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Development of a certification system and core competencies for professional ergonomists in Thailand

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ABSTRACT

To reduce ergonomic risks for their workforce, many industries in Thailand seek assistance from professional ergonomists. However, most academic programs are delivered by instructors with limited human factor and ergonomics (HFE) background, who incorporate either physical or cognitive parts of HFE. To reliably assess and design systems according to HFE principles and standards, programs should be provided by creditable HFE professionals and based on holistic HFE knowledge. The objective of the present study was to initiate a transformation of the professional development in Thailand. The process included a consolidation of the details of HFE education through questionnaires, and identification of requirements from industries through a focus group interview. The results showed a prevalent lack of holistic considerations of HFE knowledge and a primary focus on physical ergonomics. Problems with lack of resources and basic knowledge in design were also reflected by concerns from the industry regarding limited experience, design competency and use of objective methodologies of HFE practitioners. This information was subsequently used to constitute the development of preliminary competencies and a pilot certification system. The proposed competencies and system were then disseminated and additional requirements that need to be incorporated into the professional HFE system were identified.

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Relevance to human factors/ergonomics theory

While human factors and ergonomics (HFE) has high relevance for reducing risks for the industrial workforce, the qualification of HFE professionals in Thailand remains limited in terms of consideration of holistic approaches. This paper presents the development process of the certification system and identification of core competencies for Thai professional ergonomists, taking into account the local needs and resources.

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Introduction

From past to present, musculoskeletal disorders (MSDs) have been identified as one of the most significant occupational diseases in Thailand (Division of Occupational and Environmental Diseases et al. 2020). In addition, Thailand is currently undergoing a reformation of the industrial systems (Industry 4.0) by incorporating modern technology and automation in manufacturing processes as an important element in the restructuring towards the Thailand 4.0 era (Ministry of Industry 2016). While this transition is not aimed at replacing the human workforce, it will lead to substantial changes in the role of workers shifting from manual work to, for example, machine control and system monitoring (Parasuraman and Riley 1997). Such work poses additional cognitive requirements on operators, while physical stressors change from strenuous demand of traditional labor to static work.

While many industries in Thailand seek for assistance from professional ergonomists to reduce ergonomic risks for their workforce, driven either by self-awareness or to comply with requirements from international parent companies, efforts are currently limited to control excessive physical demands. Several academic disciplines in Thailand also start to include human factors and ergonomics (HFE) courses or topics in their educational programs. However, most programs are delivered by instructors with limited HFE background, who incorporate either physical or cognitive parts of HFE based on their disciplines with less consideration of holistic approaches in HFE. To reliably assess and design systems according to HFE principles and standards, programs should be provided by creditable HFE professionals and based on holistic HFE knowledge. However, a professional HFE system and competencies have not yet been developed in Thailand to date. Currently, HFE certification systems for professional ergonomists in 8 countries or regions are endorsed and 2 countries or regions are recognized by the International Ergonomics Association (IEA) (as of December 8, 2022 the IEA listed on its website https://m4v.211.myftpupload.com/iea-recognized-and-endorsed-certification-systems-for-professional-ergonomists/). Since HFE professionals are required to be proficient in certain common knowledge and skills, competency standards in HFE were developed and recently revised by the IEA in 2021 (IEA (International Ergonomics Association) 2021) However, the IEA recommended that the details of courses and certification systems are not universal and must be properly adapted to local needs and available resources.

A national ergonomics society, the Ergonomics Society of Thailand (EST), was established in Thailand back in 2001 and registered as a nonprofit organization. One of the Society's stated missions is to promote HFE knowledge and profession at national levels. To achieve the aim of formulating standards for the effectiveness and credibility of the ergonomics profession in Thailand, the EST invited and called lead HFE experts to form the first national certification board. With valuable help from the Professional Standard and Education Committee of the IEA, along with a well-established HFE Certification Board in reviewing the applicants' qualification, the Certifying Board of Professional Ergonomists – Ergonomics Society of Thailand (CBEST) was established in 2020. The board members comprise university professors currently teaching HFE courses and conducting research related to HFE, and represent a variety of relevant disciplines, including one certified professional ergonomist (certified by Board of Certification of Professional Ergonomics, USA) with background in Industrial Engineering, additional industrial engineers, physical therapists, architects and industrial designers, and public health professionals. The EST establishes strong connections between academics, government officials, and

industries across Thailand, and is thus able to provide access to various project activities and facilitate the dissemination of outcomes.

