

What is Human Systems Integration and How It Does and Does Not Relate to Human Factors and Ergonomics?"

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Overview

- What is HSI?
- How is HSI different from human factors?
- How is HSI similar to human factors:
Seven deadly fallacies of HSI/HF

A Human-System Integration in the System Development Process

A NEW LOOK

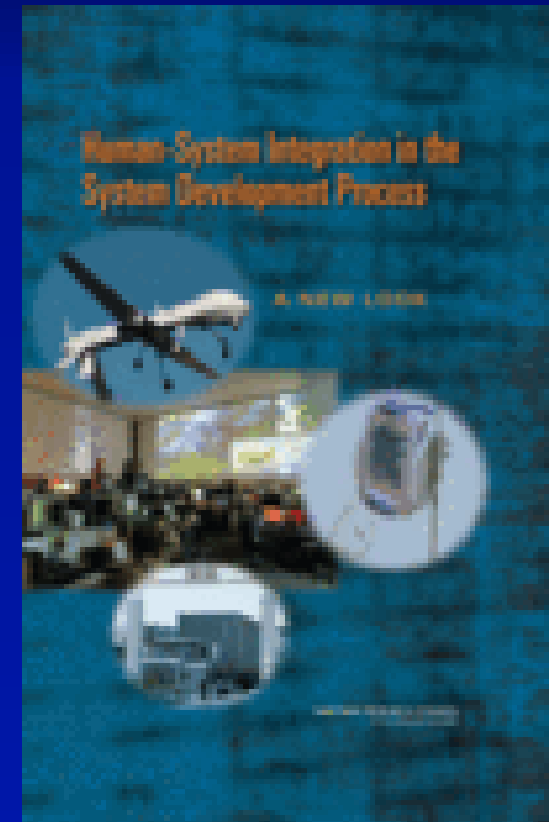
Committee on Human-System Design Support for
Changing Technology

Richard W. Pew and Anne S. Mavor, Editors

Committee on Human Factors
(now Board on Human Systems Integration)

Division of Behavioral and Social Sciences and
Education

NATIONAL RESEARCH COUNCIL OF THE
NATIONAL ACADEMIES



What is Human Systems Integration?

Human-Systems Integration (HSI) is a framework in which human capabilities and limitations across various dimensions are considered in the context of a dynamic system of people, technology, environment, tasks, and other systems with the ultimate goal of achieving system resilience and adaptation, approaching joint optimization.

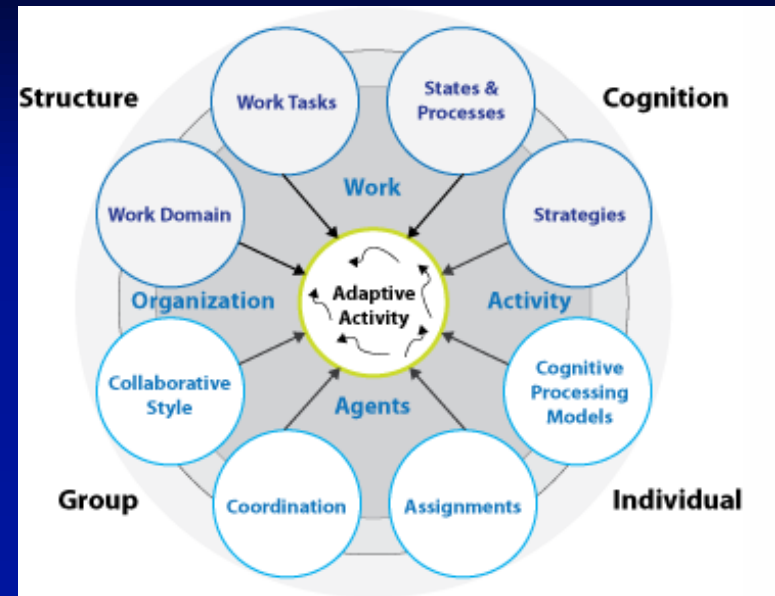
The human dimensions considered include human factors, manpower, training, personnel, safety, survivability, and habitability.

What is Human Systems Integration?

