Ambient Intelligence and Collaborative Networks
(basis for future cross-fertilization

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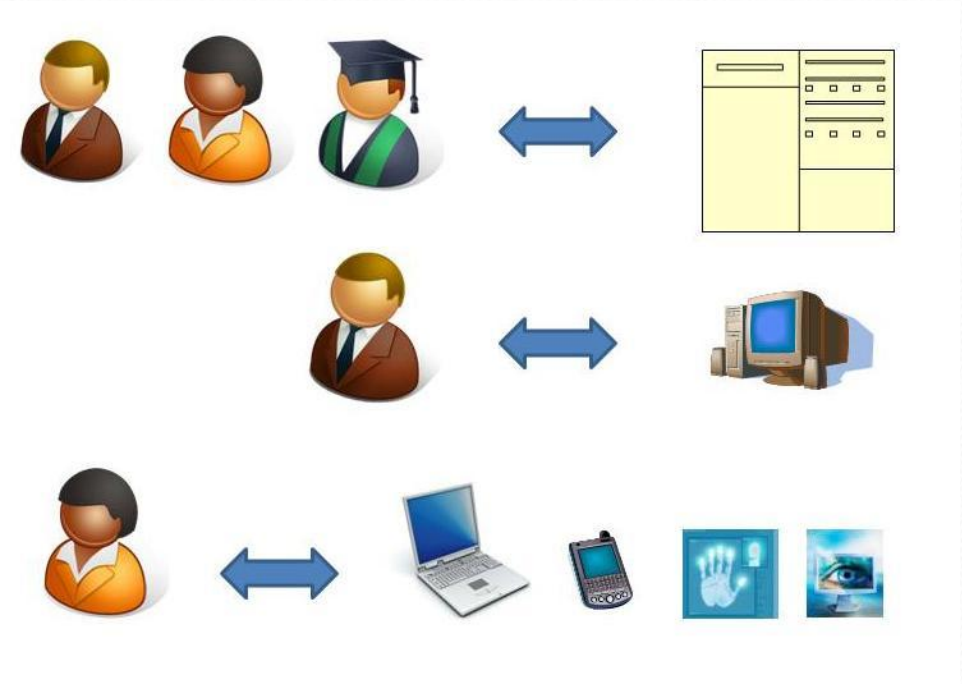
Route Map

- **Some basic concepts (Smart Environments and Ambient Intelligence)**
- Challenging Aspects of Smart Environments and Limitations of current AmI systems
- AmI and CNs: Convergence and Synergies

Aml, part of an historical trend…



Many users to one (big) computer

One user to One PC

One user to many computing devices!

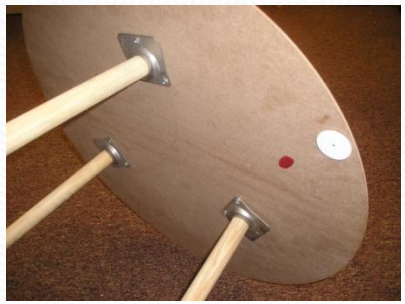
Moore's Law

"...*The complexity for minimum component costs has increased at a rate of roughly a factor of two per year ... Certainly over the short term this rate can be expected to continue, if not to increase.* ..."

[Moore 1965]

Computing **is** everywhere …

at a different scale!!



Just look at home and in public spaces…

dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 22:39:18
dwelling015001	foodcupbdoor	doorcont	opening	2010-04-26 22:41:31
dwelling015001	foodcupbdoor	doorcont	closing	2010-04-26 22:41:36
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 22:41:40
dwelling015001	hall	pir	roomvisited	2010-04-26 22:41:47
dwelling015001	livingroom	pir	roomvisited	2010-04-26 22:42:06
dwelling015001	hall	pir	roomvisited	2010-04-26 22:42:22
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 22:42:26
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 23:32:19
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 23:33:16
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 23:36:10
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 23:55:07
dwelling015001	hall	pir	roomvisited	2010-04-26 23:55:22
dwelling015001	livingroom	pir	roomvisited	2010-04-26 23:55:26
dwelling015001	downstairswc	pir	roomvisited	2010-04-26 23:55:54
dwelling015001	downstairswc	pir	roomvisited	2010-04-26 23:57:26
dwelling015001	hall	pir	roomvisited	2010-04-26 23:57:29
dwelling015001	mainkitchen	pir	roomvisited	2010-04-26 23:57:38
dwelling015001	hall	pir	roomvisited	2010-04-26 23:58:12
dwelling015001	livingroom	pir	roomvisited	2010-04-26 23:58:15
dwelling015001	masterbed	bed-chair	in	2010-04-26 23:58:41
dwelling015001	livingroom	pir	roomvisited	2010-04-26 23:58:48
dwelling015001	livingroom	pir	roomvisited	2010-04-26 23:59:26
dwelling015001	livingroom	pir	roomvisited	2010-04-27 00:31:11
dwelling015001	livingroom	pir	roomvisited	2010-04-27 00:37:28
dwelling015001	masterbedroom		bed-chair out	2010-04-27 00:37:46

dataset

Transformation of CS and its immersion in society...

