Adaptive Mixed-Initiative Problem-Solving Assistants to support Collaborative Work in Flexible Organizations (light version)

Sylvie Delprat

Knowledge Engineering & Learning Systems team

EADS CCR (Corporate Research Center France)

Presentation plan

Plan

- Introduction and Context
- Former approaches and New requirements for Mixed-Initiative Assistants
- Illustration and Scenario: System Simulation
  - Identify User profile and Context
  - Recognize user goal
  - Map to related tasks
  - Suggest/revise relevant resources, Customize/launch assistant agents
- Example of Mixed-Initiative assistance process, that interleaves different assistant agents and people
- Conclusions






Introduction and Context

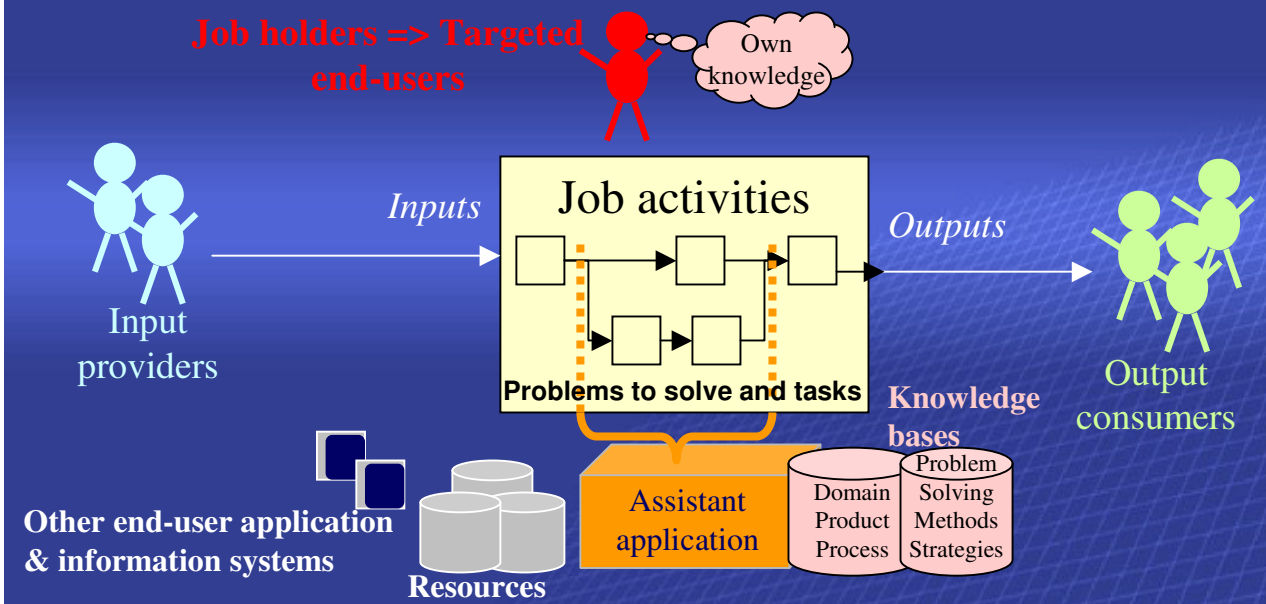
EADS challenges

- **Objective: to develop complex programs and products at the leading edge of technology**
- => need to work in transnational cooperation and to favor innovation
- => **set up dynamic and highly flexible organizations and overall business processes**

=> EADS context

- Distributed organizations
- Collaborative work, split across the partners and supply chain
- Work sharing & responsibilities of the companies/organizations differ from one program to another
- Staff turn-over on some jobs