The objective of the present study was to be transformative with respect to the importance of HFE and professional development in Thailand. The details of HFE education and related research fields were assembled from related disciplines currently offered through academic institutions in Thailand. The requirements of knowledge and skills of HFE practitioners were also identified from industries and stakeholders in the kingdom. The information obtained from both academic and industrial sections was subsequently used to identify areas of competency as well as potential lack of proficiency in HFE knowledge and skills within Thai academic institutions. The overarching goal is to develop core competencies and a certification system for professional ergonomists in Thailand.

Methods

The development process of the certification system and related competencies was designed to involve 3 groups of main HFE stakeholders in accordance with the system design described in Dul et al. (2012), including system experts, system decision makers and system influencers. The study included 5 main activities described as the following:

Data collection of the details of HFE education and related research fields

Data of HFE courses and contents, as well as research areas were collected from related disciplines (including Engineering and Technology, Physical Therapy, Architecture and Design, and Occupational Health and Safety) currently offered through academic institutions in Thailand (as a stakeholder group of system experts on the country level). Electronic questionnaires were distributed through representatives of the EST network and comprised 5 groups of questions: (1) basic information about the HFE curriculum, (2) methods of teaching, (3) course content, (4) research field and, (5) problems of teaching and learning management. Answer sets of the question group #4 were presented as choices of multiple answers, which were designed based on research data presented at international HFE conferences (e.g., IEA, HFES, AHFE). The other question groups contained open-ended questions. None of the questions in the questionnaire were used to collect any personal data of academic staff or affiliated personnel.

Investigation of requirements of HFE knowledge and skills from industries

A focus group was conducted consisting of a group of representatives from Thai manufacturing and service industries. Executive managers and HFE program managers (as representative stakeholder groups of system decision makers and system experts, respectively) from nine industries representing a variety of industrial sectors, including automotive, chemical, electronics, food and beverage, jewelry, and health service, were invited and agreed to participate in the focus group interview. All representatives signed consent forms and gave permission to publish the results of the interview under anonymization of personal data and company affiliations. Questions were structured to interview the participants on: (1) current HFE job description and skill requirements; (2) knowledge and skills of HFE practitioners that are still deemed underdeveloped or lacking; (3) current job and skill requirements related to cognitive ergonomics; (4) current job and skill requirements related

to organizational ergonomics and; (5) additional types of work and skills required for the future. As it is expected that the companies will be less acquainted or unfamiliar with cognitive and organizational aspects of HFE, a scenario-based focus group was used to acquire information on these sets of HFE skills (Cooper and Baber 2004). With this methodology, an implementation of the focus group is expected to not only serve as a means of identification of HFE requirements in different industrial sectors, but also to help system decision makers in the relevant industries to recognize holistic considerations of HFE knowledge.

Identification of HFE knowledge and skills that need to be promoted within competent disciplines

Results from the focus group conducted with the selected industries were used for a comparison of skill requirements from actual users and skills offered through educational programs. The findings were used to identify competency and non-proficiency in HFE knowledge within Thai academic institutions and should serve as a basis for recommendations of sets of knowledge and skills that need to be promoted.

Development of preliminary core competencies and a pilot certification system for professional ergonomists in Thailand

Collective results from prior activities were reviewed and used as a basis to construct the competencies of professional ergonomists. The complete preliminary core competencies along with a pilot certification system were developed by aggregating additional knowledge and skill requirements based on the expertise of the CBEST board members and assistants, as well as IEA guidelines and recommendations (IEA (International Ergonomics Association) 2021), related literatures (e.g., Dul et al. 2012, Karwowski 2012, Smith 2012) and examples from other certification bodies endorsed by the IEA.

Dissemination of the proposed competencies and certification system and identification of additional requirements

The preliminary core competencies and a pilot certification system were disseminated through several channels, including conferences and meetings held by EST and associated societies/institutes (e.g., Thailand Institute of Occupational Safety and Health), publications, social media channels (e.g., Facebook Live, Clubhouse), and small-scale public hearings from stakeholders. This activity served as a means to communicate and promote high-quality HFE education and standards to HFE stakeholders, especially system influencers. Moreover, comments, suggestions and additional requirements were subsequently reviewed and included in the revised version of the competencies and certification system.

