A Systematic Approach to Ergonomics and Human Factors: Growing both the Field and Business

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Abstract:
While humanity and ergonomics' promising future in informing the design of human-centered systems across all domains (work systems, product/service systems, etc.), the field is still lagging behind in terms of market readiness and the availability of high-quality applications. First, HF is design driven; second, it takes a systems approach; and third, it prioritizes two interconnected outcomes: performance and well-being. These three features make it stand out. It is imperative that HF improves its value demonstration to the key stakeholders in system design if it wants to be included in future system designs. When it comes to the stakeholder group of "system actors" (workers and product/service users), HF already has a solid value proposition (mostly well-being) and interaction. Value propositions (primarily performance-based) and stakeholder relationships with "system experts" (managers and other decision makers involved in system design, purchase, implementation, and use) and "system decision makers" (experts from the natural and social sciences who are involved in system design) are necessary, though. Consequently, the primary objective is to engage influential stakeholders in a conversation about the importance of high-quality HF via education, collaborations, and communication in order to raise demand for such HF. Encouraging the education of HF experts, assuring high-quality standards of HF applications and specialists, and supporting HF research excellence at universities and other organizations are all part of the second primary strategic objective, which is to enhance the application of high-quality HF. For this plan to work, the HF community as a whole—including the IEA, state and regional HF organizations, and individual HF experts—must work together. We suggest the IEA play a leading role in a global HF development strategy that we have jointly proposed.

A Brief Overview for Professionals:
When it comes to labor and product/service systems, human factors/ergonomics offers a lot of solutions to big social and commercial problems. HF has untapped potential, nevertheless. To help the HF community increase the demand for and use of high-quality HF, this paper lays forth a plan with three main points: a systemic view, design-driven approaches, and performance and well-being ambitions.

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1.0 Introduction:

Considering the expressions ergonomics and human factors interchangeably, this article lays forth a plan for the future of the field and career known as human factors and ergonomics (HF). This document details the conclusions reached by the Future of Ergonomics Committee2, a group the International Ergonomics Association (IEA) formed in December 2010 and which presented its findings during the 18th Triennial World Congress on Ergonomics, IEA2012, in Brazil. The committee's mission was to provide the HF community with a position paper outlining their hopes and dreams for the field's and profession's future. Over the course of HF's fifty years in existence, several articles have addressed the topic of ergonomics' potential future. Some recent examples are special issues in journals like Ergonomics (Stanton and Stammers 2008) and Theoretical Issues in Ergonomics Science (Hollnagel 2001). In terms of anticipated changes and impacts on the content of the discipline or on certain locations, the majority of publications foretell the future of ergonomics for particular HF topics. On the other hand, this article is all about a plan to boost HF internationally so that it can compete at the highest level on a global scale. There is no actionable approach for putting this plan into action in the document.

Members on the group as well as experts in the field of HF presented and debated their perspectives in order to formulate a plan for the field's future. In addition to virtual sessions, the committee met in person in Amsterdam in March 2011, Paris in June 2011, and Grahamstown, South Africa in April 2011 to discuss ideas with members of the IEA council. You may see a list of individuals who contributed input in the Acknowledgements, but we also interviewed and emailed many more HF experts from across the globe to get their thoughts. The committee has gathered a lot of material on HF's future, but neither that material nor a literature study formed the basis for the opinions presented in this article. But we bolstered it with citations for the sake of clarity and further reading. This document conveys the committee's concluding opinion. Western academics with strong worldwide experience and a track record of close collaboration with practitioners and customers across all sectors of business make up the bulk of the committee. Neither the HF community nor the IEA necessarily consider the opinions expressed in this text to be representative of their consensus. Anyone may access the information and use it to create new plans, tactics, and operations for their particular situation. This includes the IEA and local HF organizations.

This study begins with the premise that HF has the ability to optimize performance and well-being by shaping any created artifact from consumer goods to organizational environments—around persons' talents and desires. Failure to include HF into system design may result in less-than-ideal

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systems that suffer from quality issues, decreased efficiency, unhappiness, disease, etc. These issues have remedies that HF can provide. But the potential of HF is still being fully used. There are a minimum of four explanations. First, there is a lack of demand for HF since many stakeholders (e.g., customers, workers, managers, other professionals, society at large) are unaware of its worth. This is true throughout all stages of an artifact's lifecycle. Second, design processes often fail to incorporate sufficient high-quality HF due to a lack of HF or an overly narrow application of HF, leading to less-than-ideal solutions in contexts where HF is required (e.g., "ergonomic products" in product marketing or "ergonomic systems" in safety-critical industries like healthcare, transportation, oil, and defense). Third, there isn't much of a presence of the HF field due to its relative smallness compared to other well-established fields that deal with artifact design, such as engineering and psychology. Finally, HF's strength its multi-disciplinary foundation—may also be its downfall: the field's members come from many walks of life and have different perspectives on many issues, which may lead to muddled messages when communicating with outside parties.

We begin by outlining the essential features of HF in Section 2 so that we may formulate a plan for the HF field and career. Next, we determine whether external events are relevant to HF in Section 3. The next step is to determine how the key players in the system design may benefit from HF. In Section 5, we lay out our vision for where the HF field should go strategically, and in Section 5, we go over some key steps the HF community should do to ensure the field's continued success.

2.0 The essential characteristics of the HF field as well as employment

HF concentrates on technologies involving human interaction in the environment. The atmosphere is multifaceted, including the physical, organizational, and social aspects. These include physical elements, the structure and regulation of activities, and interactions with other individuals and culture (Moray 2000, Wilson 2000, Carayon 2006). The system may be classified as a labor system, where the human functions as a worker within a specific environment, or as a product/service system, where the human is a consumer of a product or recipient of a service within a particular environment.The main goal of Human Factors is to enhance both performance and well-being by enhancing the overall design and by better incorporating humans into the system. This is achieved by adapting the environment to suit human needs. HF usually adopts a hierarchical strategy prioritizing environmental design to suit human needs. The selection of individuals to match the environment or training them to adapt to the system is only regarded as a secondary option. Optimal environmental conditions enhance human performance. In the last 50 years, the HF community has accumulated a significant amount of information and expertise on human-environment interactions, as well as methods for analyzing and creating systems.

