

# Research on the Relationship Between the OHSAS 18000 System Implementation and Competitiveness in Taiwan's Industries

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## Abstract

In recent years, the labor consciousness is gradually valued. During the process of pursuing sustainable operation, the enterprises treat occupational hazard risk as the waste of cost. The purpose of OHSAS 18000 occupational security and health management system is to systematically establish the business managerial measures in terms of occupational security and calamity prevention. This research proceeded with questionnaire analysis with respect to the relationship between the OHSAS 18000 system implementation and competitiveness in Taiwan's industries. The research result revealed that there was significant relationship between Taiwan firms' execution of OHSAS 18000 system and industry competitiveness. Thus, the enterprises can decide the proper managerial plans according to the result of their own risk evaluation to prevent the happening of accidents and reduce the operational cost. They can thus completely control business occupational hazard risk through "systematic" management.

**Key Words:** OHSAS 18000 System, Competitiveness, Occupational Hazard Risk

## 1. Introduction

The OHSAS 18000 occupational security and health management system (Occupational Health and Security Assessment Series 18000) is the verification standard of international security and health management system introduced by SGS for serving the domestic companies. The

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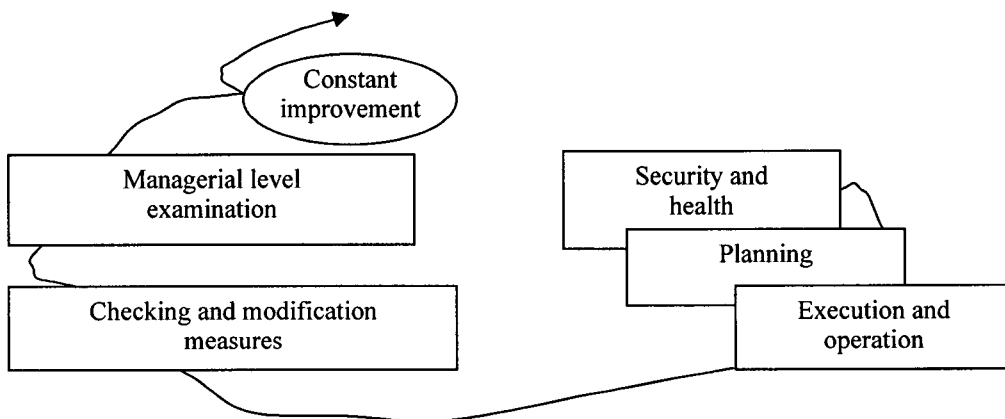
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framework is similar to BS 8800 which everyone is more familiar with (Chou, 2004). The OHSAS 18000 will replace present other security and health management system standards and become the main stream of the business circle. The ISA 2000 which was previously promoted by SGS will also withdraw and become the establishment support tool when the firms introduced OHSAS 18000. The purpose of OHSAS 18000 development is mainly to solve the problem the customer face when they encounter the security and health management system verification standards of security and health management system developed by various institutions and to replace the more well-known BS 8800 to become the international standard. Because of the unclearness of the above problem, the customers tend to wait and see the situation. Comparing with quality and environmental management system establishment, although security and health management system construction is lack of the incentive of market orientation, it has the image of respecting the employees' lives and properties. According to the statistics of European Agency for Safety and Health, the annual loss of occupational calamity in European countries is from 2.6% to 3.8% of Gross National Product (Yi-ming Gao, 2000). Therefore, the happening of occupational hazard has great impact on the loss of business property. The benefits of establishing and maintaining OHSAS 18000 system (Ke-jung, 2004) are: (1) completely regulating and improving business occupational health and security management, ensuring the employees' occupational health and life safety, ensuring business property security and upgrading work efficiency; (2) improving the public relationships with the government, employees and community and upgrading business reputation; (3) providing the mechanism which can constantly meet the requirements of laws and regulations to prevent the happening of accidents; (4) overcoming the non-customs duties trading barrier of products and service in domestic and foreign trading activities and acquiring the pass to enter the market; (5) upgrading the degree of financial credits and reducing the insurance costs; (6) upgrading business synthetic competitiveness. Greeno's (1999) implementation of OHSAS 18000 system on the firms revealed the benefits as follows: minimum occupational calamity risk, growth of business performance, business image upgrading and minimum occupational calamity risk. The research of Finnegan (1999) found out that the implementation of OHSAS 18000 system could increase business competitiveness including reducing insurance fees, increasing the chances to acquire capital, reducing fines, reducing occupational hazard cost and upgrading image. Based on the above establishment of occupational security and health management system, the benefits for business can be generalized into the following points: (1) constructing occupational security and health environment and international standardization of quality control system, helping the enterprises establish green image, upgrading product quality, reducing the happening of business occupational calamity, reducing the loss risk because of non-production factors and further increasing export competitiveness; (2) improving the constitution of the firms, strengthening the efficiency of pro-

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duction line, upgrading profit capacity, ensuring the business properties (manufacturing machinery facilities and plants), ensuring the employees' life security and health; (3) complying with international trends and upgrading business image.

The main content of OHSAS 18001 includes five aspects: (1) occupational health security guiding principles; (2) planning including identification of dangerous origins, risk evaluation and risk control planning, goal, law and other requirements and occupational health security management plan; (3) implementation and operation including institutions and responsibilities, negotiation and exchange, document and data control, emergency preparation and response, training, consciousness and competence, document and operational control; (4) checking and modification measures including performance measure and monitoring, accidents, incidents, violation, correctness and prevention measures, records and examination; (5) management evaluation which is for the integration of quality, environment and occupational security and health management system. When establishing OHSAS 18000, the compatibility with ISO 9001 and ISO 14001 is also concerned; thus, the system framework is Plan, Do, Check and Action as Figure. 1 (Shi-huang Wang, 2002).



