

## Article

# Challenges and Opportunities for Human Factors/Ergonomics as a Strategic Partner for Business Managers: In-Depth Research of Experts' Visions

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**Abstract:** The potential of human factors and ergonomics (HFE) contributions to business performances is underestimated. Companies have a narrow understanding of ergonomics and do not perceive it as a strategic partner. In order to call for attention within the HFE community and in the business world, the authors conducted a series of interviews with eleven leading HFE experts on their visions of HFE as a strategic aid to business. Results indicate the challenges and issues along with the opportunities and activities for cooperation between HFE professionals and business managers. The research illustrates examples of the crucial changes that must take place for the enhancement of HFE values and opens the floor for it as a strategic partner to business managers. HFE experts are recommended as key players and responsible actors for implementation of the changes with the aim of repositioning HFE within businesses.

**Keywords:** future of HFE; multidisciplinary cooperation; business managers; value framework; prospective ergonomics



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## 1. Introduction

During the past several decades, there has been an on-going trend and growing need for understanding the future perspective and overall position of human factors and ergonomics (HFE), and according to the International Ergonomics Association (IEA) definition, which has been adopted in the logic of this study in its entirety, “human factors” and “ergonomics” are considered to be synonymous [1]. Relatively large bodies of literature emphasize the importance for ergonomics to move away from traditionally discussed topics and therefore to increase the cooperation with non-traditional subjects, particularly in social sciences. This emphasis is to enhance and enlarge the applications of the discipline, reposition it, and increase its contribution and value in multidisciplinary cooperation [2–5]. Despite the fact that the importance of establishing cooperation with stakeholders from various disciplines has been discussed, and some ergonomics researchers and professionals are aware of its importance, the potential, and benefits of HFE are relatively unknown to professionals outside of the discipline. This indication might be due to low awareness about the added value HFE could create [6]. Traditionally, most HFE applications are associated with safety and health, such as work postures, work methods, tool design, et cetera. Therefore, HFE is perceived as a protector of employees and not associated as a contributor of business strategies. Nor is HFE considered a contributor to higher-yielding business goals, such as work quality and business productivity [7]. It is unfortunate that most high-level management do not notice the strategic contributions and the opportunities of HFE to the enterprise besides those of the micro-level HFE, e.g., safety, health, legislation, etc. Therefore, a big gap between the potential contribution of HFE to business strategies and its realization with the cooperation between HFE and business managers was observed.

The aims of this paper are to shift the representation of human factors as a non-strategic element to an existential part of core business. In this study, it is argued that ergonomics has narrow understanding and application within business and management society. For that reason, it is not used to its full potentials. The purpose is to gain a deeper understanding of the reasons behind the cooperation gap and to introduce potential steps for bridging this gap. In details the aims of the research are the following:

- Through in-depth interviews with leading professionals in the HFE area, we present broad picture of the current status of HFE—business managers cooperation;
- Explore and classify main cooperation challenges;
- Propose action plan for enhancing the cooperation and overcoming the challenges in order to suggest new directions for getting HFE accepted in the business community in its full potentials;
- Present practical examples of solutions and application of HFE as strategic partner for business managers;
- Serve as a tool for HFE professionals to gain an overview of what and why is going wrong in the cooperation with business managers. Through clear and summarized picture of the issues and understanding the role which each member of HFE can play there is significant space for improvement;
- Present to business managers practical examples which demonstrates the contribution of HFE to business goals in much wider areas, applications, and perspectives in comparison to current perception of potential contribution and cooperation.

In this paper, the relationship between HFE and business managers are presented through: (1) issues in the cooperation and (2) activities for enhancing the cooperation along with practical examples.

## 2. Literature Review

### 2.1. *The Future of HFE: New Areas of Multidisciplinary Cooperation*

Discussions on the topic of the future of HFE started with Sir Frederic Charles Bartlett, a British psychologist and professor from the first half of 20th century. Bartlett's article "The future of ergonomics", published in 1962, is a landmark in the area [8]. Since the beginning of the 21st century, decades after Bartlett, with the fast development of high technology and complex changes in almost all sectors in society, the future of ergonomics recaps people's concerns and a new series of discussions are initiated. Moray [4] emphasizes that in the 21st century, HFE will be a discipline in high demand, which will require its professionals to move away from the traditional approaches and expand their experience and knowledge with non-traditional subjects, particularly those in social sciences. Helander [2] highlighted that in the future, ergonomics will mostly be driven and shaped by the global market, which creates quick and rapid changes. It is crucial for HFE professionals to increase the interaction with other disciplines, effectively communicate the values of the discipline, and enlarge its application areas in order to achieve the goal of human performance optimization. In repositioning the discipline and creating its new future by addressing the global challenges, Thatcher and Yeow [9] suggested that HFE needs partial reorganization:

- From a specialized discipline to multidisciplinary, interdisciplinary, and transdisciplinarity;
- From micro-ergonomics to system and complexity HFE;
- From value-free to value-laden HFE;
- From mitigation to adaptation;
- From generalized to local solutions.

Further research by Thatcher et al. [5] pointed out that global challenges will require broader engagements with social sciences such as sociology, political science, anthropology, philosophy, human resources, and management. Emphasizing the need of HFE for engagement with other disciplines is constant and seen as one of the key movements for the future.