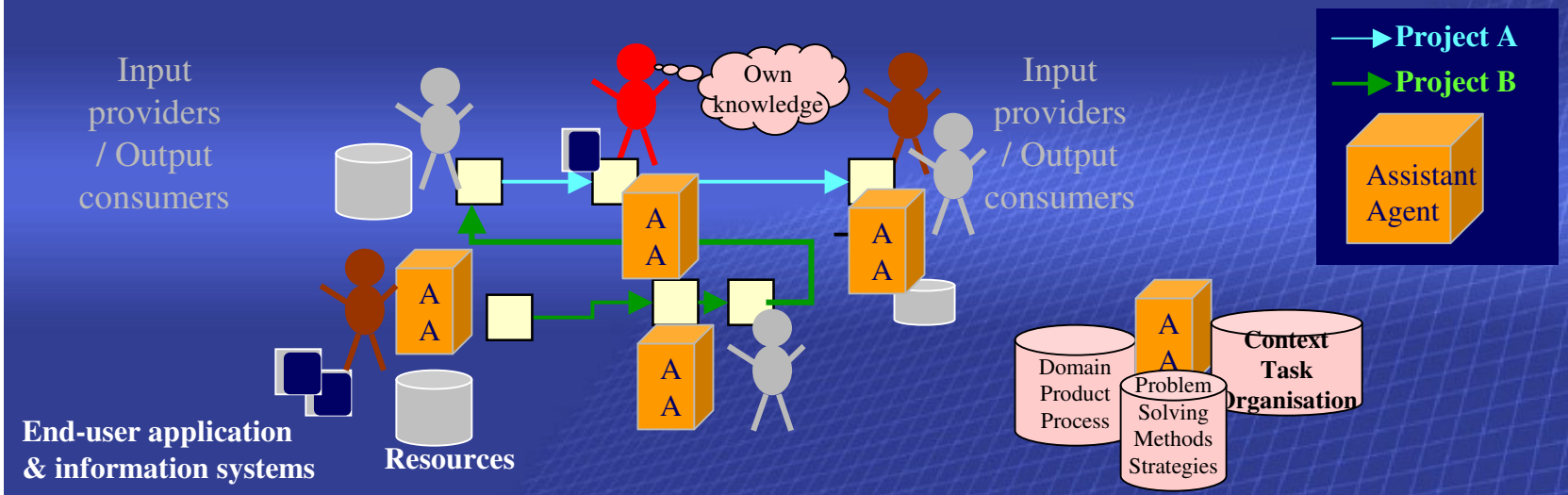
Former approaches for mixed-initiative assistants



- a **Guide & assist users. Help them to identify & solve elementary tasks**
- b **Provide dedicated user interface & workbench integrating all functions and resources**
- c **Provide users with relevant expert knowledge adapted to the experience level of each user**
- d **Exploit the best knowledge from the different (software & human) agents at each step**

=> Mixed-Initiative System

New requirements for mixed-initiative assistants



Staff know globally what they have to do and expected results
But, for a specific program, people are not always fully aware of

- surrounding context and organization (input providers, output consumers)
- information and knowledge resources
- potential useful software, abilities and behavior of their functions

Additional requirements

Be dynamic, highly modular and learn easily (they must survive organizational and staff changes)

Be adaptive to different users and to their specific role in the current process, to the context and tasks (problems to be solved)

This requires **complementary software agents**, **before being able to run mixed-initiative problem-solving assistants**:

- User and context identification
- Goal recognition & tasks mapping
- Relevant resources suggestion

Illustration & Scenario: System Simulation

System simulation

- Check aircraft systems against their functional requirements and expected performance
- Simulators may include highly approximate simulation models, as well as real equipment