The concept of HF and HF experts, as established by the IEA in 2000, include a specific body of knowledge outlined in the IEA publications of 2000 and 2023.

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Ergonomics, also known as human variables, is an area of research that focuses on examining how people connect to different components of a system. It is a profession that uses theoretical ideas, data, and methodologies to design in a way that enhances well-being and achievement.

"The ergonomics profession as well as practitioners about ergonomics work to ensure that all aspects of human work—including jobs, products, technologies, processes, organizations, environments, and systems—are considered in a way that takes human capabilities, limitations, and wants into account throughout the entire design, development, testing, and improvement the method."

The aforementioned explanations lead to the derivation of three important HF features

- ❖ HF employs a systems perspective.
- ❖ HF relies on appearance.
- ❖ HF emphasizes both success and happiness as two associated goals.

2.1 HF employs a systems perspective.

A framework consists of many interconnected, mutually reliant parts that work together to generate a cohesive whole. HF is concerned with intentional and goal-oriented systems that include people and their surroundings (Helander 1997, Schlick 2009). The term "environment" refers to any human-made object, including other people as well as the place, tool, product, technical procedures, service, software, built environment, task, and organizational design (Wilson 2000). HF takes into account several facets of the environment (physical, social, informational, physiological, psychological (affective and cognitive), and physical elements of the individual. From micro (e.g., humans using tools or performing single tasks) to meso (e.g., humanity as part of technological systems or organizations) to macro (e.g., human beings as part of connections of organizations, nations, regions, or worldwide), it can address issues on various system levels (Rasmussen 2000). System boundaries are established when defining issues and developing solutions. The focus of HF can be on particular characteristics of individuals (e.g., only physical characteristics), on particular characteristics of the environment (e.g., only workplace characteristics), or on a particular level (e.g., micro). However, the larger context of the human within the environment is always taken into account ('contextualization'). We might refer to this wide understanding of HF as a "holistic approach" or a "systems approach." HF is different from other more limited disciplines like cognitive psychology and behavioral science (Brewer and Hsiang 2002). The aforementioned other disciplines may share a human view with HF, but not a comprehensive view. This is because of the systems or general approach of HF as well as its broad (almost unlimited) background for implementation.

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2.2 HF relies on appearance.

HF aims to enhance both productivity and wellness by designing systems. Insights and evaluations lead to suggestions and actions for this design. Human Factor may play a role in every aspect of the process from planning to ongoing development of systems, as stated by the Japan Ergonomics Society in 2006. The phases are not always in a certain order; they are interconnected, interdependent, and always changing, with design being central to them. Decisions made at one point in the process may influence or be influenced by decisions made at later points. Human Factors and Ergonomics professionals may actively engage in design processes, including those who will be using the system in the development process as participants (Noro and Imada 1991). Human Factors and Ergonomics (HF) professionals may fulfill several job functions. For instance, they may serve as experts on the human aspect of the system. The human component encompasses both individual and communal factors, ranging from micro to macro levels. HF practitioners are skilled in analyzing and responding to situations, designing and evaluating technical and organizational environments, organizing and overseeing participatory approaches, and redesigning and enhancing systems continuously (Woods and Dekker, 2000). HF professionals collaborate with other contributors to analyze and resolve difficulties in order to design, as stated by Noy (1995) and Rasmussen (2000). They may contribute to design choices by using their expertise in design, which encompasses the mental processes of design contributors and collective interaction processes. Moreover, they may influence and oversee design procedures by translating technical jargon or ideas into user-friendly language and vice versa. The design focus of HF sets it apart from fields like sociology and anthropology. These other fields may have a similar holistic perspective as HF, but they may not have the same practical approach (Helander 1997).

2.3 HF emphasizes both success and happiness as two associated goals.

Adapting the environment to suit human needs can lead to two main results: enhanced performance (such as efficiency, efficacy, quality, alongside innovation) and improved well-being (including health, safety, satisfaction, and personal growth). HF experts balance various outcomes, including both practical and ethical trade-offs inside systems, as discussed by Wilson et al. in 2009. Performance and well-being have a reciprocal relationship where one may impact the other in both the short and long term.

Decreased performance and overall well-being may result from a mismatch between the environment and human talents and desires. Humans may not reach their full potential owing to obstacles within the system, such as time constraints, inadequate equipment, or lack of support (Falzon 2005, Falzon et al. 2012).

Well-being and performance are closely linked and should be seen as highly interconnected (Pot and Koningsveld 2009). HF acknowledges that every system generates two results:

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performance and well-being. HF may help optimize joint results by adapting the environment to suit human needs (Neumann and Dul 2010). The emphasis of Human Factorson two simultaneous outcomes is a distinguishing feature. Engineering, psychology, and medicine concentrate on one result like HF, rather than on both objectives.

3. 0 Modifications in the natural globe (broadly summary)/ Or Developments in the external world

Global trends are significantly affecting systems. To formulate a future plan, it is necessary to identify these advances and their relevance for HF (Hendrick 1991, Noy 2000, Japan Ergonomics Society 2006). We explain some worldwide trends related developments that effect HF, without trying to be exhaustive.