**Figure 1.** Successful occupational security and health

The framework of occupational security and health management system (Hsu and Chou, 2002) includes: (1) the top level of the firms is committed to follow the laws and regulations related to security and health, prevent the occupational calamity and accidents from happening and continue the implementation and promotion; (2) setting up the scope of managerial system; (3) investigating current situations of security and health in the firms of the previous period, listing all of the factors which might influence security and health and constructing the process for significance analysis; (4) according to the investigation result of the

previous period, setting up occupational security and health policy, constructing the goals, targets and related security, health improvement projects and external implementation and communication; (5) properly planning system organization and responsibility division and personnel training to meet the requirements of business control and emergency response; (6) monitoring measurement, internal examination and managerial examination, evaluating performance of security and health and proceeding with constant improvement. The operational model of occupational security and health management system can be based on the following process and steps (Hsu and Chou, 2002): (1) Communication of internal personnel's business; (2) complete understanding of current security and health system; (3) investigation of the following degree toward security and health laws and regulations; (4) diagnosis in previous term (investigation in advance); (5) confirmation of security and health influence; (5) confirmation of security and health policy and goal; (6) document framework in the previous term (including project plan); (7) written document standardization and system integration; (8) promotion and training (operation and implementation control); (9) security and health work examination; (10) self-effect evaluation; (11) constant tracking and improvement and fulfilling the business social responsibility.

## 2. Indicators of Competitiveness

Louis and Talbot (2000) indicated that the indicators of competitiveness included cost reduction, manufacturing and production cost reduction, inventory management cost reduction, transportation and delivery cost reduction, cost increase, market share increase, increasing profit, increasing the market opportunities of the products, complying with regulations, increasing company image, reducing the fines or punishment when not meeting the environmental laws. The competitiveness indicators proposed by John and Michael (1997) included reducing manufacturing cost, satisfying the customers' needs (quality) and reducing the burden of regulations. Porter (1990) has mentioned in the book *Competitive Strategies* that in order to acquire competitive advantages and the performance preceding other competitors, the organization had two strategies to select from: reducing cost and product differentiation. As to reducing cost, Fiksel (2001) indicated that the costs of each stage in life cycle of the products should be reduced. This research proposed that the measurement indicators of reducing cost should include reducing material or parts acquisition costs, manufacturing costs, product use and maintenance costs, packaging and delivery costs, waste dealing costs, pressure and fines from environmental regulations, etc. As to product differentiation, according to the proposal of Reinhardt (1998), three basic conditions must be satisfied: the customers' willingness to purchase environmental products, the customers can trust in the products and

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innovative products which are not easy to be imitated. Greeno (1999) pointed out that the benefits of the firms' implementation of OHSAS 18000 system were minimum occupational calamity risk, business performance growth, business image upgrading and minimum occupational calamity risk. According to the research findings of Finnegan (1999), the implementation of OHSAS 18000 system could upgrade business competitiveness including saving the insurance fees, being easy to acquire the capital, reducing fines, occupational hazard cost reduction and image upgrading. According to the result of literature review, this research divided competitiveness indicators into two items: cost and differentiation. The indicators of cost included: saving insurance fees, reducing manufacturing costs, being easy to acquire capital, reducing loan interests, reducing facility use and maintenance costs, reducing the payment of compensation or indemnification, reducing fines; the indicators of differentiation included: reducing fines, reaching risk control result, upgrading company image and reputation, upgrading import and export competitiveness, upgrading product quality and attracting prominent talents.

### **3. Research Method**

This research treated the 258 firms which have passed OHSAS 18000 certification and registered in Industrial Development Bureau, Ministry of Economic Affairs, R.O.C. as the targets of questionnaire distribution. The industry categorizations included 15 items: optoelectronics, semiconductor, electronics, chemical, textile, food, electric machinery, machinery, transportation, paper industry, metal manufacturing, environmental, steel, construction and other industry categorizations. The analytical methods of questionnaire data in this research included: (1) descriptive statistics; (2) T test; (3) One-Way ANOVA. The questionnaire of this research included five major sections:

1. Company basic information: including business volume, capital volume, industry categorization, numbers of employees and the company's cooperation with techniques of foreign business and capital in recent years.
  2. The degree of the company's implementation of OHSAS 18000: including the aspects if the company frequently executes OHSAS 18000 and if the executive degree reached the requirement of performance.
  3. The main reasons to execute OHSAS 18000: to understand if the company's introduction of OHSAS 18000 led to great benefits in terms of business image upgrading, quality upgrading, cost reduction, security and health consciousness increasing and risk reduction.
  4. The degree of company's execution of occupational security and health strategies: including the aspects if the company frequently executes occupational security and health strat-
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egies and if it often upgraded the knowledge of occupational security and health and looking for the solution to occupational security and health issues from new perspective.

5. The benefits of the company's implementation of OHSAS 18000 system: to understand if the company's introduction of OHSAS 18000 led to great improvement in terms of business human resources, competitiveness, finance, security risk, business control, employees' health and external image.

The design of questions in this questionnaire focused on optoelectronics, semiconductor, electronics, chemical, textile, food, electric machinery, machinery, transportation, paper industry, metal manufacturing, environmental, steel, construction and other industry categorizations which have passed the certification of OHSAS 18000 series. This research distributed 258 questionnaires in total and had 60 questionnaires in 2006. Thus, we analyzed these return ones and explored if the execution degree revealed significant influence through four aspects: Plan (P), Do (D), Check (C) and Action (A). According to the data of return questionnaires, the research proceed with descriptive analysis on research subject in order to understand the current execution of OHSAS 18000 in business circle. Based on the result of descriptive analysis, we realize that as to industry categorization, traditional manufacturing industry (paper, textile, food, electric machinery and machinery) were the most (33.3%); as to numbers of employees, 101~300 people were the most (30.0%) and the second was over 2,000 people (23.3%); with regard to annual business volume, over NT\$ 5 billion was the most (43.6%); with regard to capital source, self-collection was the most (56.7%); in terms of capital volume, over NT\$ 5 billion was the most (46.7%); in terms of implementation motive, innovative security environment and systematization of security and health management were the most (93.3%) and the second was increasing security and health consciousness (90%) which were the internal drive and the active motive of the business.

