

**Human Factors, Ergonomics, and Human Factors Engineering:  
An Analysis of Definitions**

Deborah M. Licht and Donald J. Polzella

Crew System Ergonomics Information Analysis Center (CSERIAC)

Kenneth R. Boff

Harry G. Armstrong Aerospace Medical Research Laboratory

Correspondence:

CSERIAC PROGRAM OFFICE

AL/CFH/CSERIAC Bldg 248

WPAFB, OH 45433-7022

Phone: (513) 255-4842

Internet: CSERIAC@FALCON.AAMRL.WPAFB.AF.MIL

## INTRODUCTION

This report was prepared in response to a request by the Human Factors Committee of the National Research Council to aid its deliberations regarding a standardized definition of *human factors*. Though many variations of definitions abound, a formally endorsed unified definition of the field does not exist. CSERIAC's approach to this query was to compile and analyze definitions of *human factors* (and related terms) from a range of key resource materials and present them in a manner to expedite the Committee's consideration of a unified definition. Subsequent to a review of the human factors literature, we collected definitions, sorted and organized them, and then examined their components. We also went beyond the human factors literature to ascertain the elements of a good definition.

### A Definition of Definitions<sup>1</sup>

A definition is a set of words or phrases expressing the essential nature, meaning, and significance of a thing or a class of things. In Aristotelian terms, we must determine the real nature of an entity by indicating both the genus that includes it and the specific differences which set it apart by distinct detail.

#### GENUS

e.g., "Engineering psychology is [an applied field of psychology]  
SPEC. [concerned with psychological factors in the design and use of  
DIFF. equipment]."

<sup>1</sup> We greatly appreciate the contributions of Anita Cochran (University of Dayton Research Institute) to this section.

A technical or scientific definition, to be useful, must be directed toward the audience for whom it is intended. For instance, defining electro-optics for a physicist would be quite different from defining electro-optics for an accountant. The terms used within a definition must be interpretable to the reader.

A definition should be detailed enough to meet the reader's needs. It should describe, expound, interpret, and use simile where indicated to clarify meaning. It should not, however, attempt to be persuasive, i.e., use language that seeks to influence the attitude of the reader through expression of opinion.

e.g., "Behavioral research...is merely a type of game."

Where the term being defined has several synonyms, or words very close in meaning, these should be included in the definition and an indication given as to whether the synonym means precisely the same thing, or its meaning is close but allows for some shade of difference.

There is a history of debate over the comparability of the terms *human factors*, *human factors engineering*, and *ergonomics*. Some argue that these and other related terms (e.g. *industrial ergonomics*, *anthropotechnics*, *engineering psychology*) can be used interchangeably. Others cite differences, some very subtle, among these terms. Especially in technical documentation, new words (or combinations of words) are constantly being introduced and readers wonder if the "new" expression means the same as the term they have seen before, almost the same, or something completely different. Because of this controversy, we decided to expand the initial task by gathering and attempting to analyze definitions for all of these related terms.

Sometimes a definition is strengthened by pointing out to the reader what the term "does not" mean, especially if the term has been used incorrectly in the past,

e.g., "...human engineering is not synonymous with human factors,"

and then explaining what the difference in meaning is, in very precise language.

Many good definitions include examples of the correct use of the term in brief phrases or clauses that highlight its correct denotation and aid the reader's understanding, especially if a term has different "shades" of meaning in different sentences according to the context of the entire thought.

e.g., "Human factors, such as arm reach and sitting height, should be taken into consideration when designing equipment."  
"Human factors is a growing profession."

An "extended" definition is an explanatory paragraph which is used when the term being defined requires in-depth consideration as to source, application, scientific results, and overall significance. The purpose of such a definition is to educate the reader, however slightly, in the term of interest and is often used as a "tutorial." An extended definition is perhaps the most logical approach to defining human factors. Finally, consideration of the difference between a definition for defining purposes versus a definition to support professional understanding of a field is important. That is, which is more appropriate, a theoretical versus an applied definition?

## METHOD

The definitions were compiled from a variety of sources. Searches were performed at four area libraries: Wright State University-General Library and Health Sciences Library, University of Dayton-Roesch Library, and the Wright Research and Development Center (WRDC)-Technical Library at Wright-Patterson AFB, OH. To locate appropriate source material, computerized catalogues were searched at each of the libraries. Subject searches were performed using suitable Library of Congress Headings (e.g. Human Engineering, Man-Machine Systems) as key words. These library searches were supplemented by source suggestions offered by human factor engineers at the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL) and the University of Dayton. Approximately 400 references were initially culled from these various locations. More than three-quarters of the references were subsequently eliminated from further analysis based upon inappropriate content and/or lack of definitions of human factors or related terms. The final sample consisted of 74 references from which the definitions were extracted (see References).

Definitions of the following terms were obtained from the final sample: *human factors*, *human engineering*, *human factors engineering*, *ergonomics*, *applied ergonomics*, *human performance engineering*, *engineering psychology*, *industrial ergonomics*, *anthropotechnics*, *applied experimental psychology*, *biotechnology*, *psychotechnology*, *human-factors psychology*, and *biomechanics*. Many of the sources contained definitions for more than one of these terms. Approximately 90 definitions were obtained. The verbatim definitions were printed onto index cards to facilitate sorting and analysis. The definitions are presented in the Appendix. Each definition is preceded by the terminology designated by its author. Multiple terms separated by a "/" indicate that the author considered the terms to be synonymous. Terms separated by an "and" indicate that the author drew distinctions among the terms.

## RESULTS

The terminology used to describe the field of human factors is quite varied. *Human factors*, *human engineering*, *anthropotechnics*, and many other related terms are deemed equivalent by many, although some people draw sharp distinctions among these terms. In order to do an objective content analysis of the data, decisions were made about the equivalency of these many related terms. In reviewing the different terminology used, there appeared to be three broad categories of definitions: *human factors* (HF), *human factors engineering* (HFE), and *ergonomics* (E). Table 1 presents the categorization scheme that was used and the terms that were classified as synonymous. The majority of miscellaneous terms were categorized as HFE based upon the similarity of content of the definitions with those of "actual" HFE definitions. Authors often assigned multiple designations to terms, (e.g. "The definition of HFE, also known as Engineering Psychology, is the application of..."). In our analyses, these terms were treated literally as if they were multiple definitions. For example, if a term was designated as being both a definition of E and HFE, it was included in frequency counts for both the E and HFE categories. The total number of definitions, including these multiple designations, was 124 (see Table 1).