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

The "disappearing computer" (Weiser)

Related Concepts

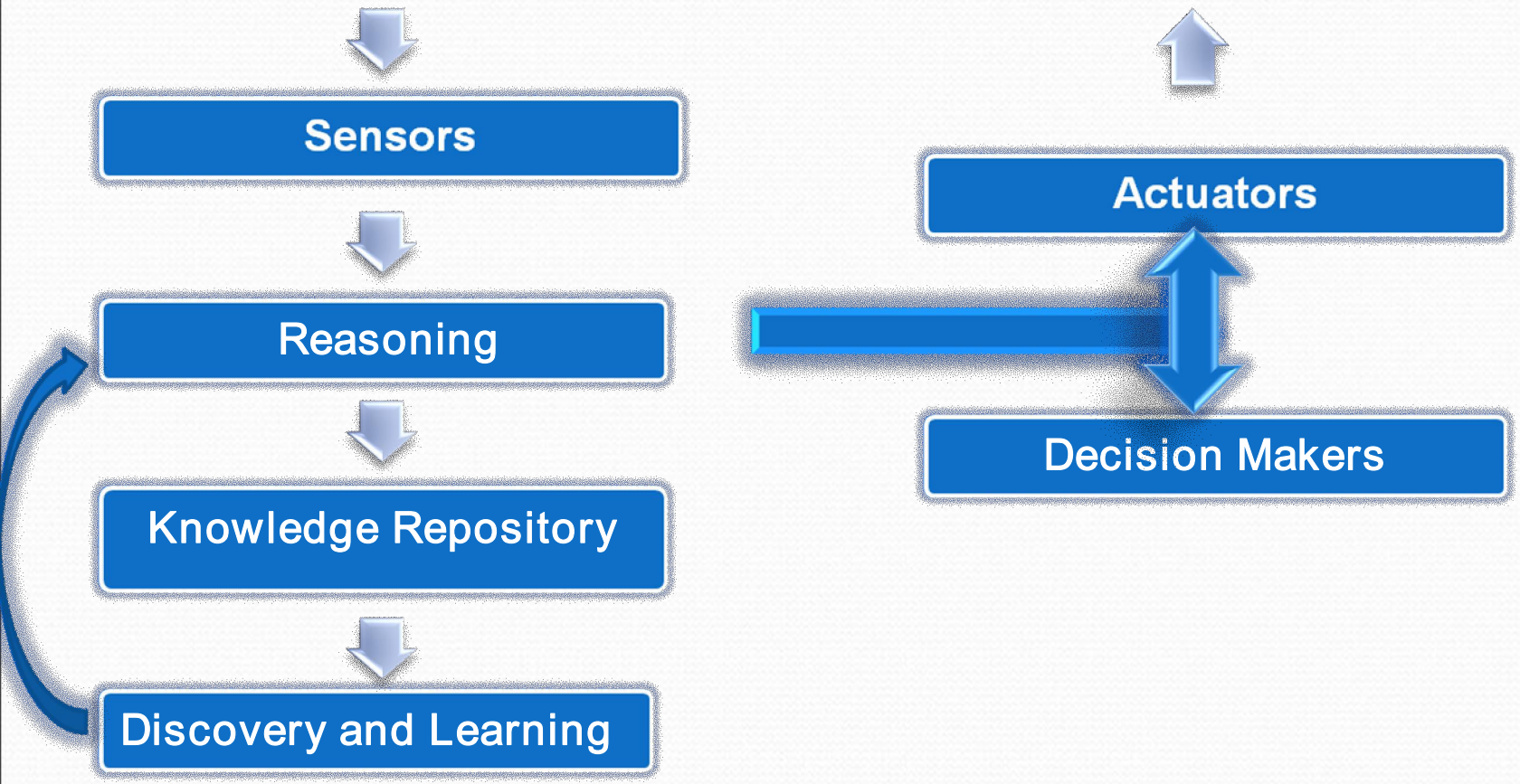
- *Pervasive/ubiquitous computing:* studies the provision of distributed computational services which are context-aware and travel with the user seamlessly across different environments.
- *Smart environments:* an environment enriched with sensing devices, some of them with capability to store and process data locally.
- *Ambient intelligence:* refers to the intelligent software that supports people in their daily lives by assisting them in a sensible way.
- *Intelligent environments:* intregartes all the previous concepts .

