Issues:—

- Understanding the true Nature of Command and Control
- Modelling Command and Control Systems
- Capturing requirements and turning them into Command and Control Systems

Rubbishing Conventional Wisdom

- "To gain the most from information systems, one has to radically reorganize overall processes so that the power of the machinery can be brought to bear. Cost-benefits can only really be achieved this way"
- Real conflict and warfare is unpredictable. Prescriptive approaches have continually failed in the past, resulting in grandiose, expensive monuments to messianic faith in technology
- Command and control is essentially of and by people, exhibiting human dimensions of leadership, charisma, *sang froid*, courage, and-particularly-adaptability to situation
- The eventual processes are not really predictable—they emerge in response to the unpredictable environment, witness DICS, where preconceived message formats were rarely used.

What *really* happens!

- In the real world, new conflicts generate new situations
- C^2 organizations are thrown together into alien situations, and teams form under pressure
- Far from depending on technology, each new situation is the subject of intense interpersonal debate, using even communications only occasionally.
- Once human decisions are reached and strategy/tactics formulated, then technology *may* be used to inform, to elaborate and support the plan.
- Engineers and technologists might like to think that technology rules C^2, but it does not.

Modelling and Simulation Shortfalls?

> "Orchestrated? You start conducting and then some son-of-a-bitch climbs out of the orchestra stalls and comes after you with a bayonet!"
>
> *General Norman Schwarzkopf*

- Is Command and Control, *in extremis*, controlled aggression through fear, while excess testosterone and adrenalin make the legs tremble and the palms sweat?
- If so, then the types of model and (to a lesser extent) simulation above—which neglect the whiff of grapeshot, the clatter of battle—are unlikely to describe reality

C2 and SE, VR

- If Command and Control is about teams, planning, briefings and group decisions, then **HCI / MMI must enable *comprehensive person-to-person interchange***.
- If Command and Control is about **team-management of aggression**, should **understanding behaviour** be to the fore?
- If Command and Control is about maintaining force **morale, esprit-de-corps, coherence,** should **group psychology** be evident?
- **Solo-immersion VR ≠ command and control**
- Networked-immersion VR may, for the first time, enable:—
  - expert C^2 personnel to develop interpersonal team performance
  - expert teams to evolve their own C^3I requirements, in SE, without writing
  - eliminate the paper chase from user ‘ specifier ‘ systems engineer ‘ information engineer ‘ commissioning engineer ‘ customer ‘ user
  - eventually, eliminate specific, prescriptive C^3I