### 3.1 Reliability and Validity Test

1. Validity test: the content in the questionnaire was based on the theoretical bases of related literatures and mostly cited the scale of measurement items used by the scholars. The questionnaire also followed the opinions of industry experts and scholars. Thus, the validity of this research should be reliable.
  2. Reliability test: With regard to the scores of each option, the research calculated Cronbach  $\alpha$  factor of each option in every aspect. Nunnally (1978) indicated that in basic research, reliability should at least reach 0.8. In exploration research, reliability should only reach at least 0.7. In this research, Cronbach  $\alpha$  factors of each option in the aspects of security and health strategy, implementation degree, competitiveness were all more than 0.7 as Table 3. Thus, this research meets the reliability requirement of this level.
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**Table 3.** Reliability value of each variable in this research

Questionnaire aspect		Cronbach's $\alpha$
Security and health strategy	Communication	0.8707
	Knowledge	0.7109
	Innovation	0.7540
Implementation degree	Management and planning aspect	0.8842
	Executive operation aspect	0.9241
	Checking operation aspect	0.8863
	Examination operation aspect	0.9654
Competitiveness	Cost reduction	0.7716
	Differentiation	0.8533

### 3.2 Variable Analysis and Test

1. The relationship between security and health strategy and implementation degree: This research explored if there was significant difference between three security and health strategies and implementation degree. The result in Table 1 revealed that three aspects of management and planning, executive operation, examination operation and knowledge all reached significant influence; in addition, examination operation had significant influence on innovation; checking operation aspect did not reveal significant influence on security and health strategy; communication and various aspects did not reveal significant influence. Therefore, the execution of security and health strategies did not necessarily influence the implementation degree.
2. The relationship between implementation motive and implementation degree: this section explored if there was significant difference of four aspects of executive degree under different implementation motives. The result of Table 2 revealed that management and planning, executive operation, examination operation aspect had significant influence on external drive; four aspects of executive degree did not have significant influence on internal drive. Thus, it seemed that the degree of internal drive did not affect the executive degree; instead, external drive was more likely to affect executive degree. The reason might be in that Taiwan industry needed external stimulation or pressure in order to fulfill its potential and manage the business better.

3. The relationship between industry characteristic and implementation degree: in this section, the research explored if there was difference of four aspects of execution of implementation degree according to the difference of the firms' capital volume, business volume, numbers of employees and industry categorization in the return questionnaires. In Table 3, we found out that capital volume was significantly influenced by management and planning, executive operation, examination operation; business volume was significantly influenced by management and planning; industry categorization was significantly influenced by executive operation, checking operation and examination operation; in addition, numbers of employees did not reveal significant difference on four aspects. In other words, apart from the factor of numbers of employees, other industry characteristics more or less would affect the execution degree. Thus, the implementation of security and health management was still affected by industry characteristics.
4. The relationship between execution degree and competitiveness: This section explored if there was significant difference with respect to three items of competitiveness through four aspects of executive degree. In Table 4, we found out that reducing cost was significantly influenced by management and planning aspect. In other words, the performance at management and planning stage would affect cost reduction. Differentiation was significantly affected by executive operation and it depended on how the business operated security and health management; the rest did not reveal significant difference and not significantly related to the upgrading of competitiveness.
5. Differentiation analysis of competitiveness: This section explored if the difference of basic information (capital volume, business volume, numbers of employees, industry categorization) led to the difference of executive degree of competitiveness (cost reduction, differentiation). The result in Table 5 revealed that only business volume had significant influence on differentiation.
6. From Table 6, we can realize that dc, ed, ha, hd, he, id, ie, ih, jd, je, jh, ji, kd, ke, kh, ki, kj, lf, mf, ml all reveal significant influence.

**Table 1.** Variable analysis and test of security and health strategy and implementation degree

Strategy\aspect	Management and planning		Executive operation		Checking operation		Examination operation	
	F value	P value	F value	P value	F value	P value	F value	P value
Communication	0.651	0.764	0.749	0.697	1.545	0.199	1.000	0.449
Knowledge	2.377	0.050**	4.941	0.002***	1.676	0.160	5.443	0.001***
Innovation	1.609	0.179	1.806	0.131	1.696	0.154	2.948	0.028**

Note) \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.



**Table 2.** Variable analysis and test of implementation motive and implementation degree

Motive\aspect	Management and planning		Executive operation		Checking operation		Examination operation	
	F value	P value	F value	P value	F value	P value	F value	P value
External drive	2.613	0.037**	2.042	0.091*	1.238	0.326	4.413	0.003***
Internal drive	1.046	0.389	0.364	0.780	0.071	0.975	0.490	0.692

Note) \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

**Table 3.** Variable analysis and test of industry characteristic and implementation degree

Aspect \ Characteristic	Capital volume		Business volume		Numbers of employees		Industry categorization	
	F value	P value	F value	P value	F value	P value	F value	P value
Management and planning	2.894	0.024**	3.109	0.026**	2.038	0.101	1.629	0.192
Executive operation	3.074	0.019**	1.621	0.193	0.766	0.604	2.263	0.082*
Checking operation	0.479	0.857	1.166	0.355	0.398	0.872	2.845	0.038**
Examination operation	2.124	0.080*	1.246	0.319	0.834	0.556	5.192	0.002***

Note) \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

**Table 4.** Variable analysis and test of execution degree and competitiveness

Aspect \ competitiveness	Reducing cost		Differentiation		Competitiveness	
	F value	P value	F value	P value	F value	P value
Management and planning	5.064	0.001***	1.220	0.342	1.622	0.192
Executive operation	1.748	0.144	2.622	0.034**	1.379	0.283
Checking operation	0.514	0.884	1.562	0.194	1.128	0.419
Examination operation	1.164	0.382	1.406	0.252	1.352	0.295

Note) \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

**Table 5.** Competitiveness difference analysis

Competitiveness \ characteristics	Capital volume		Business volume		Numbers of employees		Industry categorization	
	F value	P value	F value	P value	F value	P value	F value	P value
Cost reduction	1.533	0.205	0.904	0.495	1.683	0.170	1.551	0.214
Differentiation	0.541	0.812	3.372	0.019**	1.204	0.340	1.118	0.379

Note) \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

**Table 6.** Correlation factor analysis between the degree of business environment design execution and competitiveness

	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.
b.	-0.24											
c.	0.03	-0.14										
d.	0.10	0.09	0.35*									
e.	0.02	-0.08	0.16	0.79***								
f.	0.00	-0.13	-0.06	-0.04	0.06							
g.	-0.07	-0.04	-0.13	0.00	-0.04	0.13						
h.	0.33*	0.04	0.05	0.55***	0.43**	0.11	-0.22					
i.	0.15	0.12	0.14	0.64***	0.52***	-0.01	-0.02	0.77***				
j.	-0.05	0.24	0.27	0.63***	0.56***	-0.07	-0.02	0.53***	0.75***			
k.	0.10	0.23	0.30	0.66***	0.51***	-0.03	-0.01	0.69***	0.85***	0.73***		
l.	-0.07	0.17	0.08	-0.05	-0.02	0.51***	0.28	0.05	0.05	0.07	0.14	
m.	0.00	0.23	0.17	-0.02	-0.04	0.37**	0.07	0.05	0.21	0.10	0.11	0.60***

Note) 1. Items: a. industry categorization; b. business scale; c. communication degree; d. knowledge degree; e. innovation degree; f. internal drive; g. external drive; h. management and planning aspect; i. executive operation aspect ; j. checking operation aspect ; k. examination operation aspect; l. cost reduction; m. differentiation increase.