Results and discussion

Details of HFE education and related research fields

Eighteen responses from 14 universities were obtained and analyzed using descriptive statistics. The results indicate that HFE-related courses are predominantly included in the

undergraduate level (17 curricula) and primarily taught by class lecture, followed by exercise practice and self-learning. For the graduate level, the HFE courses are included in 7 curricula on the master level and 4 curricula on the doctoral level. The master level delivers HFE knowledge via lecture and research, while the doctoral level concentrates on research and self-learning. All HFE knowledge and skills are provided at the course level; however, there are no specific HFE curricula offered in Thailand.

Results of HFE course contents and research fields are presented in Figures 1 and 2, respectively. In line with our expectation, the findings showed both HFE education and research in Thailand to mainly concentrate on the physical aspect of HFE. Although many curricula in the field of Occupational Health and Safety cover both physical and cognitive HFE courses, the main focus and predominant research in this discipline remains the assessment of physical ergonomics. On the other hand, the Engineering and Technology field includes both physical and cognitive HFE in both courses and research areas. The other fields of study incorporate either physical or cognitive parts of HFE based on their disciplines. The main focus of the Physical Therapy education and research is set on the musculoskeletal system and associated disorders, while technical contents of Architecture and Design aims to design products, systems and interfaces with focus on the cognitive

	Occupational Health & Safety	Physical Therapy	Engineering & Technology	Architechture & Design	Sum	%
Workstation design	4	1	5		10	55.56
Work physiology*	5		3		8	44.44
Work environment	4		3		7	38.89
Musculoskeletal system		3	4		7	38.89
MSDs (risk assessment/ MMH)		4	3		7	38.89
Tool design and selection	2		4		6	33.33
Body measurement	1	1	4		6	33.33
Human ability and limitation	3		2		5	27.78
Stress and fatigue*	3		2		5	27.78
Human-machine interaction	2		3		5	27.78
Work psychology/ mental health*	3		1		4	22.22
Work design	3		1		4	22.22
Biomechanics*	1		3		4	22.22
Job/ posture evaluation		1	3		4	22.22
Human factors engineering			3		3	16.67
Work shift	1		1		2	11.11
Motivation			2		2	11.11
Cognitive design			1	1	2	11.11
Interface design*			1	1	2	11.11
Overview ergonomics		2			2	11.11
Work attitude	1				1	5.56
Human reliabilty*			1		1	5.56
Work organization			1		1	5.56
Office ergonomics		1			1	5.56
Usability testing				1	1	5.56

Figure 1. The content of HFE courses offered in Thailand, arranged according to the field of study. (* represents the content taught at the graduate level in some universities).

	Occupational Health & Safety	Physical Therapy	Engineering & Technology	Architechture & Design	Sum	%
Musculoskeletal disorder studies	7	4	4		15	83.33
Office ergonomics	7	4	4		15	83.33
Occupational safety and health	8	3	2		13	72.22
Occupational ergonomics – interventions	7	2	3		12	66.67
Industrial risk assessment methods	6		4		10	55.56
Human performance measurement in work tasks	4		5		9	50.00
Occupational biomechanics – task assessment	4	2	3		9	50.00
HFE in product/systems design	3		2	1	6	33.33
Human-centered design engineering	2		4		6	33.33
System safety techniques and analyses	2		3		5	27.78
Cognitive workload analysis and systems design	2		3		5	27.78
Human-computer interaction design	2		2	1	5	27.78
HFE in design for special populations	3		1		4	22.22
Analytical methods for HFE	2		2		4	22.22
HFE in assistive technology design	2		2		4	22.22
HFE considerations in manufacturing processes	1		3		4	22.22
Cognitive and physical performance modeling	2		1		3	16.67
User interface design	1		1		2	11.11
Cognitive engineering for optimized systems design	1				1	5.56
Team design and training	1				1	5.56
Human-automation/robot interaction design and analysis			1		1	5.56
Multimodal interface design						
Virtual reality validity, training and assessment						

Figure 2. The areas of HFE research conducted in Thailand, arranged according to the field of study.

aspect of HFE. The findings indicate the collective HFE education in Thailand to cover both physical and cognitive ergonomics; however, organizational ergonomics is unfortunately still comparatively underrepresented in all fields of study.