Following discussion explores these ideas

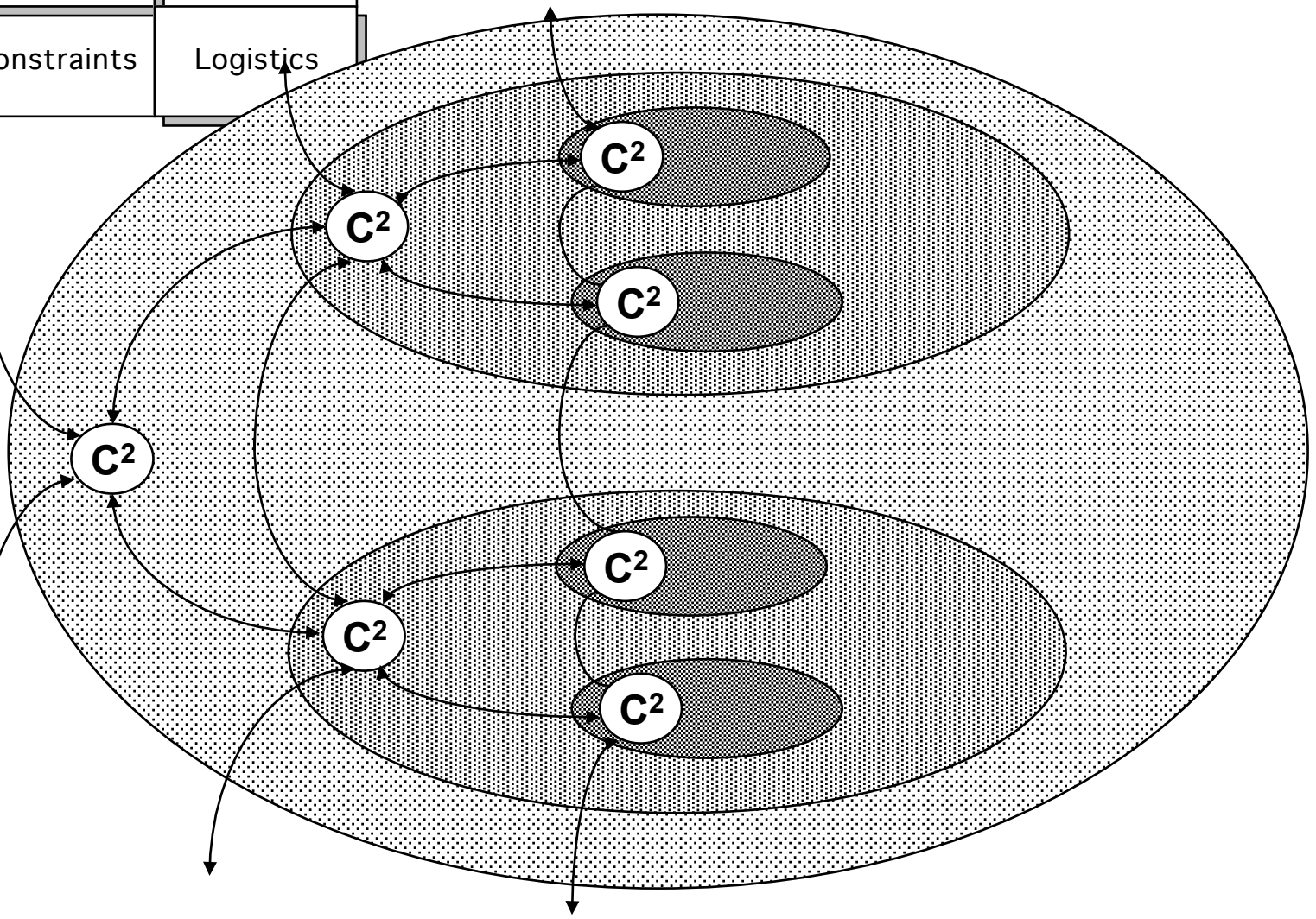
Understanding the Complexity of C^2

Fractal C^2

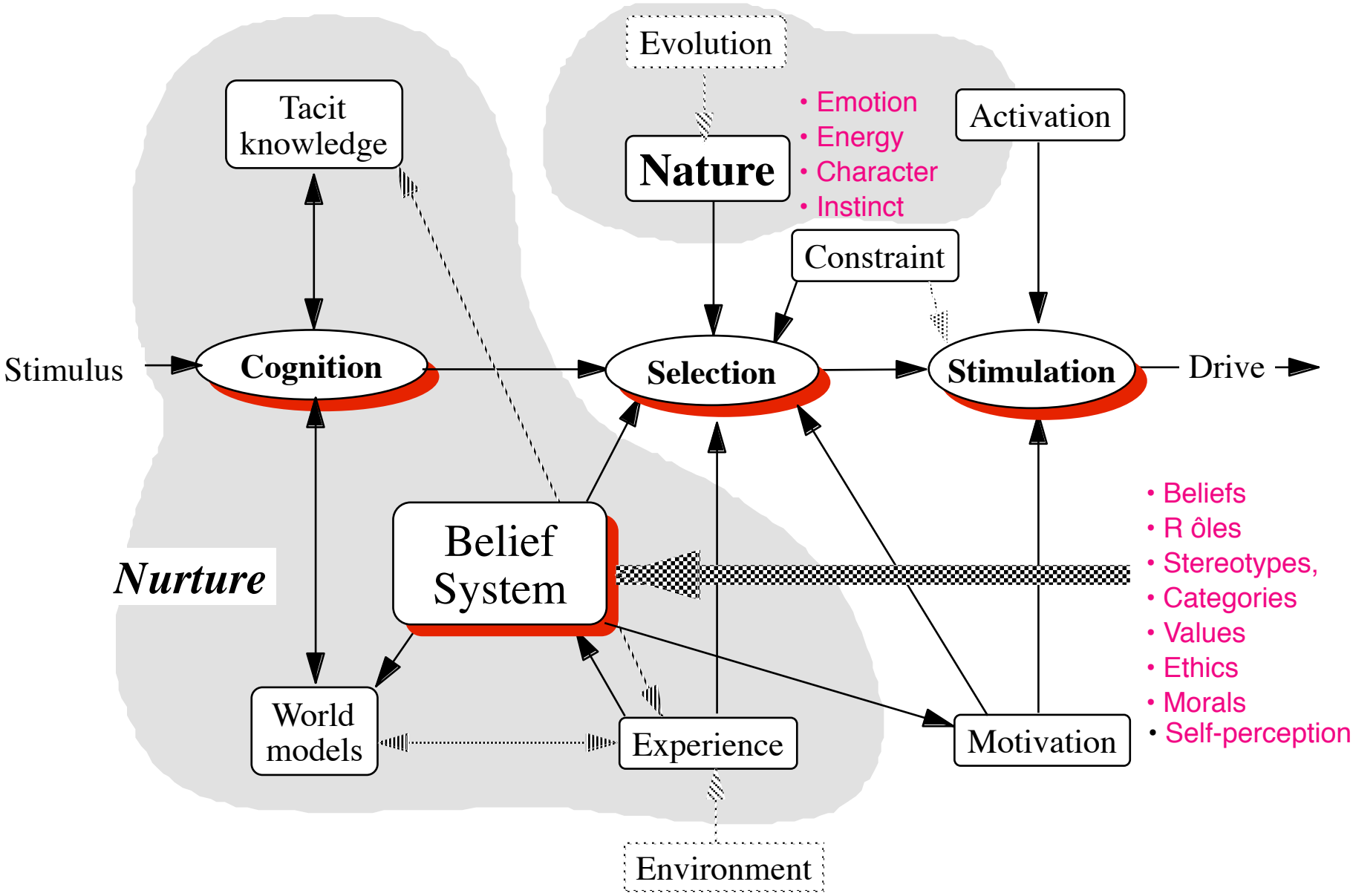
Commander	Tasking	Decisions	
Enemy ORBATS, intentions	Intelligence	Enemy ORBATS, intentions	Needs
Operations Plans	Operations Plans	Operations	Needs, priorities
	Constraints	Constraints	Logistics

