ETLS 509 - Validation & Verification
University of St. Thomas

John Engelman

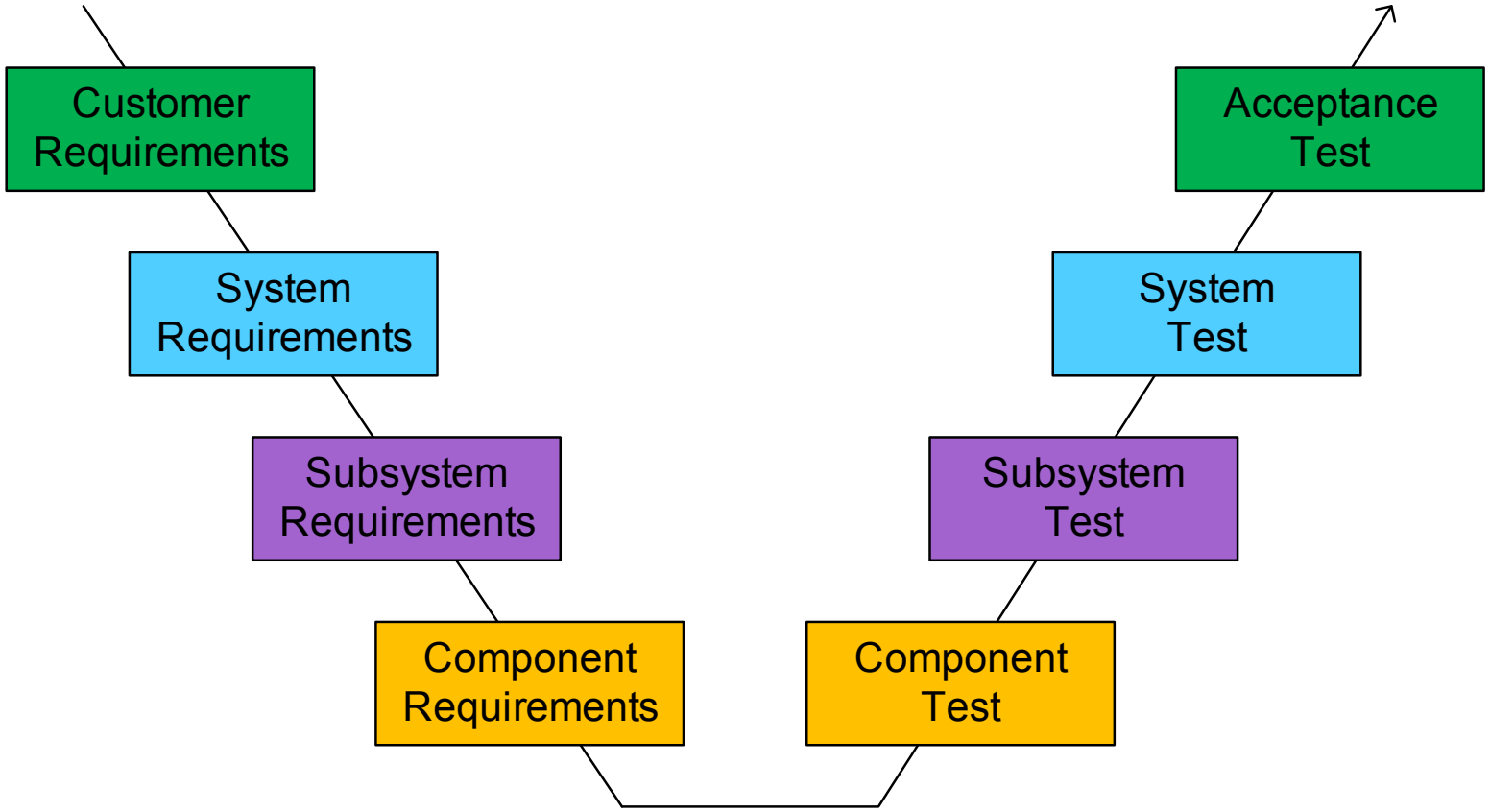
Fall 2016

Outline

- **Review**
- **Human Factors**
  - Human factors – from the news
  - Long history on systems
  - Considerations in systems requirements
  - Facilities & production facilities
  - Business considerations
  - Ergonomics
  - System effectiveness
- **Quality**