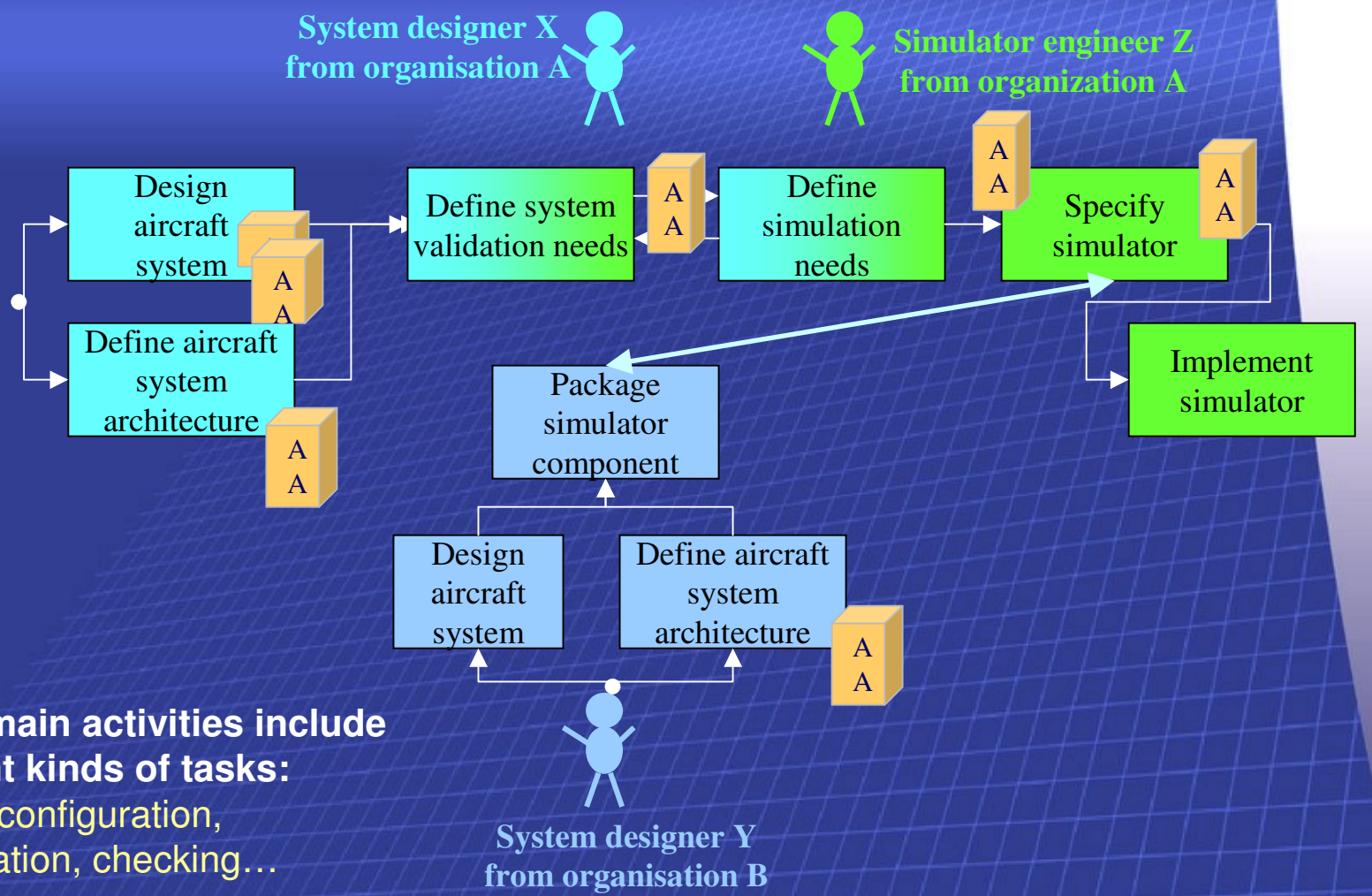
Actors

- System designers (SysDes) :
  - Design the systems and the system architecture
  - Validate the system design/implementation against the requirements
- Simulation Engineers (SimEng) :
  - Design and implement the simulator based on the validation needs
  - Provide the simulator and abilities to manage the simulation results

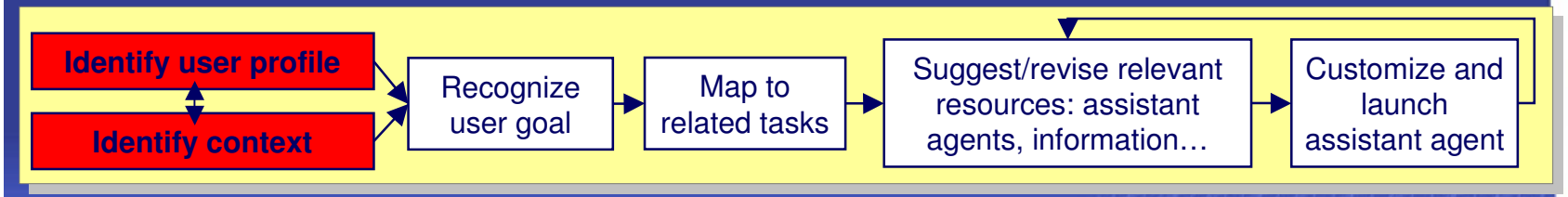
Note : For one simulator, SysDes & SimEng involved often belong to several organizations and companies