N.B. N^2 chart appears at each and every C^2 location

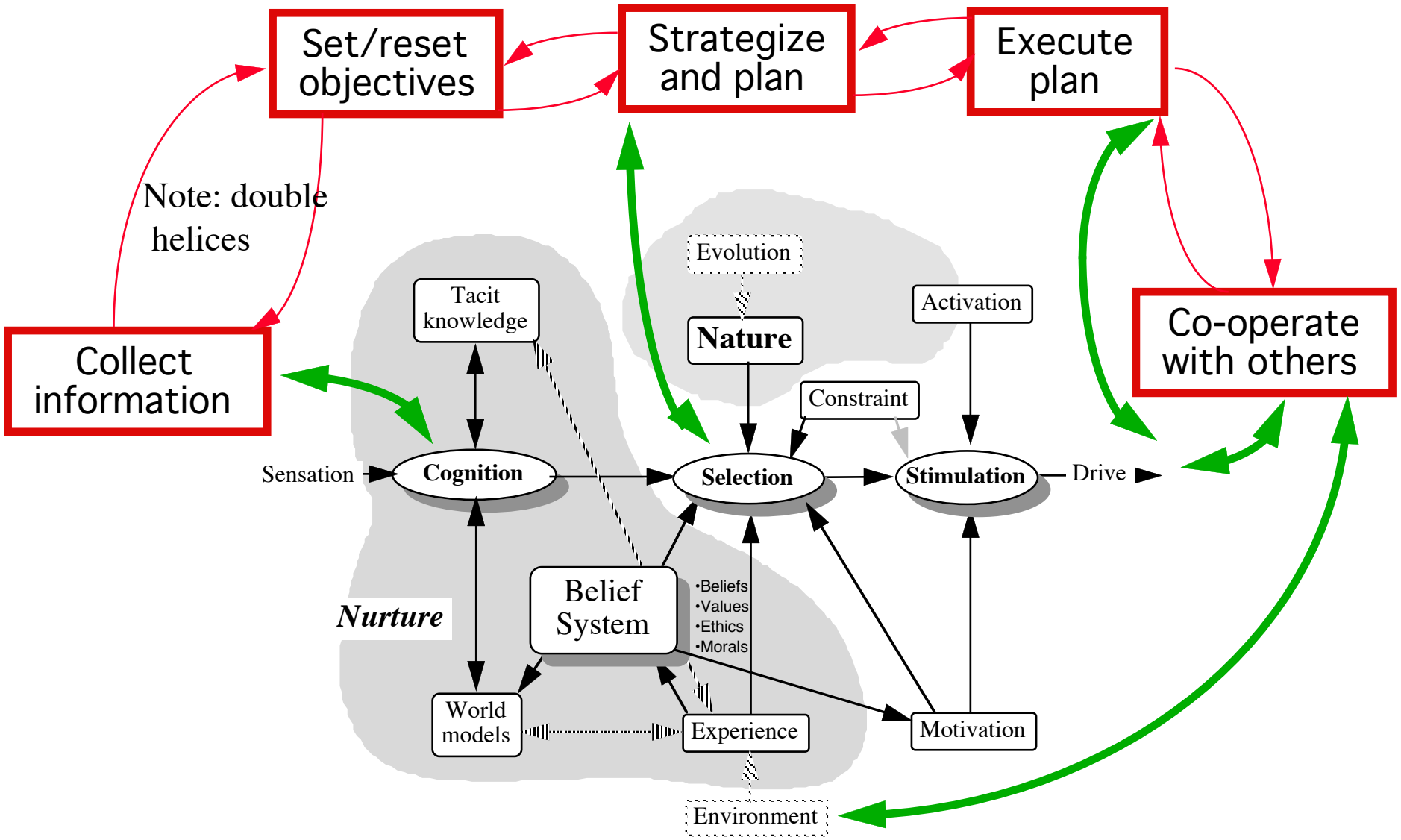
Notional C2 Organization



Behaviour Management



Mission and Behaviour Models—Interactions

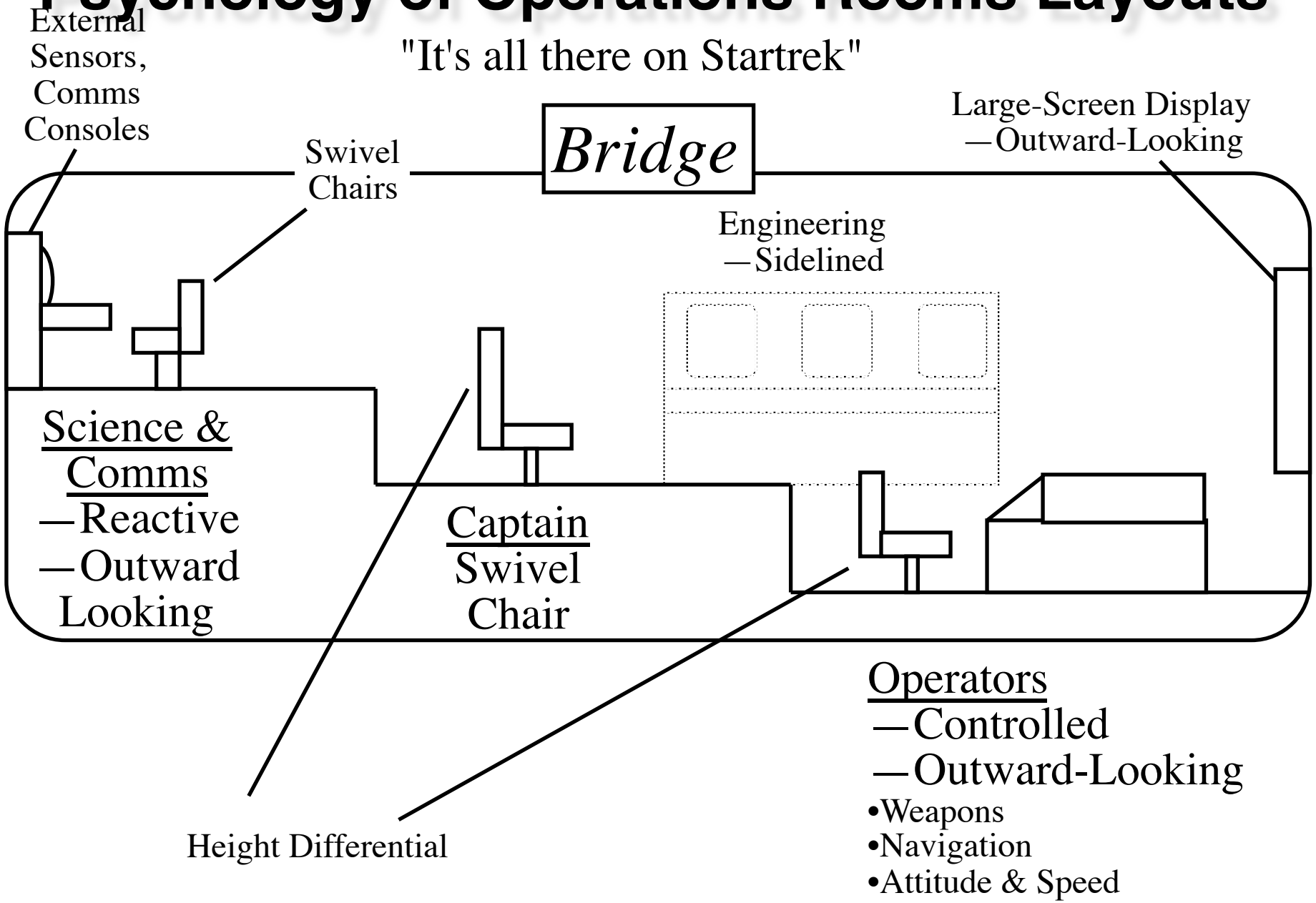


Belief is the end, not the beginning, of understanding

