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Development of Human Factors and Automotive Standards Curricula Materials for the University of Michigan and Beyond

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16. Abstract

To support National Institute of Standards and Technology's (NIST) mission to promote U.S. innovation and industrial competitiveness by advancing standards and technology, NIST is funding several projects to develop educational materials to advance knowledge of standards. This project has developed materials related to human factors / ergonomics and human-computer interaction, as well as materials related to automotive engineering. These topics are important because the automotive industry accounts for one of every 22 jobs in the United States, and making motor vehicles that are safe and easy to use is a competitive advantage.

Specifically, what has been produced are 4 PowerPoint modules as well as a YouTube video for each, a summary YouTube video, handouts for 2 of the modules to be used in classes, this summary report, and a proposed ASEE conference paper on getting started (initially as a technical report). The human-computer interaction module has 2 parts (ISO 9241, ISO 25000 series (Systems and software Quality Requirements and Evaluation) and has 85 slides. The human factors / ergonomics module has 3 parts (introduction to standards and ISO, how to find ISO standards, core standards). The core SAE standards (52 slides), has 2 parts, classical standards (carbon steel, tires specifications, vehicle diagnostics) and new technology (electric vehicles, active safety, safety messages, cybersecurity). The 4th module on automotive human factors standards (52 slides) emphasizes the standards produced by ISO Technical Committee 22, Subcommittee 39 and the SAE Safety and Human Factors Committee. These materials will be posted on the author's web site, on a NIST site to be determined, and most likely on an SAE web site.

The major challenges for this project were obtaining the ISO standards and getting the YouTube videos recorded and edited.

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Note: This is a working draft of a paper being considered to be submitted for consideration for the ASEE (American Society of Engineering Education) Annual Meeting in June of 2020. Prior to submission, to fit their format, the reference format will be changed from author-year format to sequential numbering and other changes are expected. The changes will be made later because this manuscript is easier to edit in this format. Of course, at this point, this is just a suggestion for a paper, not an accepted submission, and is being submitted as a required contract deliverable

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What Are Standards and Why Are They Important?

The International Standards Organization (ISO) defines as standard as a "*document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. … Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.*" (International Standards Organization, 2004, page 5).

Standards, also known as technical standards, are critical to international trade and travel, and innovation (Allen and Sriram, 2000; Swamm, 2000; Blind and Jungmittag, 2008; Swann, 2010). See also https://youtu.be/W82jFBKWPxE. They make it more apparent how products and services should function, and by opening the market place to more vendors across the globe, increase competition and reduce cost. Examples include standards for screw threads, one of the first topics to be addressed by the International Standards Organization when it was formed, and standards for shipping containers, a major factor in the enormous increase in international trade over the last few decades (E.H., 2013; Bernhofen, El-Sahli, & Kneller, 2016). "Being aware of and compliant with relevant laws, regulations, standards, and codes" has been identified as one of the key attributes of a professional engineering of the future by the National Society of Professional Engineers (National Society of Professional Engineers, 2013, page 12). In addition, use of standards by student is a requirement for ABET accreditation (Accreditation Board for Engineering and Technology, 2015).

What is the Problem This Project Addresses?

There is a concern that young engineers lack adequate knowledge of standards, especially in the United States. Helping to solve that problem is NIST, whose mission is "to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology ..." (National Institute of Standards and Technology, 2017). Central to NIST's mission is advancing knowledge of standards through a variety of methods, including formal academic instruction.

Why don't engineering students know much about standards? Khan, Karim, and McClain (2013), based on 149 responses to an IEEE listserv survey, reported that the 4 leading impediments to learning about standards were the (1) lack of textbook examples, (2) cost of access to standards, (3) lack of faculty expertise in their application, and (4) lack of access to them. Getting standards into textbooks is beyond what this paper can achieve. However, providing information to address the other issues were part of this project. See Green (2018a).

As part of a program for that purpose funded by NIST, the University of Michigan was awarded funding to develop course modules to educate engineers about human factors engineering, automotive engineering standards, and related topics. Four educational modules were developed (human-computer Interaction (HCI), automotive human factors, human factors (HF) standards, core vehicle standards), as well as publications associated with getting started (Green, 2018a) and a final summary publication (this report).

