwan Hi-tech company and exploring the relationship between knowledge process and knowledge effectiveness are provided by Lu and Sheng [17], no

matter what the theory [16] or practice [15], there exists a clear distinction between tacit knowledge and explicit knowledge. For example, Ho and Yang pointed out knowledge management that is relative to the customer process through the documentation management which benefit to the service industry [10]. Yang focused on the research of the business process of the insurance company submitted the practical exploring of knowledge and construct the process knowledge mode [29]. However, studies on the explicit knowledge with the perspective of formal flows have been well accepted in the literature. Also, Hwung used ISO9000 as the basis to discuss the relationship between itself and knowledge system [11], then, to infer the knowledge framework which better fits the medium and small business. Jen also explained how the traditional industry executes the promoting process of quality guarantee knowledge by ISO9001 [12].

### 2.2 Business Flows as Knowledge

What are the kernel principles of ISO9001 system is 'process-oriented' as the basis of clause from Ch.4 to Ch.8 which are dK: document control Knowledge (Ch.4); mK: management responsibility Knowledge (Ch.5); rK: resource management Knowledge (Ch.6); pK: product realization Knowledge (Ch.7); a&iK: measurement analysis and improvement Knowledge (Ch.8) (Details are shown on appendix). Once the business plans to import ISO9001, it must reach the integrity and consistency of 'speaking, writing and doing' which mean the business flows. The firm must meet each requirement of the regulations and reach the audition completely. Some of the literatures ([2]; [13]; [1]) have been apparent shown that the possibility of using formal flows as the knowledge could provide a variety of perspective inside their conclusions. In order to ensure the continuous improvement purposes of completeness and correspondence, the PDCA (Plan- Do- Check- Action) can be used as the importing process to maintain the business flows as required by ISO9001 system. Liebowitz pointed out the auditing on company as the review of knowledge asset and management system [14], then, the auditing result must be documented [26] that the participants involve the auditing process include audited enterprise and accreditation institute. Dwan also used ISO9001 concept with combination of PDCA circle as the flow which apply to knowledge management as the basic [8]. In practical, the certificating process is separated into four stages: the 1<sup>st</sup> stage: training period of 'Plan'; the 2<sup>nd</sup> stage:

standardization period of ‘Do’; the 3<sup>rd</sup> stage: implementation period of ‘Check’; the 4<sup>th</sup> stage: the corrective period of ‘Action’. Therefore, in general, knowledge for the business could be derived from the business flows. And what the explicit knowledge that is defined in our research is just a compulsive request under each keyword of “*shall*” in the statements of ISO9001 clauses. For example, *Clause 7.4.3 the organization shall establish and implement the inspection or other activities necessary for ensuring that the purchased product meets specified purchase requirements.* We found if the definition of the knowledge is based on the rule of “*shall*” in the statement of clauses which means whatever the knowledge is inside the business could be managed by the business flows which certainly met the explicit knowledge definition of Nonaka and Takeuchi [19].

### 3. DATA ANALYSIS

Our research show an understanding inside of the business processes which could be defined clearly through the key word of shall that comply with ISO9001 clauses. If business flows that can be operated based on the requirement of ISO9001, it can be delivered through the standardization and systematic characters or document, besides, it is also easy while implementing, copying and independent learning. According to [19], the characteristics of the explicit knowledge can be extracted, used repeatedly and shared at all. On the contrary, it must be difficult to deliver the tacit knowledge through the interpersonal activities. It couldn’t be formulated either and it is impossible to repeat, those reasons why our scope will not consider the tacit knowledge. Consequently, we can get the feedback for further discussion through inferring of propositions which believed that the results must become a base in knowledge practice solving from the viewpoints of samplings that owned the formality and normality of

business flows. Thus, the research framework is shown on Fig.1.