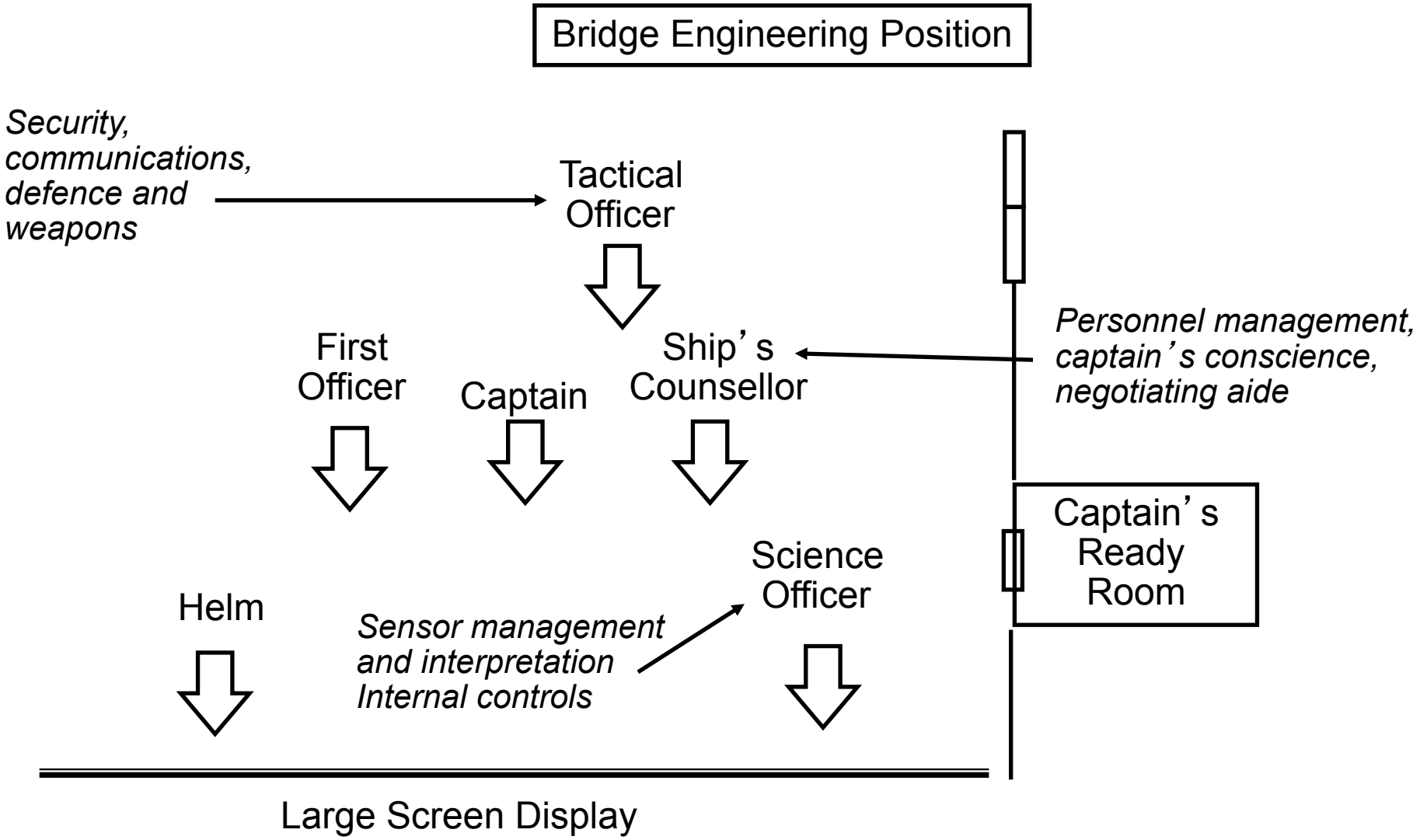
after Johann Wolfgang von Goethe

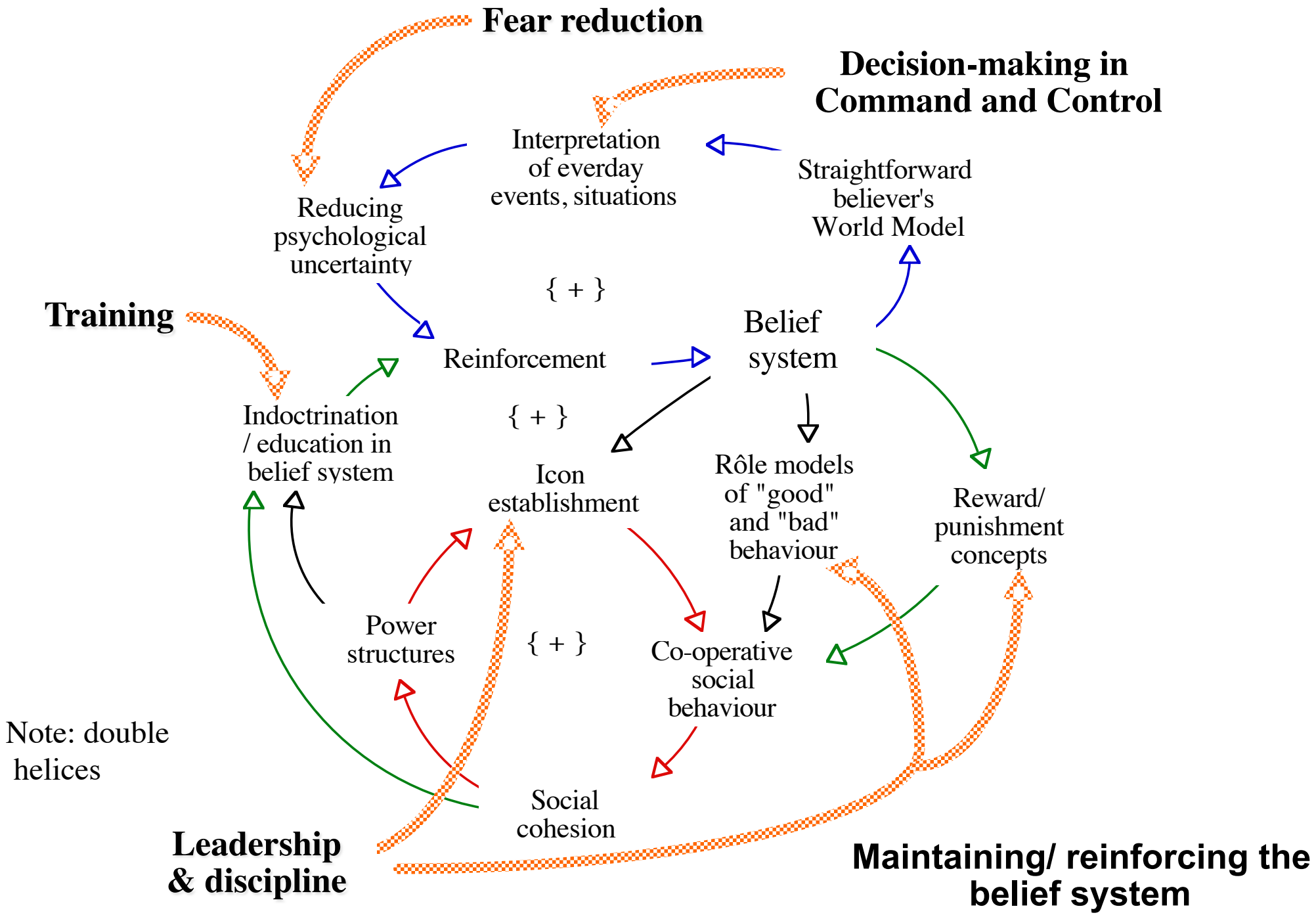
Psychology of Operations Rooms Layouts

"It's all there on Startrek"

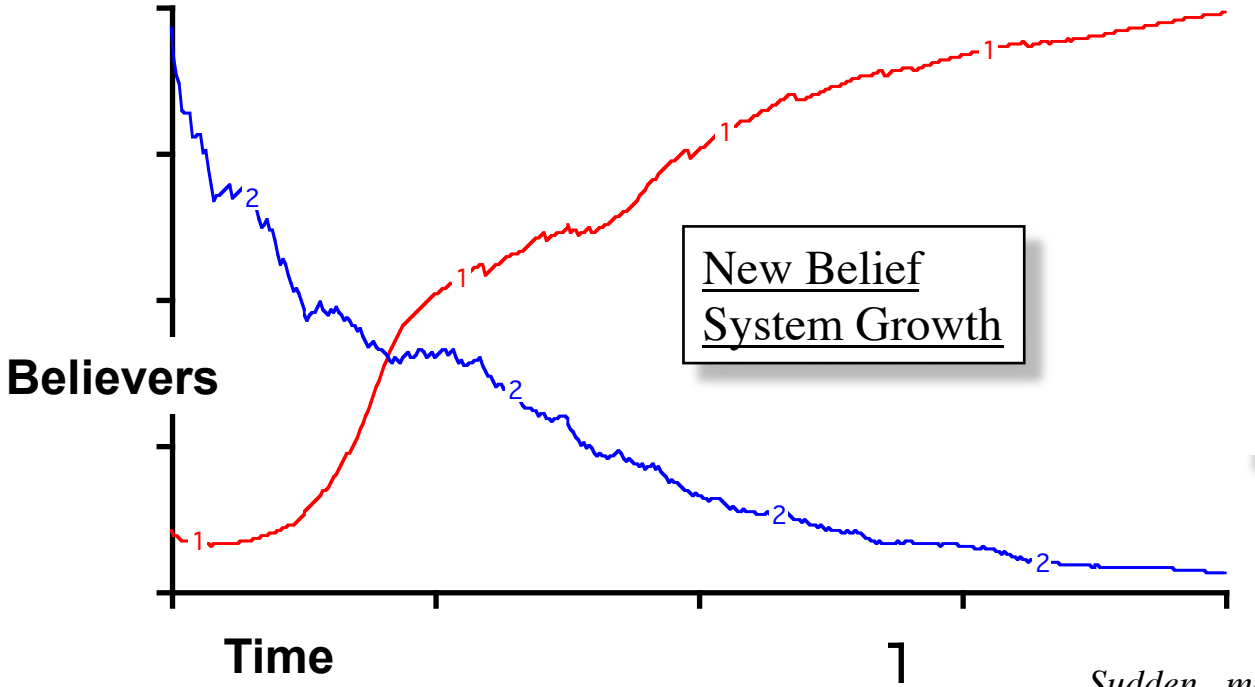


Startrek—the Next Generation—a new Psychology?




