International Ergonomics Association

CORE COMPETENCIES IN HUMAN FACTORS AND ERGONOMICS (HFE)

Professional knowledge and skills

IEA Press

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Preface

One of the main aims of the IEA is to advance the science and practice of ergonomics at an international level. Formalising and documenting the core competencies of the profession is important to this aim, as it sets the standard for educational programs and practice. However, HFE is a developing profession, and the formalisation of core competencies must allow for change. We believe that this revision of the IEA Core Competencies supports the dynamic and broad application of HFE, while building on the base that was established at the beginning of the century.

This revision of the IEA Core Competencies was commenced in 2017 following an update of all the other IEA documents relating to professional certification. The first phase involved communication with some of the original authors and informal discussions at various IEA council meetings about what needed to be done. This resulted in a first draft, in Excel format, which was circulated to all of the IEA endorsed or recognised certification bodies and a selection of educators chosen for experience, knowledge of IEA requirements and geographical location. It was important to the authors that the viewpoint of as many regions as possible should be obtained. A second draft was produced to include this feedback and the result was presented in a special session at IEA2018. Feedback from this meeting was put into the final stage of the review where the body of the competencies were incorporated into a document with explanatory text, examples of implementation and a glossary. A final review was done by the members of the IEA executive.

The chief author would like to thank all of the people who took the time to read, consider and provide feedback on the document.

August 31, 2021

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1. INTRODUCTION

Any mature profession requires an understanding of its core competencies. The term “competencies” is used here to mean the knowledge and skills needed for successful professional performance. The following outline of core human factors/ergonomics (HFE) competencies describes what all HFE professionals need to know and are able to do in practice. Most HFE professionals will have additional competencies and may be specialized in certain application domains, but this document describes what they all have in common.

These competency standards do not represent an outline of certification requirements, although they may be used as a resource for developing certification systems. It is also not the intention of the IEA to produce a curriculum document, although this document may help direct the development of a curriculum. Courses and certification systems must be adapted to local needs and resources. However, for a profession to develop, it must have common knowledge and skills that are acquired by all members.

The first IEA Core Competencies in Ergonomics were ratified by the IEA Council in October 2001. It was noted at that time, that the exercise of defining core competencies is worthwhile, because it prompts the profession to look closely at itself, its goals and its perceived contribution to society. It is a method by which the profession can ensure quality and uniformity of performance. Additionally, the core competencies can be used to communicate the added value of a HFE professional to others and are therefore useful for prospective customers, including students interested in the profession.

1.1. WHAT IS HFE?

Ergonomics / human factors (HFE) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system. HFE professionals apply theory, principles, data and methods to design in order to optimize human well-being and overall system performance. They contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

HFE, therefore, helps harmonize things that interact with people in terms of people’s needs, abilities and limitations.

Since the publication of the first version of the IEA core competencies, the paper "A strategy for Human Factors/Ergonomics: Developing the discipline and profession1" has been published. In this paper the discipline was characterized by the following points:

- *HFE takes a **systems approach**, and therefore HFE professionals are trained to always consider the broad context of the human within a system. The system includes the cultural and physical environment, the organisation of the company or institution in which work is taking place and the specific task requirements, even when focusing on specific aspects of a job.*
- *HFE is **design driven** in that an analysis of a situation results in new or redesigned approaches, recommendations and/or workplace and tool design.*
- *HFE is an iterative, **human-centred process**, where the users are a resource for developing knowledge and testing solutions,*
- *HFE focuses on two related **outcomes**, improving both **well-being and performanc**e. This includes optimizing efficiency, effectiveness, health and safety and job enjoyment.*

Historically, the terms "ergonomics" and "human factors" have been used to mean the same thing in different countries, and sometimes to differentiate between specialty areas. In some areas the term "UX" has also been used. In this document the term HFE is used as an umbrella term to include all activities that are characterized by the points described above. A HFE professional is a person who has acquired the competencies outlined in this document.

In other words, the focus of HFE, regardless of the speciality focus or the domain of application, is to jointly improve human performance and well-being by integrating the human into the system through an integrative design of the whole. This requires consideration of all aspects, not only the physical, cognitive or organisational aspects of the work system, but also environmental and cultural aspects.

Ideally, HFE is considered throughout the development of a workplace, task or tool, but it is most valuable when used proactively rather than reactively, as it then optimises the performance of the system as a whole. Examples of systemic tools that should be part of HFE education are included in Section 4.