Ambient Intelligence

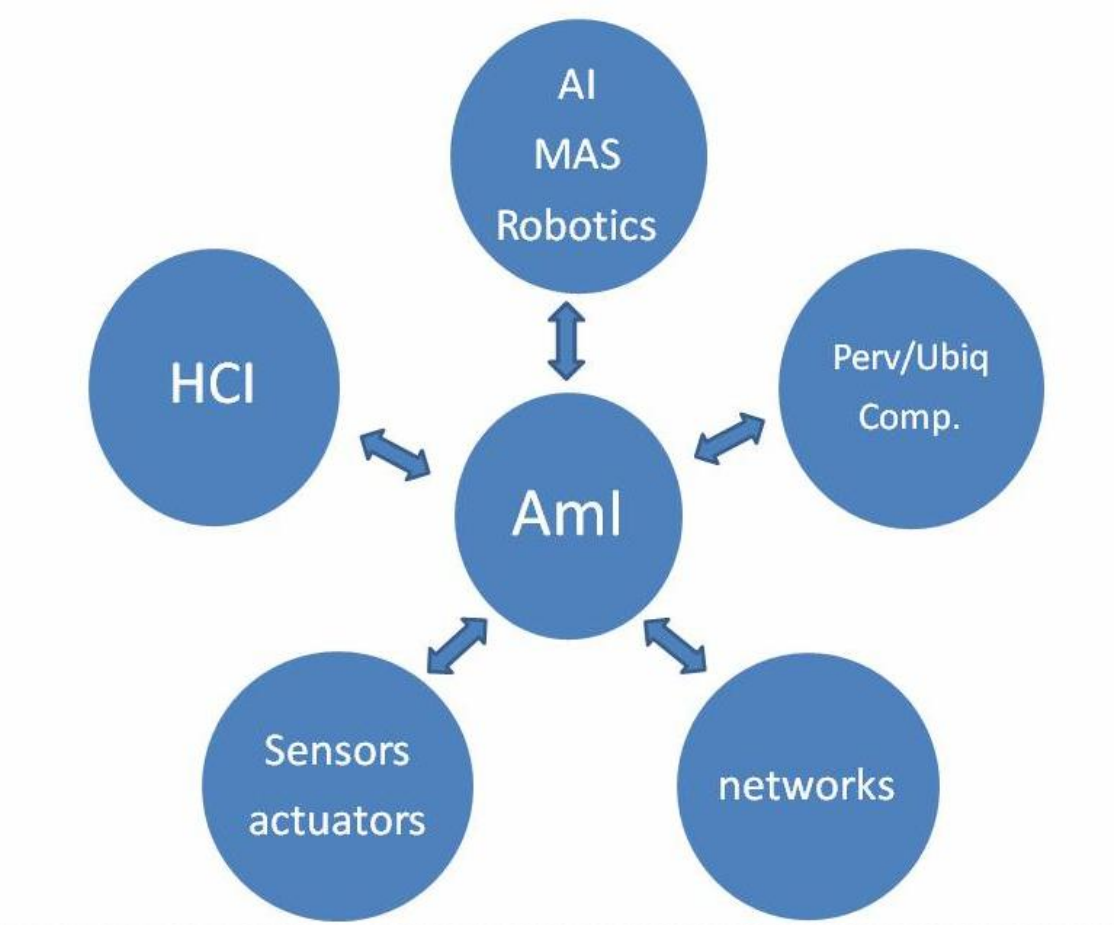
"A digital environment that proactively, but sensibly, assists people in their daily lives"

Note: 'Sensible' here includes both accurate diagnosis and timely intervention with emphasis on the users' needs and preferences.

Environment - Interactions



A Multi-disciplinary Area



Route Map

- Some basic concepts (Smart Environments and Ambient Intelligence)
- **Challenging Aspects of Smart Environments and Limitations of current AmI systems**
- AmI and CNs: Convergence and Synergies

Challenging Aspect I: Users

- Users are at the center of Intelligent Environments
- "the human is the master and the computer the slave and not the other way round" [Dertouzos2001].
- The system should be able to help people of all ages AND educational backgrounds (crucially those who do not have IT knowledge).

(Source of figure: praxis.cs.usyd.edu.au/~peterris)

A mere accumulation of technology will overwhelm users.

- Unobtrusiveness and transparency of services [Weiser1991]
- System-Oriented, (Importunate Smartness)

  vs

  People-Oriented (Empowering Smartness) [StreitzKM2007]

- Systems also have to be resilient enough to cope with:
  - users which will try to use the system in unexpected ways
  - the richness and variability of human's behaviour on a daily basis. [Satoh 2010]

Challenging Aspect II: Environments

- "*the area (physical space) that the sensors can sense*"
  - closed spaces with relatively well defined boundaries

  (e.g., houses, hospitals, classrooms, and cars)
  - open spaces which do not have well defined boundaries (e.g. streets, bridges and car parks, fields, and sea

- Usually rich, complex, unpredictable, possibly generating substantial 'noisy' data, unstructured and sometimes highly dynamic.

