V

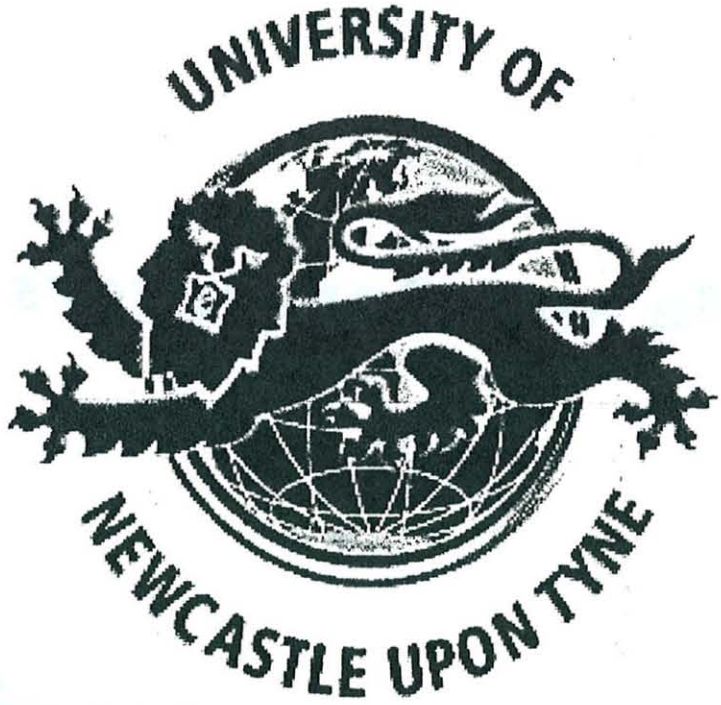
PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

and

WHAT IS INFORMATICS?

K Nygaard

Rapporteur: Neil Henderson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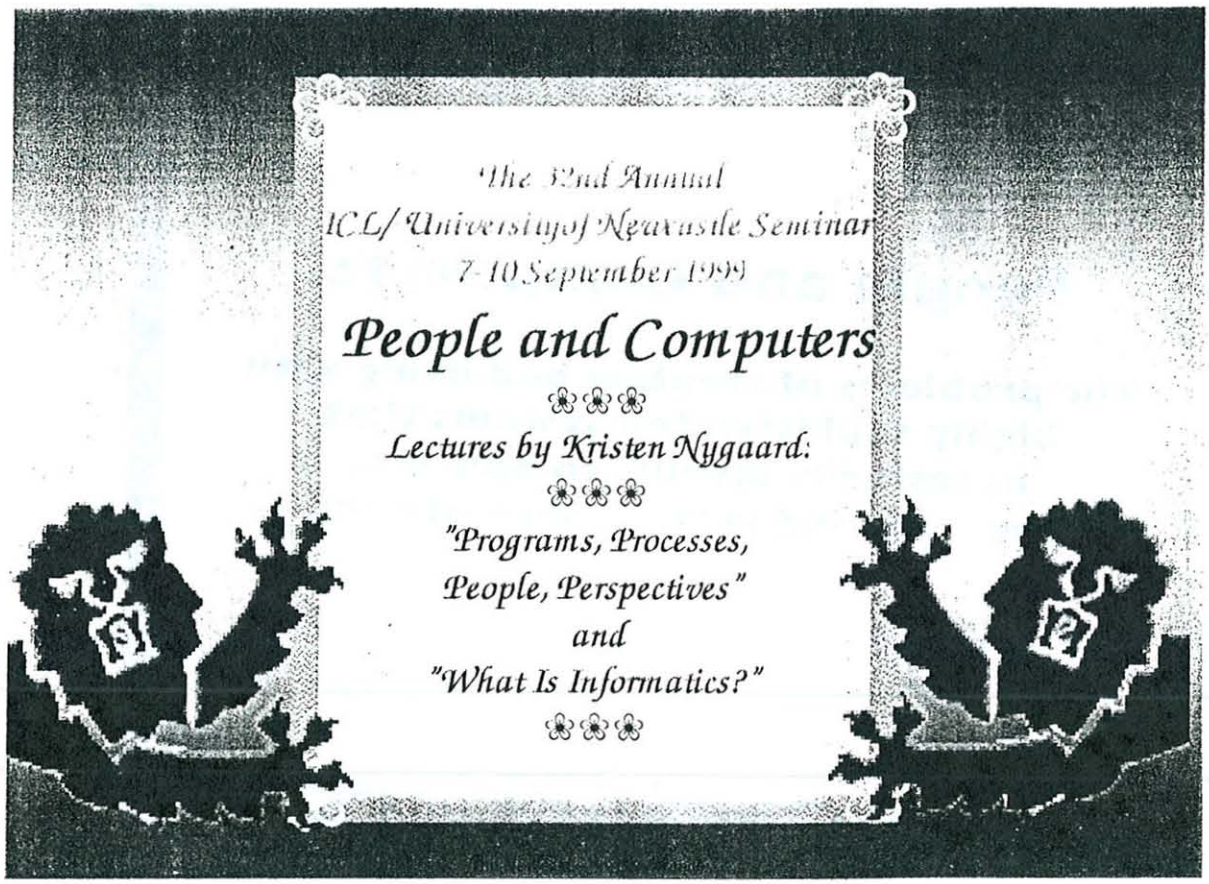
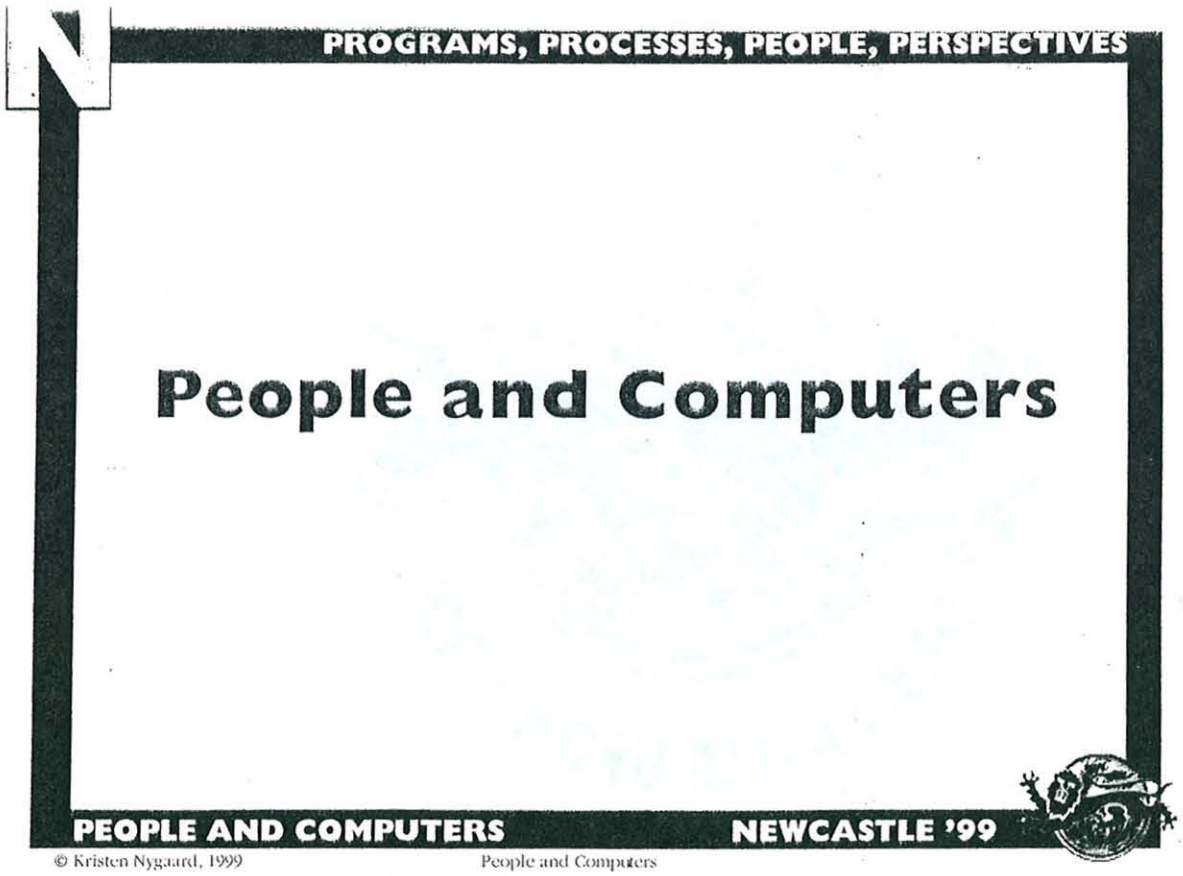
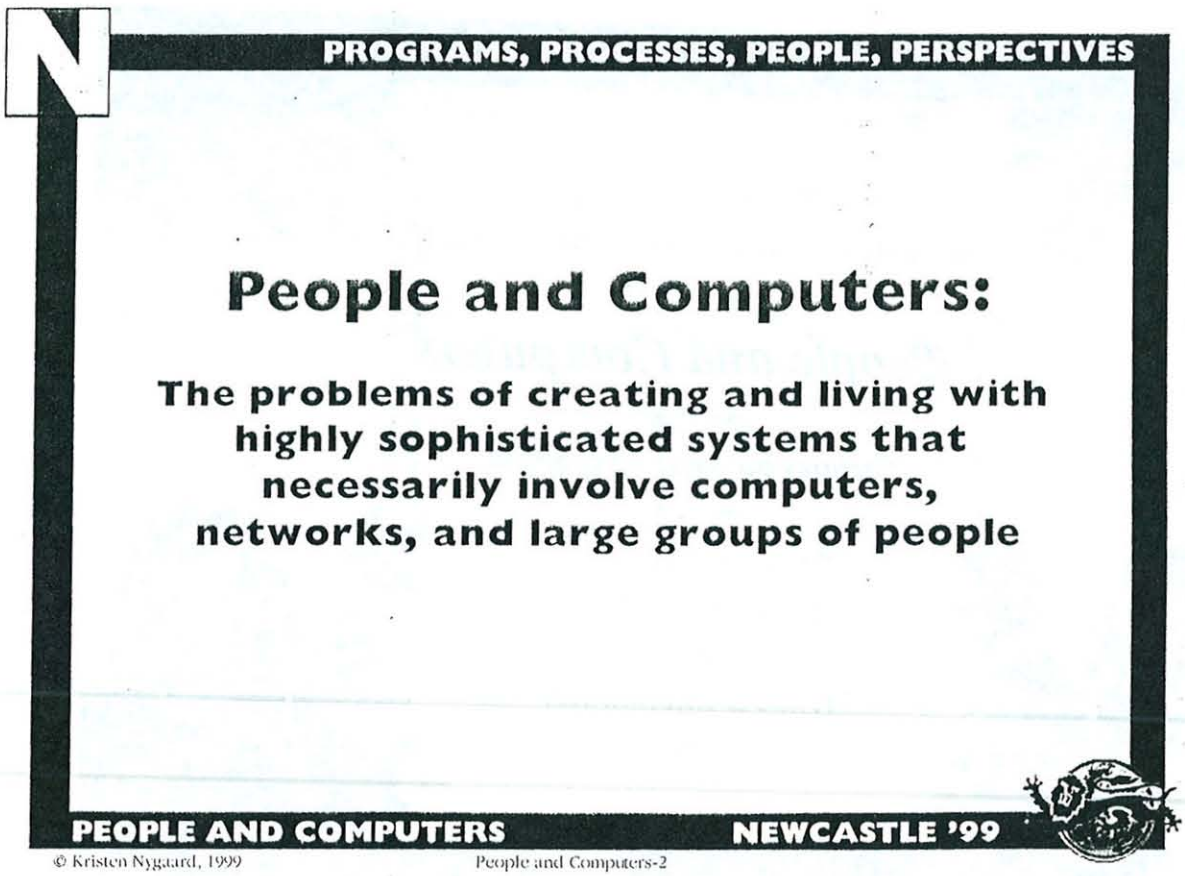
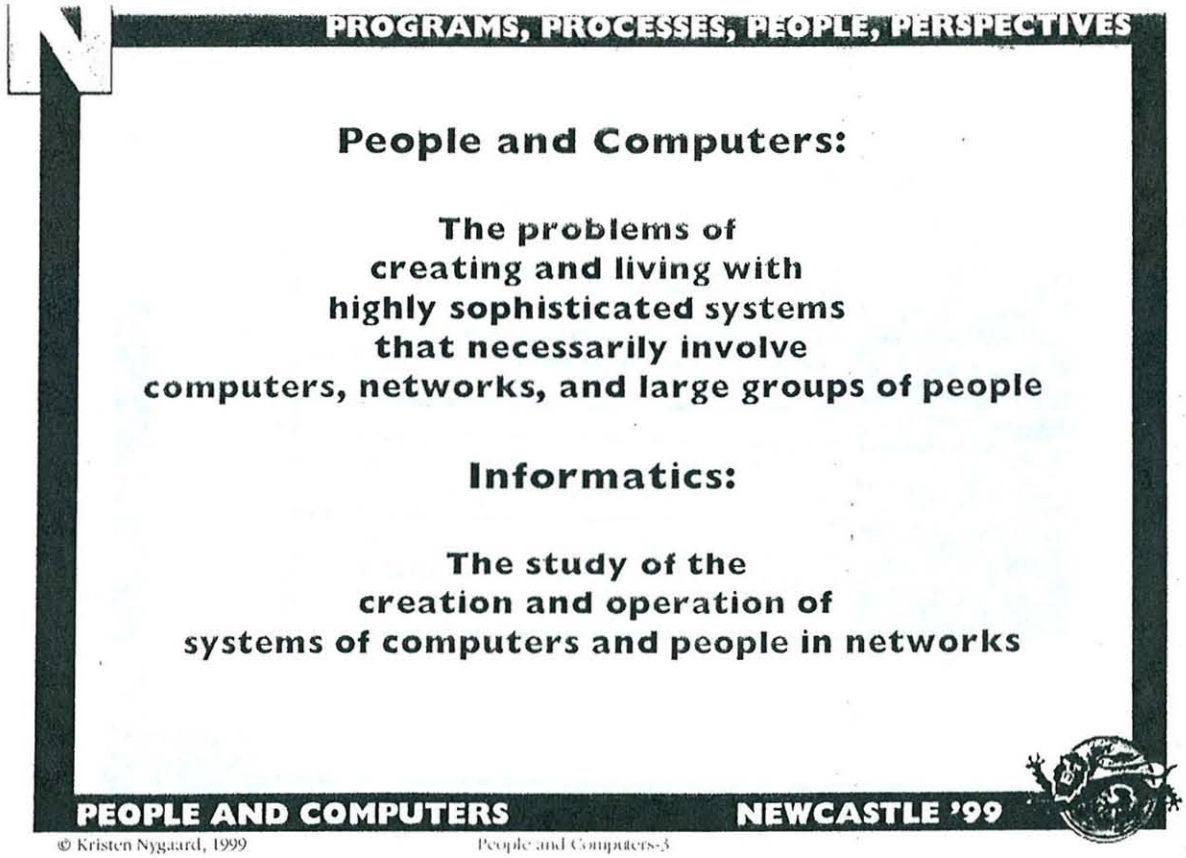
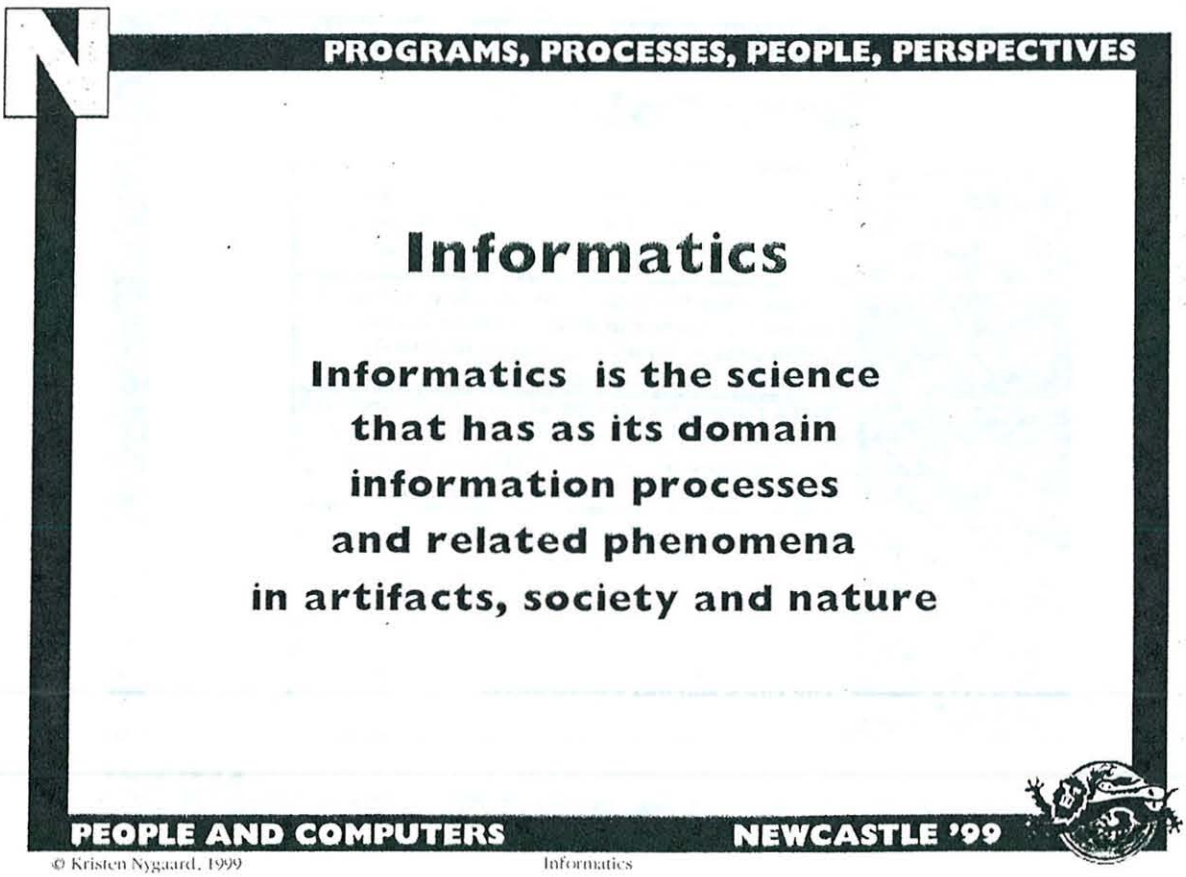

The 22nd Annual
ICL/ University of Newcastle Seminar
7-10 September 1999
People and Computers
Lectures by Kristen Nygaard:
"Programs, Processes,
People, Perspectives"
and
"What Is Informatics?"