Illustration & Scenario: System Simulation

Simplified scenario for system simulation



These main activities include different kinds of tasks:
design, configuration, specification, checking…



1) Capture automatically as much information as possible
(from user identification, computer data, user actions…)

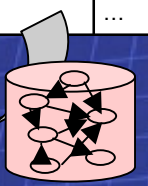
2) Analyze/consolidate the acquired information
(also with other information system –Product Lifecycle Management systems-)

3) Infer and complete the description
(by exploiting knowledge
-on organization, programs, activities…-
and by querying the user)

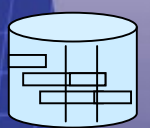
User	
Logon	5509000
Name	Bernard
Company	CieX
Department	Hydraulics
Location	Toulouse (FR)

Context	
Program	A301
Organization	SupplyChain2
Role	System Designer (PC)
Domain	System design
Sub-domain	Hydraulics system design
Development phase	M5..M8
…	…

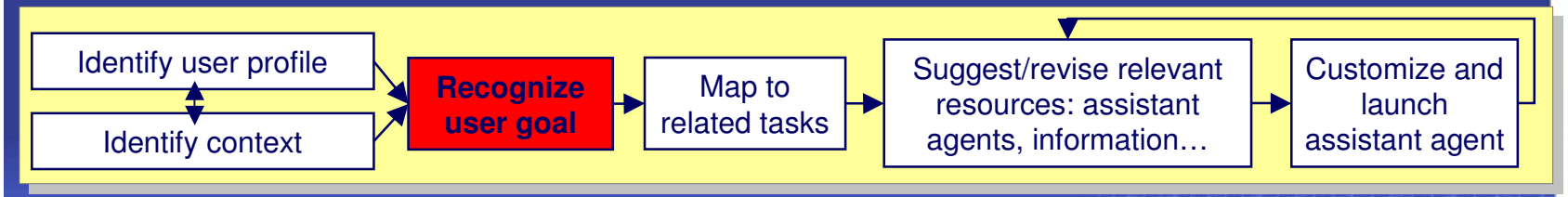
Context	
Program	??
Organization	??
Role	??
Domain	??
Sub-domain	??
Development phase	??
…	…



Knowledge model on organization



Information on the program progress (PLM)



1) Synthesize known information on user goal
(from user identification, computer data and user actions…)

2) Characterize/generalize the current goal idea

3) Ask user some questions to refine the goal description

4) Compare to « known » goals
(described or learnt from past experiences)

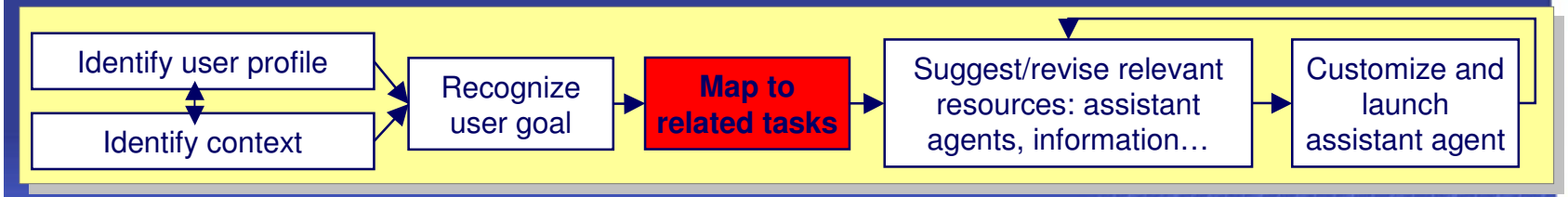
Pattern for current goal recognition	
.....	...
Role	System Designer (PC)
Domain	System design
Sub-domain	Hydraulics system design
Products involved	?? E.D.P. pump
Dev. phase	M5..M8
User actions	• Open simulation requirement template

IR AA

In this list of hydraulic systems, which are the products involved ?