Fear reduction
Decision-making in Command and Control
Interpretation of everday events, situations
Reducing psychological uncertainty
Straightforward believer's World Model
{ + }
Training
Reinforcement
Belief system
Indoctrination / education in belief system
{ + }
Icon establishment
Rôle models of "good" and "bad" behaviour
Reward/ punishment concepts
Power structures
{ + }
Co-operative social behaviour
Note: double helices
Social cohesion
Leadership & discipline
Maintaining/ reinforcing the belief system

Competing Belief Systems

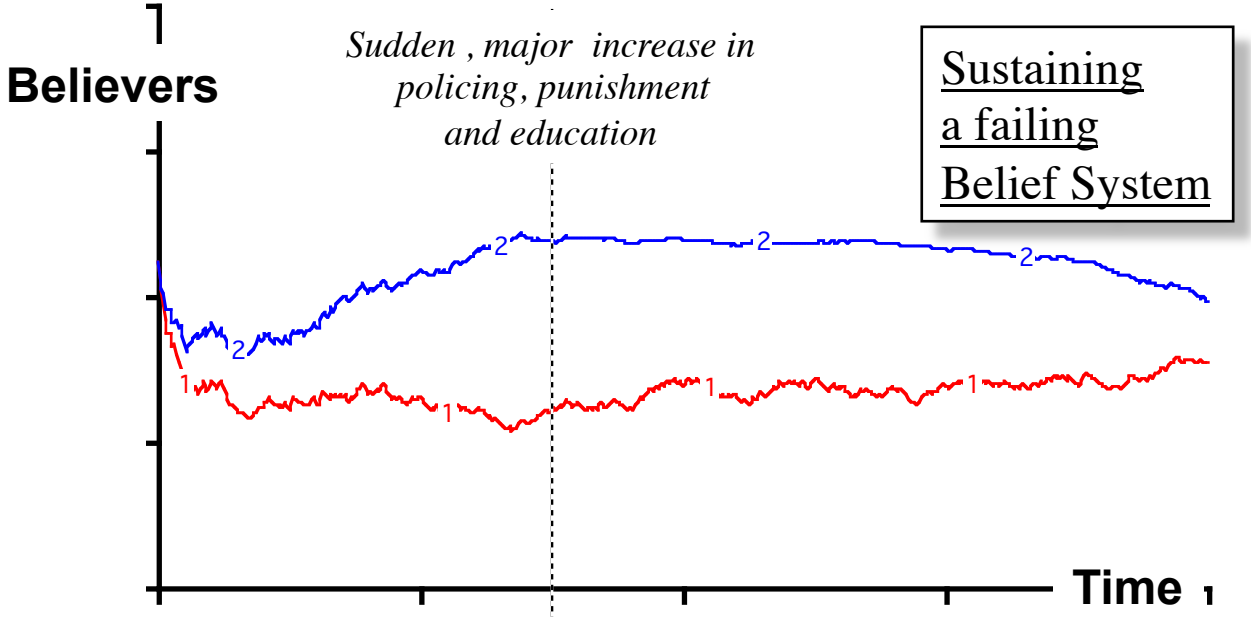


New Belief System Growth

New Belief System attracts believers if it is:—

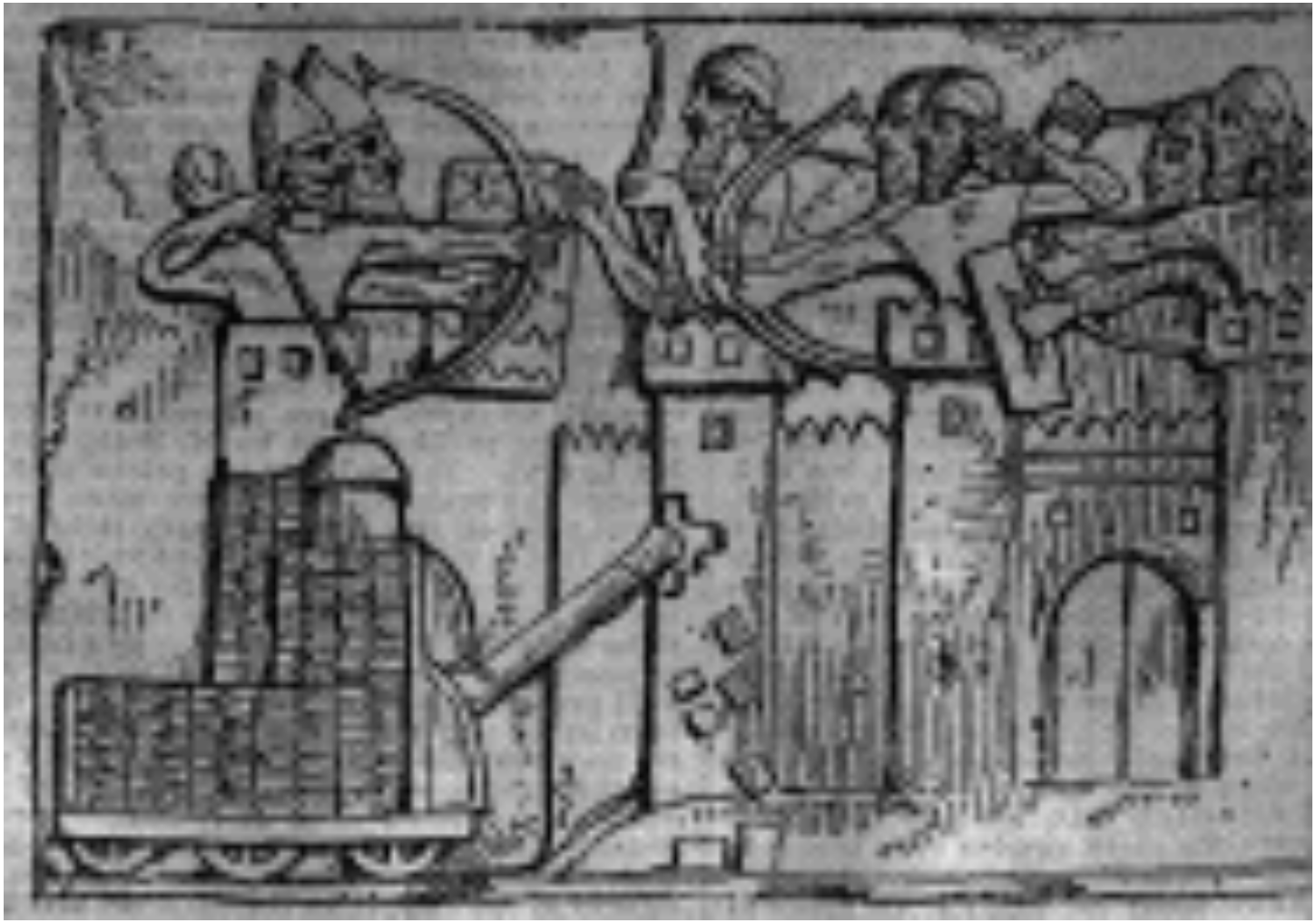
- *self-re-inforcing*
- *supported by education and regulation*