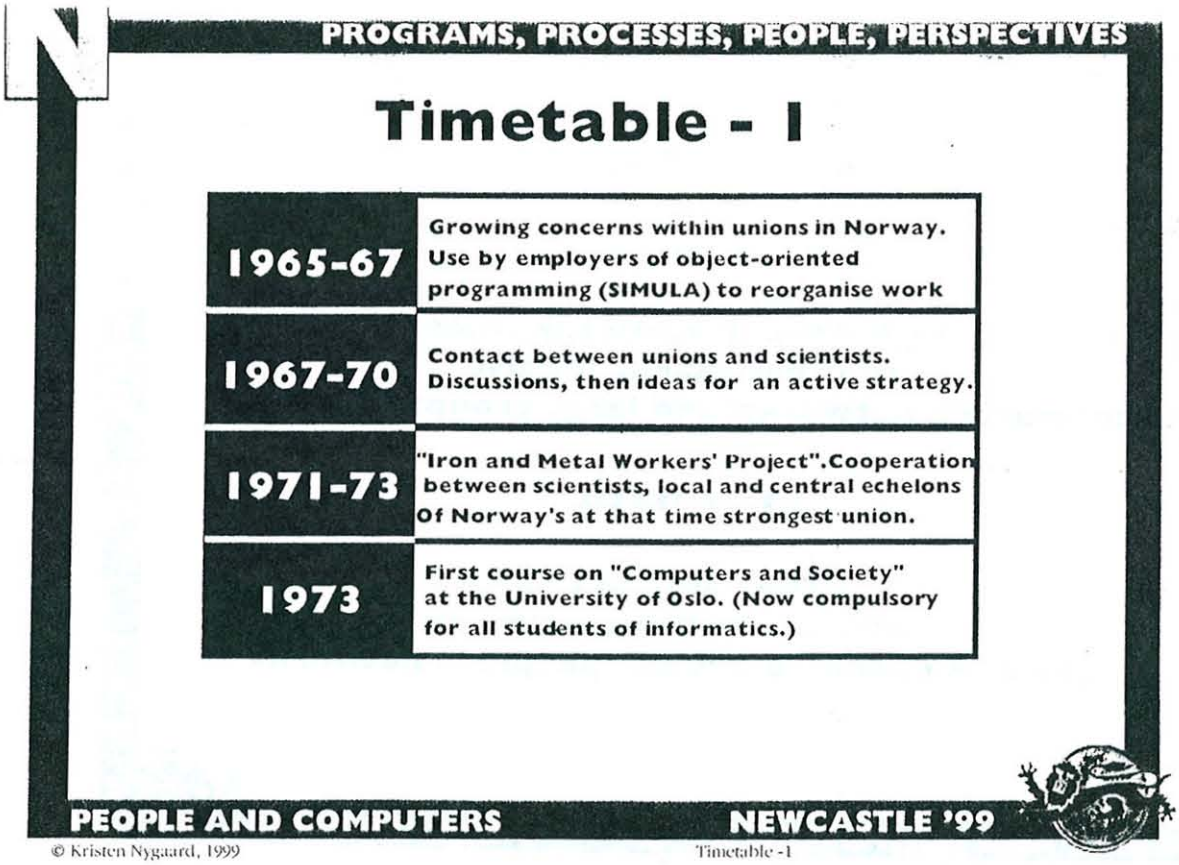




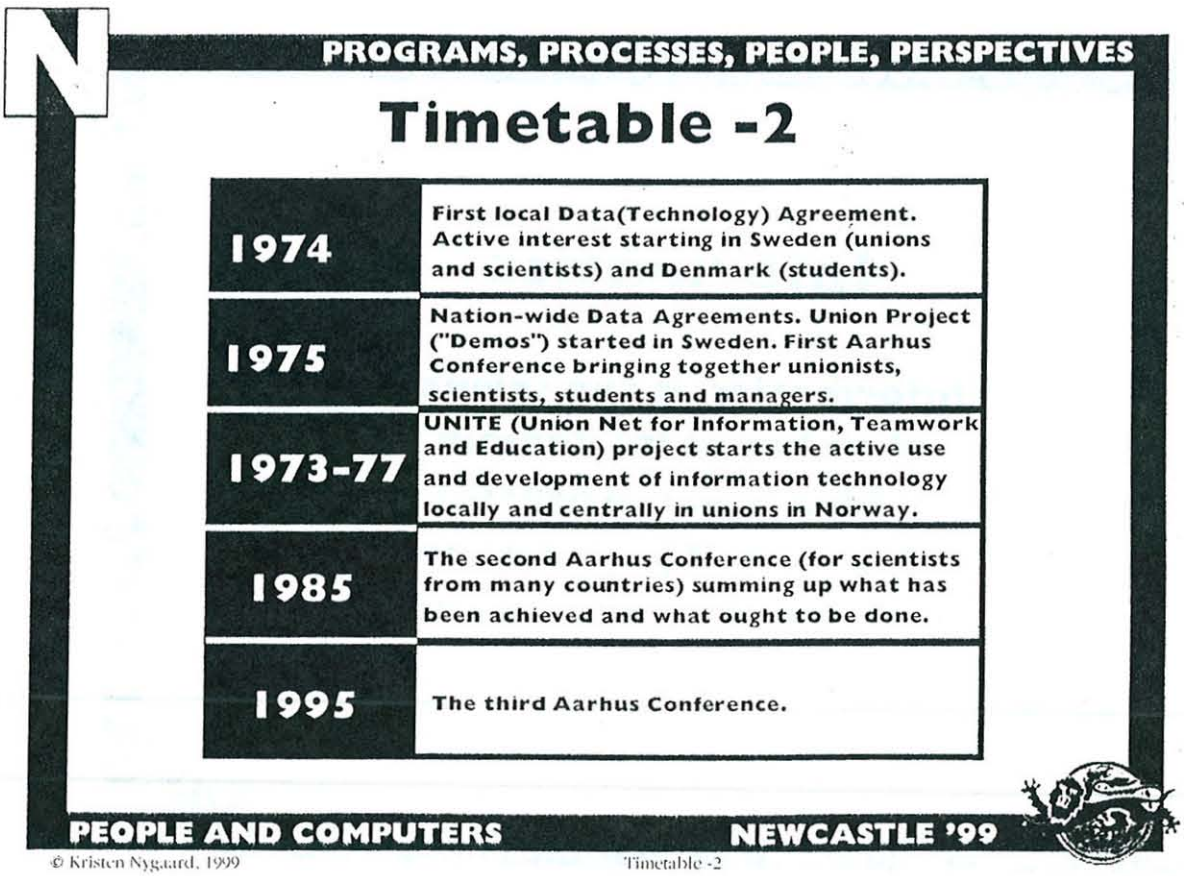
 People and Computers-3



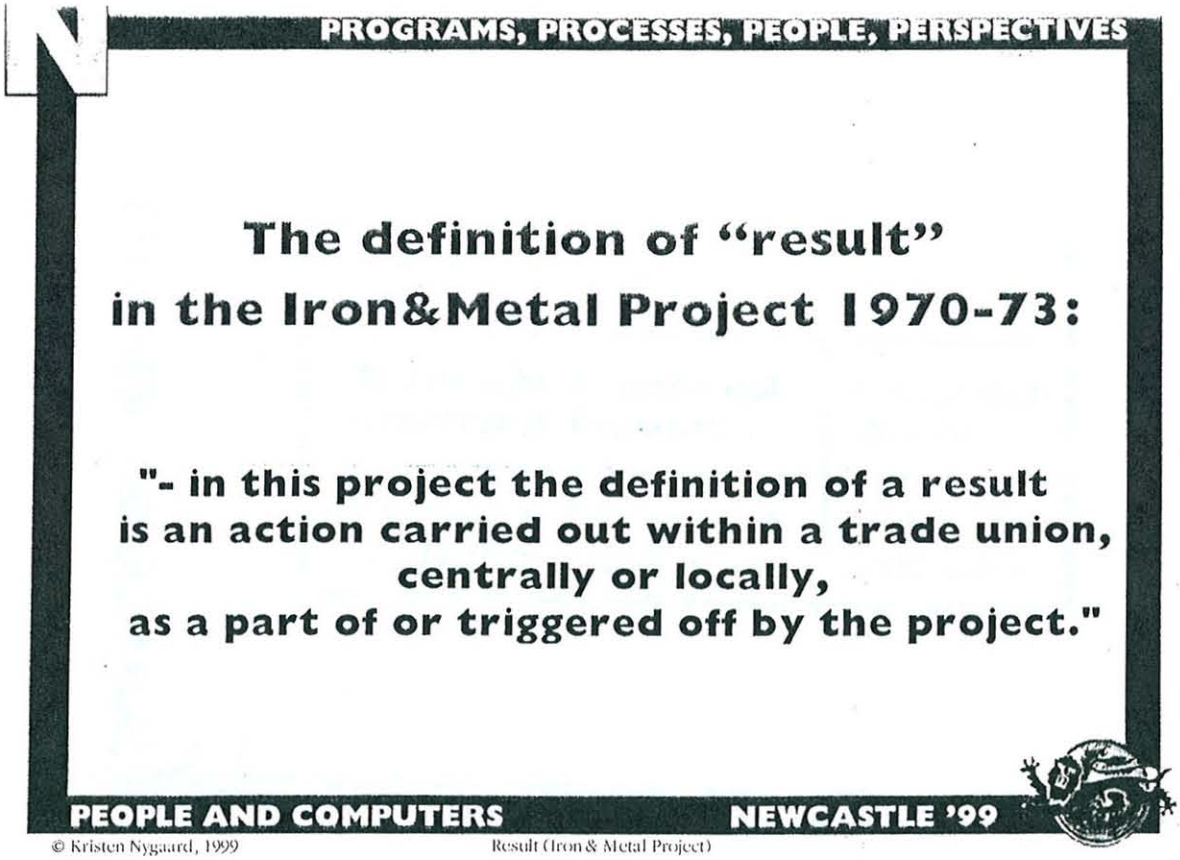
 Informatics



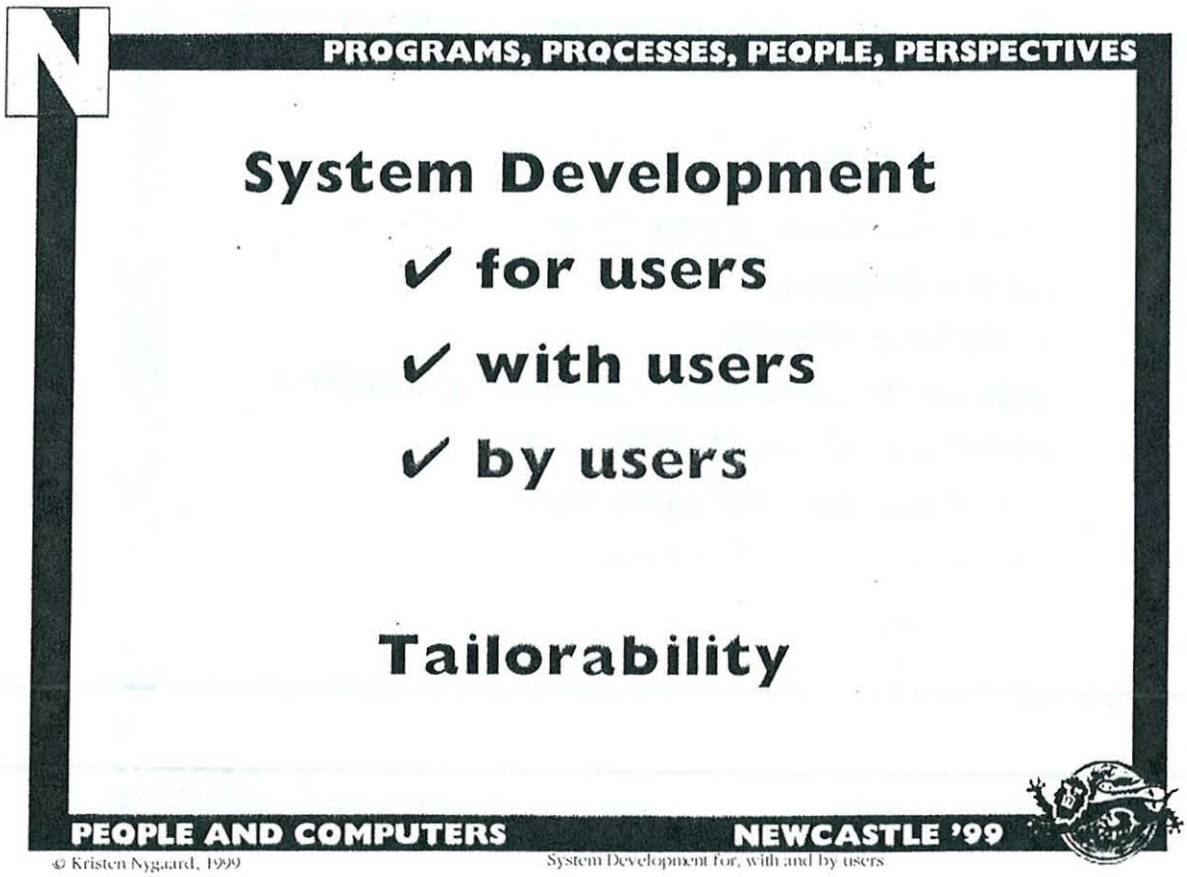
Timetable -1



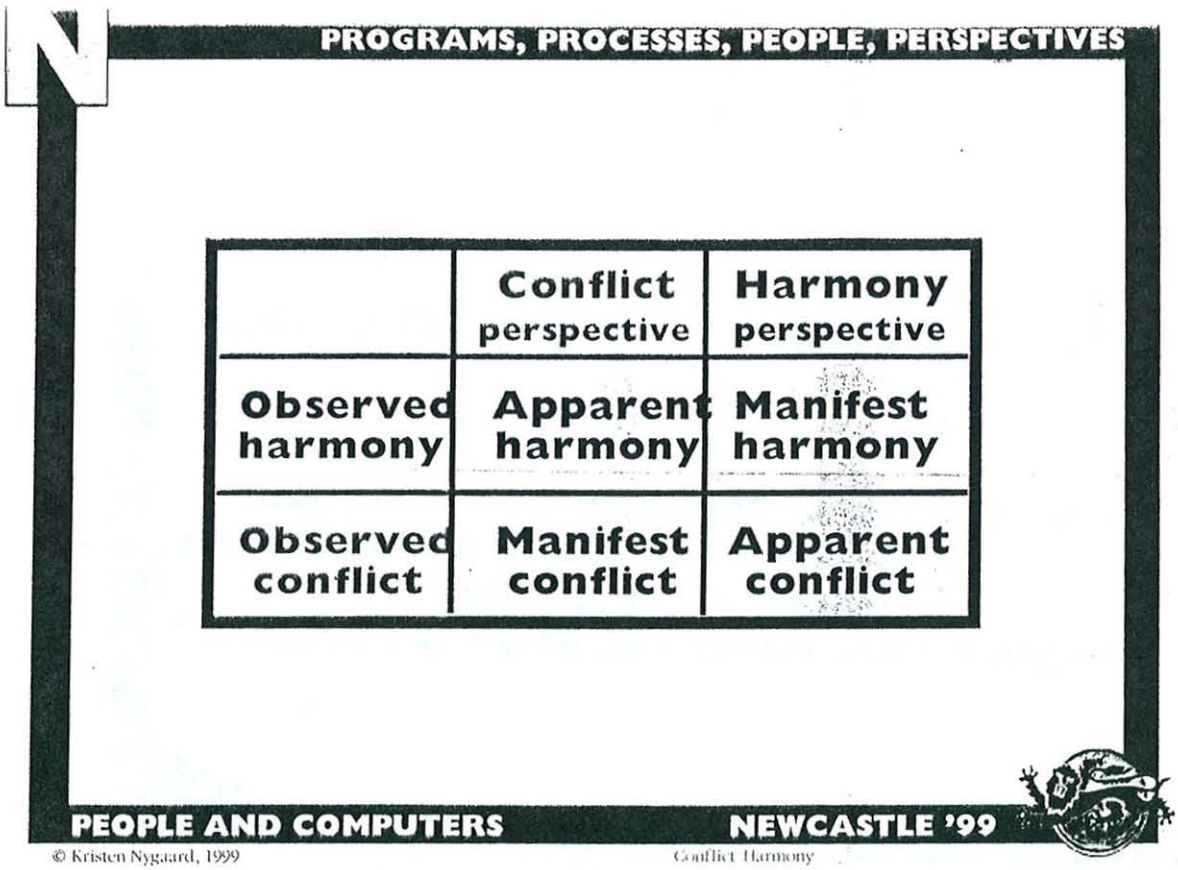
Timetable -2



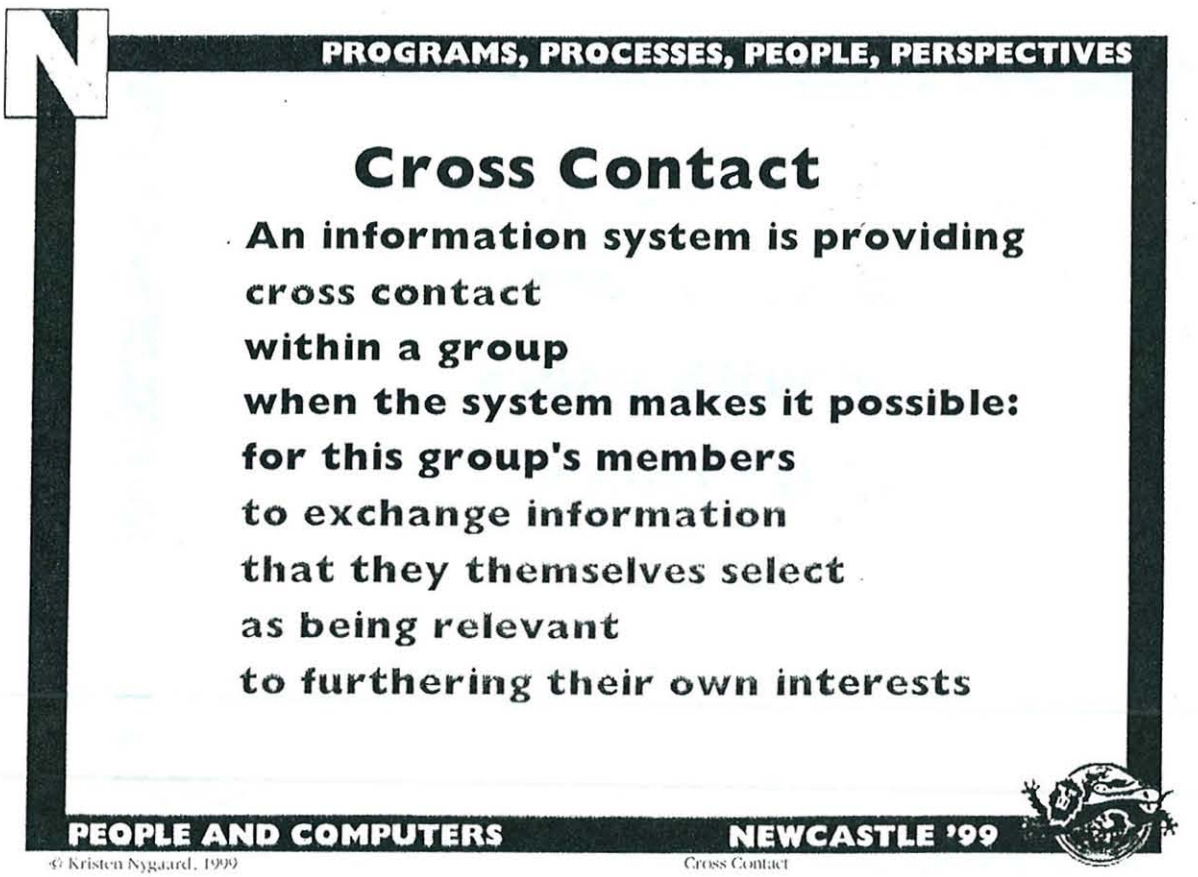
Result (Iron & Metal Project)



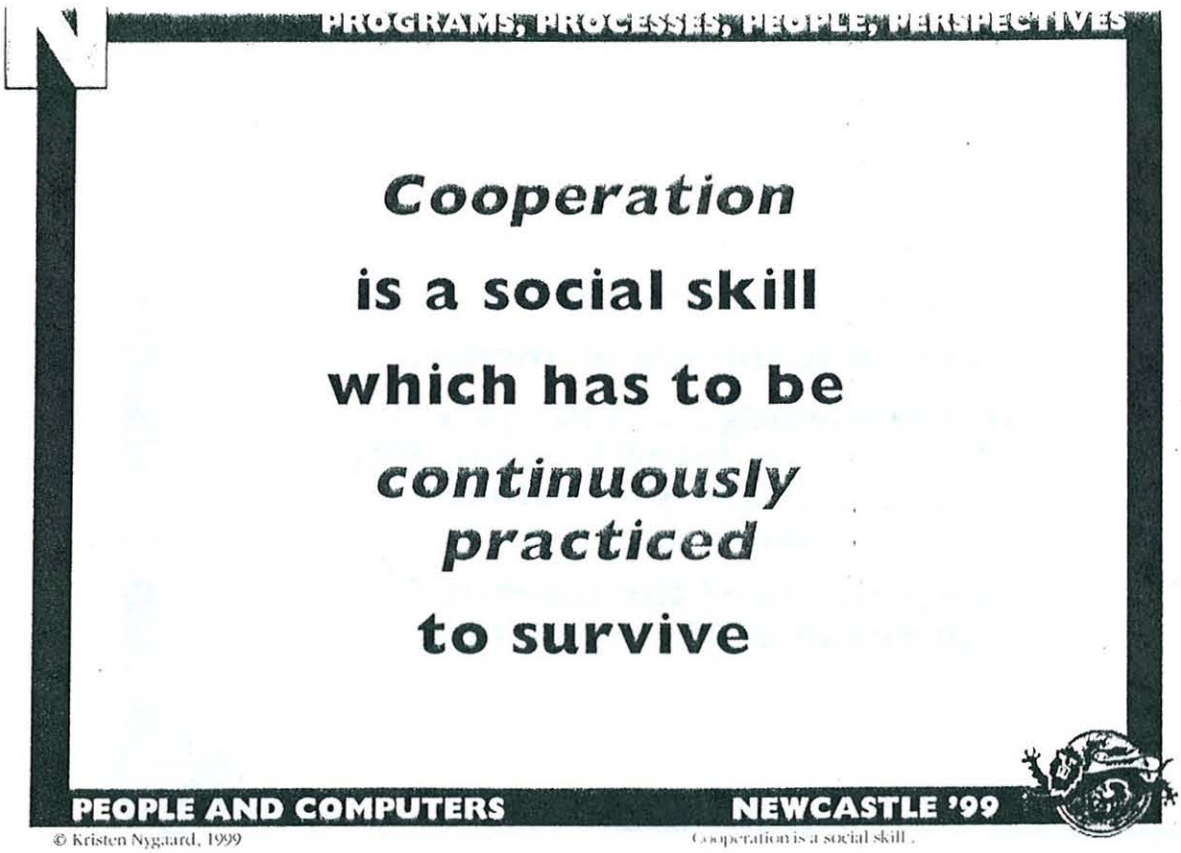
System Development for, with and by users



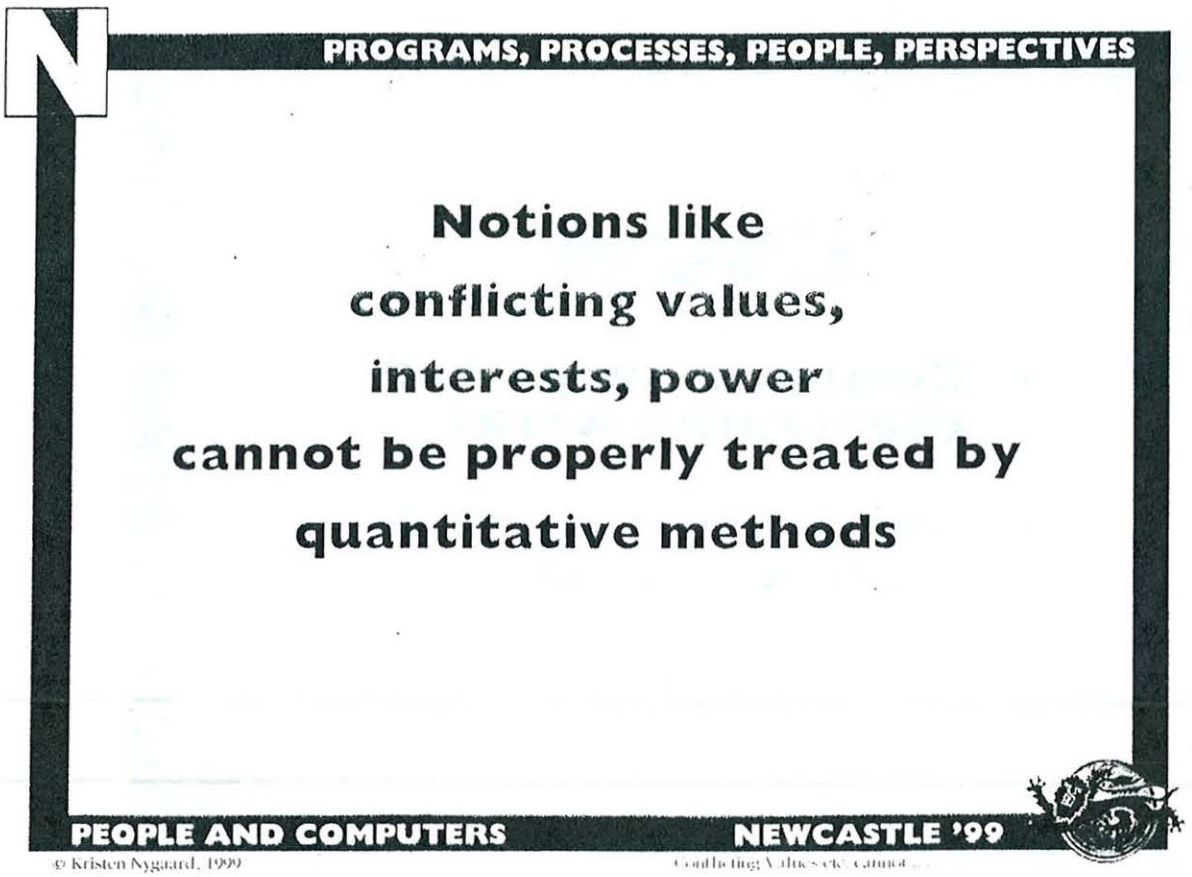
Conflict Harmony



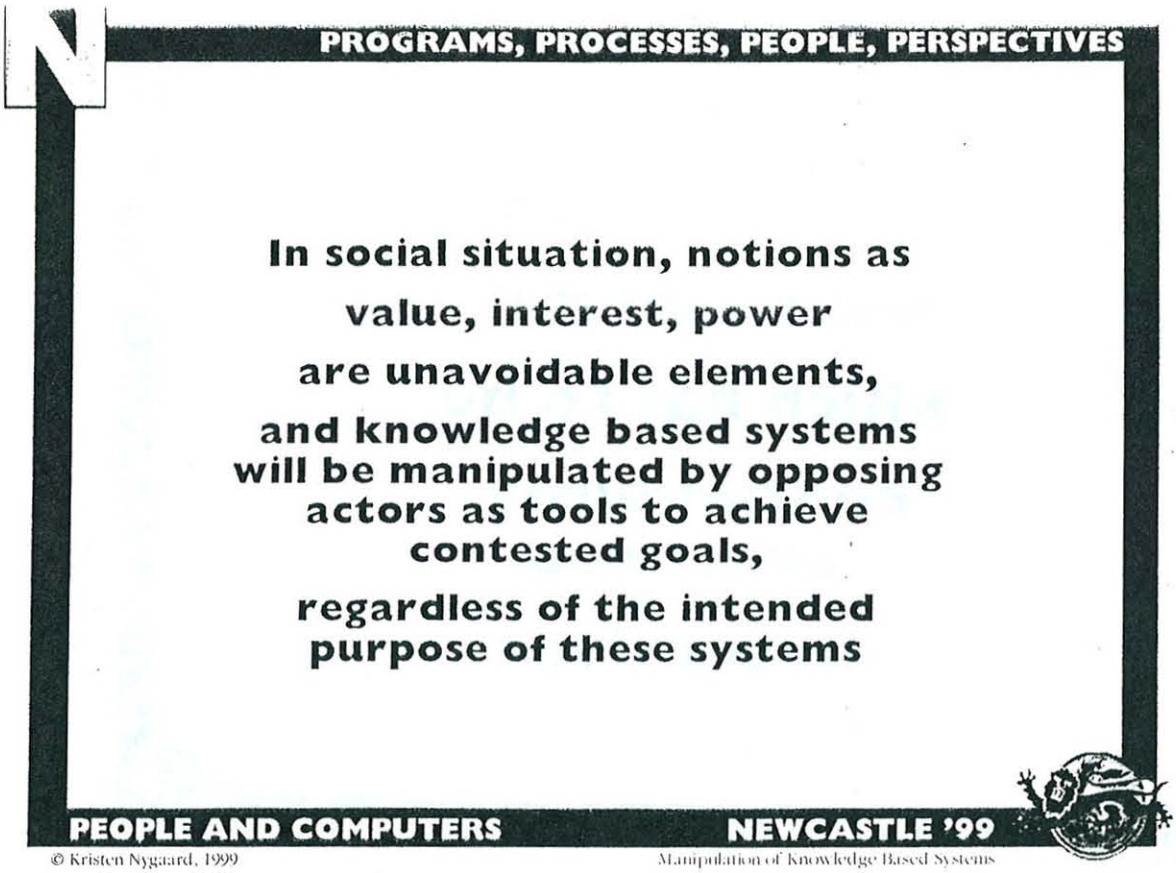
Cross Contact

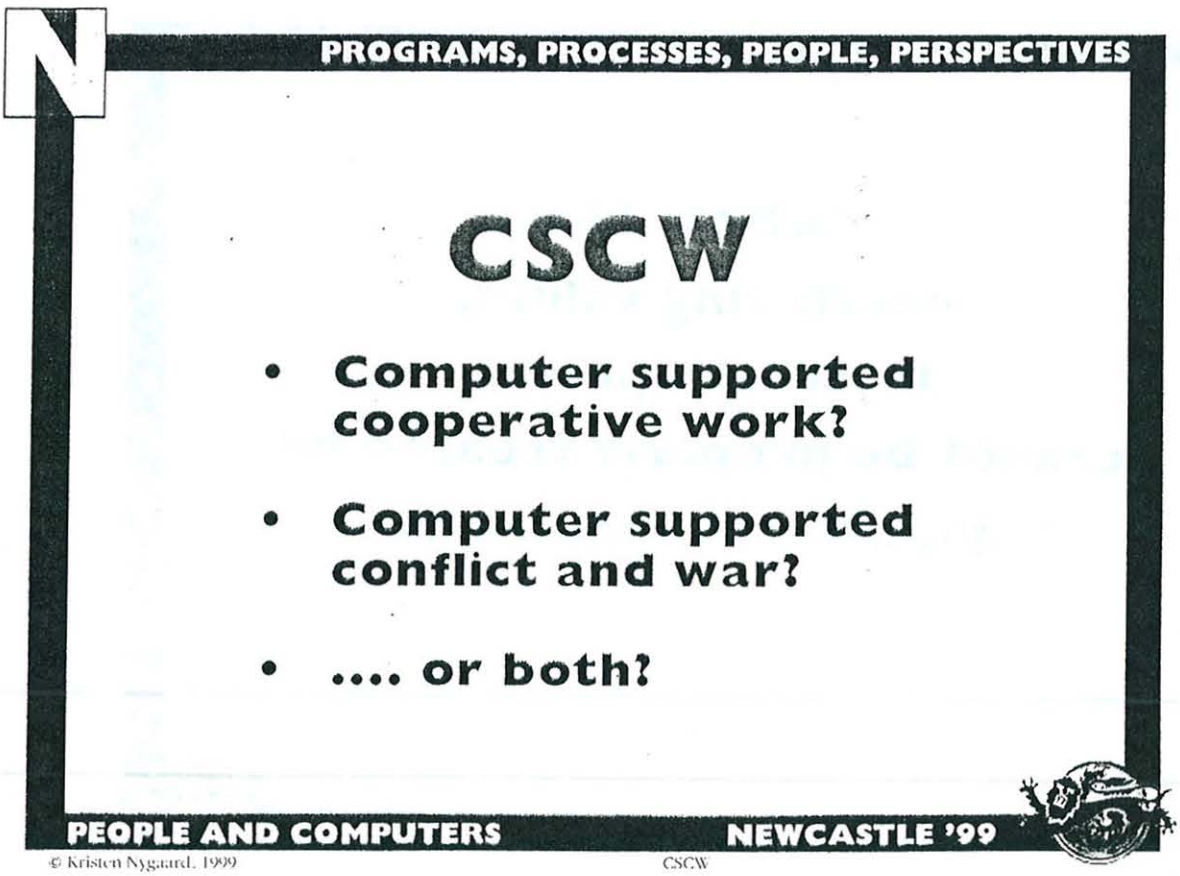


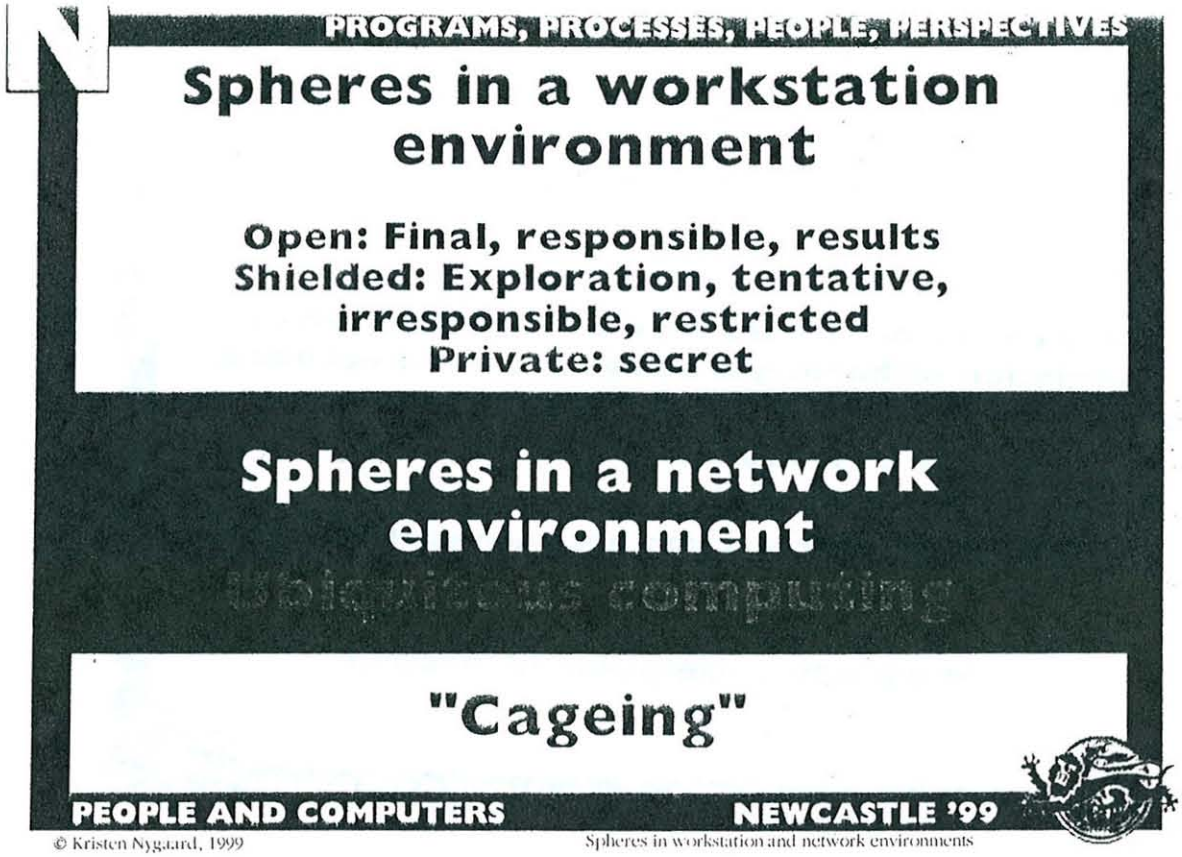
"Cooperation is a social skill"



