DEVELOPING CRITERIA FOR RECOGNIZING EXCELLENCE IN UNDERGRADUATE HUMAN FACTORS EDUCATION

Panel Chair:
Lawrence G. Shattuck, Naval Postgraduate School, Monterey, CA

Panel Members:
Ann M. Bisantz, State University of New York at Buffalo, Buffalo, NY
Richard D. Gilson, University of Central Florida, Orlando, FL
William F. Moroney, University of Dayton, Dayton, OH
Esa Rantanen, University of Illinois at Urbana-Champaign, Champaign, IL

The purpose of this panel is report on the work of the Undergraduate Program Recognition Committee and to encourage discussion among attendees on the proposed criteria developed by the committee. The paper and the panel discussion will provide an overview of the graduate program accreditation process, report on the work of the Special Task Force on Undergraduate Program, and propose criteria that can be used to recognize the various types of human factors programs that currently exist.

INTRODUCTION

The Human Factors and Ergonomics Society (HFES) has recognized excellence in graduate human factors education for many years through an accreditation process. Programs seeking accreditation conduct a self study and submit a report to HFES. If the program under review meets the standards set forth by the Society the program is accredited for a six-year period. To date, there has been no similar accreditation or recognition for undergraduate programs by the Society. Recently, the Society's Executive Council formed a committee to study the issue of undergraduate program recognition. The committee recommended to the Executive Council that the Society proceed with developing a plan and program to recognize excellence in undergraduate education. The Executive Council then formed a committee to develop criteria by which undergraduate programs would be evaluated and subsequently recognized. The purpose of this panel presentation is to provide an open forum for the Undergraduate Program Recognition Committee members to discuss their ideas and the challenges associated with identifying and rewarding excellence in undergraduate education and to provide those in the audience the opportunity to respond to the ideas put forth by the panel.

Graduate Human Factors Program Accreditation

The general approach that HFES has taken to accreditation is in line with the engineering accreditation model (ABET). Programs complete a self-study which includes the following information: Description of the Program Environment; Human Factors Specifics; Facilities; Faculty; Other Participating Departments; Practical Experience; Plans; and Summary. A significant portion of the evaluation focuses on the curriculum. No program is expected to cover the breadth and depth of the human factors discipline. However, graduate programs seeking accreditation should have the following components; Knowledge About Properties of People; Research Methodologies; Analysis and Design Methodologies; Skills; Research Experience; and, Practical Experience. In addition to these general topic areas, it is expected that each graduate program have a specific area in which it specializes.

Special Task Force on Undergraduate Programs

Prior to the current panel, a committee chaired by Richard D. Gilson and consisting of John G. Casali, Arthur D. Fisk, and Michael S. Wogalter assessed the feasibility of recognizing undergraduate human factors programs.. The following information is taken from their *Midyear 2004 Report to HFES Executive Council*.

The goal of HFES with respect to recognizing excellence in undergraduate education is to encourage undergraduate participation in human factors and in the Society as a means of improving the profession. The Special Task Force was not unanimous in its approach to recognizing excellence in undergraduate education. One approach was to set up criteria for recognition, reward programs that meet the criteria, and encourage those that don't to seek such recognition. Another approach was more process-oriented in that it suggested establishing guidelines to promote achievement in human factors. The focus is more on educational activities than on outcomes. As such, the society would provide information on current "best practices" in the training of human factors professionals. Thus, individual institutions would decide both how, and how much of this guidance they elect to incorporate into their programs. It would include developing and maintaining guidelines for majors, minors, courses, as well as short programs, speakers or any other forum that includes undergraduate education. The Special Task Force also provided some details on how these approaches might be implemented.

Approach 1. Recognize "exceptional" undergraduate programs in human factors/ergonomics based on:

- Nominations for programs of distinction by HFES members
- Number of graduates from the program that attend graduate schools each year.
- Average GRE scores of graduates (who take the exam) from the program each year.
- Number of publications by students in the program each year.
- Awards received by students in the program each year.