#### 3.1 Samplings

Beginning, we filtered the company that matches with our research purposes, then, we inquired for the willingness to entertain a survey. Followed by this, we mailed the research background instructions. In order to assure that the data of the invited sampling cases are countable in our research, the sampling cases mainly focus on the businesses those must have passed the ISO9001 certification. These cases are collected from the Standard Inspection Institute of the Ministry of Economic Affairs in Taiwan, the private accreditation institute, such as Taiwan Standard Inspection Institute, and some of consulting company. There are a total of 102 businesses owned the ISO9001 certification. In order to focus on the single-type industry that matches the requirement of internal validity, we abandoned the information technology industry after the finally decision. For the willing businesses those are finally confirmed, we chose the electronic and electrical engineering manufacturer as the sampling cases. Therefore, the only research category left was 30 manufacturers centered on the electronic and electrical related products or services. Three of them specially owned the product designing ability, too. The samplings also meet minimum requirement of normal distribution.

Since ISO9001certificated in the electronic and electrical engineering manufacturers is very normal, our analysis of these sampling cases could be a good reference to other industry. It is believed that selection is countable. Furthermore, the classification of those samplings are divided into 5 degrees based on the different amount of asset (below 6000 to 20000 above ), number of employee (below 50 to 300 above), and period of establishment (below 10 to 25 above)

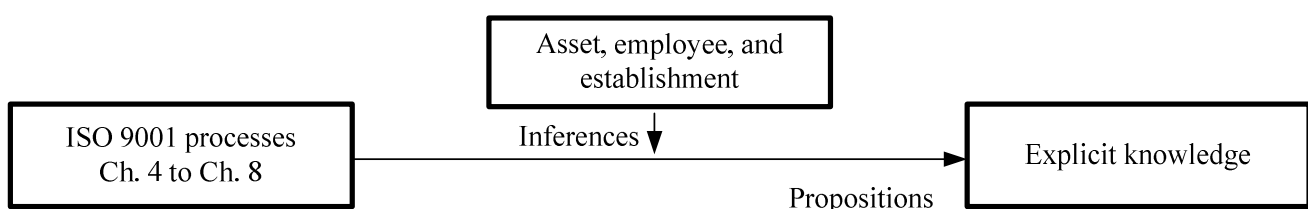


Fig. 1 Research framework

## 4. BUSINESS FLOWS AS KNOWLEDGE

Through reviewing the documentation among samplings which including the quality manual, standard procedure and working instruction that comply with the requirement of keyword '*shall*'; we accumulated the number of business flows that effected by the business size factors as discussed in the following sections.

### 4.1 Analysis on the Business Size

According to the calculation of the number based on the three business size factors; we accumulated all the appearance numbers of flows which means the explicit knowledge that regarding to each clause in ISO9001, and then divided by the samples that own the same asset amount, employee number, and establishing period. The average value is then created. If the business size factor used as the variable respectively, we found that by dK, mK, rK, pK, and a&iK as the explicit knowledge consideration, the number of business flow at different business size respectively.

The amount of asset type 5 appears as the highest requirement on the explicit knowledge and the asset type 1 appears as the lowest requirement on the explicit knowledge. We also found that various types of explicit knowledge appear with different amounts of asset. If we used the type and the asset as the cross-table by the Chi-Square test to judge the relations, the result appears that the Chi-Square value of the explicit knowledge in dK, mK and pK (p value) reaches the apparent level. Therefore, we concluded the inference 1 is that the business flows regarding to documentation (dK), management responsibility (mK) and product realization (pK) positively related to the business asset.

The employee type 5 appears as the highest requirement on the explicit knowledge; the employee type 1 appears as the lowest requirement on the explicit knowledge respectively. We also found that various types of explicit knowledge appear with different number of employees. If we used the type and asset as the cross-table and the Chi-Square test to judge the relations, the result appears that the Chi-Square value of the explicit knowledge in pK (p value) reaches the apparent level. Therefore, we concluded the inference 2 is that the business flows of product realization (pK) positively related to the business employee.

