Feasible Study of Integrated Energy Management System with International Organization for Standardization in Thailand

R. Intarajinda, W. Sriamonkitkul, R. Charoensuk, P. Bhasaputra, and W. Pattaraprakorn

***Abstract*— *This paper presents a feasible study of integrated energy management system (IEMS) with the International Organization of Standardization (ISO) including ISO 9000, ISO 14000 and ISO 18000 (OHSAS18000) for the designated factories in Thailand by considering the Integrated Management System (IMS) concept. The score card method is proposed to investigate the efficiency of the IMS in four selected designated factories which are a snack factory, a frozen food factory, a textile factory and a cosmetic factory. The completed energy management reports are reviewed by the energy experts accompanied with interview the energy management committees according to the 17 procedures of energy management system. The analytical results show that the designated factory with approved ISO 9000, ISO 14000 and ISO 18000 reveals the highest score card of 84.71% while the score card of the designated factory with approved ISO 9000 and ISO 14000 and that with approved ISO 9000 are 82.35% and 79.41%, respectively. In conclusion, the feasibility of IMS is increased by the number of approved ISO standard. However, the designated factories without approved ISO may not be obtained the less score card which depends on the specific organization standard as shown in the score card of cosmetic factory that is 87.65%. Furthermore, the proposed IMS concept can enhance the feasibility to implement EMS for the other designated factories in Thailand especially in term of the resources management. The IMS is a main key point to guarantee the success and sustainability of the Energy Conservation Promotion Act (No. 2) B.E. 2550 (2007). Finally, the briefly discussion of developing ISO 50001 framework is presented in the compatibility of ISO 9000 and ISO 14000.*

***Keywords*— Energy Management System, Integrated Management System, International Organization for Standardization, Thailand Standard Industrial Classification, Energy Conservation Promotion Act (No. 2) B.E. 2550 (2007).**

1. INTRODUCTION

Over the past few decades, the large organization has been achieved from the management tools. The continuous development mechanism of management tools motivates the international standard. The development of standardization in the past 15 years was reviewed including the International Organization of Standardization (ISO) [1]. ISO is an international standard setting body composed of representatives from various national standards organizations, founded on 23rd February 1947 at Geneva, Switzerland. The organization promulgated worldwide proprietary and commercial standards. The most well known is ISO 9000, that is the quality management standard. In 2008, more than one million organizations were registered and certified to ISO 9001 standard in 170 countries [2]. However, the ISO was diversified in many fields of management systems, such as ISO 14000 for environmental management and ISO 18000 for occupational health and safety management. The ISO documents consist of technical data and precise criteria that be used as rules or guidelines for ensuring the purposes of material, product, process and service.

The ISO 9000 standard aims to standardize procedures of quality management standard and to provide a guideline to the organizations. The development of ISO 9000 can be summarized as following:

- The ISO 9000:1987 was designed for manufacturing and enforced to be conformance with procedures rather than the overall processes of management.
- The ISO 9000:1994 was emphasized quality assurance via preventative actions, instead of just checking final product but the continuous requirement of compliance evidences is to be set in the document controlled procedure.
- The ISO 9001:2000 was the combination of the three sub-standards, ISO 9001, ISO 9002, and ISO 9003 into ISO 9001. In case of an organization with research and development department, the design and development procedures are required. The ISO 9001:2000 version is needed the involvement of vertical integration and aligned with ISO 14001:1996.
- The ISO 9001:2008 is an enhanced version of ISO 19001:2000 by giving the clear definition of the business enterprise with respect to a new version of ISO 14001:2004.

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The ISO 14000 standard, environmental management system was published in September 1996 and revised in November 2004. The ISO 14000 was developed by the enforcement of market mechanism, sustainable development, pollution prevention and compliance assurance [3]. The standard is a part of an organization's management system that used to develop and implement the environmental policy and manage the environmental aspects. By the end of 2003, more than 66,000 organizations in 113 countries were certified ISO 14001 [4]. The study of O., Boiral; and J. M., Sala provides some guidelines for the industries if ISO 14000 should be implemented [5]. Even in the the hotel industries, there are also the study of the motivations on this group by E.S.W., Chan; and S.C.K.,Wong [6].