The results of the last question, related to problems of teaching and learning management, revealed most HFE courses being offered as an elective course or HFE contents and accounting only for a part of a course to constitute a major problem. In addition, student numbers showing interest in the HFE area were found relatively low. This might be a result of an absence of HFE in a group of compulsory courses and, therefore, HFE might lose its connection with other courses in the curriculum. As a result, students are unaware of the role and importance of HFE in their field of study. Other problems, categorized based on educational and research components, included: (1) instructors (limited numbers and limited HFE background); (2) students (lack of awareness for the need of basic knowledge of HFE at work, lack of basic knowledge in design for health science students); (3) instrument (lack of tools and equipment for teaching and learning) and; (4) research (small proportion of HFE research as most HFE-related courses are taught at the undergraduate level, small number of collaborative work among technology and design researchers, lacking awareness of the scopes and roles of HFE research in the Engineering field).

Requirements of HFE knowledge and skills from industries

Responses obtained from the interview showed that most companies do not have a dedicated HFE specialist; instead, ergonomics related work is primarily in the responsibility of safety officers or industrial hygienists. Some companies have engineers involved or trained in

HFE, while for other companies, engineers are only responsible for making improvements as advised by safety officers or industrial hygienists. Among the participating companies, there is only one company that has an ergonomist responsible for an ergonomics program, which is due to specific requirements imposed by the parent company from overseas. At present, every company (including the company with a dedicated ergonomist) focuses on physical ergonomics considerations; for example, work posture, lifting weight, repetitive work, prolonged sitting/standing, forklift driving, long walking distance, workstation design, and tool selection. The scenario-based focus group successfully raised the awareness of the participants with respect to cognitive and organizational aspects of HFE in their organization. For job related to cognitive ergonomics, the companies indicated that the majority of the current workload consists of visual inspection and monitoring tasks. These types of work may lead to problems of, but not limited to: work mistakes, boredom due to monotony of work, and stress and fatigue from multitasking. For current jobs related to organizational ergonomics, the company indicated a range of tasks related to environment, working individually and within a team, training, and management of risk, job rotation and special work hours. Results from the interview are summarized in Table 1.

It can be seen that, although physical ergonomics are currently focused on in every company, a limit to observation-based risk assessment and use of administrative approaches for risk control remains and design skills for intervention still remain lacking. Several company executives also commented that a certain level of ergonomics experience relevant to the company's work (or similar businesses) would be helpful for HFE practitioners in designing a solution. Cognitive ergonomics-related work is recognized as essential for both current and future work; however, neither individuals with responsibility for HFE nor other personnel possess adequate knowledge and skills to comply with these requirements. Current work related to the organizational aspect of HFE is partially fulfilled by HFE practitioners; however, special work hours are still managed without HFE considerations. Moreover, lack of awareness and behavior of employees are indicated as a major problem for HFE training and implementation of changes. Therefore, there is a need for design or administrative controls to promote safe behavior of individuals. Related to this, the company executives suggested a participatory ergonomics approach as a competency requirement of ergonomists to come up with solutions that are acceptable to employees. Moreover, basic management and economics skills, especially expressing HFE improvement in terms of productivity increase and cost reduction, are also still lacking. Noteworthily, such skills are required for ergonomists to successfully deliver HFE training and recommendations to workers and executive levels of a company. In the future, HFE practitioners should further incorporate knowledge of national and international HFE standards. In addition, a set of future HFE competencies should consider changes in roles of workers when working with modern technology and automation in manufacturing processes, and virtual work as a result of work methods and environment changes from pandemic situations. After the participants acknowledged all aspects of HFE involved in their organization, all companies agreed that ergonomists should have skills covering cognitive and organizational ergonomics in addition to physical ergonomics. Lastly, one important issue that was raised by all companies was that HFE practitioners who graduated from different institutions have different levels of ergonomic qualification. This comment emphasized the need for development of a professional system and standardization of competencies in Thailand.

Table 1. Summary of skill requirements and status of ergonomists retrieved from the focus group interview.