The establishment type 1 appears as the highest requirement on the explicit knowledge; the

establishment type 4 appears as the lowest requirement on the explicit knowledge respectively. We also found that various types of explicit knowledge appear with different establishing periods. If we used the type and asset as the cross-table and used the Chi-Square test to judge the relations, the result shows that the Chi-Square value of the explicit knowledge in pK (p value) reaches the apparent level. Therefore, we concluded the inference 3 is that the business flows of product realization (pK) positively related to the business establishment.

### 4.2 Tendency Analysis of Asset

Following the analysis on three business size factors, we are going to make further understanding on the asset variation against the influence tendency of the explicit knowledge. We set the asset as the vertical axis, the explicit knowledge as the horizontal axis, and draw an explicit knowledge tendency graph of different types. We found that once the asset increases, the individual explicit knowledge of different type does not increase linearly. However, the explicit knowledge focused on the product realization knowledge shows an increasing tendency. Besides, if we summarized all 5 types of explicit knowledge, we found that the status of the explicit knowledge increase follows the increase amount of business asset. Therefore, we concluded inference 4-1 is that the business flows regarding to product realization (pK) has positive relation while the asset increases.

### Cross analysis of the fixed asset

Besides, the maximum number of the samples was selected as the fixed variable (there are 9 cases with asset amount exceeding 2 billions and more) from the five different levels of asset amounts, and the influence of the employee number and establishing period towards explicit knowledge is analyzed, as shown in Fig. 2 The former used the employee numbers along the vertical axis, the latter used the establishing period as the vertical axis. These two figures show the variation tendency by using the explicit knowledge as the horizontal axis. We found that when the asset amount is fixed and the meaning that stands for the factor of the same business size scale has been delimited, the relationship between the explicit knowledge, the employee numbers and the establishing periods appear apparently on the variation of pK. This expresses inferences 1 and 4-1 because it is still focused on the knowledge of production processes. Therefore, we concluded inference 4-2 is that if the business asset amount is fixed, the influence of the

employee more than the establishment towards explicit knowledge is mainly focused on business flows of product realization (pK)

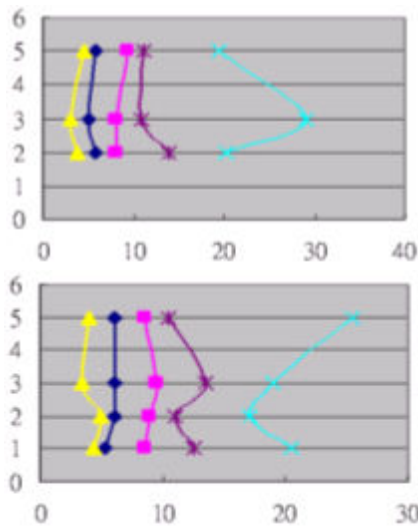


Fig. 2 Employee (left) and establishment analysis against fixed asset(dK:♦ , mK:■ , rK:▲ , pK:x,a&iK:• ,all: • )

**4.3 Tendency Analysis of Employee**

There are different employee numbers for the sampling cases, which are classified to 5 different levels, from 50 people below to 300 people above. In order to execute further analysis on the influence of employee numbers towards the explicit knowledge, we set the employee numbers along the vertical axis, the explicit knowledge along the horizontal axis and calculate the explicit knowledge tendency of different types. Once the number of employees increases, the influence of the explicit knowledge would not appear in dK, rK, and a&iK. However, there was a minor influence in mK. However, there was a major influence in pK. To make a conclusion on it, while the number of employees increases, there is an increase of tendency on the explicit knowledge. Therefore, we concluded inference 5-1 is that the business flows regarding to product realization (pK) has positive relation while the employee increases.