Table 1		
<u>Categorization of Synonymous Terms</u>		
Human Factors Engineering	18 <sup>a</sup>	(.14) <sup>b</sup>
• Anthopotechnics	1	(.01)
• Applied Exp. Psychology	1	(.01)
• Biomechanics	1	(.01)
• Biotechnology	1	(.01)
• Engineering Psychology	8	(.06)
• Human Engineering	25	(.20)
• Human Eng. Analysis	1	(.01)
• Human Perf. Engineering	1	(.01)
• Psychotechnology	2	(.02)
Ergonomics	31	(.25)
• Applied Ergonomics	2	(.02)
• Industrial Ergonomics	1	(.01)
Human Factors	30	(.24)
• Human Factors Psych.	1	(.01)
TOTAL	124	
<sup>a</sup> frequency		
<sup>b</sup> proportion		

Many of the definitions in the sample included distinctions among the major categories of definitions (see Table 2). As an example, when authors compared E with HF, one-third considered them to be distinct categories, two-thirds considered them to be equivalent. Comparisons of HFE with E resulted in equally opposing beliefs regarding their similarity.

Table 2  
Equivalency of Terms

	<u>Same</u>	<u>Different</u>
E and HF	10 <sup>a</sup>	3 <sup>a</sup>
HFE and E	2	3
HFE and HE	4	0
HFE and E and HE	3	0
EP and HE	3	2
HFE and AE	2	0
HE and HF	0	5
HE and E	0	4
HF and HFE	0	2

Note, He = Human Engineering, EP = Engineering Psychology, AE = Applied Ergonomics

<sup>a</sup> frequency

The dates of the definitions ranged as follows: HFE, 1949-1989; HF, 1963-1988; E, 1955-1989. In the HF and E categories, the majority of the definitions were written in the 1980's. For HFE, the definitions were more evenly distributed over time (see Table 3).

Table 3  
Chronological Sampling Distribution

	<u>HF</u>	<u>E</u>	<u>HFE</u>
Prior 1960	0 <sup>a</sup> (.00) <sup>b</sup>	0 (.00)	7 (.12)
1960's	2 (.06)	5 (.15)	9 (.15)
1970's	3 (.09)	5 (.15)	17 (.29)
1980's	27 (.84)	24 (.70)	25 (.43)
TOTAL	32	34	58

<sup>a</sup> frequency

<sup>b</sup> proportion

Many of the definitions were comprised of three components: the category of classification, i.e., genus, the domains of inclusion, and the objective. Some of the definitions included all three of these components, whereas others included only one.

The category of classification, the first component noted, is the predicate compliment of the definition. In other words, it is a phrase (either nominative or adjectival) that follows the linking verb and refers to or complements the subject of the verb (in the present sample the subject of the verb is HF, HFE, E, etc.). For example, in the definition, "Human Factors is a profession," **Human Factors** is the subject of the verb, **is** is the linking verb, and **profession** is the category of classification (predicate compliment). The phrases before and after the linking verb are considered to be the same. Table 4 presents the frequency of categories of classifications for the definitions.

Table 4  
Categories of Classification

<u>Category</u>	<u>HE</u>	<u>HFE</u>	<u>E</u>
Field/Branch	7 <sup>a</sup> (.19) <sup>b</sup>	6 (.17)	2 (.05)
Discipline	6 (.16)	9 (.25)	9 (.21)
Profession	1 (.03)	2 (.05)	1 (.02)
Application of Human Data	8 (.16)	11 (.30)	13 (.31)
Body of Knowledge	5 (.14)	4 (.11)	4 (.10)
Study of Human at Work	5 (.14)	0 (.00)	11 (.26)
Design of Equip/Tasks	5 (.14)	1 (.03)	2 (.05)
Process, Method	0 (.00)	3 (.08)	0 (.00)
Elements/Data/Variables	2 (.05)	0 (.00)	0 (.00)
TOTAL	37	36	42

<sup>a</sup> frequency

<sup>b</sup> proportion

For HF, it appears that the various categories of classification have an equal emphasis. However, both HFE and E seem to stress certain categories of classification over others. Discipline, field, and application are more highly represented in the HFE definitions than the other categories of classification. For the E definitions, discipline, application, and the study of humans at work are mentioned more often.

Changes in the emphasis of different categories of classification over time were also noted (see Table 5).

Table 5  
Categories of Classification Sampling Distribution

<u>Category</u>	<u>prior 1970</u>	<u>1970-79</u>	<u>1980-89</u>
Field/Branch	3 <sup>a</sup> (.25) <sup>b</sup>	0 (.00)	12 (.15)
Discipline	4 (.33)	9 (.45)	11 (.14)
Profession	0 (.00)	1 (.05)	3 (.04)
Application of Human Data	2 (.17)	2 (.10)	25 (.32)
Body of Knowledge	0 (.00)	1 (.05)	12 (.15)
Study of Human at Work	1 (.08)	4 (.20)	8 (.10)
Design of Equip/Tasks	1 (.08)	1 (.05)	6 (.07)
Process, Method	0 (.00)	1 (.05)	2 (.03)
Elements/Data/Variables	1 (.08)	1 (.05)	0 (.00)
TOTAL	12	20	79

<sup>a</sup> frequency

<sup>b</sup> proportion

Prior to 1970, field, discipline, and application were more highly represented among the three groups. From 1970 to 1979, discipline and the study of humans at work were mentioned most often. Finally, from 1980 to 1989, there appears to be a more evenly distributed representation of the categories of classification, with application standing out as being mentioned the most.

The second component discerned was the domains of inclusion. Human Factors is a multidisciplinary field and as such, draws on information from a variety of disciplines (i.e. domains of knowledge). Many of the definitions included references to these different disciplines and these were coded as domains of inclusion. Table 6 presents the domains of inclusion for the three categories.

Table 6

Categories of Domains

<u>Domain</u>	<u>HF</u>	<u>HFE</u>	<u>E</u>
Engineering, Control, Theory, System Rel.	8 a (.13)b	4 (.06)	12 (.12)
General Behavioral Science	13 (.21)	16 (.25)	18 (.18)
Biology, Physiology, Medicine	13 (.21)	22 (.34)	24 (.25)
Human Perf. Capacity/Limitation	11 (.18)	14 (.22)	36 (.37)
Manpower, Personnel, Training	12 (.19)	5 (.08)	2 (.02)
Misc.	5 (.08)	3 (.05)	5 (.05)
TOTAL	62	64	97

a frequency

b proportion

For HF, there is a fairly even distribution of the domains that were mentioned in the definitions. Biology, behavioral sciences, and human performance are the three domains that are mentioned most often for E and HFE. Changes in domains of inclusion over time are presented in Table 7.

Table 7

Categories of Domains: Chronological Sampling Distribution

<u>Domain</u>	<u>prior 1970</u>	<u>1970-79</u>	<u>1980-89</u>
Engineering, Control, Theory, System Rel.	3 a (.13)b	6 (.16)	12 (.09)
General Behavioral Science	10 (.22)	5 (.14)	32 (.23)
Biology, Physiology, Medicine	14 (.30)	8 (.22)	37 (.27)
Human Perf. Capacity/Limitation	14 (.30)	10 (.27)	37 (.27)
Manpower, Personnel, Training	2 (.04)	6 (.16)	11 (.08)
Misc.	0 (.00)	2 (.05)	9 (.07)
Total	46	37	138

a frequency

b proportion

There do not appear to be any major shifts in emphasis over time.