- HSI is more than Human Factors → Human-centered systems engineering
- But...Human Factors has always been a proponent of a systems approach
 - Yes, but the systems have typically been narrow in scope
 - ...And the methods are suited for smaller systems
- Human-Machine Interface → System → System of systems
 - Human-computer interface → Nuclear control room
 - Shipboard radar interface → Shipboard command and control
 - Design of medical device → Coordination of patient care
 - Unmanned aerial system ground control station → Integration of UAS into the National Airspace

Appreciation of Rich Context of Work

- Systems approach
- Larger systems of systems
- Multi-users and machines
- Appreciation of context of work

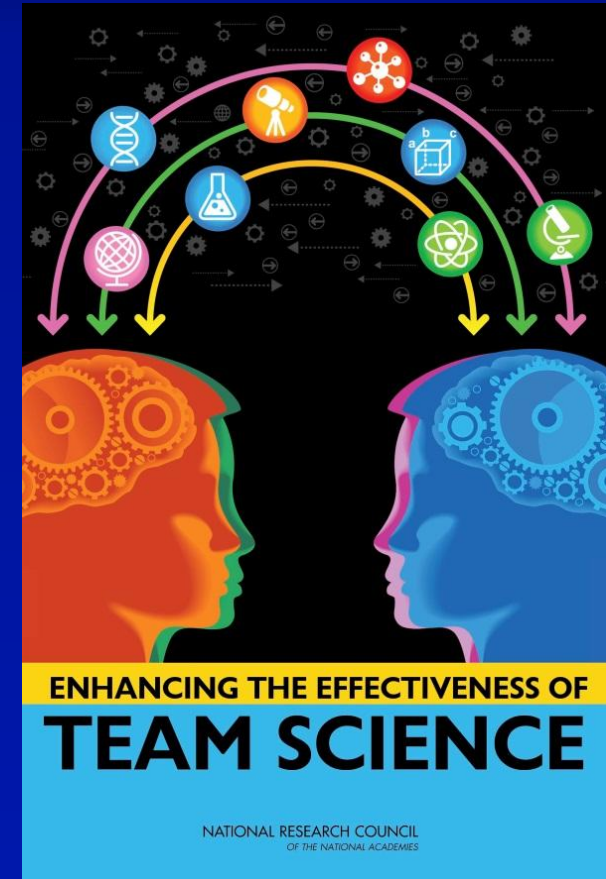


From Gavan Lintern



Appreciation of Multidisciplinary

With such a broad array of human considerations coupled with their integration into complex and dynamic systems, it is essential that **multiple disciplines** collaboratively address HSI problems (including cognitive psychologists, industrial engineers, system engineers, physicians, sociologists, organizational psychologists, etc.)

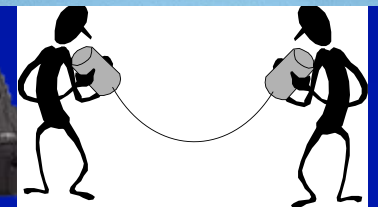


When the Larger System is Not Considered... There is potential for unintended consequences

Multiple UAS Control and
Sensor Data Proliferation



Laptop UAS Controller
that Lacks
Communication Device

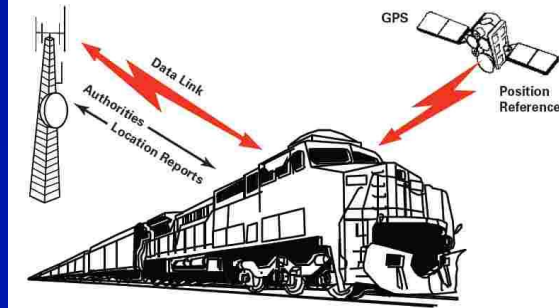


When the Larger System is Not Considered... There is potential for unintended consequences

Positive Train Control
Automation is the Answer
(NOT)



POSITIVE TRAIN CONTROL (PTC)



Two Eagles Gas
Balloon Flight



When the Larger System is Not Considered... There is potential for unintended consequences

WHEN ESCAPE IS CUT OFF

- 1. BARRICADE** 
- 2. LISTEN** for 3 shots, then ... 
- 3. SIGNAL** by pounding hard 10 times 
- 4. REST** 15 minutes, then **REPEAT** signal until...
- 5. YOU HEAR 5** shots, which means you are located and help is on the way. 

Seismic Location System (SLS)



- Late 1970's design
- Never used successfully
- Rarely deployed anymore
- Too cumbersome to deploy
- Takes 24 hrs minimum to setup



The system as defined here is the mining community including the mining industry, equipment suppliers, state, and federal governments.