3.1 International shift in employment structures

The developments in the worldwide economy over the last ten years have caused big changes in the kinds of work that people do in different parts of this globe. The economies of both monetarily developed and emerging countries have gone through these changes. In past centuries, countries with strong economies have made a lot of mass-produced things. But in the last 20 years, these countries have sent more and more industrial and service jobs to economically growing countries. This is because of the global market and supply chain. This has changed the focus of work in economically developed countries to a service economy, which includes even healthcare services. As a result, there is more attention on designing work systems for service production as well as non-work systems like customer services and human-computer interactions (Drury 2008, Hedge and Spier 2008). Also, encouraging people to become traders has led to more small and unofficial businesses opening up in some economically developed countries. At the same time, countries that are still building their economies have grown their production bases, which has led to more jobs. Because of this, work that used to be built on local farming is now more focused on industry, often without the HF perks seen in economically developed countries. People who work for low pay and in bad conditions often make things. Due to the low cost of making things, there are big rises in industry. In many of these countries that are still building their economies, there is also a rise in low-paying service jobs, like those in call centers and banks. In some countries, though, the informal sector has the most workers (Caple 2008), and agriculture is still the main industry that helps the country's economy. Sometimes, children work in agriculture for very little or no pay (Gangopadhyay et al. 2004). Not only in manufacturing but also in the service business, there is a steady movement toward mechanization and automation of work processes (Schlick 2009). The development of more technological advances and improved

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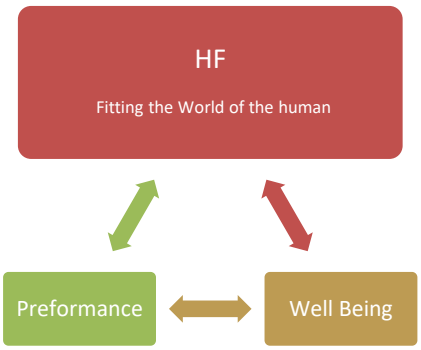

Figure 1 illustrates how the HF style affects efficiency as well as happiness.

3.2 The variety of cultures

One major impact of the trends described above have led to a significant rise in connections across economies, sectors, and organizations globally. Production and distribution systems are globally structured with a culturally diversified workforce. Products and services are used by a growing variety of clients in marketplaces worldwide. A variety of individuals with varying cultural origins, qualities, and goals have integrated into labor and product/consumer systems. Environments tailored for one demographic may not suit other demographics.

HF can tackle the increasing cultural variety by participating in the international development of manufacturing and marketing processes that suit the varied workforce, and in the cross-cultural design of goods and services that cater to the diversity of consumers (Moray 2000, Japan Ergonomics Society 2006). Cross-cultural design recognizes that individuals from many cultures possess varying talents and goals that impact the design of systems they are involved in. Examples include of the development of worldwide supply networks by Riedel and Mueller in 2009, and the creation of international digital media by Proctor et al. in 2011.

3.3. Age-related

Alteration in the population is occurring in several regions due to increased life expectancy, decreased birth rates, and the aging of the big 'baby boom' group. In the USA, the workforce is aging, but in Europe, the share of older individuals in the working populations of European nations is rising more significantly compared to other continents. India has lately increased the retirement age for office and industrial workers. Therefore, a significant number of elderly individuals have integrated into employment and product/service systems. Environments tailored for the present population may not be ideal for the elderly inside the system. As people age, there is a growing importance of equipment, furnishings, IT devices, services, etc. designed for and tailored to the needs of the older workforce.

HF may help by ensuring that work systems and products/services are tailored to meet the needs of the older population, including age-related changes in physical, cognitive, visual,

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and other capacities, as well as diverse ambitions (Japan Ergonomics Society 2006). Elderly individuals may experience some decline in some talents, but they also possess enhanced skills such as cognitive development (strategic thinking, linguistic proficiency, drive, dedication, professional experience) and certain social skills (adaptability in behavior). Nevertheless, significant differences exist within older age cohorts, and these differences seem to intensify with advancing age (Ilmarinen 2005).

HF can assist in creating more adaptable systems that are more suitable for a diverse variety of populations. This method is applicable not just to individuals of various age groups but also to those with disabilities, obesity (Buckle and Buckle 2011), or differing talents and goals ('design for all'). Nevertheless, this pattern of deteriorating is not universal. Life expectancy is decreasing in regions like Sub-Saharan African nations due to a significant portion of the population being affected by HIV and associated diseases. These nations prioritize developing a sustainable workforce that aligns with the demands of the employment market.

3.4 Technological associated with information and communication (TIC)

Various ICT-related developments influence how work and everyday activities are carried out (Karwowski 2006). Advancements in technology for computers, communications technology, and media technology have led to the emergence of interactive activities like social media and gaming, as well as a significant increase in information exchange. Individuals' lives are increasingly reliant on information and communication technology (ICT) and virtual networks. These advancements influence the provision of education. New aspects of the item's quality, this emotional design and enjoyable encounters, have become important in addition to usability.

Advancements in ICT have led to several alterations in work organization and organizational structure. The changes mentioned include an increasing emphasis on cooperation, the emergence of virtual organizations, remote work such as working from home, blurred lines between work and personal life, and a growing complexity in organizational networks (Carayon and Smith 2000).

Organizational networks have developed as a paradigm to facilitate cooperation across organizations with shared objectives. Organizational networks often depend on technology for communication and information sharing, such as supply chains in manufacturing. A separate instance is the conveyance of health data, which makes it feasible for different healthcare organisations to interact with patient information.

Companies are increasingly depending on virtual agreements to run their operations. Virtual sociotechnical systems include a variety of individuals who are spread out geographically

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and use information and communication technology to carry out their job from a distance (Gibson and Gibbs 2006).

HF professionals may assist in designing systems that facilitate collaboration and information sharing across organizational boundaries (Woods and Dekker, 2000). HF may impact the design of virtual sociotechnical systems by demonstrating how trust and cooperation can be improved when team members work remotely and communicate via technology (Patel et al., 2012). HF may aid in designing natural user interfaces for human-computer interactions.

3.5 Rising rivalry and demand for inventiveness

Growing rivalry due to globalization has compelled corporations to create novel company tactics and prioritize innovation in developing new goods, services, and production methods. Employees may provide input for improving manufacturing processes and products/services. Production processes must be more efficient and adaptable to provide quick product delivery periods, typically leading to increased labor intensity. For products and services to succeed in the market and obtain a competitive edge, they must include high-quality attributes that go beyond mere functioning, such as simplicity of use and good customer experiences.