**Cross analysis of the fixed employee**

Besides, select the totally 13 samples with the biggest employees number of 51 to 100 within the 5 different levels of employee numbers, then set it as the fixed variable, the variable is used to analyze the influence of the asset amount and establishing of periods toward the explicit knowledge, as shown in Fig. 3. The former used the asset as the vertical axis and the latter used the establishing periods as the vertical axis. Combining the explicit knowledge with

the horizontal axis, the variation tendency is plotted. We found that once the employee numbers are fixed and the factors those have the same business size are fixed, the relationship between the explicit knowledge and asset amount, the varying type of the explicit knowledge, is varied with the increase of asset amount, apparently in pK and a&iK. The change of relationship between the explicit knowledge and the establishing periods would not appear as the fixed tendency. Then a&iK showed the shape of saw tooth. The pK decreases first, and then increases and finally stabilizes. The dK, mK and rK do not show the stabilization tendency. Therefore, we concluded inference 5-2 that if the business employee number is fixed, the influence of the asset more than the establishment towards explicit knowledge is mainly focused on business flows of product realization (pK).

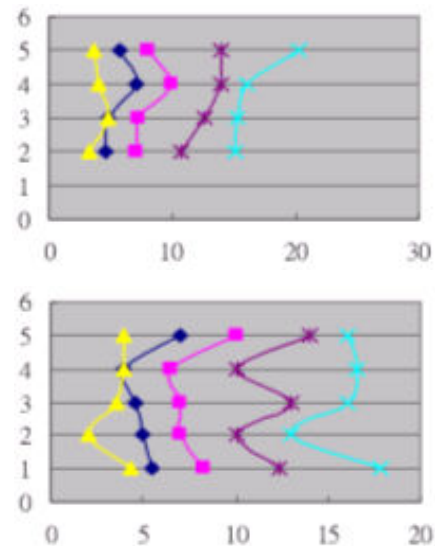


Fig. 3 Asset (up) & establishment analysis against fixed employee(dK:♦ , mK:■ , rK:▲ ,pK:x ,a&iK:• ,all: • )

**4.4 Tendency Analysis of Establishment**

The sampling cases for those with different establishing periods are 5 different levels from 10 years below to 25 years above. In order to analyze the tendency to influence the establishment variation towards the explicit knowledge, we used the establishing period as the vertical axis, and the explicit knowledge as the horizontal axis. The calculation of the explicit knowledge tendency of different types that we found that pK shows a clear influence towards the explicit knowledge upon increasing the establishing periods. The others are not clear. To make a summary of it, when the establishing periods increase, the explicit knowledge shows both increasing and decreasing tendencies.

The relation between the explicit knowledge and establishing periods was found with the help of pK. However, its p value nears the critical value 0.5. Therefore, we concluded inference 6-1 is that no matter the establishing period is long or short, the business flows that do not play a relatively influencing ability towards the any business flow.

#### Cross analysis of the fixed establishment

Finally, we selected the maximum number of samples as the fixed variable (10 samples with establishing periods from 16 to 20 years) from the 5 different levels of establishing periods and to analyze the influence of the asset and employee towards the explicit knowledge, as shown in Fig. 4. The former used the asset amount axis as the vertical axis, and the latter used the employee number as the vertical axis and draws the variation tendency while the explicit knowledge is the horizontal axis. If the establishing period is fixed with the same business size, the explicit knowledge demonstrated the increasing status while the asset amount increases. The tendency was quite clear except rK. Besides, when the number of employee increases, the explicit knowledge increased apparently in pK. There is an increase of status while the employee number is type 2 in dK, mK and a&iK. However, the change is very strange when the employee number type is 1 and 2 in rK. It could be considered as a special case and can be neglected. Therefore, we concluded inference 6-2 is that if the establishing period is fixed to understand the business flows, there is a stronger influence of the asset than that of employee towards the explicit knowledge.

