

特別講演：

Using Scenarios to Specify an Air Traffic Control System

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Using Scenarios to Specify an Air Traffic Control System

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Contents

The project

- EU Framework IV CREWS-SAVRE prototype
- Eurocontrol's CORA-2 project
- How CREWS-SAVRE works

CREWS-SAVRE in CORA-2

- Use cases written, scenarios walked through
- Some research hypotheses

Results

- Preliminary quantitative and qualitative results
- Exploring some research hypotheses

Conclusions and future work

- Follow-on implementation, new processes and tools

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Scenario-Driven CREWS-SAVRE

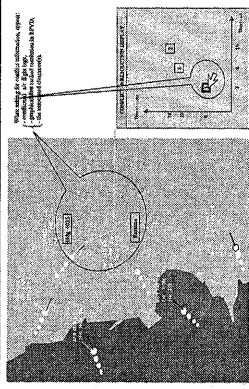
- Process and software generation and work

CORA-2: Conflict Resolution

- Automatic support
- Specification of operational technical system

CREWS-SAVRE at

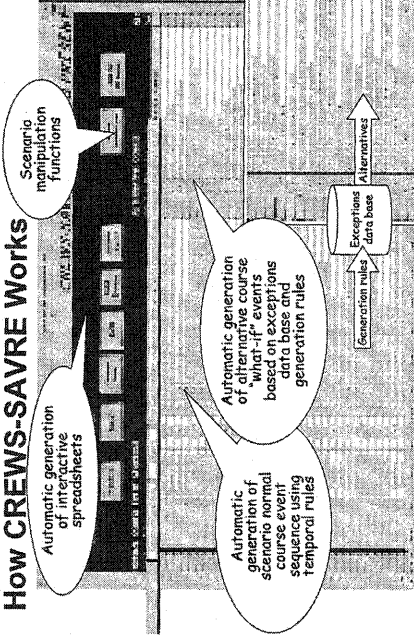
- Cornerstone of complete scenario-driven requirements engineering process implemented in Eurocontrol
- *in* agent dependency and goal modelling, creative design workshops, VOLERE-based requirements management with Requisite Pro, human activity modelling, scenario-based impact analyses



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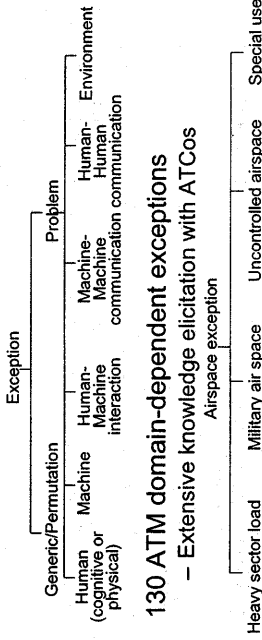
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How CREWS-SAVRE Works



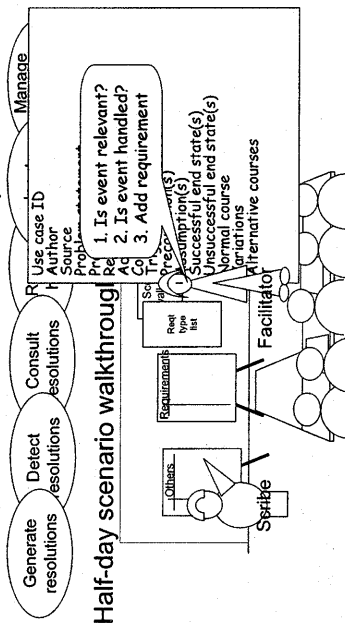
Generating Alternative Courses

Rule-based retrieval from exception class data base
 - IF action/object type THEN generate WHAT-IF questions based on exception class data base
 40 domain-independent (generic) exceptions



Using CORA-2 Scenarios

Scenario generation from use case specifications



Method and Hypotheses

Investigated variables included
 - Number and type of requirements generated
 - Triggering scenario events of each requirement
 Data capture methods
 - Critical incident observations, team member interviews, participant questionnaires, scenario and requirement artefacts, traceability links
 Some hypotheses
 - H1: CREWS-SAVRE leads to generation of more requirements in same time period that use of brainstorming, focus group and interviewing techniques
 - H7: Walking through domain-specific scenarios will generate more requirements than domain-independent scenarios