[1] J.Dul et al. 2012 *A strategy for human factors/ergonomics: developing the profession*. Ergonomics 55:4, 377-395

A key aspect of the HFE design process, not yet mentioned, is stakeholder engagement. HFE practice involves a participative process where the wishes of multiple stakeholders need to be included. Stakeholders may include, for example, managers, clients, users, workers, designers, suppliers and subscribers but also institutions like governments, employers' and workers' associations.

1.2. COMPETENCY UNITS AND ELEMENTS

The IEA competency standards were originally developed around the beginning of this century and contained the terms Units, Elements and Performance Criteria.

Units of Competency reflect the significant major areas, or bodies, of professional knowledge and skill.

Elements of Competency describe the components which contribute to and build a unit of competency.

The term "Performance Criteria" were used to describe the standards expected in the HFE professional's work. In this version of the Core Competencies, relevant points from the first version have been included in the Elements sections and a section on Implementation (Section 4) has been added to provide information on the standard that is applied by a sample of IEA endorsed certification bodies.

The Elements of Competency provide a concise overview of the core of the HFE profession. It is expected that any assessment of a professional person or educational program would require evidence of competence across all of the summary elements, although not all the suggested points listed under the elements need to be covered and performance criteria may vary between them, according to local needs. The detail given under the elements is used to illustrate and give examples of professional work for each Element. There is no intention that any one ergonomist is expected to show competence on all these points, but they should be aware of all and be competent in a significant number, applying a system approach that includes all points.

HFE professionals require a good basis of knowledge and skills, but they cannot stand still afterwards. They will have to constantly adjust their competencies to the special applications and problems that they encounter and find solutions in a team of people with diverse competencies. They will have to be able to integrate these different perspectives, e.g., from people with different backgrounds and origins in other domains. This requires a commitment to life-long development of competencies.

1.3. SPECIALISATION IN HFE

The IEA does not wish to be prescriptive in course design or certification criteria, recognizing that some areas of competency may be more relevant in some regional and cultural contexts than others. However, the term "core" emphasizes that these competencies (all Units and Elements) form a basis on which further competence and specialisation can be built.

Traditionally, the IEA described specialization areas of physical, cognitive and organizational ergonomics. This division created the impression that HFE could be divided into these sub-domains. However, according to the definition of HFE given above (Section 1.1) such a division is not in accordance with the characteristics of the profession: A concentration on one of these aspects, without consideration of the other aspects, is not HFE. Although a specific professional task may be aimed at one aspect of a design, or one specific problem area, the others will never be ignored by a HFE professional. For example, it would be poor HFE practice to design the physical load limits for an activity (physical aspect), without ensuring that the supervisors and leadership of the organization support it, or that the instructions are understandable to the workers (organizational and cognitive aspects). Conversely no optimization of the cognitive aspects of machine feedback will result in efficient work, if the shift system is poorly designed, and workers are constantly overtired due to constrained postures at the workplace. A HFE professional considers the whole system and takes a holistic approach. This will also consider environmental and cultural aspects.

Although there are courses in some countries that contain all of the core competencies, most are designed as "post-graduate" in that some university level education has already been acquired in other disciplines, e.g., engineering, psychology, medicine, physical therapy, etc. The HFE education approach, therefore, generally consists of the provision of basic additional knowledge that was not included in the previous discipline, plus a full set of principles, concepts, values and methods belonging to the HFE discipline.

The scope of the implementation of HFE is broad, with professionals active today in many domains and economic sectors (see Section 4). In fact, HFE can be applied to all environments where human activities are involved: Humans at home, humans at leisure…they are all within the scope of HFE. HFE professionals can be involved in both pro-active and retro-active problem solving. The core competencies should be interpreted with this breadth of scope in mind. The contexts for HFE practice are very diverse and competence must relate to the most common workplaces or areas of activity in any region or cultural group.

1.4. USES OF CORE COMPETENCIES

HFE core competencies may be used in a variety of ways. These include:

- the development or review of curricula in HFE education programs.
- the accreditation of new and existing HFE educational programs.
- the development of comprehensive and equitable assessment processes for the evaluation of a person's professional competence.
- the recognition by HFE certification authorities of the competency of graduates holding qualifications in HFE conferred by recognized institutions.
- the assessment of competence of eligible qualified HFE professionals seeking to practice in another country.
- the assessment of eligible HFE professionals who have not practiced for a defined period of time and who are seeking to re-enter the profession or to be re-certified.
- the development of continuing education programs offered by the Federated Societies.
- the determination of need for continuing HFE professional roles and responsibilities.
- helping to design the scope of HFE information systems / observatories (how to select HFE data, what HFE data to report about, or include as useful information) for keeping professionals and HFE courses updated on news, regulations, standards, organizational changes and innovation occurring in the world of work.
- a description of competencies when applying for jobs or submitting government, university or private company tenders for novel contracts.