ETLS 509 - Session 7

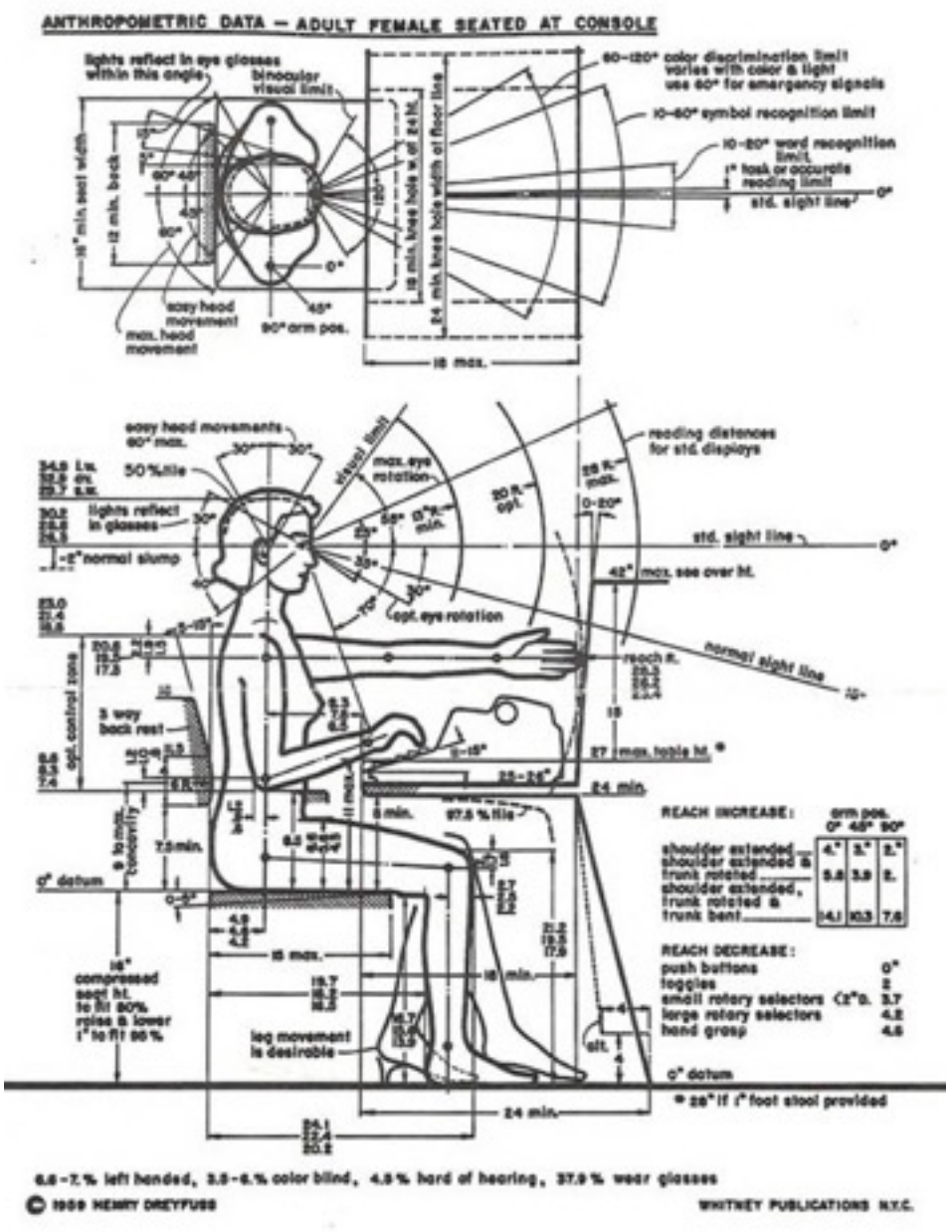
- **Requirements Definition - Human Factors Engineering**



Human Factors

http://comp1220uwigroup.weebly.com/ergonomics.html

Long time consideration -



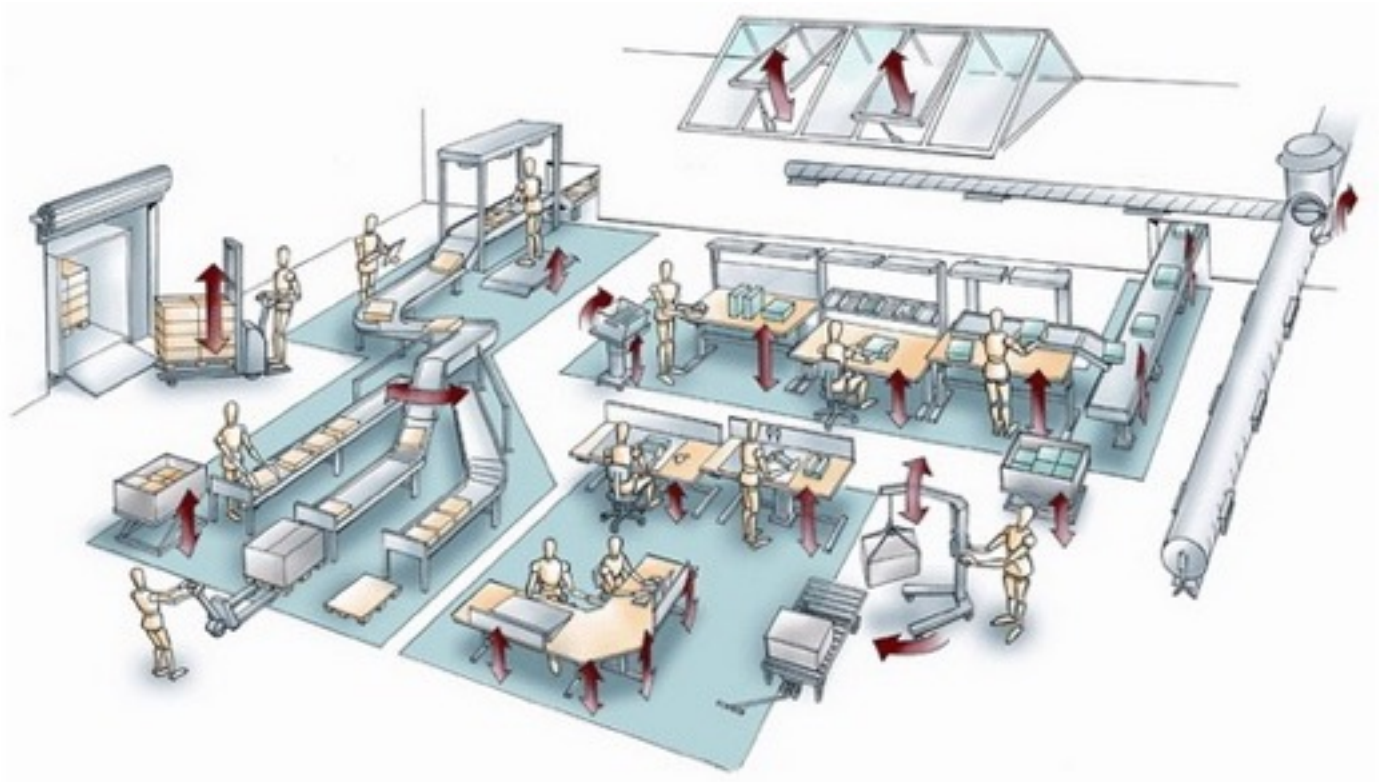
Anthropometric Data of the Adult Female Seated at a Console, 1959
Alvin R. Tilley, design engineer for Henry Dreyfuss