Failing Belief System is v. difficult to sustain once a downward trend is established



Sustaining a failing Belief System

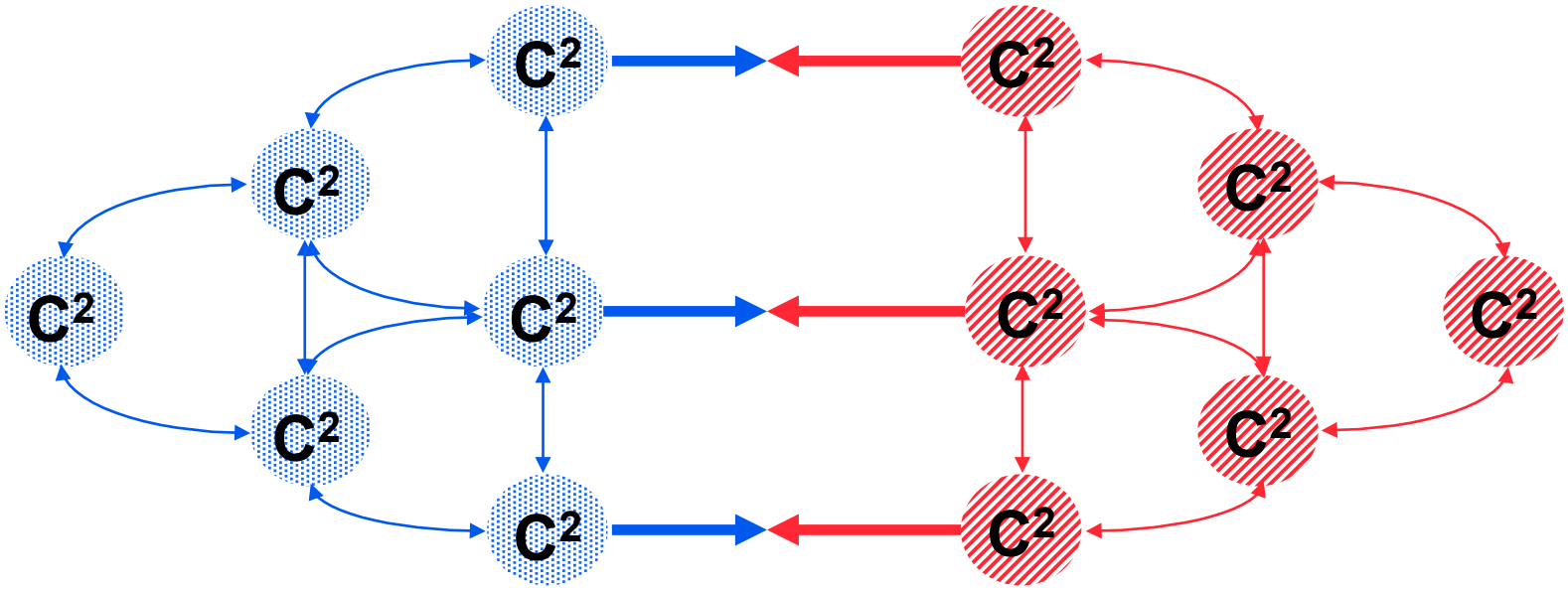
Belief System Battle



Assyrians besieging a city

—from the Assyrian Marbles, British Musem

Conclusion from Models



Arrows show propagation of *Belief System*

- Command and Control is about *two* distinct Struggles

1. The Struggle within **Blue**/**Red** **Force to maintain its own Belief System**
2. The struggle between **Blue** **Force's Belief System and** **Red** **Force's Belief System**

The Bottom Line

1. If **Command and Control** is about **decision-making**, then…
2. …models of technology or decision-making do not explain C ^{2}

…possibly because…

3. Shared/unshared **Belief Systems colour** individual's and group's **decision-making**

…showing that,, at its heart…

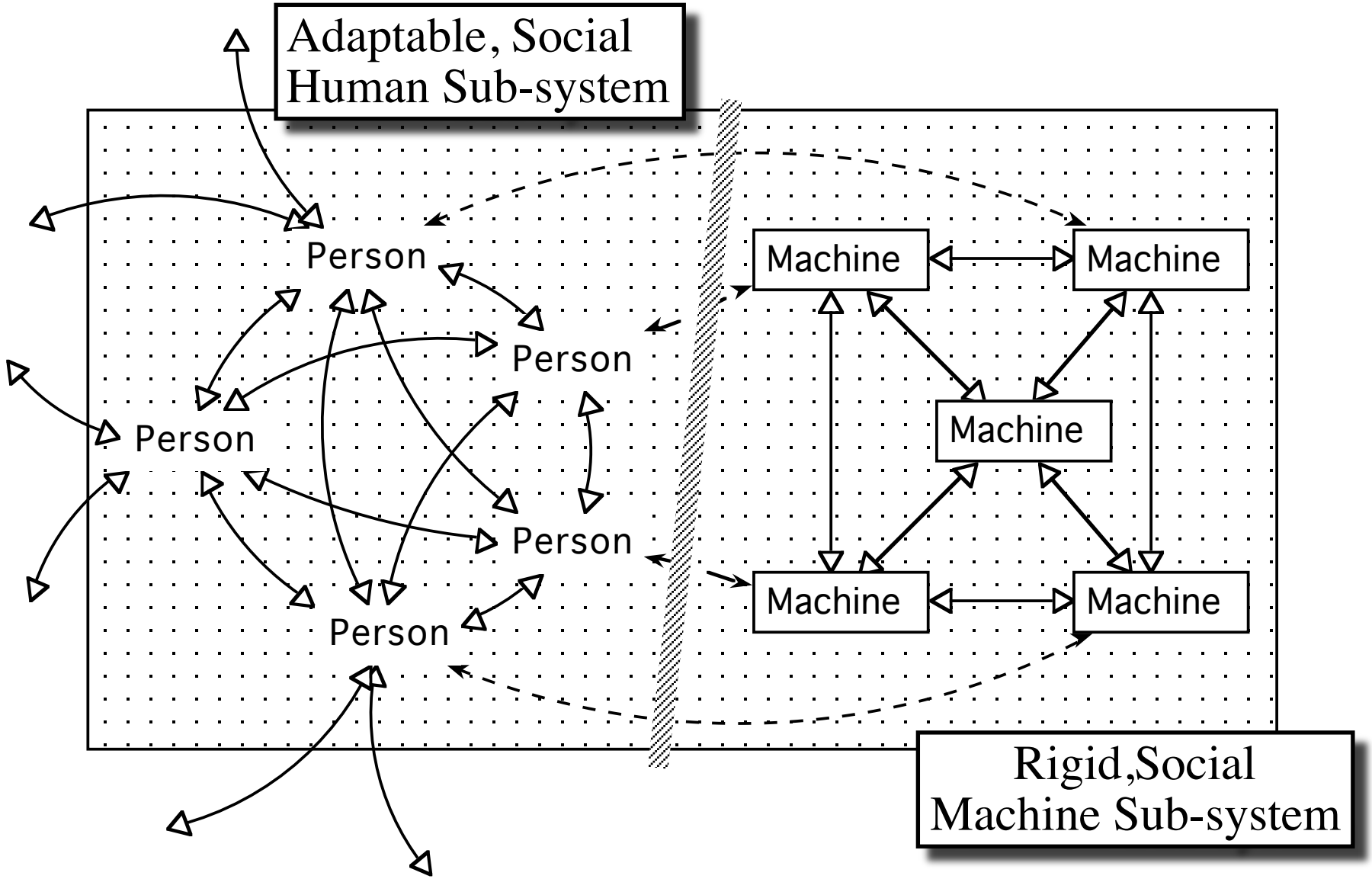
4. **C ^{2}** is a **struggle** within and between **Belief Systems**