	HFE skills requirements		Skill of practitioners	
HFE Aspects	Current	Future	Sufficient	Lacking
Physical	Risk assessment in production lines, office and laboratory using observational methods		✓	
	Risk assessment skills using direct instruments (e.g., physiological signals, sensors)			✓
	Preliminary assessment of whether employee's MSDs are work-related by using objective and subjective ergonomic methods			✓
		Remote or virtual risk assessment and/or new design for self-assessment		✓
	Administrative controls for jobs posing high risk		✓	
	Design competency to solve problems for jobs posing high risk			✓
	Developing HFE guidelines or adopting guidelines from parent company		✓	
		Knowledge of standards and ISO related to HFE		✓
Cognitive	Administrative control of boredom, stress and fatigue by, for example, training of multitasking skills and providing frequent breaks.			✓
	Ergonomic design to prevent or reduce boredom, stress and fatigue			✓
	Usability study of machine and computer interfaces			✓
		Work with automation and robots		✓
Organizational	Measurement and recommendations of workplace lighting		✓	
	Risk management		✓	
	Management and plan of shift work and overtime *(currently done by human resource department by considering job value and working time)*			✓
	Job rotation based on exposure to high risk		✓	
	Teamwork		✓	
	Ability to work as a team with employees coming up with solutions that are acceptable to employees (i.e., participatory ergonomics)			✓
	Team training		✓	
		New design for remote or virtual training		✓
	Design or administrative control to promote safe behavior and awareness of employees			✓
Basic skills	Economic skills in consideration of productivity, monetary outcomes (e.g., reducing cost associated to injury, reducing environmental impact), and project feasibility			✓
	Management skills in presentation, communication, persuasion and negotiation of the ergonomic recommendations and training			✓

HFE knowledge and skills that need to be promoted within competent disciplines

The current HFE job description and skills of HFE practitioners are in accordance with the current status of HFE education and research in Thailand. In general, physical and environmental ergonomics were identified as major competences of current Thai ergonomists. The findings also revealed non-proficiency in HFE knowledge within Thai academic institutions and should serve as a basis for recommendations of sets of knowledge and skills that need to be promoted as follows.

(1) Cognitive aspect of HFE - Although many institutes offered Occupational Health and Safety degrees covering both physical and cognitive HFE courses for students, which constitute a major group of HFE practitioners in the Thai industrial sector, main areas of research within this discipline continue to primarily involve assessment in physical ergonomics. From an industry viewpoint, cognitive ergonomics-related work starts to be recognized for both current and future work; however, knowledge and skills for these aspects still remain limited.
(2) Organizational aspect of HFE - Organizational ergonomics is still comparatively underrepresented in Thai education. In the industry, current works related to the organizational aspect of HFE are partially fulfilled by HFE practitioners, including consideration of environmental factors, risk-based management, and teamwork. However, such competencies are taught as parts of safety classes, in non-HFE courses, or achieved from work experience. The majority of knowledge and skills related to macro ergonomics are still lacking in both offers from academics and requirements from the industry.
(3) Holistic consideration of HFE - Since cognitive and organizational HFE are still deficient and most academic programs incorporate either physical or cognitive parts of HFE based on their disciplines, holistic approaches in HFE (IEA (International Ergonomics Association) 2021) have not yet been considered during the assessment and recommendation processes.
(4) Design of intervention and engineering recommendations for changes - The lack of basic knowledge in design is noted for students and practitioners with health science background, including Physical Therapy and Occupational Health and Safety. Architecture and Engineering fields mostly offer HFE as elective or graduate level courses; and therefore, not all designers and engineers are equally equipped with basic HFE knowledge in the design process. It is important to ensure design competency for HFE practitioners from all fields as a key practice of HFE is design driven (IEA (International Ergonomics Association) 2021).
(5) Practice, research and experience in HFE - Current HFE-related courses were mostly included in the undergraduate level, which are primarily taught via conventional class lecture. The inadequacy of tools and equipment for teaching and learning also causes limited opportunities for students to practice with measurement tools for objective assessment of risks and evaluation of designs. This is in line with concerns from companies stating that the competency of current HFE practitioners is still limited to observation-based risk assessment. Related to the design competency requirements, the company also recommended that ergonomics experience would be helpful for HFE practitioners in designing solutions.

Therefore, experience on HFE research or projects is deemed mandatory for qualification as a HFE professional.