Challenging Aspect III: Perception

- All AmI systems are embedded in a world they have to act upon. Sensors allow the system to perceive what happens in a place without a human being necessarily being there.
- Perception is as good or bad as the sensing network
- This sensing network informs but at the same time oversimplifies reality.

A metaphor of the current state of the art is like driving on a foggy day ...

Limitations in Current Systems

- balancing preferences and needs
- mindreading
- recognizing many users
- mediating between many users
- deploying reliable systems
- ensuring ethics and privacy

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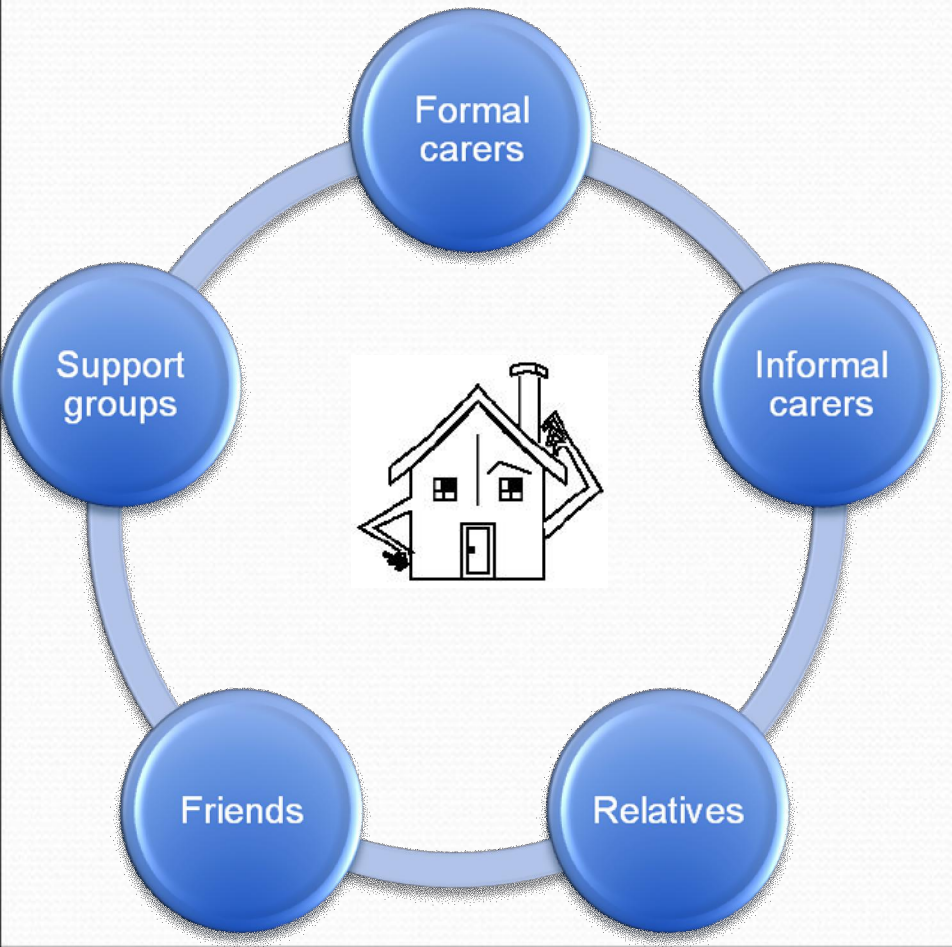
A collaborative network (CN)

...is a network consisting of a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network.

[Camarinha-Matos and Afsarmanesh, 2006]

