
AUTOMOTIVE


INFOCOM


TRANSPORT, ENVIRONMENT & POWER ENGINEERING


AERONAUTICS


SPACE


DEFENCE & SECURITY

Man-Machine Teaming in Autonomous Technologies and Systems

Analysis and predication of impact and challenges

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iABG The Future.

The Human Role in Autonomous and Automated Systems

Military tactical - operational perspective

Concept perspective

Ethic perspective

Technical perspective

Human Factors perspective

Inter-organisational perspective

Cultural perspective

processes perspective

Man / Team
(soldiers)

Decision Making
Perception of Situation

Information Sharing

Collaboration
Planning
Situation
Awareness

Unmanned Military Systems

Organisation
(led by soldiers)

Technology
(made and run by soldiers)

Virtual Teams

Network Centric Operations

- The Human Being as integral element of any **(socio-technical) system**
- The Human Being as part of a **functional unit**
- The Human Being as an **operator**
- The Human Being as a **pilot**
- The Human Being as a **system controller**
- The Human Being as a **planer**
- The Human Being as a **communicator**
- The Human Being as a **team member**
- The Human Being as a **decision maker**
- The Human Being as a **leader**
- The Human Being as an **actor**
- The Human Being as a **flaw**
- The Human Being as a **problem solver**
- The Human Being as a **threat**
- The Human Being as a **protection**

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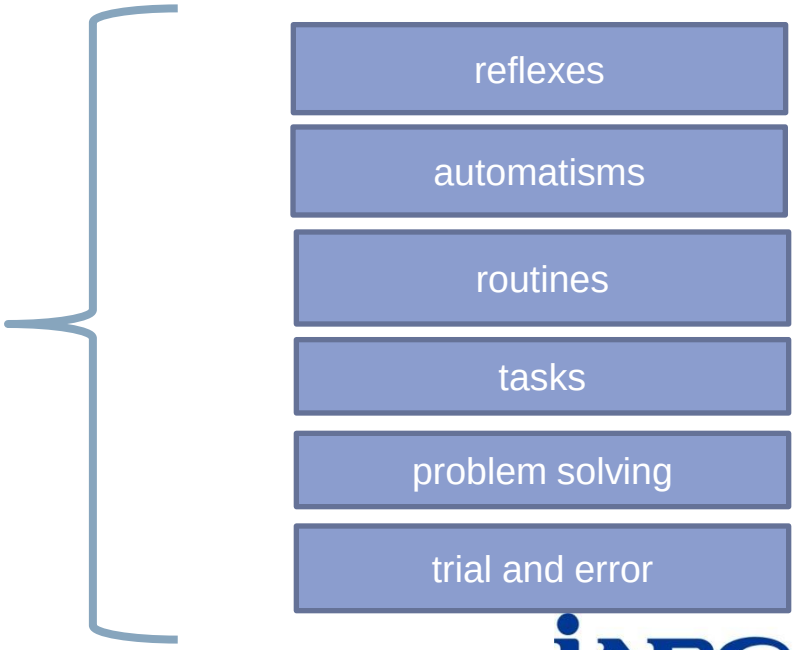
Which *role* will we assign to machine, to human or to both?

Levels of action

Levels of action

Which *actions* will we assign to machine, to human or to both?



contexts of actions

- individual problem solving
- team work
- leadership / C2
- organizational structures
- inter-organizational cooperation
- nation, culture and society
- transnational cooperation

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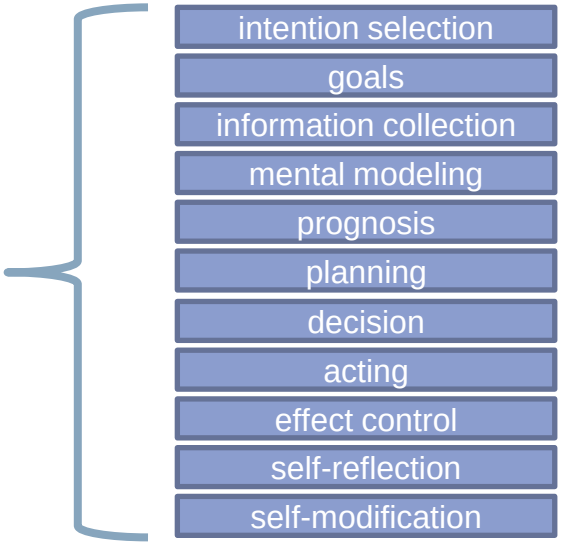
phases of action regulation

