16.422

Human Supervisory Control

Social Implications

Massachusetts Institute of Technology

Advantages of Automation

- Improve:
  - Efficiency & productivity
  - Task performance & reliability
- Human safety, both operators & public
  - Remote operations
- Reduction of human labor
- Technological advancements
- Improved quality of life
  - Health care
  - Leisure
- But there are some problems….

Automation Issues for the Individual

- Employment
  - Centralization of management
  - Identity & desocialization
- Work dissatisfaction
  - Supervising as opposed to interactive control
    - Technological (il)literacy
- Deskilling
- Responsibility & accountability
  - Trust and biases
- "It will always be far easier to make a robot of a man rather that to make a robot like a man." (Engelberger 1981)

Problems with Automation for Society

- "Technological imperative"
  - Technological determinism as opposed to social construction
- Productivity vs. meaningfulness
- Tele-governance
  - Feed forward versus feedback
  - Privacy
    - Cell phones, automobiles, employee monitoring
- Reduced social contact

More Problems with Automation…

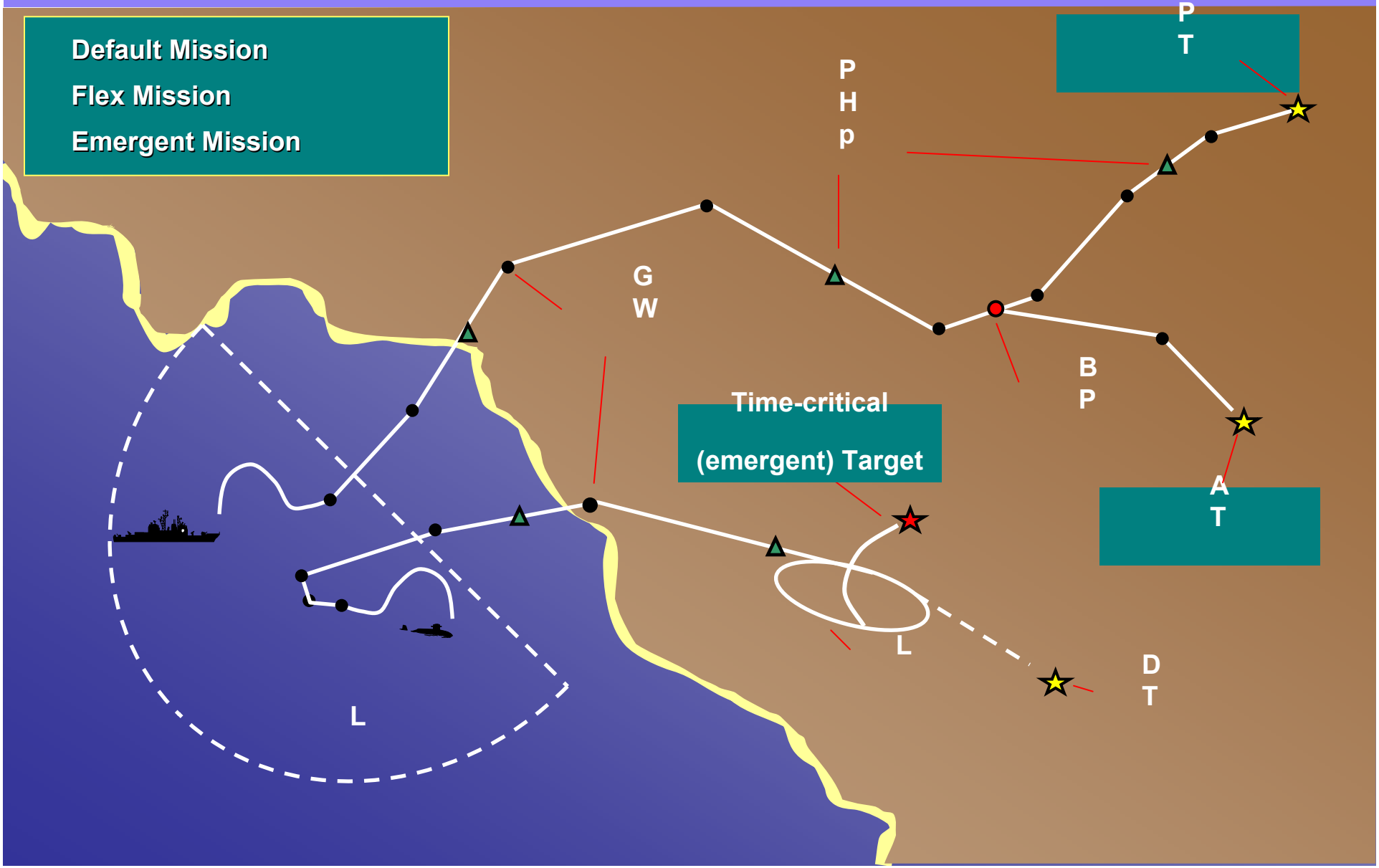
- System complexity & cost
  - Affects both the individual and groups
- Group diffusion of accountability
- Impact on natural resources
- Tele-robotic spies
- Over-trusting technology
- Smart weapons