ISO 18000 in the namely of OHSAS 18001 standard, was an international occupational health and safety management system published in 1999. According to the higher specification of OHSAS 18001, ISO had dropped the developed process to set up ISO 18000. OHSAS 18001 was developed to be compatible with ISO 9000:1994 and ISO 14001:1996 in order to facilitate the integration of quality environment as well as occupational health and safety management systems [7]. Thailand had launched the TIS 18001 standard similar to OHSAS 18001 standard. An example for ISO 18000 to the industrial is the study of Duijm, Fiévez, Gerbec, Hauptmanns and Konstandinidou presents the management of health, safety and environment in process industry [8].

According to rapid growth of energy consumption around the world, the energy management system (EMS) is proposed to encourage the energy efficiency and greenhouse gas (GHG) reduction strategy through systematic procedures. The several individual standards for national down to organization level are developed to meet the ultimate requirement. In Thailand, the EMS is developed for the designated factories and designated buildings, according to the Energy Conservation Promotion Act (No. 2) B.E. 2550 (2007) [9]. The Energy Minister with the advice of the National Energy Policy Council shall have the power to issue Ministerial Regulations on the establishment of the standards, criteria and energy management procedures to be complied by the owners of designated factories and designated buildings. In 2009, there are 3,549 designated factories in Thailand which can be classified in 9 groups by Thailand Standard Industrial Classification (TSIC), almost half of them already implemented and certified ISO standard, but require energy management system (EMS). The effective 17 procedures are proposed to the designated factories and buildings. This paper presents the feasible study of integrated energy management system (IEMS) with ISO 9000, ISO 14000 and ISO 18000 for the four designated factories in Thailand. The feasibility score of integrated management system (IMS) is evaluated by the factory's experts. In addition, the similar procedures of EMS and ISO 9000, ISO 14000 and ISO 18000 are also investigated. Finally, the guidelines of IMS for EMS and ISO 9000, ISO 14000 and ISO 18000 are concluded.

Fig. 1 shows the details of the designated factories classified by Thailand Standard Industrial Classification which ISO 9000, ISO 14000 and ISO 18000 are certified. The preliminary study shows that 990 designated factories are approved only ISO 9000, 345 designated factories are approved ISO 9000 and ISO 14000, and 170 designated factories are approved ISO 9000, ISO 14000 and ISO 18000.