HF may enhance the development of company strategy and innovation in multiple manners (Dul and Neumann 2009). HF can enhance staff creativity to drive innovation, contribute to product/service innovation by creating new products and services with distinctive usability and experience features, and assist a company in innovating processes and operations by introducing more efficient and effective methods of producing goods and offerings.

3.6 Sustainable development and CSR

Sustainability involves meeting current needs without jeopardizing the capacity of next generations to satisfy their own requirements. It encompasses physical and environmental assets ('planet'), human and social resources ('people'), and economic sustainability ('profit'). It suggests that corporations consider more than simply financial success. Corporate Social Responsibility (CSR) involves beyond the basic legal requirements related to environmental and social aspects. Inadequate health and safety standards may harm a company's reputation in terms of Corporate Social Responsibility (CSR), posing a direct risk to the value of CSR initiatives and the sustainability of the business. HF may help create initiatives and strategies that integrate the human and financial aspects of sustainability and social responsibility to enhance both efficiency and welfare (Pfeffer 2010, Zink 2005, 2006).

In several economically growing nations, comprehending the human factor necessitates knowing intricate social and cultural contexts. In South Africa, the workforce often encounters challenges including HIV, cardiovascular disorders, other infectious diseases,

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and deliberate violence. These concerns impact the population's ability to work. Specialists in Human Factors and Ergonomics in these nations play a crucial role in enhancing both performance as productivity, and well-being.

Ultimately, the aforementioned examples demonstrate that systems evolve in response to changes in the human component, the environmental component, or both. HF has the ability to enhance the conception of new systems by providing its core characteristics.

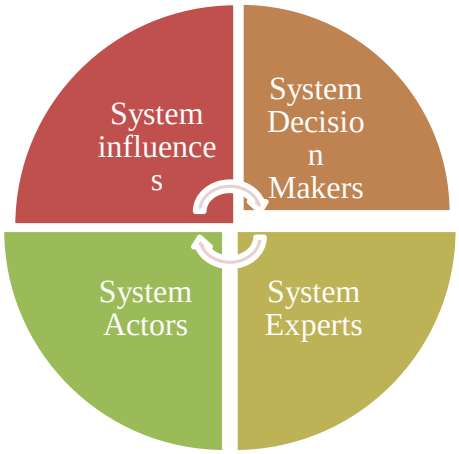
4.0 The importance of Human Factors Management for stakeholder

The influence of Human Factors on system design is determined by the level of interest in HF from stakeholders participating in the design process. The demand for Human Factors is influenced by how stakeholders engaged in system design perceive its worth. In order to be a recognized and sought-after partner in the design process, HF must demonstrate its ability to give worth to stakeholders.

This section begins by identifying the primary stakeholder groups for system design. We will now explain how stakeholder groups might benefit from the use of Human Factors(HF) in systems design. We will assess the alignment or discrepancy among the potential , perceived, and delivered value of HF.

4.1 System development stakeholder

Four primary stakeholder categories during the development of systems could be acknowledged:



Researchers identify four layers of stakeholders per every major stakeholder collection: person (direct stakeholder), firm, country/region, and global (direct stakeholders). A stakeholder at a higher level, such as a nation, may represent a stakeholder at a lower level, such as a firm. Table 1 provides a detailed description of instances of stakeholders from the primary stakeholder categories who are directly or indirectly engaged in or impacted by

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systems design. We have designated the HF specialist as one of the 'system experts' for reference.

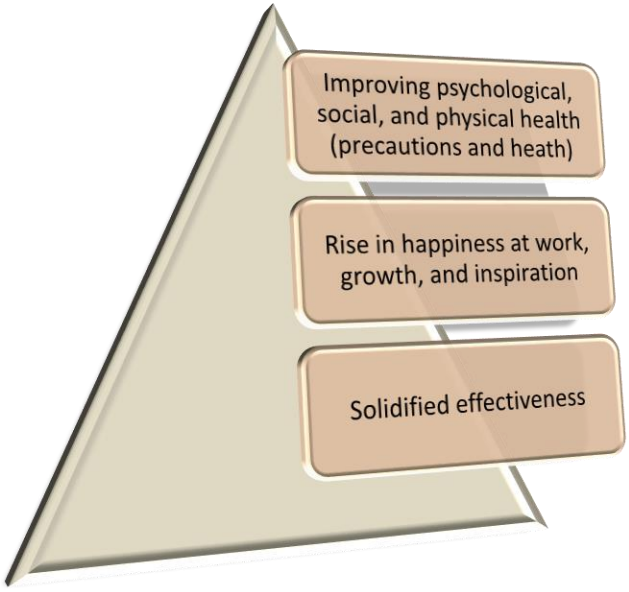
Individuals may be affiliated with various stakeholder groups based on their respective roles. Employees who constitute a component of a work system are considered system actors. Yet, they acquire expertise in the system by their involvement in the redesign process. Managers who make decisions on system designs are considered system decision makers. Once the systems are put into operation and the managers have management responsibilities inside the newly designed structures, they are then classified as system participants.

4.2 The stakeholders' assessment of HF's performance

The next section outlines the significance of HF contributions to the development of systems for multiple stakeholders, including people and their representative organizations at the business, national, and worldwide levels.