The mitigation of any one of multiple failures at Sago would have likely resulted in all of the miners safely exiting the mine (and we would have never heard anything about the accident).

How many other mine incidents/accidents approach this tipping point but don't result in a disaster?

Sago Mine Disaster

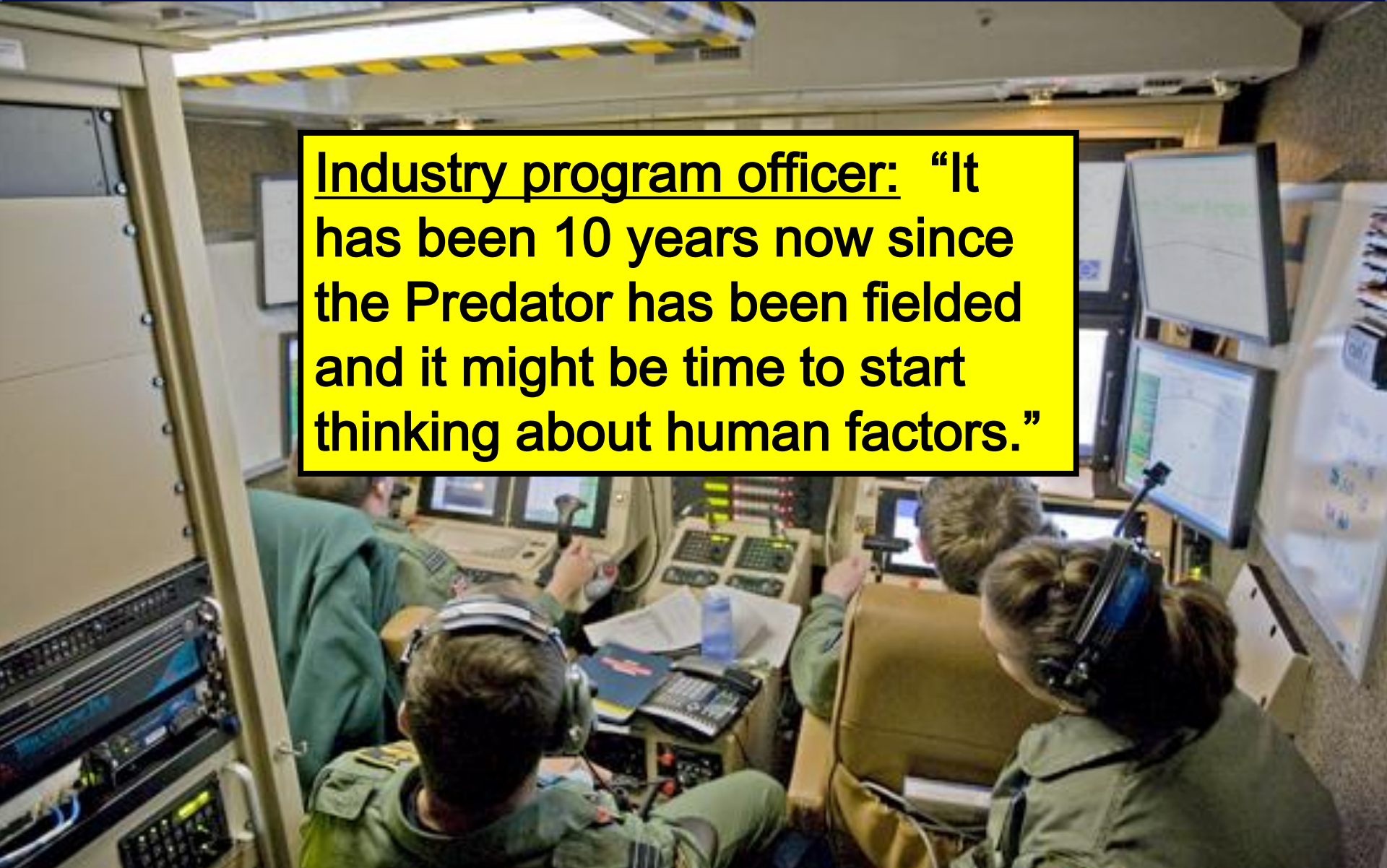