What is human factors / ergonomics?

For those unfamiliar with the term, human factors, also known as ergonomics, is defined as "*the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."* International Ergonomics Association (2017). (See also Green and Torres, 2019.)

To expand upon that definition, human factors experts are concerned with a wide range of systems: nuclear power plants and control rooms, the controls and displays a driver uses, all user related aspects of a snow blower (but in particular the forces required to move it), the legibility of labels on a medication bottle (and understanding what they mean), web site usability, and even something as simple as the comfortable use and effectiveness of a hammer. To expand on the definition, well-being refers to safety, health, comfort, convenience, and other characteristics. Overall system performance can include effectiveness, efficiency, total output, and output quality. Thus, the ultimate goal of human factors work is to make things – products, devices, jobs, and tasks – better for people.

What were the project goals?

The goal of the project was to create instructional matters that could be immediately used in specific courses at the University of Michigan, and then based on that experience, offer those materials for use elsewhere to support standards education via a variety of mechanisms described later. Specifically, two of the University of Michigan courses were Industrial and Operations Engineering (IOE) 436 (Human Factors in Computer Systems and IOE 437 (Automotive Human Factors), both 3-credit courses, typically with enrollments about 30 students each, primarily undergraduates in IOE with some graduate students and a few students from other disciplines (e.g., automotive engineering, mechanical engineering, design).

In addition, an important application is the University of Michigan Human Factors Engineering Short Course (http://isd.engin.umich.edu/professional-programs/human-factors-engineering/index.htm). This two-week continuing education course for those in industry and government is now in its 60th year. Attendance the first week is close to 80, about 40 for the second week (and climbing). It is the flagship course in the field. For the most part, those taking the course have never had formal education in human factors / ergonomics, but have been working on some application of that material for a few years. Most often, they are engineers, but their college degrees span the full range that universities offer.

What Was Done to Accomplish the Project Goals?

As was mentioned earlier, to achieve the project goals, 4 educational modules were produced along with supplemental materials (Table 1).

Table 1. Project Deliverables.

Deliverable and Initial Audience	Deliverable Objective	Larger Objective (in addition to supporting NIST)
HCI module: Module for human-computer interaction class (IOE 436 – 30 students) PPT, handout, YouTube video	• identify primary standards for human-computer interaction and their content (PowerPoint (PPT) and handout)	• support human factors engineering short course (80 students, once/year) • support lectures on the topic at other universities
Automotive HF module: Module for automotive human factors class (IOE 437 – 30 students) PPT, handout, YouTube video	• identify primary standards for automotive human factors and their content (PPT and handout) • describe process for their development (both SAE and ISO – PPT, see above)	• support SAE standards in the classroom initiative • support lectures on the topic at other universities
HF standards module: Overview module on human factors standards (Human Factors Engineering Short Course (80 students) PPT, YouTube video	• identify primary human factors standards and their content (PPT) • introduce topic of standards and how to find relevant standards to some topic	• support lectures on the topic at other universities
Core SAE vehicle standards: PPT on most important SAE ground vehicle standards (SAE Committee Activities) PPT, YouTube video	• describe both classical and new technology automotive standards	• support SAE Standards in the Classroom Initiative • support SAE project teams (Baja SAE, solar car, Formula SAE Electric / hybrid, Supermileage, AutoDrive) • support lectures on the topic at other universities
Getting started in standards: report (to be submitted as paper to the Conference) (faculty elsewhere)	• describe importance of standards • describe types that exist • describe how and where to find them • describe what makes for a good standard • describe how standards are developed by ISO • propose new standards-related requirements for publications	• support SAE Standards in the Classroom Initiative and ANSI Committee on Education

Final summary report – this document (NIST (contractual requirement), faculty elsewhere)	• describe project importance • describe project goals • describe project outcomes (deliverables, the emphasis of the report) • describe dissemination methods • describe evaluation methods • describe lessons learned	• support SAE Standards in the Classroom Initiative and ANSI Committee on Education

Following are details concerning each of the modules produced. For each of the modules there is a YouTube video as well as an introductory YouTube video summarizing the series.