A Comparison of Nuclear vs. Command & Control Domains

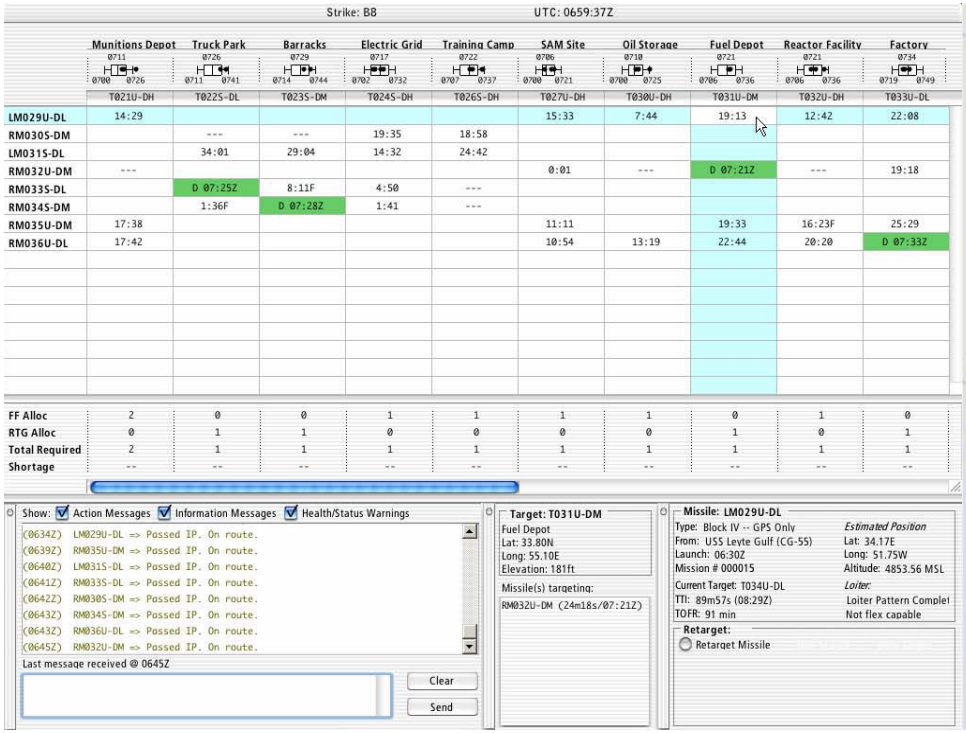
Factor\Domain	Nuclear Power Plant	Command & Control
Start-up	Only when conditions are normal	A response to an unexpected problem
Shutdown	Automatic on abnormality	Hard to stop once started
Experience	Hundreds of plant years	Very little
Personnel	Semi-permanent	High turnover
Error records	Public	Secret
Simulation	Accidents can be simulated	Difficult to do in realistic settings
Goal state	Control nature	Control intelligent opponent
Scientific analysis	Open	Secret