## 2.2. HFE from the Viewpoint of Business Managers

Business managers generally have very limited understanding of the value of ergonomics; thus, ergonomics in companies is associated with cost, sickness absence, pain, and legislations and considered as an alien discipline [7]. Business managers do not perceive HFE as a contributor to business strategy and achievement of business goals because HFE is considered to have a “side-car” status that will be useless if it does not mount to the main motorcycle [10]. As HFE value is underexplored and underrated, the managers’ expectations on its contribution are low. Thus, HFE is usually implemented too late in business processes and is unable to make an influential overall change. Dul [11] and Wang and Mulaomerovic [12] searched in the *Social Sciences Citation Index* (SSCI) journals database for HFE-related articles in the business management area. Although these studies cover different periods (1992–2001 and 2004–2013, respectively), both papers concluded that articles published in business management journals hardly associate with HFE. The importance of this cooperation and current state of its development open the need for further investigation of the causes of low level of cooperation and potential solutions. Dul and Neumann [7] suggested that it is the duty of ergonomists to show that HFE can contribute to company strategy and reaching core business goals; therefore, the change should come from the HFE side. There seems to be opportunities for ergonomists to contribute to business goals, but new approaches, ways of thinking, research, and implementation of findings are required [13]. Dul et al. [6] argued that to raise business managers’ awareness about the values of HFE, they need to be approached through communication, building partnerships, and education. There are examples of companies and products that are organized, operated, managed, designed, and manufactured based upon HFE principles and turned out very successful, but rarely is HFE mentioned when discussing these successful stories [6]. It would be most convincing if ergonomists could present the HFE values that they can bring to companies through real examples from practice and communicate it in a way, which is understandable and important to business managers [14].

## 2.3. Value Framework—What Business Managers Are Looking for?

Dul et al. [6] looked at the HFE value proposition among different stakeholders groups, including the following:

- System actors—such as employees and product users/service receivers;
- System experts—for example, professionals from social sciences involved in design processes;
- System decision makers—for instance, business managers;
- Social influencers—such as the general public.

The HFE community has a less-developed value proposition and relationship with the dominant stakeholders. On the other hand, the dominant stakeholders have power over the decision-making processes. Dominant stakeholders include system decision makers along with system experts. These dominant stakeholders are not aware of the value that HFE can bring. Therefore, Dul et al. [6] suggest that ergonomists should strengthen the value proposition (particularly performance-related) to raise the interest of business managers.

Traditional approach associates the existence of companies with mainly economic and monetary benefits. Den Ouden [15] introduced the value framework, which, apart from economic values, incorporates psychological, sociological, and ecological values. Each of these values connects to stakeholders, including users, organizations, ecosystems, and society as a general category. In order to create value to all stakeholders, business managers are looking for innovations more than ever. From the perspective of the value framework [15], meaningful innovations should bring added value from each of the four dimensions to all stakeholders. Ergonomics that focus on humans as the main interest of research should offer its knowledge, experience, and expertise to businesses in the process of consideration of the human characteristics and users’ needs during the creation of innovations. The transition from monetary-oriented companies toward an emphasis on value framework and consideration of all stakeholders groups opens up opportunities for

ergonomists to become strategic partners to business managers. This new way of doing business opens up the floor for presentation and implementation of HFE principles within business strategies.

New business trends are in need of HFE approaches; however, HFE position in companies is still mainly associated with health, safety, and legislation. The question is why this is the case and who is responsible for improvement. Business managers cannot be blamed for the current lack of cooperation [7]; therefore, it is the duty of HFE to take responsibility and initiate the change and improve the cooperation. Ergonomists need to rethink their approaches to businesses and take advantage of the opportunity that comes from the importance of value framework in business strategies.

#### *2.4. Prospective Ergonomics—Need for Innovations*

Understanding the value framework, offering a value proposition to business managers, and repositioning the relationship requires HFE proactiveness, creativeness, and innovativeness. Reflecting on the HFE future development, Robert and Brangier [16] strongly argue for adopting prospective ergonomics. They emphasize a future-focused aspect. Robert and Brangier [16] added the prospective position of the discipline to the traditionally discussed aspects of corrective and preventive ergonomics. At its core, corrective ergonomics deals with the correction and solving of existing problems. Preventive ergonomics' primary purpose is avoiding some of the previously experienced pitfalls. Both corrective and preventive ergonomics can lead to innovations; however, innovativeness is not the priority [17]. These ergonomics activities are based on the demand from a client, which partially limits the freedom and innovative mindset. Contrarily, prospective ergonomics focus on anticipating the future and users' unmet needs. This focus fosters creativity and leads toward innovation [18]. The shift toward prospective ergonomics does not neglect the importance of correction and prevention. Instead, it adds a new dimension that introduces a new method of approaching research problems and could potentially lead to innovations, enlargement of discipline applications, and its repositioning in multidisciplinary cooperation. The prospective approach viewpoint requires ergonomists to take a leading role in anticipating users' unmet needs. Innovativeness and leadership are crucial. This approach in the discipline has huge potential to contribute to the much-needed shift from health and safety association towards ergonomics as a strategic contributor to companies' business strategies. A human-centered approach with anticipation of future needs is turning into main driver for ergonomists to change their position and justify the value of the discipline to business managers [17].

This article emphasizes the importance of new approaches, interdisciplinary cooperation, and the wider area of HFE applications. In particular, it looks into the HFE and business managers' relationship. HFE focuses on the human aspect as a central figure of interest, while companies hold the role of humans as employees or customers as a primary interest. Merging these two focuses by implementing ergonomics in business strategies will cause two positive outcomes—improved employee well-being and improved business performance [6]. Based on the literature review, there is an existing gap between the potential contribution of HFE to business strategies and its realization. This research focuses on this gap by investigating factors behind the perception that HFE is not essential to achieving business objectives [19] and possible steps to overcome this gap.