The Perfect Storm of
HSI Failures

An Example from My Work: MQ-1/9 Operator Control Station

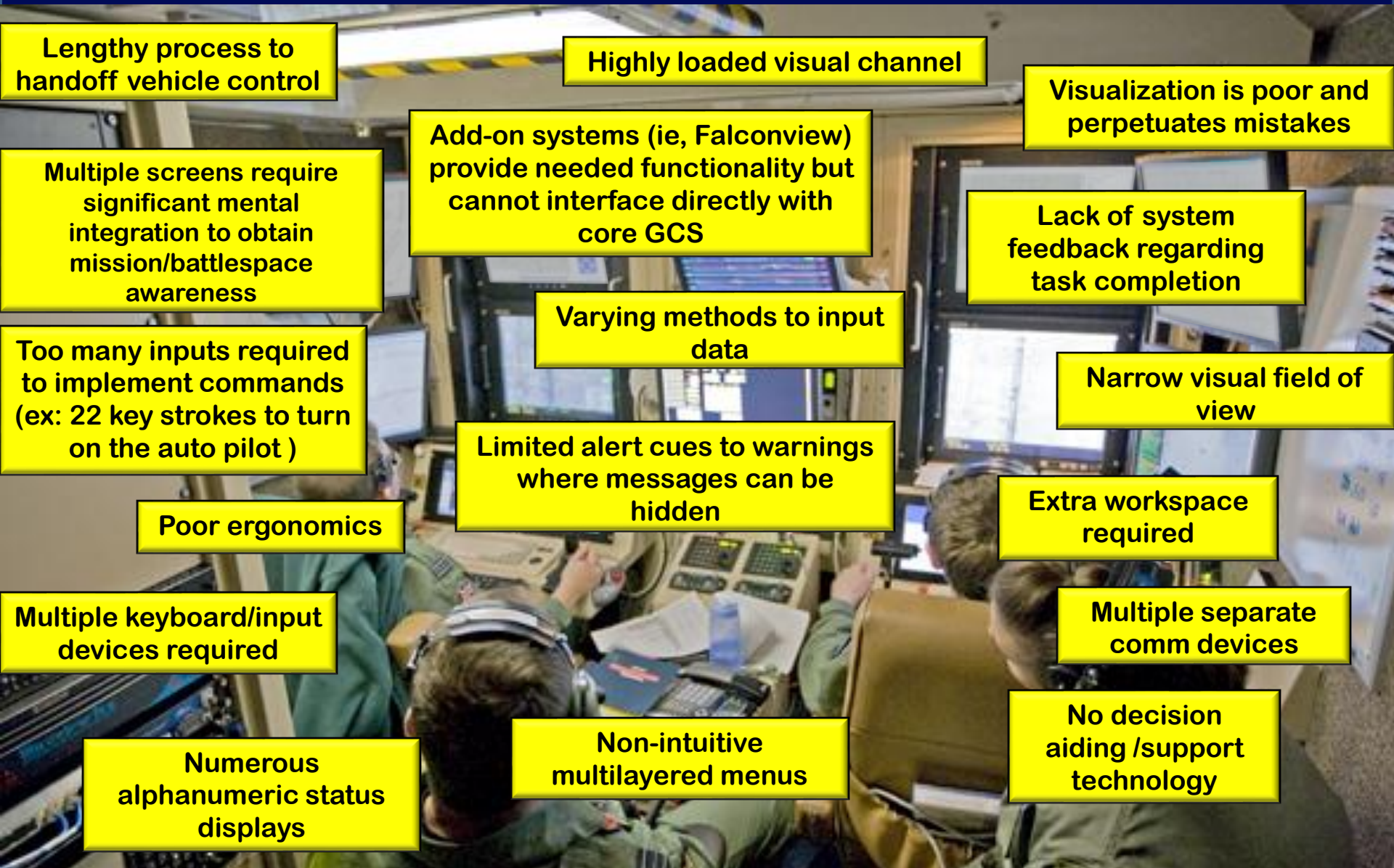


MQ-1/9 Operator Control Station

Industry program officer: “It has been 10 years now since the Predator has been fielded and it might be time to start thinking about human factors.”



