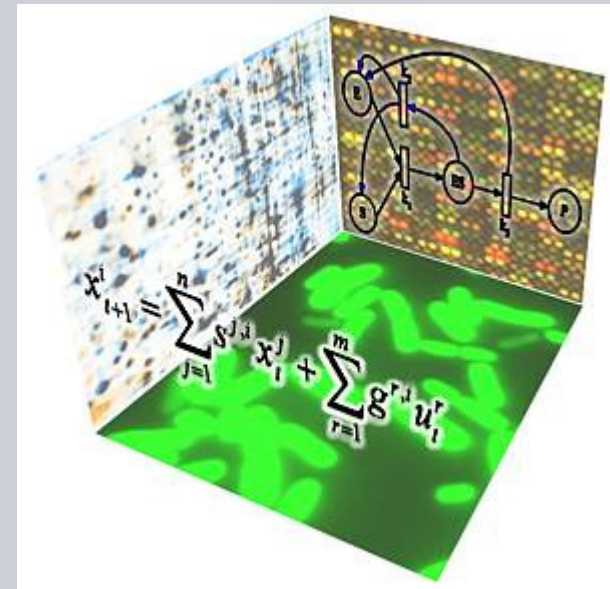


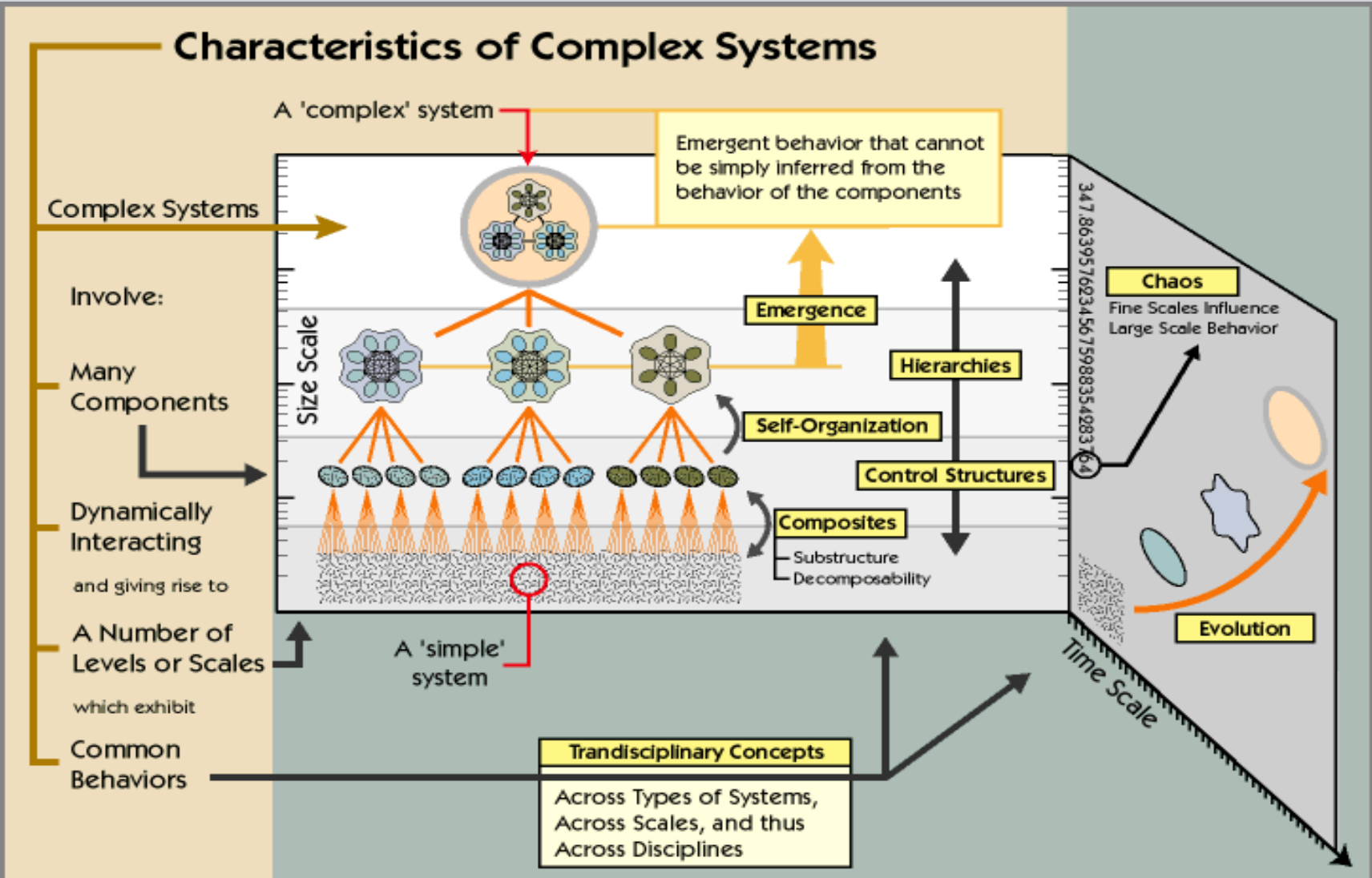
Complex Systems

Using ITC for efficiency increase in complex systems



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What is a Complex System?



**A definition for the purpose of this discussion:
not physical, biological or sociological systems, but:**

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Complex Product Systems (CoPS)

(Hobday, M. 1999, p.619 ff; see also Tidd/Bessant/Pavitt 1997)

- Built from high cost, capital goods, made of **many interconnected, often customized elements** (including control units, sub-systems, and components). Often their sub-systems are themselves complex, customized & high cost. System boundary sometimes unclear or varying
- Are **dynamic** (change their state over time as result of internal and external stimuli)
- Tend to be **produced in projects** or in small batches which allow for a **high degree of user involvement**, the needs of business users feed directly into the design process
- Once installed, **further evolve in response to feedback from users** (e.g. intelligent buildings, business information networks, ...)
- Usually require services (VAS) for operation.

Theory, intuition and experience of humans acting in a complex system may be inapplicable or plain wrong



Issues of users and operators of a complex system

Interconnectedness of many and disparate components/subsystems leads to ***intransparent and often non-linear cause-effect relations***

- => many parameters need to be watched in parallel
- => reaction of the system to (unexpected) changes in one of the control parameters may be unknown or unpredictable

Time dependency: dynamic, often ***fast, changes of system states***

- => no time to gather all necessary data, even if available
- => need to react on the basis of incomplete data (heuristics)
- => (human) reaction time can be too slow

Humans can be the weakest link in the operation of a CoPS

Science is addressing the problem, entrepreneurs are seeing a market

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Many dedicated research institutes are addressing problems relevant for industry, e.g.

- New England Complex Systems Institute
- Complex Product Systems Innovation Centre
- Commonwealth Scientific and Industrial Research Organisation
- Santa Fe Institute
- Cranfield Complex Systems Management Centre
- Max-Planck-Institut für Dynamik komplexer technischer Systeme

A number of startup companies offering consulting and tools dealing specifically with complex system issues, e.g.*

Manufacturing:	Pertinence (E2E production control)
Utilities:	SEAMS (decision support) Dynamic Knowledge Corp. (decision support environment)
Healthcare:	Clinical Care Systems (decision support in care delivery)
Financial Services:	Ortec International (risk management, resource optimization) Sequr (in-process decision support for fraud management)
Security:	Rontal (incident management) Orsus (situation management solutions for site safety and security)