2. \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

### 3.3 Implementation Degree Analysis

#### 3.3.1 T Test $H_0: \mu = 4$

1. Implementation degree of management and planning aspect: In this aspect, we explored if the items of implementation degree revealed significant difference through managerial aspect. From Table 7, we can realize that only “devoted to reducing the cases of the employees’ protests and complaints” and “devoted to upgrading accomplishment rate of risk evaluation” did not reveal significant influence; the implementation of other items revealed significant standard.
2. Implementation degree of executive operation aspect: In this aspect, we explored if the implementation degree reached significant difference through executive operation aspect. In Table 8, the result revealed that the executive degree all had significant influence.
3. Implementation degree of checking operation: In this aspect, we explored if the items of implementation degree revealed significant difference through checking operation aspect. In Table 9, we realize that only “devoted to upgrading improvement and accomplishment rate of internal examination” did not reveal significant influence. The rest all reached significant effect.

**Table 7. Implementation degree of management and planning aspect**

Items	Average	Standard error	T-value	P-value
1. Devoted to meeting the customers' needs	4.567	0.504	6.158	0.000***
2. Devoted to upgrading the degree of the managers' value on security and health policies	4.433	0.568	4.176	0.000***
3. Devoted to meeting requirements of regulations	4.833	0.379	12.042	0.000***
4. Devoted to upgrading the success rate of the goals and management plans of security and health policies	4.500	0.861	3.181	0.003**
5. Devoted to reducing the cases of the employees' protests and complaints	4.267	1.048	1.393	0.174
6. Devoted to reducing the fines or amount of money of law and regulation violation	4.767	0.430	9.761	0.000***
7. Devoted to reducing the notices/times of accidents (including false alarm)	4.467	0.900	2.841	0.008**
8. Devoted to reducing low quality rate of products	4.800	0.407	10.770	0.000***
9. Devoted to upgrading preciseness degree of manufacturing process	4.633	0.490	7.077	0.000***
10. Devoted to upgrading accomplishment rate of risk evaluation	4.333	1.028	1.775	0.086
11. Devoted to reducing the cases of protests and complaints from neighboring community	4.433	0.898	2.644	0.013*

Note) \*\*\* p < 0.001; \*\* p < 0.01; \* p < 0.05.

**Table 8. Implementation degree of executive operation aspect**

Items	Average	Standard error	T-value	P-value
1. Devoted to upgrading the completeness and propriety of communication with customers	4.367	0.669	3.003	0.005**
2. Devoted to upgrading production efficiency and delivery accomplishment rate	4.533	0.629	4.646	0.000***
3. Devoted to upgrading managerial capacity	4.300	0.750	2.192	0.037*
4. Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	4.467	0.681	3.751	0.001**
5. Devoted to upgrading business principles/regulation accomplishment rate	4.600	0.621	5.288	0.000***
6. Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	4.567	0.626	4.958	0.000***
7. Devoted to upgrading automatic checking and fault improvement and accomplishment rate	4.600	0.498	6.595	0.000***
8. Devoted to upgrading the propriety rate of machinery (instrument) facilities	4.500	0.572	4.785	0.000***
9. Devoted to upgrading control rate of hazard materials	4.467	0.571	4.474	0.000***
10. Devoted to reducing the happenings of unusual situations or break down of fire control facilities	4.600	0.563	5.835	0.000***
11. Devoted to upgrading the use rate of personal protective instruments	4.433	0.626	3.791	0.001**
12. Devoted to upgrading propriety rate of employees' consulting and communication	4.333	0.711	2.567	0.016*

Note) \*\*\* p < 0.001; \*\* p < 0.01; \* p < 0.05.

4. Implementation degree of examination operation: In this aspect, we explored if the items of implementation degree revealed significant difference through examination operation aspect. In Table 10, the result revealed that the executive degree revealed significant influence.

### 3.3.2 One-Way ANOVA Analysis

1. The firms' business volume and One-Way ANOVA analysis of current implementation: this section explored if there was significant difference in current implementation through the firms' business volume. In Table 11, the result revealed that these four aspects did not reveal significant difference through implementation principles.

**Table 9.** Implementation degree of checking operation aspect

Items	Average	Standard error	T-value	P-value
1. Devoted to upgrading improvement and accomplishment rate of internal examination	4.733	0.521	7.712	0.000***
2. Devoted to upgrading the customers and residents' identification with security and health requirements	4.167	0.834	1.095	0.283
3. Devoted to increasing the employees' industrial security consciousness	4.600	0.621	5.288	0.000***
4. Focusing on the checking of instruments	4.667	0.606	6.021	0.000***
5. Devoted to upgrading the accomplishment rate of accident investigation	4.700	0.535	7.167	0.000***
6. Devoted to upgrading qualification rate of operational environment test	4.567	0.728	4.264	0.000***
7. Devoted to upgrading the pass rate of employees' health checking	4.600	0.675	4.871	0.000***
8. Devoted to increasing the frequency of personnel security and internal examination	4.467	0.730	3.500	0.002**
9. Devoted to reducing the cases which do not meet the examination	4.633	0.615	5.641	0.000***

Note) \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ .

**Table 10.** Implementation degree of examination operation

Items	Average	Standard error	T-value	P-value
1. Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	4.600	0.621	5.288	0.000***
2. Devoted to upgrading managerial examination frequency or accomplishment rate	4.533	0.681	4.287	0.000***
3. Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	4.600	0.724	4.539	0.000***

Note) 1. The measurement is based on Likert 5 Points Scale. "1" means "never execute", "2" means "rarely execute", "3" means "sometimes execute", "4" means "frequently execute", "5" means "always execute".

2. When the absolute value  $t$  is larger, average is more away from 4; when absolute value  $t$  is smaller, average is closer to 4.

3.  $p < 0.05$  means average does not equal to 4,  $p > 0.05$  means average equals to 4.