…explaining, perhaps, why…

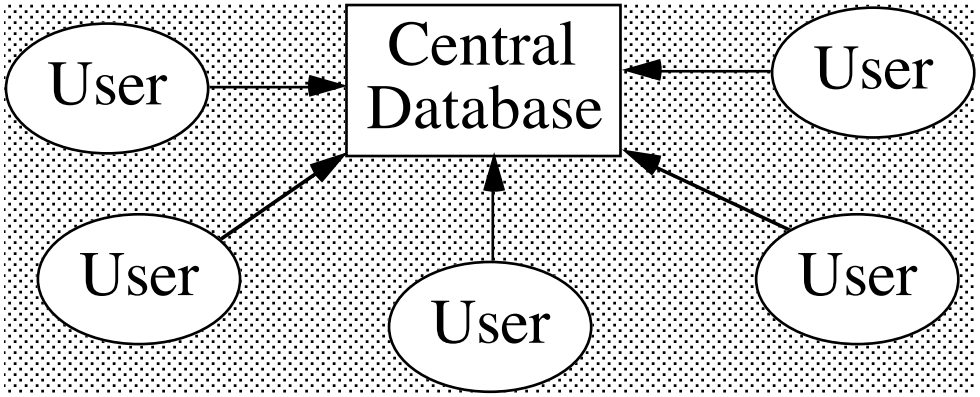
5. Traditional models and simulations fall short.
6. In time, and with caution, **VR** could let :—
   - **engineers provide** ever-improving **environments**
   - **commanders propagate beliefs, values and leadership** through those environments
   - **users design, train and operate** in self determined environments

A Human-Centred View of C^2 Organization

Adaptability in Systems

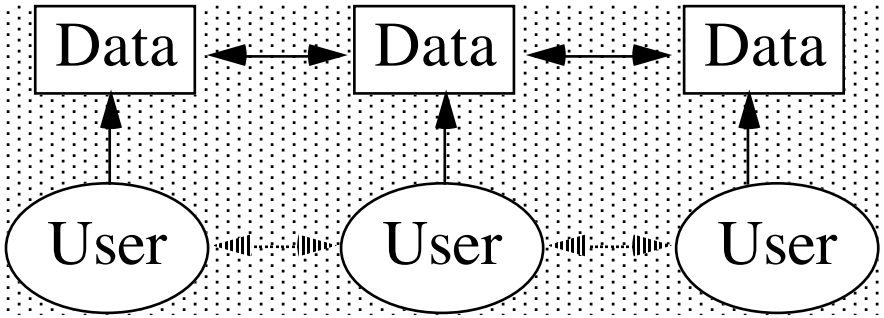


Information System Paradigms



"Deus ex Machina"

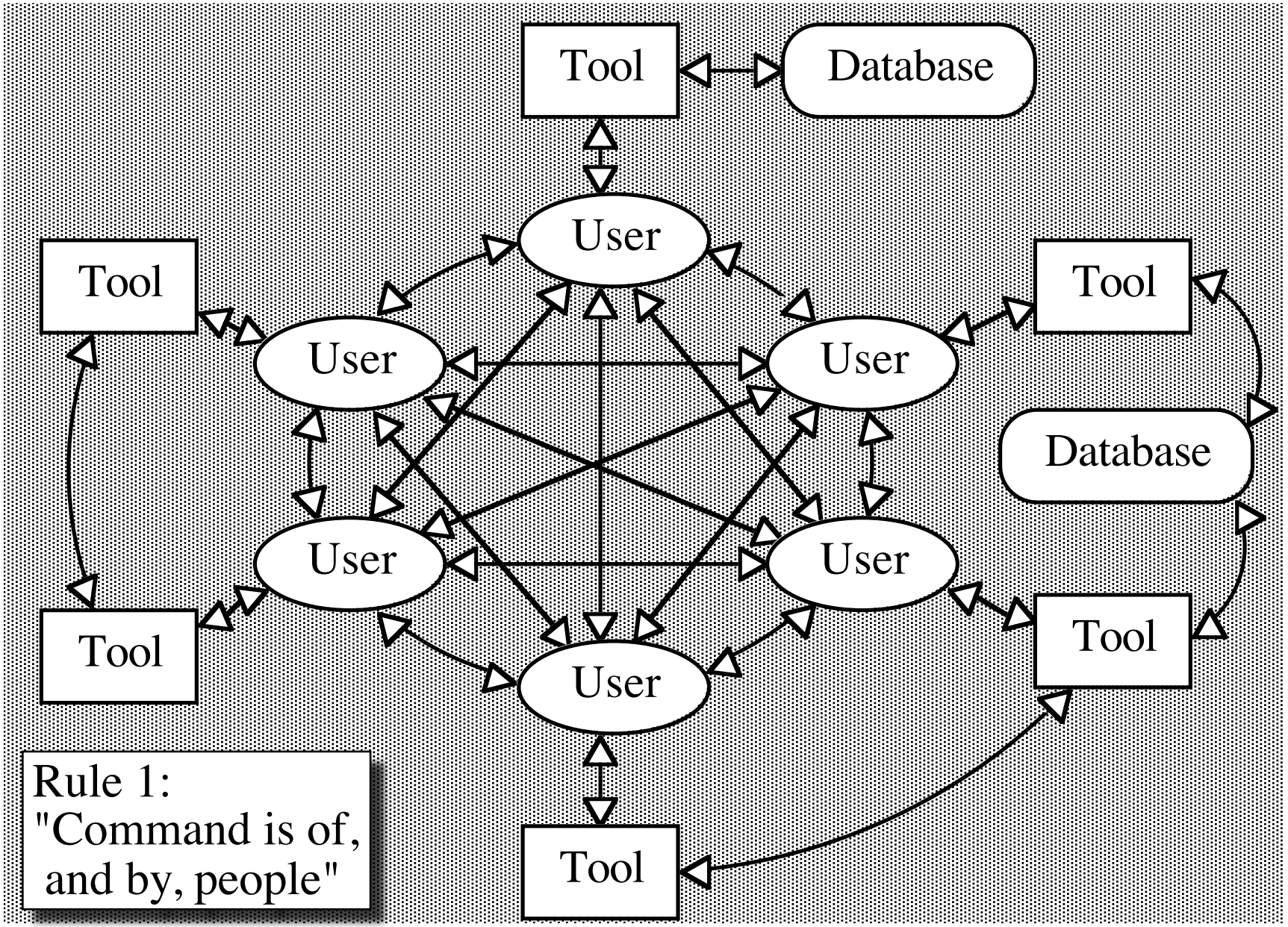
Users communicate via rigid, limited database, using only one of five senses—slow, ineffective, non-adaptive, humans as machine-minders