The objective was the third component that was prominent. The objectives were goals/aims that were cited in the definitions. There were generally three subcomponents within many of the objectives: a system or object to be changed/effectuated, the desired nature of change/effect, and the medium for change. First, many of the definitions pointed to systems or objects that needed to be either designed or changed. These **end-systems** included objects (e.g. "machines", "displays") as well as processes ("training", "procedures"). Second, often when an end-system was slated for design or change, the author stipulated the desired **nature of change** or effect on the system. An example of this would be to increase safety or comfort of an end system. Third, often the **medium for change**/effect to the system was noted. This involves the actions taken to effect the desired changes, such as the design and evaluation of an end-system.



Table 8 presents the numerous end-systems that were mentioned in the three types of definitions.

Table 8  
Objective End-System Changed

<u>End-System</u>	<u>HF</u>	<u>E</u>	<u>HFE</u>
Human-Machine	11 a (.18) b	16 (.21)	20 (.36)
Interface (Display/Control)	0 (.00)	0 (.00)	3 (.05)
Equipment (Machines/Tools)	15 (.25)	19 (.25)	15 (.27)
Products	7 (.12)	3 (.04)	4 (.07)
Jobs (Tasks/Activity)	6 (.10)	15 (.19)	5 (.09)
Environment (Working/Living)	12 (.20)	17 (.22)	8 (.14)
Process, Procedure, & Method	3 (.05)	5 (.06)	1 (.02)
Training/Selection	4 (.06)	2 (.03)	0 (.00)
Recreations/ Health Care	3 (.05)	0 (.00)	0 (.00)
TOTAL	61	77	56

a frequency  
b proportion

For HF definitions, "equipment", "human-machine interaction", and the "environment" were noted most often as end-systems which were candidates for change. Further, for E, the same three end-systems and "jobs", were mentioned most often. The HFE definitions placed a much greater emphasis on the "human-machine interaction" and "equipment" than it did on the other end-systems. There do not appear to be major shifts in emphasis of changes to end-systems over time (see Table 9).

Table 9  
System Changed: Chronomological Sampling Distribution

<u>End-System</u>	<u>HF</u>	<u>E</u>	<u>HFE</u>
Human-Machine	9 <sup>a</sup> (.32) <sup>b</sup>	9 (.38)	29 (.20)
Interface (Display/Control)	0 (.00)	0 (.00)	3 (.02)
Equipment (Machines/Tools)	7 (.25)	5 (.21)	37 (.26)
Products	1 (.04)	0 (.00)	13 (.09)
Jobs (Tasks/Activity)	4 (.14)	2 (.08)	20 (.14)
Environment (Working/Living)	5 (.18)	6 (.25)	26 (.18)
Process, Procedure, & Method	2 (.07)	2 (.08)	5 (.04)
Training/Selection	0 (.00)	0 (.00)	6 (.04)
Recreations/ Health Care	0 (.00)	0 (.00)	3 (.02)
TOTAL	28	24	142

a frequency  
b proportion

An interesting similarity exists among the three categories in regards to the desired nature of change to the end-system (see Table 10).

Table 10  
Nature of Change: Chronological Sampling Distribution

<u>Nature of Change</u>	<u>HF</u>	<u>E</u>	<u>HFE</u>
Comfort (Habitability)	3 <sup>a</sup> (.07) b	2 (.05)	7 (.17)
Effectiveness	14 (.32)	16 (.40)	12 (.30)
Efficiency (Speed, Accuracy)	3 (.07)	6 (.15)	6 (.15)
Productivity	3 (.07)	5 (.13)	0 (.00)
Safety	5 (.11)	5 (.13)	5 (.13)
Understanding	4 (.09)	0 (.00)	0 (.00)
Usability (Operability)	7 (.16)	2 (.05)	5 (.13)
Well-Being (Health, Happiness)	4 (.09)	3 (.07)	0 (.00)
N/A	1 (.02)	1 (.02)	5 (.13)
TOTAL	44	40	40

Note, N/A no aim/ objective  
<sup>a</sup> frequency  
<sup>b</sup> proportion

All three emphasize "effectiveness" as the desired nature of change. The other nature of changes are fairly evenly distributed. Table 11 presents the nature of change over time.

Table 11  
Nature of Change: Chronological Sampling Distribution

<u>Nature of Change</u>	<u>prior 1970</u>	<u>1970-79</u>	<u>1980-89</u>
Comfort (Habitability)	1 <sup>a</sup> (.07) b	4 (.22)	7 (.08)
Effectiveness	7 (.47)	7 (.39)	28 (.31)
Efficiency (Speed, Accuracy)	2 (.13)	5 (.28)	8 (.09)
Productivity	0 (.00)	0 (.00)	8 (.09)
Safety	1 (.07)	2 (.11)	12 (.13)
Understanding	1 (.07)	0 (.00)	3 (.03)
Usability (Operability)	3 (.20)	0 (.00)	11 (.12)
Well-Being (Health, Happiness)	0 (.00)	0 (.00)	7 (.08)
N/A	0 (.00)	0 (.00)	7 (.08)
TOTAL	15	18	91

Note, N/A no aim/ objective  
<sup>a</sup> frequency  
<sup>b</sup> proportion

Prior to 1970, there was a heavy emphasis on "effectiveness", and a slight emphasis on "usability". From 1970 to 1979, there is still an emphasis on "effectiveness", but "usability" has dropped, and "comfort" and "efficiency" seemed to have gained in emphasis. Finally, from 1980 to 1989, there seems to be a drop in the emphasis on "effectiveness" and a more even distribution among the other nature of change variables.

The medium/actions taken to effect change are presented in Table 12.

Table 12  
Objective: Medium for Change

<u>Medium</u>	<u>HF</u>	<u>E</u>	<u>HFE</u>
Applicable Knowledge	9 <sup>a</sup> (.21) <sup>b</sup>	3 (.08)	0 (.00)
Application	4 (.09)	8 (.20)	1 (.04)
Design/Development	16 (.37)	11 (.28)	21 (.78)
Engineering	3 (.07)	0 (.00)	2 (.07)
Evaluation	3 (.07)	0 (.00)	1 (.04)
Scientific Study, Measurement	5 (.12)	17 (.43)	1 (.04)
Training/Selection	3 (.07)	0 (.00)	1 (.04)
TOTAL	43	39	27

<sup>a</sup> frequency  
<sup>b</sup> proportion

For HF, the use of design and applicable knowledge were mentioned most often as vehicles for changing end-systems. For E Scientific study and design were mentioned most often. There is a very heavy emphasis on design in the HFE definitions. The medium for change over time is presented in Table 13.

Table 13  
Medium for Change: Chronological Sampling Distribution

<u>Medium</u>	<u>prior 1970</u>	<u>1970-79</u>	<u>1980-89</u>
Applicable Knowledge	0 <sup>a</sup> (.00) <sup>b</sup>	0 (.00)	12 (.14)
Application	1 (.07)	1 (.11)	11 (.13)
Design/Development	8 (.57)	6 (.57)	34 (.39)
Engineering	0 (.00)	0 (.00)	5 (.06)
Evaluation	1 (.07)	0 (.00)	3 (.03)
Scientific Study, Measurement	4 (.29)	2 (.22)	17 (.20)
Training/Selection	0 (.00)	0 (.00)	4 (.05)
TOTAL	14	9	86

<sup>a</sup> frequency  
<sup>b</sup> proportion

Prior to 1970, design and scientific study are emphasized most often. This is the same for the period from 1970 to 1979. From 1980 to 1989 there is still an emphasis on design but there is a more even distribution across the other mediums.