Approach 2. Recognize all undergraduate programs that offer a degree in human factors/ergonomics, or that adopt an approved human factors curriculum (and perhaps which have local student chapters of HFES). Provide guidelines for a standardized core of human factors courses/activities that might serve as the basis for such recognition. As incentives:

- Offer free subscriptions to the HFJ and Ergonomics-in-Design to any such undergraduate program.
- Provide citations, perhaps in the form of certificates and mention in the Bulletin.
- Highlight programs recognized by HFES at the Annual meeting, initially as they are recognized, and later on a rotating basis.
- Recognize students graduating from HF/E programs with a certificate from the Society.

The Special Task Force concluded its report by recommending that the Society promote the achievement and inclusion of undergraduates in human factors but deferred the task of development of criteria for recognition. The Task Force encouraged the Society to make a strong pitch to undergraduates and their institutions that HF/E is an interesting and rewarding career choice.

UNDERGRADUATE PROGRAM RECOGNITION COMMITTEE

The HFES Executive Committee reviewed the findings of the Special Task Force and decided to proceed with the process of recognizing (rather than accrediting) undergraduate human Factors programs. The question with which the present Undergraduate Program Recognition Committee has wrestled is the degree to which the graduate school accreditation criteria could (or should) scale down to undergraduate program recognition criteria. Undergraduate programs differ significantly from graduate programs. The major difference is in their structure. Some colleges and universities offer undergraduate degrees in human factors engineering or engineering psychology. Other institutions offer degrees in psychology but provide students the ability to focus or concentrate their coursework in human factors. Some human factors education occurs in engineering departments in which the most that a student could do would be to take courses in which human factors content has been integrated. Still other human factors programs exist in a focused discipline, such as aviation human factors.

The recognition criteria should be broad enough to encompass the diversity of programs that exist but stringent enough to separate programs which are truly excellent from those which merely exist. In addition, the administration of undergraduate program recognition should not be burdensome on either HFES or the institutions seeking recognition.

The following sections provide the perspective of panel members, preceded by initial remarks by William Moroney, a longtime member of the Graduate Program Accreditation Review Committee.

William Moroney, Former Chair of the Graduate Program Accreditation Review Committee

What constitutes undergraduate education in human factors and ergonomics that is worthy of recognition? Perhaps the first criterion should be breadth of courses. While this will vary as a function of the departments in which the program in located, ideally the courses should provide knowledge about the human as both an information processor and as a physical engine. Thus courses such as perception, cognition, learning, physiology and biomechanics are desired. Methodological courses including statistics, experimental design and analysis should also be required. Programs could be expected to have a unique emphasis; such as HCI or work physiology. Since HF/E emphasizes the application of knowledge, programs worthy of recognition would provide research experience and/or practical experience in a domain in which faculty have expertise. Graduates could be expected to demonstrate an integration of their knowledge in a capstone course, which might include an honors thesis or an interdisciplinary project. Interdisciplinary courses which broaden the student's horizons should be encouraged.

Ann M. Bisantz, State University of New York at Buffalo (HF in an Industrial Engineering Program)

In engineering schools, HFE material and courses (when offered) are typically provided as part of engineering degree programs such as Industrial, Systems, or Mechanical engineering programs. Often, the only engineering students exposed to concepts of HFE, including important aspects of technology design, human-computer interaction, and workplace safety are those who pursue these degrees in those departments where HFE courses are offered. In the United States, most engineering schools pursue national accreditation for their undergraduate programs, and only offer degrees that can be accredited. National accreditation is considered a key indicator of quality engineering programs and is required for students seeking licensure as a professional engineer. Issues regarding the recognition or certification of HFE curriculum and/or degree programs vis-à-vis undergraduate engineering education are numerous, and include the following: First, ABET (the national accrediting body) does not accredit a program with the title Human Factors Engineering. Most engineering schools will therefore be unlikely to offer such a program/degree. Second, undergraduate engineering curricula already required at least 8 semesters of coursework. For certification or recognition to be relevant, it must dovetail

within current curricular constraints (e.g., make recommendations regarding commonly taught course content, rather than a new courses or programs). Third, any process should fit within the already extensive accreditation process undergone by engineering programs. Finally, it is important to create a process that can fit within these constraints, because it is critical to continue to provide, and encourage more programs to offer, HFE content to engineering students.