4.2.1 performers in the framework

This community of stakeholders consists of those involved in workplaces (employees) and those engaged in product/service systems (goods and services users, service recipients). Employees may get advantages from Human Factors(HF) in designing work systems since it guarantees wellness, including:



Beneficiaries of goods and offerings can derive advantages from HF development of structures, which guarantees efficiency and health in respect of, for instance:

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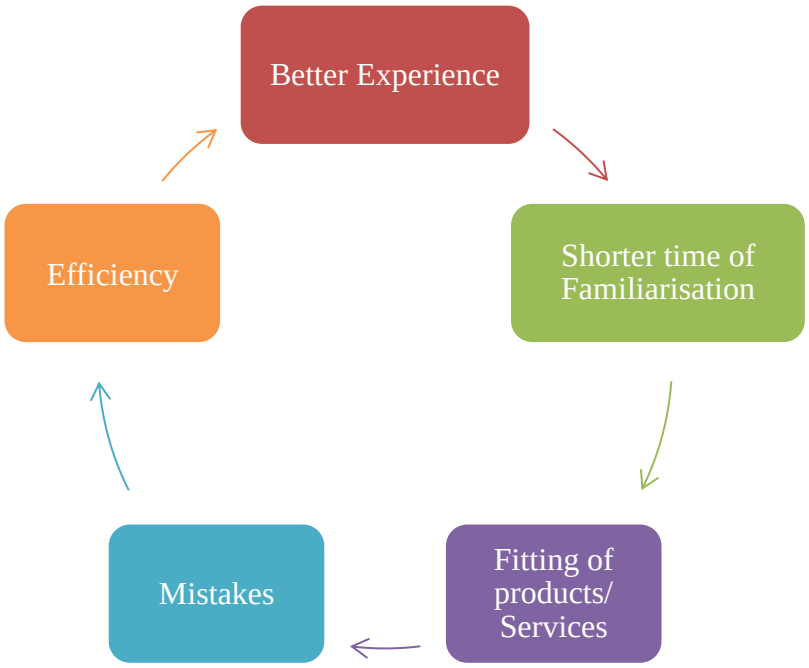

4.2.2 The system professionals

The stakeholder community comprises individuals with expertise in the scientific and social fields, including but not limited to (industrial) a career in engineering information technology/computer sciences, psychology, leadership consulting services, interior design, architecture, facility management, operations management, and human resource management. Their contributions may be instrumental in the design process of systems. The objective of these experts is to develop a system that operates efficiently in accordance with the criteria set forth by system decision makers and the standards of their respective fields. HF helps to achieve these objectives by ensuring the following through its contributions as well as

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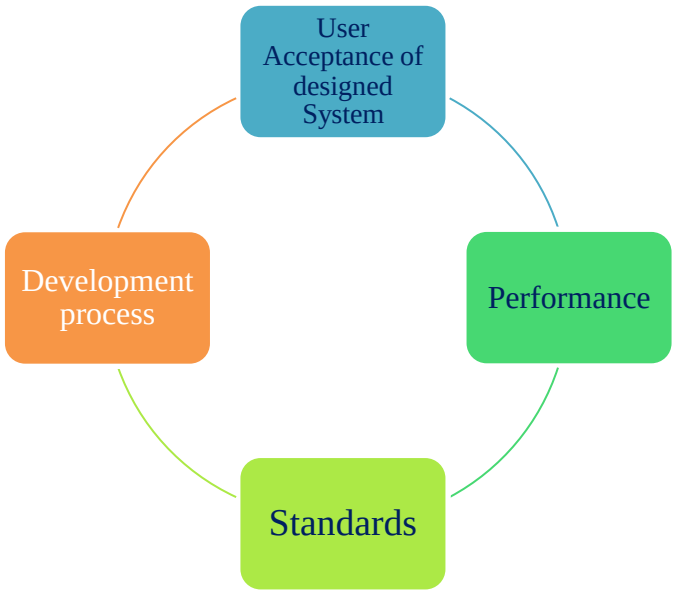

4.2.3 Managers systemic determinations

The stakeholder community comprises administrators such as administrators and buyers who determine the design aspects, such as requirements and ultimate design, of work systems and product/service systems. Management in firms strives to ensure optimal efficiency for work processes while minimizing the consumption of resources. Common key performance indicators for work systems include productivity (output per unit of time), job completion time, and the quality of the product or service.

HF offers beneficial to administrators in organizational structures since it guarantees achievement when it comes of, for example:

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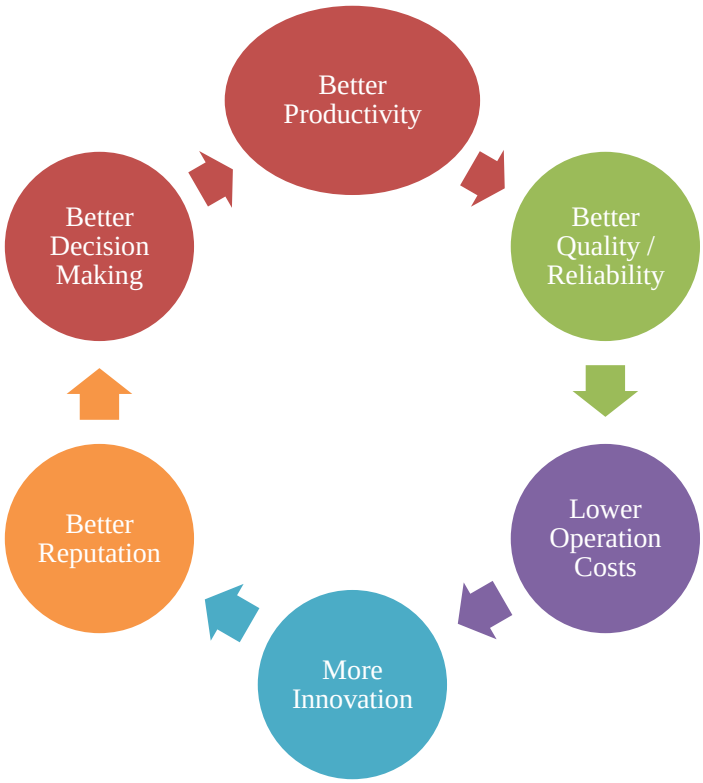
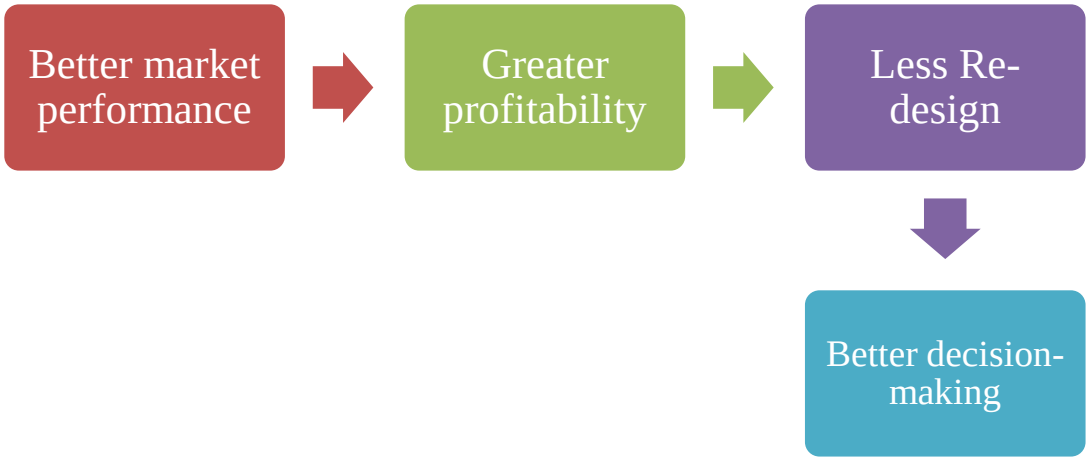