An analysis of trend words was an additional procedure used for analyzing the definitions. Table 14 presents some words that were chosen as being potentially representative of shifts of focus in human factors.

Table 14  
Trend Words

	<u>prior 1970</u>	<u>1970-79</u>	<u>1980-89</u>
Efficiency	4 <sup>a</sup> (.13) <sup>b</sup>	4 (.13)	12 (.13)
Environment	7 (.23)	9 (.29)	24 (.26)
Error	2 (.07)	0 (.00)	3 (.03)
Machine	12 (.40)	15 (.48)	24 (.26)
Products	1 (.03)	0 (.00)	18 (.19)
Reliability	0 (.00)	1 (.03)	1 (.01)
Speed/Accuracy	2 (.07)	1 (.03)	2 (.02)
TOTAL	30	31	94
<sup>a</sup> frequency			
<sup>b</sup> proportion			

Two major shifts seem to appear. First, there is a drop in the frequency with which *machines* are mentioned. Second, there is an increase in the frequency that *products* is mentioned.

## DISCUSSION

The results of our compilation and analysis of definitions of human factors and related terms suggest that the construction of a single unifying definition requires the consideration of the following: (1) the apparent differences among human factors, human factors engineering, and ergonomics; (2) the categories of classification of the definition; and (3) the domains or disciplines and the objectives that the definition includes.

The fact that a number of writers think of human factors, human factors engineering, and ergonomics as interchangeable, notwithstanding, our analyses suggest that there are differences among these terms. For example, definitions of human factors include a broader range of classification categories and domains of inclusion; definitions of human factors engineering place an overwhelming emphasis on design as the medium to effect change on an end-system; and definitions of ergonomics emphasize the study of humans at work as an important characteristic.

Although many authors classify human factors in a single category, it is obvious from these analyses that human factors can be categorized in various ways, e.g., a "field," a "discipline," a "profession," etc. When constructing a unifying definition it is obviously important to define which categories are being referred to. An important question that was not analyzed in this study is whether definitions of the same term, classified differently, also differed in other ways. For example, do definitions describing human factors as a profession differ in their objectives and domains of inclusion from definitions describing human factors as body of knowledge?

A unifying definition of human factors should specify the domains of inclusion and the objectives, since there appears to be a chronological trend towards a broadening of these considerations. In its early history, human factors had a much narrower focus, whereas more recently the field has expanded to include a variety of applications. Originally, the focus of human factors was on the design of military man-machine systems. It is obvious that this focus has expanded to include private industry and consumer products as well. Thus, the field has moved from a discipline born in a post-war militarily oriented engineering environment to a more global manufacturing and consumer oriented environment.

There are two major limitations to this study. First, because we did not use a systematic sampling approach, the definitions are not fully representative of all extant resources. (For example, introductory textbooks in psychology, engineering, etc., many of which contain appropriate definitions, were not included.) Although we attempted to gather a group of definitions that was chronologically representative, the majority of human factors books available in the area libraries were published in the 1980's. Yet even with these sampling limitations, it appears that the sample of texts included offered a representative range of definitions.

A second limitation of this study is that because many definitions were represented in multiple frequency counts, we were unable to perform higher level statistical analyses (e.g. Chi Square), and the data should be interpreted with caution.

## APPENDIX

Adams, J. A. (1989)

### **Human Factors Engineering:**

"The field of human factors engineering uses scientific knowledge about human behavior in specifying the design and use of a human-machine system. The aim is to improve system efficiency by minimizing human error." (p. 3)

Air Force Systems Command (1977)

### **Human Factors and Human Engineering:**

"...human engineering is not synonymous with human factors. The term 'human factors' is more comprehensive, covering all biomedical and psychosocial considerations applying to man in the system. It includes not only human engineering, but also life support, personnel selection and training, training equipment, job performance aids, and performance measurement and evaluation." (p. 2-1)

Alexander, D. C. (1986)

### **Industrial Ergonomics:**

"The field of industrial ergonomics is devoted to the alleviation of the rigors of the workplace and to the improvement of the persons performance on the job." (p. 1)

"Industrial ergonomics is the application of those sciences relating human performance (physiology, psychology, and industrial engineering) to the improvement of the work system, consisting of the person, the job, the tools and equipment, the workplace and work space, and the immediate environment." (p. 2)

Applied Ergonomics Handbook (1974)

**Ergonomics:**

"...knowledge based on scientific studies of ordinary people in work situations...applied to the design of processes and machines, to the layout of work places, to methods of work, and to the control of the physical environment, in order to achieve greater efficiency of both men and machines." (p. 2)

"...area of study..." (p. 2)

Bailey R. W. (1982)

**Human Performance Engineering:**

"The primary purpose [of human performance engineering] is to provide designers, particularly those with limited background in psychology, with some knowledge of how people sense, process information, and respond; as well as to introduce data, principles, and methods that are useful in eliciting an acceptable level of human performance in systems." (p. xxi)

"Human performance engineering includes the scientific study of performance-related processes and functions; the translation of research results into meaningful human performance data, design principles, methodologies and techniques; and the appropriate application of this information in systems." (p. 24)

Behan, R. A., & Wendhausen, H. W. (1973)

**Human Factors Engineering:**

"The main goals in human factors engineering are to - 1) Consider any man/machine combination as a total system to insure that the equipment operational requirements do not exceed human abilities 2) Consider the human performance tolerance, thereby insuring optimal speed, accuracy, and quality of performance; eliminating hazards to operating personnel; and maximizing the comfort of the operator" (p. 3)



Bennett, E., Degan, J., Spiegel, J. (1963)

**Human Factors:**

Scientific or engineering studies of human factors in technology are customarily interdisciplinary. They involve identifiable groups of mechanical engineers, electrical engineers, psychologists, anthropologists, industrial designers..." (p. 3)

"Scientific research and engineering studies of human factors in technology seek to realize greater recognition and understanding of man's characteristics, needs, abilities, and limitations when the procedures and products of technology are being designed." (p. 3)

Bernotat, R. K., & Gartner, K.-P. (1972)

**Anthropotechnics and Human Engineering:**

"Anthropotechnics'...means and goals are similar to those of the American 'Human Engineering'...Anthropotechnics is the scientific discipline dealing with the interrelationship between man and machine and is aimed at the optimum of this functional unit in terms of efficiency, reliability, and cost effectiveness through the adaptation of the machine to man's capabilities and requirements." (p. 5)

"...try to adapt the human operator to the machine. This discipline which is oriented towards the "human factor", is largely a field activity of medical and psychological experts..." (p. 5)

"...adaptation of the machine to given human characteristics, i.e. 'Human Engineering' in a more restricted sense...Work in the field of Human Engineering calls for wide interdisciplinary knowledge covering a multitude of subjects such as special vehicle technology, psychology, physiology, control theory, information theory, experimental physics, electronics, measuring techniques, and so on." (p. 5)

Brown, O., & Hendrick, H. W. (1986).

