An Architecture for Simulated and Monitored Continuous Training for improving Operators Performance and Experience

Application to the New Launcher Tracking & Flight Safety Operations Centre at Europe's Spaceport, French Guiana

Sandra STEERE, Frédéric MANON, Jean-Noel HOURCASTAGNOU, **Joël EGALGI** (CNES)
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Presentation outline

What's new at Europe's Spaceport, CSG in French Guiana

CSG-NG objectives : 6 components to modernize the launch base

New concepts : Simulation based training concepts going beyond state of the art

Applied methodology to the CSG-NG new operations centre (the CDO)

The CSG – New Generation main objectives

- Cost reduction
- Greening
- Modern
- Robustness
- More flexible
- New services

2020 – 2026

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The CSG – New Generation : 6 components

CSG NG
Nouvelle Génération
New Generation

CLIENTS (Satellite clients, launch operators …)

Guiana Space Centre – **NG**

The new **OPERATIONAL HEARTBEAT** of the European Spaceport

CDO

New systems, new building

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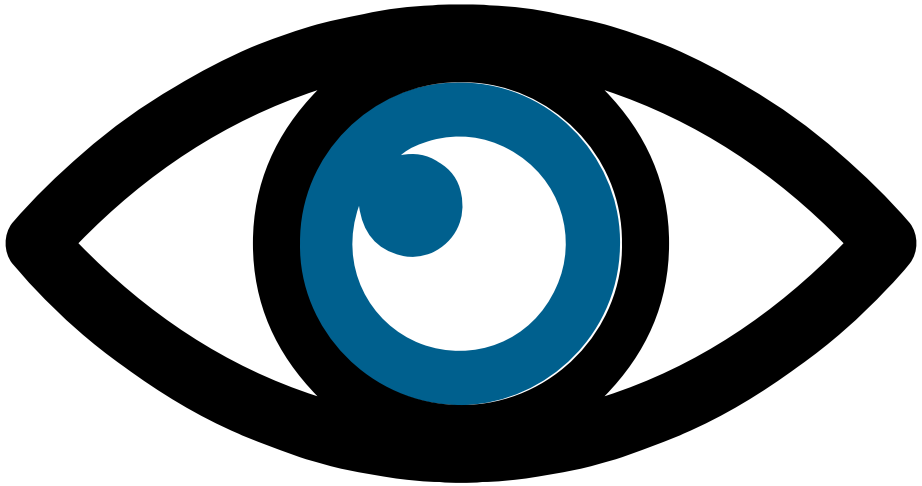
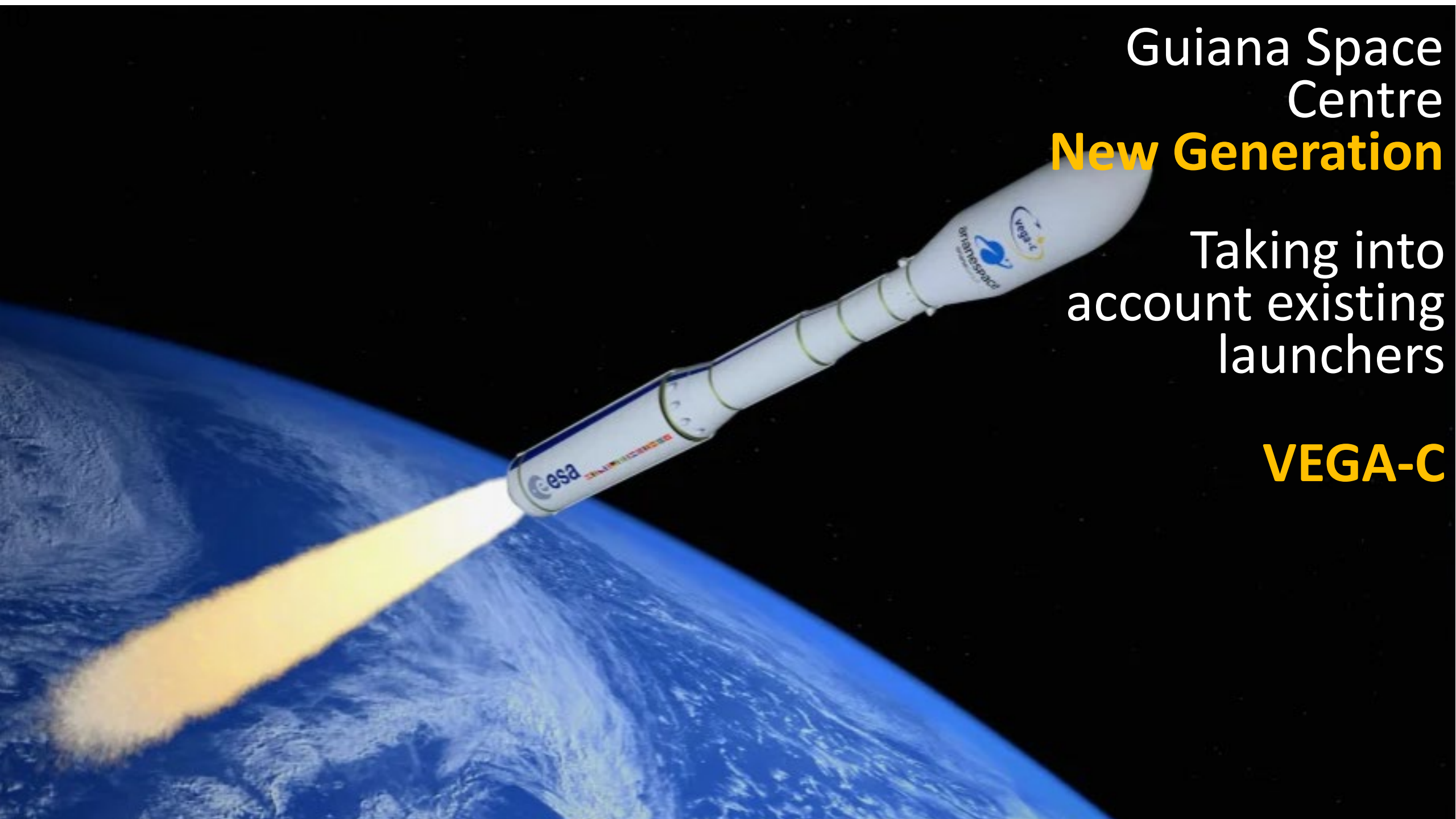
European Spaceport **New Generation**