(6) Knowledge in management, economics, and HFE standards and regulations - Basic management and economics skills were indicated as additional requirements from the industry. Knowledge of national and international HFE standards was also suggested for HFE practitioners. These sets of knowledge and skills were not mentioned by the educators in the course content. However, an inclusion of these skills as basic knowledge of competency would be greatly beneficial for HFE professionals.

(7) Knowledge update for future requirement – As a result of continuously emerging technology and changes in post-pandemic ways of working, HFE practitioners should regularly update their knowledge and skills, and HFE education should be periodically revised in order to keep up with these changes.

Preliminary core competencies and pilot certification system for professional ergonomists in Thailand

Preliminary core competencies were constructed, which comprised of 3 components (Figure 3). The first component of competency areas was based on the core elements of HFE measurements, recommendation, implementation and evaluation skills set out by the IEA (IEA (International Ergonomics Association) 2021). This component showed that the design and recommendation competency, which is currently identified as an under-proficiency HFE skill in Thailand, is mandatory to be acquired for professional ergonomists. The contexts of use (the second component) that should be considered in competency areas of system assessment, design and implementation were identified based on contexts of systems that humans interact with and derived from other IEA endorsed certification systems (e.g., Bord of Certification in Professional Ergonomics (2019) (BCPE; www.bcpe.org) and Human Factors and Ergonomics Society of Australia (HFESA; www.ergonomics.org.au)). The third component included knowledge and skills that are required in order to achieve the first two

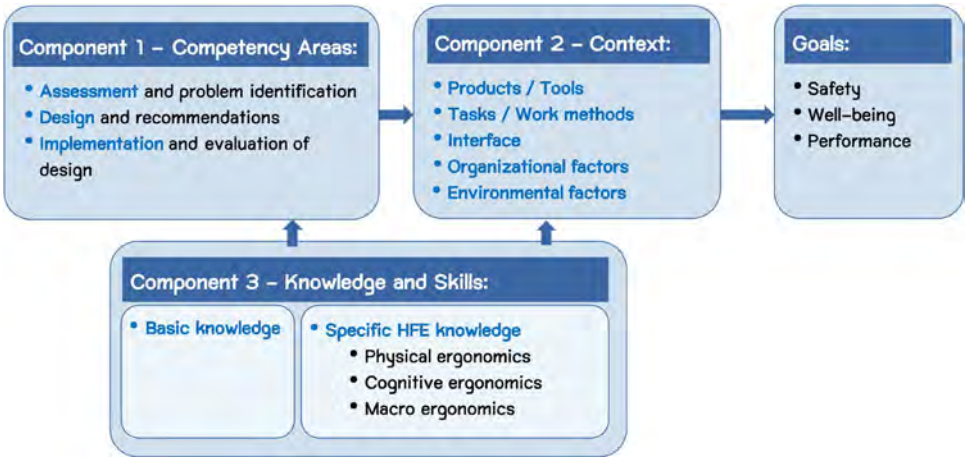

Figure 3. Overview of core competencies for professional ergonomists in Thailand.

components. Detailed knowledge and skills were identified by using collective results from prior activities, competency elements recommendations from the IEA, as well as expertise of the CBEST board members and assistants. The set of skills was divided into basic knowledge and specific HFE knowledge. The basic knowledge included IEA recommended core elements of fundamental knowledge and scientific skills, and covered knowledge in management, economics, and HFE standards and regulations identified by industries. The goal of the proposed HFE competencies was not only focused on safety and well-being of the individual, but also performance of the system, as emphasized by the IEA.

A pilot certification system for professional ergonomists was formulated in accordance with the IEA standard for accreditation of systems, and adapted to the local needs and resources in Thailand. Multi-level certification of professionals was designed by referring to examples of accredited systems, including the entry-level Associate Professional Ergonomists (APE*X*) and Certified Professional Ergonomists (CPE) systems. The former is a locally-managed system and the latter is to be applied for endorsement by the IEA. These two levels are different in terms of coverage of knowledge and skills according to core competencies and work experience (see Figure 4). The requirement of work experience was added as an essential part of competencies, which aligns with the need of practice and experience identified by industries. Additional requirements including continued education and practice for certification renewal were specified to ensure continual professional development and up-to-date knowledge for future requirements from stakeholders.