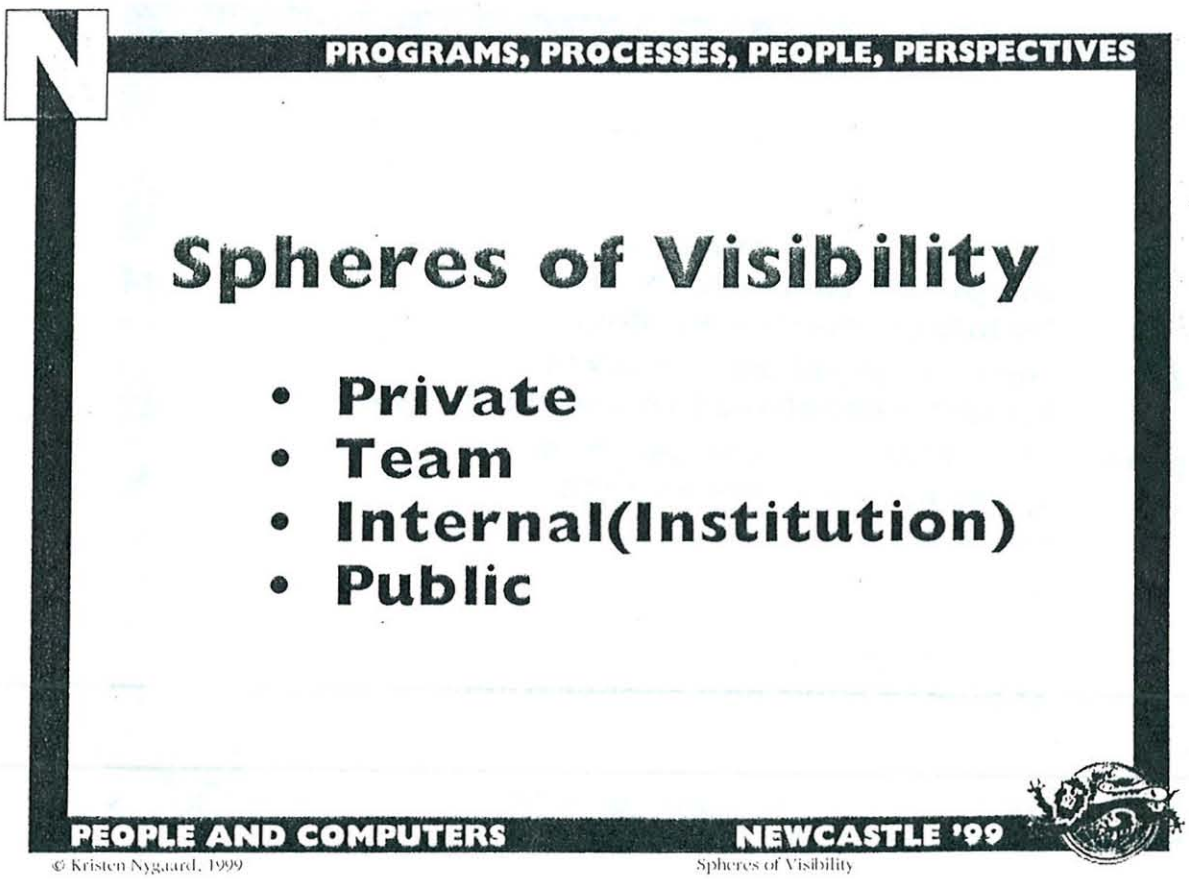
"Conflicting Values etc. cannot ..."







Spheres in workstation and network environments



Spheres of Visibility

Does the information technology create unemployment ?

Incorrect phrasing of the question!

Correct phrasing:

How is employment influenced by the way in which information technology is being used in the economic system in our society ?

A question of economics?

A question of technology?

A question of interaction between economics and technology!

A question of a politically based assumption about how society should function

Two Key Points:

1: **Skills are being built into the production equipment by information technology**

2: **Data communication makes remote administrative control possible.**

But: **information technology also opens up for a wider range of other alternatives for organisation of the society - and may be used in the development and support of human skills and cooperation.**

PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

Professional responsibility - a cornerstone in complex tecnological societies

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PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

A Necessary Condition for Responsibility in Skills and Professions:

A person may be made responsible for her/his decisions

only if she/he may reasonably be regarded as being responsible for the selection and use of the knowledge base involved in the decision.

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Perspectives

- A carefully structured attack, resulting in a beautiful goal?
- Or an evident penalty kick?
- Or evidence of sports as an outlet for aggression?

- Is the model railway a model of the real shunting yard?
- Or the device for finding the layout that the real shunting yard will be modelled after?

What is the referent and what is the model?

Perspectives - Football - Model Train

Perspective

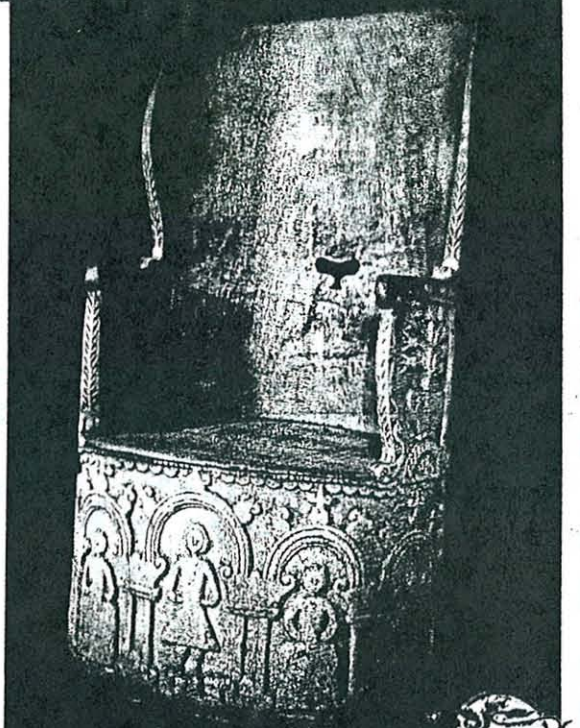
In any given situation,
a person's cognitive process
is structured by a perspective that:

- is common to a domain of situations considered similar to the given one,
- selects those properties of the situation that are being considered (and, by implication, those that are ignored), and
- provides concepts and other cognitions that are being used in the interpretation of the selected properties.

Perspective Definition

PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

Perspectives
When is a chair a chair?



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When is a chair a chair?

WHAT IS INFORMATICS?

Example of differing perspectives:

Strong typing

1. "Strong typing is fascism"

   (MIT manual, allegedly written by students, quoted by KN in a lecture at a "Fourth Generation Language" user conference in Garmisch.)

2. "Why is it fascism to hit hard at the keyboard?"

   (The response from the audience.)

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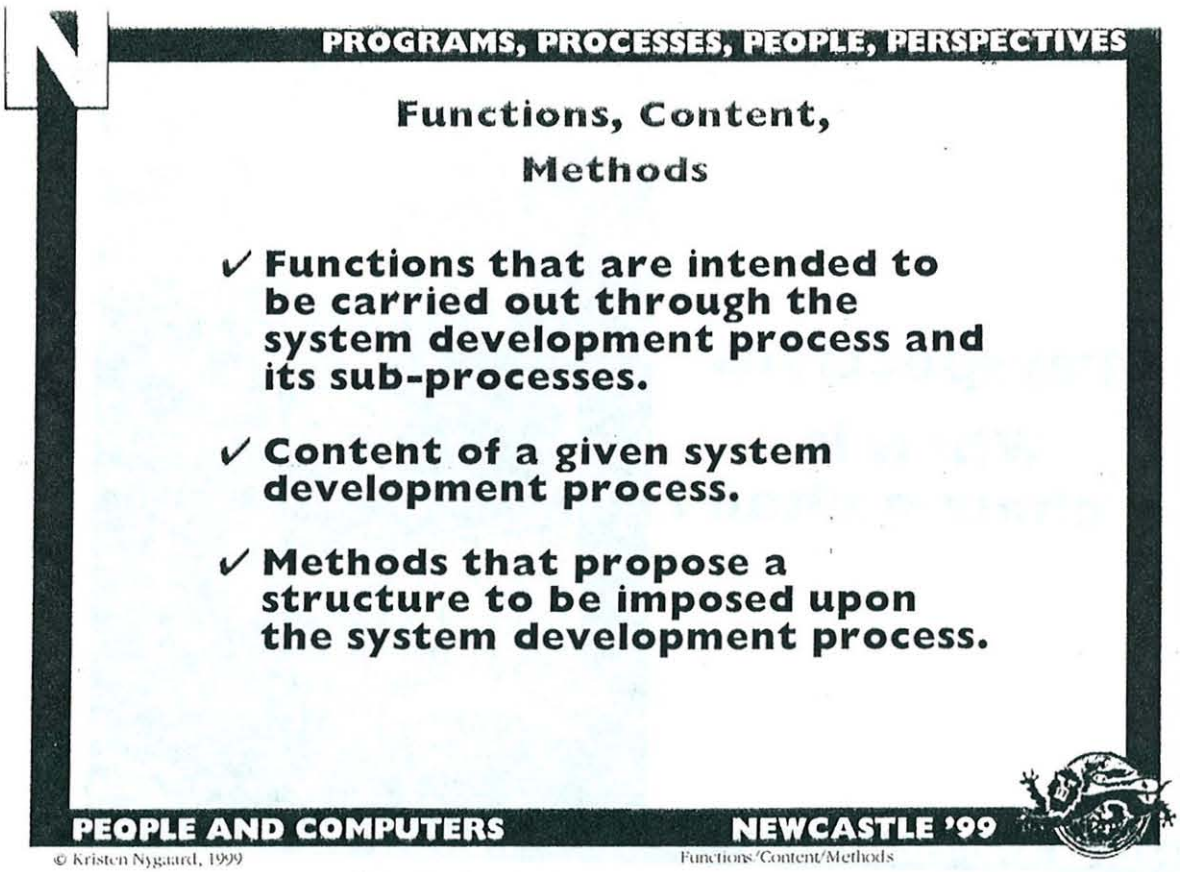
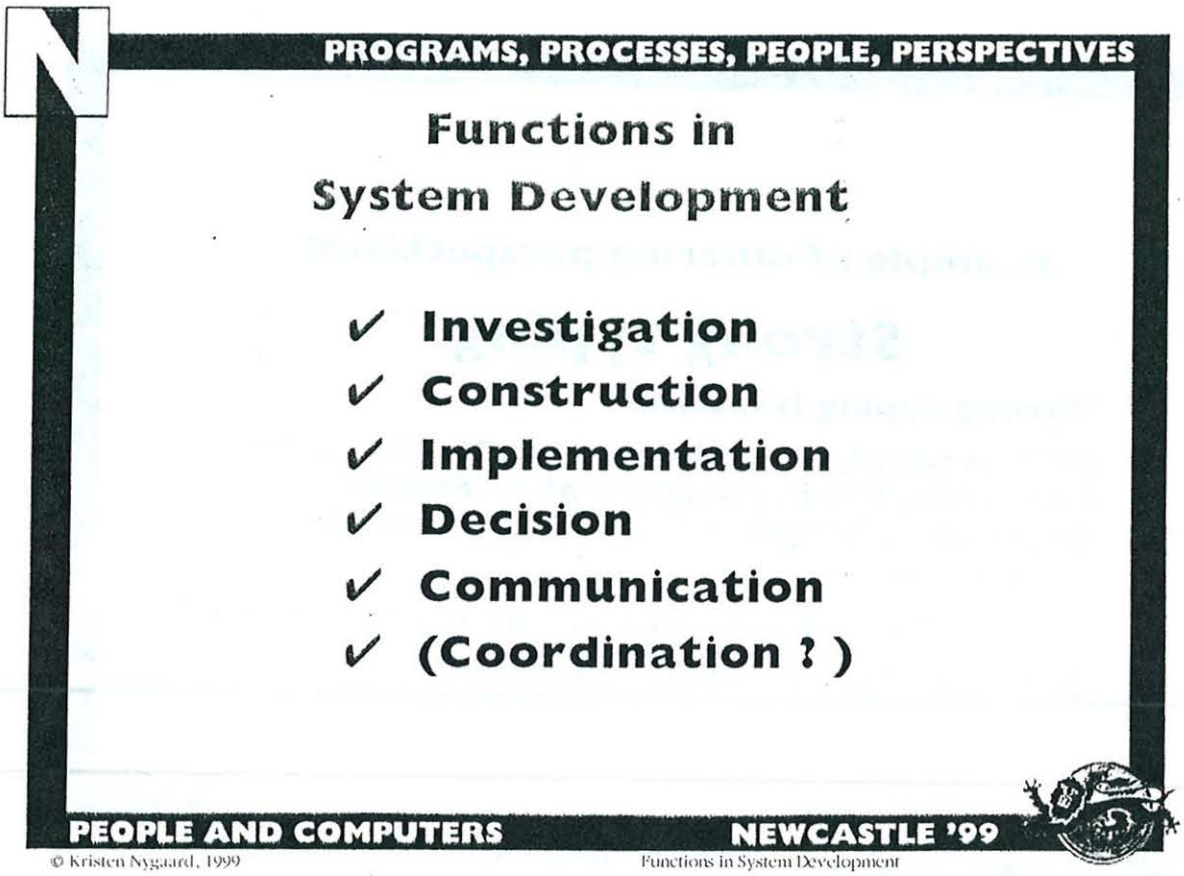
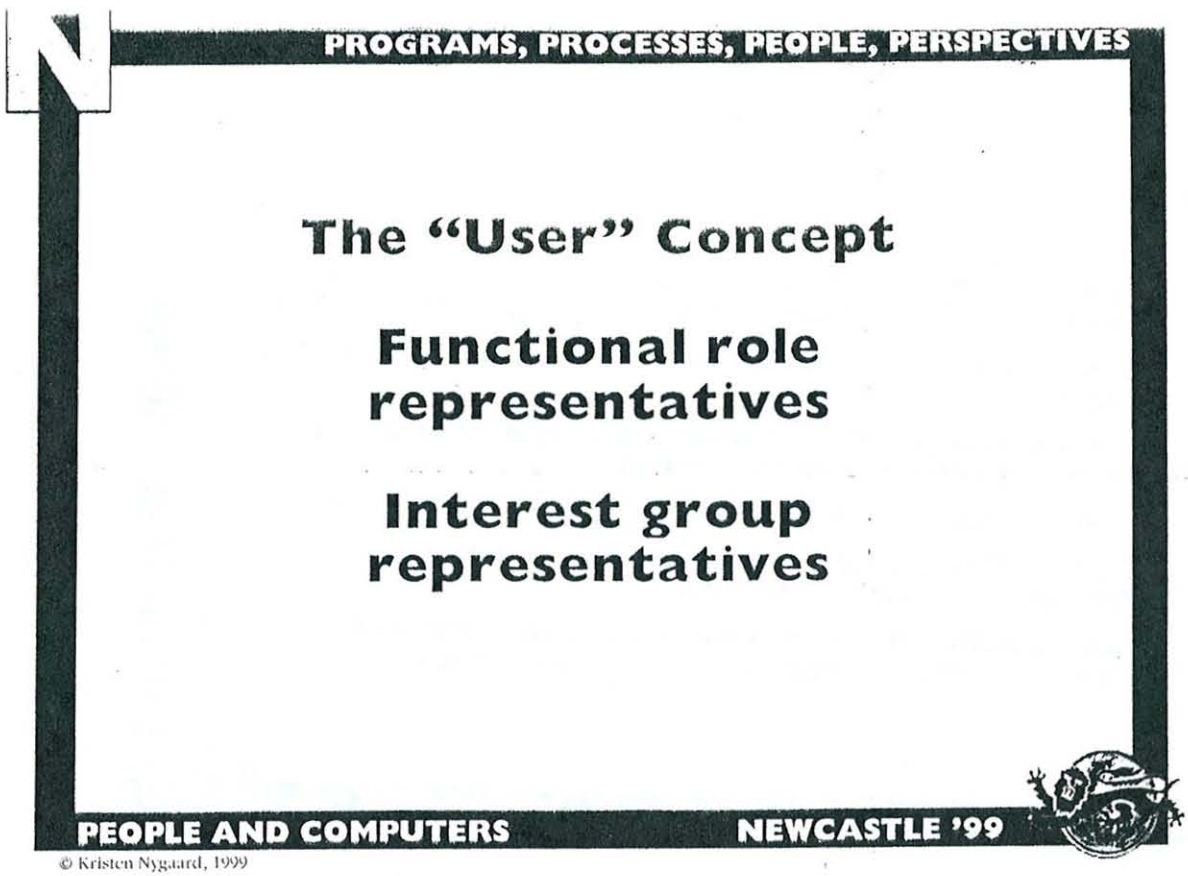
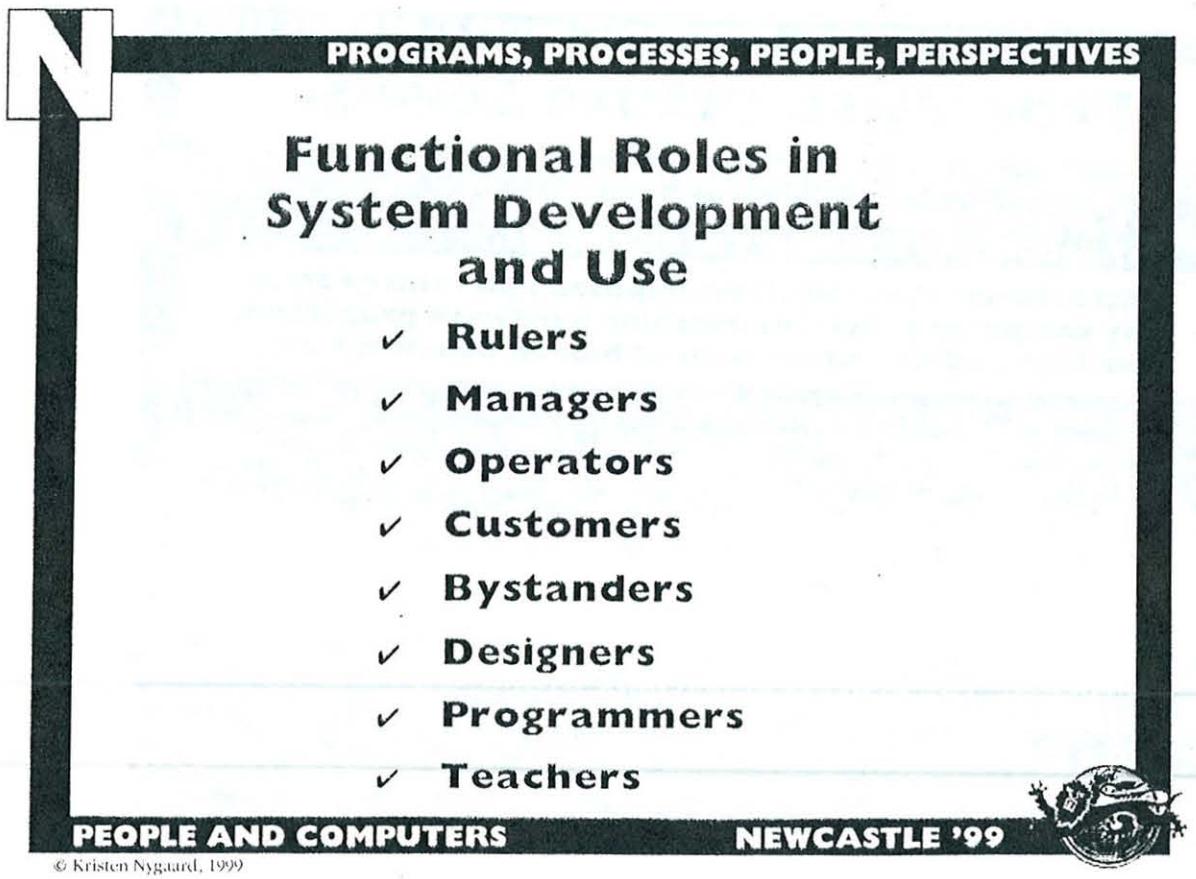
Strong typing is fascism









PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

Group Interests in Systems

- ✓ Which economic benefits will we (the group and its members) gain from the system (as employees, middle management, top management, owners or shareholders) ?
- ✓ To what extent will we be able to exercise control over the system?
- ✓ How will the system influence our physical and psychological work environment?
- ✓ How will the system influence the content of jobs?
- ✓ Will the interhuman contact net be changed to our advantage or disadvantage ?
- ✓ What are the interrelationships between the purpose of the system and our preferred societal objectives?

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Group Interests in Systems

PROGRAMS, PROCESSES, PEOPLE, PERSPECTIVES

Process-structure Levels.

1 Process: The information process (e.g. program executions,data processing by people and machinery in offices, etc.).

2 Structure: The limitations imposed upon this process by computer programs, machine hardware properties, written and unwritten rules of human behaviour etc.

3 Process: The system development process, including programming as a partial process, that has the structure of the information process (or modification of its structure) as its product.

4 Structure: The limitations imposed upon system development by organisation, existing knowledge, available resources etc.

5 Process: The process of learning within organisations, the research process, the adaptation of organisations to a changed environment.