2. OVERVIEW OF UNITS

The IEA uses the term “competency” to describe the ability to use knowledge appropriately. Education is not the same as competency. Education teaches skills but experience brings competence in using those skills. The HFE professional must therefore be trained both in the field and classroom so that he/she knows how to collect data on human activity “in the wild” and can then analyse and model to design solutions that work in the real world. The aim is to keep the gap between work-as-done (in the real world) and word-as-imagined (by the designer, manager, lawmakers, etc.) within acceptable limits.

Competency = Education + Experience

The competency units below are essential for a HFE professional and define the profession. All HFE Specialists should meet the aims of these competencies. They describe the "added value" of the profession.

	Short name	Aim
1	Foundation knowledge	Has a basic understanding of the sciences necessary for a HFE assessment. This knowledge must be sufficiently broad to conduct a holistic systems approach. These cover the physical, physiological, cognitive, organizational, environmental and cultural aspects of the work environment.
2	HFE Measurement and Analysis skills	Conducts HFE assessments using a systems approach and appropriate methods for measurement and analysis.
3	HFE Evaluation skills	Determines the compatibility of human capabilities and limitations to planned or existing demands using a systems approach and considering the requirements of stakeholders.
4	HFE Recommendation skills	Makes appropriate recommendations for HFE design, redesign or intervention. Using a systems approach, develops a plan in collaboration with the appropriate people.
5	HFE Implementation skills	Collaborates with stakeholders to implement recommendations to optimize human well-being and performance. Documents HFE findings, records interventions appropriately.
6	Scientific skills	Evaluates outcome of implementing HFE interventions appropriately.
7	Professional behaviour	Engages stakeholders and demonstrates professional behaviour, in accordance with ethical principles.

3. CORE ELEMENTS

Core competency elements in red are essential. The points below each element provide information on the scope of knowledge required for each element. It is not essential for HFE professionals to have full knowledge of all of the points.

3.1. UNIT 1: FOUNDATION KNOWLEDGE

The contents of educational programs should be adapted to the educational background of the students. Some scientific disciplines may not be necessary, if they were part of the previous education of all students. If the HFE professional is being trained as a specialist in a particular field, he/she must be sufficiently educated in other areas of UNIT 1 that he/she is able to recognise risks to well-being and decreased performance and maintain a holistic approach to the work system. See Section 1.3. Specialization in HFE.

(1) Understands the theoretical concepts and principles of biological, physical and environmental sciences relevant to HFE

- *Has a working knowledge of functional anatomy and biomechanics and understands how they determine human performance.*
- *Understands the principles of anthropometry and how they should be applied to workplace and tool design.*
- *Has sufficient knowledge of basic sensory physiology (particularly vision, touch, hearing, proprioception) and understands how they affect performance.*
- *Understands the effects of the environment (illumination, thermal, acoustic, vibration) on human health and performance.*
- *Has a basic awareness of adverse chemical conditions and major pollutants that affect health and performance.*

(2) Understands the theoretical concepts and principles of social, behavioural and emotional science relevant to HFE.

- *Can apply knowledge of cognitive psychology, particularly perception processes, information processing and decision making and as they relate to human performance and causes of human error.*

- *Understands the influences of human development principles and ageing on performance.*
- *Understands how emotional responses, attitude formation and motivation influence human performance.*
- *Understands the principles of organizational behaviour and social processes relevant to HFE, particularly group functioning and socio-technical systems.*

(3) Understands basic engineering concepts relevant to HFE

- *Understands the principles of system theory relevant to HFE.*
- *Understands the role of humans in technological systems and understands the limitations of technology design.*
- *Demonstrates an understanding of the basic technologies common in human activities, for example, human-computer interaction.*

(4) Understands basic management concepts and practices relevant to HFE

- *Understands the basic principles of organisational management relevant to human performance and well-being, such as individual and organisational change techniques, including training, work structuring, shift work, and motivational strategies.*
- *Understands the terminology of management theory and has a basic understanding of management tools affecting performance and well-being, for example, quality management, employee engagement surveys, benchmarking.*
- *Understands productivity and how it is measured within enterprises, and the factors that commonly influence it.*

3.2. UNIT 2: HFE MEASUREMENT AND ANALYSIS SKILLS

HFE professionals may be specialised in only one or two application domains. This may limit their expertise in using measurement methods from other domains, however awareness of them is necessary.