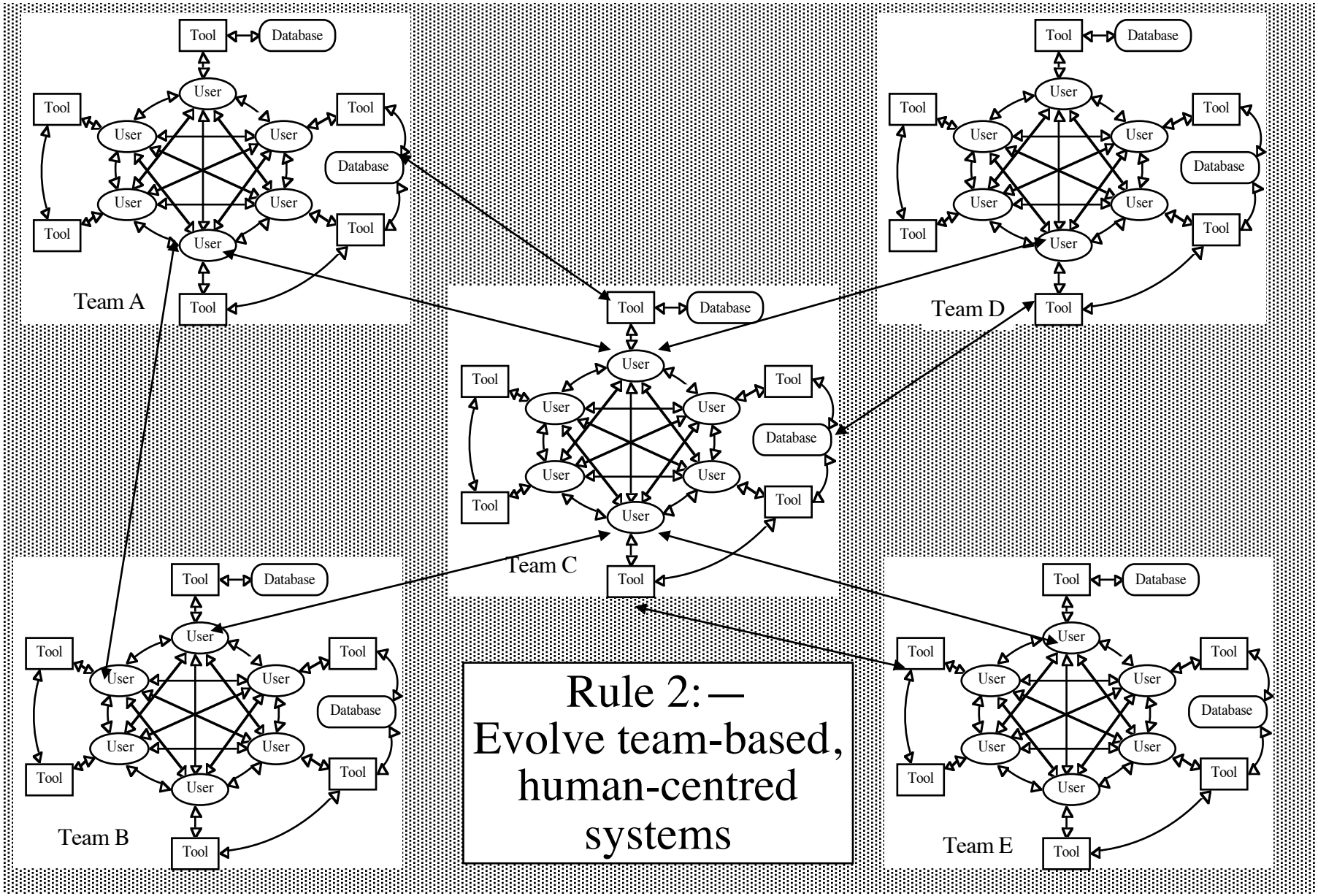
"Users Good—Machines Better"

Users communicate directly *and* via machine; humans adapt, machines do not. Machine quickly obsolescent.

Human-Centred Paradigm



Team-based Command and Information Technology



The Potential Rôle for SEVR

An Alternative Procurement Philosophy

- Who knows what they want to do?—The User
- Who has all the experience at doing it?—the User
- Who should be developing C2 and Management Systems?
- —the Expert User

Robust Command Systems

- There is no job so mundane that it lacks a 'wrinkle'. Humans are past masters at finding easier / better ways to do anything
- Experienced Command system operators have already learned many wrinkles as individuals, *but also as teams*
- Requirements capture is therefore virtually impossible by our present methods—e.g. talking to individuals, building fast prototypes.
- Rule 1. Use expert Command system operators to capture their ***own*** requirements

Accelerated Evolution Approach—AEA(1)

- **Step 1**. Eliminate as much technology as possible —create a *human* Command System Team of current experts which uses manual methods.
- **Step 2.** Give the Team *time* to build its repertoire of individual and group skills, interpersonal relationships, group effectiveness. Use extra manpower to achieve performance.
- **Step 3.** *Stress* the Team—simulated Command, cooperation with other force elements, real drudgery, simultaneous representative variety. External DS to be experts, too. Continue until manual team is highly proficient

Accelerated Evolution Approach—AEA(2)

- **Step 4.** *Team* identifies Sub-Teams, bottle-necks, areas for improvement—i.e. the Team proposes its own productivity enhancement, individual-by- individual, sub-team-by-sub-team, absolute minimal technology *integration*
- **Step 5.** Provide the Team with its proposed support
- **Step 6.** Repeat steps 2 to 4
- **Step 7.** Resist the temptation to integrate all the technological support features—that's the path to software overruns, project delays and inflexible technological 'solutions'

The AEA System

- Conceived and evolved by current experts for experts
- User-effort directed at System Performance, not at overcoming technology limitations
- Guaranteed outcome:—
  - » —evolves from a manual system (=working system)
  - » —degree of evolution controllable (= time/cost controlled)
- Self validating design—user-specified, situation-evolved
- Emergent-property directed—performance, interoperable, flexible, adaptable, damage tolerant (non-nodal)
- Inherent team training
- Avoids "integrate / automate" trap = reduced complement, but:
  - » • increases maintenance • increases cost • reduces adaptability • causes near-term obsolescence.

Division's Virtual Representation of HMS Marlborough Combat Centre

Getting the Picture Straight

- Division's VR Picture of HMS Marlborough Combat Room is missing the essential ingredient…
- …so, put *experienced users* into virtual environments
- Allow experienced users to adapt mutual behaviour to deal with variety of (simulated) threats
- review, update, evolve supporting virtual technology
- Set virtual teams against virtual teams, not just to train, but to evolve mutual technology requirements

Understanding—the Bottom Line

- 1. Understand our own *superb human capabilities*
  - » —communication, cooperation, correlation, commitment, courage, intellect, ingenuity (C5I2?)
  - » —adaptability
  - » —mental-modelling
  - » —fast individual decision-taking/satisficing
- 2. Understand our *human frailties*
  - » —decision-information overload
  - » —slower group dynamics
- 3. Use technology to *compensate* for our *weaknesses*
- 4. *Avoid* technology which *impairs* our individual and group *strengths*