### **3. Research Methods**

This study has a qualitative research design aiming to explore the cooperation between HFE and business managers. By nature, qualitative research tends to be inductive, searching to comprehend, describe, or understand a phenomenon while accessing the meanings participants ascribe [20]. The research team used interviews to conduct this qualitative research. The authors aimed to explore the HFE experts' opinion about the status of the HFE—business managers' cooperation. Participants were eleven leading HFE experts

and were internationally recognized. They were probably the strongest participants ever recruited, and their opinions would be most representative and trustworthy.

As the research looks into the relationship between two parties, it would be beneficial to hear the voice of both sides for understanding the point of view of all interest groups and propose solutions that reflect in the best possible manner the state of cooperation. However, as this article sets the foundation for further understanding of this topic, it started by delving into the opinion of the HFE professionals, as it argues that change in the cooperation should come from the HFE side.

This research reflected the general opinion of business managers via the HFE experts as research participants. HFE experiences in cooperation, discussions, and interaction with business managers acted as data sources. Interviewing discipline professionals was seen as a legitimate way for data collection with the purpose of understanding their views and accounts [21]. Furthermore, research design in the form of interviews was the most accessible and affordable and ensured reaching a wide range of participants from different countries within the boundaries of the limitations. Research respondents were selected based on their expertise in the discipline, particularly in cooperation with business managers. For validity of the results in terms of global context and worldwide application values, the sample consists of representatives from different geopolitical regions including Australia, Brazil, Denmark, France, Japan, Netherlands, Singapore, South Korea, Sweden, Taiwan, and the USA. Consideration of cross-cultural diversity is an essential task in HFE [22]. Based on the theory of cross-cultural research [23], to ensure reliability and validity of research results, the research sample should consist of eleven countries and more. This research is aligned with the requirement of sample size. However, in future research, it might be beneficial to increase the number of countries and the number of participants per country. It would allow a deeper understanding of corporate geopolitical circumstances, their achievements, and potential for improvement.

Cross-cultural research is particularly challenging in terms of approaching the appropriate research sample. With support of colleagues from the international scene, the authors managed to carry out eleven in-depth interviews with respected representatives of HFE discipline around the world. For participants' privacy, only limited information about their profiles is provided. All of the participants have a rich history in the HFE discipline. They have been presidents of IEA and its federated societies, IEA executive members, award winners of IEA, keynote speakers on a wide range of recognized conferences, authors of State of Science articles with high impact and citing value, and other professional achievements.

Part of the interviews was held in person and the rest through teleconference programs, with an average interview time of 70 min. Interviews were audio-taped with the prior approval from the participants. A list of semi-structured questions was, on request, sent out to all the participants before the actual interview. Interviews were conducted based on pre-prepared questions; however, additional questions supported actual conversations for clarification and deeper thematic understanding. Four main categories set the basis for the semi-structured questionnaire and aimed to give a deeper insight and understanding of the importance, challenges, and opportunities for HFE contribution towards business managers. The questions were designed to explore the opinions of the participants about the following four categories (details presented in Appendix A):

- Ideas and strategy for the future of HFE;
- Interdisciplinary cooperation;
- HFE position among business managers and its' contribution to business strategy;
- Promotion of HFE and steps for achieving the vision of the HFE future.

The research method was a thematic analysis for identifying, analyzing, and reporting patterns (themes) from the data source. Participants' statements analysis went through a phased thematic analysis process as proposed by Braun and Clarke [24]:

1. *Familiarizing with the data*—researchers had to become immersed in the data for a comprehensive understanding of the content. Interviews acted as a verbal data source. The audio-taped interviews were listened to several times and then transcribed

verbatim. Reading and re-reading transcriptions acted as a quality control measure for ensuring data understanding and generating an initial list of idea statements from the data;

2. *Generating initial codes*—the purpose of this phase is a generation of initial codes based on the features of data that appear thought-provoking and relevant to the analysis. Written notes on the analyzed text acted as manual coding with potential patterns highlighted for reference. The purpose was to identify as many initial codes as possible, which later served as clustering of implied themes. An example of how the data are analyzed and codes applied is presented in Table 1. Table 1 presents a short segment of the interview responses to which codes are applied. This process was completed for the entire interview data with the purpose to identify codes that appeared interesting to the analysis;
3. *Searching for themes*—this phase acted as analogizing themes and subthemes. The process involved analysis and application of code implementation into potential themes. The purpose is to sort long lists of generated codes into a broader level of themes;
4. *Reviewing themes*—this phase helped to identify different themes, how they fit together, and the overall story they present about the data;
5. *Defining and naming the themes*—repeated listening of audio recordings supported the analytical process of capturing relevant themes [25]. Name identifiers as well as clear and concise definitions were attributed to each theme.

**Table 1.** Data extracts with codes applied: example of phase 2 of the thematic analysis process based on generation of initial codes from the interviews.