2. The firms' capital volume and One-Way ANOVA analysis of current implementation: This section explored if there was significant difference in current implementation through the firms' capital volume. In Table 12, the result revealed that these four aspects were not significantly affected by implementation principles.
  3. The firms' numbers of employees and One-Way ANOVA analysis of current implementation: This section explored if there was significant difference in current implementation through the firms' numbers of employees. In Table 13, we can realize that "management and planning aspect" was significant influenced by "devoted to upgrading the success rate of the goals and management plans of security and health policies" ( $2,4,6 > 5$ ) and "devoted to reducing the cases of protests and complaints from neighboring community" ( $2,4,5,6 > 3$ ); executive operation aspect was significantly affected by "devoted to upgrading propriety rate of employees' consulting and communication" ( $6 > 2,5$ ); checking operation aspect was significantly affected by "devoted to increasing the employees' industrial security consciousness" ( $4,6 > 2,3$ ); examination operation aspect was significantly influenced by "devoted to upgrading managerial examination frequency or accomplishment rate" ( $2,4,6 > 3$ ;  $6 > 5$ ).
  4. Difference of the firms' industry categorizations and One-Way ANOVA analysis of current implementation: this section explored if there was significant difference in current implementation through the difference of the firms' industry categorizations. In Table 14, we found out that management and planning aspect was significantly affected by "devoted to upgrading the degree of the managers' value on security and health policies" ( $2,4,5 > 1$ ) and "devoted to reducing the cases of the employees' protests and complaints" ( $4,5 > 1$ ). The rest aspects did were not significantly affected by implementation principles.
  5. The firm's technique and capital cooperation and One-Way ANOVA analysis of current implementation: this section explored if there was significant difference through the firms' technique and capital cooperation. In Table 15, the result revealed that these four aspects were not significantly affected by implementation principle.
  6. Difference analysis of the relationship between implementation motive and basic information: this section explored if there was significant difference in basic information through implementation motive (15 items). In Table 16, we could find out that capital volume was significantly affected by meeting the customers' requirements, competitors' threats and increasing profit; industry categorization was significantly affected by creating safe environment and improving community relationship; finally, technique and capital cooperation was also significantly affected by competitors' threats and increasing profit.
  7. Difference analysis of the relationship between implementation motive and average execution of each aspect: this section explored if there was significant difference in the average execution degree of each aspect through implementation motive. In Table 17, we could find out that the implementation motive (15 items) was not significantly affected by the aspects.
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**Table 11.** The firms' business volume and One-Way ANOVA analysis of current implementation

Aspect	Implementation principle	F value	P value	LSD multiple test
Management and planning aspect	Devoted to meeting the customers' needs	0.192	0.940	
	Devoted to upgrading the degree of the managers' value on security and health policies	2.677	0.055	
	Devoted to meeting requirements of regulations	0.683	0.611	
	Devoted to upgrading the success rate of the goals and management plans of security and health policies	1.800	0.160	
	Devoted to reducing the cases of the employees' protests and complaints	1.315	0.292	
	Devoted to reducing the fines or amount of money of law and regulation violation	0.773	0.553	
	Devoted to reducing the notices/times of accidents (including false alarm)	1.155	0.354	
	Devoted to reducing low quality rate of products	0.214	0.928	
	Devoted to upgrading preciseness degree of manufacturing process	1.117	0.371	
	Devoted to upgrading accomplishment rate of risk evaluation	1.293	0.300	
	Devoted to reducing the cases of protests and complaints from neighboring community	0.847	0.509	
Executive operation aspect	Devoted to upgrading the completeness and propriety of communication with customers	0.223	0.923	
	Devoted to upgrading production efficiency and delivery accomplishment rate	0.930	0.462	
	Devoted to upgrading managerial capacity	0.867	0.497	
	Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	1.946	0.134	
	Devoted to upgrading business principles/regulation accomplishment rate	1.040	0.407	
	Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	1.104	0.377	
	Devoted to upgrading automatic checking and fault improvement and accomplishment rate	0.592	0.672	
	Devoted to upgrading the propriety rate of machinery (instrument) facilities	0.751	0.567	
	Devoted to upgrading control rate of hazard materials	1.572	0.213	
	Devoted to reducing the happenings of unusual situations or break down of fire control facilities	0.454	0.769	
	Devoted to upgrading the use rate of personal protective instruments	0.868	0.497	
Devoted to upgrading propriety rate of employees' consulting and communication	2.217	0.096		
Checking operation aspect	Devoted to upgrading improvement and accomplishment rate of internal examination	0.755	0.565	
	Devoted to upgrading the customers and residents' identification with security and health requirements	1.494	0.234	
	Devoted to increasing the employees' industrial security consciousness	1.163	0.351	
	Focusing on the checking of instruments	0.312	0.868	
	Devoted to upgrading the accomplishment rate of accident investigation	0.255	0.904	
	Devoted to upgrading qualification rate of operational environment test	1.771	0.166	
	Devoted to upgrading the pass rate of employees' health checking	2.162	0.103	
	Devoted to increasing the frequency of personnel security and internal examination	0.877	0.492	
	Devoted to reducing the cases which do not meet the examination	0.387	0.816	
	Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	0.887	0.486	
	Devoted to upgrading managerial examination frequency or accomplishment rate	1.057	0.398	
Examination operation aspect	Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	1.265	0.310	