Richard D. Gilson, University of Central Florida (Concentration in Human Factors)

The University of Central Florida's (UCF) model for participation by undergraduate students in human factors is one of informal "inclusion" in the graduate educational process. Participation by these students often starts at the upper-class level with a standalone undergraduate course in human factors that surveys the discipline and typically generates a strong interest in the area. Following this course, it is not unusual for undergraduates to take mixed-level first-year graduated courses in human factors studies along with graduate students. Others also branch out to join in unfunded or funded research projects, often assisting graduate students in their work, while others conduct research projects on their own with honors theses incorporating human factors into or as their major area of study. With success, guidance is given to top students in applying to graduate schools whether it is to UCF or to many other fine graduate schools across the country with offerings in human factors. If a student is undecided as to their entry into graduate school, many avail themselves of postgraduate course offerings. These postgraduate courses allow successful students who finally matriculate into graduate education at State Schools in Florida [and often beyond] to use up to nine credits towards their doctoral work.

Esa Rantanen, University of Illinois (Major in Aviation Human Factors)

The field of human factors spans a vast assortment of topics and areas. While this is what makes human factors such an exciting and rewarding discipline it also necessarily results in a wide variety of programs and curricula, which must balance depth and breadth within the constraints of available credit hours. It is hence apparent that to expect a comprehensive education in human factors within a single program is simply not reasonable. To define criteria for evaluation and comparison of necessarily very diverse programs, then, is a uniquely challenging task. There are several alternative solutions to this dilemma. First, a higher-level classification scheme may be devised that divides human factors into different areas of concentration, or specialization, within which different programs would fall. Then, it might be feasible to define topics and subtopics that a program would be expected to cover within its area and use such standard as evaluation criterion. This approach, however, necessarily limits the variability of programs and may stifle innovative approaches to human factors education. Evaluation criteria could also be defined at a higher level that transcends specific topics and be applicable to any program that is even remotely relevant to the human factors discipline, but the utility of such general criteria may be questionable. Finally, it may be possible to identify existing programs that are exemplary and demonstrably excellent and use these as benchmarks against which other programs may be evaluated. This approach, however, begs the question of criteria by which the benchmarks are chosen.

Lawrence G. Shattuck, U.S. Military Academy (Major in Engineering Psychology)

As the Director of the U.S. Military Academy's Engineering Psychology Program for ten years, I was responsible for ensuring that cadets enrolled in the curriculum received the best possible education in the field of human factors and that they were also prepared to lead soldiers upon graduation. Cadets majoring in Engineering Psychology take ten courses in a specified sequence, all of which are directed. There are no electives. The courses are divided into three general topic areas: research methodology; physical and psychological theories and principles; and, application. In addition, there are a variety of skills that are strategically sprinkled through the curriculum. For example, cadets are taught to critically evaluate research articles, to design field and laboratory experiments, to collect and analyze data, to report their findings both orally and in writing, to model human performance, and to construct prototypes. In addition, prior to graduation, nearly all cadets present their research at a professional human factors conference and visit at least one professional human factors research facility. Given that this program has excellent support of the institution and is one in which cadets can major in human factors, it is able to meet many of the criteria established for graduate program accreditation.

A PROPOSAL FOR COURSEWORK CRITERIA

Using the four program exemplars described above, and adapting the criteria from the graduate program accreditation process, the Undergraduate Program Recognition Committee members mapped the courses in their curricula to those criteria. In addition, they assessed what ought to be included in undergraduate HF programs of excellence. Their thoughts are provided in the matrix at Appendix A. This is only a proposal and it is hoped that the discussion generated by the panel will assist the committee members in refining the criteria. Much work remains, including establishing criteria or guidelines for faculty and facilities, as well as determining how and by whom the recognition program will be administered. The Undergraduate Program Recognition Committee expects to leverage the feedback from this panel and make its recommendations to the Executive Council shortly after the annual meeting.