(5) Applies a holistic systems approach to the analysis.

- *Understands the diversity of factors influencing human performance and quality of life within an organisation, the user, the planned or existing (workplace) environment, the tasks, the products used, and their inter-relationships, and has a holistic approach to assessing demands.*
- *Uses a systems approach for defining the task, tools or technology, environmental and organisational factors relevant to HFE projects.*

(6) Appropriately identifies the factors influencing health and human performance in a variety of contexts.

- *Can define user needs in terms of efficiency, safety, reliability, durability, health and comfort criteria, and ease of use of products, equipment and work organisation.*
- *Accesses sources of appropriate information and describes the scope of information required for assessment of relevant HFE factors.*
- *Uses activity analysis and participatory methods to ensure an understanding of work as it is really done rather than as it was imagined, prescribed or disclosed.*
- *Understands the impact of individual factors on other possible factors, such as the work team, and the implications for HFE assessment.*

(7) Analyses current HFE guidelines, national legislation international standards relevant to their professional activity.

- Refers to and applies relevant national and international recommendations and standards appropriate to the analysis.

(8) Demonstrates an understanding of methods of measurement relevant to HFE appraisal

- *Is familiar with common data acquisition, understands the type of quantitative and qualitative data required for HFE appraisal and knows how to explain the scientific or empirical rationale for the measurements selected.*
- *Demonstrates the ability to carry out appropriate surveillance and identification of the nature and magnitude of risks to well-being and productivity.*
- *Applies appropriate measurement procedures and has the expertise to use HFE measurement instruments effectively.*

3.3. UNIT 3: HFE EVALUATION SKILLS

(9) Appreciates the extent of human variability influencing design.

- *Understands the diversity in user body size, skills, physical and cognitive abilities, age, sensory capacity, motivations, general health and experience and can assess individual and collective requirements and risks.*

(10) Evaluates products or activities in relation to users and other stakeholder requirements.

- *Identifies all relevant stakeholder requirements*
- *Carries out a systematic, efficient and goal-orientated review of demands on people in their interactions with material, tools, equipment, technologies, environments and services.*
- *Appropriately evaluates how well user needs are met.*
- *Consults appropriately with all stakeholders regarding analysis and interpretation of findings.*
- *Specifies the indicators of poor match between people and their tools, equipment, technologies, environments and services.*
- *Demonstrates an understanding of the HFE principles of human-machine interface technology.*

(11) Identifies potential or existing high risk areas and high risk tasks and the risk of human error

- *Understands the concepts and goals of risk assessment and risk management.*
- *Demonstrates up-to-date knowledge of the local legal requirements relevant to safety and HFE design.*
- *Has a basic understanding of crisis management.*

3.4. UNIT 4: HFE RECOMMENDATION SKILLS

(12) Adopts a holistic systems view of HFE in developing solutions

- *Depending on the field of activity, recommendations may relate to organisational management, physical environment, tools, equipment, technologies, services or a combination of any of these.*

- *Prefers reasonable and justified adaptions of organizational systems and technical solutions to behavioral change solutions – adapting the work, workplace and tools to the human, rather than adapting the human to the work.*

(13) Outlines appropriate and scientifically valid recommendations for HFE design

- *Recognises those aspects of the problem and/or environment that are flexible and amenable to HFE intervention.*
- *Provides design specifications and guidelines for design or redesign based on HFE measurement and analysis.*
- *Applies relevant scientific theory and makes evidence-based recommendations.*
- *Considers alternatives for optimisation of the HFE quality, including short- and long-term goals.*
- *Considers the cost effectiveness of alternative solutions in terms of human well-being, improvement in productivity, and product usability, as appropriate.*

(14) Understands emergence and how to consider it within the designing process

- *Recognizes that all systems will display characteristics and operate in ways not expected or intended by the designer.*
- *Understands how to deal with emergent[2] system properties where human users are involved and develops strategies to achieve a healthy and safe human environment.*

(15) Understands the importance of a participatory approach to designing solutions