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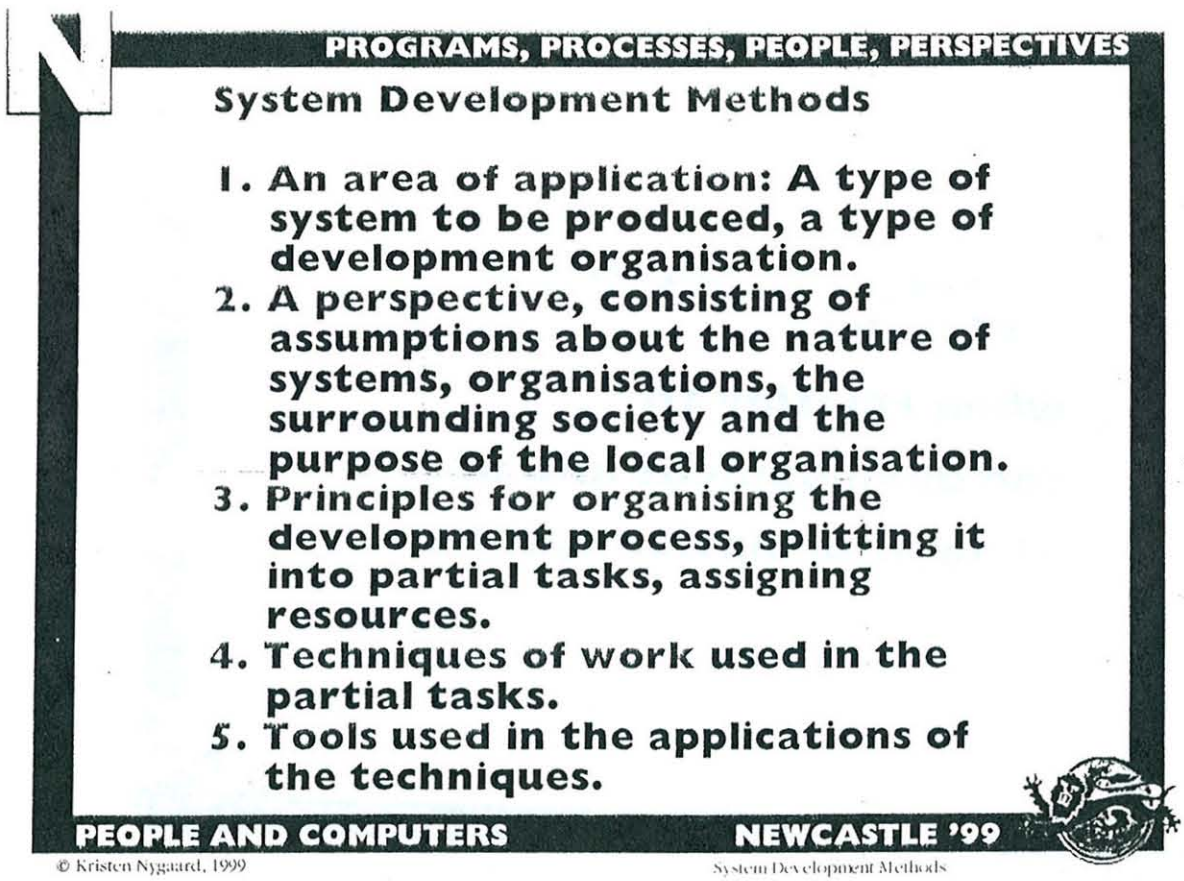
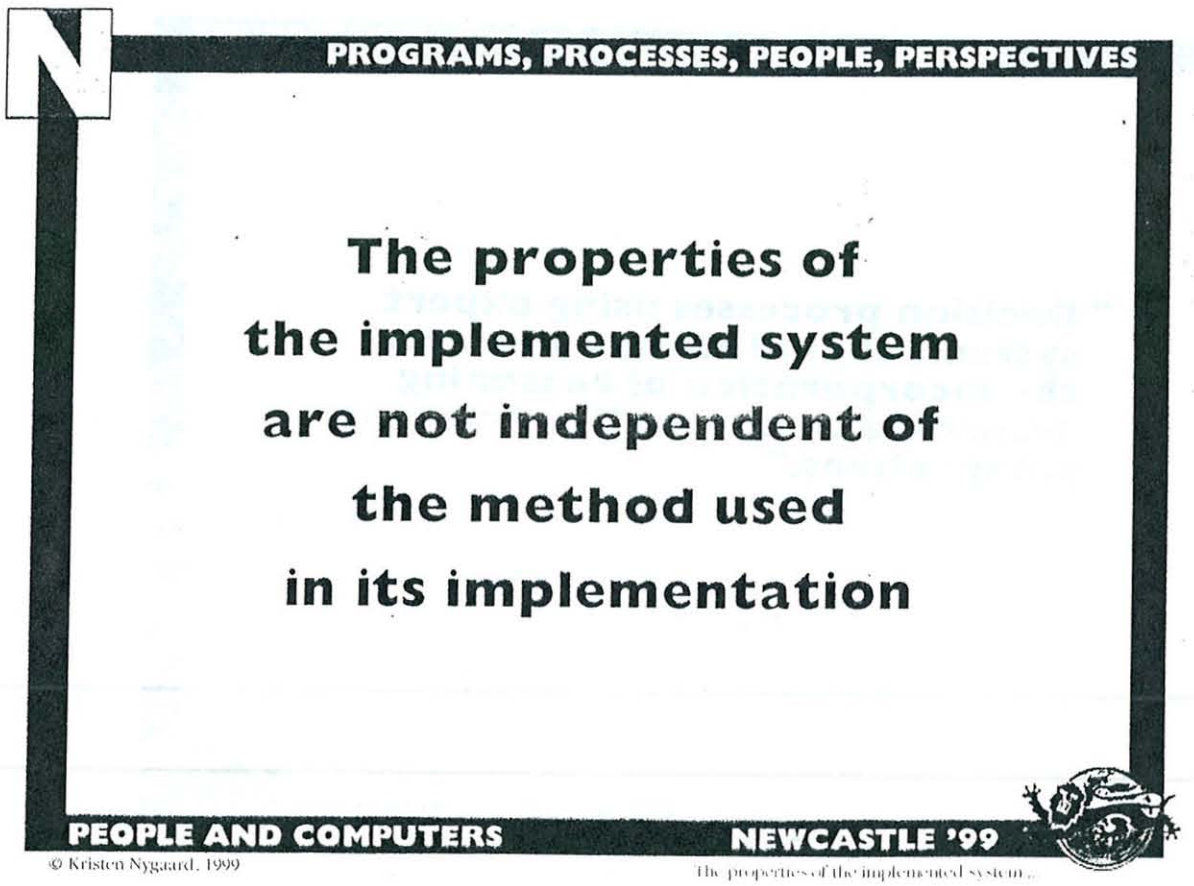
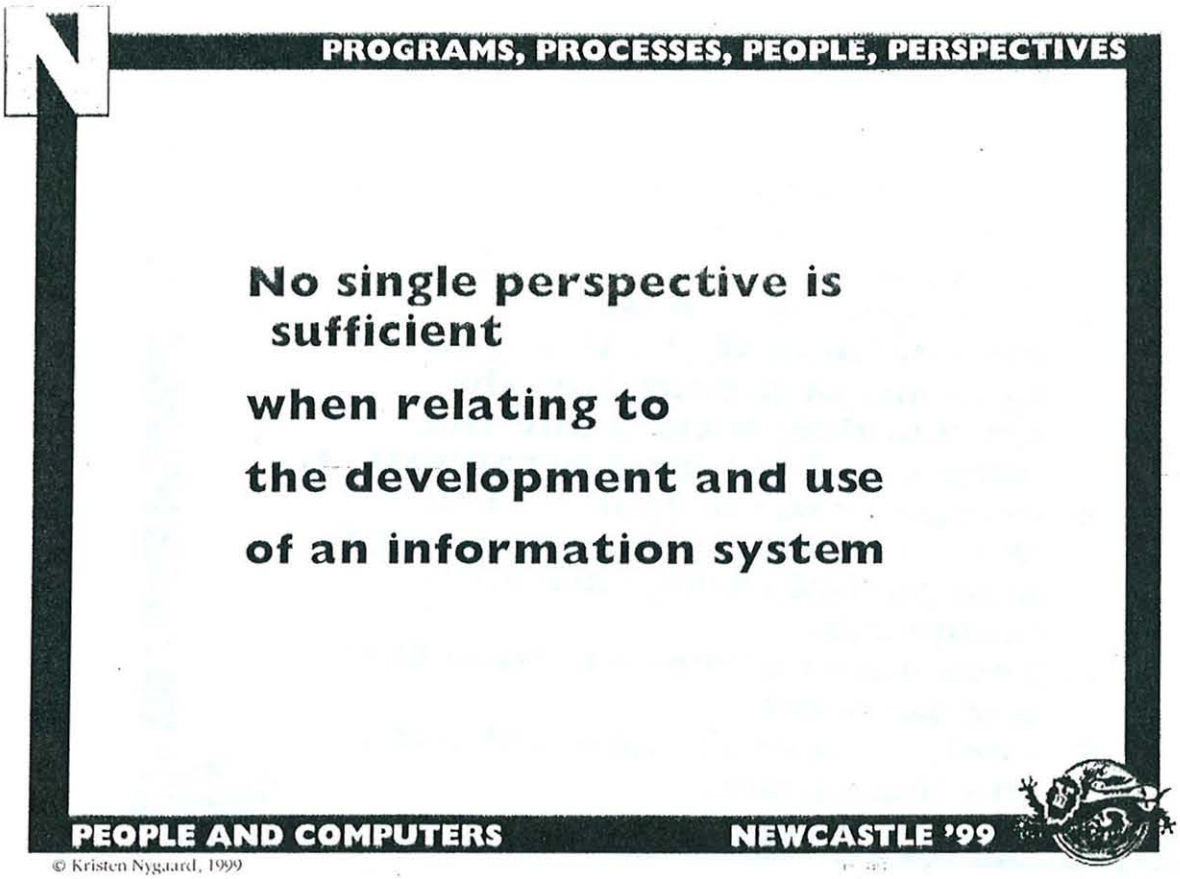
Process structure levels

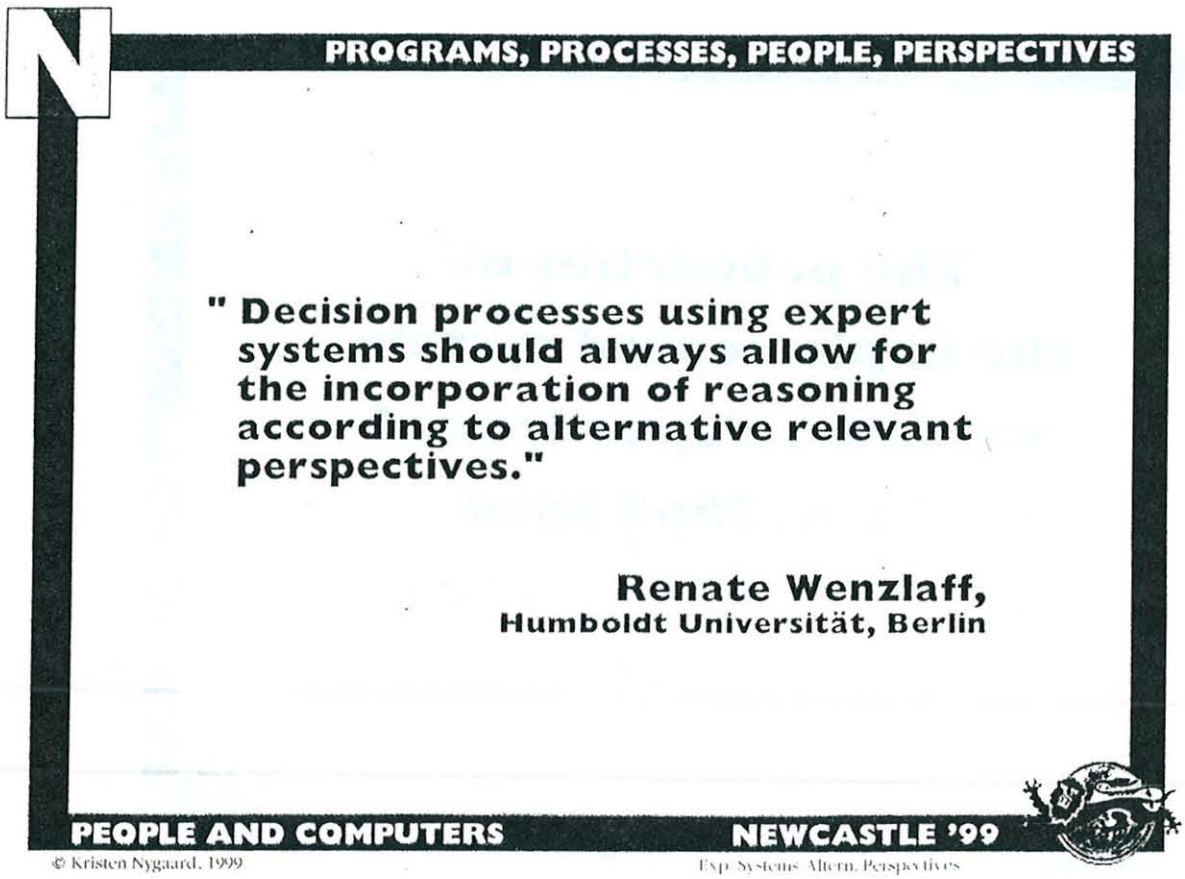


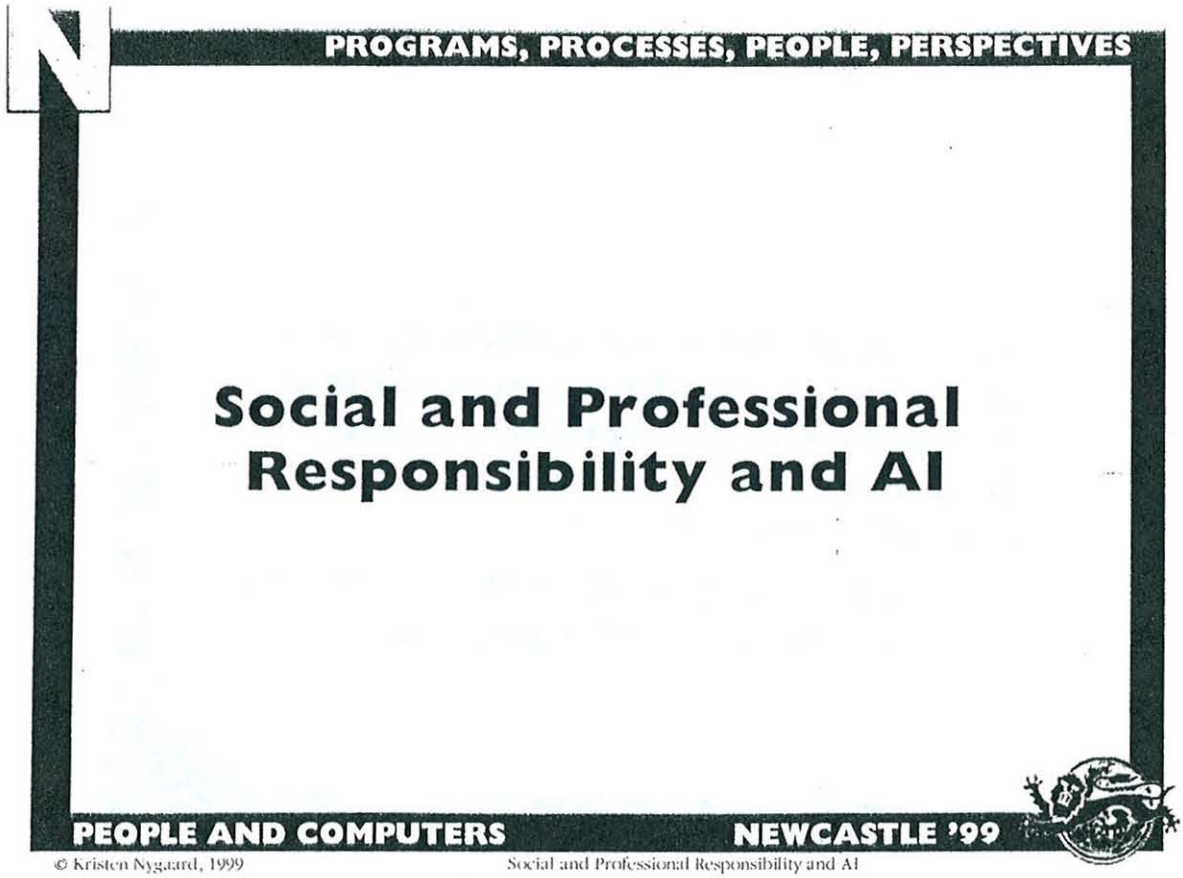
System Development Methods

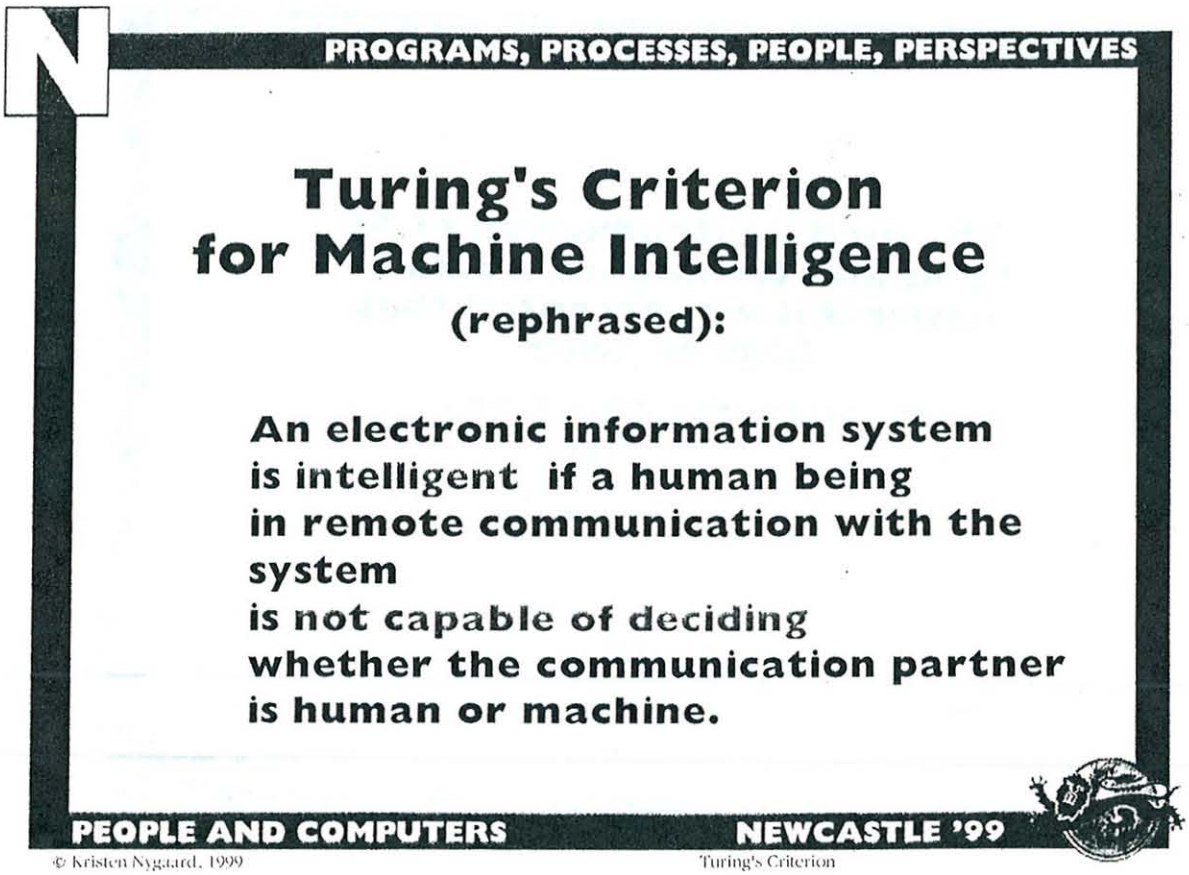


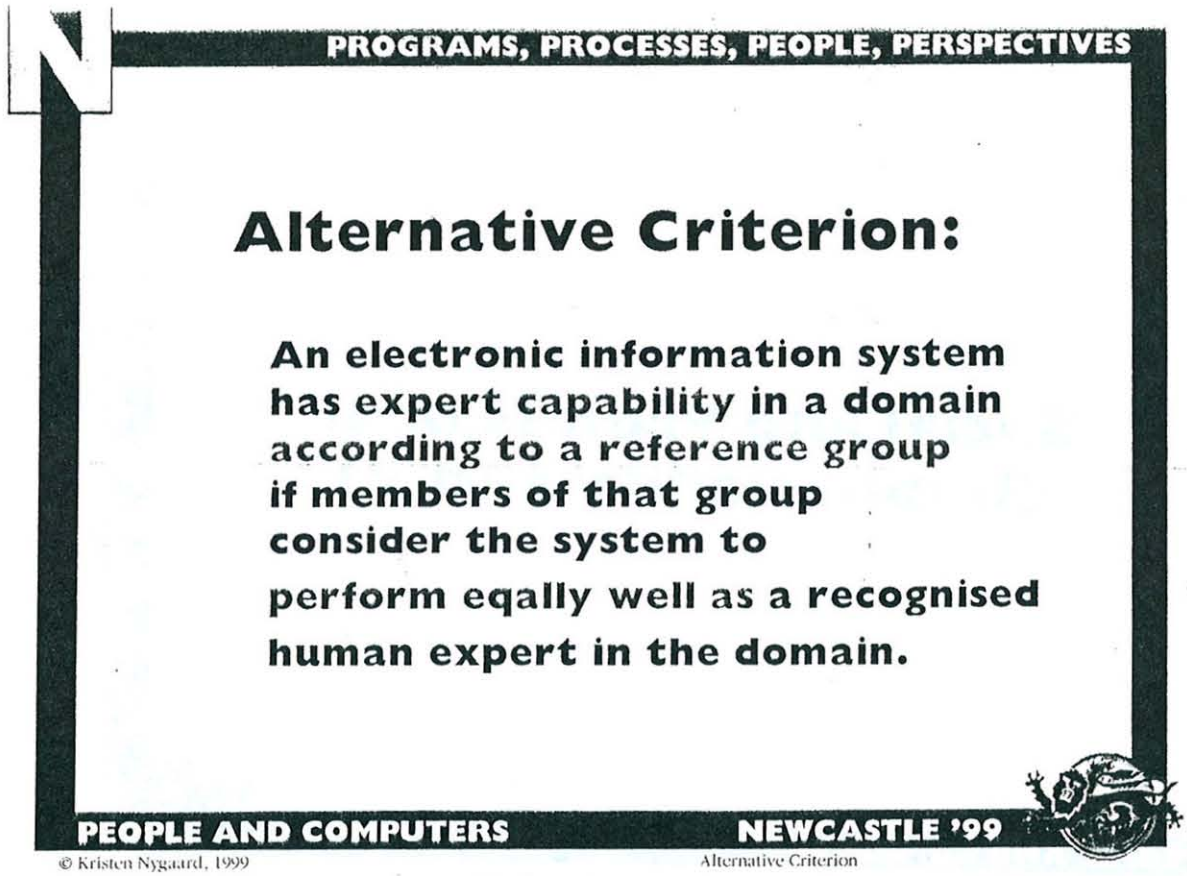
The properties of the implemented system ...