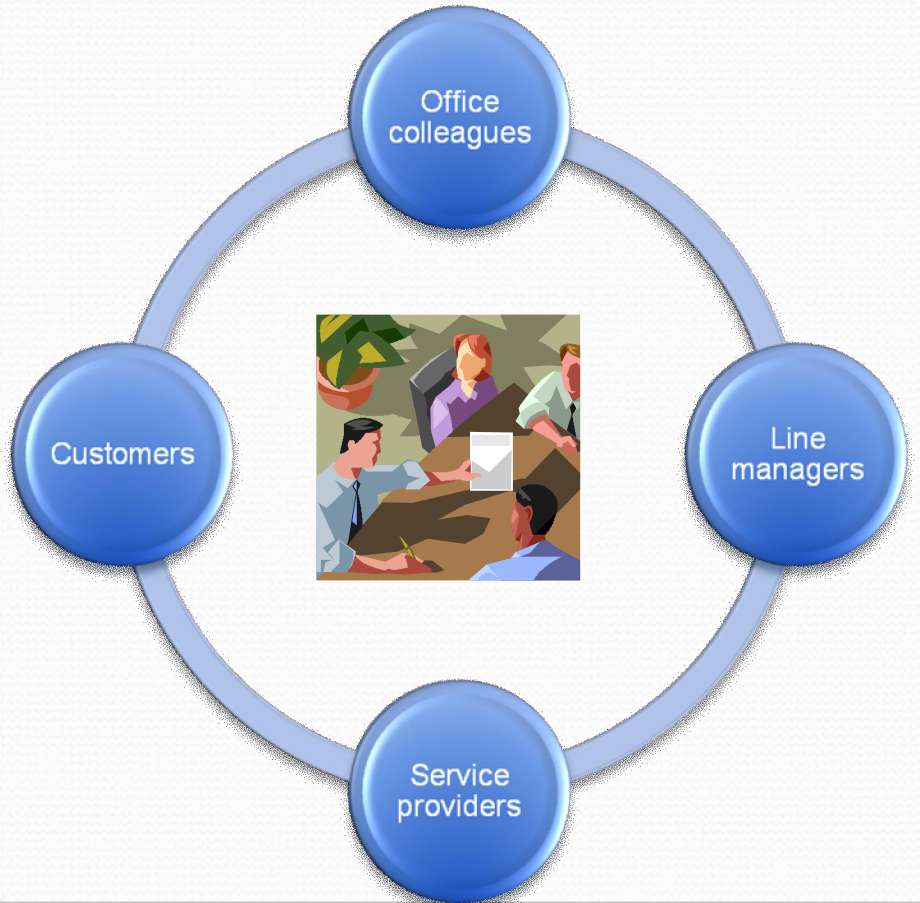
(*) CNs -Value creation in a knowledge society
In Proceedings of PROLAMAT'06 (Springer) – Shanghai, China, 2006

CNs in AAL



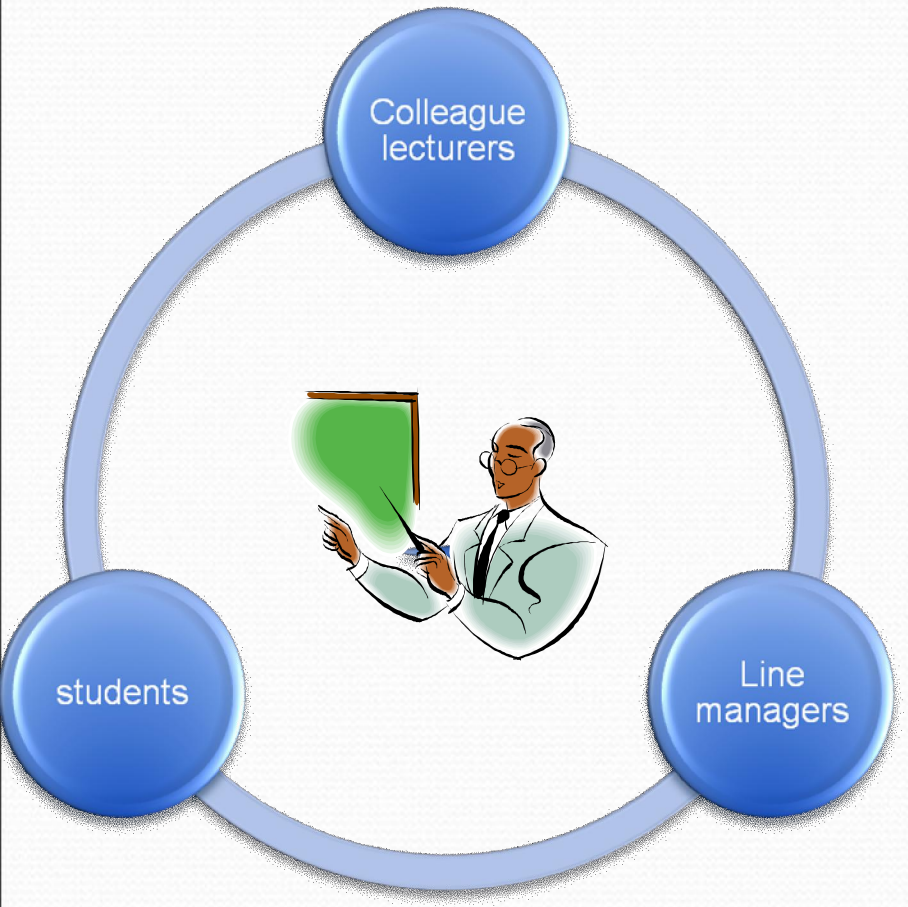
- Emphasis safety. Aimx at keeping client safe and happy.
- Circle of care can stay connected and form a Social Network (SN) which supports the CN.