Data extract—short example of the interview participants' answers, which are analyzed	Codes—identifying features of the data that appear interesting to analyze—organizing data into meaningful groups
<p>“We need to change the language, this is why I went and got a management degree as well. Cause in my couple of first jobs as an ergonomist I was said ‘Oh, no, you are not part of the decision making’ and I had to change the environment and learn the appropriate knowledge and educate myself about business.”</p>	<ul style="list-style-type: none"> <li>• Educate ergonomists about management</li> <li>• Become part of company decision-making body</li> <li>• Communication and language barriers</li> </ul>
<p>“As our discipline is multidisciplinary we need to understand the language of managers so we can translate our research into their language which is going to resonate into them helping achieve their goals. For us it is important to understand what their goals are and how ergonomics as a science can help them to reach the goals. We might need to take step back, change our vocabulary, come on different angle, we need to understand what they want to create and how we can bring data and science to support. Then values of our profession become important to them because we help them achieve their goals.”</p>	<ul style="list-style-type: none"> <li>• Improve communication with managers</li> <li>• Understand values and goals of managers</li> <li>• New application values of HFE</li> </ul>
<p>“Ergonomics is used as sanity check, it is used to test if something is done right, but it is not used to drive innovation and change. I think that the history and contribution which the field has made to the other discipline needs to be pointed out and HFE should be proud of what is done.”</p>	<ul style="list-style-type: none"> <li>• Limited application of HFE</li> <li>• Limited understand of HFE contribution</li> <li>• Marketing of the discipline</li> </ul>

Source: Part of the process of thematic analysis prepared by the authors.

#### 4. Research Results

Through the process of thematic analysis, two main themes were identified. The first theme represents the issues in the cooperation between HFE and business managers. Within that theme, four sub-themes that give further insights are identified.

The second theme represents the activities or actions whose implementation could lead toward improvement of the relationship between HFE and business managers. This theme is further segmented into five sub-themes.

The two main themes along with the subthemes are presented in Table 2.

**Table 2.** Presentation of the identified themes and subthemes.

	<b>Theme 1: Issues</b>	<b>Theme 2: Activities for enhancing</b>
	In HFE and business managers' cooperation	The HFE and business managers' cooperation
<b>Subthemes</b>	Misperception and narrow association of HFE	Creation of new and more appealing term for HFE
	Ergonomists are not perceived as team players	Presentation of existing HFE contributions
	Communication and language barriers	Positioning of ergonomists as leaders of multidisciplinary cooperation
	HFE involvement in late stages of the projects	Analysis of business managers and creating values for them
		Adoption of new competences among ergonomists

Source: Results of the process of thematic analysis prepared by the authors.

In the following section, further explanation of the research results presented in Table 2 is given.

#### 4.1. Theme 1: Issues in the Cooperation between HFE and Business Managers

The first category of topics focuses on the importance of understanding the current position of the cooperation between HFE and business managers. Four topics were identified:

(1) Misperception and narrow association of HFE.

There is a decidedly limited understanding of the discipline's contribution to business strategy. According to one of the research participants, the perception of HFE is overly focused on regulations, procedures, and ways of doing things. However, it is bigger and broader than just giving standards. Furthermore, a participant suggested that the discipline has "a wrong image" and that "people understand only the surface of ergonomics". Management often responds with "yes, yes, you have to have proper shoes or office furniture" to the topic of ergonomics. Often, HFE is misunderstood. This misunderstanding manifests in its value proposition and its contribution to businesses. The indication then leads to HFE's partial utilization and its degradation.

(2) HFE professionals are not perceived as team members.

The perception of HFE professionals is focused on evaluators and critics rather than team members who share similar corporate goals and vision. According to one of the research participants, "people do not like to mess with HFE professionals, as they always say something is not enough, they create problems, delay things ...". The team spirit between HFE professionals and representatives of other disciplines often manifests as weak and with a low level of HFE flexibility depending on the audience. According to one of the research participants, there is a sense that ergonomists are the opposition rather than someone with similar goals. Therefore there is a need to establish cooperation with an emphasis on understanding and sharing the same values and goals. It seems that if business managers perceive ergonomists as a "barrier" in business operations, they are not willing to cooperate unless it is mandatory. There is a need to change the relationship between the stakeholders. HFE can contribute to the corporate value and strategic competencies in terms of creation and enhancement.

(3) Communication and language barriers.

There is a substantial issue of misunderstanding between HFE professionals and business managers. Different backgrounds are causing this gap. One of the participants suggested that when an ergonomist talks to company managers and the public, it is critical to avoid technical jargon. The concepts should rather be interpreted in plain language. Applying alternative terminology might diminish communication barriers. Another research participant suggested business managers do not need to know a great

deal about the science of HFE to apply some HFE principles, so it is essential to keep the jargon simple. One of the research participants suggested that well-studied topics from both business and HFE have similarities but are named and interpreted differently. The two fields have different traditions, and it seems that there are no connections between the disciplines.

Another participant confirmed that an important skill to be developed is the ability to understand different languages. “Language” here is a metaphor for expressing and communicating among different fields. HFE has to communicate and present the discipline in language and values meaningful and understandable by business managers. New mutual projects can open the floor to increase understanding and overcoming communication barriers.

(4) Low level of utilization of HFE in the design process due to involvement in later stages.

Consultation of HFE is at the end of the production process for input on the design of products, services, and processes. This is how one of the participants described the perception of businesspeople about the contribution and purpose of HFE: “HFE is people that you bring in after a lot of creative work has been done and they have to check if the product, process, or service works. People in business perceive HFE as a sanity check used to test if things have been done the right way, but it is not used to drive innovation or changes”. Another participant confirmed this opinion by adding that “from companies’ point of view, ergonomics is just an added value, but from the interviewee’s point of view, ergonomics should be included from the very beginning of any process, and shift from the added value to the core value”. This is a direct result, as previously mentioned, because of a lack of communication and team spirit within the corporation. If business managers do not understand the potential contribution of HFE to their business goals, they do not include them in the innovation processes. The result is a loss of opportunity and a decrease of value for all stakeholders within the value framework, including end-users.