http://hamiltonhughes.com/blog/?p=2722

Human Factor Considerations in System Requirements

- **Environmental Considerations**
  - Temperature extremes
  - Humidify
  - Vibration
  - Noise
- **Operational Efficiency**
  - Manpower considerations
  - Workload
  - Training
- **Anthropometric considerations**
  - Repetitive motion
  - Reach & viewing
- **Other Considerations**
  - Safety
    - Chemical Environment
    - Foreign Objects
    - Other Health Hazards
    - Regulations, e.g., OSHA (Occupational Safety and Health Administration)
  - Organizational
  - Training Requirements
    - Is a person efficient at utilizing a system in a day, month, or a year?
    - Implanting pacemaker

Facilities

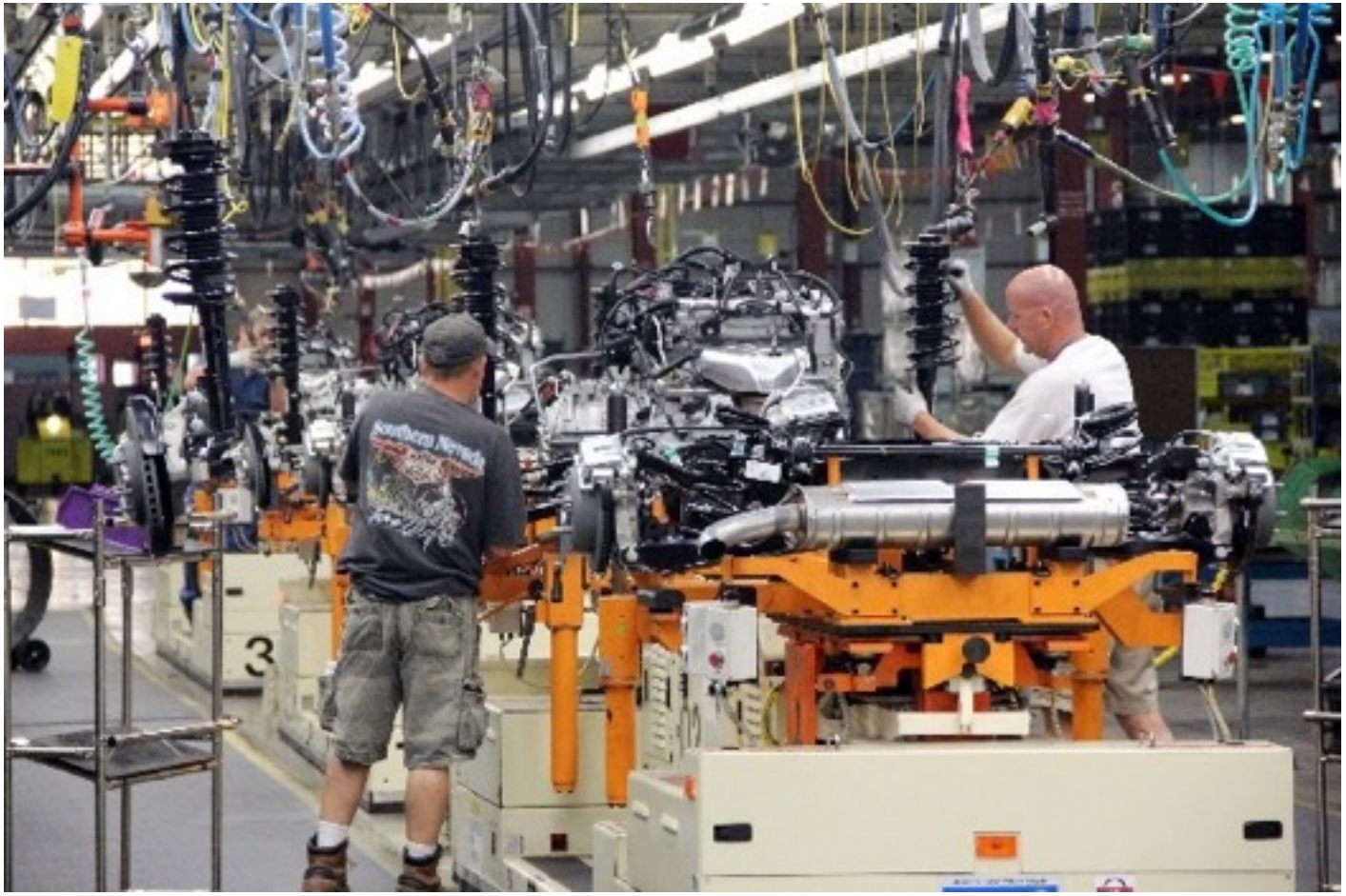


http://www.optimumorg.com/dyn/operations-development/operational-excellence/ergonomics/

Human Factors in the Production of a System, Not Just the System Itself

http://breakingdefense.com/2013/07/f-35-prices-drop-8-percent-in-7-billion-deal/

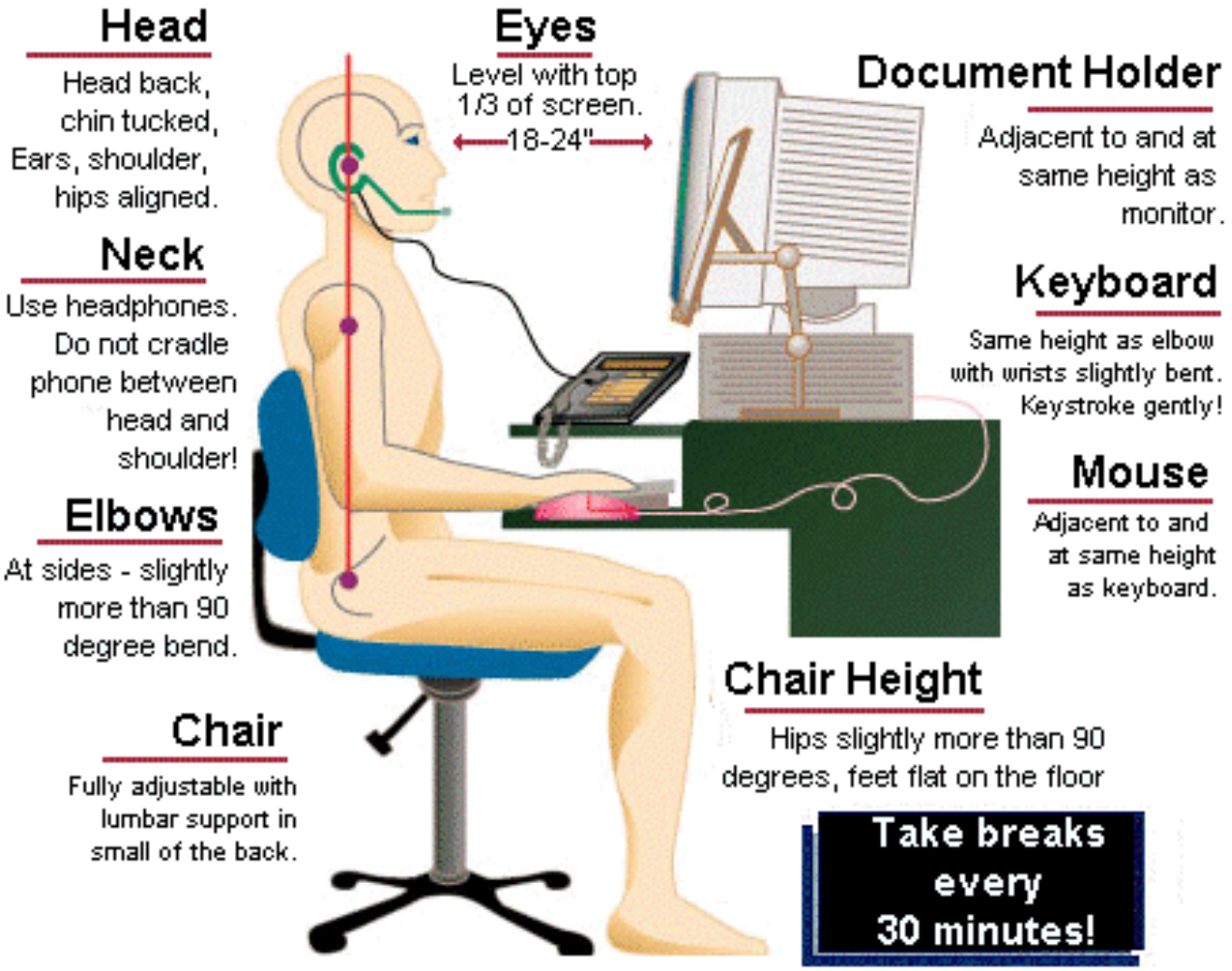
Human Factors Play a Major Role in Business Decisions