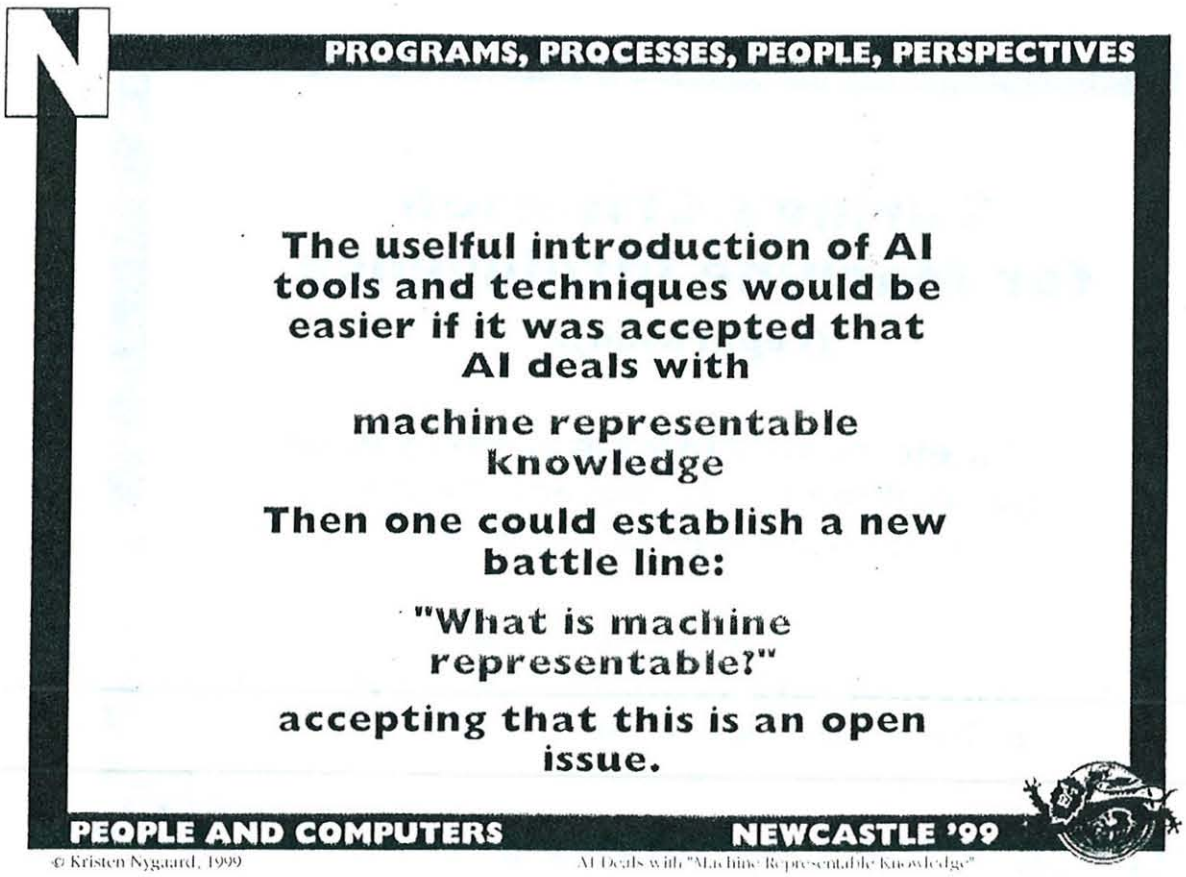




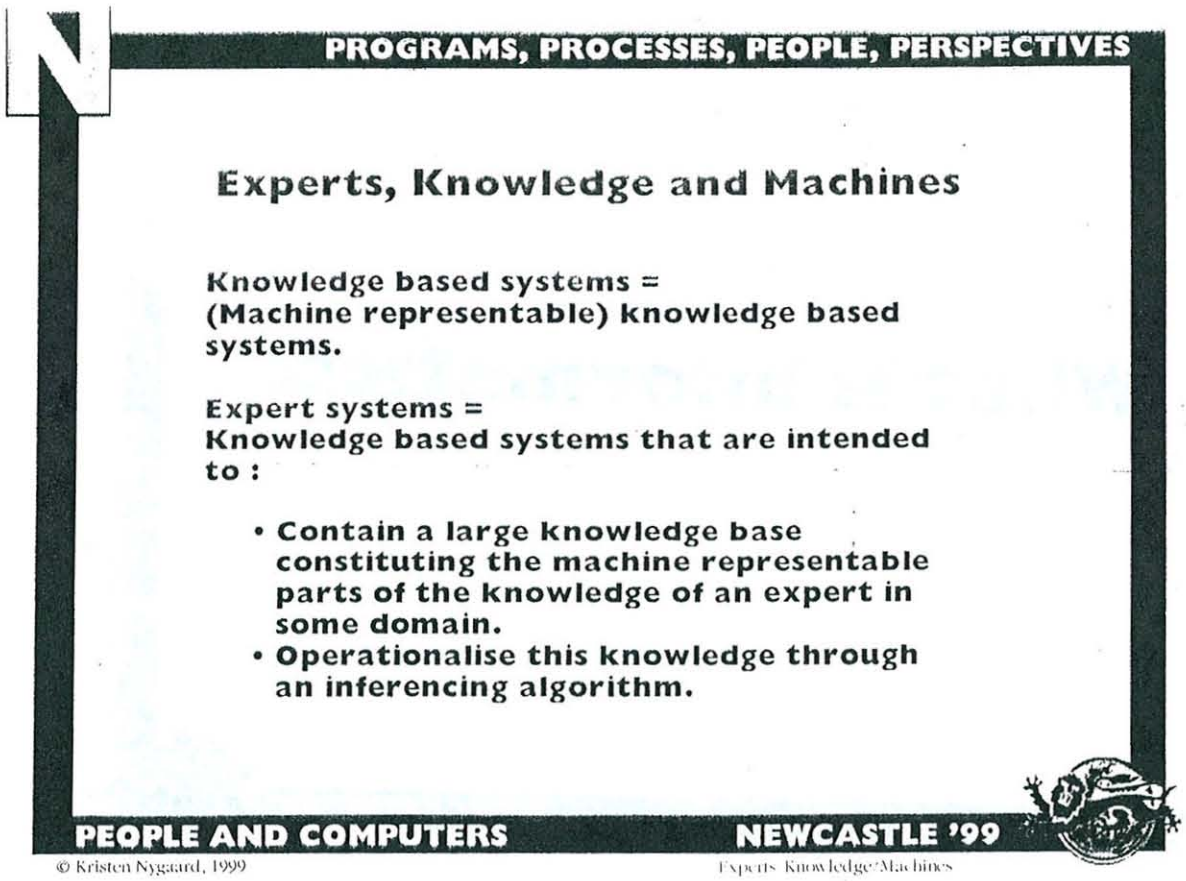


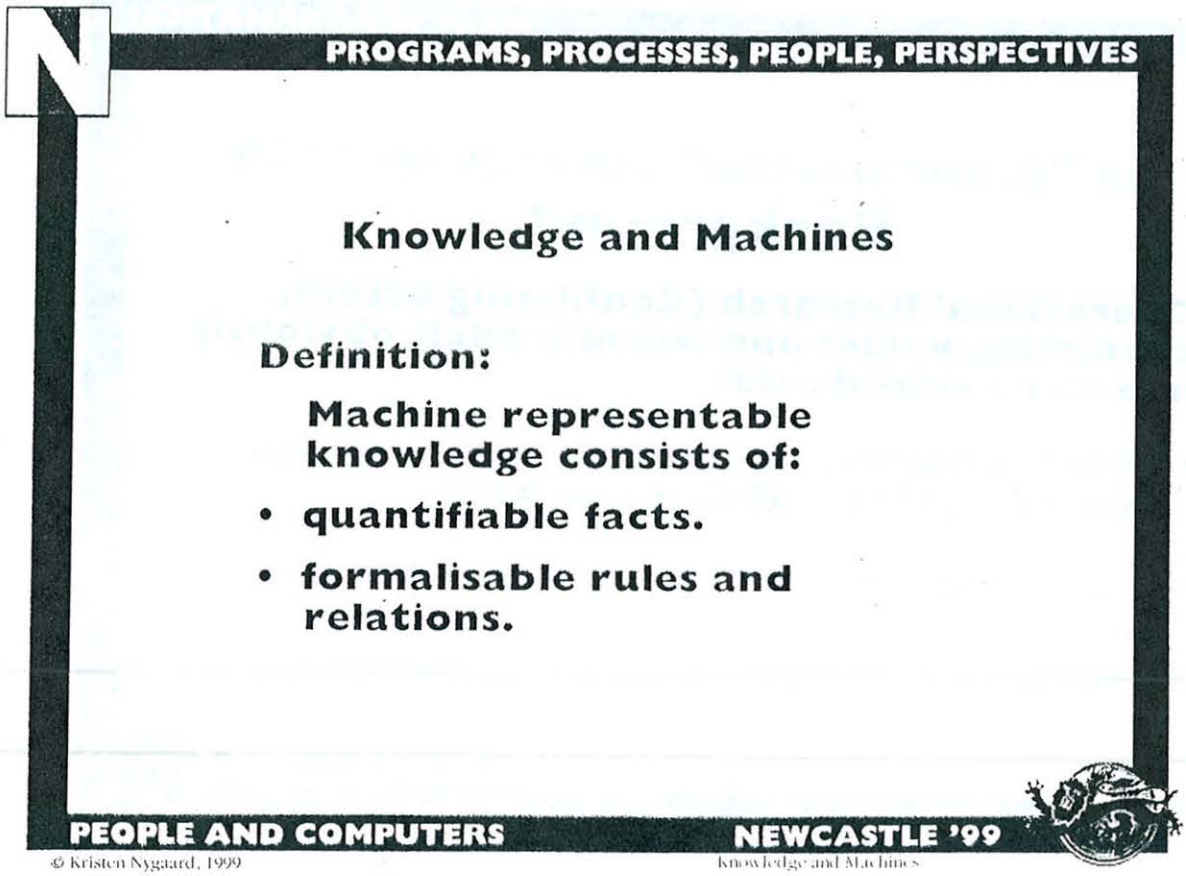


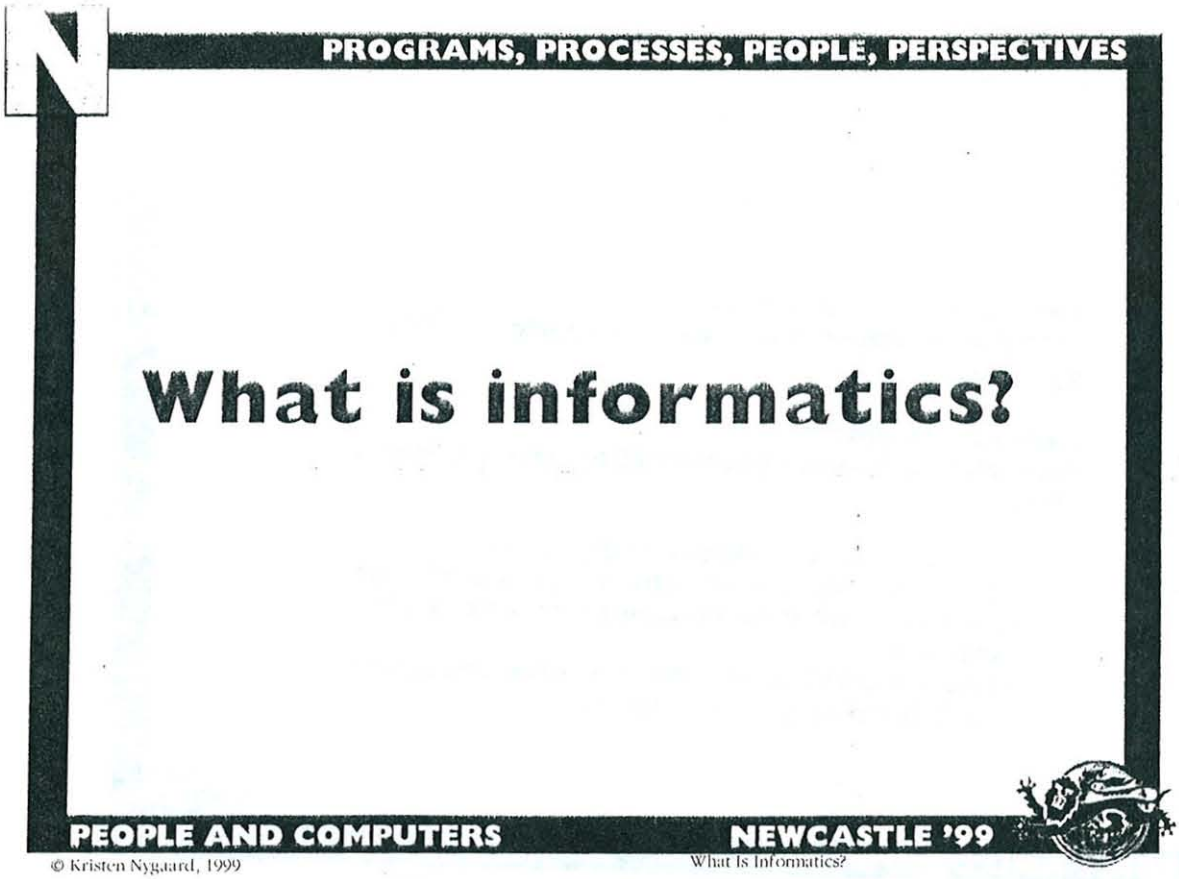
Alternative Criterion

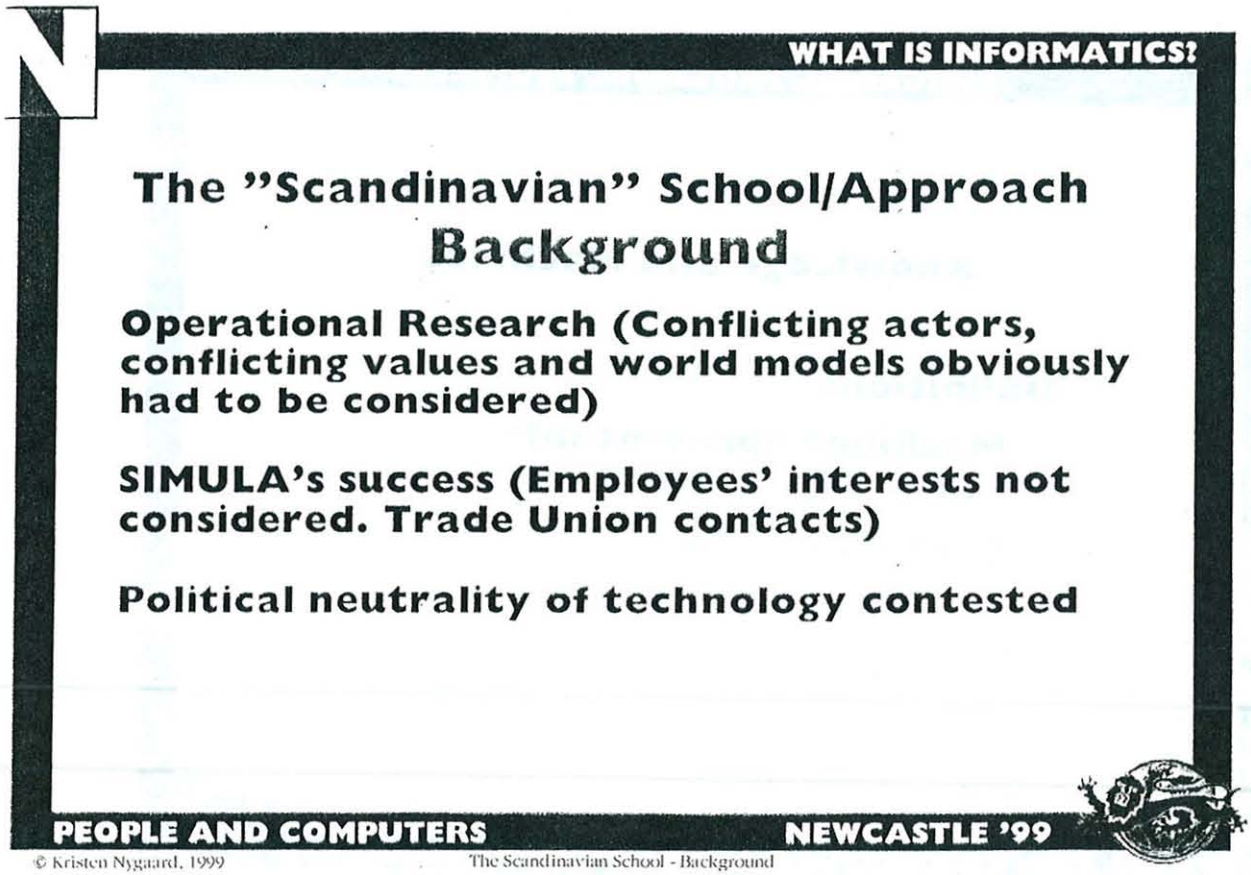


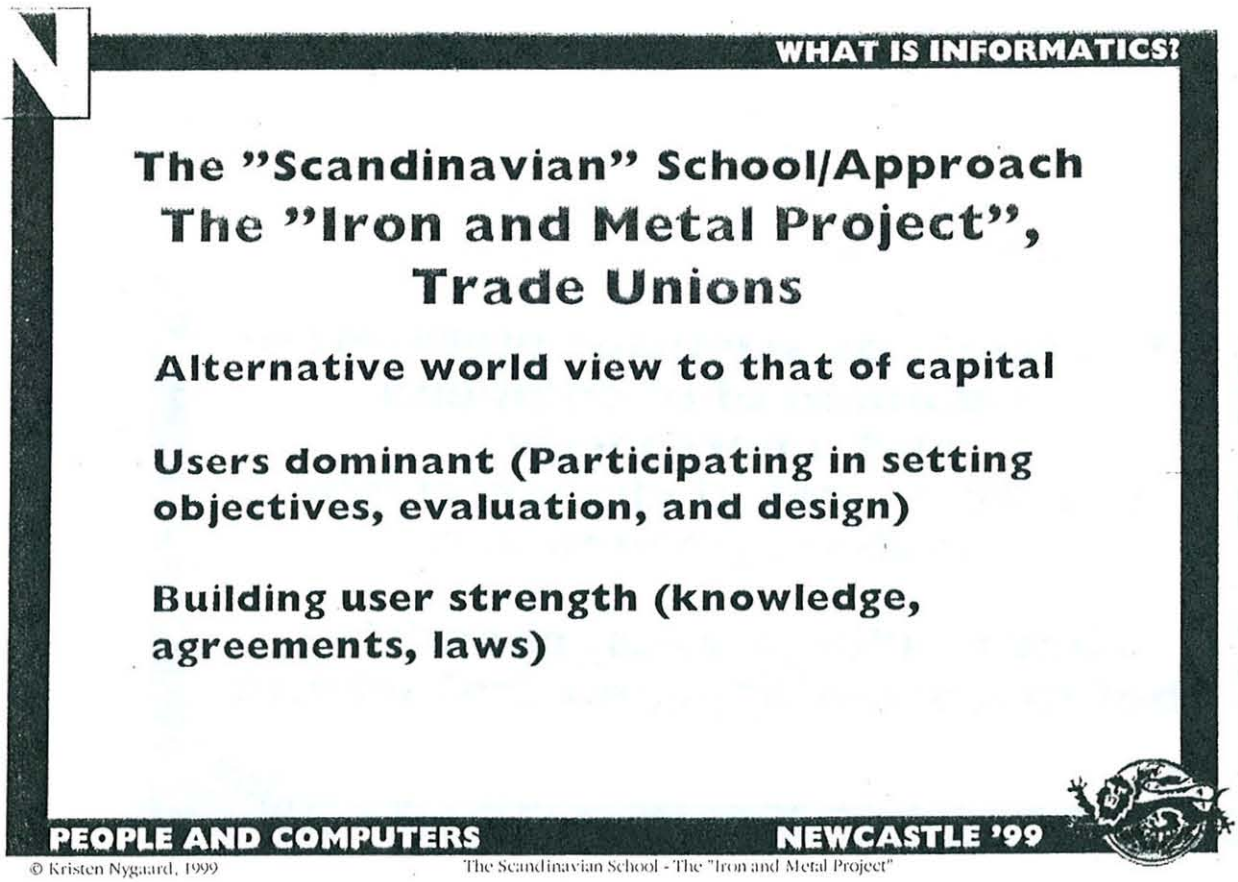
AI Deals with "Machine Representable Knowledge"



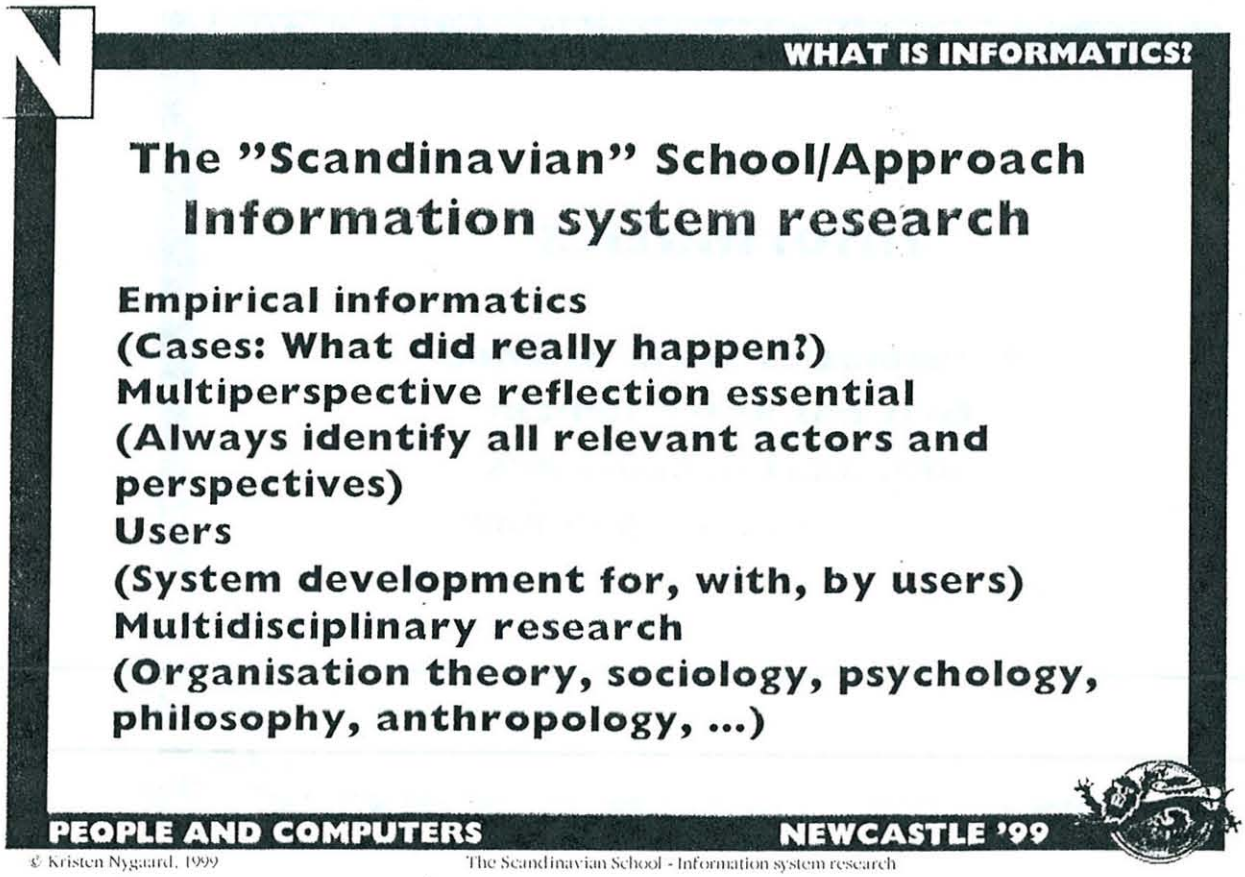




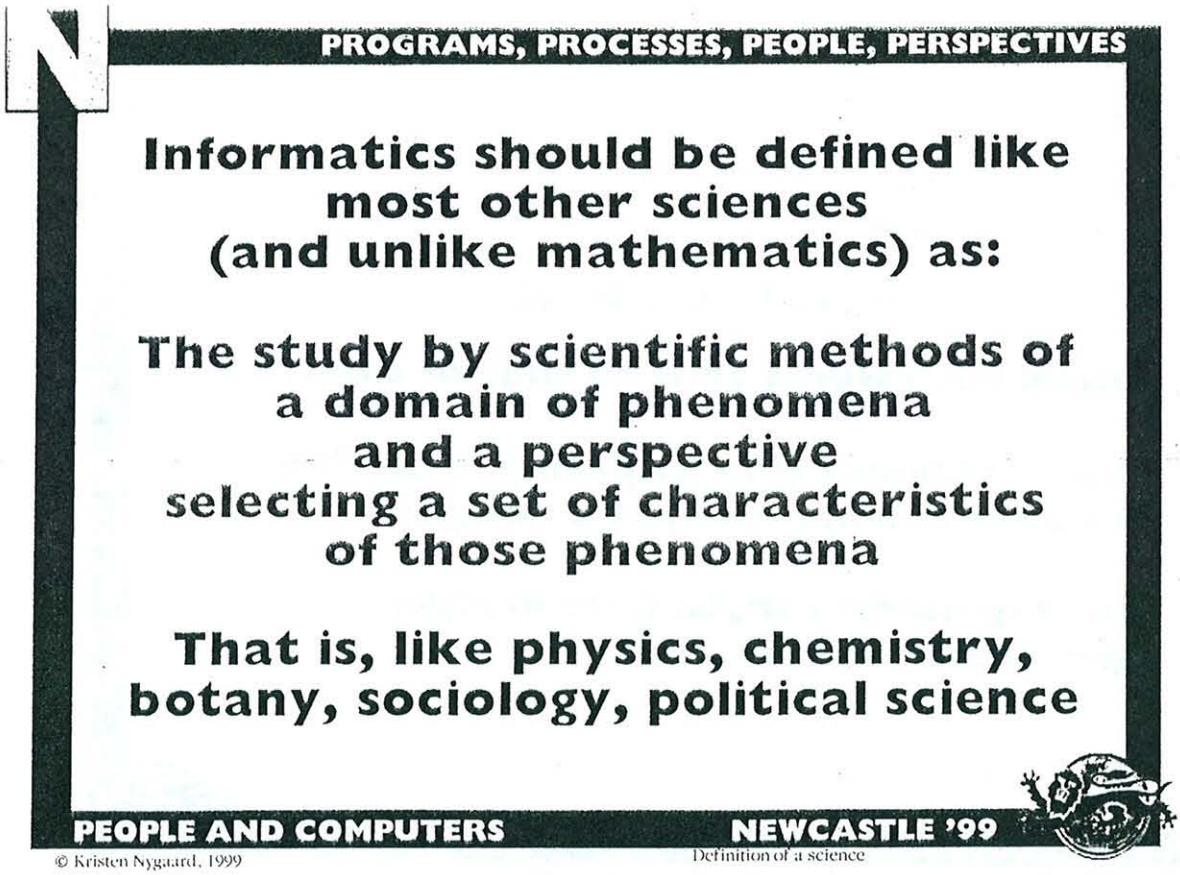




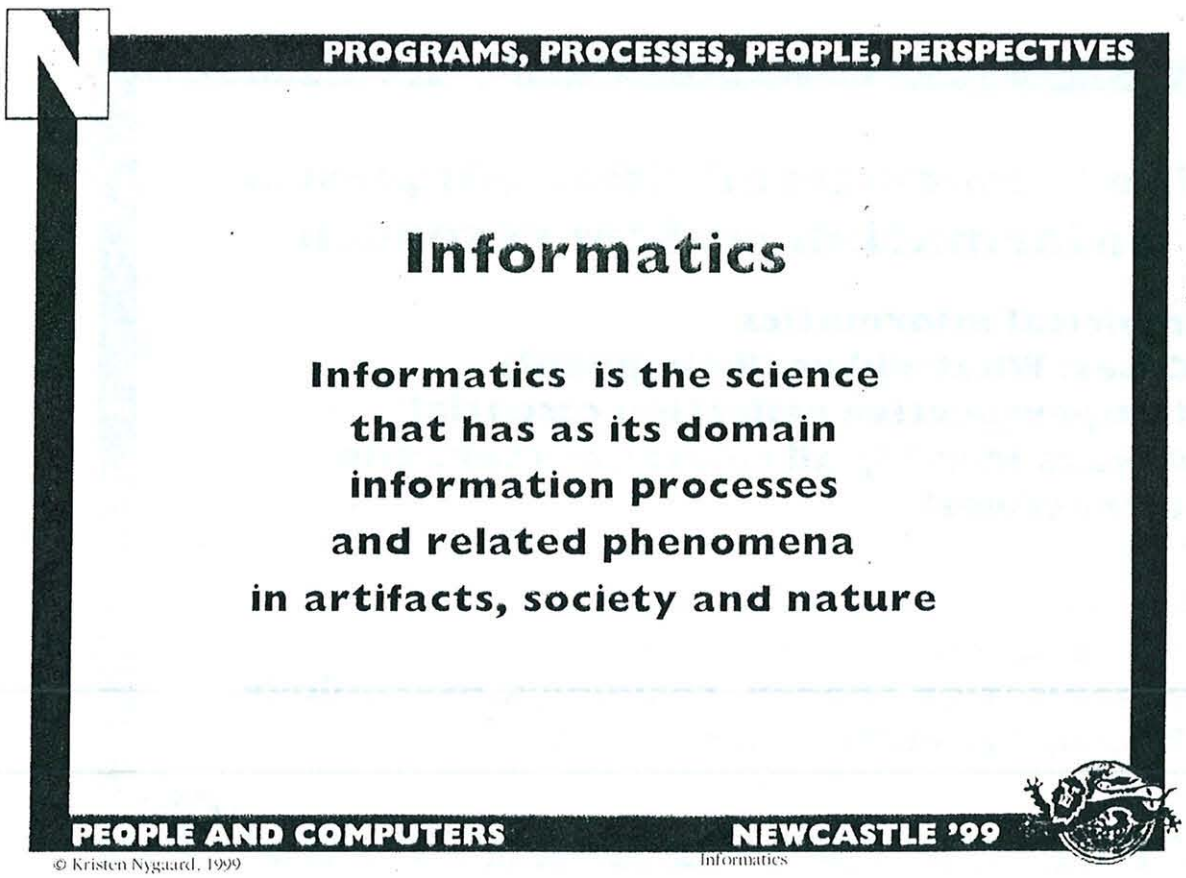
The Scandinavian School - The "Iron and Metal Project"



The Scandinavian School - Information system research



Definition of a science



Informatics

Aspects of Sciences

1. **Observation:** The empirical study of the phenomena - their identification, observed properties and behaviour. (Tycho Brahe in astronomy, Carl von Linné in botany.)
2. **Analysis:** Comprehension and explanation of phenomena in terms of an underlying theory. Identification of important properties and concepts, relations between properties and concepts, description and predictions of behaviour. (Isaac Newton in astronomy, Charles Robert Darwin in biology.)
3. **Synthesis, construction, technology :** Knowledge organized for the purpose of designing, generating or modifying phenomena. (Edward Teller in nuclear physics.)
4. **Multiperspective reflection:** The concurrent or alternating use of several perspectives in the consideration of phenomena, from within the same science (light: as waves - Christiaan Huygens, as particles - Isaac Newton), or from different sciences (civilisations: Karl Marx in economy, Talcott Parsons in sociology).
   The study of how changes introduced according to one wiewpoint affect properties of the phenomena when regarded from another viewpoint.

Perspectives

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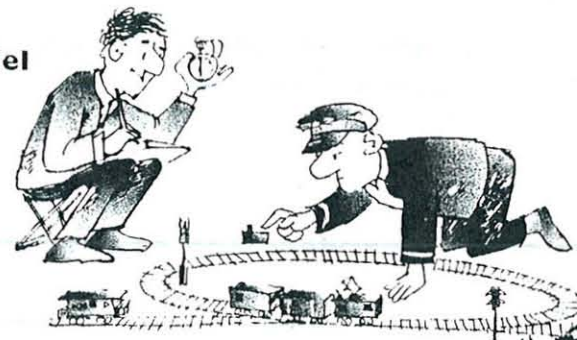

Perspectives
When is a chair a chair?

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- **provides concepts and other cognitions that are being used in the interpretation of the selected properties.**

Perspective

Model

"A phenomenon M is a model of a phenomenon R, according to some perspective P,

if a person regards M and R as similar according to P.

We will call R the referent phenomenon (or simply referent) and M the model phenomenon (or simply model).

We will call P the perspective of the model M."