Human Computer Interface Issues with the MQ-1/9 Operator Control Station



Lengthy process to handoff vehicle control

Highly loaded visual channel

Visualization is poor and perpetuates mistakes

Multiple screens require significant mental integration to obtain mission/battlespace awareness

Add-on systems (ie, Falconview) provide needed functionality but cannot interface directly with core GCS

Lack of system feedback regarding task completion

Too many inputs required to implement commands (ex: 22 key strokes to turn on the auto pilot)

Varying methods to input data

Narrow visual field of view

Poor ergonomics

Limited alert cues to warnings where messages can be hidden

Extra workspace required

Multiple keyboard/input devices required

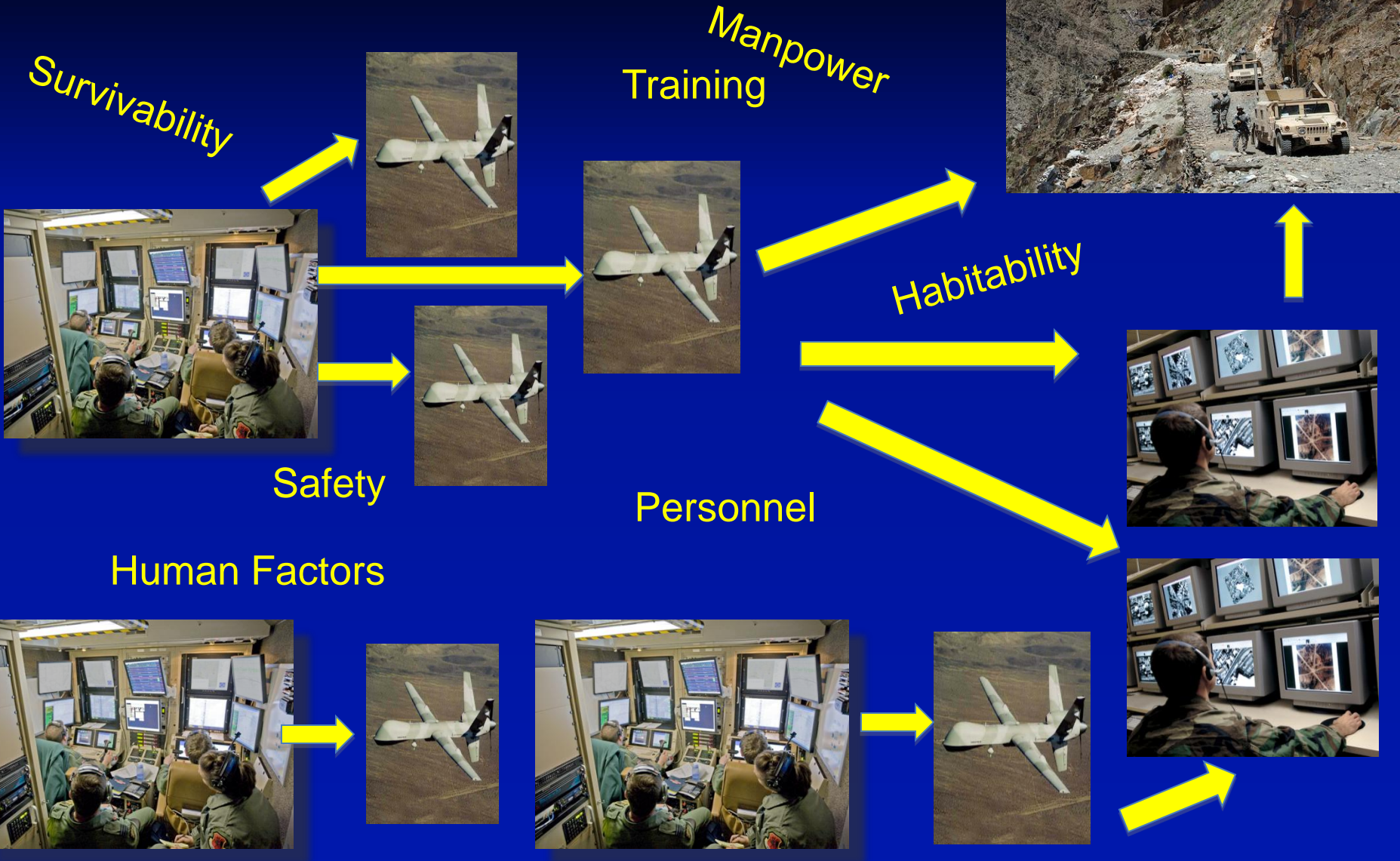
Multiple separate comm devices

Numerous alphanumeric status displays

Non-intuitive multilayered menus

No decision aiding /support technology

HSI Issues



UAV vs. UAS

- A system that includes the vehicle, the ground control station, and the payload which is typically part of a larger system → e.g., NAS
- And the human is an important part of that system