Administrators may benefit through Human Factors Research (HFR) design since it guarantees product/service reliability.



4.2.4 Influencers inside the framework

Systems influences are interested in the results of work and the goods or services platforms due to their audience's relevance. HF may contribute concurrently to two overarching objectives:

- Societal wealth of people and society as a whole, achieved via the well-being achievements of Human Factorssystem planning.

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- ❖ The financial stability of individuals and the community as a whole resulting from successful implementation of Human Factorssystem development.

4.3 Opportunities value, perceived worth, and delivered benefit are all out of equilibrium.

The above research indicates that HF having the capability to provide benefits to all primary stakeholders involved in the creation of systems. Every stakeholder group might get advantages from the use of Human Factors in systems design. The investigation indicates that stakeholders possess varying demands, leading to differing perspectives on the actual significance of HF for them. Although it actors such as employees and product/service users, along with system influencers like governmental agencies focusing on health and safety, will value the well-being benefits of Human Factors(HF). On the other hand, system experts such as engineers and the system decision makers like managers will value the performance benefits of HF.

The perceived value of Human Factors (HF) by all stakeholders is restricted, as shown by Helander (1999) and Neumann and Dul (2010). Some individuals argue that HF prioritizes well-being exclusively, while others contend that it concentrates only on manufacturing, such as labor-intensive tasks, or on specialized products like chairs or computer mice. While numerous successful companies have effective work systems that prioritize the well-being of workers in physical, psychological, and organizational aspects, fostering creativity, productivity, and employee retention, these strategies are not always linked to Human Factors (HF). There are many popular items, like iPhones and other high-tech devices, that have achieved success due to their usability, simplicity of use, and perceived efficiency. These gadgets are very successful due to their Human Factors (HF) characteristics, although the phrases human factors or ergonomics are seldom used when discussing these goods, leading to a lack of perceived value in HF. These instances illustrate a hidden need for the value of HF (performance and well-being), without a conscious recognition and direct request for the HF field and profession. Therefore, there is less acknowledgment and understanding of how Human Factors(HF) may enhance healthy, safe, pleasant, and efficient work environments and product/service systems.

While the impact of HF on improving well-being may be appealing to certain stakeholders like system actors and influencers, it might not be enough for other groups such as systems experts and decision makers who prioritize the performance aspect of HF. The HF community emphasizes well-being in their research and practice, leading to closer relationships with stakeholders who value this objective, rather than with stakeholders who prioritize performance outcomes. The interactions between the HF community and some system influences, such as governments, often prioritize well-being above performance. The IEA has closer formal ties with international organizations that primarily focus on well-being, such as the International Labour Organization (ILO), International Occupational Hygiene Association (IOHA), and the International Commission on Occupational Health (ICOH), than with organizations that primarily focus on performance, such

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as those representing industrial engineers, product designers, or managers. There might be a comparable disparity among several local HF associations and individual HF professionals.

The HF community has a less developed value proposition and weaker relationships with influential stakeholders who have significant power to impact system design, including organizations representing system experts (like design organizations) and organizations representing system decision makers (such as management organizations) (Mitchell et al., 1997). The HF community has a well-established value proposition and robust connections with stakeholders that have a great interest in the result of system design but have little control over it. Ultimately, the stakeholders, who are the key system players, need and get advantages from the well-being aspect of Human Factors (HF), leading to a clear request for HF from this group. The stakeholder groups consisting of system specialists and system decision makers largely need the performance value of Human Factors (HF). However, individuals often fail to recognize the importance of Human Factors (HF) while having an inherent need for it. Consequently, there is less direct request for HF from this population. The HF community should enhance its value proposition, focusing on performance outcomes, and improve communication and relationships with system professionals, decision makers, and influencers to have a greater impact on the design phase. The following will boost the need for high-quality Human Factors and Ergonomics (HF) and therefore enhance HF's contributions to system design, leading to a rise in high-quality HF implementations.