(Lindsjørn and Sjøberg, 1987)

Processes (1)

1. The economic development of Norway in the years 1992-1998
2. "Ms. Brown recovered after an exhausting disease"
3. The operation of a restaurant
4. The design and operation of the harbour at an oil refinery

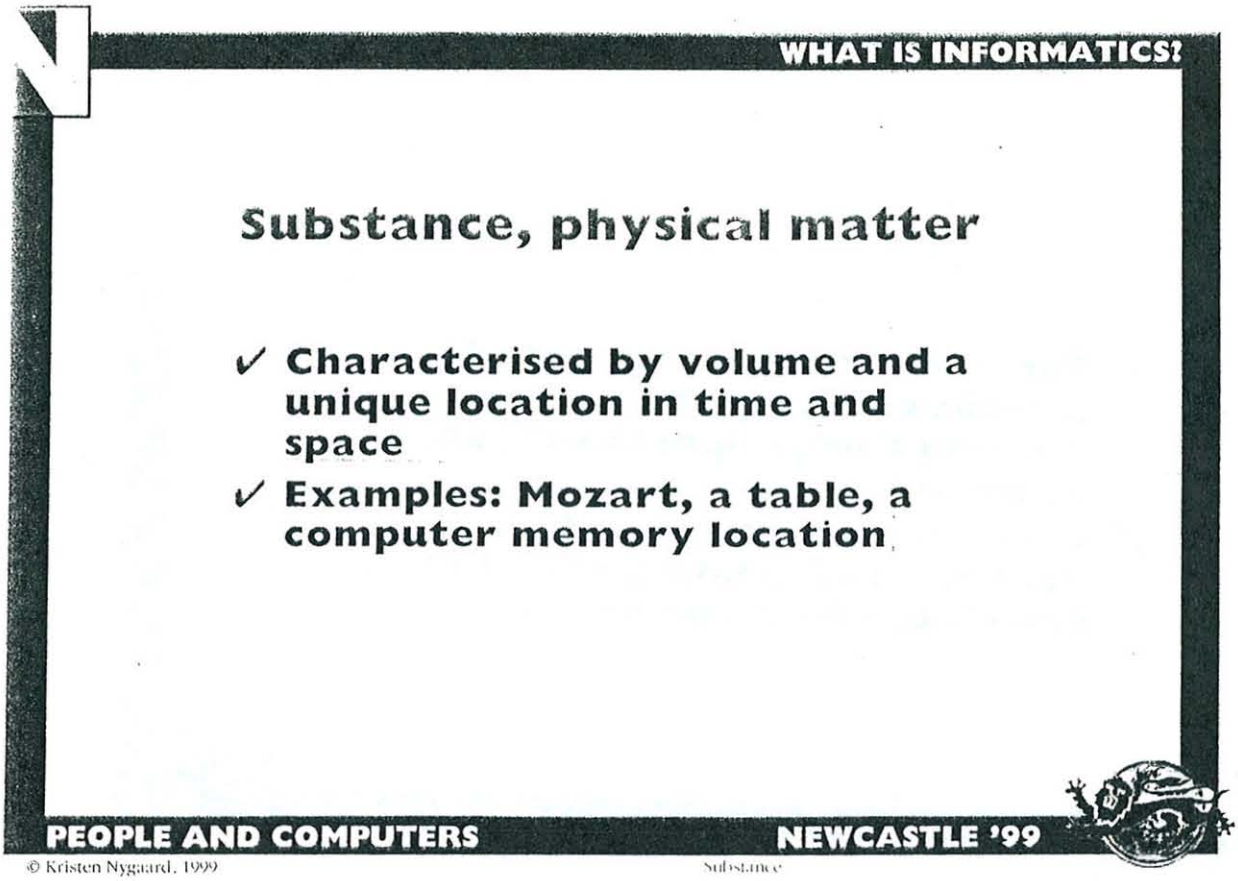
Processes (2)

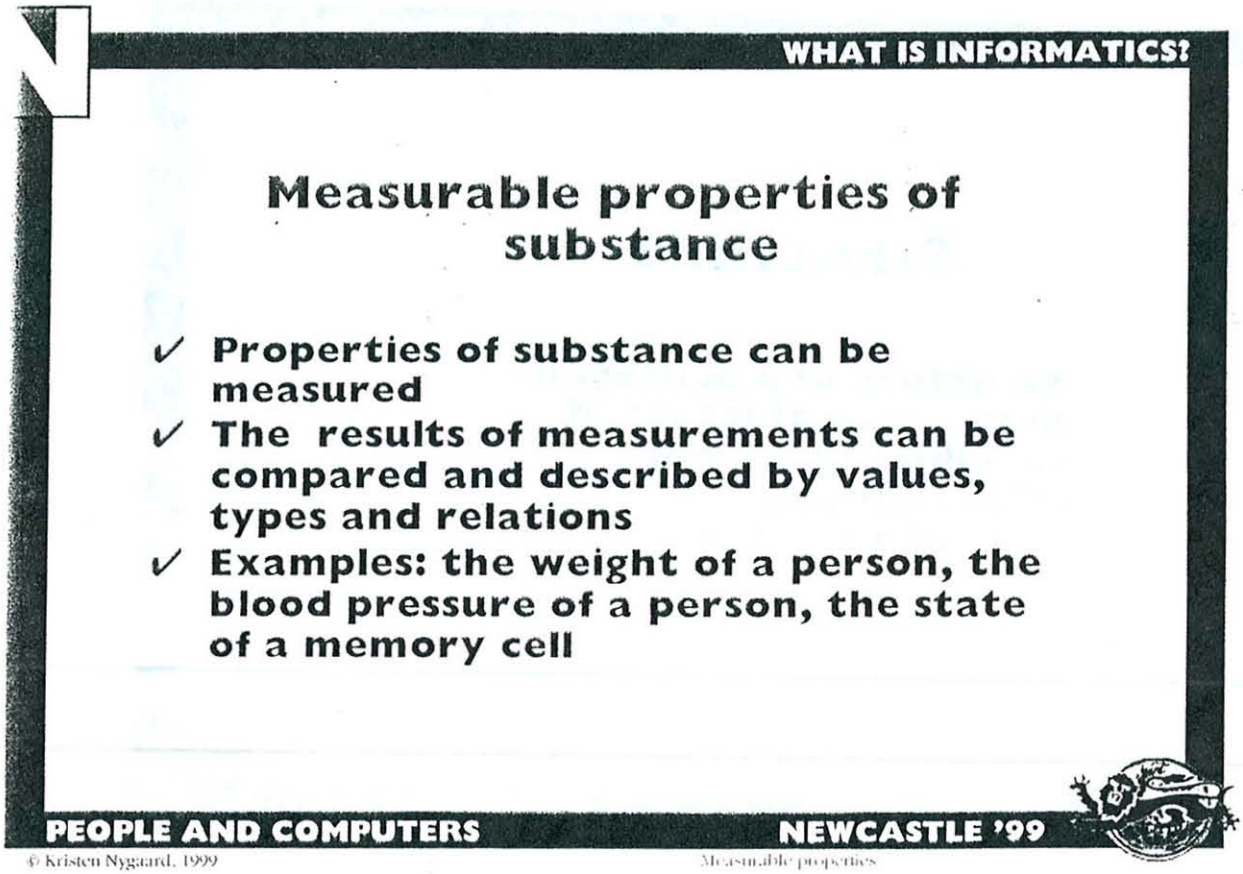
5. The chain of events (and changes of state) in an office, in a hospital.
6. The execution of a computer program.
7. The operation of a database.
8. Thinking (cognitive processes in the minds of people).

Process

A process is a phenomenon
that we choose to regard
as a development of a part of the world
through transformations
during a time interval
called its life span.

The basic qualities of a process are
- its substance,
- its states,
- its transitions, and
- its structure.





Transformations of substance

- ✓ Partially ordered sequence of actions changing the (measurable properties of) some substance
- ✓ Examples: pushing a button, drilling a hole, eating,changing the state of a memory cell

Structure

Structure of a process is limitations of its set of possible states and of transitions between these states.

Structures

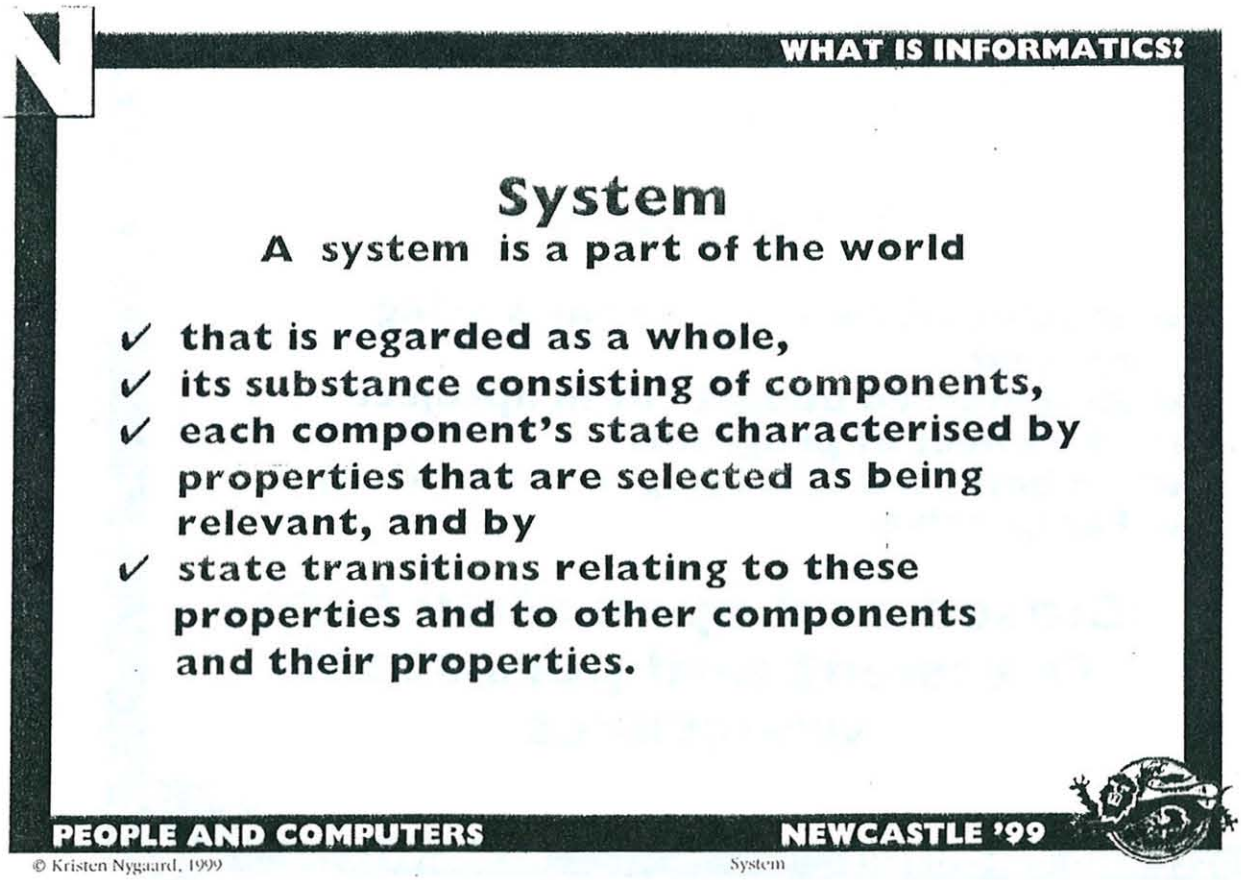
- ✓ Written and unwritten rules being obeyed
- ✓ An enforced budget cut in aproject
- ✓ The effect of programs
- ✓ An enforced state (e.g. initialisation)
- ✓ Perspectives

Closed and open structures
Transient and persistent structures

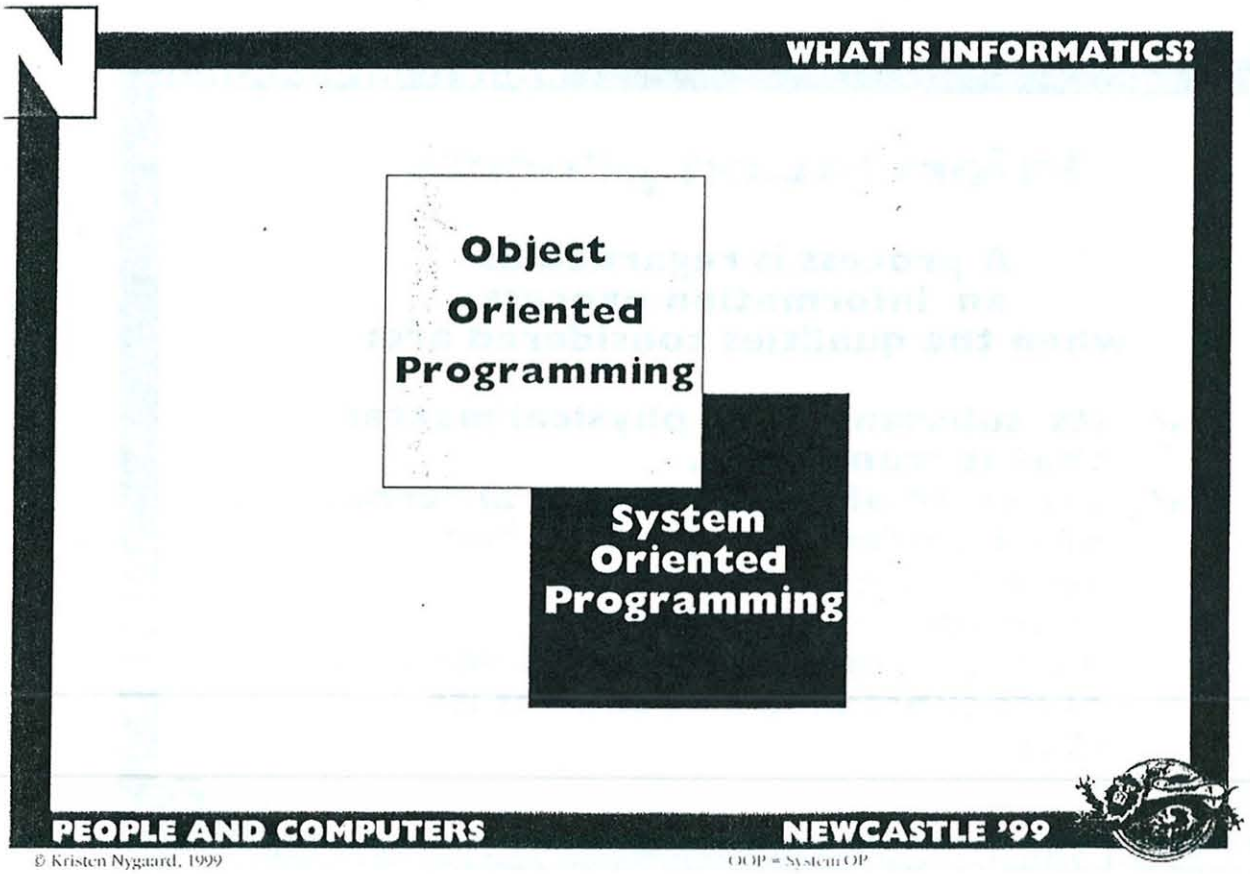
Information process

A process is regarded as an information process when the qualities considered are:

- ✓ its substance, the physical matter that it transforms,
- ✓ the state of its substance, in terms of measurable properties, the results of measurements represented by values,
- ✓ its transitions, the transformations of its substance and thus of its state.



System



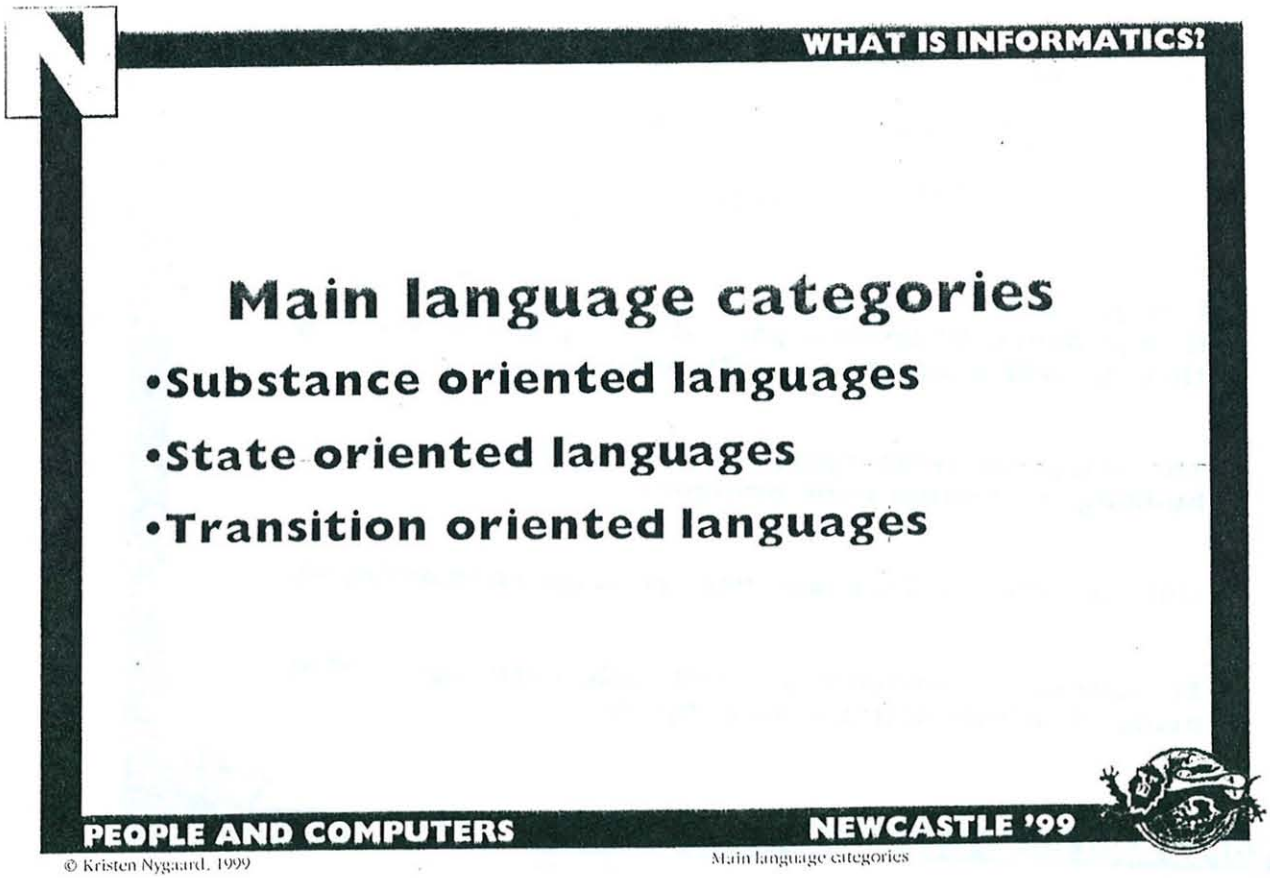
OOP = System OP

Object Oriented Programming

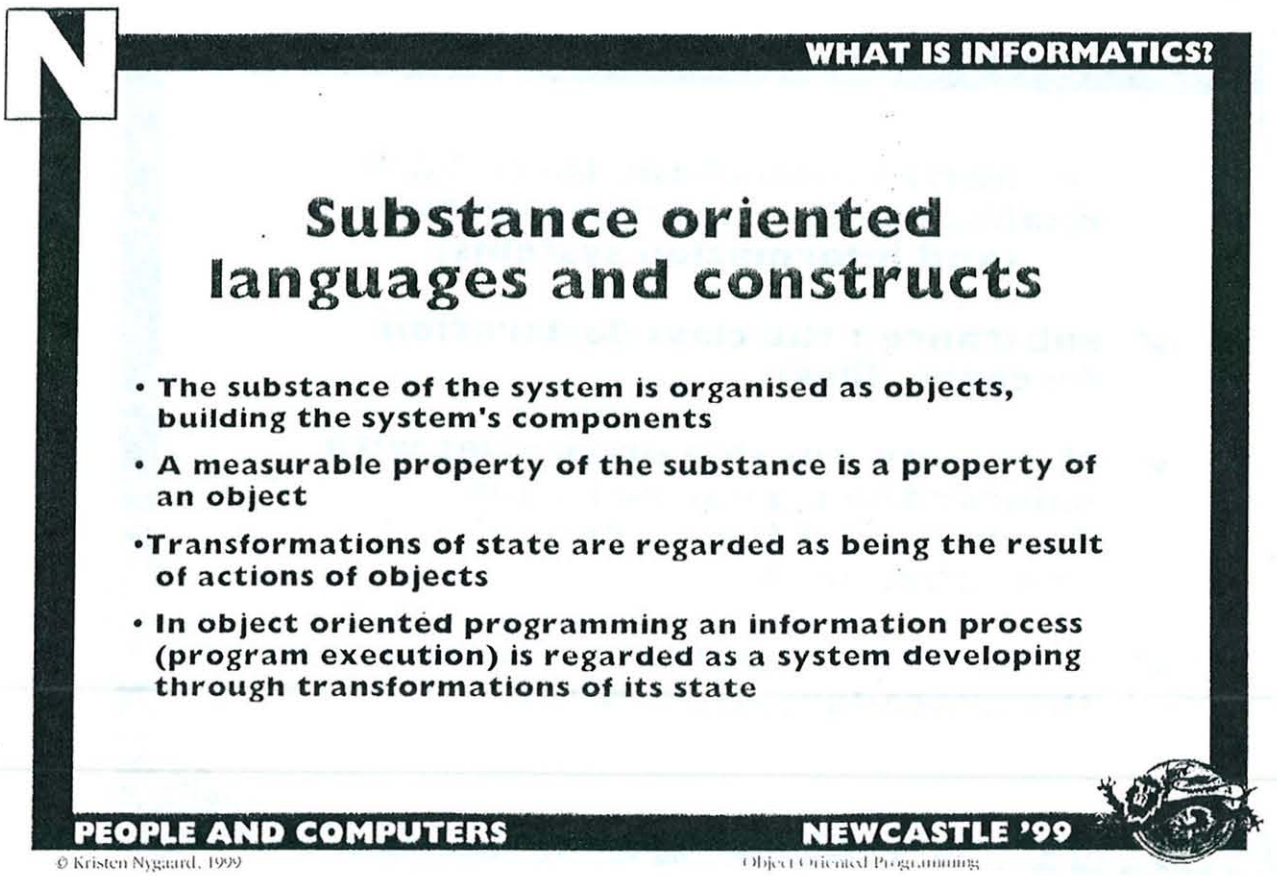
- In object oriented programming an information process (program execution) is regarded as a system developing through transformations of its state
- The substance of the system is organised as objects, building the system's components
- All attributes of the substance are properties of objects
- Transitions - transformations of state - are regarded as being the result of actions of objects

The abstraction of the three basic qualities of information processes (and information systems)

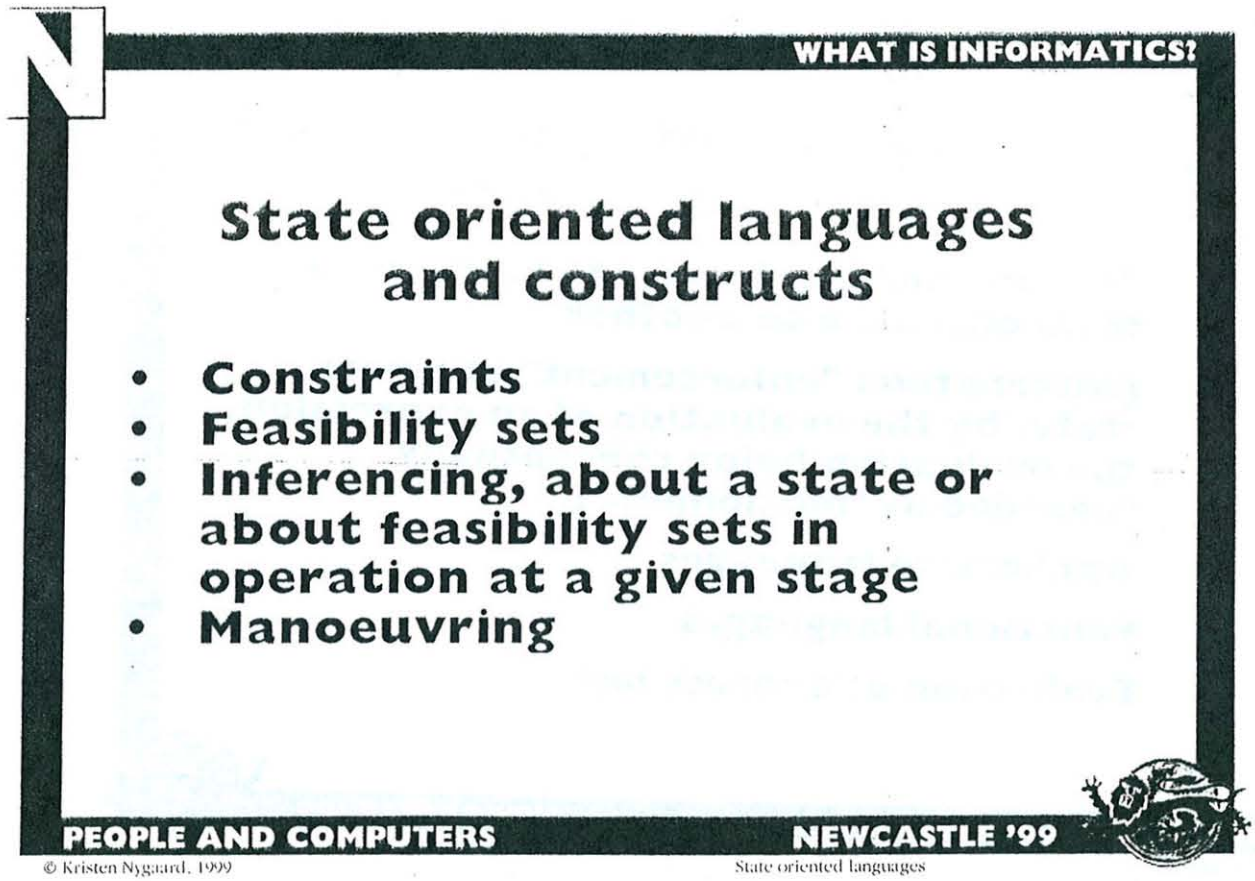
- ✓ substance : the class declaration (records, files)
- ✓ state - measurable properties with values : the type declaration (quantities, integer and real variables, etc.)
- ✓ transition - transformation, action: the procedure declaration.