Automation & Weapons in the Future

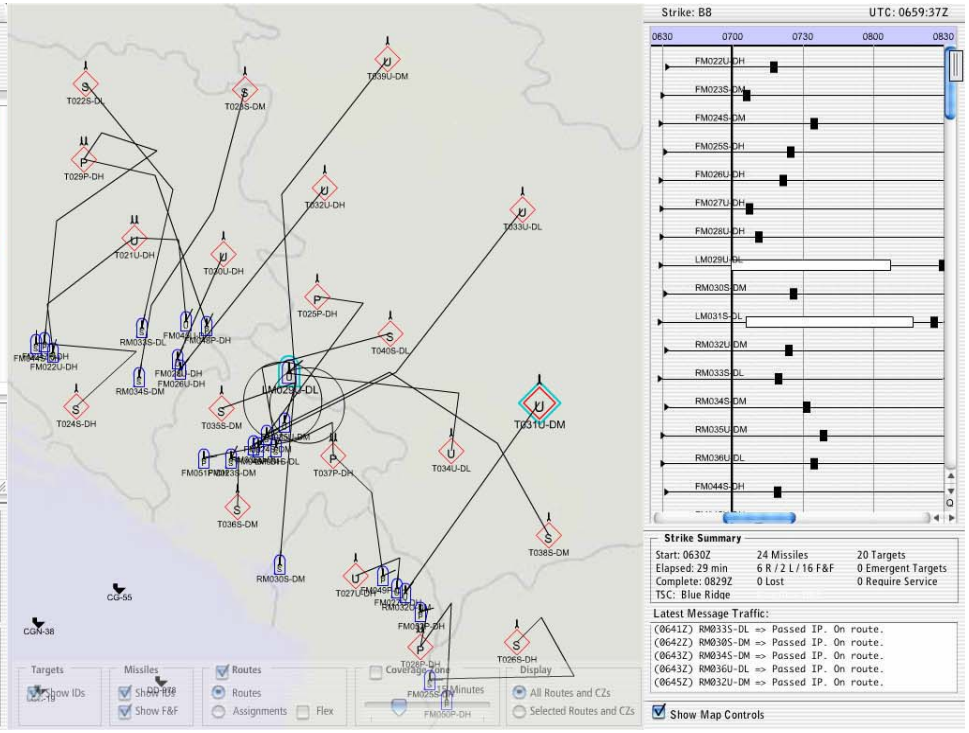
Proposed Tactical Tomahawk Missions



Controlling Multiple Autonomous Vehicles/Weapons In-Flight

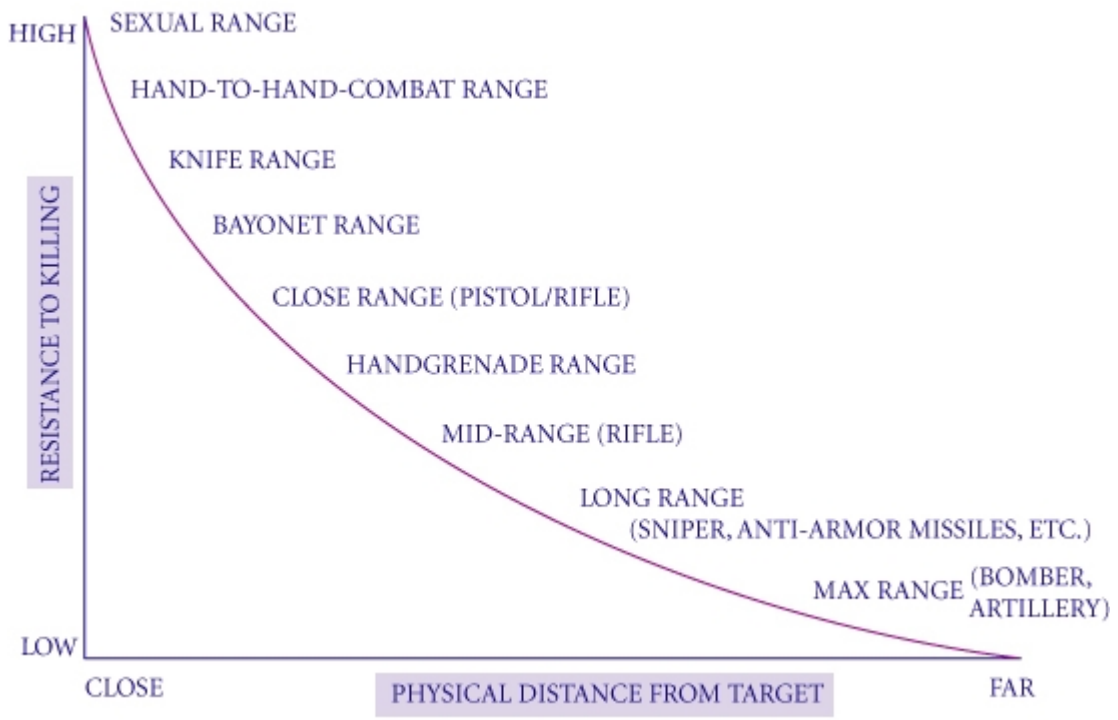


Retargeting Display



Monitor Map

Resistance to Killing as a Function of Distance



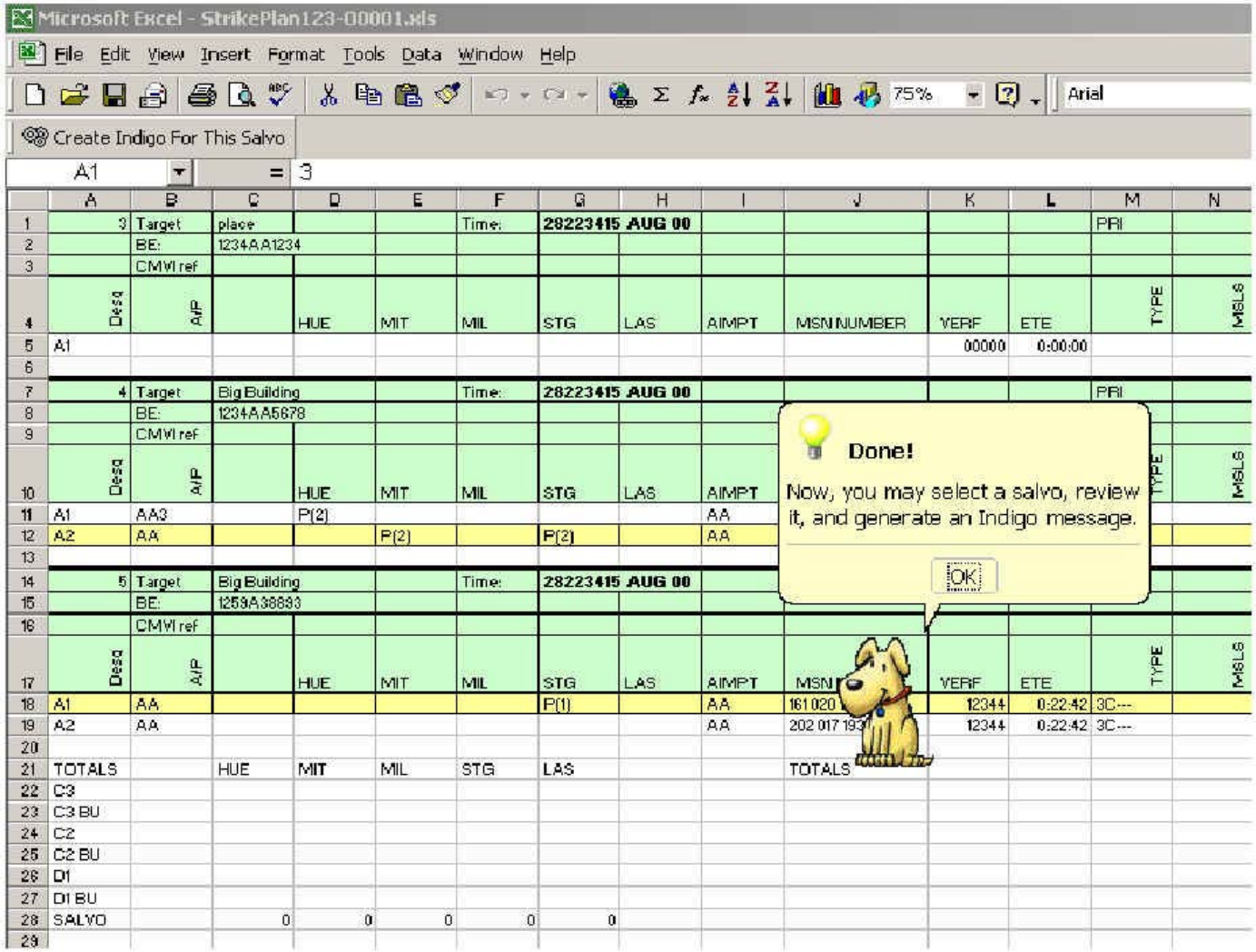
Obedience & Remoteness

- Milgram studies of 1960's
  - Deception experiment under the guise of 'learning'
- When the learner was in sight, 70% of the subjects refused to administer the shocks as opposed to only 35% who resisted when the subject was located in a remote place, completely out of contact with the teacher.
- Milgram proposed "out of sight, out of mind" phenomenon.
- Highly applicable to surgical strike weaponry

Assigning Moral Agency to Computers

- Do people assign moral agency to computers?
  - Low observability: High levels of automation authority but little feedback for the human operator