Appendix A

	University at Buffalo (HF in an IE Program)		**University of Illinois (Major in Aviation Human Factors)**	
"Program" Components	**Course numbers and titles in Present Curriculum**	**Courses/Opportunities That Should Be Included in a Recognized Program**	**Course numbers and titles in Present Curriculum**	**Courses/Opportunities That Should Be Included in a Recognized Program**
Core Area 1:				
Human as Information Processor	**Coverage in IE 323**, Intro to Ergonomics	An IE curriculum should include at least one HF core course (most include one to 2 courses on ergonomics, HF, and or work measurement)	**PSYC/AVI 358/IE 340** (Intro to HF Eng) **PSYC/AVI 456/IE 445** (Hum Perf & Eng Psych); **AVI 447/PSYC 457** (Human Error); P**SYC 497/AVI 495** (Aviation Psych)	
Human as Physical Engine	**Coverage in IE 323**, Intro to Ergonomics	An IE curric should include at least 1 HF course (most include 1 to 2 courses on ergonomics, HF, and or work measurement)		
Core Area 2:				
Research Methodology	**IE 305** (Probability); **IE 306** (Stats & Exper Design); IE 420 Industrial and Systems Laboratory	An ABET criteria - design of experiments, data analysis. Any IE curriculum that includes HF should include aspects of human performance data collection & analysis as part of its stats & lab components.	**PSYC/AVI 358/IE 340** (Introduction to Human Factors Engineering)	
Core Area 3:				
Analysis & Design Methodology	**IE 323** (Ergonomics); **either IE 435** (HCI) **or IE 441** (Safety Systems); **IE 420** Indus and Sys Lab (integrates HF analysis & design w/ other IE core concepts)	An IE program with an HF component should include analysis of human perf & design of systems/components that integrate humans w/tools, environments, tasks. Could be provided in a separate course, or as part of other lab courses.	**PSYC/AVI 358/IE 340**: (Intro to HF Eng)	
Core Area 4:				
Mathematical Skills	4 sem of calculus + at least 3 years of additional courses, most of which are mathematically intensive	Any engineering program will have this covered.	**Quant I**, (Introduction to Statistics); **Quant II**, (Select from approved list)	
Computer Skills	**EAS 230** (a C++ course) + **IE 477** - Digital Simulation + exposure/ use of Maple, Excel	Any engineering program will have this covered.		
Communication Skills	This is an ABET requirement; all eng programs have to assess skills in this area. Typically includes tech reports/lab write ups, oral presentations.		**Composition I**, (combination of selected courses, e.g, Academic Writing, College Composition and Writing, Verbal Communication, plus **Composition II.**	
Core Area 5:				
Research Experience/ Opportunities	opportunity for IE 498 (Undergraduate Research)	Unlikely all students in an eng curric will complete this, even if offered, & it may not be in HF. Therefore, cannot include this as a reqmt for recognizing an engineering based program.	PSYC/AVI 358/IE 340: Introduction to Human Factors Engineering	
Practicum	IE 496 - Industrial Eng Internship ((Work at a company, w/supervision. Serves as capstone design course. Couldn't guarantee HF content.	Capstone/integrative design exper (e.g., sr design/ internship project) is req'd of all eng students. Unrealistic to constrain projects to w/ HF content. Instead, could require a project in an HF course.		