Known goal	
Role	System Designer
Domain	System design
Sub-domain	Hydraulics system design
Products involved	System || Equipment
Dev. phase	M5..M8
User actions	• Open Cax software
Id goal	**Design hydraulics system X**

Known goal	
Role	System Designer
Domain	System design
Sub-domain	Any
Products involved	Aircraft ||System || Equipment
Dev. phase	M3..M18
User actions	• Open simulation requirement template || •access simulation portal
Id goal	**Validate system(s)**



1) Suggest a list of potential related tasks

2) User selects the tasks of interest

Some major difficulties are:

a) Often no immediate relation between:
- the goal (e.g. validate a system),
- the business tasks (e.g. specify validation needs),
- the generic elementary tasks (e.g. write specifications, design a solution)

b) Learning from experience: what are the generic tasks? In which context is still applicable? What can be similar contexts? …

c) Describing (enough generic) goal and tasks
(to be adapted to different organisations, companies and programs)

Known goal	
Role	System Designer
Domain	System design
Sub-domain	Hydraulics system design
Products involved	System || Equipment
Dev. phase	M5..M8
User actions	• Open Cax software
Id goal	Design hydraulics system X

IR AA

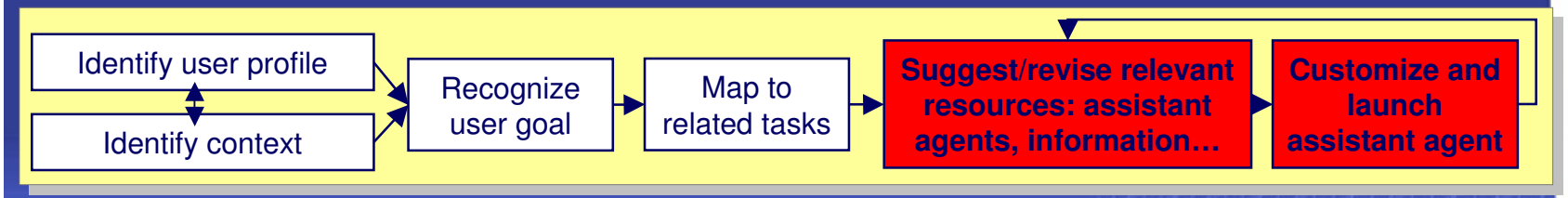
Goal: Design hydraulics system X	
Available assistants agents	❑ System architecture design ❑ Generate pump specifications

Known goal	
Role	System Designer
Domain	System design
Sub-domain	Any
Products involved	Aircraft ||System || Equipment
Dev. phase	M3..M18
User actions	• Open simulation requirement template || •access simulation portal
Id goal	Validate system(s)

User selection

IR AA

Goal: Validate system(s)	
Available assistants agents	❑ Specify validation needs ❑ Run simulator ❑ Analyse simulation results



1) Identify resources relevant to the user according to his goal and context
   (selected tasks)

2) Suggest/revise relevant resources
   (information, knowledge, software tools, **assistant agents**)

3) Customize and launch assistant agents
   Customizations may be related to the user interface, granularity, knowledge to be applied, expected outputs, IPR policy (white/black box)

Some major difficulties are:

c) All this process should be as transparent as possible. The challenge is to provide the most complete assistance without becoming too intrusive, laborious or annoying

d) In most of the cases, several assistant agents are required and they are interleaved