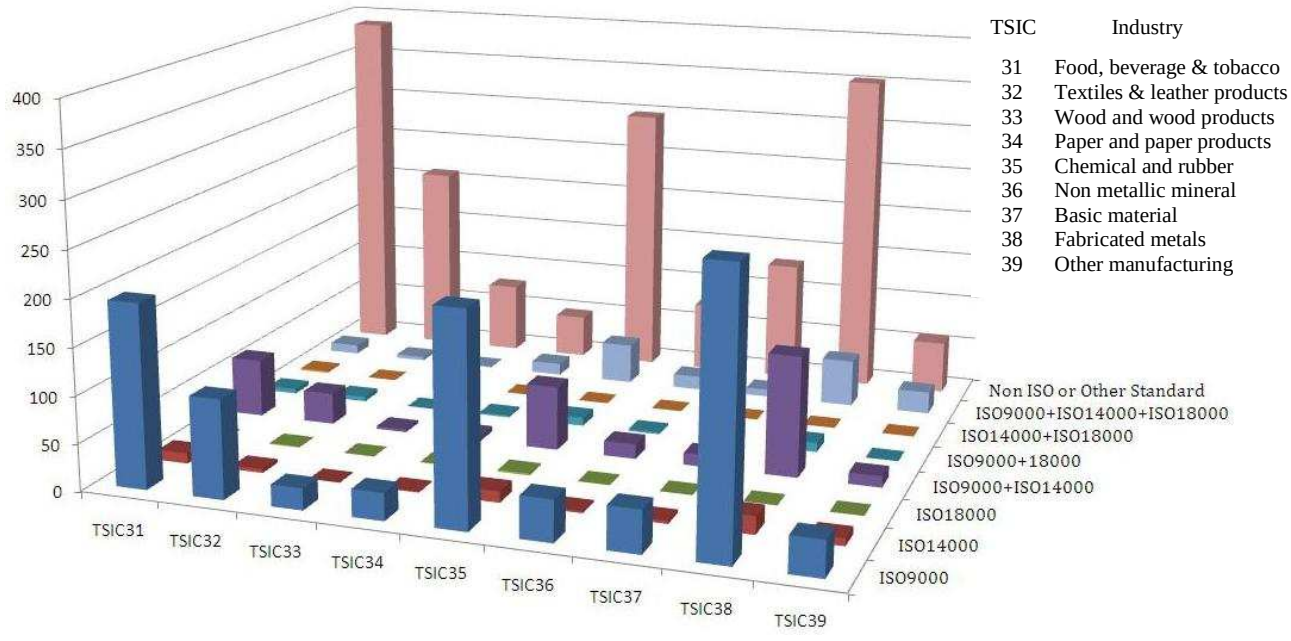


Fig.1. ISO and Non ISO standard implementation in different TSIC

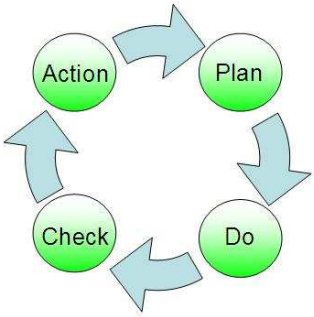


Fig. 2. The PDCA cycle

Furthermore, some organizations require more than one certification which depends on business cultures and organization characteristics. For example, integrated ISO 9000 with ISO 14000 is dominant implementation more than other integrated standards. Integrated ISO 9000, ISO 14000 and ISO 18000 are also favor for some organizations as shown in Fig. 1. Although, in each ISO standard is developed based on different proposes, the basic concept of all standards is developed according to the continuous improvement or Plan-Do-Check-Action cycle (PDCA) as shown in Fig. 2. Therefore, some organizations prefer to implement IMS for maximize their business benefits.

2. REVIEWS OF ISO, EMS AND IMS

ISO reviews

The International Organization for Standardization was first created after the World War II [10], known as BS 5750, to solve the problems in the British high-tech industries. However, BS 5750 is known as a management standard because there is no specified on what it is manufactured, but how the manufacturing process manage. In 1987, The British Government adopted BS 5750 as international standard called ISO 9000. The early developed phase of ISO 9000 focuses on the quality management system by reducing the process variation in manufacturing with standardization of all processes and procedures. And after that ISO had concentrated on continuous improvement and environment involvement. Now there are many ISO standards using in widely purposes, such as ISO 9000, ISO 14000, ISO 18000 or OHSAS 18000, ISO 22000 for food safety management and ISO 27000 for information security management.

EMS reviews

A definition from DS-information in Danish standard DS/INF136E upgrade1 2001-12-03 [11], "Energy management - Guidance on energy management" describes that EMS is a systematic and structured approach to improve energy efficiency. Energy management strengthens the overall environmental profile of the organization and can considerably reduce cost for electricity, oil or natural gas. Each energy management system requirement should be guided and offered practical advice on how organization can address the element of energy management and improve their energy performances without implying uniformity of interpretation. The implementation of energy management should be dynamics and ongoing process which adapt to the diverse cultural and social conditions of an organization.

What Energy management benefits the organization is

- draw up energy policy,
- set energy target and prioritize action to be taken
- review the significant energy consumption and indentify area for energy conservation,
- indentify applicable law, order and condition as well as other schemes to which organization subscribes
- establish a structure and plan for implementing the policy and achieving target,
- facilitate planning, control, monitoring, auditing and evaluation of energy activities to ensure that the energy management operates as intended and the energy targets are achieved,
- adapt to change conditions in term of exchange energy prices, new regulation requirement, organization changes and factory extensions.

IMS reviews

Many countries and organizations made an attempt to develop an IMS to create a competitive advance and sustainable development contribution. There are difference approaches of integrated of management systems, such as ISO 9000, ISO 14000, ISO 18000, SA 8001, ISO 22000, ISO 26000, ISO 27000 and many other management systems. The level difference to make and coherent standard with the focus within organization or country's readiness and characteristic should be consider. R. Salomone [12] investigates the potential for integration of management system from Italian companies by using analysis of motivation, obstacles, driving forces and external pressures that the companies implement the following standards, ISO 9001:2000, ISO 14001:2004, ISO 18001:1999 and SA 8000:2007 for social responsibility management system. T. H. Jørgensen, et al [13], also study IMS with 3 different levels of integration for the standard using in Denmark and Spain. S. Karapetovic, et al. [14] analyze how the implementation of environment management system with ISO 14000, ISO 9000, ISO 18000, ISO 27000 and SA 8000 has been carried out in organization with more than one standardized management system. The study uses the survey from 176 organizations. A. Labodova [15] has been examined the benefits of the IMS concepts for all quality, environment, occupational health and safety standards such as to avoid parallel management systems, to reduce the internal and external resources, to reduce waste paper work, to enhance economic saving and to reduce working time. Mostly ISO 9000 and ISO 14000 are implemented in the industrial due to the impact to the society when the companies concern about social responsibility as described by P. Castka and M.A. Balzarova [16]. A. Douglas and D. Glen focus the study in IMS in small and medium enterprises [17]. J. Fresner and G. Engelhardt study the experiences with integrated