5.0 Future-oriented method

Having established in the beginning that there is underutilization of HF's capabilities. In Section 2, we demonstrated how HF is distinct from other disciplines due to its three core characteristics: systems approach, design driven, joint performance, and well-being results. The advancements discussed in Section 3 show that systems are evolving and will do so in the future. HF can assist in designing systems that suit individuals, ensuring that performance goals and well-being are met in systems of the future. In Section 4, we discovered that although HF already provides reasonably good results for the primary stakeholder group of system actors, it still needs to provide higher-quality HF for the primary stakeholder groups of system specialists and system decision makers. These stakeholder groups have a significant interest in performance and have greater influence over system design than system actors. They could also only be partially aware of the capabilities that HF is capable of. Consequently, HF need to reach out to system decision-makers and specialists in the field, putting more of a focus on its efficiency objective and the variety of possible application fields.

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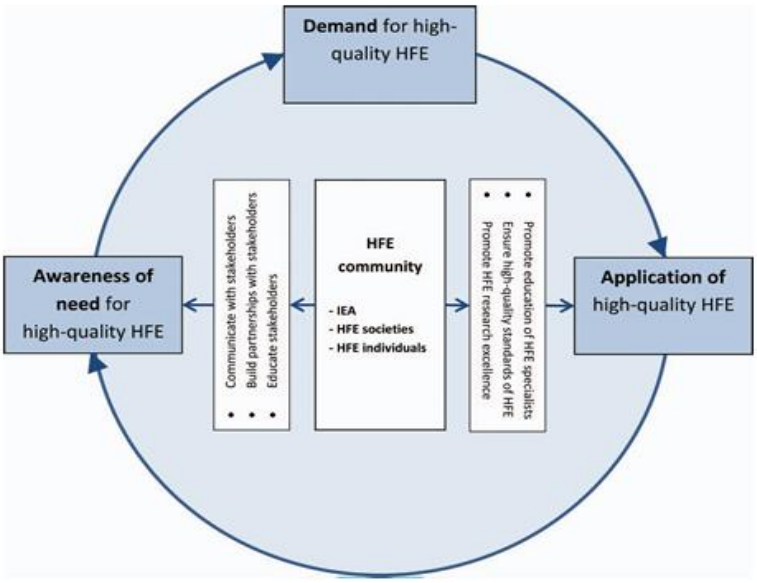

Figure 2: HF phase related to demand growth.

The HF belonging may enhance this cycle by emphasizing simultaneously the attraction and push techniques. It may improve partners' understanding of the importance of high-quality Human Factors Engineering. This may be achieved via interaction with stakeholders, partnership development, and stakeholder education (Karwowski 2007). HF experts must be able to incorporate HF goals into stakeholders' plans, policies, and activities according to Dul and Neumann (2009). Consequently, there will likely be a higher need for top-notch HF. The HF community can improve the quality of HF entries. One way to do this is by training top-tier HF professionals, assuring high-quality HF applications and specialists, and promoting HF research of the highest caliber at institutions as well as other institutions (Buckle 2011). Reflecting on successful implementations of high-quality Human Factors (HF) and the problems faced might increase HF understanding and practice as professionals. Therefore, the HF community is the primary agent behind this suggested strategy shift. The operation may occur at three tiers: the global Human Factors and Ergonomics (HF) society (IEA), local societies (national and regional HF societies, such as IEA Federated Societies and IEA networks), and individual entities (HF researchers, HF teachers/trainers, HF consultants, HF administrators).

6.0 Execution of a strategy

The key strategic direction advocated is to enhance the demand for and use of excellent in quality HF. Implementing this primary approach has significant implications for the policies and practices of HF groups and people, considering local variations and objectives.

Implementing the technique is crucial but complex and requires more refinement. We examine the following two elements: (1) creating an action plan by turning the strategy into achievable tasks, and (2) overseeing the development and execution of the action plan.

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Section 6.1 (and the Appendix) contains instances of potential strategic initiatives. We recognize that these strategic initiatives and their methodology are not exhaustive and need more elaboration and attention. In Section 6.2, we suggest assigning a leadership position to the IEA to oversee the creation and execution of the action plan.

6.1 Situations of strategic maneuvers

In order to implement both of the primary orientations of the suggested plan, we as a species provide examples of action items below. There are more examples in the Appendix. In the end, relevant parties within the HF community must transform those strategic measures into targeted and successful actions. These actions need to be "smart" in order to be successful: they need to be realistic (people need to be prepared to put in the effort to put their energies on them), achievable (it must be conceivable to do them as well), measurable (e.g., responding to inquiries like how much, for how long), timely (e.g. setting time horizons for strategic actions such as 1, 2, 5 and even 10 years), and precise (e.g., defining whom, what, where, when, that, precisely why).

Improving stakeholders' knowledge of their requirement for high-quality HF will boost the appetite for it as follows:

❖ Engage with important stakeholders such as system specialists and decision makers by highlighting the performance objective and essential aspects of Human Factorsin terms they understand, such as quantifying results and doing cost-benefit analysis. Enhancing stakeholders' awareness and comprehension of high-quality Human Factors(HF) through the presentation of positive and negative case studies, as well as by offering recognition, awards, and prizes for exemplary HF practices.

❖ Establishing strategic alliances with specialists in various fields such as technical and social sciences, decision-makers like managers, and influencers such as government bodies, industry organizations, and the media. Long-term collaborations should guarantee continuous improvements in both performance and well-being.

❖ Teaching the importance of Human Factors and Ergonomics (HF) to stakeholders at many educational levels and locations, including elementary schools, professional education institutions, universities (such as engineering, design, and business programs), and other educational contexts. It is essential to educate system experts on the principles of Human Factors(HF) so they can incorporate basic HF principles into their designs independently and recognize when to involve an HF specialist for high-quality applications, as it is not feasible for HF specialists to be present in all system designs.

- **Optimizing the implementation of grade HF:**
  - ❖ Campaigning for the advancement of high-quality Human Factors Technology (also called HF by establishing standards for both high-quality HF and authorized HF

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specialists, focusing on the three key characteristics: systems approach, design driven, and performance and well-being. Ensuring that educational and training institutions comply with these standards.

