THE GEORGE WASHINGTON UNIVERSITY
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Usability: the Forgotten 'ility' in the Engineering Process

Kevin Hovis - PhD Candidate
Under the advisement of
Blake Roberts, PhD.
Michael Grenn, PhD.

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Abstract

- Joseph Carl Robnett Licklider said in the early 1960s simpler interaction was needed when humans interact with computers. Indeed, he was correct with what he saw in the 1960's. It took 30 years for simple computer graphical user interfaces to become common place. Today, most human systems interfaces control computers which, in turn, control the mechanical systems. Engineers often focus on the controls part of the design where the computer controls the mechanical system while the interaction between the human and the computer is neglected. They compensate by investing significant time in training the user how to use the systems interface. Even with expert training, a user may lose situational awareness while trying to operate the system because the system is too complicated.
- A new test is needed to help engineers and designers create usable systems.

What makes a system usable?

- What makes a system usable, and how should user considerations be brought into system design in order to ensure a highly usable system?
  - Major companies have designed elaborate systems, following Human Systems Integration and Human Factors principles, yet the system fails usability standards for being usable.
  - What have these companies missed?

Hypothesis

- Highly useable systems provide “friction” to the user. Systems that are “frictionless” are deemed by the user to be less useable.
  - Not mechanical friction. ”Friction” is being defined as how the system responds to the user.
- Problem is more than ergonomics, Human Factors or Human Systems Integration.
  - These sciences may be applied to the design of the system, yet the final system is so difficult to use extensive operational training is necessary to understand how to operate the system.
- A new methodology is needed within the engineering process to ensure usability is properly considered.

Research

- What makes some systems usable and others less so?
- What is being said in Human Factor Integration and Human Systems Integration about “usability”?
- What separates HFI, HSI, and “usability”?
- Seeking additional data sets
  - Case studies
  - Quantifiable data
  - Suggested readings

Research

Hermawati, Setia, and Glyn Lawson. "Establishing Usability Heuristics for Heuristics Evaluation in a Specific Domain: Is There a Consensus?" Applied Ergonomics 56 (2016): 34-51. ScienceDirect. Web. 26 Apr. 2016.
- Shows there is a need to define usability heuristics for specific domains.

Howarth, Jonathan, Tonya Smith-Jackson, and Rex Hartson. "Supporting Novice Usability Practitioners with Usability Engineering Tools." International Journal of Human-Computer Studies 67.6 (2009): 533-49. ScienceDirect. Web. 26 Apr. 2016.
- Human Computer usability. This paper may apply to a comparison of Apple versus Microsoft

Sauer, Jürgen, Katrin Seibel, and Bruno Rüttinger. "The Influence of User Expertise and Prototype Fidelity in Usability Tests." Applied Ergonomics 41.1 (2010): 130-40. ScienceDirect. Web. 26 Apr. 2016.
- Discusses the dilemma of developing a high fidelity prototypes for ergonomics testing because of the cost to develop. A low fidelity prototype my not be valid.

Research

Sonderegger, Andreas, and Juergen Sauer. "The Influence of Design Aesthetics in Usability Testing: Effects on User Performance and Perceived Usability." Applied Ergonomics 41.3 (2010): 403-10. ScienceDirect. Web. 26 Apr. 2016.
Kanis, H. "Estimating the Number of Usability Problems." Applied Ergonomics 42.2 (2011): 337-47. ScienceDirect. Web. 26 Apr. 2016.
- Task completion time may be over-estimated when using a prototype software. User emotions were positively affected by more attractive phones

Dong-Han Ham, "A model-based framework for classifying and diagnosing usability problems." Cognition, Technology & Work, 08/2014, Volume 16, Issue 3
- Focuses on software but may provide a framework that can be extrapolated to physical interfaces as well.

J. C. R. Licklider, "Man-Computer Symbiosis." IRE Transactions on Human Factors in Electronics (Volume:HFE-1 , Issue: 1) , March 1960
- Licklider disucses human and computer interactions. His vision for input and output may still be relevant but forgotten.

Systems engineering handbook : a guide for system life cycle processes and activities / prepared by International Council on Systems Engineering (INCOSE) ; Forsberg, Kevin, editor ; Hamelin, R. Douglas, editor ; Roedler, Garry J., editor ; Shortell, Thomas M., editor ; Walden, David D., editor ; Ebooks Corporation Fourth edition.. Hoboken, New Jersey : John Wiley & Sons Inc., 2015.
- Standard for Systems Engineering. Discusses Usability. Even when these processes are followed, a system may not be usable.

CASES

THE FOLLOWING CASES DEMONSTRATE GOOD AND BAD USABILITY.