**Ergonomics/Human Factors:**

"...the relations between man and his occupation, equipment, and environment in the widest sense, including work, play, leisure, home, and travel situations." (p. viii)

Chapanis, A. R. (1959)

**Human Engineering:**

"Human engineering is the name applied to that branch of modern technology which deals with ways of designing machines, operations, and work environments so that they match human capacities and limitations. Another way of saying this is that human engineering is concerned with the engineering of machines for human use and the engineering of human tasks for operating machines." (p. vii)

Chapanis, A. R. (1965)

**Human Factors Engineering/Human Engineering:**

"Human factors engineering, or human engineering, is concerned with ways of designing machines, operations, and work environments so that they match human capacities and limitations. [In other words it is concerned with] the engineering of machines for human use and the engineering of human tasks for operating machines." (p. 8)

"...the rationale behind the approach of the human factors engineer: he starts with the certain knowledge and conviction that people are fallible and careless, and that they have human limitations, but he then turns to the machine and the job to see whether he can eliminate their error-provocative features." (p. 8)

"The information that human factors engineers need in their work comes from all the social and behavioral sciences." (p. 10)

Chapanis, A. R. (1971)

**Human Factors Engineering/Human Engineering and Ergonomics:**

"Both are concerned with designing for human use [and] apply information about human characteristics, capacities, and limitations to the design of human tasks, machines, machine systems, and environments so that people can work safely, comfortably, and effectively." (p. 1)

"..ergonomics seems to be more physiologically-oriented than does its American counterpart [human factors engineering]." (p. 1)

"Both ergonomics and human factors engineering are relatively new disciplines..." (p. 1)

Chapanis, A. R. (1975)

**Human Factors Engineering/Human Engineering/Ergonomics:**

"Both disciplines apply information about human characteristics, capacities, and limitations to the design of human tasks, machines, machine systems, living spaces, and environments so that people can live, work, and play safely, comfortably, and efficiently." (p. 1)

"Human engineers draw upon data from the full spectrum of human and biological sciences and seek additional data through experimental and survey research." (p. 1)

Chapanis, A. R. (1986a)

**Human Factors Engineering/Human Engineering/Ergonomics:**

"...the application of information about human characteristics, capacities, and limitations to the design of machines, machine-systems, and environments so that people can live and work safely, comfortably and effectively. The term also designates the profession that deals with such problems. (p. 549b)

Chapanis, A. R. (1986b)

**Human-Factors Engineering:**

"This discipline is concerned with designing both products and processes and equipment used in manufacturing so as to maximize their ability to be used comfortably, safely, and effectively by human beings." (p. 202)

"The term human-factors engineering is used to designate equally a body of knowledge, a process, and a profession. As a body of knowledge, human-factors engineering is a collection of data and principles about human characteristics, capabilities, and limitations in relation to machines, jobs, and environments. As a process, it refers to the conception of designing machines, machine systems, work methods, and environments to take into account the safety, comfort, and productiveness of human users and operators. As a profession, human-factors engineering includes a range of scientists and engineers from several disciplines that are concerned with man at work." (p. 228)

"Because of its broad scope, human-factors engineering draws upon parts of such social or physiological sciences as anatomy, anthropometry, applied physiology, environmental

medicine, psychology, sociology, and toxicology, as well as parts of engineering, industrial design, and operations research." (p. 228)

"The basis of human-factors engineering [is] the consideration of information about human users in the design of tools, machines, jobs, and work environments..." (p. 228)

Chapanis, A. R., Garner, W. R., & Morgan, C. T. (1949)

**Applied Experimental Psychology/Engineering Psychology/ Human Engineering:**

"...the objective [of human engineering, engineering psychology, and applied experimental psychology] is the same - to develop, through fundamental research and applied tests, a science that can deal adequately with the design and operation of machines for human use." (p. v)

Christensen, J. (1987)

**Human Factors Engineering/Applied Ergonomics:**

"'Human factors engineering' (HFE) and 'applied ergonomics' are concerned with the application of the data and principles of human factors and ergonomics to the design of equipment, subsystems, and systems. HFE is an engineering enterprise." (p. 8)

"The research basis for the field of human factors is found in virtually all the so-called life-sciences -- biology, anthropology, physiology, neurology, psychology..." (p. 8)

Christensen, J. M. (1988)

**Human Factors/Ergonomics:**

"...is that branch of science and technology which includes what is known and theorized about human behavioral and biological characteristics. It serves as a repository and source of data and principles that can be validly applied to the specification, design, evaluation, operation, and maintenance of products and systems that are intended for safe, effective, satisfying use by individuals, groups, and organizations. The term 'human factors' is considered synonymous with the term 'ergonomics.'" (p. 9)

**Human Factors Engineering/Human Engineering/Applied Ergonomics:**

"...is the application of the data and principles of human factors to the specification, design, evaluation, operation, and maintenance of products and systems that are intended for safe, effective, satisfying use by individuals, groups, and organizations. The term 'human factors engineering' is considered synonymous with the terms 'applied ergonomics' and 'human engineering.'" (p. 9)

Considine, D. M. (1983)

**Human Factors Engineering:**

"...is a systematic approach to studying problems of human-machine interaction and to arriving at practical solutions on a scientific basis." (p. 1532)

"Thus traditional human factors engineering concerns itself with data gathering and experimentation meant to yield precise information about human capabilities. With such information, machines can be built to fit humans." (p. 1532)

Damon, A., Stoudt, H. W., & McFarland, R. A. (1966)

**Human Engineering/Human Factors Engineering/Ergonomics/ Biotechnology:**

"[This] is not a single scientific discipline but a synthesis which integrates the biological sciences--psychology, anthropology, physiology, and medicine--with engineering." (p. 2)

De Greene, K. B. (1970)

**Human Factors and Engineering Psychology:**

"Human factors [in the broad sense] includes training, manpower determinations, analysis, evaluation, equipment design, and so forth. On the other hand, engineering psychology can be equated most readily to human engineering-equipment, facilities, and environments designed for compatibility with human capabilities and limitations." (p. 5)

Department of Defense (1988)

**Human Engineering:**

"The application of human performance principles, models, measurements, and techniques to systems design. The goal of human engineering is to optimize systems

performance by taking human physical and cognitive capabilities and limitations into consideration during design." (p. 2-1)

**Human Factors:**

"A body of scientific facts about human characteristics, covering all biomedical and psychosocial considerations. Human factors include principles and applications in the area of human engineering, personnel selection, job performance aids, and human performance evaluation."  
(p. 2-1)

Dhillon, B. S. (1986)