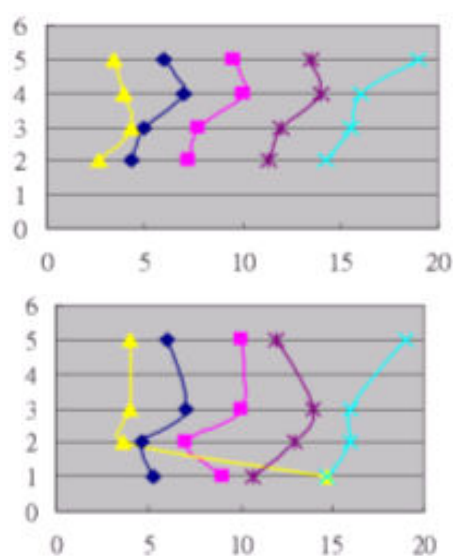


Fig. 4 Asset (up) & employee analysis against fixed establishment(dK:◆ ,mK:■ ,rK:▲ , pK:x , a&iK:· ,all:● )

#### 4.5 Management Practices Discussion

Discussions are based on the previous analysis towards the inferences which will be the basis to develop the propositions accordance with the business flows as definition of explicit knowledge that induced the management practices. The three business size factors determine different business flows that comply with the ISO9001 clause. In business, the asset amount is important than others. Since ISO9001 is involved in business activities, from the inference 1 we know that the business flows are the basis of explicit knowledge that resulted from dK, mK and pK. Therefore, if the business operation allows the business flows to be considered explicit knowledge by employees, then more of such business flows will be formalized and normalized. These can be observed from the average of business flow, which is used to more than zero. For these reasons, we can conclude that *P.1-1: The explicit knowledge according to the business flow is stronger influenced by the business size factors of asset and employee than establishing period.*

For a business, process is the most important factor to affect the business, as more of business flows that comply with the ISO9001 clauses, the explicit knowledge will depend more on the product realization. These can be observed by the business flows of pK, which are the biggest. In other words, the meaning of inference 2 is that there is a positive relation between product realization and employee number. Therefore, the more business flow accordance with product realization, the more employees there are. Another inference 3 is kind of similar meaning between product realization and establishing period. For these reasons, we can conclude that *P.1-2: Most of the firms are focused on the explicit knowledge of product realization that is influenced more significant than other business flows.*

Besides, we also have the inferences 4 to 6 that concluded the following proposition. According to the inference 4-1 and 5-1, the business asset and employee are positive related to the product realization that can be found from the summarization of all 5 types of asset and employee respectively. On the other hand, if the asset amount is fixed, the influenced of employee towards explicit knowledge stronger than that of establishment (inference 4-2); inference 5-2 has the same conclusion which is the influence of asset towards explicit knowledge is stronger than that of establishment under the fixed employee. However, we finally concluded that asset amount is stronger than employee number towards

explicit knowledge in inference 6-2. As the reasons we can conclude that *P.2-1: The higher the asset amount, the higher employee number appears; then the explicit knowledge according to the business flow is more positive influence by product realization knowledge (inference 4-1, 4-2, 5-1, 5-2 and 6-2).*

With the same reasons as inference 4-2 and 5-2 that the influence of establishment towards explicit knowledge for which they are not the major factors of asset and employee. It means the explicit knowledge concerns the business flow which accumulated by the increasing of asset amount and employee number rather than the establishing period in business. It can also be proved by inference 6-1 which described the establishing period is long or short without positive ability towards the explicit knowledge. As the reasons we can conclude that *P.2-2: The influence of establishment period towards the explicit knowledge demonstrates weaker positive relation than others (inferences 4-2, 5-2 and 6-1).*

All The development of propositions are shown on the Fig. 5.

The business flows are important with regard to the ISO9001 clauses among the electronic and

electrical engineering manufacturers, which are significant in explicit knowledge, either internal or external processes. When a business seeks to become more knowledge orientated, the business flows with the attributes of formality and normality can easily guide employees to obey the corrective behavior in doing all business works with referring to P.1-1 & P.1-2. Traditionally, business activities can be connected through a synthetic orientation but it cannot keep long time to sustain the competitive advantage. [7] thought that knowledge becomes the key point of the business success in the future. In academia, rare study has been undertaken in relevant subject. This work seeks to analyze influence on business flow as knowledge at different viewpoint of business size factors. Explicit knowledge is also a practical issue, which is deeply influenced by the daily operation such as the product realization (pK) as well as the asset amount and employee number (P.2-1 and P.2-2). This work not only proposes many descriptions of business flow in business, but also provides manager with practices of explicit knowledge considerations.