Playchess.com competition

- A “freestyle” chess tournament in 2005.
  - Groups of grandmasters working simultaneously with several computers entered.
  - Hydra, a chess-specific supercomputer, was easily defeated by a human player using a weak laptop.
- The winner of the competition was a pair of amateur American chess players simultaneously using three computers.
  - The winners were able to quickly direct their computers to investigate moves which counteracted both grandmaster and super computer opponents

- **Weak human + machine + usable process > supercomputer**
- **Weak human + machine + usable process > strong human + machine + inferior process.**

First generation of BMW iDrive

- A user interface that combines most user functions into a single controller
- First generation appearing in 2001 was the rotary controller only

- Loathed by automotive journalists
  - James Cobb needed an hour to figure out how to adjust the FM radio presets by using a total of 5 steps. (Cobb 2002)
- In 2 years, a menu button and a back button were added.
- By 2009, 7 buttons were added.

FCA recall of automatic transmissions

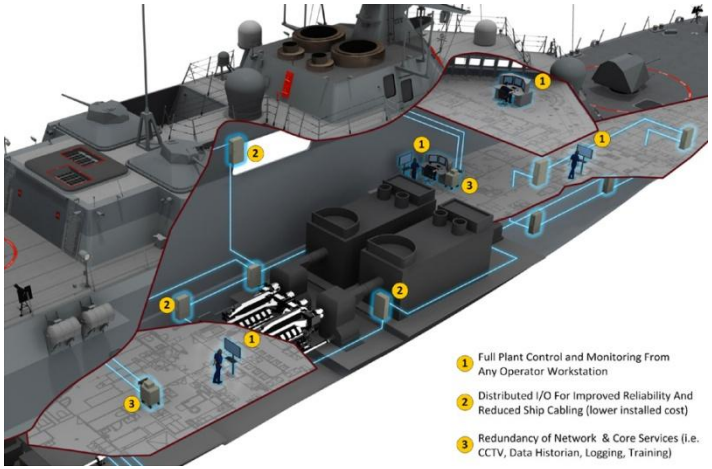
- User interface confusing.
- System provides visual feedback and soft “clicks” as different gears are selected.
- The motion to place the car into reverse is the same motion as to put the car in to Park.
- In response to NTSB report, FCA recalled vehicles with affected transmissions.
- Why didn’t FCA use the rotary transmission controller?

Flight controls of Airbus A330

- Flight control system lost air speed when piezo tube froze over resulting is the loss of autopilot and autothrottle.
- Pilot lost situational awareness and failed to pay attention to stall warnings and continued to pulled the nose up.
- The side sticks did not communicate the inputs of the other pilot.
- The controls did not provide enough force feedback for the pilot to know how the system was interpreting the pilots' forces on the control.

- Boeing uses a traditional yoke which allows provides better feedback to the pilots.

Freedom class Littoral Combat Ship



- *USS Fort Worth*, damaged during an in port operational test of its port and starboard diesel engines
- Caused by an apparent failure to follow procedures
- Combining gear not getting lubrication when diesel engines started.

- Incident attributed to inadequate training. Why was the system designed in a way that would allow such damage?

CPS parachute drogue release

- Parachute systems currently in use by the Marine Corps
- System designed by Bill Booth
  - Selected handle of drogue release by having users feel different materials.
  - Users always were able to identify golf ball by feel.
- Simple control design with feedback to the user
- **Why can’t all systems be this intuitive?**

Apple Operating Systems

- Apple never tried to combine the mobile and desktop operating systems
- Frequently used apps are pinned at the bottom of the screen allowing for one click opening of the program
  - Open most frequently used apps with one click
- The operating system incorporated touch gestures into the touchpads and mice. Minimal explanation and training demonstrates how the feature works.

1. Human Factors and Human Systems Integration exist and are related. Human factors or ergonomics relates to the anatomical well-being of humans. Something can be ergonomical, but not very usable. Human Systems Integration focuses on how the human with interact with the machine.
2. I am proposing a topic that integrates HSI, HFI and how the system responds to the user. The three are linked. System designers create systems that meet requirements of HSI and HFI, yet the system fails a usability requirement. The cases are listed in the presentation show proof.
3. I do not know how I will provide a measurement. I am considering plotting these systems on a graph and creating an equation to match the line. I am considering this because I don't have data to manipulate.
4. If I can create an equation, I will be able to compare A to B and get a predicted usability rating. Right now, the data would be arbitrary.

Summary

- Engineers are focusing designing controls for the human to input information to the system. Engineers are neglecting how a system should communicate with the human.
- Engineers compensate by investing significant time in training the user how to use systems with poor usability interface.
- New parameters are needed in the design process to ensure a newly developed system is usable.

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