- *Recognises stakeholders needs, incorporating these, as appropriate, in the design process.*
- *Recognises that user participation increases the quality of developed recommendations and their acceptance and promotes their involvement.*
- *Can work in a team to achieve communal goals.*

[2] See glossary for a definition

(16) Understands that designing for all is rarely achievable and responds appropriately

- *Is aware of population diversity factors such as culture, age, gender, size, health status, etc.*
- *Is aware of the limits to the effectiveness of education and training in HFE solutions.*
- *Can develop appropriate HFE training programs, when necessary.*
- *Can generate appropriate personnel selection criteria based on HFE principles, when necessary.*

(17) Understands the hierarchies of control systems and design methodology for systems development

- *Uses the systems approach to integrated design for new or modified systems.*
- *Recognises the safety hierarchy, application of primary and secondary interfaces (controls and displays) and the order of introducing them.*

3.5. UNIT 5: HFE IMPLEMENTATION SKILLS

(18) Communicates effectively in a participatory manner with clients and other stakeholders at all levels and professional colleagues.

- *Discusses with the client, users and management the design or intervention strategies available, their rationale, realistic expectations of outcome, limitations to achieving outcome, and the costs of the proposed HFE plan.*
- *Engages stakeholders and establishes effective relationships and collaborates effectively with professional colleagues in other disciplines in the development of HFE design solutions.*
- *Uses appropriate processes to motivate the client to participate in the recommended HFE program.*
- *Where necessary, provides HFE guidelines for personnel in a form understandable to the user and other stakeholders.*

(19) Manages change efficiently and effectively

- *Uses a systems approach to integrate HFE with other design elements.*
- *Develops a balanced plan with priorities for risk control.*

- *Uses basic project management skills to steer the implementation of agreed measures and monitor progress.*
- *Understands the iterative nature of design development.*
- *Recognises the practicalities and limitations of applying HFE, including the introduction of change.*

(20) Provides appropriate feedback to the client and other stakeholders on findings and recommendations.

- *Documents activities and findings appropriately.*
- *Produces clear, concise, accurate and meaningful records and reports.*

3.6. UNIT 6: SCIENTIFIC SKILLS

The depth of research skills adapts to the desired future employment (academic versus practitioner).

(21) Understands and can apply the basics of data collection and analysis, including experimental methodologies and statistics

- *Has sufficient knowledge of statistics and research methods to assess the quality of a scientific research paper. More detailed knowledge is necessary if the HFE professional works in research.*

(22) Effectively evaluates the results of HFE design or intervention

- *Selects appropriate criteria for project evaluation, including user acceptance and customer satisfaction.*
- *Selects appropriate tools to measure the appropriate outcome criteria.*
- *Makes judgements on the quality and effectiveness of HFE design or intervention.*
- *Remains prepared to modify solutions in accordance with results of evaluation, where appropriate.*

3.7. UNIT 7: PROFESSIONAL SKILLS

(23) Shows a commitment to ethical practice and high standards of performance

- *Is aware of current international and/or national professional codes and standards of professional behaviour and behaves in a manner consistent with them.*
- *Demonstrates rational, critical, logical and conceptual thinking.*
- *Critically evaluates new concepts and findings in terms of human well-being, short and long-term.*
- *Respects the privacy of professional contacts and acts responsibly in terms of the social and psychological impact of HFE investigations.*

(24) Acts in accordance with legal requirements

- *Fulfils government legislation relating to occupational health, control of environmental hazards and other areas relevant to HFE practice.*
- *Takes appropriate action regarding industrial, legal and liability issues that impact upon professional HFE practice.*

(25) Recognizes personal and professional strengths and limitations

- *Shows willingness to consult and collaborate with others as part of a multidiciplinary team.*
- *Is aware of their own scope of practice and knows when to refer to another discipline or another HFE practitioner or researcher.*
- *Maintains contact with other HFE professionals e.g. networking opportunities.*

(26) Demonstrates lifelong learning, to ensure that HFE knowledge and skills are up-to-date

- *Maintains up-to-date knowledge of concepts, knowledge, procedures and strategies relevant to HFE practice.*
- *Regularly reviews and updates knowledge and skills relevant to current practice of HFE and the latest tools and methods relevant to HFE work, (ensures continuing professional development (CPD)).*

(27) Has a clear concept of professional identity and recognizes the impact of HFE on peoples' lives

- *Understands and can explain the "added value" of HFE.*

4. IMPLEMENTATION

4.1. COMMENTS ON THE ROLE OF APPLICATION DOMAINS

HFE professionals work in a wide variety of employment sectors and provide technical advisory services to clients with very diverse types of problems. The list of IEA Technical Committees (https://iea.cc/leadership/technical-committees/) gives an indication of the current range of practice across economic sectors. These Technical Committees are formed as platforms to exchange up-to-date information and facilitate professional discussion. Although each sector has a set of unique issues, measurement methods and intervention strategies, the core competencies of HFE professionals working on (or in) them remain essentially the same.