MODERNIZING
THE EUROPEAN SPACEPORT

FIRST
MAJOR UPHAUL

FIRST STEP IN THE IMPROVEMENT OF THE EUROPEAN SPACEPORT



Guiana Space Centre

New Generation

Taking into account existing launchers

VEGA-C

Guiana Space Centre

New Generation

Preparing for new launch operations

ARIANE-6

Guiana Space Centre

New Generation

Preparing for new operational concepts

CALLISTO

Guiana Space Centre

New Generation

Preparing for new launch operators

SPACE RIDER

The CDO – The New operations centre

Big drivers

Reducing human errors, saving time

Automation

Operational efficiency

Operational flexibility

Virtualization

Parallelization & Flexibility

Exploitation & maintenance cost reduction

Genericity

Versatile means & human resources

Designed for new launchers, new launch operators, Space rider

Scalability

New missions & new services

Shared & redundant software & infrastructure means

Renewal & redundancy

Availability & resilience

Multiple optimizations

Cost reduction !

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The CDO – The New operations centre –training needs

Big drivers

Reducing human errors, saving time

Automation

Operational efficiency

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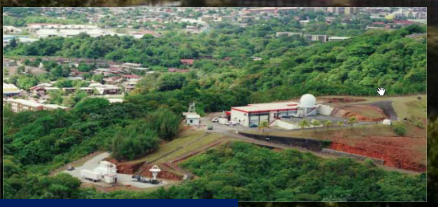
The CDO & its external environment