    - Can cause humans to view the automated system as an independent agent capable of willful action (Sarter & Woods 1994)
  - Friedman and Millet study in 1997
  - Acute Physiology and Chronic Health Evaluation (APACHE) system
    - Prognostic system for removal of groups of individuals from life support
    - Consultation tool vs. legitimate authority
- The danger: Automated recommendations could become a heuristic which becomes the default condition that requires little cognitive investigation.

Designing a Moral Buffer



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	3	Target	place			Time:	28223415 AUG 00						PRI	
2		BE:	1234AA1234											
3		CMWI ref												
4	Desig	A/P		HUE	MIT	MIL	STG	LAS	AIMPT	MSN NUMBER	VERF	ETE	TYPE	MSLS
5	A1										00000	0:00:00		
6														
7	4	Target	Big Building			Time:	28223415 AUG 00						PRI	
8		BE:	1234AA5678											
9		CMWI ref												
10	Desig	A/P		HUE	MIT	MIL	STG	LAS	AIMPT				TYPE	MSLS
11	A1	AA3		P(2)					AA					
12	A2	AA			P(2)		P(2)		AA					
13														
14	5	Target	Big Building			Time:	28223415 AUG 00							
15		BE:	1259A38883											
16		CMWI ref												
17	Desig	A/P		HUE	MIT	MIL	STG	LAS	AIMPT	MSN	VERF	ETE	TYPE	MSLS
18	A1	AA					P(1)		AA	161 020	12344	0:22:42	3C---	
19	A2	AA							AA	202 017 193	12344	0:22:42	3C---	
20														
21	TOTALS		HUE	MIT	MIL	STG	LAS			TOTALS				
22	C3													
23	C3 BU													
24	C2													
25	C2 BU													
26	D1													
27	D1 BU													
28	SALVO		0	0	0	0	0							
29														

Group & Agency Accountability

- Social accountability is defined as people having to explain and justify their social judgments about others
  - Social loafing
- Nissenbaum's Four Barriers
  - The problem of "many hands"
  - Software glitches (bugs)
  - The computer is seen as a scapegoat
  - Ownership without liability.
    - "Government Contractor's Defense"