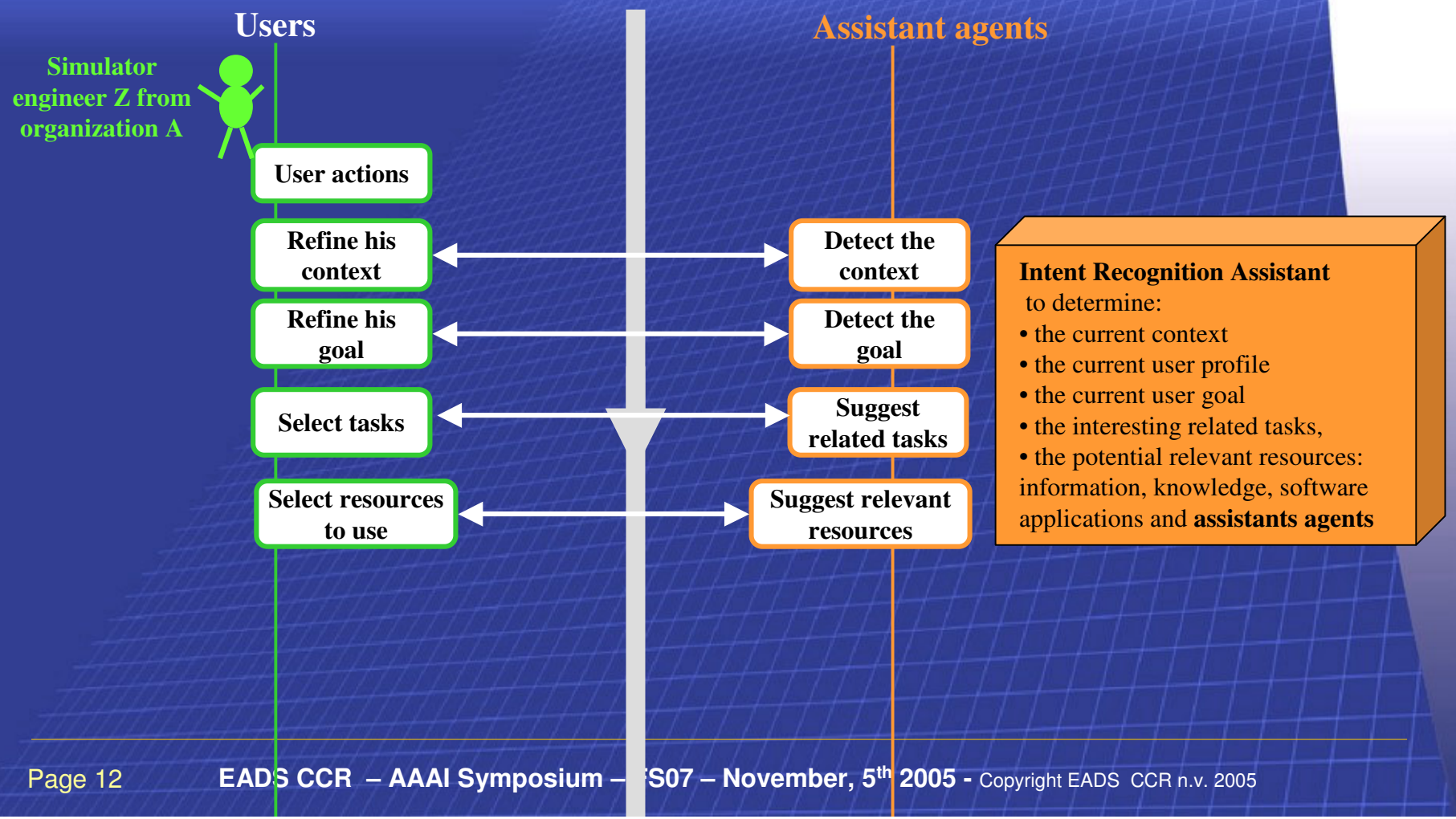
e) Often, several people are required and they may belong to different organizations. This leads to run the complete process with different timescales and with different problem solving processes in parallel

(first targeted user has selected his assistant agent, but this latter may require some actions from an other person, that is not immediately available… and later this second person may be assisted by an other agent…)

Example of Mixed-Initiative assistance process, that interleaves different assistant agents and people