management systems for two small companies in Austria[18]. T.H. Jorgensen, et al. (2006) describes the integrated management systems in three different levels of integration. The focus of the article is primarily to discuss three ambition levels of integration: from increased compatibility of system elements over coordination of generic processes to an embeddedness of an integrated management system (IMS) in a culture of learning and continuous improvements [19]. T.H. Jørgensen, et al (2004) present the integrated management systems in Denmark, discussing the development of a standard for IMS, the organizational challenges with IMS, the experiences with IMS in industry and finally the drafts of IMS standards in Danish and Spanish context is analyzed. [20].

3. ISO AND EMS IN THAILAND

In 1968, Ministry of Industry promulgated the Thai Industrial Standard Act to establish the Thai Industrial Standards Institute as national standards body responsible for standardization activities in Thailand. In 1981, ISO 9000 was introduced to Thailand and later in 1991; the institute announced an adoption of TIS/ISO 9000 series as National Standard for Quality Systems. In every aspect, it is similar to the international ISO 9000 series established by the International Organization for Standardization and to the European Standards EN 29000. Thai factory can be more competitive in the international market through the world class standard. In 1985, ISO 14000 was promulgated to standardize environmental protection issues. Then the other standards were launched mainly in the industries such as ISO 18000 etc. As shown in Fig. 1, three industrial groups that comprise with fabricated metallic industries, chemical and rubber industries, and food, beverage and tobacco industries (TSIC 38, TSIC 35, TSIC 31) are the dominant groups of ISO's implementations. Although, the implementation of ISO and other standards is not the law or regulations for industries in Thailand, the certified factories will have greater opportunities than the uncertified ones, especially in market shares and production cost.

The first energy policy of Thailand had developed since 1973 during the third National Economic and Social Development. After two decades of the continuous improvement, the first energy law of Thailand was established in the name of the Energy Conservation Promotion Act B.E.2535 (1992). Until 2007, the Energy Conservation Promotion Act (No. 2) B.E. 2550 (2007) was regulated to the designated buildings and the designated industries. The main objectives are the establishment of the standards, criteria and energy management procedures to be complied by the owners of designated factories and the requirement for the owners of designated factories to arrange to have personnel responsible for energy, stationed at each designated factory and the establishment of qualifications and duties of the personnel responsible for energy.

A feasible study to implement EMS for the designated factories is the first step of the achievement of EMS in Thailand. In addition, the appropriate management tools should be identified to minimize the internal resources requirement. IMS is the most applicable concept to integrate two or more standards for an organization. Lastly, a feasible study of integrated energy management system with International Organization for Standardization in Thailand is required to indicate the optimal criteria for implementation EMS.

4. METHODOLOGIES

In this study, four designated factories in Thailand are interviewed about the feasibility of integrated ISO standards with EMS by considering the 17 procedures according to the Energy Conservation Promotion Act. (No. 2) B.E. 2550 (2007). The proposed IEMS concept is illustrated in Fig.3. The interviewees are factory's experts who have the ISO knowledge according to factory standard certifications. The surveyed factories for this study comprise with two factories of food, beverage and tobacco (TSIC 31), a fabricated metallic factory (TSIC 38) and a cosmetic factory (TSIC 39). The selected factories have been certified with different standards. Moreover, the overview of four factories is investigated for their feasibility in order to integrate their standards with EMS, which consider four scenarios as followed:

Factory 1 is approved ISO 9000,

Factory 2 is approved ISO 9000 and ISO 14000,

Factory 3 is approved ISO 9000, ISO 14000 and ISO 18000,

Factory 4 is approved own standard which is certified by Germany Association for the Certification of Management System (DQS).