General Motors cars are assembled at the General Motors Spring Hill Manufacturing Plant in Spring Hill, Tenn. General Motors announced Tuesday it is spending another $167 million at the factory so it can build two new midsize vehicles.
Photo by Associated Press /Chattanooga Times Free Press.

http://www.timesfreepress.com/news/2013/aug/07/gm-revs-up-tennessee-facility/?businesstnvalley

Ergonomics



https://www.fin.ucar.edu/sass/hess/ergo/posture.html

Human Factors are Fundamental to System Effectiveness

- **Consider an automated video surveillance system**
  - False alarms at a rate greater than 1/week can make a system unusable
    - Operators will not pay attention to alarms
- **Staring at screens for long periods of time may not be effective**
  - Missed events

http://www.westecservices.net/video-surveillance-/

Human Factors can be/are a Dominate Force in Determining System Effectiveness

Elements of Effectiveness

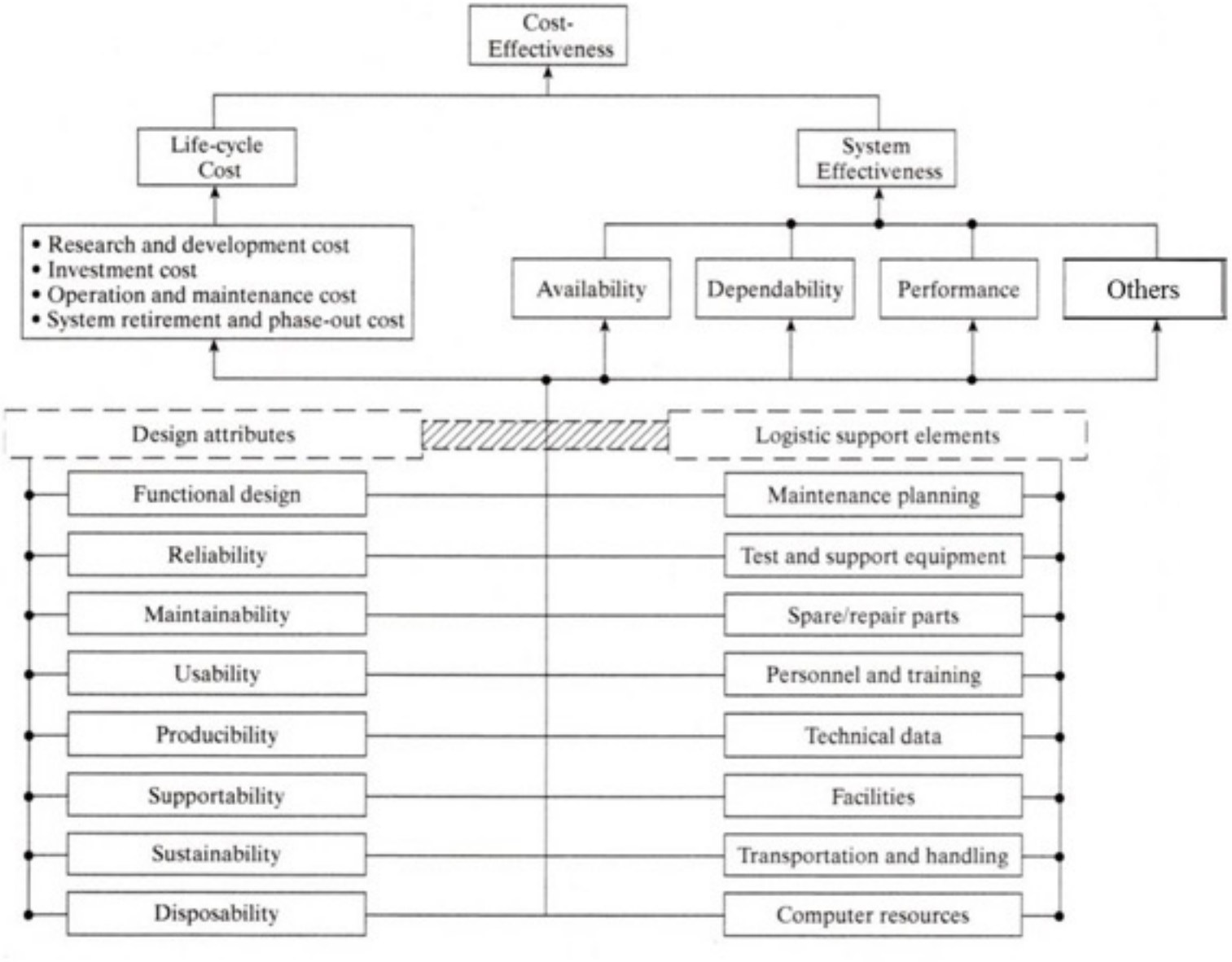
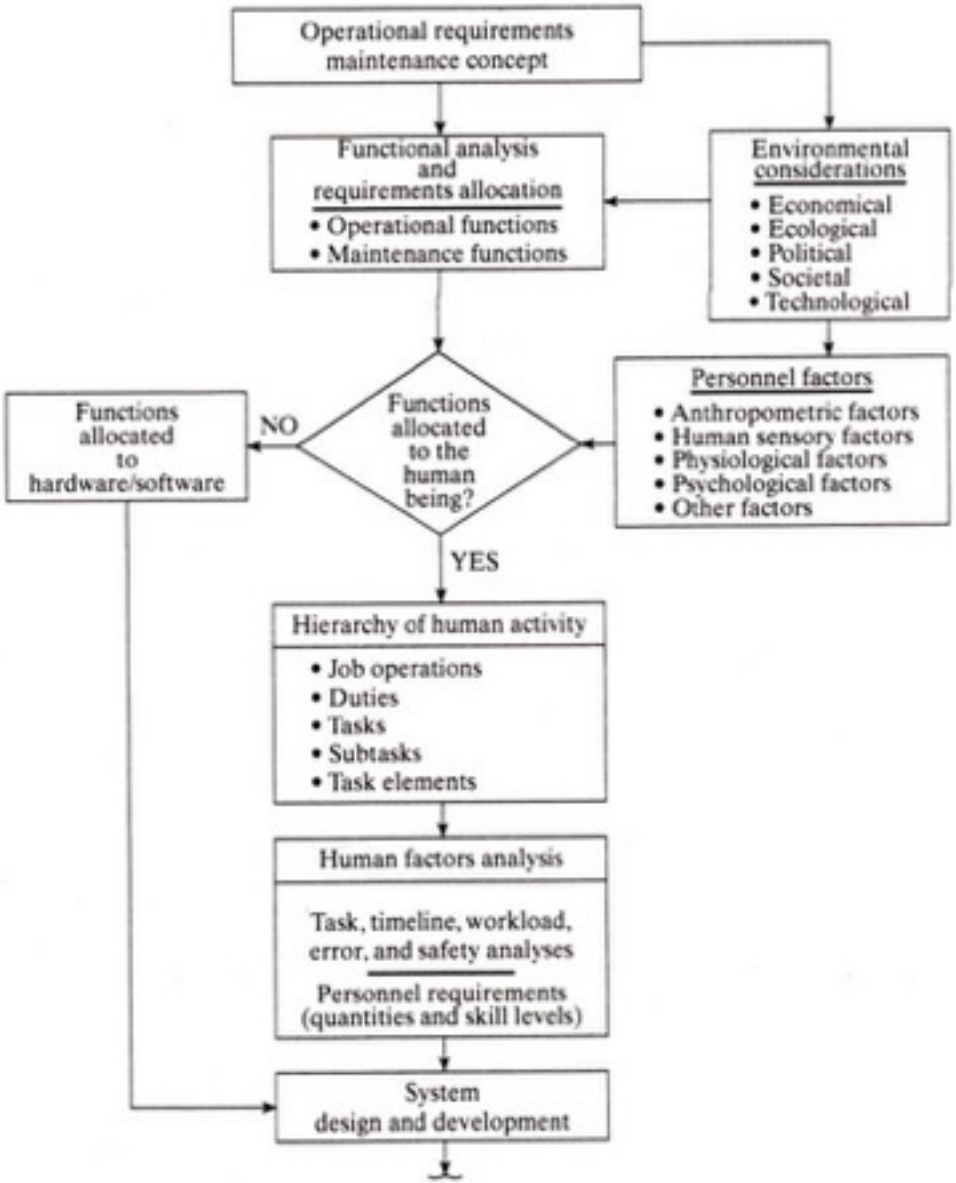