#### 4.2. Theme 2: Activities for Enhancing the Cooperation between HFE and Business Managers

The second category of topics focuses on how to improve HFE and business managers’ relationships. This category also represents potential milestones for improvement, including the following:

(1) Creating new and more appealing terms for HFE.

A research participant mentioned, “Many good ideas from HFE are used nowadays; it is just that they are not called HFE”. There is a need to create more appealing terms to attract the attention of business managers and overcome the issue of an evident association of HFE with health and safety. Another participant confirmed the same idea by stating, “When a word gets a certain meaning it is problematic to change it”. Ergonomists should, therefore, not be restrained by the definitions of the discipline. There is a predominant agreement by participants to create new terminology. This terminology should reflect something fun, unique, and exciting. Terminology needs to be adopted based on specific industries and cultural characteristics in different geo-political regions. Examples of new terminology used in different parts of the world, which research participants shared, include terms such as “human-centered design, design for all, inclusive design, innovation consulting, joy at work, well-being, system performance, wellness program, quality of work-life and others”. A highly industry-respected research participant with a track record in HFE-business cooperation mentioned that “HFE” (as a term) does not even manifest in company communication. Communication emphasis should explain values and concepts of HFE instead of HFE terminology. In conclusion, attractive terminology would serve as a marketing tool for promoting HFE and apprehend the interests of business managers. Creating and using more memorable names and phrases can help the business community to understand HFE values. It will also further promote these values.

(2) Let the world know about the great contributions of HFE from the past.



The best way to market and promote HFE is to feature previous contributions. A suggestion from one of the participants is “to demonstrate business managers the historical input of HFE and how it contributed to innovations”. Presenting the valuable contribution of HFE should be done in the language and values understandable to business managers.

(3) Take the responsibility for a stronger multidisciplinary cooperation.

A research participant stated, “HFE must be more in the drivers’ seat, take the facilitating role and merge disciplines”. Of importance is to establish the position of HFE as a full member of multidisciplinary teams. The discipline has to move towards less evaluation and more innovation. As mentioned by a participant, “HFE has to add value to the process rather than check if something has been done correctly or not”. Taking the role of a cross-disciplinary cooperation leader is a decisive task for the future. According to one of the research participants, “Time is ready now”. There is an on-going trend in the HFE community about repositioning the discipline as the community is open and ready. The next step should therefore focus on how to implement this initiative.

(4) Analysis of business managers and creating value for them.

Currently, HFE demonstrates a lack of understanding of who the business managers are and what their goals are. Thus, opportunities for cooperation and creating value are being lost. HFE perceives business managers as mainly interested in profits and numbers. Cooperation enhancement relies on business managers’ analysis. This includes understanding their role, missions, goals, and values. This will allow HFE to position itself as a contributor to business strategies. Business interests are not limited to revenue and profit relationship only. In the contemporary world, the outcome of companies’ operations create value for different stakeholders such as users, organizations, ecosystems, and society in general. These changes of the business objectives are an opportunity for HFE to understand business managers and to reposition into strategic partners for contributing to value framework creation for different stakeholders. Substantial opportunities for HFE prevail. HFE can therefore contribute to the formation of companies’ value framework. Therefore, ergonomists need to understand business managers, their profiles, their goals, and strategies. A research participant highlighted that the contribution of the HFE profession could become relevant to business managers if we help them achieve their goals. Another participant emphasized that relationship building is of great importance for HFE professionals. It is important to use inclusive language appropriate for a specific context of the application. Inclusive language creates a sense of good teamwork when communicating with different levels inside of a company. “We” rather than “you” is an example of inclusive language. It creates a feeling of working together rather than HFE only acting at solving internal company obstacles.

(5) Adoption of new competences among ergonomists

An important takeaway for the whole HFE society is that we have to accept that the world is changing, and we also need to change. Ergonomists need to expand their skill base to facilitate a fast-changing world with relevant multidisciplinary cooperation. Some of the research participants indicated that we have to get out of our comfort zones. Another participant emphasized that it is crucial to educate HFE professionals in marketing, negotiation, and communication skills. Learning good corporate communication skills and understanding what is important to others is necessary. It will encourage others to take the input seriously. Building abilities to successfully promote the values of the discipline is a far-reaching step to impact the future. One of the research participants shared a personal decision to obtain a business degree, in addition to HFE schooling, to ensure better communication, cooperation, and acceptance by business managers. The same participant emphasized that ergonomists should enroll in business and marketing classes. This participant also stated that it is essential to learn the jargon of the trade.

#### 4.3. Practical Examples of Challenges and Opportunities for HFE as a Strategic Partner for Business Managers

The aim of this section is to present practical examples on how HFE is utilized to bring strategic value to businesses. The company that was selected for demonstration in this practical part is Samsung Electronics Co., Ltd.

There is a strong belief among the HFE society that has been confirmed during the interviews conducted for preparation of this article that, even though HFE is applied in some business areas, its value and terms are not mentioned. Particularly, it means that values and principles of HFE are utilized; however the discipline remains as having a not-significant contribution. A participant in the primary research mentioned that Samsung has started to publicly mention the contribution of HFE in their business strategy.

