



Command and Control Research is a "Science of the Artificial"

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Outline

- The "Sciences of the Artificial"
- The outer and inner systems in C2
- Goal directed systems
- The functions that must be achieved in C2
- The design perspective
- Does it make a difference?

The "Sciences of the Artificial"

- The concept was proposed by Herbert Simon
- Natural sciences are concerned with what is, the sciences of the artificial with what could or should be
- The sciences of the artificial are concerned with the artifacts that are designed to help us achieve our goals
- Not only physical artifacts (clocks) but also methods (economics) and human goal directed thinking
- A "Science of the Artificial" can be both normative (design science) and descriptive (describing how people use artifacts to achieve their goals)

The outer system, the inner system and the interface

- The *outer system* is that part of the environment where the goals are to be reached
- The *inner system* is the model of those aspects of the environment that are important for reaching the goals
- The *interface* refers to the means used to actually produce the desired effect
- The demarcation between the outer and the inner system depends on the goals

The outer system, the inner system and the interface in C2

- In training, the outer system is the force to be trained, and the inner system is the model used for training (the training manual)
- When the forces are put to use, they become the interface, the outer system is the environment in which one seeks to achieve military effects (including the enemy), and the inner system consists of the commander's model of the aspects of the outer systems relevant to achieving the effects

The functions constitute the glue that connects the inner system to the outer system

- The functions are part of the logic of design
- The specify *what needs to be done* to achieve the goal
- Design is then a matter of finding the form that will achieve the functions

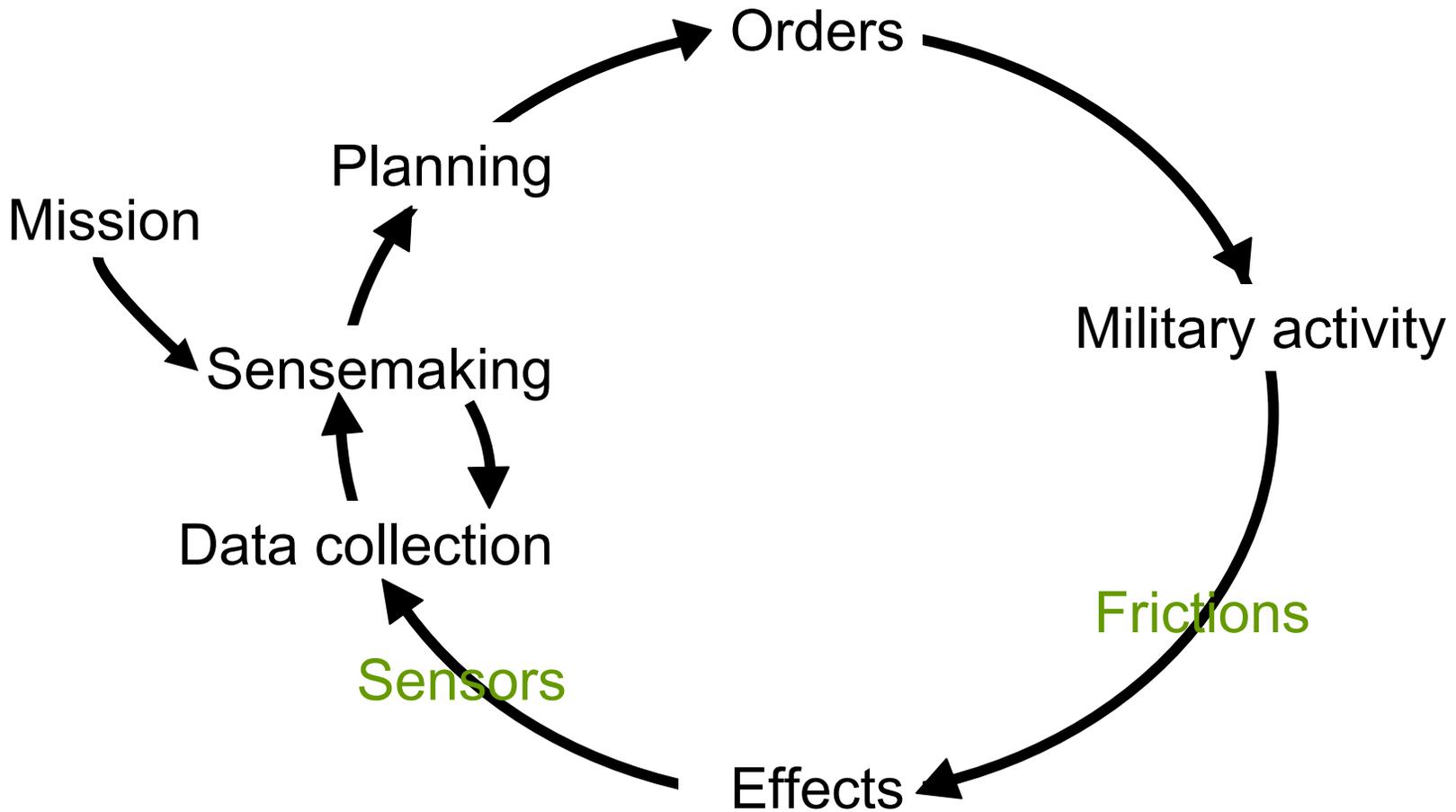
Goal Directed Systems

- A goal directed system is a system that can select the appropriate course of action in a range of environments
- If the system can reach its goals in only one environment, it is a mechanism
- A fundamental question in a science of the artificial is how to design (or evolve) the inner system that can do this
- We propose that this is done by considering the functions that must be achieved to reach the goal
- This means that the inner system must be able to specify what information it needs, decide what to do, and how to do it by means of the interface that it has (or can develop)

The Functions that Must be Achieved in C2

- C2 is the function of the military system that achieves direction and coordination
- To achieve its goal, we propose that the C2 system must be able to fulfill three functions
- It must be able to collect the data that it needs
- It must be able to understand its mission in terms of what it needs to do in the situation at hand (sensemaking)
- It must be able to shape the course of action that represents what it needs to do to fit the circumstances, i.e., it must be able to decide not only what to do but also how to do it (planning)

The Dynamic OODA Loop



The Design Perspective

- C2 is always carried out within a C2 system
- The goal of C2 science is to design effective C2 systems
- A C2 system consists of the organization, methods, procedures and support systems that are used to produce the course of action that is necessary to achieve the effects specified in a mission
- Existing C2 systems must be understood and evaluated in terms of design
- The product of C2 is design, the design of military operations
- C2 is a matter of designing systems that produce effective design of military missions

Does this make a difference?

- It provides a coherent perspective for understanding C2
- C2 research is concerned with designed systems that produce design of military action
- The key is understanding how the functions can be achieved and developing support in the form of better organization, better methods and procedures, and better support systems for achieving these functions

Thank you for your attention

Questions?

Comments?