Economic sectors for which the IEA has a current Technical Committee

- *Aerospace HFE*
- *Agriculture*
- *Building and Construction*
- *Ergonomics in Manufacturing*
- *Healthcare Ergonomics*
- *Ergonomics for Children and Educational Environments*
- *Mining*
- *Transport Ergonomics and Human Factors (TEHF)*

4.2. EXAMPLES OF APPLICATION IN CERTIFICATION SYSTEMS

The HFE profession is relatively new vis-à-vis its older founding disciplines and the emphasis in education and practice changes according to developments in the workplace and society. For this reason, the IEA does not wish to be too restrictive in defining the educational content, however, the question is often raised, about how much education is required and what depth of knowledge is expected. This section attempts to provide some examples that may be used as a guide.

In general, to achieve adequate education as a HFE professional a full year of dedicated HFE academic education is considered necessary. This is generally taught at post-graduate level, where substantial basic knowledge has been acquired in relevant undergraduate studies. HFE professionals come from a wide variety of academic disciplines including engineering, psychology, biophysical, medical, environmental and social sciences. The HFE education provides additional basic knowledge in disciplines that were not covered in undergraduate studies and goes on to teach the methods and theory of the HFE discipline.

The following examples of the implementation of the IEA Core Competencies into certification systems may be useful for course designers and people setting up new regional certification systems for HFE professionals, as they indicate the weighting of each area of expertise and the expected training hours in different areas of the world.

The Board of Certification of Professional Ergonomists BCPE, based in the USA, requires 360 contact hours and three years of professional experience. Further details are available at https://www.bcpe.org/why-certify/core-competencies/).

CATEGORY	Academic Credit Hours (Semester)	Academic Credit Hours (Quarter)	CE Credit Hours*	Contact Hours**
A. Basic Principles	3	4.5	4.5	45
B. Core Background	6	9	9	90
C. Core Methodology: Analysis & Design of Processes & Products	6	9	9	90
D. Application of Analysis, Design, Validation & Implementation	8	12	12	120
E. Professional Issues	1	1.5	1.5	15
Total	**24**	**36**	**36**	**360**

****Note:** Each semester credit hour requires 15 contact hours. A CE credit hour is equivalent to one quarter credit hour and both require 10 contact hours. One semester credit hour is equivalent to 1.5 quarter or CE credit hours.

The Centre for Registration of European Ergonomists (CREE) uses European Credit Transfer and Accumulation System units (ECTS), the standard academic units in all of Europe. One ECTS is considered equivalent to 10 contact hours (or 30 hours of total workload). CREE certification requires at least 600 contact hours (60 ECTS) dedicated to HFE education (and three years of practice experience).

Area of Knowledge	**Level of competence**
A. Principles of Ergonomics (min. 2 ECTS)	The candidate is able to integrate his or her knowledge of the definition, aims and approach of ergonomics into work activities.
B. Populations and General Human Characteristics (min. 2 ECTS)	The candidate has a basic understanding of fundamental human physiological and psychological characteristics and can analyse problems taking them into account.
C. Design of technical systems (min. 2 ECTS)	The candidate has a basic understanding of fundamental engineering principles and systems design and can solve problems taking them into account.
D. Research, evaluation and investigative techniques (min. 2 ECTS)	The candidate can evaluate results using appropriate statistical methods and instruments and is able to evaluate the quality of ergonomics research reports written by other people.
E. Professional Issues (min. 2 ECTS)	The candidate knows the laws and standards that are applicable to his or her work and can synthesise this knowledge into his or her recommendations. The candidate understands the ethical requirements and limits of his or her work and can reflect on his or her activities using this knowledge. The candidate can communicate his or her professional knowledge effectively to other people and synthesise his or her knowledge into comprehensible and legally adequate project documentation.