Human-Computer Interaction Module (85 slides + handout)

ISO is the primary developer of international standards on human-computer interaction. ISO Technical Committee 159, Subcommittee 4 (TC 159/SC 4) (Ergonomics of Human-System Interaction), with ISO 9241 being the most important. Currently there are more than 40 subparts (and increasing). Table 2 shows the scope of the ISO 9241 series. In fact, ISO 9241 is so extensive in its coverage and value, that it could be the focus of an entire NIST project.

Table 2. Scope of ISO 9241

Topic	Topic
1: General introduction	11: Guidance on usability
2: Guidance on task requirements	12: Presentation of information
3: Visual display requirements	13: User guidance
4: Keyboard requirements	14: Menu dialogues
5: Workstation layout & postural requirements	15: Command dialogues
6: Guidance on the work environment	16: Direct manipulation dialogues
7: Display requirements with reflections	17: Form filling dialogues
8: Requirements for displayed colors	20: Access. guidelines for ICT equip. & services
9: Requirements for non-kb input devices	
10: Dialogue principles	

Given the project scope only 2 subparts of ISO 9241 were reviewed though readers will to go the next further beginning with the subparts and other standards listed in Table 3.

Table 3. Standards from ISO TC 159/SC 4 Summarized in the HCI Module

ISO Standard	Title
Reviewed	
9241-210	Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems-defines usability in terms of effectiveness, efficiency, satisfaction
9241-420	Ergonomics of human-system interaction — Part 420: Selection of physical input devices, tests to selected devices
Next Steps	
9241-302	Ergonomics of human-system interaction — Part 302: Terminology for electronic visual displays
9241-303	Ergonomics of human-system interaction — Part 303: Requirements for electronic visual displays
9241-304	Ergonomics of human-system interaction — Part 304: User performance test methods for electronic visual displays
14915	Software ergonomics for multimedia user interfaces — Part 1: Design principles and framework
TR 16982	Ergonomics of human-system interaction -- Usability methods supporting human-centred design

Not as well known in the human factors community, but equally important, is the work of ISO/IEC JTC 1 (Information Technology), responsible for global information and communications technology standards for business and consumer applications (e.g., MPEG, smart cards, SQL language). At first glance, the most relevant subcommittee to this project would be SC 35 (User Interfaces) with Table 4 providing examples of relevant standards. Again, their work is so extensive that it could be the sole focus of a NIST project (Table 3).

Table 4. Examples of Standards from ISO/IEC JTC 1/SC 35

ISO/IEC Standard	Title
9995	Information technology -- Keyboard layouts for text and office systems
10741	Information technology -- User system interfaces -- Dialogue interaction
11581	Information technology -- User system interfaces and symbols – Icon Symbols and functions
15411	Information technology -- Segmented keyboard layouts
17549	Information technology -- User interface guidelines on menu navigation

However, much of the significant activity is in SC 7, (Software and systems engineering) as part of the SQuaRE (Systems and software Quality Requirements and Evaluation) project and it is these standards that were reviewed as part of this project (Table 5). As that project is ongoing, other standards are anticipated to be added in the near future. NIST was very instrumental in the developed of several of the standards in this series.

Table 5. Core Standards from ISO/IEC JTC 1/ SC 7 (SQuaRE Project)

ISO Standard	Title
TR 25060	Systems and software engineering — Systems and software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability: General framework for usability-related information (ISO/IEC TR 25060:2010)
25062	Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability test reports (ISO/IEC 25062:2006)
25063	Systems and software engineering — Systems and software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability: Context of use description (ISO/IEC: 25063:2014)
25064	ISO/IEC 25064:2013 Systems and software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability: User needs report (ISO ISO/IEC 25064:2013)
25065	Systems and software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for Usability: User requirements specification (ISO/DIS 25065)
25066	Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for Usability — Evaluation Report (ISO/IEC 25066:2016)

Thus, the human-computer interaction module consists of 2 parts, (1) ISO SQuaRE series, and (2) ISO 9241 (but only 2 standards are reviewed here as examples).