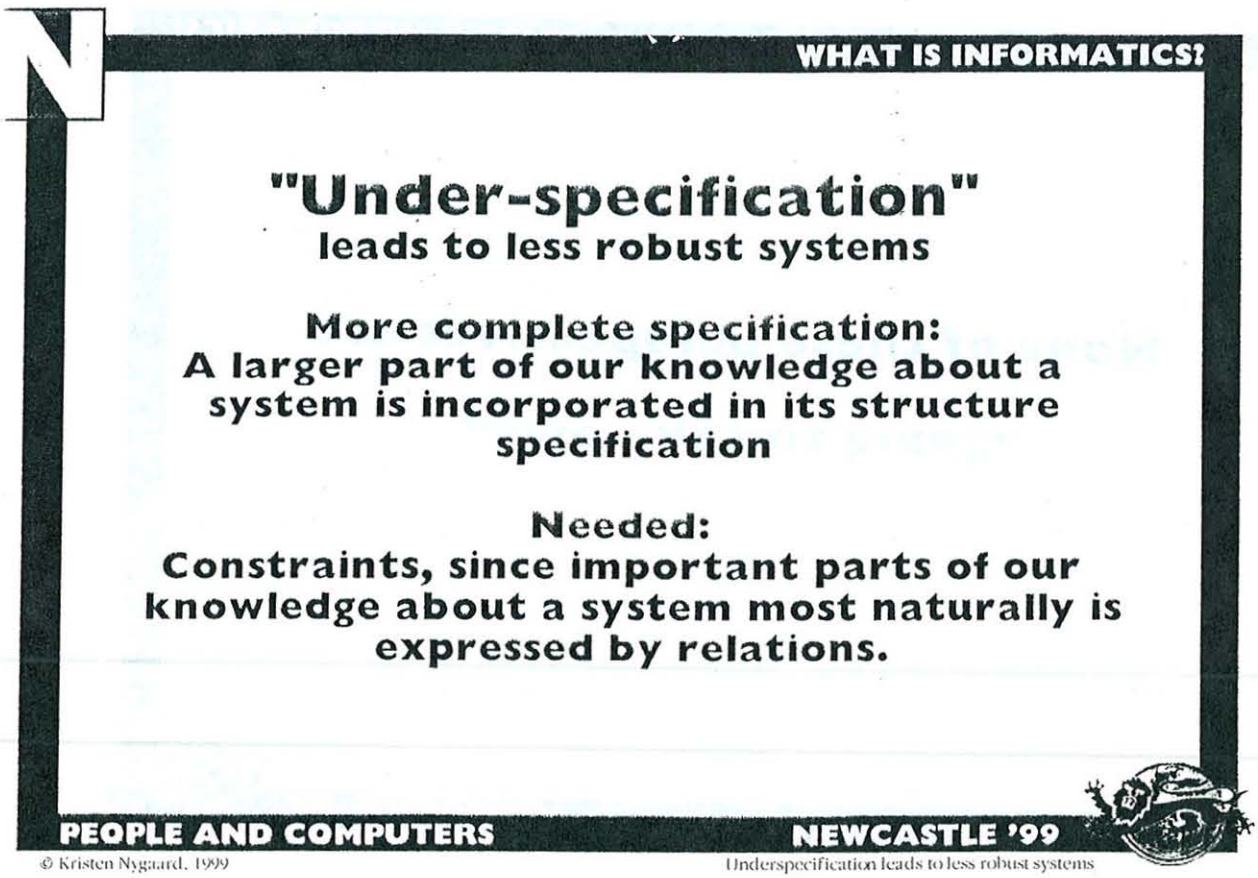
Main language categories



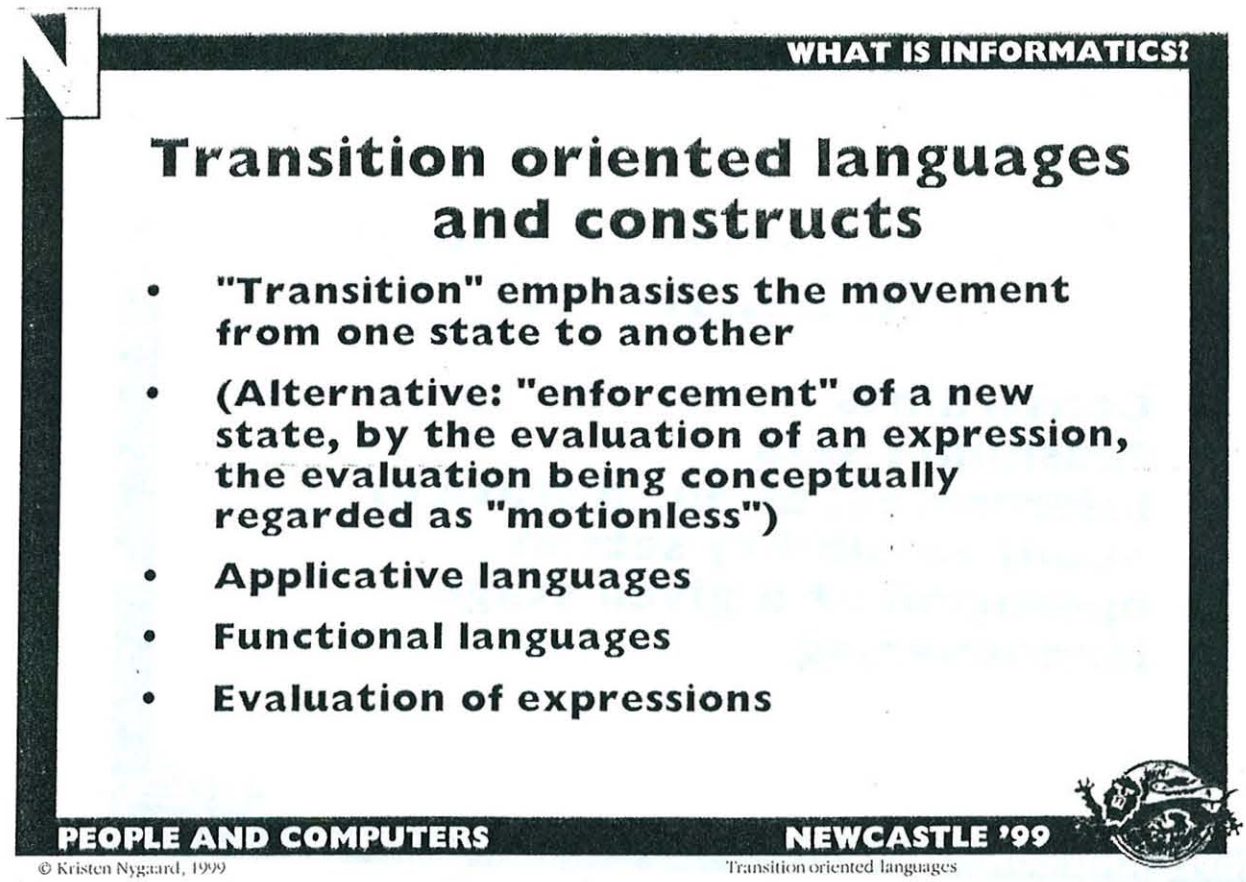
Object Oriented Programming



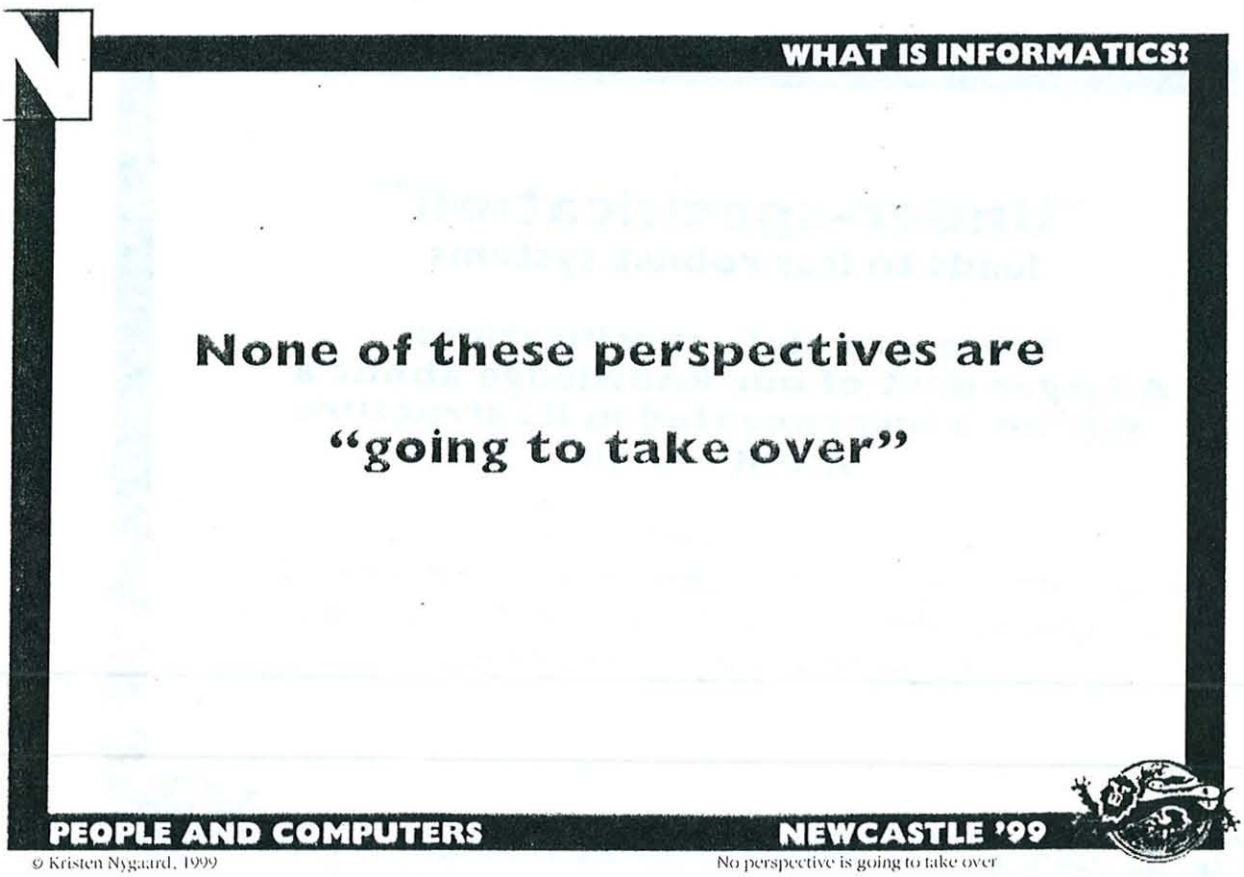
State oriented languages



Underspecification leads to less robust systems



Transition oriented languages



No perspective is going to take over

Language and work

- ✓ Application oriented languages
- ✓ Job oriented languages
- ✓ Profession oriented languages

Language about work

Language in work

•Manoeuvre

- •n.[Fr. *manoeuvre*, orig., hand labour < L. *manu operare*, to work by hand] ...
- •3. any movement or procedure intended as a skillful or shrewd step toward some objective. ....
- •- vi., vt. ...
- •3. to move, lead, get, put, make, compel, etc. (a person or thing) by some stratagem or scheme.
- •(Webster, New World Dictionary, 1984)

From transient and closed processes to persistent and open processes, manoeuvred by enforcment of states and transient structures

DELTA extended the notion of actions :

"The actions of a component (object)
may be divided into the categories:

time consuming actions,
as, e.g. the heating of ore
to the melting point within a furnace,
or the traversing of a crane from one point to another,
or discussing which decision alternative to choose, all
being executed during a time interval.

instantaneous actions,
as, e.g., the leaving of a queue,
or the selection of which ship
in a queue of waiting ships should be allowed
to occupy an empty quay position in a busy harbour,
considered as initiated, executed and completed
at a discrete point in time."

WHILE {temperature ≤ melting point} LET {temperature = start-temperature + F(Energy-supply(time))};

WHILE{time < delivery time} LET {candidates work, each in isolation, on their written exam};

LET {Evaluation of exam} DEFINE passed, mark;

LET {x ** + y ** ≤ r **} DEFINE x, y;

LET {Position of cardinals be inside conclave}; WHILE {no pope is elected} LET {Negotiations go on. Emit black smoke after each indecisive vote}; WHILE {Voting slips are burning} LET {White smoke be emitted};

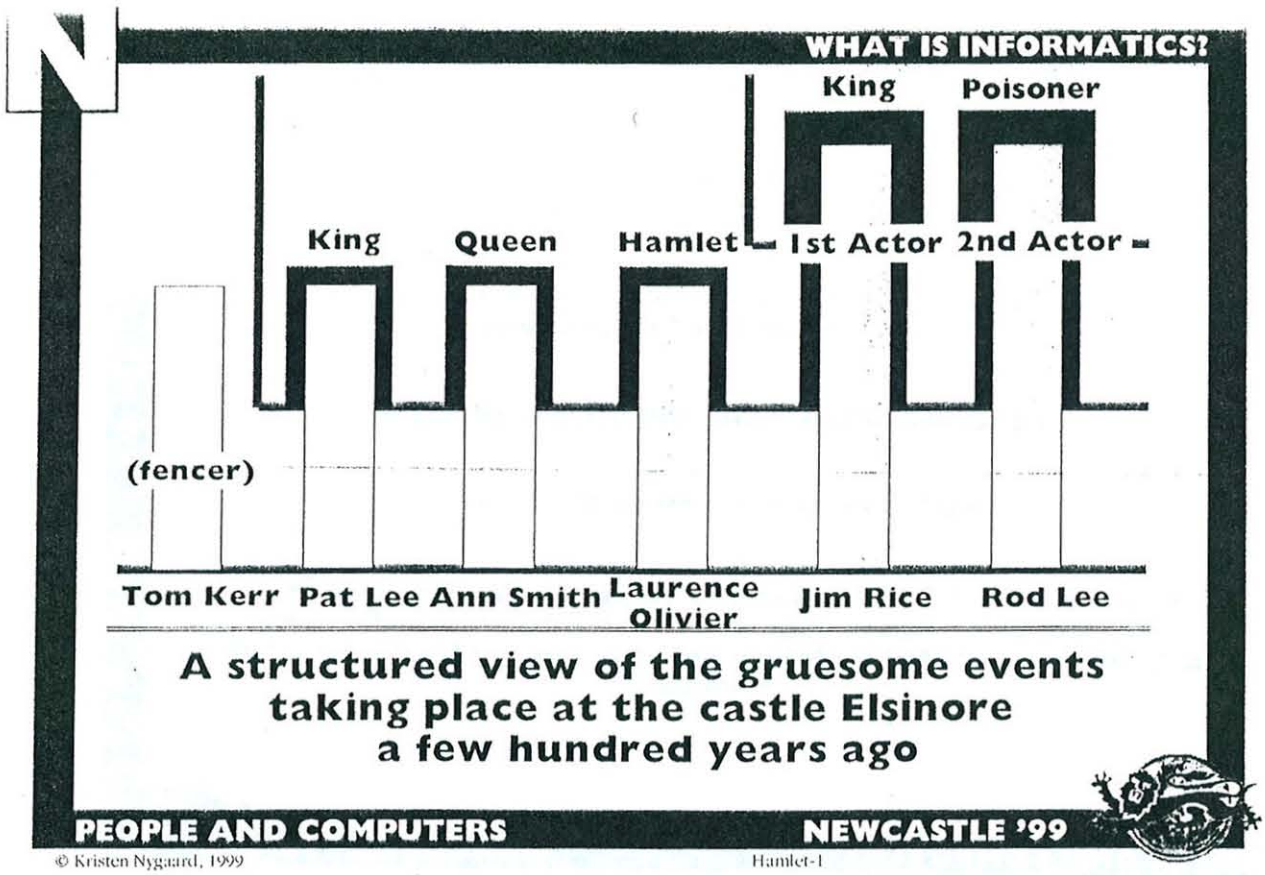
Examples of property descriptors

Actors and roles

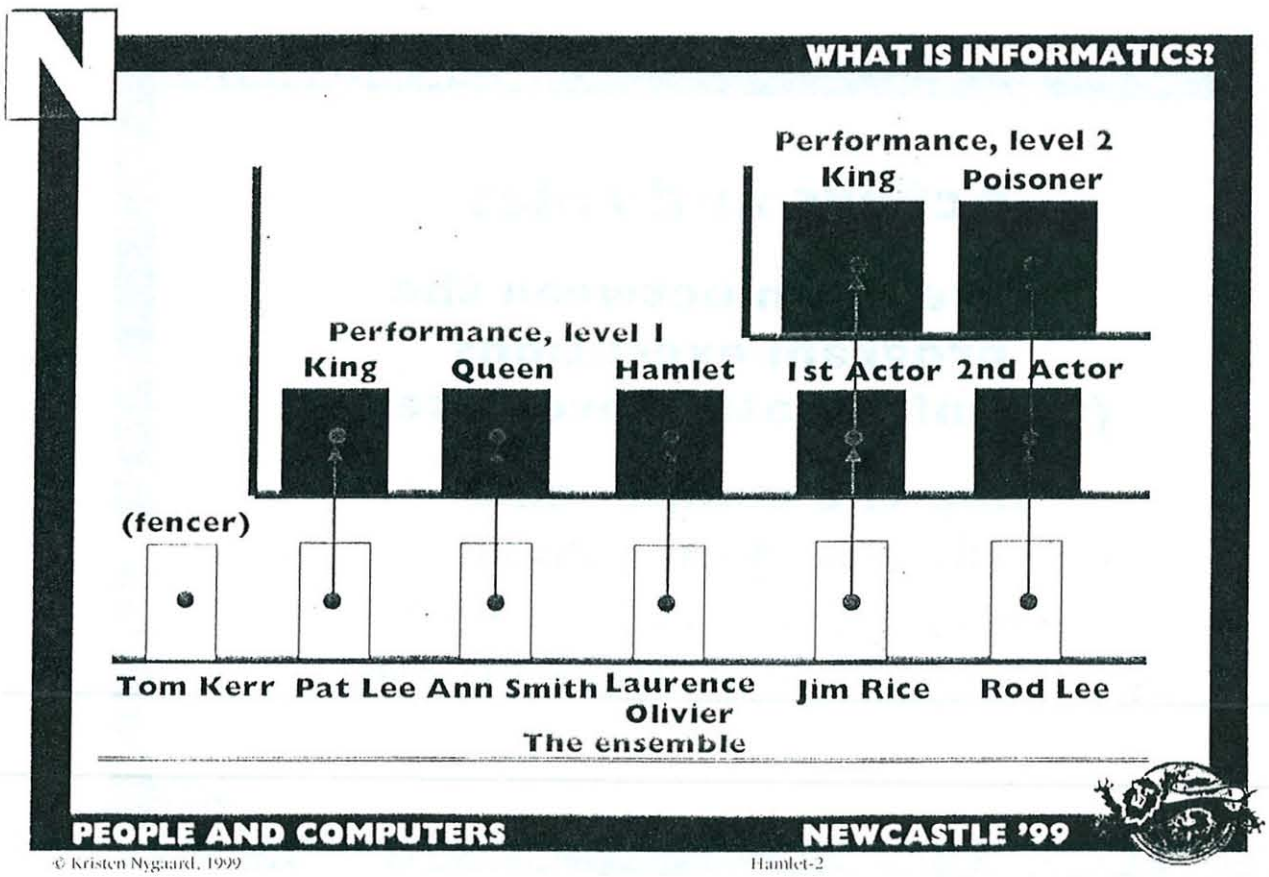
The relation between the program executions (the information processes)

and the components (men and machines) carrying out the actions (in the information processes)