<table>
<tr><th>Area of Knowledge</th><th>Level of competence</th></tr>
<tr><td>F. Ergonomics: Activity and/ or Work Analysis (min 2 ECTS)</td><td>The candidate knows the methods for conducting an activity or work analysis and is able to choose an appropriate method, reflecting on its strengths and weaknesses.</td></tr>
<tr><td>G. Ergonomic Interventions (min 2 ECTS)</td><td>The candidate understands the theoretical aspects of designing and evaluating appropriate ergonomics intervention projects.</td></tr>
<tr><td>H. Ergonomics: physiological and physical aspects (min. 2 ECTS)</td><td rowspan="3">The candidate must have a basic knowledge across all areas H, I, and J (each with a minimum of 2 ECTS per item).

At least 48 ECTS must be in F, G, H, I and J: This includes a minimum of 2 ECTS and a maximum of 20 ECTS for the practical project.

Where a candidate is specialised in one knowledge area (H,I or J), he or she should have enough knowledge and understanding of the other areas to take appropriate action when problems arise relating to them.</td></tr>
<tr><td>I. Ergonomics: psychological and cognitive aspects (min. 2 ECTS)</td></tr>
<tr><td>J. Ergonomics: social and organisational aspects (min. 2 ECTS)</td></tr>
</table>

4.3. RECOMMENDED HFE SYSTEMIC TOOLS

The following tools are recommended to support the systemic approach to HFE interventions.

Cognitive Work Analysis (CWA) is a framework that was developed to model complex sociotechnical work systems. The framework models different types of constraints, building a model of how work could proceed within a given work system.

ACCIMAPS : A systems-based technique for accident analysis, specifically for analysing the causes of accidents and incidents that occur in complex sociotechnical systems. The approach was originally developed by Jens Rasmussen[1] as part of a proactive risk management strategy.

Systems Theoretic Accident Model and Process (STAMP),

Networked Hazard Analysis and Risk Management System (Net-HARMS)

Event Analysis of Systemic Teamwork (EAST).

5. GLOSSARY

The following set of terms is based on the United Kingdom Chartered Institute of Ergonomics and Human Factors (CIEHF) list of knowledge areas. It has been expanded to include definitions of terms used in the IEA Core Competences.

Abnormal environments: The norms, properties and effects of unusual and extreme environments on human biology, psychology and task performance.
Affective design: Designing to produce emotional responses in users, generally to steer behaviour towards specific outcomes.
Ageing: Effects of the ageing process on physical and cognitive capabilities and wellbeing.
Anatomy: The structure of the human body and how this affects physical performance, function, risk of trauma and wellbeing.
Anthropometry: Data collection and application of human body measurements.
Attention: The theories relating to the way in which people attend to and process information, and knowledge of common limitations.
Auditory environment: The norms, properties and effects of the auditory environment including noise, reverberation and sonics on human biology, psychology and task performance.
Behaviour and attitudes: The theories relating to influences and processes affecting attitudes and behaviours.
Behavioural safety: The attitudes and behaviours related to safety, together with the theories and principles that are involved in creating safe behaviours.
Biomechanics: The mechanics of force transmission and movement in the human body.
Change management: The factors and methods involved in the management of change within organisations.
Cognition: The mental actions or processes used to acquire knowledge and understanding through thought.
Communication: The relationships and behaviours associated with person-to-person or group communication, both at an individual and organisational level.
Communication systems: The mechanisms and methods used (including spoken, written and pictographic) and problems involved in person-to-person and person-to-group communications.
Culture: The ideas, behaviours, attitudes, and traditions that exist within groups of people and organisations.

Data collection and analysis: The methods used to collect and analysis data to ensure validity and accuracy.
Decision making: The cognitive processes and biases involved in selecting a course of action or opinion.
Disabilities and vulnerabilities: The effects of physical and cognitive disabilities and vulnerabilities on work performance.
Emergent properties: Understanding properties or behaviors which emerge only when the parts interact in a wider whole. Dealing with unanticipated outcomes of an intervention or design process, that may not be predicted from the individual parts.
Ethics: The principles, moral values and safeguards involved in undertaking HFE activities, in particular with regard to the people involved, whatever their role.
Experimental design: The development, design, conduct, data management and analysis of experiments.
Evaluation of work activities: The methods involved in collection and analysis of data obtained from observing people in their work environment and their limitations.
Focus groups: A method of information elicitation through group discussion.
Group behaviour: The dynamics, interactions of groups and the factors that influence group performance.
Human auditory system: The mechanisms and problems involved in the perception of sound and the faculty of hearing.
Human computer interaction: The design, evaluation and implementation of interactive computing systems for human use.
Human machine systems: The design, evaluation and implementation of interactive machine systems for human use.
Human reliability and error: Human failure types and the identification and assessment of performance shaping factors that influence human reliability, and knowledge of measures to prevent/reduce human failure.
Human visual system: The mechanisms and problems involved in the perception of light and the faculty of sight.
Job design: The factors relating to jobs and work and their relationship with organisational, social and personal requirements.
Job satisfaction: The attributes of job design that influence an individual's fulfilment at work.
Knowledge elicitation: The principles and methods to capture tacit knowledge explicitly, by interacting directly with individuals, teams and organisations,