CNs in Smart Offices



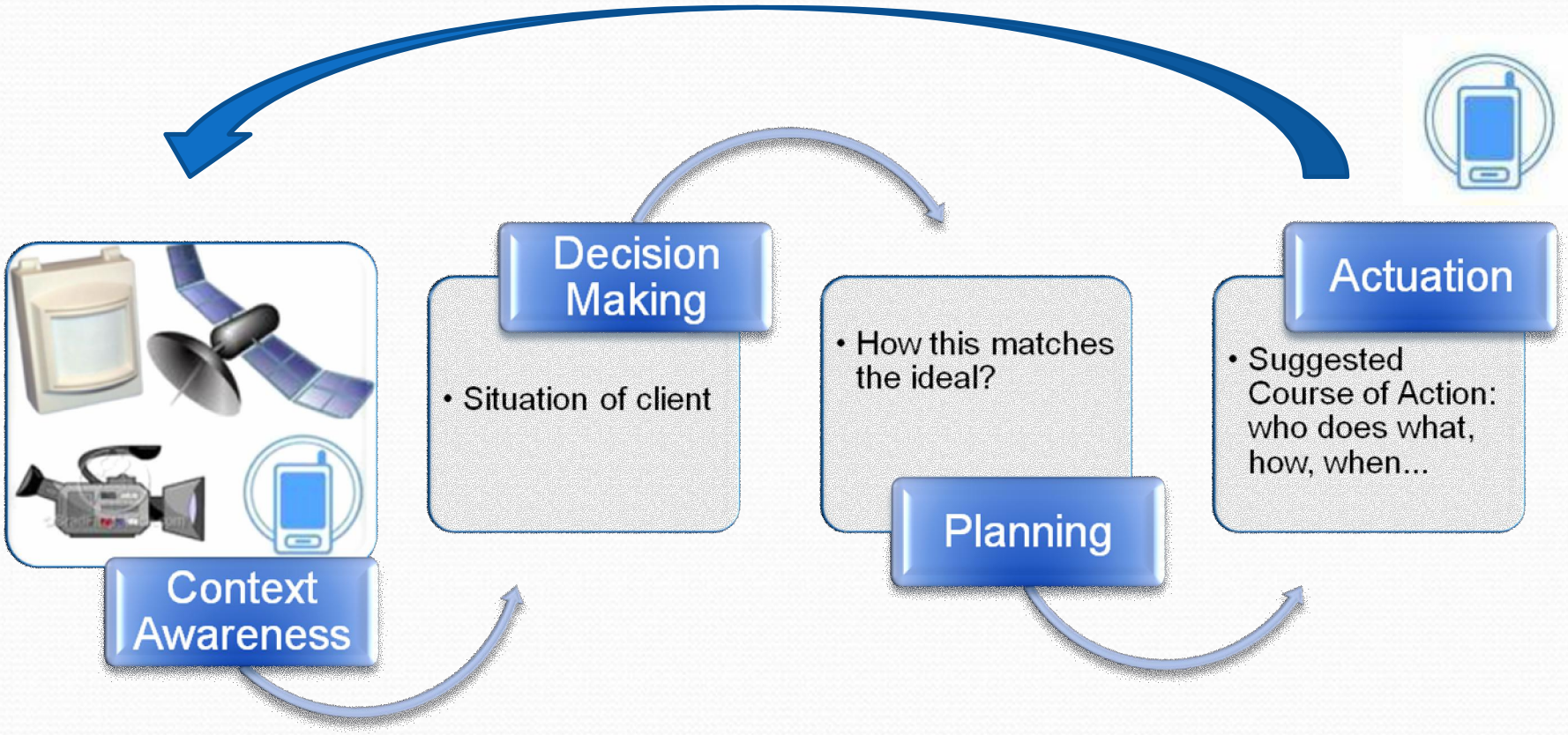
- Emphasis on Productivity. Aims at keeping team working optimizing quality/quantity whilst keeping good team spirit.
  - Strategic levels: g0od DM.
  - Executive levels: efficiency