**Human Factors:**

"This is a body of scientific facts concerning the characteristics of human beings. The term embraces all biomedical and psychosocial considerations. It includes, but is in no way restricted to, personnel selection, training principles and applications in the area of human engineering, evaluation of human performance, aids for job performance and life support." (p. 3)

**Human Engineering:**

"This is the area of human factors considerations that makes use of scientific facts in the design of items to produce effective man-machine integration and utilization effectively."  
(p. 3)

Eastman Kodak Co. (1983)

**Ergonomics and Human Factors:**

"...a multidisciplinary activity striving to assemble information on people's capacities and capabilities for use in designing jobs, products, workplaces, and equipment." (p. 3)

"The probable benefits of well-designed jobs, equipment, and workplaces are improved productivity, safety, health, and increased satisfaction for the employees." (p. 3)

"...both are concerned with trying to reduce unnecessary stress in the workplace." (p. 3)

"Ergonomics...has traditionally focused on how work affects people...The emphasis of human factors is often on designs that reduce the potential for human error." (p. 3 - 4)

Edholms, O. G. (1961)

**Ergonomics:**

"...ergonomics is 'fitting the job to the worker.'...A more precise definition is to be found in the rules of the ergonomics Research Society, i.e. the anatomical, physiological and psychological study of man in his working environment." (p. 6)

Edwards, E. (1985)

**Human Factors:**

"The most appropriate definition of the applied technology of Human Factors is that it is concerned to optimize the relationship between people and their activities by the systematic application of the human sciences, integrated within the framework of systems engineering." (p. 18)

Edwards, E. (1988)

**Human Factors/Ergonomics:**

"...the discipline of human factors..." (p. 4)

"...the technology concerned to optimize the relationship between people and their activities by the systematic application of the human sciences, integrated within the framework of system engineering." (p. 9)

"...the terms ergonomics and human factors may be regarded as synonymous. (p. 5)

Fitts, P. (1963)

**Engineering Psychology:**

"[Engineering psychology] seeks to understand how human performance is related to task variables and to formulate theory and principles of human performance that can be applied to the design of human tasks, human-operated equipment, and man-machine systems."

Gagne, R. M., & Melton, A. W. (1962)

**Psychotechnology:**

"...the available properties or functions of man must be considered in planning the mating of man and machine components to achieve the desired system function;..." (p. v)

Galer, I. A. R. (1987)

**Ergonomics/Human Factors:**

"An area of study and application has developed which is devoted to the problem of fit [between user and machine or tool]..." (p. 2)

"...ergonomists measure human characteristics and human function, and establish the way that the human body and the human mind work...the results of scientific work in the human sciences are applied by ergonomists in the solution of practical problems in the design and manufacture of products and systems." (p. 2)

Goldenson, R. M. (1984)

**Human Engineering:**

"...a branch of psychology concerned with the design of environments and equipment that promote optimum use of human capabilities and optimum efficiency and comfort." (p. 350)

**Human Factors:**

"...a broad field concerned with the design, maintenance, operation, and improvement of operating systems in which human beings are components, such as industrial equipment, automobiles, health-care systems, recreational facilities, consumer products, and the general living environment." (p. 350)

**Human-Factors Psychology:**

"...a branch of psychology that studies relationships between humans and their work and home environments with the objective of enhancing habitability by redesigning buildings and equipment to fit human abilities and characteristics. New designs are based in turn on user experience with earlier models." (p. 350)



Grandjean, E. (1980)

**Ergonomics:**

"Ergonomics is a study of man's behaviour in relation to his work. The object of this research is man at work in relation to his spatial environment" (p. ix)

"...the most important principle of ergonomics: Fitting the task to the man. Ergonomics is interdisciplinarian: it bases its theories on physiology, psychology, anthropometry, and various aspects of engineering." (p. ix)

"In the past it served mainly to increase efficiency, and thereby productivity. This is no longer the prime goal... the following objectives more closely define the benefits to be gained by ergonomic research: 1) Fitting the demands of work to the efficiency of man in order to reduce stress. 2) Designing machines, equipment, and installations so that they can be operated with great efficiency, accurately, and safely. 3) Working out proportions and conditions of the work place to ensure correct body posture. 4) Adapting lighting, air-conditioning, noise, etc., to suit man's physical requirements." (p. ix)

Handbook of Human Engineering Data (1952)

**Human Engineering:**

"The task of human engineering...is to increase the effectiveness of a man-machine system by treating it as a unified system. We hope to have included in the plans for a machine design some new tolerances - tolerances based on the limits of performance of the man running the machine." (p. 1)

"Specifically, human engineering attempts to analyze the factors that help a man do his job with speed and accuracy. These, with the quality of performance of the machine, help determine the efficiency of the man-machine system. What human engineering is trying to do is to eliminate the danger of making an operator the bottleneck of this man-machine system." (p. 1)

Harre, R., & Lamb, R. (1983)

**Ergonomics:**

"The application of the human sciences to the study of work, including domestic and leisure activities. The core human sciences are anatomy, physiology and psychology, but

there are also contributions from other subjects such as medicine, sociology and cybernetics." (p. 208)

**Human Factors:**

"Is concerned with the interaction of human operators and new technology." (p. 280)

"...is predominantly a psychology/engineering partnership aimed at increasing system efficiency, whereas ergonomics incorporates a stronger anatomical/physiological/medical component and pays considerable attention to health and well-being as well as to efficiency." (p. 280)

Hawkins, F. H. (1987)

**Human Factors:**

"Human factors is about people. It is about people in their working and living environments. It is about their relationship with machines and equipment, with procedures and with the environment about them. And it is also about their relationship with other people...Its twin objectives can be seen as effectiveness of the system, which includes safety and efficiency, and well-being of the individual." (p. 18)

Hertzberg, H. T. E. (1955)

**Human Engineering:**

"...fitting the machine to the man, and keeping him functioning with efficiency, with safety, and without discomfort in any environment."

Huchingson, R. D. (1981)

**Human Factors:**

"...a comparatively new discipline concerned with designing manufactured objects so that people can use them more effectively and creating environments that are better suited for human living and work." (p. ix)

"In [a] broad sense, human factors is concerned with virtually every consideration of the human in the system, for example, reasons<sup>26</sup> for being in the system; functions and tasks, the design of jobs for various personnel, training and evaluation." (p. 5)

"The objectives of an effective human factors program may be summarized as follows: (1) improved human performance as shown by increased speed, accuracy, and safety, and less energy expenditure and fatigue; (2) less training and reduced training costs; (3) improved use of manpower through minimizing the need for special skills and aptitudes; (4) reduced loss of time and equipment as accidents due to human errors are minimized; (5) improved comfort and acceptance by the user/operator.  
(p. 7)

"...is concerned with improving the productivity of the operator by taking into account human characteristics in designing systems." (p. 7)

### **Human Engineering/Human Factors Engineering:**

"In [a] broad focus, human engineering (or human factors engineering) is only one of several endeavors, the one concerned with the design and layout of equipment, facilities, and environment. A very simple definition of human engineering is "a discipline concerned with designing man-made objects (equipment) so that people can use them effectively and safely and creating environments suitable for human living and work." (p. 5)