	U.S. Military Academy (Major in Engineering Psychology)		University of Central Florida (Major in Psychology)	
"Program" Components	**Course numbers and titles in Present Curriculum**	**Courses/Opportunitities That Should Be Included in a Recognized Program**	**Course numbers and titles in Present Curriculum**	**Courses/Opportunitities That Should Be Included in a Recognized Program**
Core Area 1:				
Human as Information Processor	**PL391** (Sens & Perc); **PL392** (Cog Psych)	About right.	**EXP 3404**(Learning); **EXP3204C** (Percep); **EXP3604C**(Cog Psych); **PSB4422** (Brainwaves & Behav); **PSB4240C** (Neuropsych); **PSY3302** (Psych Msrmnt); **EXP4507C** (Adv Hum Mem&Cog)	**EXP 3404** (Learning); **EXP3204C** (Percep); **EXP3604C**(Cog Psych); **PSB4240C** (Neuropsych); **PSY3302** (Psych Msrmnt);
Human as Physical Engine	**PL390** (Biological Psychology); **PL394** (Anthropometrics & Biomechanics)	About right.	**EXP3250** (HF); **PSB3002** (Physio Psych); **PCB3703C** (Hum Physio); **ZOO3733C** (Hum Anat); **PET4312** (Biomech); **PET4351C** (Appl Exer & Hum Physio); **PHT3122** (Kinesio); **PHT3122L** (Kinesio Lab)	**EXP3250** (HF); **PSB3002** (Physio Psych); **PCB3703C** (Hum Physio); **ZOO3733C** (Hum Anat); **PHT3122** (Kinesio);
Core Area 2:				
Research Methodology	**PL386** (Experimental Psychology); **MA206** (Intro to Prob and Stats); **MA376** Applied Prob & stats)	PL386 (Exp Psych) is a 1 sem research methods course that should really be expanded to 2 sem and perhaps integrated with the stats course.	**PSY3213C** (Rsch Meth in Psych); **PSY4215C** (Adv Rsch Meth); **PSY3302** (Psych Msrmnt); **PSY3320C** (Surv Meth in Psych); **PSY4305C** (Psych Msrmnt Lab)	**PSY3213C** (Rsch Meth in Psych); **PSY4215C** (Adv Rsch Meth); **PSY3320C** (Surv Meth in Psych)
Core Area 3:				
Analysis & Design Methodology	**PL475** (HCI); **PL485** (HF Eng; **PL488E** (Human Error); **PL490** (Eng Psych in Design); plus a 3-course engineering sequence in 1 of 7 engineering disciplines.	Curriculum could be augmented with instruction on training, on cost-benefit analysis, and on organizational impacts of implementing new technologies in the workplace.	**STA2023** (Stat Meth), **PSY4213L** (Adv Rsrch Meth Stat Lab); **STA4102** (Computer Proc of Stat Data); **STA4163** (Stat Meth II); **STA4164** (Stat Meth III)	**STA2023** (Stat Meth), **PSY4213L** (Adv Rsrch Meth Stat Lab); **STA4102** (Computer Proc of Stat Data)
Core Area 4:				
Mathematical Skills	2 sem of Calculus; 1 sem of Math Modeling	About right.	**MAD2104** (Discrete Math); **MAC 1105** (Algebra); **MAC2233** (Calc)	**MAD2104** (Discrete Math); **MAC 1105** (Algebra); **MAC2233** (Calc)
Computer Skills	2 sem of Information Technology (includes programming and web design)	About right.	**COP3502C** (Comp Sci I); **COP3503C** (Comp Sci II); **COP2200** (Comp Pgming)	**COP2200** (Comp Pgming)
Communication Skills	1 sem English Lit; 2 sem Composition; Oral and/or written presentations in APA format req'd in all Eng Psych courses.	About right.	**COM1000** (Comm); **COM3011C** (Comm & Hum Rel); **COM3110** (Bus & Prof Comm); **ENC3241** (Writing for Tech Prof); **ENC3211** (Theory & Pract of Tech Writing); **ENC4280** (Tech Writing Style)	**COM1000** (Comm); **COM3110** (Bus & Prof Comm); **ENC3241** (Writing for Tech Prof)
Core Area 5:				
Research Experience/Opportunities	**PL386** (Exp Psych), **PL391** (Sens & Perc), **PL485** (HF Eng), and **PL490** (Eng Psych in Design) all require course projects (i.e., experiments in HF with APA-formatted reports).	About right.	**PSY4903** (Directed Readings); **PSY4970** (Undergrad Thesis)	**PSY4903** (Directed Readings); **PSY4970** (Undergrad Thesis)
Practicum	3-week internships are offered to cadets between junior & senior years to work on govt-related HF projects. PL490 (Eng Psych in Design) also serves as a capstone/ integrative experience for cadets.	Internships should be encouraged but not necessarily mandatory for graduation.	**PSY3951** (Undergrad Field Work)	**PSY3951** (Undergrad Field Work)