CNs in Smart Classrooms



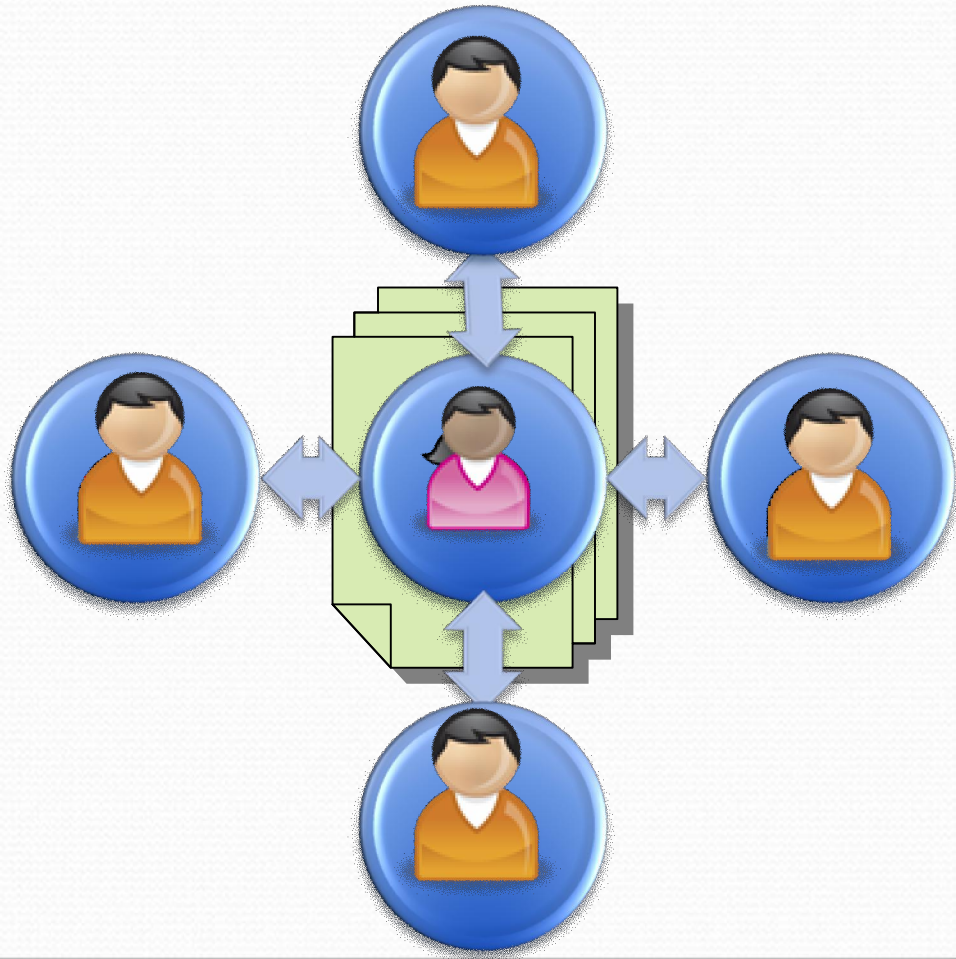
- Emphasis: Pedagogy. Aims at supporting T&L activities. Help
  - Teachers to deliver content and meaning
  - Students to learn better an enjoy experience

Overall sensing-informed process



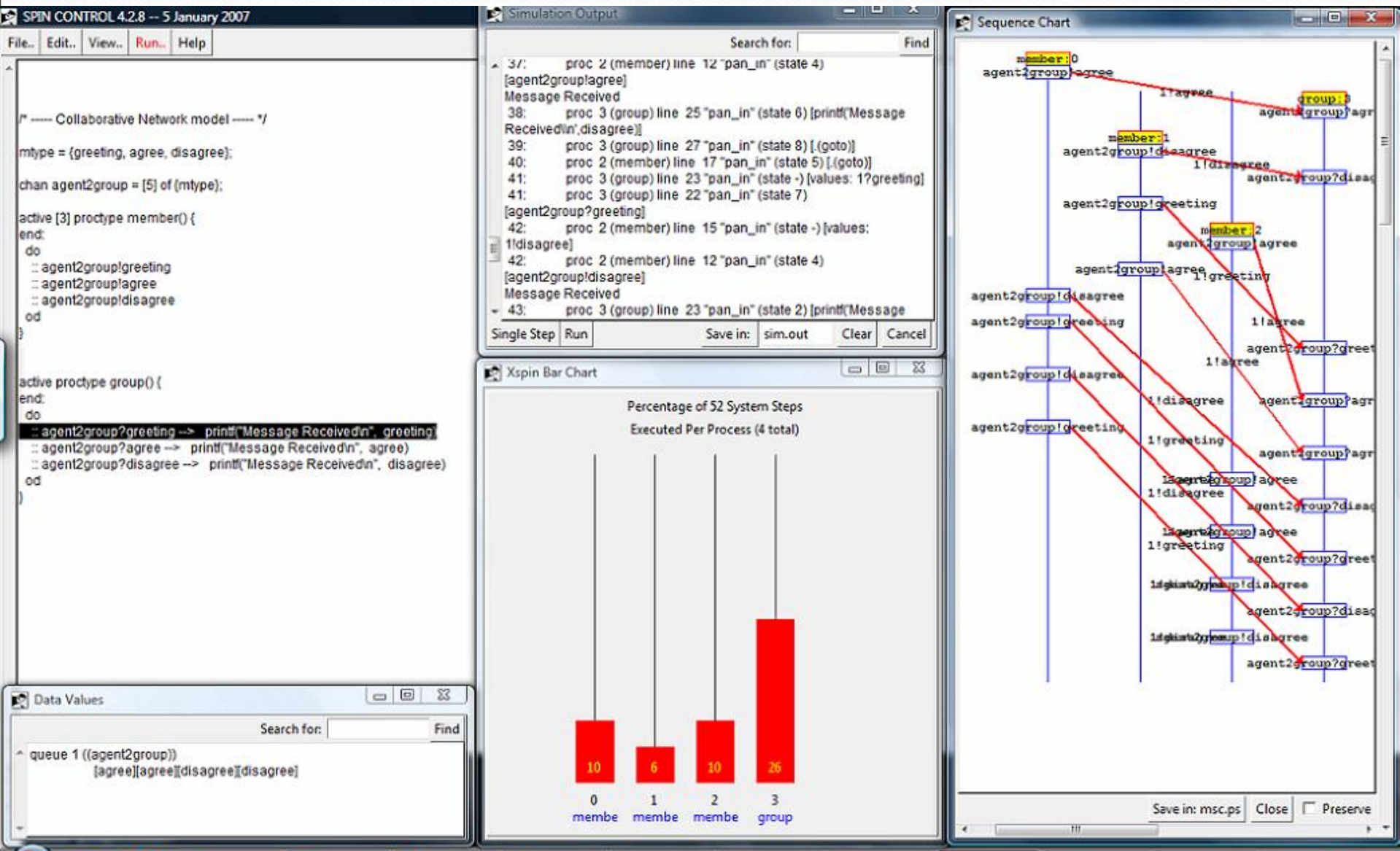
Design/Development I (MAS)