Telemetry, Location, Remote monitoring, Remote operation, Remote control, Videos

LAUNCHER

CINETELESCOPE

FLIGHT TERMINATION STATION



RADARS

TM STATIONS

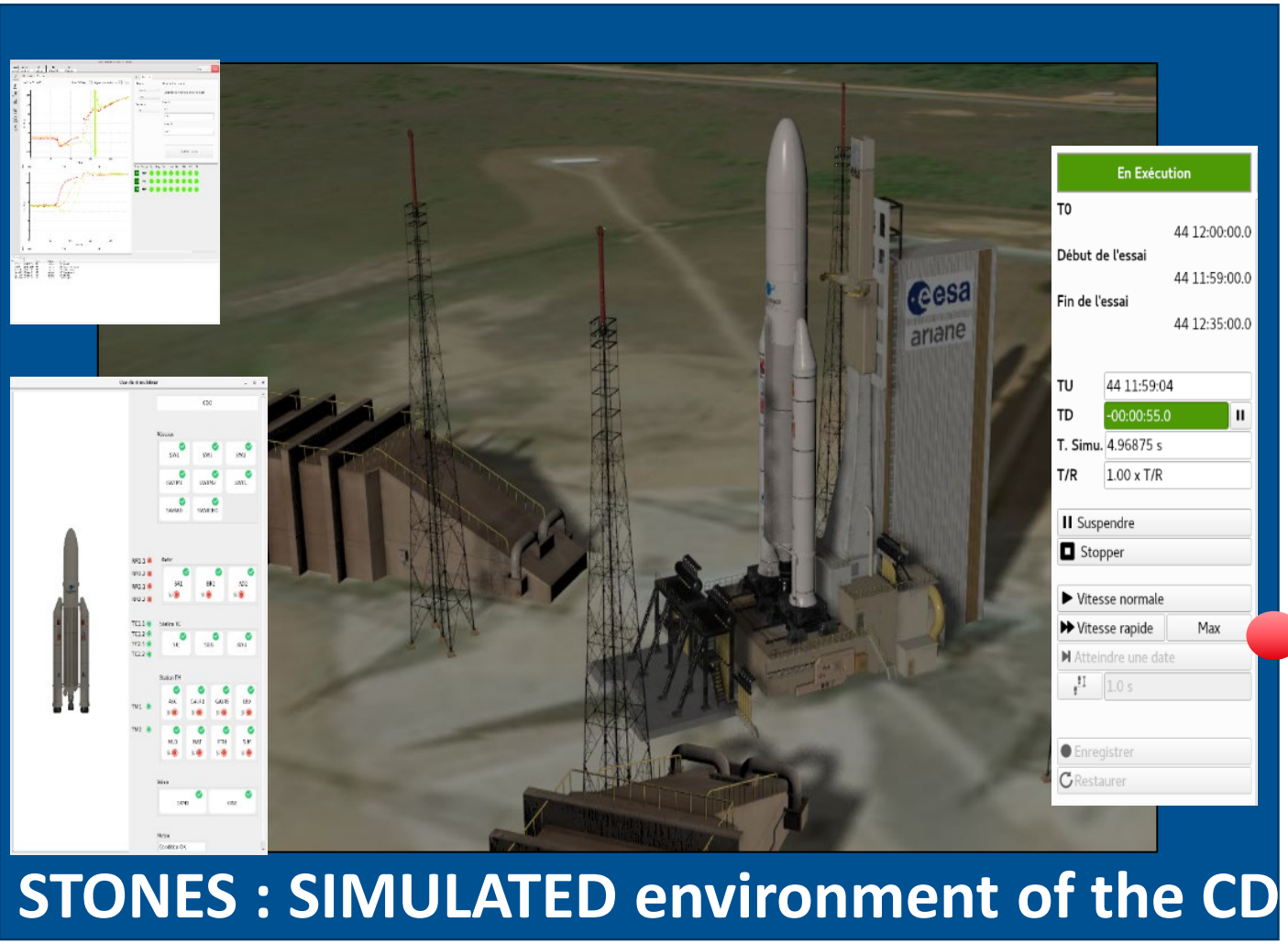
Real CDO environment

CDO building

CDO BLA control room

The CDO – STONES : Simulator Training Operations Numerical Environment System

Telemetry, Location, Remote monitoring, Remote operation, Remote control, Videos



STONES : SIMULATED environment of the CD

CDO building

CDO BLA control room

The first developments of the CDO BLA

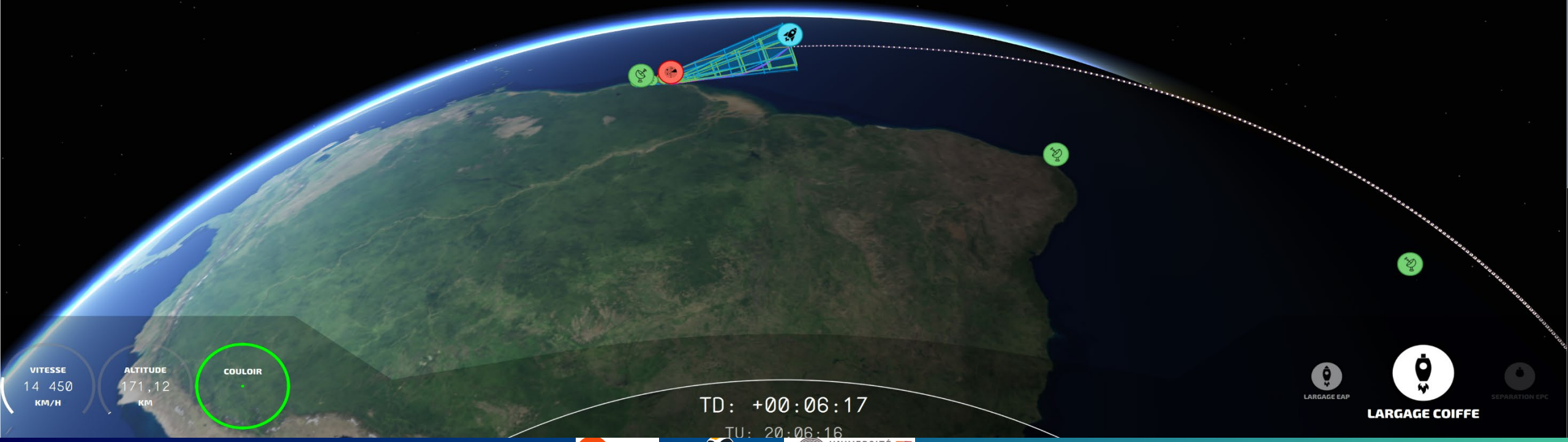
Simulator : STONES

- ✓ Train the ground systems operational teams
- ✓ Develop & test operational procedures