When large and influential companies and business managers give public contribute to HFE, it is a significant stimulation for others in the business management area to look at the broader picture of HFE and its potential strategic values.

Practical examples from different Samsung business units are presented, which demonstrate opportunity for cooperation and overcoming challenges in HFE–business management cooperation.

- Samsung received the Grand Prix Ergonomic Design Award at the Asian Conference on Ergonomics and Design (ACED) in Tokyo, Japan, 2017, in the home appliances category. Hyunjoo Song, Vice President of the Digital Appliances Business at Samsung Electronics said, “This recognition reflects our effort to create consumer-focused and ergonomic products derived from countless hours of behavioral research and user analyses. We will continue to make ground-breaking new technologies and innovations to better the lives of our devoted consumers” [26]. These kinds of recognitions have multiple benefits on the perspectives of HFE–business managers’ cooperation. It demonstrates how overcoming cooperation challenges and coming closer to the business leaders increase the understanding of the strategic value that HFE can bring to business goals. Public communication of the value that brings the cooperation serves as further support on this path.
- Samsung is promoting and developing the area of workplace wellbeing. The company starts from the point that ergonomics is often one of the most overlooked health concerns within offices, which results in serious cost to both business and economy as well to the dissatisfaction of employees with working conditions and lifestyle. By following the ergonomics principles at the workplace, Samsung aims to achieve better productivity and a more positive workforce [27]. Starting from this perspective, Samsung has developed the Samsung business monitor line, which is based on ergonomic benefits for office wellbeing.

The above-mentioned practical examples demonstrate how close cooperation between HFE and society (e.g., awards, recognition, promotion of values) increases the cooperation and leads to overcoming of challenges and utilization of opportunities, which lead toward better business results but also toward overall human wellbeing as a primary goal of HFE.

#### 5. Discussion and Conclusions

This research identified a significant gap in multidisciplinary cooperation, particularly the position of HFE within a business management society. Even though strengthening the relationships with social sciences is a compelling step in the right direction for the development of the discipline [4,22], business managers as key decision makers [6] are unaware of the contribution that ergonomics could bring to business strategies. Current data indicate the importance of understanding the HFE and business world relationship and its relevance to the times and geopolitical environment. However, very little is done to develop this. That creates a gap in the available published literature, which in very limited scope reflects this issue. Dul [11] and Wang and Mulaomerovic [12], based on a review of the *Social Sciences Citation Index* (SSCI) journals database, concluded that articles published in business management journals hardly associate with HFE.

A series of interviews with HFE experts from eleven countries contribute to a deeper understanding of the main reasons for weak multidisciplinary cooperation. Results indicated main issues in four categories, including misperception and narrow association of HFE; ergonomists not perceived as team players; communication and language barriers; and HFE involvement in later stages of the projects. Generally, business managers consider HFE as an opposing, non-complementary discipline that brings some regulations and rules but no other benefits. The results confirm that there is low awareness about the added value that HFE could create [6] and particularly that HFE is not considered as a contributor to higher-yielding business goals [7]. However, the misperception does not come only from limited understanding of HFE from management; it exists on both sides. Ergonomists, if without a far-sighted business sense, would have a weak perception of business values. This perception then is reduced to a sense of profit relationship only. Profit-making and monetary considerations are traditional beliefs for the existence of companies. However, according to Den Ouden [15], companies have a more prominent role to play than just economic benefits. These include psychological, sociological, and ecological values to all stakeholder groups, which include users, organizations, ecosystems, and society in general. Contributions to better products, services, and systems for end-users and other stakeholders are lost if HFE focuses on company profit only. Therefore, it culminates in a loss of human optimization, wellbeing, and overall system performances [1]. In an era when customers demand companies to be conscious about the users, ecosystems, and society, businesses are in constant search for meaningful innovations that can bring multi-dimensional value to the stakeholders. The understanding that in order to create monetary value, companies are covering the whole spectra of value frameworks [15] creates a great deal of space for HFE to become an important player in business strategy.

This research goes further into understanding the gap between low cooperation and misunderstanding. The question that arises is how the loss of cooperation opportunities can be overcome. This would directly influence the loss of potential contribution to the value framework and different stakeholders. Research results suggest that the initiative should come from the HFE side, as ergonomists should show businesses how they can contribute to the creation of values. This should be done by activities that are clustered into five categories: creating new and more appealing terms for HFE, presenting the HFE contributions from the past, taking responsibility for stronger multidisciplinary cooperation, analysis of business managers and creating values for them, and adoption of new competencies among ergonomists. The key issue of very limited understanding of the value of HFE and its association with cost, sickness absence, pain, and legislation [7] creates the need for repositioning of the discipline. Very strong association of HFE with safety and health creates a barrier in perceiving the potential contribution of the discipline in other areas. To overcome the barrier, it is the duty of HFE to create the strategy and initiate the change [7]. Research results give guidance to ergonomists about the future steps to reposition HFE among business managers. Ergonomists should be proactive, gaining a broader understanding of the value framework of businesses and identifying the potential contribution to it. Moving away from traditionally discussed topics and developing new skills and competencies will contribute to this process. Prospective ergonomics that foster creativity and lead toward innovation [18] will support HFE experts to better understand the needs of the businesses and offer their knowledge to create value and contribute to important strategic goals. In order to achieve this, the HFE expert should work on two areas. Firstly, they need to understand the value framework that introduces the values and stakeholders that are important to businesses [15]. In that way, HFE will be able to identify the areas in which it can contribute and strengthen the value proposition to raise the interest of business managers [7]. However, in order to establish the cooperation apart from understanding the unmet needs of businesses and creating value to support them, it is important to gain their attention and confidence in the cooperation. This needs to be approached through presenting to companies real examples from practice [14] that can serve as evidence and support of the thesis that products, services, systems, and orga-

nizations which are organized, operated, managed, designed, and manufactured upon HFE principles turned out very successful. Marketing of HFE and leadership within the HFE–business management cooperation is fundamental toward overcoming the misperceptions and low level of collaboration. The change should come from HFE side and, more specifically, should start within the HFE society.