Automotive Human Factors and Related Topics Module (52 slides + handout)

This module not only covers a specific standards topic, but because it is intended for students who know almost nothing about standards, it provides a significant introduction, covering how ISO is organized, and how ISO standards are developed (parts 1 and 2 of the video). The third part covers ISO TC 22 (Road Vehicles), Subcommittee 39 (Ergonomics) (Table 6), the SAE Safety and Human Factors Committee (Table 7), as well as those produced by the U.S. Department of Transportation (the Federal Motor Vehicle Safety Standards). The SAE standards are well known to the author because he wrote some of them and commented on many of them as a member of the supervising SAE committee. For this section, the approach taken was to be more extensive in describing the wide variety of standards that existing and providing fewer details about each standard. That approach makes sense because there are other documents that provide those details. For a more complete list of standards, see Green (2012) and Green (2018a). For related information, see Zhou, Jeong, and Green (2017).

Table 6. Examples of Standards from ISO TC 22/SC 39

ISO/IEC Standard	Title
2575	Road vehicles -- Symbols for controls, indicators and tell-tales
3409	Passenger cars -- Lateral spacing of foot controls
3958	Passenger cars -- Driver hand-control reach
4040	Road vehicles -- Location of hand controls, indicators and tell-tales in motor vehicles
15005	Road vehicles -- Ergonomic aspects of transport information and control systems -- Dialogue management principles and compliance procedures
15006	Road vehicles -- Ergonomic aspects of transport information and control systems -- Specifications for in-vehicle auditory presentation
15007	Road vehicles -- Measurement of driver visual behaviour with respect to transport information and control systems

Table 7. Examples of Standards from the SAE Safety and Human Factors Committee

SAE Standard	Title
J2364	Navigation and Route Guidance Function Accessibility While Driving
J2365	Calculation and Measurement of the Time to Complete In-Vehicle Navigation and Route Guidance Tasks
J2395	ITS In-Vehicle Message Priority
J2396	Definitions and Experimental Measures Related to the Specification of Driver Visual Behavior Using Video Based Techniques
J2399	Adaptive Cruise Control (ACC) Operating Characteristics and User Interface
J2802	Blind Spot Monitoring System (BSMS): Operating Characteristics and User Interface
J2944	Operational Definitions of Driving Performance Measures and Statistics

Human Factors / Ergonomics Standards Module (86 slides)

The module for this topic consists of 3 parts (1) and introduction to standards and their value, (2) how to find ISO standards, and (3) core human factors / ergonomics standards. This module was created specifically for human factors practitioners This module builds upon a webinar presented to the Human Factors and Ergonomics Society and supplements the first lecture in the Human Factors Engineering Short Course. There are 8 collections standards of general importance to human factors engineering (Table 6). Of these, the most important is Military Standard 1472, the human factors "Bible," by far the most common referenced human factors standard.

Table 6. Primary Human Factors / Ergonomics Standards

Standard	Title
ANSI/AAMI HE75 & ANSI/AAMI/IEC 62366	Human Factors Engineering – Design of Medical Devices (Medical devices: Application of Usability Engineering to Medical Devices)
ANSI/HFES 100, 200	Human Factors Engineering of Computer Workstations, Human Factors Engineering of Software User Interfaces
FAA HF-Std-100	Human Factors Design Standard
ISO TC 159/ SC 4 standards	multiple standards from that subcommittee, especially ISO 9241
Military Standard 1472	Human Engineering Design Criteria
NASA/SP 2010-3047	Human Integration Design Handbook
NUREG 0700	Human-System Interface Design Review Guidelines
OSHA standards	

For additional information, see https://webstore.ansi.org/industry/ergonomics/control-centre-ergonomics, Furman, Theofanos and Chapman (2013), and Furman, Theofanos and Wald (2014).

Core SAE Vehicle Standards (52 slides) classical, new tech

The module consists of 2 parts, classical standards (Table 7) and those related to new technology (Table 8). As with ISO, the challenge was identifying the most significant work, here from 609 committees. The classical standards are those that have been existence for some time, that every automotive engineer should know about, and are likely to be important in the future. Their selection was guided by sales data provided by SAE. The new technology standards concern active safety, automation, cyber security, electrification, and vehicle communications. For the new technology standards, the reviews were more cursory because there were so many standards that were important to mention.