Figure 13.9 Blanchard

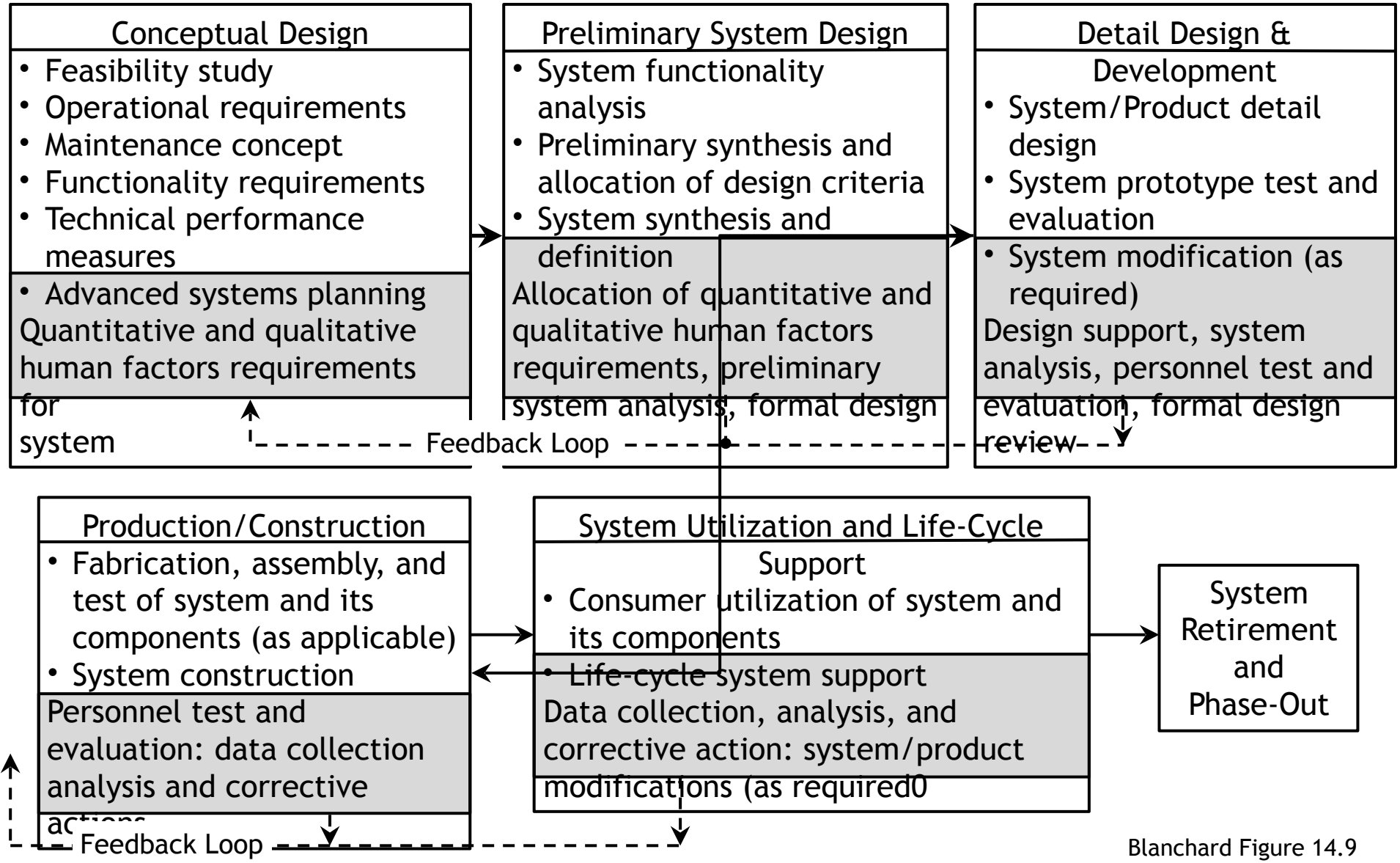
Where do Human Factors Play a Major Role?

Human Factors Requirements



Blanchard Figure 14.1

Human Factors in the System Life-Cycle



Blanchard Figure 14.9

Levels of Expertise (Dreyfus & Dreyfus)

- **Novice**
  - During this stage various objective facts, rules, and features relevant to the desired skill are learned, though they may be so clearly and objectively defined as to be context-free. This is to say that the novice pilot might be aware that the term *angle of attack* describes airflow over a wing in flight but would not be able to describe how it relates to the safety of a flight.
- **Advanced Beginner**
  - During this stage, the learner begins to apply facts, rules, and features learned in the previous stage in practical situations. Rules for practice begin to include both situational and context-free components.
- **Competence**
  - During this stage, a hierarchical process of decision-making emerges. The learner starts to choose a goal and devises ways to achieve the goal. Because learners are setting goals, they begin to take ownership of the goal. Achieving or not achieving the goal is an emotional experience.
- **Proficiency**
  - During this stage, though intuitively organizing and understanding a task, the learner will still think through the task in an analytical way. Task elements that, from experience, are important will be assessed and combined with rules to produce decisions on how to best manipulate an environment to achieve a desired goal.
- **Expertise**
  - During this stage, performance is so instinctual that learners are no longer aware they are thinking about it. The expert becomes one with the environment, and performance becomes “natural.”

Human Systems Engineering From Recent News – Ebola

- **Dr. Tom Frieden, Director CDC on Dallas Nurse Infected with Ebola after caring for Ebola patient once:**
  - "I think the fact that we don't know of a breach in protocol is concerning because, clearly, there was a breach in protocol. We'll conduct a full investigation of what happens before health workers go in, what happens when they're there, and what happens in taking out -- taking off -- their protective equipment, because infections only occur when there's a breach in protocol."
- **What's wrong with Dr. Frieden claim from a system's engineering perspective**
  - Statement as if it were fact: "There was a breach in protocol" – No factual basis for backing up this claim. Significant evidence suggests that the CDC protocols recommended at the time of this nurse was infected were, in fact, not sufficient
  - Protocols prescribed by the CDC for hospitals to follow were not the "best known protocols" e.g., The "Buddy System" was not part of CDC protocol, wash downs were not part of the protocol, there was no consideration for human error in the protocol. In addition, there was minimal/no training for hospital staff treating patients with this disease. CDC director approach of blaming infected worker indicates lack of knowledge of human systems engineering.
- **Additional Human Systems Engineering Issues:**
  - CDC as stated that the only a person with symptoms can transmit the virus, i.e., there is no such thing as a "Ebola carrier" – e.g., an asymptomatic person that has the virus and can transmit the virus – (June 2000 – The Lancet - http://www.nytimes.com/2000/06/27/world/people-carrying-ebola-in-some-cases-may-be-free-of-symptoms.html)
  - Question: What is the fewest number of virions that have been scientifically shown to transmit a disease.
    - Answer: One virion has been demonstrated to be sufficient for transmission