- ✓ Qualify the ground system (factory and on-site)
- ✓ Test the ground system flight configuration for each new launch
- ✓ Replay launch sequences post-flight for anomaly analysis
- ✓ Reduce the human & physical resources by automating tests & optimizing the preparation of the tests

The first developments of the CDO BLA

Simulator : STONES

- High precision 3D views
- Simulation means for mission analysis, training & validating new software
- Operational Excellence → Training !



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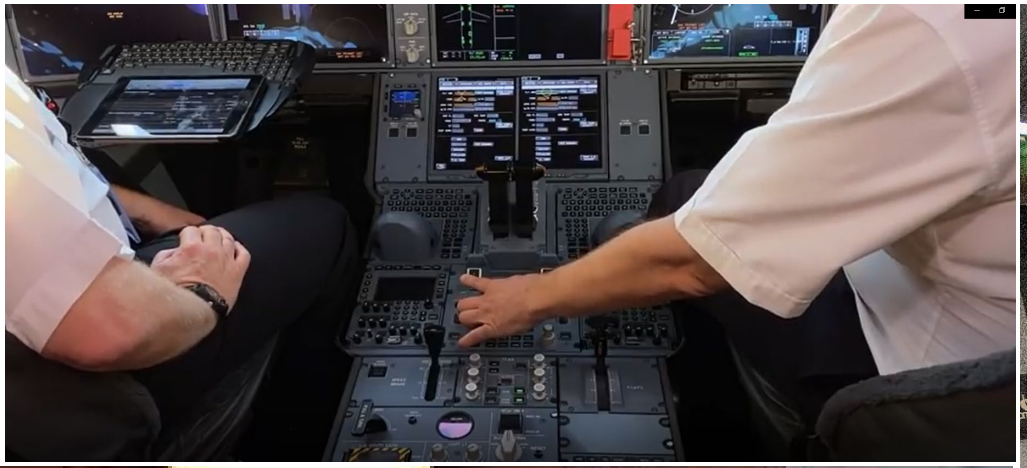
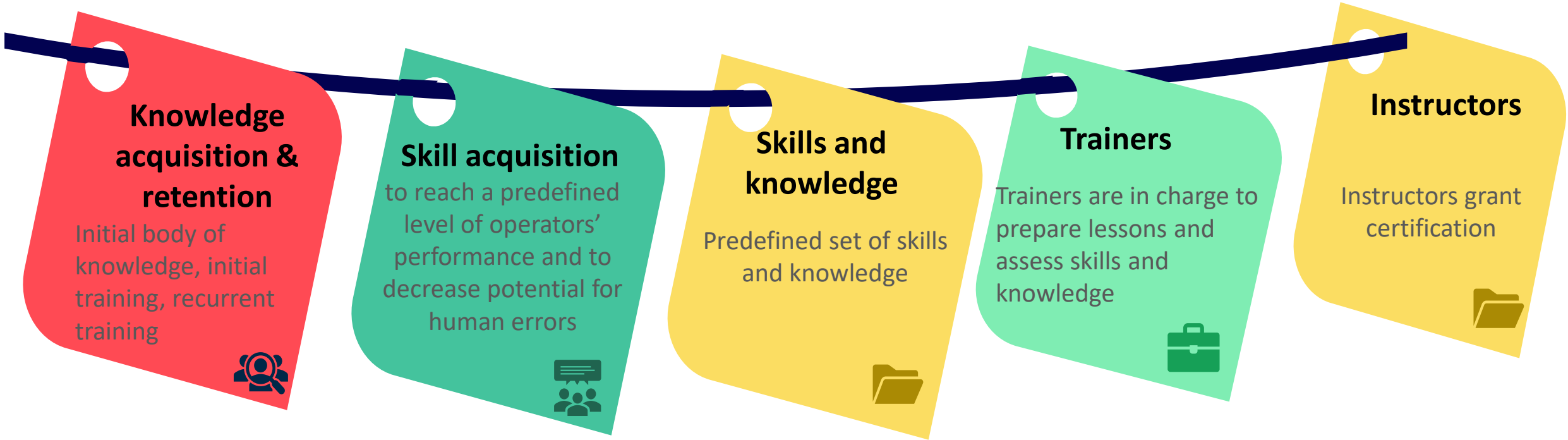
Applied methodology to the CSG-NG new operations centre (the CDO)