5. CASE STUDY RESULTS

5.1 General Information of Factory

Case study in Factory 1

Factory 1 is one of the leading snack manufacturers which set up in 1984, and launched the first product in 1985. In 1989, the company expanded the production line for cookies and potato chips and launched other products on 1990. In 1993, the company successfully developed new production line for breakfast cereal. Nowadays the snacks from the company are very popular in the market. The main office locates in Bangkok metropolis area while the factory locates in the urban area of Bangkok. There are about 1,000 employees in this organization.

Factory 1 successfully passed the final ISO's audit, good manufacturing practices criteria (GMP) and received ISO 9000:2000 certificate from SGS Yardley. This guarantee that the company plays a vital role in maintaining recognized world quality standard in both local and international markets. All management and staff of the factory committed to maintain the requirement of ISO 9000 system into the future.

Case study in Factory 2

Factory 2 started commercial operations in 1992. Since

then, this factory has become known and trusted as a leading and reliable manufacturer and exporter of seafood products. As a result, this company has an outstanding record for developing new value-added food products – and of developing the world market share for seafood products for over 10 years. The business is about manufacturing and exporting mainly surimi filamented crab sticks and other surimi-based product.

Every product type is made in strict accordance with GMP and controlled by Hazard Analysis Critical Control Points (HACCP) at each stage from start through to final customer delivery. Factory 2 has achieved ISO 9000 and the ISO 14000. The company's commitment was further recognized when in 1999, and was upgraded by the European Food Safety Inspection Service (EFSIS) in the United Kingdom to a "Higher Level" accreditation. The company has also been authorized by the Thai Department of Fisheries with factory approval number "Thailand 1004" to export worldwide. With all above accreditations from local and overseas competent certifying bodies, the clients can be assured that every shipment of the product meets the highest international standards for safety and hygiene.

Case study in Factory 3

Factory 3 is a large contract manufacturer in Asia for the hospitality, cruise linear, aviation and automotive industries with pride to fulfill the requirement of customer uses. With more than 28 looms it is a largest carpet weaver in South East Asia, producing Wilton, Hand Tufted, Machine Tufted, Carpet Tile and Needle punched. The main office located in the metropolis area of Bangkok. The factory area is about 160,000 square meters with 16,000 people. The materials are imported from the United Kingdom, and New Zealand. However, nylon olefin and polyester fibers are also produced in house.

For ISO standard, factory 3 is the first in the region that obtain ISO 9000, ISO 14000, and ISO 18000 International Certification. The health, safety and happiness of their employees as well as their communities are also valued. The safe transportation for employees to and from work and are arranged as well as the safe workspace are always ensured.

Case study in Factory 4

Factory 4 is leading international company of branded consumer products for skin and beauty care. The establishment was in 1987. In 1999, factory 4 become a "designated factory" regarding the "The Energy Conservation Promotion ACT B.E. 2535". The standard using in this factory is Environmental Protection and Safety Management Audit Scheme (ESMAS). However, the standard was based on ISO 14000 and ISO 18000. This standard is internal standard developed by the organization as an efficiency instrument for implementing and regularly monitoring compliance with high standards. Core aspect is reviewing the compliance with legislation. This standard was certified by DQS.

5.2 Feasible Study Results

A feasible study of integrated ISO standards and EMS are considered according to 17 common procedures. The main procedures are comprise with general requirements, review current energy situations, policy and objective, energy assessment, legal and other requirement, planning, structure and responsibility, training, awareness and competence, training, awareness and competence, communication, control of document, purchasing process, energy operational control, monitoring and measurement, internal audit, implementation and preventive action, control of records and management review. The similarity of 17 procedures in ISO9000, ISO14000 and EMS are shown in Fig 3. Then, the scores of feasibility in 17 EMS's procedures are evaluated and illustrated in Fig. 4. The results of a feasible study can be summarized as following**:**

- The four selected factories have the potential to integrate EMS with their certified standard. The feasibility score card of Factory 1 is 79.41% which is the lowest one. However, this factory is not much different from other factories. Factory 1 just needs to improve on 4 lowest scores of the following procedure: general requirement, planning, document control and record control.
- Factory 2 has the feasibility score card of 82.35%. The potential of factory 2 to integrate with EMS is higher than Factory 1. Consequently, this factory requires improvement in many procedures from the average score.
- Factory 3 has 84.71% of the feasibility score card that shows the highest potential to integrate EMS with ISO standard. However, there are some procedures need to be improved, which are the implementation and preventive action in order to increase the feasibility score card.
- Factory 4 has 87.65% of the feasibility score card which is the highest one. Though, the designated factory without approved ISO may not be obtained the less score card due to the certified individual standard.
- The four factories have a positive attitude to implement integrated EMS and ISO standard in the organization with overall average score 83.5% of the integrated feasibility**.**