"No single professional group is responsible for research in human engineering to the design of systems. Psychologists, physiologists, anthropologists, physicians, and various engineering professions are among the contributors." (p. 6)

Kantowitz, B. H., & Sorkin, R. D. (1983)

### **Human Factors:**

"...the discipline that tries to optimize the relationship between technology and the human." (p. 4)

Kidd, J. S., & Van Cott, H. P. (1972)

### **Human Engineering Analysis:**

"...consists of methods whereby decisions can be made concerning the design of the system and particularly the safety, effectiveness, role, and integration of man in the system." (p. 1)

"The goal of the human engineer working with the design of a traditional system is largely one of improvement or optimization." (p. 2)

**Human Engineering:**

"...in the case of a new system the human engineer is concerned with conceptually synthesizing a total system, with determining the role that human performance will play in such a system, and then with designing the environment and man-machine interface to make that performance possible." (p. 3)

Lederer, J. (1988)

**Human Engineering:**

"...fitting the machine to human limitations." (p. xv)

Mark, L. S., Warm, J. S., & Huston, R. L. (1987)

**Ergonomics/Human Factors:**

"...attempts to optimize the fit between people and their environment." (p. 2)

McCormick, E. J., & Sanders, M. S. (1982)

**Human Factors/Ergonomics:**

"The field of human factors-referred to as ergonomics in Europe and elsewhere-deals with the consideration of human characteristics, expectations, and behaviors in the design of the things people use in their work and everyday lives and of the environments in which they work and live. In simple terms, human factors has been referred to as designing for human use." (p. vii)

"The central focus of human factors relates to the consideration of human beings carrying out such functions as (1) the design and creation of man-made objects, products, equipment, facilities, and environments that people use; (2) the development of procedures for performing work and other human activities; (3) the provision of services to people; and (4) the evaluation of the things people use in terms of their suitability for people." (p. 4)

"The objectives of human factors...are twofold, as follows: (1) to enhance the effectiveness and efficiency with which work and other human activities are carried out; and (2) to maintain or enhance certain desirable human values (e.g., health, safety, satisfaction).

"Although no short catch phrase can adequately characterize the scope of the burgeoning field of human factors, such expressions as designing for human use and optimizing working and living conditions may at least lend a partial impression of what human factors is about." (p. 4)

Meister, D. (1971)

**Human Factors:**

"...those elements which influence the efficiency with which people can use equipment to accomplish the functions of that equipment." (p. 5)

"...the number and type of personnel selected to run the system and how they function. This includes a) the number of operators and maintenance technicians in the system... b) their skill level... c) the functions and tasks they must perform in controlling their equipment...d) how they perform their tasks." (p. 6)

"...the manner in which personnel perform in using the equipment...and the effect of that performance on other system elements...or on over-all system goals..." (p. 6)

"...the effect of the over-all system upon its personnel elements." (p. 6)

"...the profession in which human factors specialists function." (p. 6)

Meister, D. (1976)

**Human Factors:**

"Equipment design which consciously takes advantage of human capabilities and constrains itself within human limitations amplifies and increases system output." (p. vii)

"Human Factors is one of the newer engineering disciplines." (p. vii)

Meister, D. (1985)

**Ergonomics/Human Factors:**

"...the purpose of ergonomics/human factors is to describe, analyze, measure, predict, and control the real world of systems functioning operationally (i.e., not under experimental control)." (p. viii)

"The study of the relationship between this personnel subsystem and the other system elements, including most importantly, the terminal system output, is the most important research goal for ergonomics/human factors." (p. viii)

Meister, D., & Rabideau, G. F. (1965)

**Human Factors:**

"...the variables involved in the relationship between the capabilities and limitations of men and the characteristics of machines. The practice of human factors is the application of these variables to the design and evaluation of man-machine systems." (p. 3)

"Human factors is descended from and related to industrial engineering and experimental psychology and also involves physiology, medicine, and anthropology." (p. 3)

"...the variables involved in (1) the characteristics (capabilities and limitations) of man, (2) the characteristics (design features) of individual machines and machine systems, and (3) the relationship between them. The industrial practice of "human factors" (or human engineering, biotechnology, engineering psychology, or ergonomics, as it has been variously called) as a professional "discipline" is the application of these variables in the development and evaluation of man-machine systems. The purpose of applying these variables is to improve the performance of men in operating and maintaining their machines, so that resulting system operations will meet specified performance requirements." (p. 4)

Morgan, C. T. (1961)

**Human Engineering:**

"In psychological usage, the field of specialization concerned with the design of equipment and of tasks performed in the operation of equipment; sometimes called engineering psychology." (p. 674)

### **Engineering Psychology:**

"An applied field of psychology concerned with psychological factors in the design and use of equipment." (p. 671)

Murrell, K. F. H. (1965)

### **Ergonomics:**

"...the scientific study of the relationship between man and his working environment. In this sense, the term environment is taken to cover not only the ambient environment in which he may work but also his tools and materials, his methods of work and the organization of his work, either as an individual or within a working group. All these are related to the nature of the man himself; to his abilities, capacities and limitations." (p. xiii)

National Research Council (1983)

### **Human Factors Engineering:**

"...can be defined as the application of scientific principles, methods, and data drawn from a variety of disciplines to the development of engineering systems in which people play a significant role. Successful application is measured by improved productivity, efficiency, safety, and acceptance of the resultant system design. The disciplines that may be applied to a particular problem include psychology, cognitive science, physiology, biomechanics, applied physical anthropology, and industrial and systems engineering." (p. 2)

The New Encyclopedia Britannica (1986)

### **Human-Factors Engineering/Ergonomics:**

"...application of information on physical and psychological characteristics to the design of devices and systems for human use. Its data and principles apply to activities of the home, the workplace, and recreation." (p. 136)

"Human-factors engineering as an interdisciplinary profession is concerned with human performance, behaviour, and training in man-machine systems; the design and development of man-machine systems; and systems-related biological or medical research." (p. 136)

"Human-factors engineering deals in large part with improving the practicality, efficiency, and safety of the man-machine model..." (p. 136)

North, K., Stapleton, C., & Vogt, C. (1982)

**Ergonomics:**

"The relation between man and his occupation, equipment and environment and, particularly, the application of anatomical, physiological and psychological knowledge to the problems arising therefrom." (p. 140)

**Human Engineering:**

"A branch of engineering science and applied psychology." (p. 158)

Park, K. S. (1987)

**Human Engineering:**

"...human reliability is the raison d'etre of Human Engineering; for the latter is a discipline responsible for the design of dependable man-machine systems fitted to the man for functional effectiveness so that he can go about 'doing his job'." (p. v)

Parker, S. P. (1989)

**Ergonomics:**

"The study of human capability and psychology in relation to the working environment and the equipment operated by the worker." (p. 660)

**Human-Factors Engineering:**

"The area of knowledge dealing with capabilities and limitations of human performance in relation to design of machines, jobs, and other modifications of the human's physical environment." (p. 660)



Pelsma, K. H. (1987)