**Table 12.** Capital volume of the firms and One-Way ANOVA analysis of current implementation

Aspect	Implementation principle	F value	P value	LSD multiple test
Management and planning aspect	Devoted to meeting the customers' needs	1.214	0.324	
	Devoted to upgrading the degree of the managers' value on security and health policies	0.576	0.636	
	Devoted to meeting requirements of regulations	0.525	0.669	
	Devoted to upgrading the success rate of the goals and management plans of security and health policies	0.524	0.670	
	Devoted to reducing the cases of the employees' protests and complaints	0.539	0.660	
	Devoted to reducing the fines or amount of money of law and regulation violation	0.822	0.494	
	Devoted to reducing the notices/times of accidents (including false alarm)	1.073	0.378	
	Devoted to reducing low quality rate of products	0.163	0.920	
	Devoted to upgrading preciseness degree of manufacturing process	0.576	0.636	
	Devoted to upgrading accomplishment rate of risk evaluation	1.743	0.183	
	Devoted to reducing the cases of protests and complaints from neighboring community	1.352	0.279	
Executive operation aspect	Devoted to upgrading the completeness and propriety of communication with customers	2.003	0.138	
	Devoted to upgrading production efficiency and delivery accomplishment rate	0.497	0.688	
	Devoted to upgrading managerial capacity	0.249	0.861	
	Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	1.040	0.391	
	Devoted to upgrading business principles/regulation accomplishment rate	0.054	0.983	
	Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	1.012	0.403	
	Devoted to upgrading automatic checking and fault improvement and accomplishment rate	0.533	0.664	
	Devoted to upgrading the propriety rate of machinery (instrument) facilities	0.350	0.789	
	Devoted to upgrading control rate of hazard materials	0.319	0.812	
	Devoted to reducing the happenings of unusual situations or break down of fire control facilities	0.918	0.446	
	Devoted to upgrading the use rate of personal protective instruments	0.528	0.667	
Devoted to upgrading propriety rate of employees' consulting and communication	1.743	0.183		
Checking operation aspect	Devoted to upgrading improvement and accomplishment rate of internal examination	0.600	0.621	
	Devoted to upgrading the customers and residents' identification with security and health requirements	0.551	0.652	
	Devoted to increasing the employees' industrial security consciousness	0.518	0.674	
	Focusing on the checking of instruments	0.472	0.705	
	Devoted to upgrading the accomplishment rate of accident investigation	0.970	0.422	
	Devoted to upgrading qualification rate of operational environment test	0.458	0.714	
	Devoted to upgrading the pass rate of employees' health checking	0.647	0.592	
	Devoted to increasing the frequency of personnel security and internal examination	0.766	0.524	
Examination operation aspect	Devoted to reducing the cases which do not meet the examination	0.416	0.743	
	Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	0.684	0.570	
	Devoted to upgrading managerial examination frequency or accomplishment rate	0.938	0.437	
	Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	1.042	0.390	

**Table 13.** Numbers of employees of the firms and One-Way ANOVA analysis of current implementation

Aspect	Implementation principle	F value	P value	LSD multiple test
Management and planning aspect	Devoted to meeting the customers' needs	0.563	0.692	
	Devoted to upgrading the degree of the managers' value on security and health policies	1.459	0.246	
	Devoted to meeting requirements of regulations	1.478	0.240	
	Devoted to upgrading the success rate of the goals and management plans of security and health policies	3.002	0.038*	2,4,6 > 5
	Devoted to reducing the cases of the employees' protests and complaints	2.061	0.118	
	Devoted to reducing the fines or amount of money of law and regulation violation	0.603	0.664	
	Devoted to reducing the notices/times of accidents (including false alarm)	2.195	0.100	
	Devoted to reducing low quality rate of products	0.479	0.751	
	Devoted to upgrading preciseness degree of manufacturing process	0.370	0.828	
	Devoted to upgrading accomplishment rate of risk evaluation	1.040	0.407	
Executive operation aspect	Devoted to reducing the cases of protests and complaints from neighboring community	2.812	0.048*	2,4,5,6 > 3
	Devoted to upgrading the completeness and propriety of communication with customers	1.285	0.303	
	Devoted to upgrading production efficiency and delivery accomplishment rate	0.529	0.716	
	Devoted to upgrading managerial capacity	2.079	0.115	
	Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	2.765	0.051	
	Devoted to upgrading business principles/regulation accomplishment rate	1.737	0.175	
	Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	2.660	0.057	
	Devoted to upgrading automatic checking and fault improvement and accomplishment rate	1.918	0.140	
	Devoted to upgrading the propriety rate of machinery (instrument) facilities	0.807	0.533	
	Devoted to upgrading control rate of hazard materials	0.792	0.542	
	Devoted to reducing the happenings of unusual situations or break down of fire control facilities	1.087	0.385	
	Devoted to upgrading the use rate of personal protective instruments	1.853	0.152	
	Devoted to upgrading propriety rate of employees' consulting and communication	2.873	0.045*	6 > 2,5
	Checking operation aspect	Devoted to upgrading improvement and accomplishment rate of internal examination	0.962	0.446
Devoted to upgrading the customers and residents' identification with security and health requirements		0.521	0.721	
Devoted to increasing the employees' industrial security consciousness		3.069	0.036*	4,6 > 2,3
Focusing on the checking of instruments		1.486	0.238	
Devoted to upgrading the accomplishment rate of accident investigation		2.129	0.108	
Devoted to upgrading qualification rate of operational environment test		1.327	0.288	
Devoted to upgrading the pass rate of employees' health checking		2.175	0.102	
Devoted to increasing the frequency of personnel security and internal examination		0.324	0.859	
Devoted to reducing the cases which do not meet the examination		0.701	0.599	
Examination operation aspect		Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	2.328	0.085
	Devoted to upgrading managerial examination frequency or accomplishment rate	3.115	0.034*	2,4,6 > 3; 6 > 5
	Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	2.188	0.101	

Note) 1. \*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05.

2. LSD; 1~6 means the numbers of employees of the firms are respectively the following: less than 100 people, 101~300 people, 301~500 people, 501~1,000 people, 1001~2,000 people, and over 2,000 people.