Table 7. Classical Motor Vehicle Standards Reviewed

SAE Standard	Title
J182	Motor Vehicle Fiducial Marks and Three-dimensional Reference System (2015)
J300	Engine Oil Viscosity Classification (2015)
J403	Chemical Compositions of SAE Carbon Steels (2014)
J607	Small Spark Ignition Engine Test Code (1988)
J670	Vehicle Dynamics Terminology (2008)
J918	Passenger Car Tire Performance Requirements and Test Procedures (2018)
J1100	Motor Vehicle Dimensions (2009)
J1978	OBD II Scan Tool — Equivalent to ISO/DIS 15031-4:December 14, 2001 (2002)
J1979	E/E Diagnostic Test Modes (2017)
J2944	Operational Definitions of Driving Performance Measures and Statistics (2015)

Table 8. New Technology Motor Vehicle Standards Reviewed

SAE Standard	Title
J1772	SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler (2017)
J2907	Performance Characterization of Electrified Powertrain Motor-Drive Subsystem (2018)
J2954	Wireless Power Transfer for Light-Duty Plug-In/Electric Vehicles and Alignment Methodology (2017)
J3063	Active Safety Systems Terms & Definitions (2015)
J3116	Active Safety Pedestrian Test Mannequin Recommendation (2017)
J3087	Automatic Emergency Braking (AEB) System Performance Testing (2017)
J2945	Dedicated Short Range Communication (DSRC) Systems Engineering Process Guidance for SAE J2945/X Documents and Common Design Concepts (2017)
J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary (2016)
J3016	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles (2018)
J3114	Human Factors Definitions for Automated Driving and Related Research Topics (2016)
J3018	Guidelines for Safe On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving Systems (ADS) (2015)
J3061	Cybersecurity Guidebook for Cyber-Physical Vehicle Systems (2016)

Getting Started Materials

The goal of this deliverable (Green, 2018a) is to help faculty at other universities prepare course materials on standards. Having given many presentations on standards to professionals, the author has observed that many in academia know little or nothing about standards.

To incentivize faculty and students to connect research with practice though standards, the getting started report (eventually to be an ASEE paper) proposes a change in the submission requirements for engineering conference papers and journal articles. Specifically, when appropriate, authors must list the relevant standards as keywords after the abstract and include revised language for that standard based on the research. These requirements should be waived for where basic research is being reported.

To achieve this change, faculty and students will need to know much more, and thus most of the report contains “standards 101” material. That includes information to make (1) faculty and students aware of the importance of standards, and to describe (2) the types that exist (definitions-focused, methods-focused, etc.), (3) how and where to find them (e.g., using IHS Markit, Techstreet, or the ISO online browsing platform), (4) what makes for a good standard (e.g., table of contents, readability, references, sourced definitions), and (5) how standards are developed by ISO (to maximize the utilization of faculty and student research). Extensive lists of web-based search tools for standards (e.g., ANSI, ISO, ITU, NIST, SAE) and web sites with instructional materials on standards (e.g., ANSI, ASTM, IEEE) are provided to support finding standards and learning more about them. Additional information for this purpose is contained in all of the PowerPoint modules and YouTube videos.

Final Summary Materials

The purpose of this report, required by the contract, is to (1) describe the project and its importance, (2) explain the original project goal, (3) describe the project outcomes, (4) describe how the output is evaluated, (5) report lessons learned, and (6) describe how the output will be disseminated. Of these topics, description of the primary project deliverables, the PowerPoint modules, is covered in the greatest detail. Further development of this report into a presentation at the American Society for Engineering Education (ASEE) annual conference, an audience who should find this project of particular interest, is being explored.

How will these materials be distributed?

Each of the PowerPoint modules will be available on the public site of the author's research team (www.umich.edu/~driving), probably on a NIST site to be determined, and probably on an SAE web site (to be determined). Of course, the YouTube videos will be available for YouTube and the ASEE paper will be on their web site (assuming it is accepted) was well as the author's web site. There are a number of web sites where those most passionate about standards education post materials, candidate sites for this project as well. They include the International Cooperation for Education about Standardization (ICES, http://www.standards-education.org/workshops), Donald Percell's web site (http://www.strategicstandards.com/), and Mike Anthony's site (http://standardsmichigan.com).