Aerovironment Black Widow

Swarming Technology

IAI Scout

Gen. Atomics – Predator B

A significant human supervisory control problem of the future…

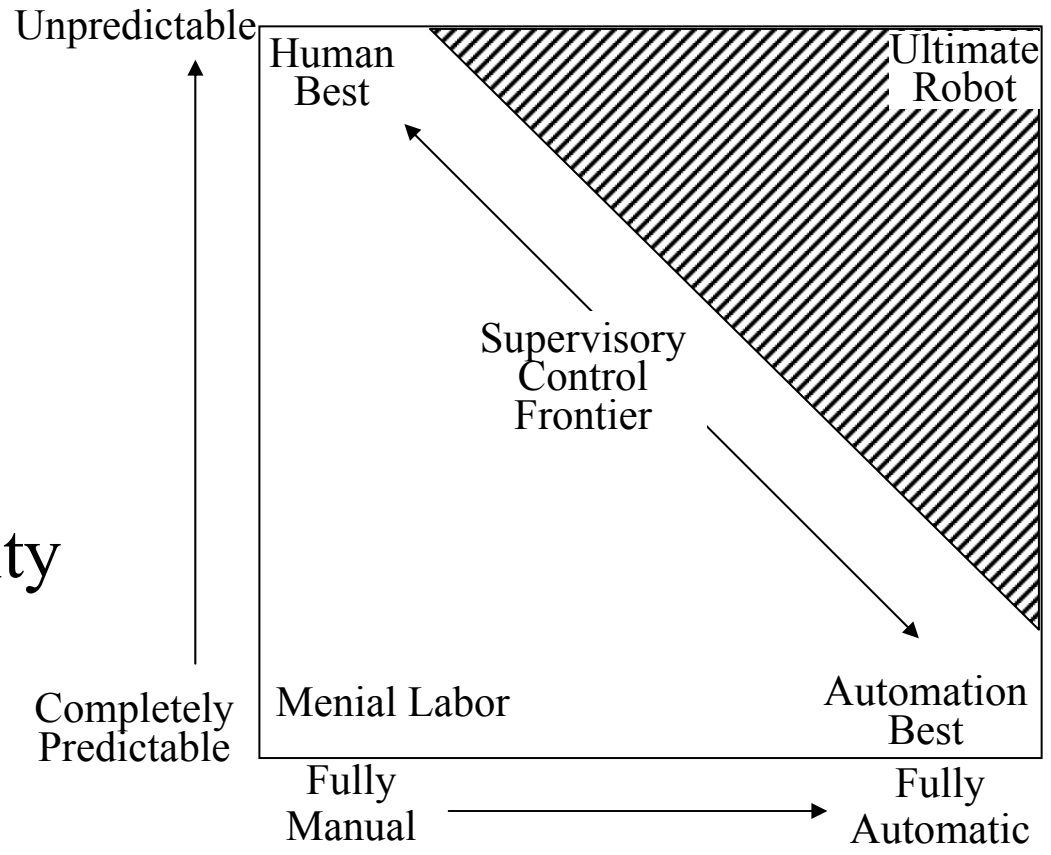
Boeing X-45A UCAV

And the future?

The speed of technologically fed developments does not leave itself the time for self-correction – the further observation that in whatever time is left the corrections will become more and more difficult and the freedom to make them more and more restricted –Jonas, 1979

Issues to Consider for the Future (Sheridan)…

- Retention of responsibility & accountability
- Operator free will vs. design constraints
- Reliability vs. creativity
- Complexity
- Joint constraint interactions



References

- T. B. Sheridan, *Telerobotics, Automation, and Human Supervisory Control*. Cambridge, MA: MIT Press, 1992.
- Grossman, D. (1995). *On Killing*. Boston: Little Brown & Co.
- Milgram, S. (1975). *Obedience to Authority*. New York: Harper and Row.
- Sarter, N. B., & Woods, D. D. (1994l). Decomposing Automation: Autonomy, Authority, Observability and Perceived Animacy. First Automation Technology and Human Performance Conference.
- Nissenbaum, H. (1995). Computing and Accountability. In H. Nissenbaum & D. G. Johnson (Eds.), *Computers, Ethics, and Social Values*. Englewood Cliffs, NJ: Prentice Hall.
- Jonas, H. (1979). *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*. Chicago: The University of Chicago Press.