through focus groups, interviews, observation, role playing, surveys and workshops.

Leadership: The psychology underpinning the skills required to influence and lead teams to achieve successful outcomes.

Learning: How individuals acquire new, or modify existing, knowledge, skills and attitudes through experience, study or training.

Manual handling: The nature of manual handling tasks, the risks involved (e.g. fatigue, musculoskeletal disorders and injury) and how these risks may be avoided or mitigated in line with manual handling regulations.

Measurement techniques: The principles and practice of making measurements to obtain valid, accurate and reliable data.

Mechanical environment: The norms, properties and effects of the mechanical environment including vibration, shock, jitter, high/low and changing g-forces on human biology, psychology and task performance.

Memory: The cognitive processes involved in acquiring, storing and recalling information in the short and long term.

Motivation: The processes involved in attention, enthusiasm and positive attitudes towards an activity.

Musculoskeletal disorders (MSDs): The effects of physical activity on musculature and the skeleton, and knowledge of common disorders.

Organisational change: How organisations change their processes, arrangements, culture and behaviours.

Organisational learning: The methods and theories of how an organisation learns and adapts to change.

Perception: The mechanisms by which people sense, process and interpret information through their senses.

Physiology: The processes and functions of the human body.

Product design: The methods involved in the design, development, testing and use of products.

Process analysis: The methods to analyse the inputs, outputs and operations that together form a process.

Psychological stress: The factors that influence a person’s state of arousal and knowledge of the effects of stress on an individual, knowledge of the symptoms and measures to manage stress.

Psychometrics: The methods of testing and assessing an individual’s mental ability and personality.

Psychophysics: The relationship between, and measurement of, physical stimuli and an individual’s sensory response/perceptual processes.

Questionnaire and interview design: The development, design, administration and scoring of questionnaires and interviews to obtain valid and accurate data.
Repetitive strain injuries: The causes and symptoms of RSI and knowledge of measures to remove or reduce its effect.
Safety culture: The values, attitudes, perceptions and behaviours exhibited by an organisation with regard to safety.
Shiftwork: Chronobiology and the effects of shift and other working patterns on human biology, psychology and task performance.
Situation awareness: How an individual and/or group perceives a physical/cognitive real-time situation, how situation awareness changes, how this awareness influences decision making, and how it may be measured, modelled and assessed.
Socio-technical systems: The interactions between social and technological systems and their effects on human biology, psychology and task performance.
Statistics: Statistical theory and practice, including methods to collect, classify, analyse and interpret qualitative and quantitative data to derive numerical information.
Supervision: The attributes required for effective leadership of a working team or group.
System engineering: The methods and processes in the design and management of complex human-engineering systems.
Task analysis: The methods used to represent tasks in a structured manner and to describe the physical and mental activities of those tasks.
Team work: The principles of team working covering issues such as person-to-person interaction, team leadership and supervision.
Thermal environment: The norms, properties and effects of the thermal environment including temperature, humidity and air movement on human biology, psychology and task performance and how to apply this knowledge.
Training and competence: The methods that enable an individual to increase their knowledge, skills and abilities and knowledge of methods to manage training and competence at work.
User centred design: The methods and processes that focus on the end user through the design life-cycle.
User experience: The methods and processes that design for and assess the total user experience (including usability, user feelings, motivations and values) with respect to products and services.
Visual environment: The norms, properties and effects of the visual

environment including light level and flow, glare, strobes and flicker on human biology, psychology and task performance.

Workplace design & assessment: The design and assessment of the physical workspace.

Workload: How an individual and/or group is affected by physical or mental workload, especially overloads, and knowledge of techniques and constraints relating to its measurement.

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