Furthermore, the analysis of potential to implement 17 procedures is ranking in 6 groups with the average score as shown in Fig. 4. The extended results are discussed as below:

- The procedure of training, awareness and competence is the highest scores of the feasibility, the employee of four factories provided equality of score by 90%.
- The procedures of policy and objective, monitoring and measurement are the second of feasibility by 87.5%.
- The procedures of legal, structure and responsibility, communication, energy operation

control and management reviews are the third of the feasibility by average 85%.

- The procedures of review current energy situation, energy assessment, planning, purchasing process, internal audit and implementation and prevention action are the forth ranking of the feasibility by 82.5%.
- The procedure of general requirement is the fifth ranking of the feasibility by average 80%.

The last group of procedures with the lowest score of integrated EMS and ISO standard is control document and control record by average 77.5%.

The results of four factories are encouraging others factories to implement the EMS and ISO standard, but some weakness of integrated EMS and ISO of four factories have also been discussed. For example, the factory concerned the large and complex management system after implemented integration of standards that may not suit to the organization and current responsibilities. In addition, the employees or their consultants who are expected more knowledge and experience in energy, quality, environment and safety are limited.

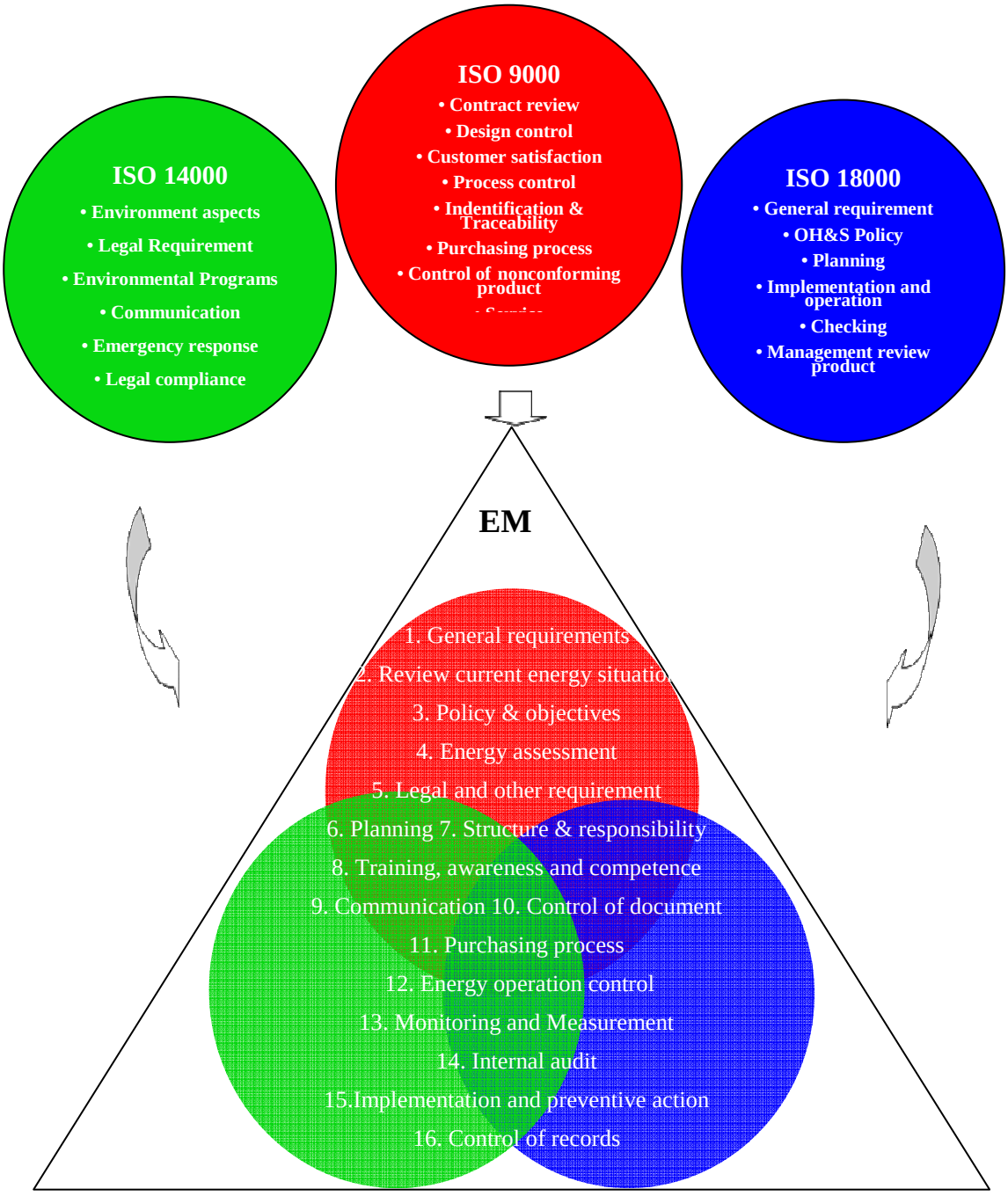
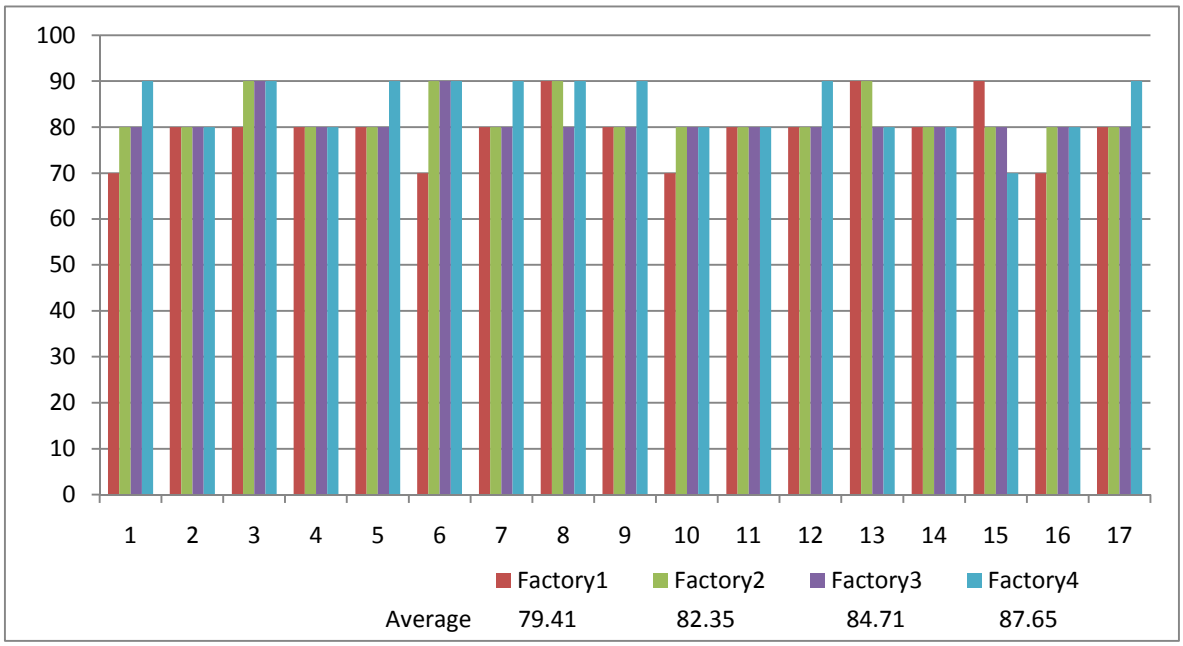


Fig. 3. The overview of ISO 9000, ISO 14000, ISO 18000 and EMS procedures



Procedure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Average score	80.0	82.5	87.5	82.5	85.0	82.5	85.0	90.0	85.0	77.5	82.5	85.0	87.5	82.5	82.5	77.5	85.0
Ranking	5	4	2	4	3	4	3	1	3	6	4	3	2	4	4	6	3

Note: The number of procedure can be described as following : 1-General requirement, 2-Review current energy situation, 3-policy& objective, 4-Energy Assessment, 5-Legal and other requirement, 6-Planning, 7-Structure & Responsibility, 8-Training, awareness and competence, 9-Communication, 10-Control of document, 11-Purchasing process, 12-Energy operational control, 13-Monitoring and measurement, 14-Internal audit, 15-Implementation and preventive action, 16-Control of records, 17-Management review