Ergonomics can contribute to businesses and support creating value for different stakeholders and interest groups. Due to significant gaps and misunderstandings between ergonomists and business managers, its potentials are underestimated and not utilized. Overcoming this gap requires a paradigm shift in the way ergonomists educate themselves, evaluate their discipline and past achievements, look at the companies and their value framework, and promote HFE. By overcoming the issues and enlarging the cooperation with business managers, ergonomists can create value for different stakeholders such as users, employees, the general public, and others. They will be able to improve “optimization of human well-being and overall system performance” [1]. The results of this research in the form of two themes with accompanying subthemes present a practical tool for HFE as a discipline as well as for each HFE expert. It provides insights about the main reasons behind the cooperation gap as well as activities for bridging the gap. It is a necessity that HFE professionals start marketing the discipline and its potentials through new communication methods and taking responsibility for enhancing cooperation with business managers. It is necessary to start the change, to lead the discussion, understand the needs, and offer the value of HFE. For achieving this adoption of new competences, changes in the discipline approach are needed. Evidence from the practices presented in the example of Samsung shows how closer cooperation between HFE and business managers can result in successful business projects that aims to increase human wellbeing and overall system performances. The practical evidence shows that in the case of Samsung, a great deal of support and discussion from different HFE associations (such as Asian Conference on Ergonomics and Design and the Ergonomic Society of Korea) positively contributed to achievement of these HFE–business managers’ cooperation results.

## 6. Research Limitations and Directions for Future Research

Interpretation of this research is within the boundaries of its limitations. As pioneers in this area, the authors aimed to present a bigger picture of the issues at hand. They furthermore suggest potential steps to overcoming this from a global perspective. It would contribute more if future research could engage in the following:

- Enlarge the research sample of HFE professionals;
- Include business managers in the research sample. It would be beneficial to hear the voice of both sides and respected stakeholders;
- Dig deeper into countries and region-specific circumstances consisting of even more countries and participants per country. Doing this can help to identify specific concerns to address locally. Likewise, it could present successful stories that could serve as a raw model to the rest of the HFE society;
- Develop action plans for how activities leading to HFE–business management cooperation can be realized.

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## Appendix A. Semi-Structured Interview Questions

The interviews were conducted based on a list of semi-structured questions that were separated into four categories. Although the base of the interviews was the pre-prepared questions, additional questions supported the actual conversation for clarification and deeper thematic understanding.

1. Category 1: Ideas and strategy for the future of HFE
  - Can you please share your ideas about the strategy for development of HFE discipline in near future?
  - What is your opinion about the recently discussed topic in the area of HFE related to “need to go apart from traditionally discussed topics and to open new areas of application”?
2. Category 2: Interdisciplinary cooperation
  - Which actions are currently HFE professionals taking to contribute toward better promotion and position of HFE in interdisciplinary cooperation? Which actions do you recommend?
  - Marketing or promotion of HFE discipline is considered to be one of the key issues to be solved in the coming period for enhancing interdisciplinary cooperation. What are your advices on this issue?
3. Category 3: HFE position among business managers and its’ contribution to business strategy
  - What is the position of HFE among companies’ key decision makers such as managers? Is there room for improvement of these relations? Please provide your suggestions.
  - How HFE can contribute to companies’ strategic goals? Can you please share some examples related to some (non-traditionally approached) departments. Please share your experience from practical examples.
  - Do you think communication between HFE and management is sufficient. Is there room for improvement? Do HFE understand the companies’ problems and try to address them, as well communicate in “language” understandable by companies’ leaders?
  - Which companies’ departments do you believe are the first to be approached?
4. Category 4: Promotion of HFE and steps for achieving the vision of the HFE future
  - Whose responsibility is to promote HFE as discipline and “sell” the HFE solutions to companies’ leaders?
  - What is the role of IEA in the promotion of the discipline?
  - What are the main constrains and issues within current promotion of HFE?
  - Could you please share successful example of HFE promotion in practice?
  - What are key activities for enhancing the promotion of HFE in order to reach its full potentials?