Results: The Basics

Successful walkthroughs
 - Half-day walkthroughs of 10 scenarios with key stakeholders over 3-week period from Nov-Dec 2001
 • Total 254 normal course events, 3000+ alternative courses
 - Effective process for discovering new requirements
 • Led to 189 new requirements on top of original 249, kept 134
 • New requirements tended to more fine-grained and complete
 - Follow-on questionnaires to all stakeholders

	Av	Low	High	Comments
How well do you understand this techniques?	5.9	5	6	Some alternatives difficult to understand
How easy was it to discover requirements?	5.2	4	6	Exhaustive elicitation process
How well do you believe did the tool support you in discovering requirements	4.8	2	7	Very impressed Problems with alternatives

Results: Follow-Up Interviews

CREWS-SAVRE Strengths

- ☑ Walkthrough requirements tended to be more complete, stable and testable, with rationale
 - ☑ Walkthrough process acquired both coarse- and fine-grain requirements
 - ☑ Scenarios provided common ground for discussion
 - ☑ Scenarios imposed the use of the project glossary
- ### CREWS-SAVRE Weaknesses
- ☐ Skip events when requirements already known
 - ☐ Stakeholders disagreed with some high-level design decisions taken into account when writing scenarios
 - ☐ Some requirements were linked to multiple events in multiple scenarios
 - ☐ Usability problems - scrolling, cell width, navigation

Results: Cost-Effectiveness

Were walkthroughs cost-effective?

- H1: CREWS-SAVRE walkthroughs lead to the generation of more requirements in the same time period than other requirements acquisition techniques

	Before walkthrough	During walkthrough
Duration	10 months	3 weeks
New reqs	247	134
Reqts per week	6	45

- Walkthroughs led to more testable requirements that often replaced less adequate requirements from other acquisition techniques - Facilitators
- Planning further qualitative analysis
 - Blind expert judgement of randomly-selected requirements from scenario walkthroughs and other techniques

Where Requirements Came From

Was domain-specialisation effective?

- H7: Walking through domain-specific scenarios will generate more requirements than domain-independent scenarios
- Paired t-test on scenarios $p < 0.002$, refute hypothesis H7
- Stated possible reasons include poor expression of some domain-specific alternative courses

Event type	Normal	Generic alternative	Domain alternative	All types
No. of requirements	51	79	4	2

Alternative course	Total in scenarios	%age of total in scenarios
Generic	2404	78.8
Domain-specific	646	21.2

Where Requirements Came From

Exploring normal course events

- All requirements linked to a normal course event
- Cross-tab analysis indicates variable independence
- Strong focus on human-machine interaction and functional requirements in scenarios
- Facilitation guidelines strongly influence resulting requirement types and triggering events

Action type	Normal	Generic Alternative	Domain Alternative	All Unknown
Commun.	16	31	0	0
Cognitive	0	0	0	0
Complex	0	0	0	0
System	35	40	4	2
Total	51	71	4	2

Taking the Process Forward

Overall results

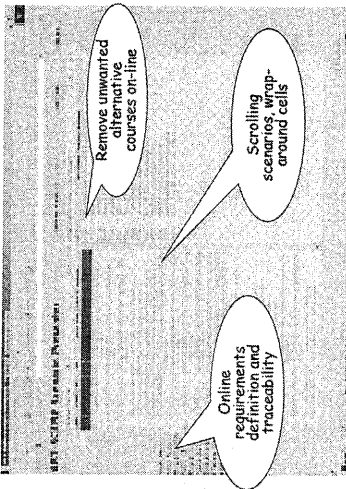
- ▣ CREWS-SAVRE walkthroughs were central element of scenario-driven requirements engineering process
- ▣ Sufficient for follow-on contracts to support 3 further Eurocontrol projects using an improved process

Improving the process

- ▣ More cost-effective scenario generation
- ▣ Scenarios can be edited during walkthroughs
- ▣ More widespread adoption of use cases and scenarios, to make design decisions more explicit, and to provide common ground during workshops
- ▣ More effective scenario-requirement linkage
- ▣ A more usable scenario walkthrough tool

The New Scenario Presenter

Web-based access to CREWS-SAVRE scenarios



Process in Research Context

Wider research activities

- CORA-2 requirements engineering process exploits results from research initiative into scenario-driven systems integration
 - EPSRC SII-funded SIMP project, Dstl-funded scenario-based goal modelling, Eurocontrol-funded follow-on projects
- Prototype ART-SCENE environment delivering new processes and tools