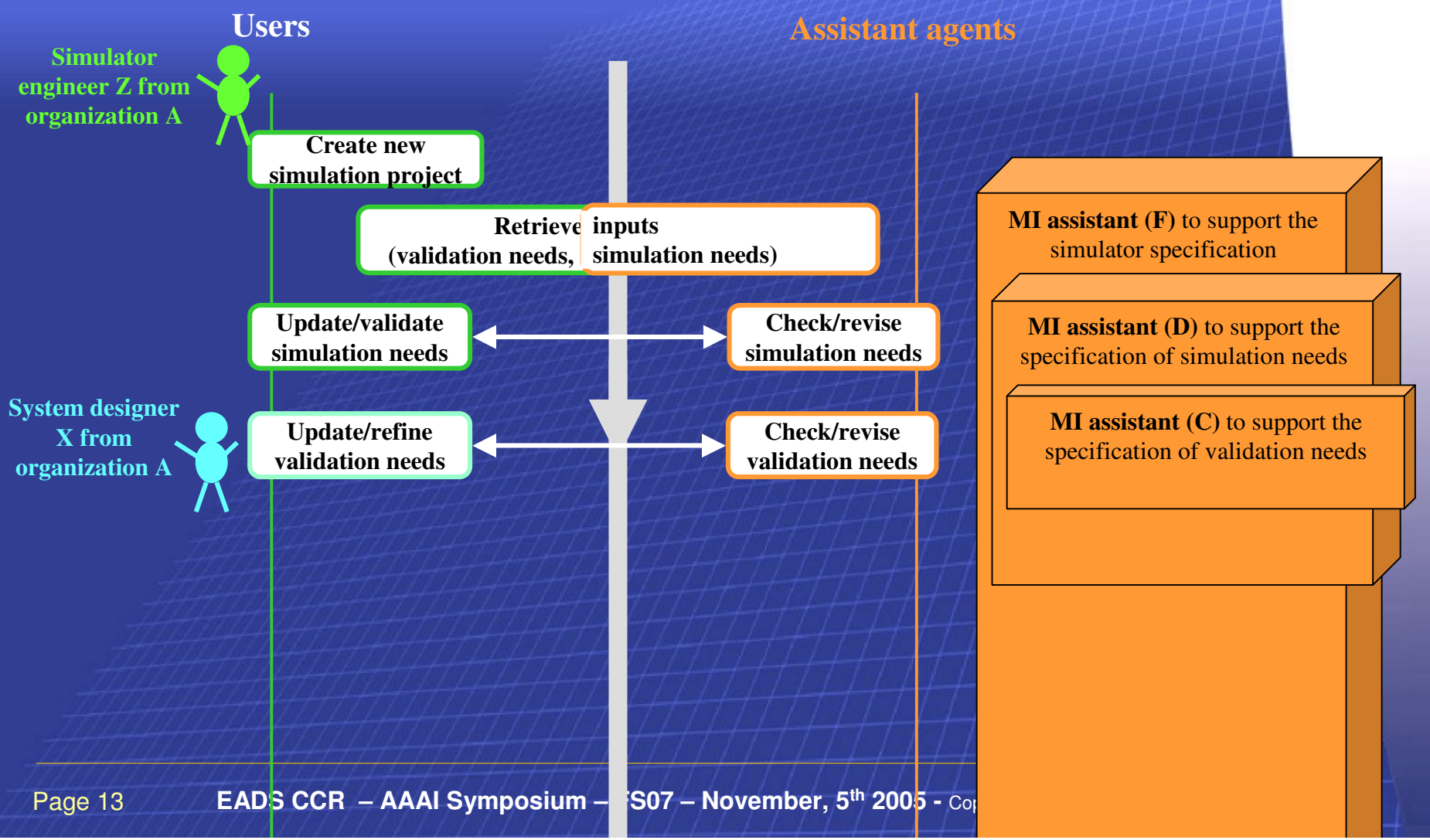
Example of goal "Specify simulator to answer the validation needs ABC"