Although by definition of HFE and as communicated by the IEA, traditional specialization areas of physical, cognitive and organizational ergonomics are not recommended to be separated since HFE professionals should consider all aspects of the work system (IEA (International Ergonomics Association) 2021), the HFE in Thailand in its current education form, as described in previous sections, is heavily divided into physical and cognitive domains. Therefore, the domain-specific certification of APE*X* was expected to facilitate matching the current demand and resources available in Thailand. To our best knowledge,

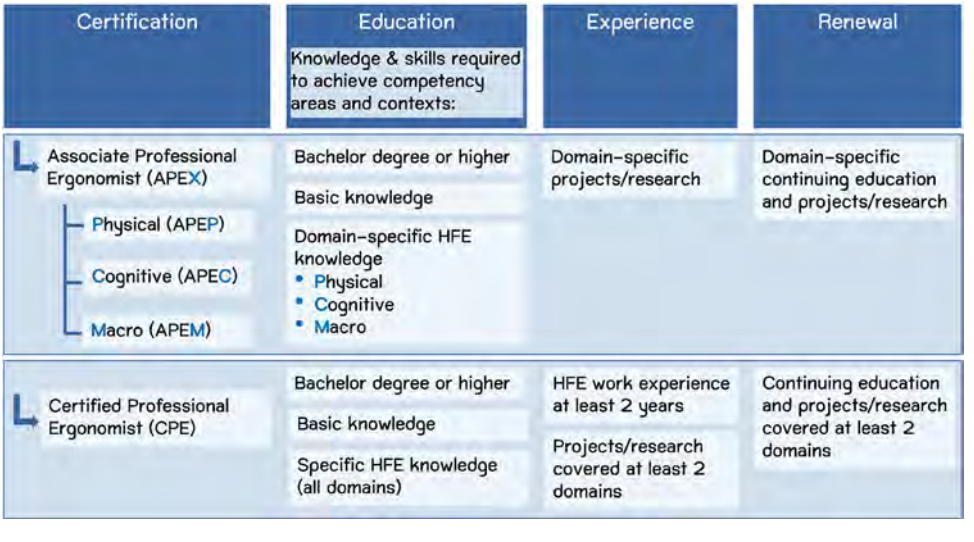

Figure 4. Overview of certification system for professional ergonomists in Thailand.

the Professional Affairs Board – Human Factors and Ergonomics Society of New Zealand (HFESNZ; www.hfesnz.org.nz) is the only certification system that offers single-field HFE knowledge as Technical Professional Members, although still requiring to have some knowledge of other HFE aspects.

Additional requirements and revision of the proposed competencies and certification system

The preliminary core competencies and a pilot certification system were successfully disseminated through several media and conference channels. A small-scale public hearing was also held after disclosure of detailed core competencies and publishing a draft for the certification system. The set audience included academic instructors, government agencies, and representatives from service and manufacturing industries. Besides academic instructors, which also included engineering and health science professionals, a majority of the audience were working in the occupational safety and health area. Involvement of architecture and industrial design professions was still very limited. As a result, the domain of greatest interest remained in physical ergonomics. Questions and comments were summarized along with proposed future actions as follows.

(1) Concern regarding an awareness of the HFE certification system development from all academic institutes in Thailand – Although we made best efforts to reach out to many higher education institutions by several means, still not every institute and HFE related field could be successfully covered. Communication will continue to be maintained and further extended to more available channels.
(2) Concerns regarding the uniqueness of HFE professionals as compared with other professions, especially Occupational Safety and Health professionals – The fundamental characteristics of HFE, in terms of systems approach, design driven and performance and well-being outcomes, must be well clarified and the uniqueness needs to be emphasized to differentiate HFE from other disciplines. A revised version of the certification system and future dissemination process will include such emphasis prior to defining the details of the system.
(3) Although the certification is currently voluntary, future law enforcement might render it compulsory or not consistent with proposed HFE core competencies – The CBEST need to communicate and work in close alignment with government authorities involved in health and safety legislation.
(4) Information of credit count obtained from practical courses and courses with satisfactory/unsatisfactory (S/U) options needs to be explicitly defined in the certification system.
(5) Problems with insufficient credit hours available for compulsory courses in academic system. Students have a limited number of credit hours allowed to register in each semester – The certifying body needs to pay close attention to accreditation of the curriculum and approved HFE courses that are offered as elective courses. Alternatively, the curriculum can be certified with conditions and external accredited training courses can be used to supplement standard HFE competencies. The evaluation process needs to be clearly stated for individual and institutional applicants.