HSI Issues of UASs



- Integration of UAS in the national air space
- Ground Control Station standardization
- Autonomy and UAS/swarming
- Training UAS pilots and sensor operators
- Selecting UAS pilots and sensor operators
- UAS sensor data exploitation from multiple sensors
- UAS crew coordination
- Psychosocial issues with remote operation



How is HSI similar to Human Factors?

Seven deadly fallacies of HSI/HF



Fallacy #1: We need more technological innovation to solve the problem. With enough automation the human will be unnecessary and there will be no more pesky human issues.

Tendency to throw automation/technology at the problem

- Better incident command
- Improvised explosive device detection
- Cyber situation awareness
- Positive Train Control



#1: Technology Alone is NOT the Answer

Tendency to throw automation/technology at the problem

- Incident command centers in which technology gets in the way
- Equipment too heavy for a soldier to carry & goes unused
- Laptop UAV controllers without communications capability
- DVR functions that are not apparent and manuals that are unreadable
- Automation changes the human's task – sometimes making it more difficult.

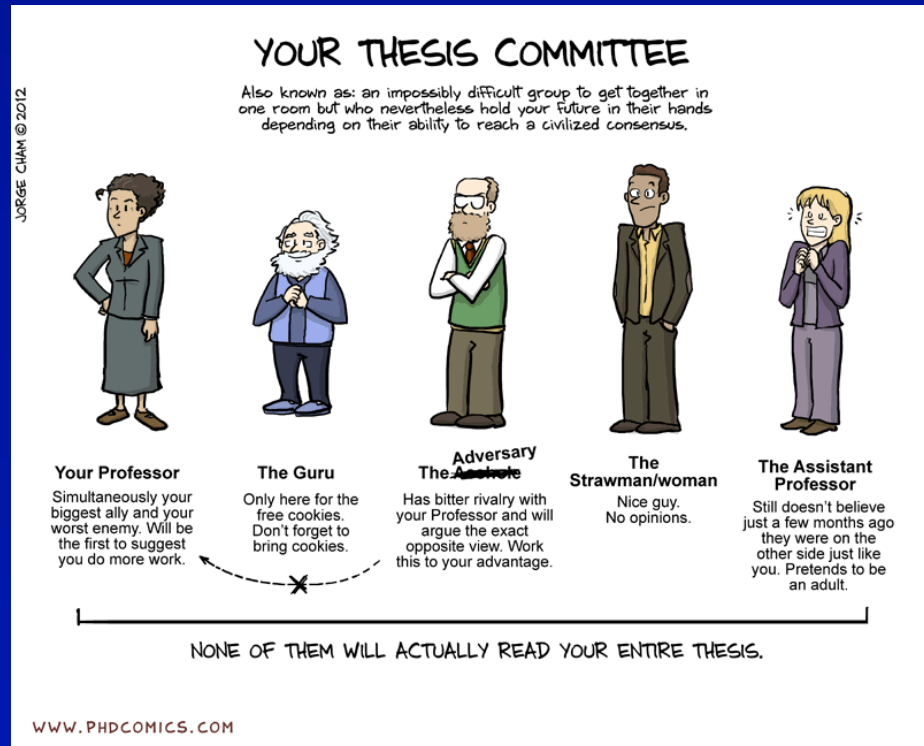


Fallacy #2: I am a human, therefore I can do HSI. After all, it is intuitive isn't it?



Joe Software Engineer

#2: No, Doing HSI correctly actually takes multiple experts each with advanced degrees. You can get a PhD in HSI and related areas.



We May Think HSI is Intuitive...

Which knob works
which burner?



*ATM that can only be reached by the tallest man
in the world (8'5")*



Which side of
the rental car is
the gas cap?



And how do I
open it?



Which way does it
go?



To go right or not?

But clearly, it is not!
For more see www.baddesigns.com

Fallacy #3: What, a PhD you say? But isn't HSI about fairly simple stuff like what color to make the display and how to design a chair?



#3: No, wrong again.