Question: What is the USA capacity for Ebola patients at specialized hospitals
Answer: 11

http://abcnews.go.com/Health/us-capacity-11-ebola-patients-specialized-hospitals/story?id=26251721

Relationship Between Interaction Categories and the Systems Engineering Process

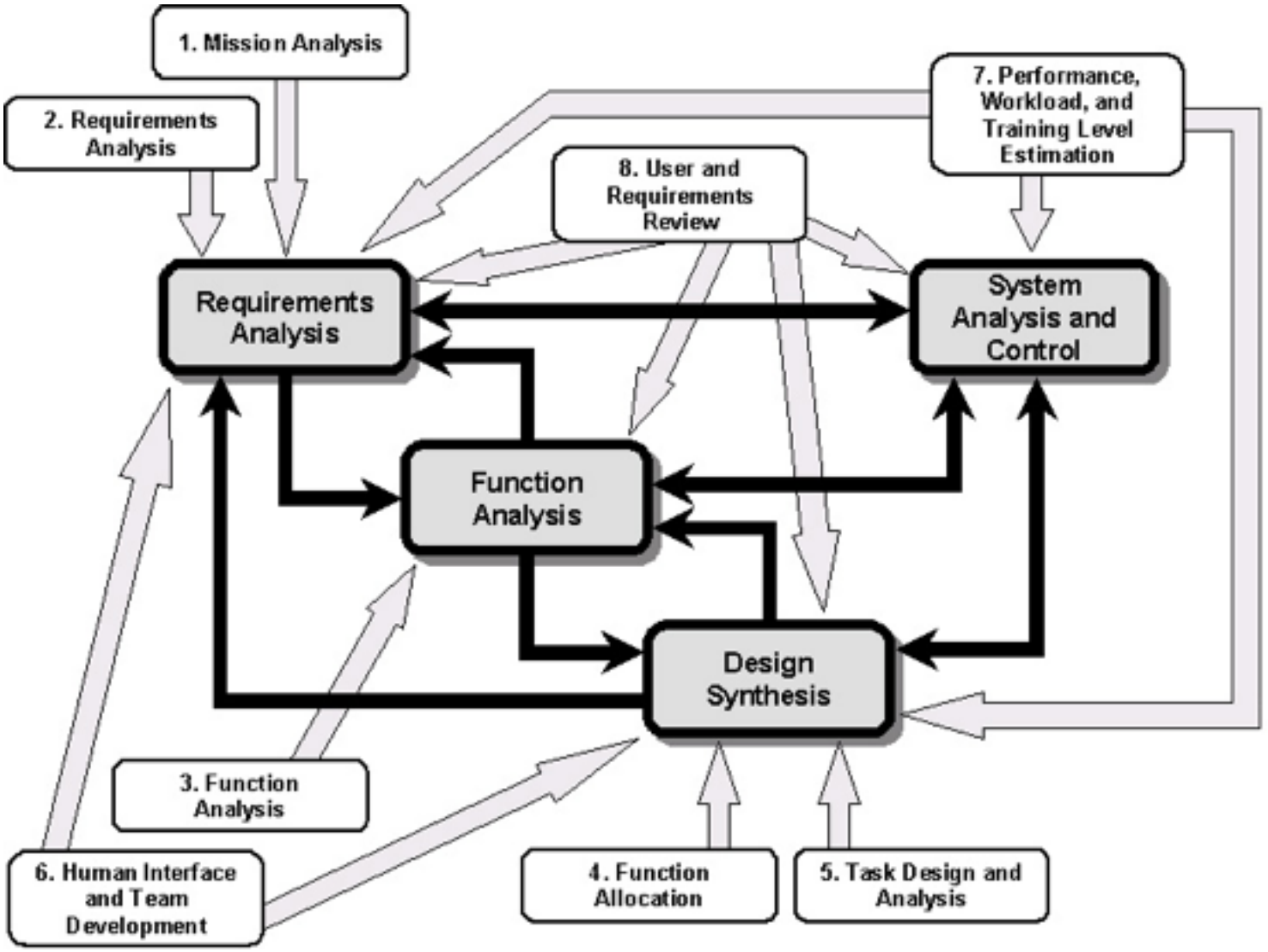


Figure 1-2 from Human-Systems Engineering: Understanding the Process of Engineering the Human into the System

Human Factors Reading/References

Dr. Daniel Wallace, et.al, *Human-Systems Engineering: Understanding the Process of Engineering the Human into the System*

- http://www.hf.faa.gov/docs/508/docs/Human_System_Engineering_(NSWC).pdf (government document not subject to copyright - also on the blackboard) – note document is out of DOD not FAA

John R. Gersh, Jennifer A. McKneely, and Roger W. Remington, *Cognitive Engineering: Understanding Human Interaction with Complex Systems*

- http://techdigest.jhuapl.edu/TD/td2604/Gersh.pdf

Wayne D. Gray, *Cognitive Modeling for Cognitive Engineering*

- http://homepages.rpi.edu/~grayw/pubs/papers/2008/OUP-chptr/gray-070829.pdf

777 Project

- What are the human factors considerations for the 777?
- 21st Century Jet - Making the Boeing 777 4-1