- MAS can be used to simulate and study behaviour of CNs
  - Agent A signs in to CN
  - A agrees and access shared rules of CN participation
  - A can propose modif. to rules of CN participation
  - Messages are sent
  - Coordinating agent monitors CN's achievement



Design/Development II (SPIN)

- SPIN can be used to:
  - model interactions and
  - to model whether messages can reach:
    - (the right) destination
    - In the right order
- Using SPIN has limitations (e.g. deadlines)


SPIN CONTROL 4.2.8 -- 5 January 2007
File.. Edit.. View.. Run.. Help
/* ----- Collaborative Network model ----- */
mtype = {greeting, agree, disagree};
chan agent2group = [5] of {mtype};
active [3] proctype member() {
end:
do
:: agent2group!greeting
:: agent2group!agree
:: agent2group!disagree
od
}
active proctype group() {
end:
do
:: agent2group?greeting --> printf("Message Received\n", greeting)
:: agent2group?agree --> printf("Message Received\n", agree)
:: agent2group?disagree --> printf("Message Received\n", disagree)
od
}
Simulation Output
Search for: Find
37: proc 2 (member) line 12 "pan_in" (state 4)
[agent2group!agree]
Message Received
38: proc 3 (group) line 25 "pan_in" (state 6) [printf('Message
Received\n',disagree)]
39: proc 3 (group) line 27 "pan_in" (state 8) [.(goto)]
40: proc 2 (member) line 17 "pan_in" (state 5) [.(goto)]
41: proc 3 (group) line 23 "pan_in" (state -) [values: 1?greeting]
41: proc 3 (group) line 22 "pan_in" (state 7)
[agent2group?greeting]
42: proc 2 (member) line 15 "pan_in" (state -) [values:
1!disagree]
42: proc 2 (member) line 12 "pan_in" (state 4)
[agent2group!disagree]
Message Received
43: proc 3 (group) line 23 "pan_in" (state 2) [printf('Message
Single Step Run Save in: sim.out Clear Cancel
Xspin Bar Chart
Percentage of 52 System Steps
Executed Per Process (4 total)
10
6
10
26
0 memb
1 memb
2 memb
3 group
Data Values
Search for: Find
queue 1 ((agent2group))
[agree][agree][disagree][disagree]
Sequence Chart
member:0
agent2group!agree
1!agree
group:3
member:1
agent2group!disagree
1!disagree
agent2group!greeting
member:2
1!greeting
Save in: msc.ps Close Preserve

Summary

- AmI problems with
  - Sensing and reasoning on incomplete data
  - Acceptance of technology
- CNs problems with
  - Communication
  - Agreement of goals
- May be worth exploring synergies and complementarities...
  - AmI can benefit from the cooperation of CN's humans
  - CNs can resort to AmI as an alternative source of information when conflicts arise

- **AmI to CNs:** AmI offers “Automated Real-Time and Context Aware, user-friendly assessment of dynamic inhabited spaces”

- **CNs to AmI:** Know-How to successfully build and exploit systems with collaborative components which is an important feature of many IEs (so far AmI is mostly 1 user centred; CNs can support the escalation to N users)

Questions?