Of course, these materials will be on the web sites for the course with which they are associated (IOE 436, IOE 437, Human Factors Engineering Short Course).

Also, the author is part of an effort within the Human Factors and Ergonomics Society to require citing standards in its journal articles and conference papers. The project materials are central to that effort, and posting on the HFES.org web site is being considered.

Finally, is it expected that the various committees of which the author is a member (ANSI Committee on Education, the SAE Technical Standards Board (TSB) Standards in the Classroom Advisory Group), and others will distribute information though newsletters of their organizations.

How Will These Materials Be Used?

The modules that are directly linked to courses at the University of Michigan, Human-Computer Interaction (IOE 436), Automotive Human Factors (IOE 437), Human Factors / Ergonomics (Human Factors Short Course) have already been used at least once and will continue to be used and improved over time. The core SAE standards module will be used in conjunction with variety of SAE activities. It is expected that other universities needing coverage of these topics will use the YouTube videos though making the PPT available will allow faculty to modify them as desired. It is expected that this report and the getting started report (Green, 2018a) will be used to support those activities, as well as a potential ASEE conference paper version of this report.

To a large degree, use of the materials depends on promotion. SAE clearly wants to get the work out (though the Safety and Human Factors Steering Committee, the Committee on Standards in the Classroom, and other groups). UMTRI will give it some publicity (as a news item on its home page), and now that UMTRI is part of the College of Engineering, there could be additional opportunities. In addition, the author will use his LinkedIn site, which has almost 2000 connections.

How Will They Be Evaluated?

For educational materials of this type, the most common method to evaluate them is to survey users after the fact. That could be done for the Human Factors Engineering Short Course, but is likely that in other instances, the response rate will be too low to provide meaningful data. Thus, that application, the focus will be on comments that users provide directly to the author. For the application in IOE 436 and 437, sample sizes given response rates are too small for the scoring to be useful, so again the focus will be on making improvements based on comments. However, there will be a review of the homework assignments associated with the standards modules. Keep in mind that there were versions of these 2 modules prior to this project, but they were not nearly as complete.

Outside of the University, feedback will be sought from members of the SAE Standards in the Classroom Committee, the ANSI Committee on Education, the SAE staff in Detroit and in Warrendale, and from the Human Factors and Ergonomics Society Task Force on Standards. That Task Force, formed in October of 2018 and of which the author is the chair, is exploring implementing the requirements in the Getting Started paper (Green, 2018a) for its publications. For that to occur, the materials produced for this project are critical and without them, that proposal would have no traction.

Some feedback is expected from the proposed ASEE publications, with the most important feedback being emails, though download counts will be examined as well. For reasons not apparent to the author, ASEE papers generally do not have high citation counts.

That would seem to suggest that no quantitative evaluation is anticipated. The most important indication of use will be counts the downloads of the PowerPoints from the author's web site (and others), the viewing times for on-line materials (did they skim them or read them), the number of views of the YouTube videos, and the distribution of viewing times (if available), of the YouTube videos. As an example, the author was involved with a promotional video for the Human Factors Engineering Short Course. Currently, that video has been viewed 8,600 times. As the YouTube videos will be course material, and significant promotion is anticipated, a similar level of viewing seems feasible.

Closing Comments

This report was written as requested by NIST, potentially to satisfy administrative requirements. However, the author has elected to provide considerable addition information about standards relevant to this topic, both reviewed and not reviewed. This is consistent with the project goal of providing materials for faculty and students at other universities to learn about standards, and to those in industry seeking an introduction to this topic with the goals of finding and applying standards.

Acknowledgments

The funding provided by NIST will enable working with students to develop improved teaching materials to be used in courses where standards pertaining to motor vehicle design in general, and human factors/human-computer interaction in particular are taught, at the University of Michigan and elsewhere. I want to thank the program manager, Mary Jo DiBernardo of NIST for supporting this project, for her input, and for her encouragement. The author would like to thank Tali Gorokhovsky, Beijia Wang, and Christine Fischer, all of the University of Michigan, and Mike Anthony of Standards Michigan, for their comments on this report.

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