## References

1. International Ergonomics Association. Definition and Domain of Ergonomics. 2017. Available online: <http://www.iea.cc/whats/> (accessed on 1 June 2017).
2. Helander, M.G. Forty years of IEA: Some reflections on the evolution of ergonomics. *Ergonomics* **1997**, *40*, 952–961. [[CrossRef](#)]
3. Meister, D. Views on the future of ergonomics: Some comments on the future of ergonomics. *Int. J. Ind. Ergon.* **1992**, *10*, 257–260. [[CrossRef](#)]
4. Moray, N. Culture, politics and ergonomics. *Ergonomics* **2000**, *43*, 858–868. [[CrossRef](#)] [[PubMed](#)]

5. Thatcher, A.; Waterson, P.; Todd, A.; Yeow, P.H.P. The Way Forward for Human Factors/Ergonomics and Sustainability. In Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018), Florence, Italy, 26–30 August 2018; Advances in Intelligent Systems and Computing. Bagnara, S., Tartaglia, R., Albolino, S., Alexander, T., Fujita, Y., Eds.; Springer: Cham, Switzerland, 2018; Volume 825. [CrossRef]
6. Dul, J.; Bruder, R.; Buckle, P.; Carayon, P.; Falzon, P.; Marras, W.S.; Wilson, J.R.; van der Doelen, B. A strategy for human factors/ergonomics: Developing the discipline and profession. *Ergonomics* **2012**, *55*, 377–395. [CrossRef] [PubMed]
7. Dul, J.; Neumann, W.P. Ergonomics contributions to company strategies. *Appl. Ergon.* **2009**, *40*, 745–752. [CrossRef] [PubMed]
8. Hockey, G.R.J. From theory to practice: Commentary on Bartlett (1962). *Ergonomics* **2008**, *51*, 21–29. [CrossRef] [PubMed]
9. Thatcher, A.; Yeow, P.H.P. *Ergonomics and Human Factors for a Sustainable Future: Current Research and Future Possibilities*; Palgrave Macmillan: Singapore, 2018.
10. Village, J.; Greig, M.; Salustri, F.A.; Neumann, W.P. Linking human factors to corporate strategy with cognitive mapping techniques. *Work* **2012**, *41*, 2776–2780. [CrossRef] [PubMed]
11. Dul, J. Ergonomics in management. In Proceedings of the XVth Triennial Congress of the International Ergonomics Association of the Ergonomics Society of Korea, Seoul, Korea, 24–29 August 2003.
12. Wang, E.M.-Y.; Mulaomerovic, E. Developing human factors and ergonomics as a contributor to sustainable companies' growth. In Proceedings of the 7th International Conference Management of Technology—Step to Sustainable Production (MOTSP 2015), Dubrovnik, Croatia, 22–24 April 2015.
13. Fulton Suri, J. The next 50 years: Future challenges and opportunities for empathy in our science. *Ergonomics* **2001**, *44*, 1278–1289. [CrossRef]
14. Rempel, D.; Reid, C.R.; McGowan, B.; Williamson, C.; Alexander, D.; Whitehead, C.; Sobhani, A. Communicating the Value of Ergonomics to Management—Part 1: Language, ROI, and Models. In Proceedings of the Human Factors and Ergonomics Society 2017 Annual Meeting, Austin, TX, USA, 9–13 October 2017.
15. den Ouden, E. *Innovation Design: Creating Value for People, Organizations and Society*; Springer: London, UK, 2011.
16. Robert, J.-M.; Brangier, E. What Is Prospective Ergonomics? A Reflection and a Position on the Future of Ergonomics. In Proceedings of the International Conference on Ergonomics and Health Aspects of Work with Computers, San Diego, CA, USA, 19–24 July 2009; Lecture Notes in Computer Science. Karsh, B.-T., Ed.; Springer: Berlin/Heidelberg, Germany, 2009; Volume 5624, pp. 162–169.
17. Robert, J.-M.; Brangier, E. Prospective ergonomics: Origin, goal, and prospects. *Work* **2012**, *41*, 5235–5242. [CrossRef] [PubMed]
18. Liem, A.; Brangier, E. Strategic design and prospective ergonomics: Differences, similarities and relationships. In Proceedings of the 11th European Academy of Design Conference, Paris, France, 22–24 April 2015.
19. Village, J.; Salustri, F.A.; Neumann, W.P. Cognitive mapping: Revealing the links between human factors and strategic goals in organizations. *Int. J. Ind. Ergon.* **2013**, *43*, 304–313. [CrossRef]
20. Polit, D.F.; Beck, C.T. *Essentials of Nursing Research: Appraising Evidence for Nursing Practice*; Wolters Kluwer/Lippincott/Williams & Wilkins Health: Philadelphia, PA, USA, 2014.
21. Hignett, S. Hospital ergonomics: A qualitative study to explore the organizational and cultural factors. *Ergonomics* **2003**, *46*, 882–903. [CrossRef] [PubMed]
22. Thatcher, A.; Waterson, P.; Todd, A.; Moray, N. State of Science: Ergonomics and global issues. *Ergonomics* **2018**, *61*, 197–213. [CrossRef] [PubMed]
23. Hofstede, G. *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*, 2nd ed.; Sage Publications: Thousand Oaks, CA, USA, 2001.
24. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
25. Karlsen, M.-M.W.; Gabrielsen, A.K.; Falch, A.L.; Stubberud, D.-G. Intensive care nursing students' perceptions of simulation for learning confirming communication skills: A descriptive qualitative study. *Intensive Crit. Care Nurs.* **2017**, *42*, 97–104. [CrossRef] [PubMed]
26. Samsung. Samsung Washing Machines Win “Ergonomic Design Award” at the Asian Conference on Ergonomics and Design. Available online: [https://www.samsung.com/latin\\_en/news/local/samsung-washing-machines-win-ergonomic-design-award/](https://www.samsung.com/latin_en/news/local/samsung-washing-machines-win-ergonomic-design-award/) (accessed on 21 January 2023).
27. CIO. How Ergonomics and Technology Combine to Help Health Best Practices. Available online: <https://www.cio.com/article/411435/how-ergonomics-and-technology-combine-to-help-health-best-practices.html/amp/> (accessed on 21 January 2023).

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