Fig. 4 Score of implement energy management system in the selected factories

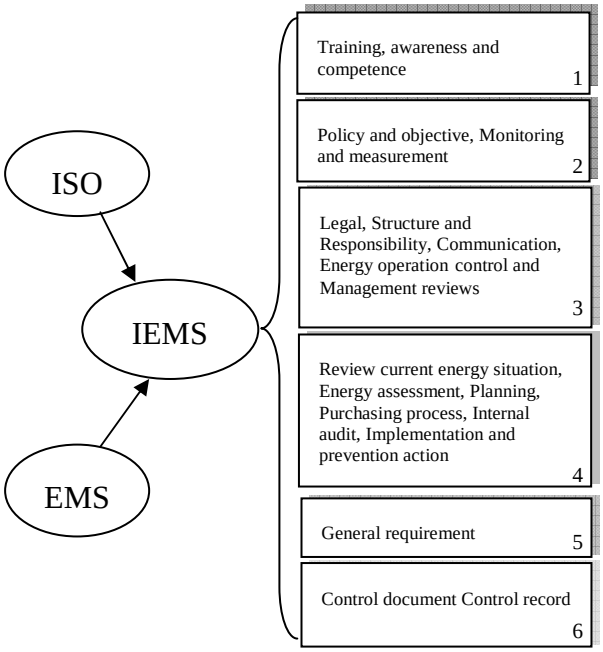


Fig. 5. Ranking the feasibility of 17 procedures in the selected factories

The practical implementation from this study could be presented in term of the guidelines for the companies in Thailand that have the condition that align with this integration and make an adjustment to suit their organization.

6. CONCLUSION AND DISCUSSION

According to a large number of the designated factories in Thailand, the energy management system is very important issues as well as the quality, environment, occupation health and safety management systems. The energy consumption affects to the energy efficiency and also involves to the cost of productions and services. The optimal energy management leads to the cost minimization objective for increasing business opportunity. In this paper, the analytical results of feasibility score can be concluded that the selected designated factories have a positive attitude to implement the integration of EMS and their standards with average score 83.5%.

According to the business constraints, the management system based on ISO 9000, ISO 14000, ISO 18000, and the individual standards is a basic requirement for business agreement. The Energy Conservation Promotion Act (No. 2) B.E. 2550 (2007) enforces all designated factories to implement EMS. Therefore, the concept of integrated management system for energy, product quality, environment and safety is enabled to achieve the business goal. However, the various sizes organizations may be adapted the integrated concept in their organization's cultures in case by case to minimize

resources requirement and maximize organization benefits.

The possible benefits for Thailand based on this study are related to the benefit that the factories got from the IMS implementation which are the duplex work reduction, the lucid guideline, the operator's skill development, working time reduction, clear responsibilities, better process structure, good time and cost planning, productivity incretion, cost reduction, easy–understanding document, less process and paperwork, higher yield, verifiable procedures, multi-task utilization decision-making improvement. The reduction in factory operation cost leads to the IMS implementation. Finally, the factories in Thailand will gain the energy saving and conservation with the IMS that includes the EMS.

The further important issue about integrated EMS is that the ISO now has launched a development of the energy standard called "ISO 50001: International Standard Energy Management". The future ISO 50001 will establish a framework for factories, commercial facilities or entire organizations to enhance energy efficiency. The current situation of this standard is still developing the framework by several experts from 25 countries in all regions of the world and the representation from the United Nations Industrial Development Organization (UNIDO). All the participating countries have existing activities on energy management and have a strong interest in also developing a harmonized solution at the international level. A major point of discussion is the need to ensure compatibility with the existing suite of ISO management system standards. This will ensure maximum compatibility with key standards such as ISO 9000 for quality management and ISO 14000 for environmental management. The scope of ISO/WD 50001 is to specify requirement for energy management system which is enabled the organization to take systematic approach with the continual improvement of energy performance including energy supply, procurement practices for energy using equipment and systems, energy use and any use-related disposal issues. The standard will also address measurement of current energy usage, implement a measurement system to the report and validate continuous improvement in area of energy management. The final ISO 50001 is expected to be available by the end of 2010.

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