**Table 14.** Different industry categorizations of the firms and One-Way ANOVA analysis of current situation

Aspect	Implementation principle	F value	P value	LSD multiple test
Management and planning aspect	Devoted to meeting the customers' needs	1.437	0.251	
	Devoted to upgrading the degree of the managers' value on security and health policies	5.253	0.003**	2,4,5 > 1
	Devoted to meeting requirements of regulations	0.681	0.611	
	Devoted to upgrading the success rate of the goals and management plans of security and health policies	1.795	0.161	
	Devoted to reducing the cases of the employees' protests and complaints	2.766	0.050*	4,5 > 1
	Devoted to reducing the fines or amount of money of law and regulation violation	0.420	0.792	
	Devoted to reducing the notices/times of accidents (including false alarm)	1.925	0.138	
	Devoted to reducing low quality rate of products	0.418	0.794	
	Devoted to upgrading preciseness degree of manufacturing process	0.088	0.985	
	Devoted to upgrading accomplishment rate of risk evaluation	1.130	0.365	
Executive operation aspect	Devoted to reducing the cases of protests and complaints from neighboring community	1.295	0.299	
	Devoted to upgrading the completeness and propriety of communication with customers	0.878	0.491	
	Devoted to upgrading production efficiency and delivery accomplishment rate	0.518	0.723	
	Devoted to upgrading managerial capacity	0.642	0.637	
	Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	0.400	0.806	
	Devoted to upgrading business principles/regulation accomplishment rate	0.537	0.710	
	Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	0.417	0.795	
	Devoted to upgrading automatic checking and fault improvement and accomplishment rate	0.386	0.816	
	Devoted to upgrading the propriety rate of machinery (instrument) facilities	0.079	0.988	
	Devoted to upgrading control rate of hazard materials	0.255	0.904	
Checking operation aspect	Devoted to reducing the happenings of unusual situations or break down of fire control facilities	1.069	0.392	
	Devoted to upgrading the use rate of personal protective instruments	1.173	0.346	
	Devoted to upgrading propriety rate of employees' consulting and communication	1.229	0.324	
	Devoted to upgrading improvement and accomplishment rate of internal examination	0.459	0.765	
	Devoted to upgrading the customers and residents' identification with security and health requirements	0.564	0.691	
	Devoted to increasing the employees' industrial security consciousness	0.943	0.456	
	Focusing on the checking of instruments	0.702	0.598	
	Devoted to upgrading the accomplishment rate of accident investigation	0.376	0.823	
	Devoted to upgrading qualification rate of operational environment test	1.556	0.217	
	Devoted to upgrading the pass rate of employees' health checking	1.835	0.154	
Examination operation aspect	Devoted to increasing the frequency of personnel security and internal examination	1.098	0.379	
	Devoted to reducing the cases which do not meet the examination	0.402	0.805	
	Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	1.119	0.370	
	Devoted to upgrading managerial examination frequency or accomplishment rate	0.947	0.454	
Examination operation aspect	Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	0.788	0.544	

Note) 1. \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ .

2. LSD ; 1-5 means the firms are respectively the following: high-tech, petrifaction, traditional manufacturing, construction and others.

**Table 15.** The firms' skill and capital cooperation and One-Way ANOVA analysis of current implementation

Aspect	Implementation principle	F value	P value	LSD multiple test
Management and planning aspect	Devoted to meeting the customers' needs	0.052	0.950	
	Devoted to upgrading the degree of the managers' value on security and health policies	1.689	0.204	
	Devoted to meeting requirements of regulations	2.241	0.126	
	Devoted to upgrading the success rate of the goals and management plans of security and health policies	0.981	0.389	
	Devoted to reducing the cases of the employees' protests and complaints	1.935	0.165	
	Devoted to reducing the fines or amount of money of law and regulation violation	2.516	0.100	
	Devoted to reducing the notices/times of accidents (including false alarm)	0.899	0.419	
	Devoted to reducing low quality rate of products	0.838	0.444	
	Devoted to upgrading preciseness degree of manufacturing process	0.108	0.898	
	Devoted to upgrading accomplishment rate of risk evaluation	0.642	0.534	
Executive operation aspect	Devoted to reducing the cases of protests and complaints from neighboring community	0.484	0.621	
	Devoted to upgrading the completeness and propriety of communication with customers	0.629	0.541	
	Devoted to upgrading production efficiency and delivery accomplishment rate	0.137	0.873	
	Devoted to upgrading managerial capacity	0.610	0.551	
	Devoted to upgrading security and health educational training and participation rate of emergency response drilling and execution	1.523	0.237	
	Devoted to upgrading business principles/regulation accomplishment rate	0.318	0.731	
	Devoted to reducing the times of violation against business control regulations and times of contractors' violation against the rules	0.318	0.731	
	Devoted to upgrading automatic checking and fault improvement and accomplishment rate	0.083	0.921	
	Devoted to upgrading the propriety rate of machinery (instrument) facilities	1.205	0.316	
	Devoted to upgrading control rate of hazard materials	0.167	0.847	
	Devoted to reducing the happenings of unusual situations or break down of fire control facilities	0.569	0.573	
	Devoted to upgrading the use rate of personal protective instruments	0.033	0.968	
Checking operation aspect	Devoted to upgrading propriety rate of employees' consulting and communication	0.010	0.990	
	Devoted to upgrading improvement and accomplishment rate of internal examination	0.455	0.639	
	Devoted to upgrading the customers and residents' identification with security and health requirements	0.525	0.597	
	Devoted to increasing the employees' industrial security consciousness	0.769	0.474	
	Focusing on the checking of instruments	0.558	0.579	
	Devoted to upgrading the accomplishment rate of accident investigation	0.904	0.417	
	Devoted to upgrading qualification rate of operational environment test	0.236	0.792	
	Devoted to upgrading the pass rate of employees' health checking	0.134	0.876	
Examination operation aspect	Devoted to increasing the frequency of personnel security and internal examination	0.557	0.580	
	Devoted to reducing the cases which do not meet the examination	0.068	0.934	
	Devoted to upgrading the propriety and effectiveness of OHSAS 18000 system	0.033	0.968	
	Devoted to upgrading managerial examination frequency or accomplishment rate	0.116	0.891	
Examination operation aspect	Devoted to upgrading the overall accomplishment rate of OHSAS 18000 system performance	0.232	0.795	

**Table 16.** Difference analysis of relationship between implementation motive and basic information

Implementation motive \ basic information		Business volume	Capital volume	Industry categorization	Numbers of employees	Skill and capital cooperation
Meeting the customers' requirements	$x^2$	6.923	9.260	6.979	1.533	0.401
	p-value	0.140	0.026*	0.539	0.821	0.818
Competitors' threats	$x^2$	6.724	9.310	6.724	8.976	8.976
	p-value	0.151	0.025*	0.567	0.062	0.011*
Upgrading image	$x^2$	2.527	4.887	8.889	2.157	1.516
	p-value	0.640	0.180	0.352	0.707	0.469
Reducing cost	$x^2$	8.428	6.908	8.478	8.248	3.372
	p-value	0.077	0.075	0.388	0.083	0.185
Complying with governmental policies	$x^2$	2.432	5.893	11.335	3.801	0.945
	p-value	0.657	0.117	0.183	0.434	0.623
Pressure from community residents	$x^2$	–	–	–	–	–
	p-value	–	–	–	–	–
Upgrading product quality	$x^2$	8.938	2.293	5.317	5.389	2.563
	p-value	0.063	0.514	0.723	0.250	0.278
Increasing profit	$x^2$	8.632	13.069	11.667	8.514	11.664
	p-value	0.071	0.004**	0.167	0.074	0.003**
Suppliers' requirements	$x^2$	5.893	7.641	3.482	2.524	4.774
	p-value	0.207	0.071	0.901	0.640	0.092
Pressure from industrial and business organizations	$x^2$	–	–	–	–	–
	p-value	–	–	–	–	–
Increasing security and health consciousness	$x^2$	1.937	2.222	12.407	6.409	0.389
	p-value	0.747	0.528	0.134	0.171	0.823
Creating safe environment	$x^2$	2.802	1.875	16.607	3.1792	1.516
	p-value	0.591	0.599	0.034*	0.526	0.469
Improving community relationship	$x^2$	3.111	1.158	16.607	2.524	3.959
	p-value	0.539	0.763	0.034*	0.640	0.138
Reducing damage risk	$x^2$	4.725	2.066	8.889	2.624	1.516
	p-value	0.317	0.559	0.352	0.623	0.469
Systematization of security and health management	$x^2$	3.111	5.510	4.286	3.303	0.498
	p-value	0.539	0.138	0.830	0.508	0.779

Note) \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ .