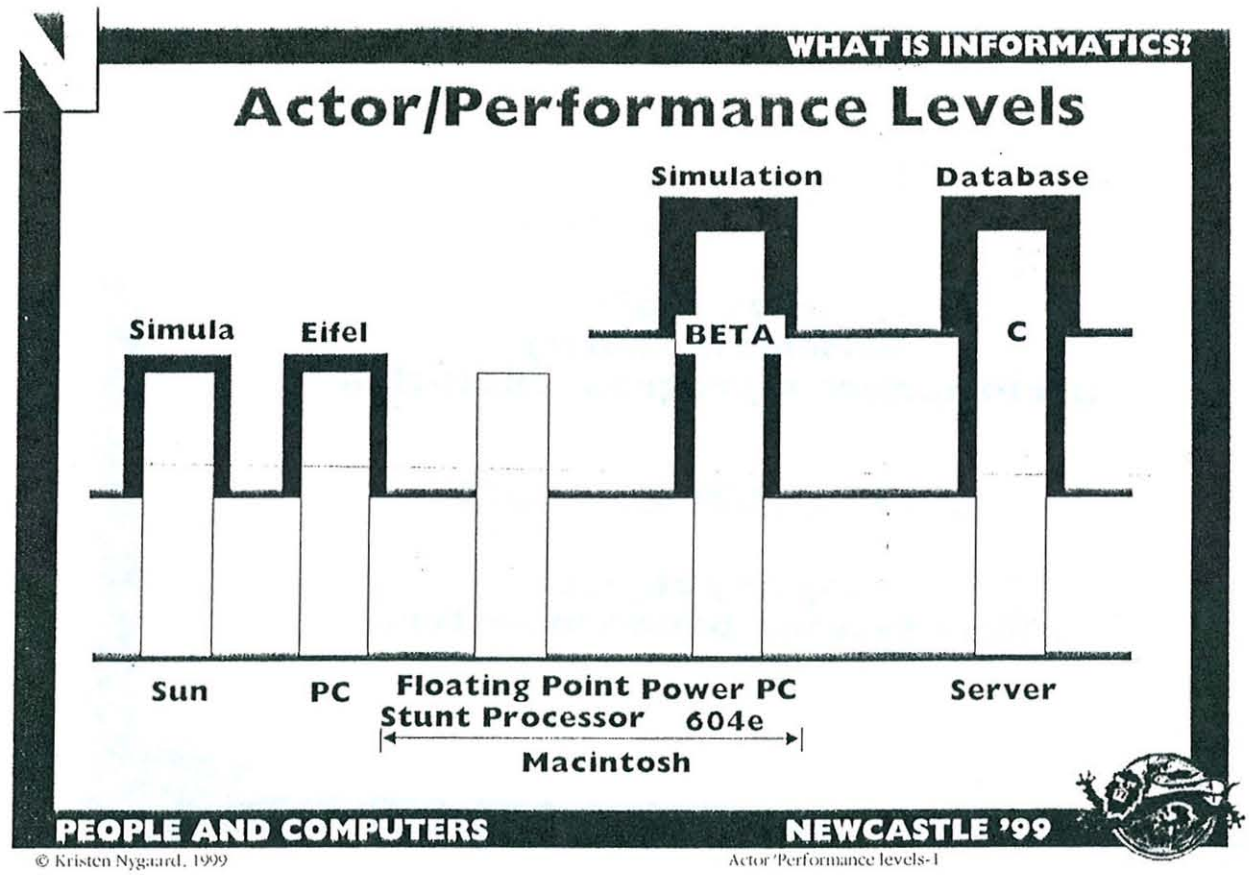
Actor and roles

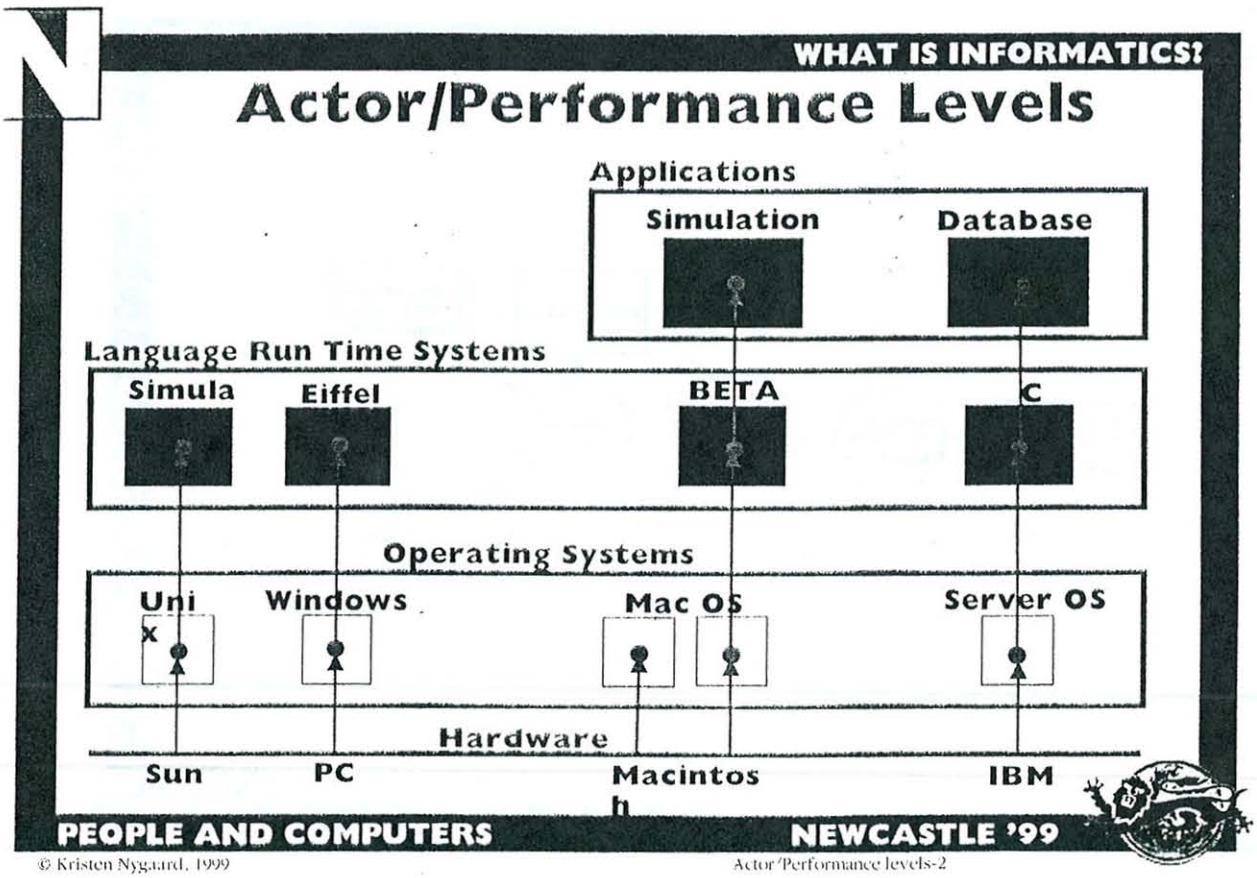


Hamlet-1



Hamlet-2



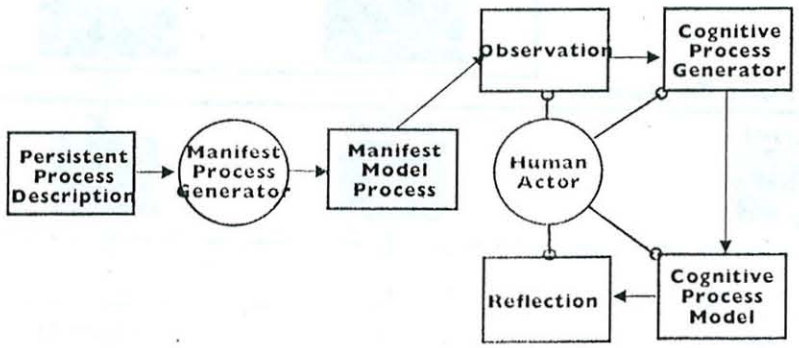


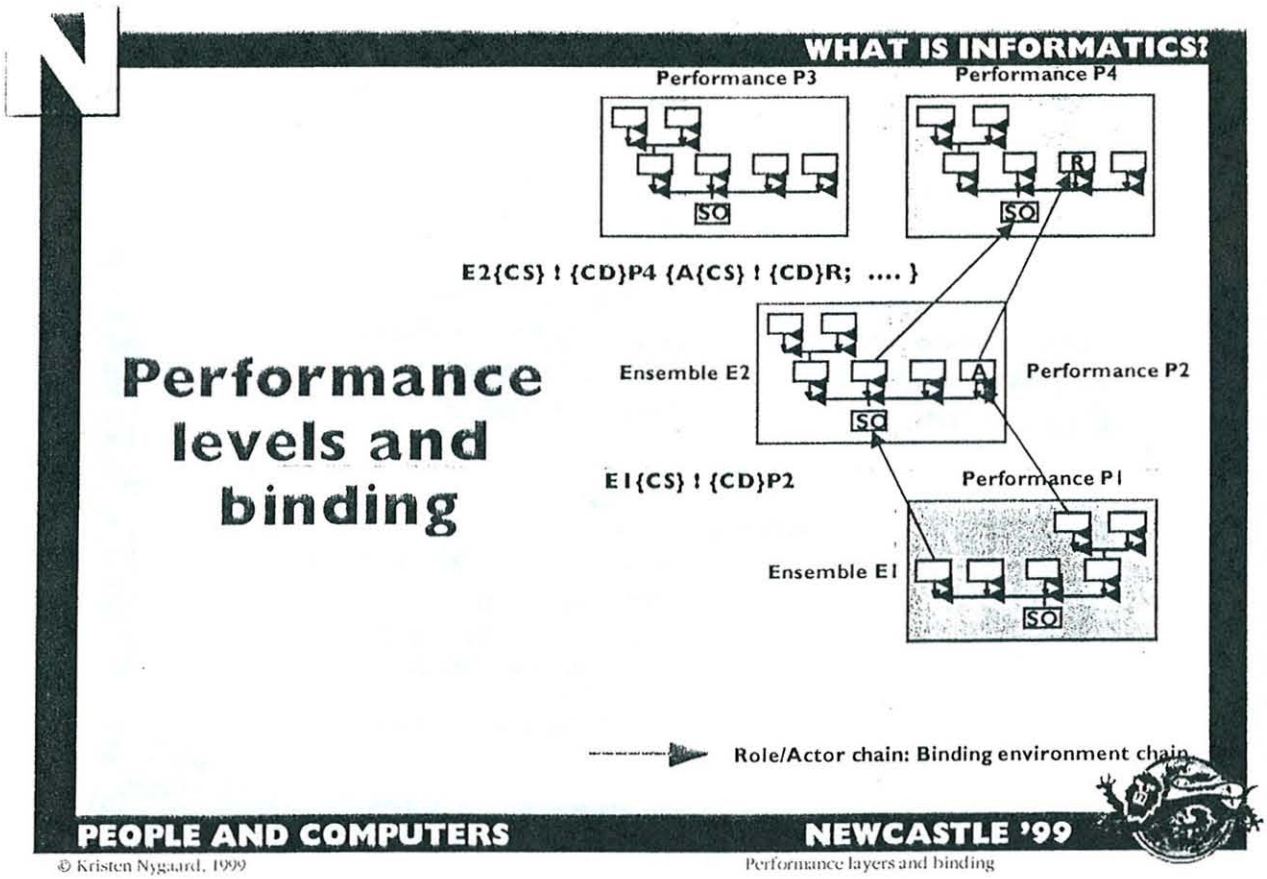
Interpretation

actor / role
(ensemble / roles)
performance = program execution

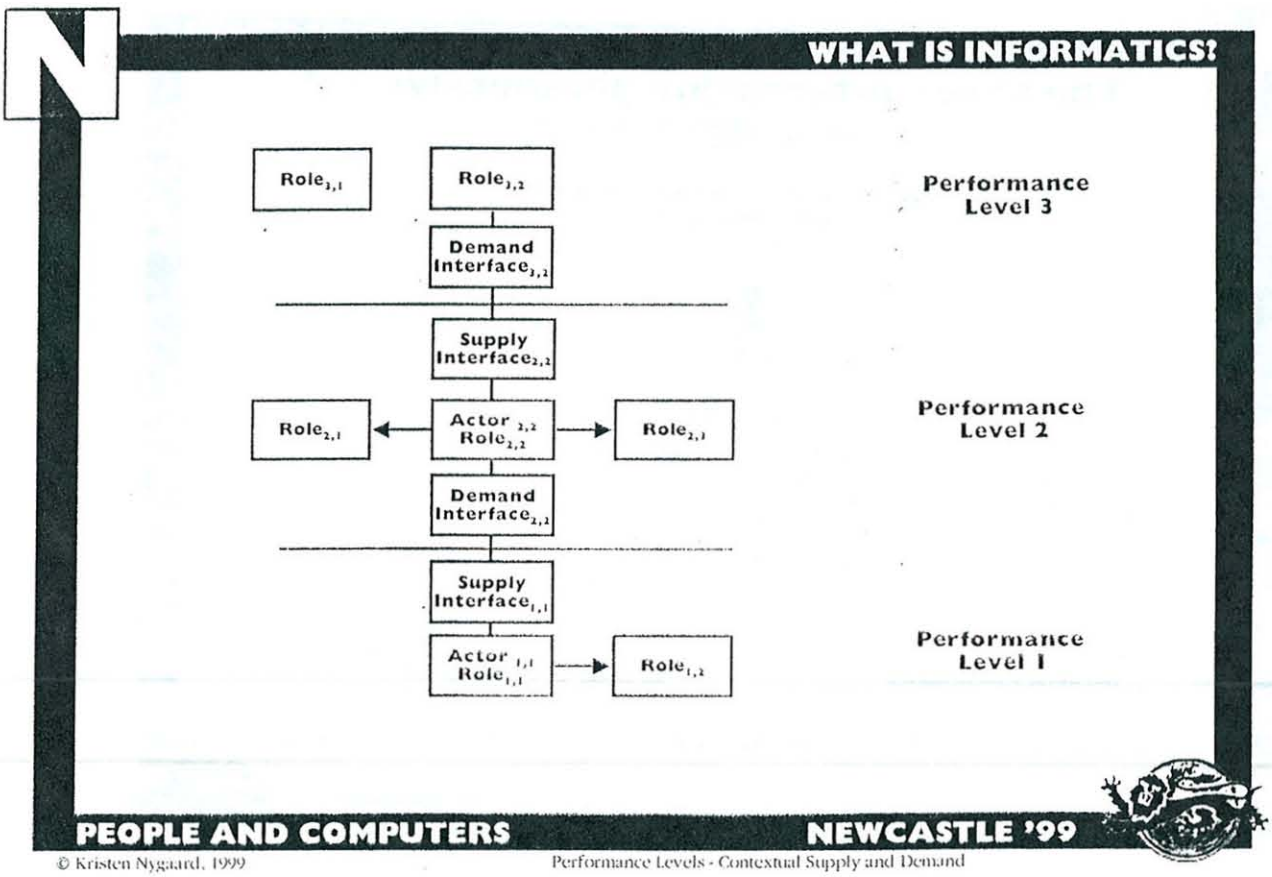
Communication

object / object
within system, between systems





Performance layers and binding



Performance Levels - Contextual Supply and Demand

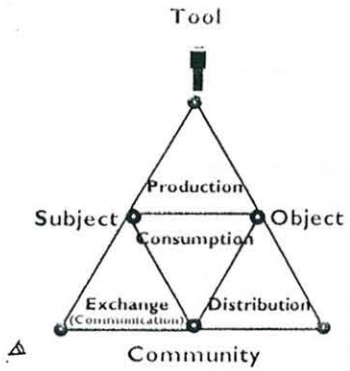
Theatre and operating system functions

Stage	Man/machine system
Ensemble	People and hardware
Performance	Program execution
Actors, props etc.	People, objects
Stage director	Operating system
Artistic director	Site manager
Playwright	Programmer
Play	Program
Play->script adaptation	Compilation
Stage directions	Program's OS demand
Staging	OS activities:
	Link, Load, Run, Interrupt, I/O File handling, Communication Exception handling

 Theatre and operating system functions

The three interacting perspectives of activity theory

The production of the outcome of the activity, like a service or goods

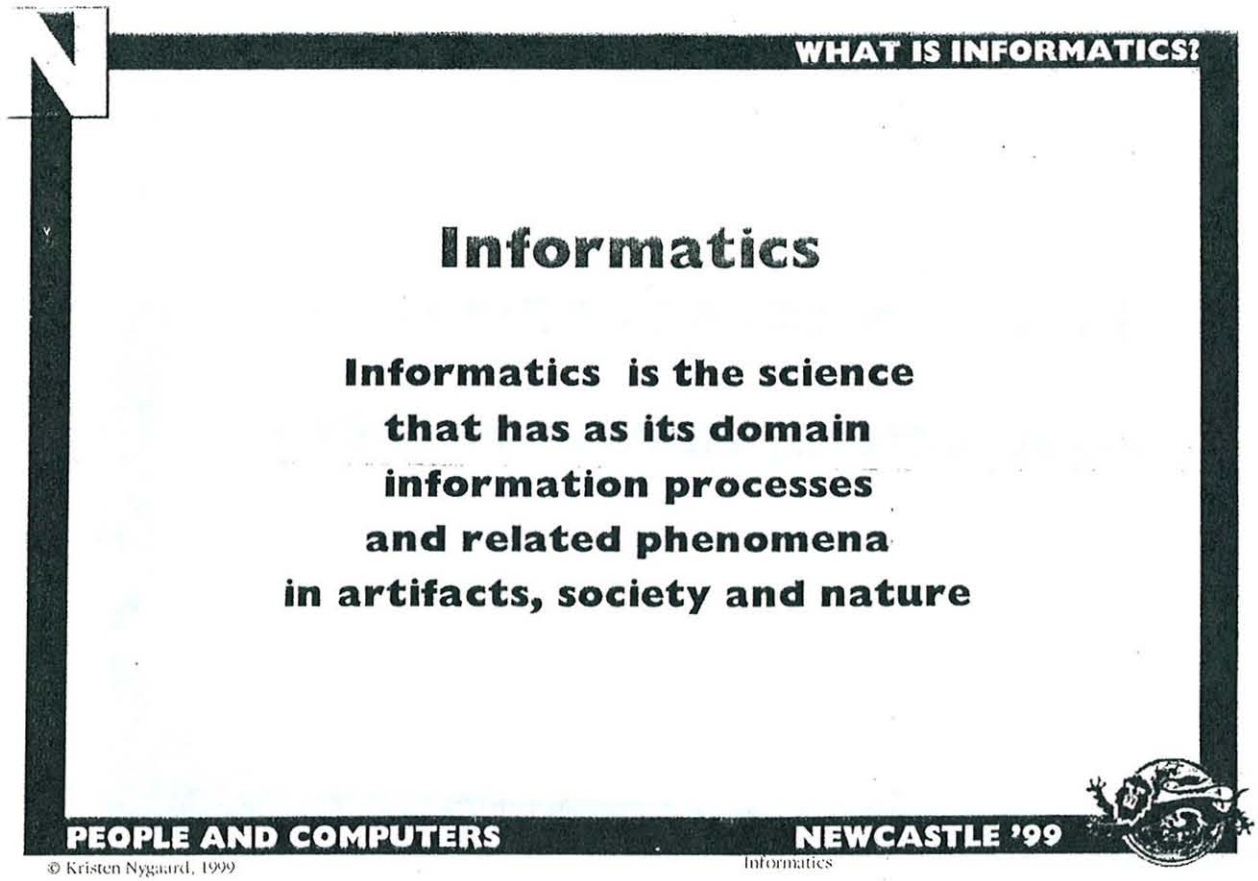


Medium
The exchange (flow) of messages necessary to produce

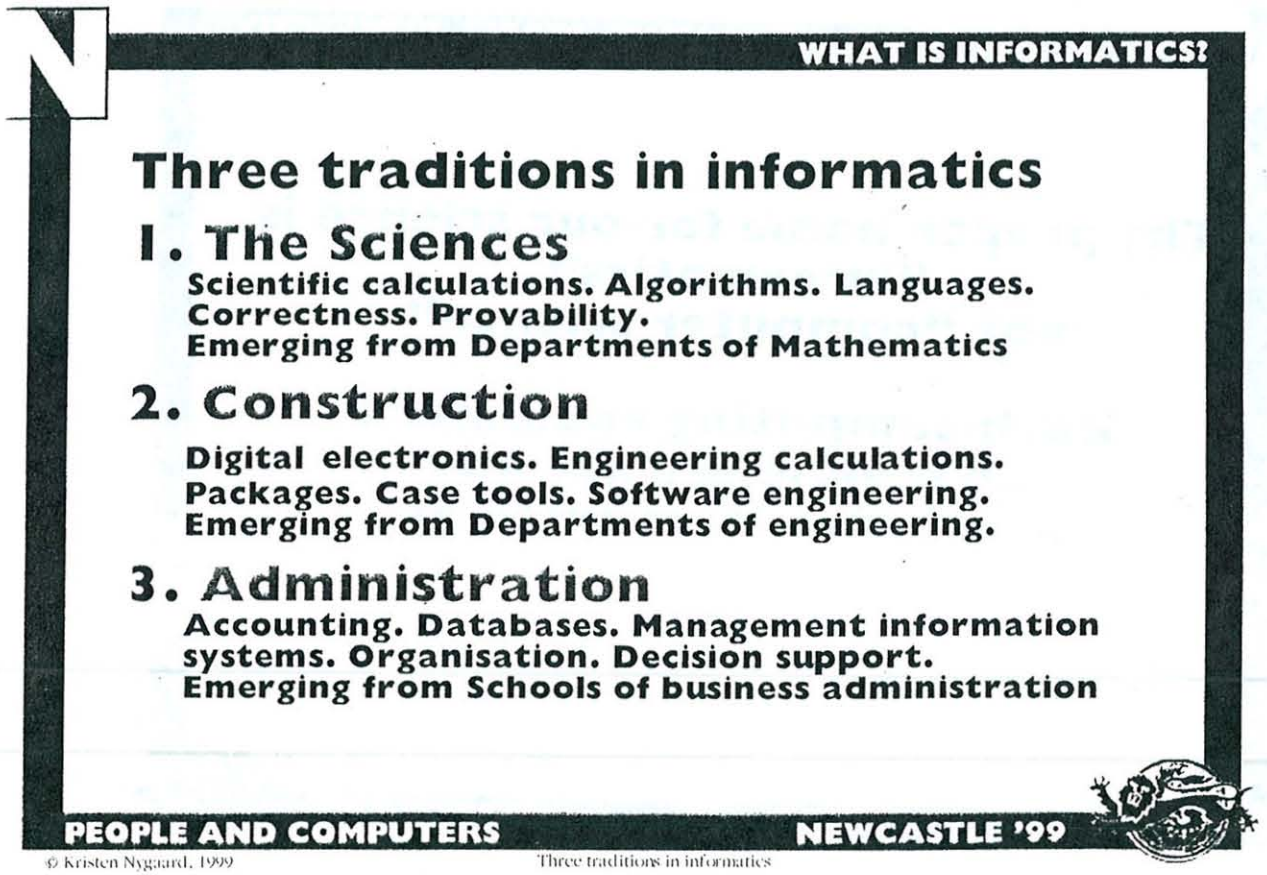
Organisation
Aspects of the collective work done in order to realise production

According to Ole Smordal's Ph.D.-Thesis (May 1999)

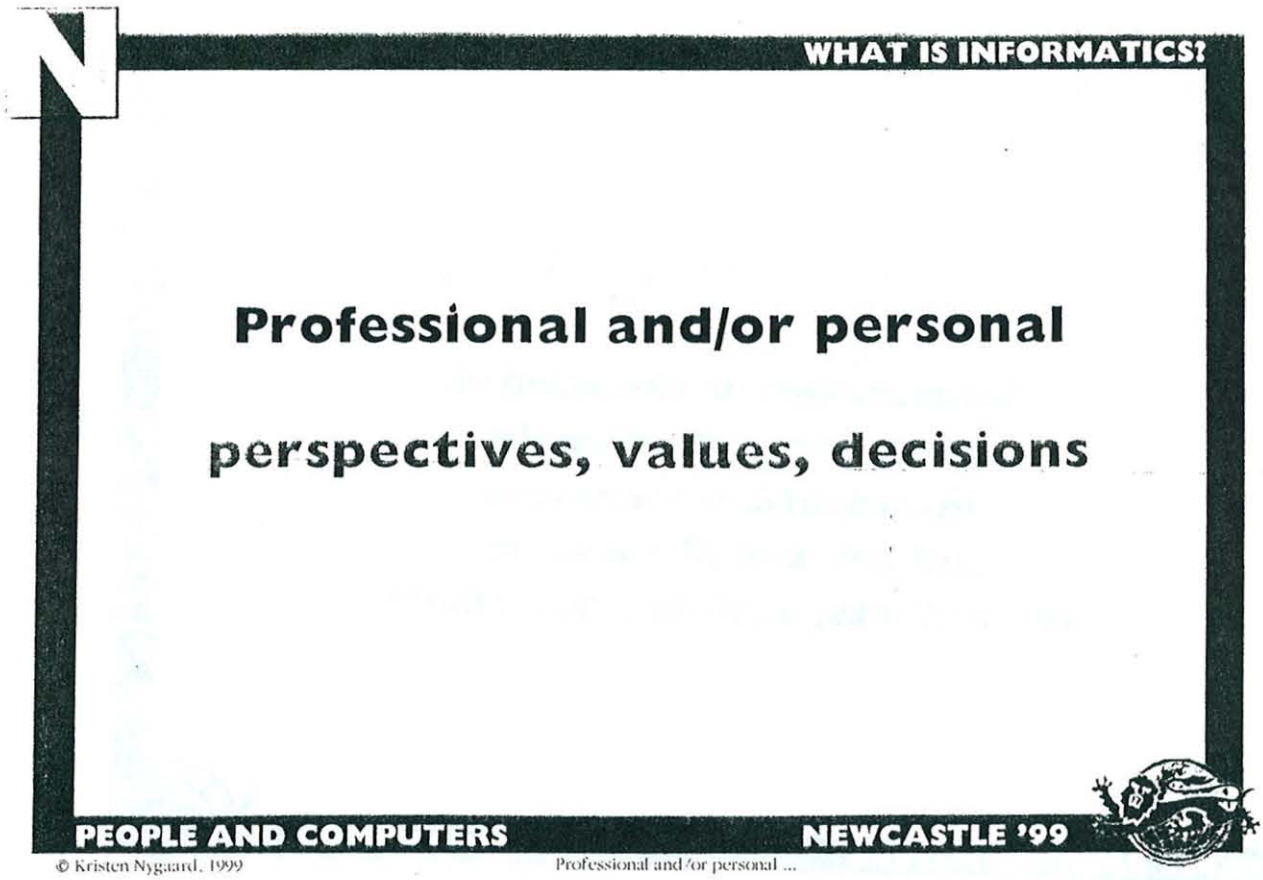
 Activity theory



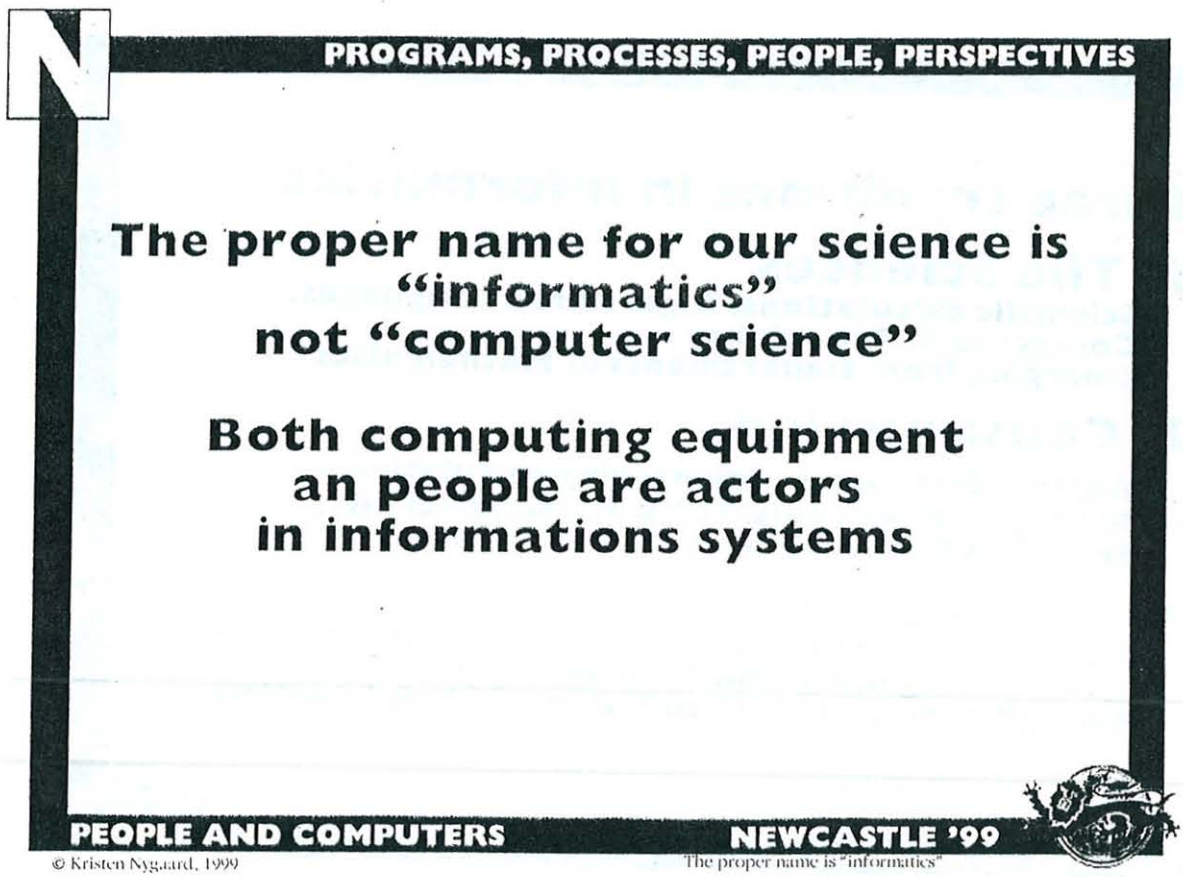
Informatics



Three traditions in informatics



Professional and /or personal ...



The proper name is "informatics"

DISCUSSION

Rapporteur: Neil Henderson

Lecture One

Professor Nygaard talked about the challenges of creating and living with sophisticated computer systems, such as the impact on employment and the requirement for proper training. He also pointed out that, in general, there is conflict between at least two parties when a new system is implemented, for example between an employer who may wish to automate a process to reduce costs and the users who may loose their jobs as a result of the automation. Also when a system is used to achieve a particular goal often there is conflict, for example when a system is used to determine where budget cuts should occur between different departments in an organisation, and it is the party that can use it best that wins.

There is an issue of whether the records on a system should be open, for example to see if a doctor's diagnosis for a patient was correct. Obviously there are implications for the patient whose medical records were accessed, but also they could be used to assess the ability of individual doctors to see if they were making correct diagnoses. Dr Davis pointed out that an incorrect diagnosis may not be the doctor's fault - it may be affected by incorrect answers by the patient to questions asked by the doctor during the consultation.

The speaker then introduced the notion of "cages" for information and accepted Professor Martin's point that it is not necessarily just information that needed to be "caged".

The talk concluded with the notion that an individual's view of a system is very much influenced by the perspective that they are viewing it from. A company wants the best system, but at an acceptable price, whereas a user wants a system that is easy to use. Professor Martin hypothesised that science is generally outside of a problem looking in and the speaker had provided some very convincing arguments that computing professionals were inside the problem. Professor Nygaard agreed that this was an issue and that the social perspective needed to be taken into account.

Lecture Two

Professor Nygaard propounded that the properties of information systems are dependent on the processes used to develop them. He defined a process as a phenomenon that we choose to regard as a development of part of the world through transformations throughout its lifetime - that a process consists of substance, state, transitions and instructions. Professor Mamdami asked if he considered a process only to be dynamic and Professor Malek stated that by this definition a state machine is not a process, but is the execution of a process. The speaker agreed that a process was dynamic and indicated he felt a static process was meaningless. Professor Cockton added that he felt these questions about Professor Nygaard's definition were an issue of perspective - that computer scientists tend to stick to a sub set of language and have their own definitions of the world based on that restricted perspective. They do not feel happy with wider definitions and that he found this point of view strange, as someone coming from other disciplinary perspectives.

Mr Yapp then added that processes do not always produce the same output and it is necessary to know whether the different outputs are as a result of something within the system or because of external influences, and the results therefore need to be analysed from a statistical perspective. The variability of outputs impact on people and technology and cannot be ignored. Professor Nygaard agreed that these influences were important and they should always be considered.

Professor Mamdami asked if a process always had to have substance and Dr Davis added that sometimes it is not possible to measure everything concerned with a process. Professor Malek added that every program was surely an infinite number of processes. Professor Nygaard answered that he felt processes did always have substance and that it was important to observe

and measure them, it is his opinion that we only deal with observable and measurable properties in informatics. Dr Kay asked if emotional motivations were observable and measurable and the speaker answered that hate was an emotion and had state, but indicated he was not certain it could be observed and measured.

Professor Mamdami observed that causation was not part of the definition given for a process and Professor Nygaard answered that by his definition the sequence of changes of state comprised the observation of the process.