Human factors is more than knobs and dials and HSI is more than human factors.

HSI > Human Factors >



The Reach of Human Factors and HSI

BROADER IMPACT

- Aviation – WW II ...; cockpit design, aviation safety, situation awareness
- Communications – Info. Age...; phone keypads; small displays, speech interfaces
- Computing – Info. Age...; command vs. GUI; web sites, menus, mice
- Energy – Three Mile Island 1979...; process control, control room design, decision aids, displays



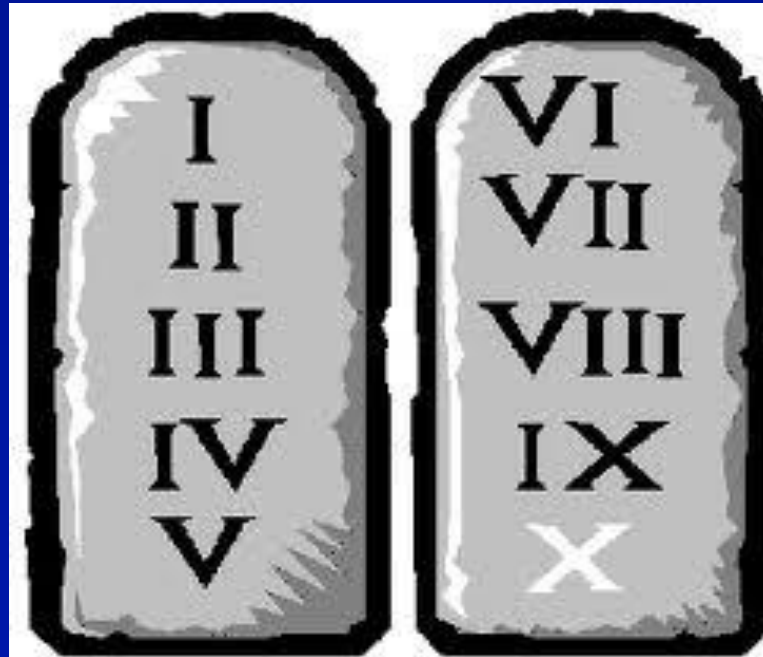
The Reach of Human Factors and HSI

BROADER IMPACT

- Highway Safety – high accident rate...; high-mounted tail lights, seat belts, driver perception of passing distance
- Medicine/Health – patient safety issues...; medical devices (glucometers); anesthesia displays; drug barcodes; morphine pumps, hospital coordination
- Military Systems – Vincennes 1988; command and control, training, decision aiding
- Homeland Security – 9/11...
- Disaster Response



Fallacy #4: But, HSI is just a matter of applying certain principles or “human factors.” Just tell me what they are.



“ IV. Thou shalt not create modes.”

#4: Wrong again. There are very few general principles. This is because HSI is highly context dependent. It depends on:

- The task
- The technology
- The other people
- The culture
- Training
- THE TOTAL CONTEXT



Fallacy #5: HSI is done at the very end of the project so that we can know that what we have developed is great!



#5: Absolutely wrong on this. HSI is useless if you wait until the end. It needs to be addressed from the beginning (requirements) and continue through spiral development and right up to the end of the life cycle.

HSI involves requirements/needs analysis, design, iteration, and continual testing. Wait until the end and you will make something that is not used, unsafe, brittle, or user-hostile



Fallacy #6: Could you help me do the HSI for my project that is due tomorrow in the next 34 minutes? Please.....



#6: Have you been listening? See Fallacies #2-6!



- HSI needs to be done from the beginning of a project
- HSI requires expertise of different kinds
- HSI should progress in parallel with system development

Fallacy #7: But...HSI is too expensive. We can skip it this time.



#7: Building a system that is unsafe, never used, or hated by users is even more expensive!



Conclusion

Do HSI early, often, and skillfully

- HSI should be an integral part of systems engineering
- HSI is applied to systems
- HSI requires expertise
- HSI is context dependent
- HSI needs to be done early and often (continually)
- HSI takes time
- HSI is worth it!

Implications of HSI?

- Need for new methods

	RESEARCH QUESTIONS		
METHODOLOGY	Cyber & Big Date	Autonomy	Medicine
Measures & Metrics			
Modeling			

- Need for multidisciplinary collaboration
- Need for new curriculum

Thank You!

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