**Ergonomics/Human Factors:**

[The application of] knowledge about human characteristics and capabilities - physical, psychological, and cognitive - to the design of products, processes, and environments with the goal of improving well-being and optimizing productivity." (p. ix)

Poulton, E. C. (1966)

**Engineering Psychology:**

"The aim of engineering psychology is not simply to compare two possible designs for a piece of equipment, but to specify the capacities and limitations of the human, from which the choice of the better design should be deducible directly." (p. 29)

Proceedings of Conference on Ergonomics in Industry (1961)

**Ergonomics:**

"...describes in one word many and varied applications of sciences like anatomy, physiology and experimental psychology to the problems of fitting the job to the worker. The objective is to improve industrial efficiency by designing equipment to ensure that its operation is within the limits of the mental and physical capacities of most normal people, taking into account the effects on performance of the complexity of the job, and of environmental conditions such as noise, lighting and temperature." (p. vii)

Rubinstein, R., & Hersh, H. (1984)

**Human Factors/Ergonomics:**

"...the study of how people and machines interact. It is a technology for creating designs that work well in human terms." (p. 5)

"...is both an engineering discipline and an applied science. Human factors engineers are concerned with designing safer, more productive, easier-to-use equipment and environments, and with selecting and training people to deal with existing environments." (p. 6)

Salvendy, G. (1985)

**Ergonomics and Human Factors:**

"The word ergonomics implies the study of man at work while word human factors implies the study of man in relation to equipment and environment." (p. 97)

Salvendy, G. (1987)

**Human Factors:**

"...the role of humans in complex systems, the design of equipment and facilities for human use, and the development of environments for comfort and safety." (p. xvii)

Sanders, M. (1988)

**Human Factors:**

"... is that branch of science and technology that includes what is known and theorized about human behavioral and biological characteristics that can be validly applied to the specification, design, evaluation, operation, and maintenance of products and systems to enhance safe, effective, and satisfying use by individuals, groups, and organizations. (p. 8)

Schultz, D. P. (1982)

**Engineering Psychology/Human Factors/Human Engineering:**

"...matching of operator and machine...The field is a hybrid of engineering and psychological knowledge. We may formally define it as a science of engineering machinery or equipment for human use, and as the science of engineering human behavior for proper operation of the machines." (p. 374)

Sheridan, T. B (1987)

**Human-Factors Engineering:**

"The area of knowledge dealing with the capabilities and limitations of human performance in relation to design of machines, jobs, and other modifications of the physical environment. Human-factors engineering seeks to ensure that humans' tools and

environment are best matched to their physical size, strength, and speed and to the capabilities of the senses, memory, cognitive skill, and psychomotor preferences." (p. 525)

Singleton, W. T., Easterby, R. S., & Whitfield, D. C. (1967)

**Ergonomics:**

"...the parts of psychology, physiology and anatomy which are relevant to the study of and the design of human tasks, work-places, machines and environments...systems design [is] an organized approach to the business of decision-making in any design context with what we regarded as a proper emphasis on human factors. This combination of disciplines is the stock-in-trade of the systems ergonomist..." (p. xvii)

Spencer, R. H. (1985)

**Human Factors Engineering:**

"...characteristics of man in useful combination with machines, products, systems, and processes actively contributing to the production of a result." (p. 7)

Taylor, F. V. (1971)

**Human Engineering/Biomechanics/Psychotechnology/Engineering Psychology:**

"...help the engineers [in the production of] machines which required less of the man and which, at the same time, exploited his special abilities...psychologists...with the help of anatomists, physiologists, and of course, engineers they started a new inter-discipline aimed at better machine design..." (p. 4)

Thomas, J. C. (1984)

**Human Factors/Ergonomics:**

"...the scientific study of the relationship between humans and their work...not just as a scientific study but as **using** what we know about the way people really are to design systems and tools that help make people more productive and happier." (p. 30)

Tichauer, E. R. (1978)

**Ergonomics:**

"...the discipline dealing with the interaction-physical as well as behavioral-between man, his workplace, his tools, and the general environment, is a very broad field. It utilizes, as tributaries, so many aspects of the biological, behavioral, medical, and technological sciences..." (p. i)

University of Michigan, Center for Ergonomics (1988)

**Ergonomics:**

"...derived from the greek words "ergon", work, and "nomos", law, means the study, or principles, of work. Ergonomists are interested in the design of human-hardware systems that are at once productive, efficient, and safe. They are concerned with improving both the design of machines, vehicles, and tools, as well as the design of work methods and work environments in general."

Webster's Ninth New Collegiate Dictionary (1983)

**Ergonomics:**

"...an applied science concerned with the characteristics of people that need to be considered in designing and arranging things that they use in order that people and things will interact most effectively and safely."

Wickens, C. D. (1984)

**Human Factors:**

"[The aim of human factors is the design of] machines that accommodate the limits of the human user..." (p. 3)

The goal of human factors...is to apply knowledge in designing systems that work, accommodating the limits of human performance and exploiting the advantages of the human operator in the process." (p. 3)

Wolman, B. B. (1973)

**Engineering Psychology:**

"1. Study of the relationships between man and machines. 2. Adjusting the design of machines to the needs and capacities of man. 3. Study of the effect of machines on man's behavior." (p. 122)

**Ergonomics:**

"The scientific study of the relationships between men and machines, particularly the psychological, biological, and cultural with the purpose of adapting machines and jobs to meet the needs of men and of choosing suitable persons for particular jobs or machines." (p. 126)

**Human Engineering:**

"An applied area of psychology and engineering which concerns itself with the design of the physical conditions, machines and other equipment in relation to human capabilities, learning capacities, efficiency and comfort." (p. 178)

Woodson, W. E. (1954)

**Human Engineering:**

"Briefly, human engineering means engineering for human use. More specifically, human engineering is defined as follows: the design of human tasks, man-machine systems, and specific items of man-operated equipment for the most effective accomplishment of the job, including displays for presenting information to the human senses, controls for human operation, and complex man-machine systems. In the design of equipment, human engineering places major emphasis upon efficiency, as measured by speed and accuracy of human performance, in the use and operation of equipment. Allied with efficiency are the safety and comfort of the operator." (p. 0-1)

Woodson, W. E. (1981)

**Human Factors Engineering/Ergonomics:**

"...the intent of human factors engineering on the whole is to focus on and resolve human-product interface problems and solutions wherever or whatever they are...Inherent in this philosophy are the following objectives: (1) To make the user's contribution to product

output as efficient as possible...(2) To make the combined user-product involvement as safe as possible...(3) To minimize stress that a product imposes on the user as he or she uses, operates, services, or maintains it...(4) To maximize acceptability of the product..." (p. i)

"...the practice of designing products so that the user can perform required use, operation, service, and supportive tasks with a minimum of stress and a maximum of efficiency. To accomplish this, the designer must understand and acknowledge the needs, characteristics, capabilities, and limitations of the intended user and design 'from the human-out.' In other words, the designer should make the design 'fit the user,' as opposed to trying to make the user 'fit the design.'" (p. i)

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