(6) HFE knowledge and contexts of use might change and/or newly emerged in the future – Core competencies should be periodically revised in order to keep up with these changes.

Conclusion

The present study consolidated the details of HFE education and acquired requirements from industries in order to identify specific HFE knowledge and skills either already proficient or still in need to be promoted in Thailand. The results showed a general lack of holistic considerations of HFE knowledge due to a primary focus on physical ergonomics; lack of basic knowledge in design, management, economics, and HFE standards and regulations; and limited practice and experience of HFE practitioners. Collective results, along with guidelines and recommendations from the IEA, accredited HFE certification systems, related literatures, and suggestions obtained from the dissemination process were used as a basis to construct the competencies and certification system of Thai professional ergonomists.

We attempt to initiate the system development through a quick, locally-managed system by launching a low-level certification (i.e. APE*X*) targeting ergonomists working in relevant industries and academic scholars in their early career. The motivation for this plan is based on the interest of several ergonomists working in the industrial sector in obtaining certification by the EST. Although potential certified individuals might have been working extensively in HFE areas, it is not certain whether they actually have adequate and appropriate knowledge about HFE as they do not have major education or a degree in HFE. Therefore, this is expected to be an opportunity to promote the importance of HFE and professional development and build a professional certification system in Thailand.

The present study is further expected to establish a guideline for knowledge and skill requirements for professional ergonomists in Thailand. The set of HFE competencies will aid HFE educators and practitioners, as well as industries and other stakeholders to recognize and apply holistic HFE knowledge. This will help assess and design proper systems, considering physical, mental, and organizational aspects for total safety and productivity improvement. The study is also expected to help promote the importance and role of HFE in various public and private sectors, and eventually become a mandatory consideration in manufacturing and service industries.

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References

BCPE (Bord of Certification in Professional Ergonomics). 2019. "BCPE Core Competencies". https://bcpe.org/wp-content/uploads/2020/03/BCPE_Core-Competencies-2019.pdf

Cooper, L., and C. Baber. 2004. "Focus Groups." In *Handbook of Human Factors and Ergonomics Methods*, edited by Neville Stanton, Alan Hedge, Karel Brookhuis, Eduardo Salas, and Hal Hendrick, 347–354. Boca Raton, FL: CRC Press.

Division of Occupational and Environmental Diseases, Department of Disease Control, Ministry of Public Health. 2020. "Annual Report 2020." http://inenvocc.ddc.moph.go.th/E-Book/annual_report2020/Index.html#p=1

Dul, J., R. Bruder, P. Buckle, P. Carayon, P. Falzon, W. S. Marras, J. R. Wilson, and B. van der Doelen. 2012. "A Strategy for Human Factors/Ergonomics: Developing the Discipline and Profession." *Ergonomics* 55 (4): 377–395. doi:10.1080/00140139.2012.661087.

IEA (International Ergonomics Association). 2021. "Core Competencies in Human Factors and Ergonomics (HFE) Professional Knowledge and Skills." *IEA Press*. https://m4v211.p3cdn1.secureserver.net/wp-content/uploads/2014/10/Core-Competencies-in-Human-Factors-and-Ergonomics-2021.pdf

Karwowski, W. 2012. "The Discipline of Human Factors and Ergonomics." In *Handbook of Human Factors and Ergonomics*, edited by Gavriel Salvendy, 3–37. Hoboken, NJ: John Wiley & Sons.

Ministry of Industry. 2016. "The Achievement in Implementation of the Government Policy and Industrial Strategy: Fiscal Year 2016." https://www.industry.go.th/web-upload/1xff0d34e409a13ef56eea54c52a291126/m_magazine/12668/375/file_download/ff2fb839a8919284a7e5f59ae5dbaa93.pdf

Parasuraman, R., and V. Riley. 1997. "Humans and Automation: Use, Misuse, Disuse and Abuse." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 39 (2): 230–253. doi:10.1518/001872097778543886.

Smith, T. J. 2012. "Certification of Professional Ergonomists: A Global Perspective." *Ergonomics in Design: The Quarterly of Human Factors Applications* 20 (4): 22–28. doi:10.1177/1064804612455639.