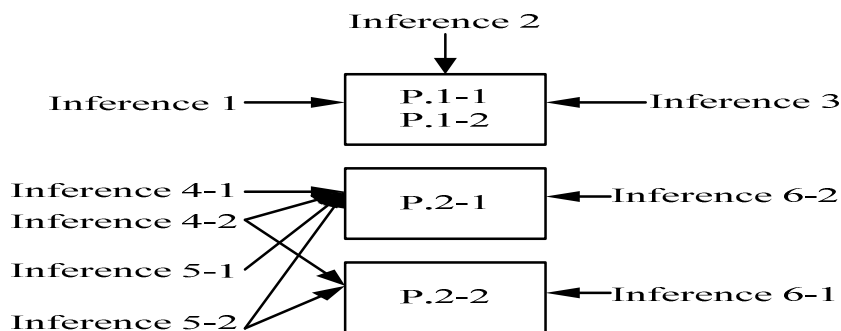


Fig. 5 The proposition development

## 5. CONCLUSIONS

Knowledge is the core competition ability of the business. However, it would be a huge influence on the business process due to the different industries and various operational methods. In order to have the research procedure own the feasibility towards the knowledge operational among electronic and electrical engineering manufacturer, our research abandoned the personal tacit knowledge but focused on the explicit knowledge to generalize research results with definition of the business flows that comply with the clauses of ISO9001 as explicit

knowledge. We consulted the internal managers of sampling cases for collecting raw data to calculate the number of business flows. In addition, the influence of the asset amount, employee number and establishing period towards the business flows are distinguished based on the business size factors. We adopted the tendency and cross analysis to display the variation status of the explicit knowledge. After the analysis of the related data, our research proposes two important research propositions what could provide as the future design of knowledge management system by ISO9001 clause.

Our study would like to suggest further defining the attribute of business flows as knowledge because



knowledge activity is influenced by many factors. How to define the knowledge content and make it more operational would reflect the different consideration of the knowledge. Besides, the operation of the tacit knowledge is difficult to formulate and normalize. How to define the quantitative tacit knowledge is the development direction of the future study. It would be a direction to research and discuss other business size factors that can find other notable outcomes in the future.

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#### Appendix: Major sections in ISO9001 clauses

	4.1 General Requirement
	4.2.1 General Introduction
dK	4.2.2 Quality Manual
	4.2.3 Documentation Control
	4.2.4 Recording Control
	5.1 Management Level Promise
	5.2 Customer Priority
	5.3 Quality Policy
	5.4 Planning
mK	5.5.1 Responsibilities and Authority
	5.5.2 Management Representative
	5.5.3 Internal Communication
	5.6 Management Level Audit
	6.1 Resource Provide
rK	6.2 Human Resource
	6.3 Infrastructure
	6.4 Work Environment

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- 7.1 Product realization Plan
  - 7.2 Process Related Customer
  - 7.3 Design and Development
  - 7.4 Purchase
    - 7.5.1 Control on Production and Service Providing
    - 7.5.2 Confirmation on Product and Service Providing
    - 7.5.3 Identification & Trace
    - 7.5.4 Customer Property
    - 7.5.5 Product Protection
  - 7.6 Monitor & Measure Device control
  
  - 8.1 Measure, Analysis & Improvement
    - 8.2.1 Customer Satisfaction
    - 8.2.2 Internal Audit
    - 8.2.3 Monitor & Measure on Process
    - 8.2.4 Monitor & Measure on Product
  - 8.3 Control of nonconforming product
  - 8.4 Data Analysis
  - 8.5 Improvement
    - 8.5.1 Continuous Improvement
    - 8.5.2 Correction Plan
    - 8.5.3 Prevention Plan

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(Ch.4: dK; Ch.5: mK; Ch.6: rK; Ch.7: pK; Ch.8: a&iK.