- intention selection
- goals
- information collection
- mental modeling
- prognosis
- planning
- decision
- acting
- effect control
- self-reflection
- self-modification

phases of action regulation



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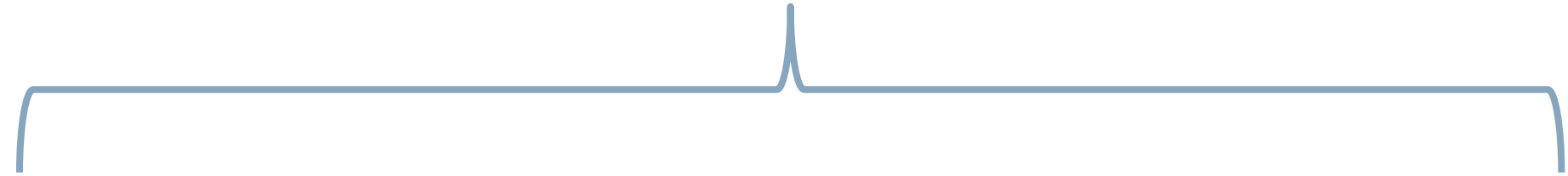
Man-machine teaming
A holistic, system-approach



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- reflexes
- automatisms
- routines
- tasks
- problem solving
- trial and error



- **Fallacy:** There are no humans and there is therefore no need for human factors

- **But**: Unmanned does not mean uncontrolled, Operators are remote relative to UAV not absent, huge demand for Ground personnel

- **Fallacy:** Air traffic controllers monitor dozens of vehicles, why not UAV operators?

- **But**: One operator per vehicle is "state of the art". The UAV control task involves much more than monitoring and control of aircraft position, Dynamic re-tasking and re-planning maximally exploits the UAV system

- **Fallacy**: How can it be different from manned flight? A UAV is a vehicle. UAV piloting is the same as piloting in the cockpit. A single pilot should be sufficient

- **But**: It is not a vehicle, but a system that includes vehicle(s), ground control, air operations, operator(s), intelligence, weather personnel, payload operators, maintainers… Piloting analogy ignores years of studies on time lag, loss of visual cues, depth perception, etc. Piloting analogy ignores the system functions beyond flight (i.e., re-tasking, replanning, sensor operation)

- **Suitability of task**
  - Complexity of the operation, function range for the accomplishment of the requirements
- **Self description ability**
  - Overview of the function offer
- **Controllability**
  - Which functions are contained in which form
- **Expectation conformity**
  - the system corresponds to cognitive expectations
- **Error robustness**
  - as the system is tolerant in relation to control errors
- **Individualizing**
  - as the system can be adapted to own desires
- **Learning**
  - in which respect the interface helps to understand the system

- **Awareness**
  - Attention
  - Perceptual focus
  - Perceptual control
- **Situation Awareness**
  - Information collection
  - Information fusion
  - Information evaluation
- **Shared Situation Awareness**
  - Communication of situation elements and evaluations
  - Alignment of the mental models
  - Interpretation consistency

- **Political accountability**
  - Government level *and politicians*
- **Ethical accountability**
  - Fundamental rights
- **Administrative accountability**
  - Internal rules and norms
- **Individual accountability**
  - Ability, resources, legal framework

Man **Machine**

Teaming

Deployed Operator

Autonomous and Automated Systems: Kicking the Human out of the System?

The Human Role in Autonomous and Automated Systems

Man

Machine

Teaming

Deployed Operator

Remote Operator

Engineer

Maintenance

Management

Autonomous and Automated Systems:
Moving the Human Factor from Operator to "Back Office"

And we lose the operator as the general problem solver at the sharp end of the system