- ❖ Attracting students and professionals from many fields to become specialists in Human Factors and Ergonomics with proficiency in all three essential criteria. Utilizing top-notch Human Factorscannot be accomplished via mechanical application of a toolset. Ongoing training of HF trained professionals, incorporating knowledge from various fields like industrial engineering, interaction design, cognitive psychology, human movement studies, organizational behavior, and operations management, is crucial to ensure their ability to provide top-notch HF applications. HF professionals from human or health-related fields who mainly concentrate on well-being outcomes of system design may need additional education on performance outcomes and establishing connections with powerful stakeholders like system decision makers.
- ❖ Advancing high-quality Human Factors (HF) in all activities of HF societies and people to ensure high standards of HF applications and experts. Ensuring accreditation and certification organizations adopt high-quality HF standards. Advancing HF research excellence at universities and other organizations via the promotion of high-quality research as well as journals.

6.2 IEA's position as leadership

We propose designating a leadership position to the IEA to oversee the formulation and execution of that strategy. The IEA might serve as a strategic leader in this endeavor via many means:

- ❖ We propose designating a leadership position to the IEA to oversee the formulation and execution of that strategy. The IEA might serve as a strategic leader in this endeavor via many means:
- ❖ Encouraging IEA affiliated organizations and network to establish individualized strategies for action based on their unique circumstances. The IEA ought to oversee and assess the progress of these action plans and exchange insights gained.
- ❖ By creating a strategic plan on a global scale, focusing on relevant international organizations and organizations.

Various HF subgroups and important stakeholders should participate in this method to ensure that the execution of the strategy is tailored to particular requirements and opportunities. IEA affiliated societies and organizations should play a key role in this strategy initiative. Only they possess the knowledge of their unique national or regional circumstances, the obstacles they encounter, the possibilities they may take advantage of, and the individuals and groups that can support them. IEA networks might serve as crucial intermediaries. IEA federated societies and

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networks should first design a locally appropriate plan of action with their members and communicate it at the IEA platform.For a worldwide initiative to be successful, it is essential that each member of the federated society comprehends it. It may be beneficial to translate this article into the native language of civilizations where English is not prevalent.
Additionally, additional HF organizations should also participate. Certification authorities should review their certification requirements to ensure they align with the essential attributes of high-quality HF outlined in this paper. It is important to engage with professional organizations of Human Factors and Ergonomics (HF) professionals that are independent of the International Ergonomics Association (IEA) to establish consensus on the definition of HF and its effective implementation.

Major stakeholders must be included in the plan to demonstrate and provide value to them. It is essential to comprehend stakeholders' perspectives on Human Factors (HF) and its advantages, as well as how HF professionals may collaborate with them in system design.
In the next ten years, the primary focus and significant task of the IEA Executive Committee, the IEA Council, and local HF organizations will be the formulation and execution of this strategy. Long-term success of the plan led by the IEA depends on the establishment of circumstances like consistent governance, efficient mobilization of federated societies, and enough resources. This may need a thorough reassessment of the present IEA structure.

7.0 Conclusion

This article presents an approach to strategy for the future of the HF research including line of work, aiming to inspire the creation of new approaches, techniques, and operations tailored to unique local situations within the HF community. Creating and executing a strategic action plan for the HF field and profession necessitates a sustained and collaborative effort from the complete HF community. The outcome will be gratifying. The external community will acknowledge the importance of the HF field and industry as an important collaborator in effective system development.

- In this article, we view 'ergonomics' and " human factors' as interchangeable terms and therefore adhere to the IEA description of the field (IEA 2000): Ergonomics, also known as human factors, is a scientific field that focuses on studying how humans engage with multiple parts of an organization. It is a profession that uses academic subjects principles, information, and techniques to design systems in a way that improves human well-being and overall system performance. We have chosen to refer to the field as 'human factors/ergonomics' (HF) in this study to establish its discipline. By embracing this concept, we acknowledge that HF is a scientific field rather than just a multidisciplinary

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problem-solving technique. We acknowledge that this definition aligns more with a positivist perspective compared to an evolutionary one in the field.

- The group of members comprises Jan Dul (Chair, Netherlands), Ralph Bruder (Germany), Peter Buckle (UK), Pascale Carayon (USA), Pierre Falzon (France), William S. Marras (USA), John R. Wilson (UK), as well as Bas van der Doelen (Secretary, the Netherlands).
- HF tends to concentrate on two kinds of systems: labor systems including people in private or public organizations, and products such as consumer or corporate goods as well as services. The concept of 'work' is a fundamental focus in Human Factors Engineering, as shown by the origin of the term ergonomics (ergo¼labor). HF focuses on many activities outside paid labor, including multiple users such as consumers, citizens, and patients with diverse characteristics like age, in various settings like domestic, leisure, sport, transit, and others. When we refer to a 'work system,' it encompasses various systems that are alive.
- Excellent workmanship HF refers to using all three fundamental parts of HF: systems strategy, design-driven, and effectiveness and positive outcomes, while identifying issues and devising solutions. The HF technique is restricted in the absence of certain crucial components. High-quality Human Factors(HF) involves focusing on particular aspects of individuals (such as physical characteristics), specific environmental factors (like technical elements), particular outcomes (such as well-being), or approaches with restricted connections to design, as long as the limitations of the specific approach and how to address them are discussed (‘contextualization’). One way to do this is by working with other experts, developing more comprehensive strategies in the latter phases, and recognizing the constraints of issue definitions and solutions. Particular situations may arise, such as when the Human Factors(HF) expert has a restricted involvement in the design process as a whole or when there are limitations that need simpler solutions, especially in economically developing nations (Kogi 2007). High-quality Human Factors(HF) techniques are favored over restricted alternatives due to the unique value proposition they provide to all participants.
- In this research, we refrain from employing the word 'optimization' to refer to the mathematical process of determining the optimum possible value for a certain objective function. Optimization involves identifying design solutions that maximize simultaneously happiness and execution, often necessitating trade-offs amongst the two goals.

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