**Table 17.** Difference analysis of relationship between implementation motive and average execution degree of each aspect

Implementation motive \ aspect	Management and planning		Executive oper- ation		Checking operation		Examination oper- ation	
	F value	p-value	F value	p-value	F value	p-value	F value	p-value
Meeting the customers' requirements	1.220	0.342	1.723	0.150	1.730	0.146	0.934	0.490
Competitors' threats	–	–	0.356	0.967	0.736	0.693	–	–
Upgrading image	0.573	0.826	1.155	0.387	0.920	0.543	1.057	0.416
Reducing cost	1.291	0.304	2.072	0.084	1.166	0.373	2.421	0.058
Complying with governmental policies	0.579	0.822	1.176	0.374	0.686	0.735	0.447	0.840
Pressure from community residents	–	–	–	–	–	–	–	–
Increasing product quality	0.392	0.942	0.933	0.544	1.201	0.352	0.980	0.461
Increasing profit	0.484	0.889	0.985	0.504	0.774	0.662	0.113	0.994
Suppliers' requirements	2.029	0.088	0.607	0.815	0.655	0.761	0.185	0.978
Pressure from industrial and business organizations	–	–	–	–	–	–	–	–
Increasing security and health consciousness	2.151	0.072	1.262	0.326	1.376	0.264	1.950	0.115
Creating safe environment	–	–	1.526	0.210	0.713	0.712	0.185	0.978
Improving community relationship	0.655	0.761	1.832	0.125	1.418	0.246	0.185	0.978
Reducing damage risk	1.309	0.295	0.559	0.853	0.638	0.775	0.980	0.461
Systematization of security and health management	0.293	0.979	1.067	0.445	0.655	0.761	0.185	0.978

#### 4. Conclusions

This research was mainly to explore the influence of OHSAS 18000 system execution of the firms which have passed OHSAS 18000 series certification in Taiwan on competitiveness. Through the theories and literature review, the research developed the theoretical model affecting relationship and analyzed the firms passing OHSAS 18000 certification in Taiwan. The OHSAS 18001 was a series of occupational security and health management which en-

abled the organizations to control occupational security health risk and improve performance. According to the analytical result of this result, only Table 11, Table 12, Table 15, Table 17 did not reveal significant influence. For example, in Table 14 which revealed more problems, the implementation principles of "devoted to upgrading the degree of the managers' value on security and health policies" and "devoted to reducing the cases of the employees' protests and complaints" revealed the reasons of significant effect. The reasons might be in that the implementations of occupational security and health management in some industry categorizations were not completely based on OHSAS 18000 since the framework of OHSAS 18000 was consistent with ISO 14001 and ISO 9001. The research constantly improved model design according to P-D-C-A. Thus, for the firms which have implemented ISO 9001 or ISO 14001, there would be certainly no managerial burden and the overall efficiency of management could even be upgraded. According to the result of risk evaluation, the enterprises decided their own proper managerial plans which could not only prevented the happening from accidents and reduced operational cost, but also promoted overall business management through "systematic" management, upgraded the employees' security consciousness, controlled the business security risk. Following OHSAS 18000 standard, establishing and maintaining occupational health and security managerial system is to introduce new idea, establish security and health operational indicators as the bases of performance evaluation and completely control the security and health situations in the business.

## References

1. Shi-huang Wang(2002), "Industrial Security Risk Evaluation," Yang Chih Culture, Taipei city.
2. Chi-ming Hsu and Huang-jie Chou(2002), "Planning of Business Security and Health Managerial System," Yang Chih Culture, Taipei city.
3. Jun-yan Chou(2005), "OHSAS 18000 is the Next Focus of Managerial System," International Examination Service Office, website: <http://www.sgs.com.tw/ics/michelle/newsletter02/ohsas18000.htm>.
4. Ke-jung Management Consulting Limited Co.(2005), "OHSAS 18000 is generally the same as ISO series," website: <http://www.formalwin.com>.
5. Ming-chou Lin(2000), "Integrated Exploration of ISO14000 and OHSAS 18001," Issue 17, Environmental Management Report, Taiwan, pp. 12-14.
6. Yi-ming Gao(2000), "Integrated Examination of ISO14000 and OHSAS 18001," Industrial Security and Environmental Protection Monthly, Taiwan, March.
7. Fiksel, J.(2001), "Design for Environment: Creating Eco-efficient Products and Processes," New York: McGraw-Hill.

8. John, E. and Michael, J. L.(1997), "The Development and implication of DFE programs," *The Journal of Sustainable Product Design*, pp. 17-27.
  9. Louis, A. Lefebvre and Stephane Talbot(2000), *Proceedings of the IEEE EMS International Engineering Management Conference*, pp. 674-679.
  10. Reinhardt, F. L.(1998), "Environmental product differentiation: implication for corporate strategy," *California Management Review*, Vol. 40, No. 4, pp. 43-72, Summer.
  11. Finnegan L.(1999), "Sustainable Develop: Business without Footprints," *Occupational Hazards*, Vo. 61, No. 5, pp. 54-56.
  12. Greeno, J.(1999), "Using EH and S to Create Business Value and Strategic Advantage," *Corporate Strategy*, 3, pp. 40-46.
  13. Porter, M. E.(1990), "Competitive advantage: creating and sustaining superior performance," *The Free Press*, New York, pp. 57-68.
  14. Nunnally, J. C.(1978), *Psychometric Theory* (2<sup>nd</sup> ed.). McGraw-Hill, New York.
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