Part 1: goal recognition, access to resources relevant to context & user profile



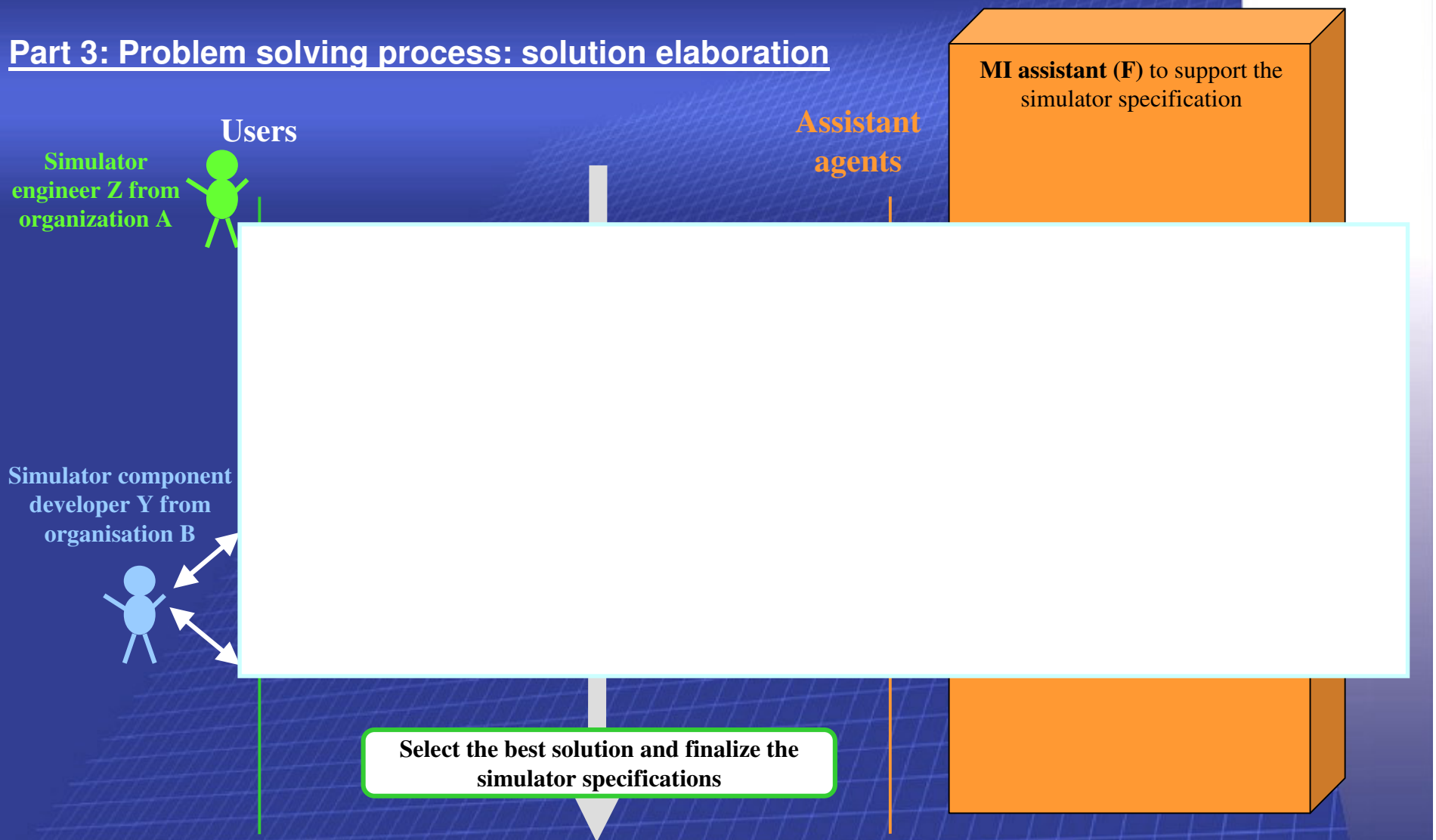
Example of Mixed-Initiative assistance process, that interleaves different assistant agents and people

Part 2: Problem solving process: query elaboration phase/problem description



Example of Mixed-Initiative assistance process, that interleaves different assistant agents and people

Part 3: Problem solving process: solution elaboration



Conclusion

To cope with the on-going context evolution (collaborative work in flexible organizations), MI assistants must change from some local applications to numerous light assistant agents,

that:

- **may be integrated in flexible manner in different organizations /contexts**
- **provide dynamically relevant assistance**
- **interact with several users to solve a problem**

The global vision of what we need has been presented here,

- **we have some of the components or mechanisms**

but

- **most of the remaining issues are current concerns of research community**
- **there are still many complex issues**

(notably: context recognition, goal recognition, interactions with multiple agents and users, distributed problem-solving assistants, shared ontologies and knowledge bases, adaptive task-oriented user interfaces, knowledge capture and learning without being intrusive for the user, dynamic assistance without being annoying…)