Training operators of interactive critical systems



Training operators of complex interactive critical systems



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Salas, E., Cannon-Bowers, J. (2001). **The Science of Training: A Decade of Progress**. Annual Review of Psychology, 471-499.

Salas, E., Tannenbaum, S., Kraiger, K., & Smith-Jentsch, K. (2012). **The Science of Training and Development in Organizations: What Matters in Practice**. Psychological Science in the Public Interest, 13(2), 74-101.

Example of training requirements (1/2)

1. Main goal / Objective: Operator's high level tasks
2. Practical training settings
   - Training equipment
   - Instructor to acknowledge tasks completed
3. Rating - examiner to validate test completion

	PRACTICAL TRAINING					ATPL/[MPL/]TYPE-RATING SKILL TEST/PROF CHECK	
Manoeuvres/Procedures (including Multi-Crew Cooperation)	OTD	FTD	FS	A	Instructor's initials when training completed	Chkd in FS A	Examiner's initials when test completed
SECTION 1							
1 Flight preparation							
1.1 Performance calculation	P						
1.2 Aeroplane ext. visual inspect.; location of each item and purpose of inspection	[P#]			P			
1.3 Cockpit inspection		P					
1.4 Use of checklist prior to starting engines, starting procedures, radio and navigation equipment check, selection and setting of navigation and communication frequencies	P----->	----->	----->	----->		M	
1.5 Taxiing in compliance with air traffic control or instructions of instructor			P----->	----->			
1.6 Before take-off checks		P----->	----->	----->		M	
ke offs with ngs, including			P----->	----->			
take-off; ment flight is rotation or coming airborne			P----->	----->			
2.3 Cross wind take-off (A, if practicable)			P----->	----->			
2.4 Take-off at maximum take-off mass (actual or simulated maximum take-off mass)			P----->	----->			
2.5 Take-offs with simulated engine failure 2.5.1* shortly after reaching V_2,			P----->	----->			

1.4 Use of checklist prior to starting engines, starting procedures, radio and navigation equipment check, selection and setting of navigation and communication frequencies	P----->	----->	----->	----->		M	

References

Joint Aviation Authorities (2006). JAR - FCL 1 - Flight Crew Licensing (Aeroplane).

Example of training requirements (2/2)

	PRACTICAL TRAINING					ATPL/[MPL/]TYPE-RATING SKILL TEST/PROF CHECK	
Manoeuvres/Procedures (including Multi-Crew Cooperation)	OTD	FTD	FS	A	Instructor's initials when training completed	Chkd in FS A	Examiner's initials when test completed
SECTION 1							
1 Flight preparation							
1.3 Cockpit inspection		P					
1.4 Use of checklist prior to starting engines, starting procedures, radio and navigation equipment check, selection and setting of navigation and communication frequencies	P----->	----->	----->	----->		M	

Where is training taking place

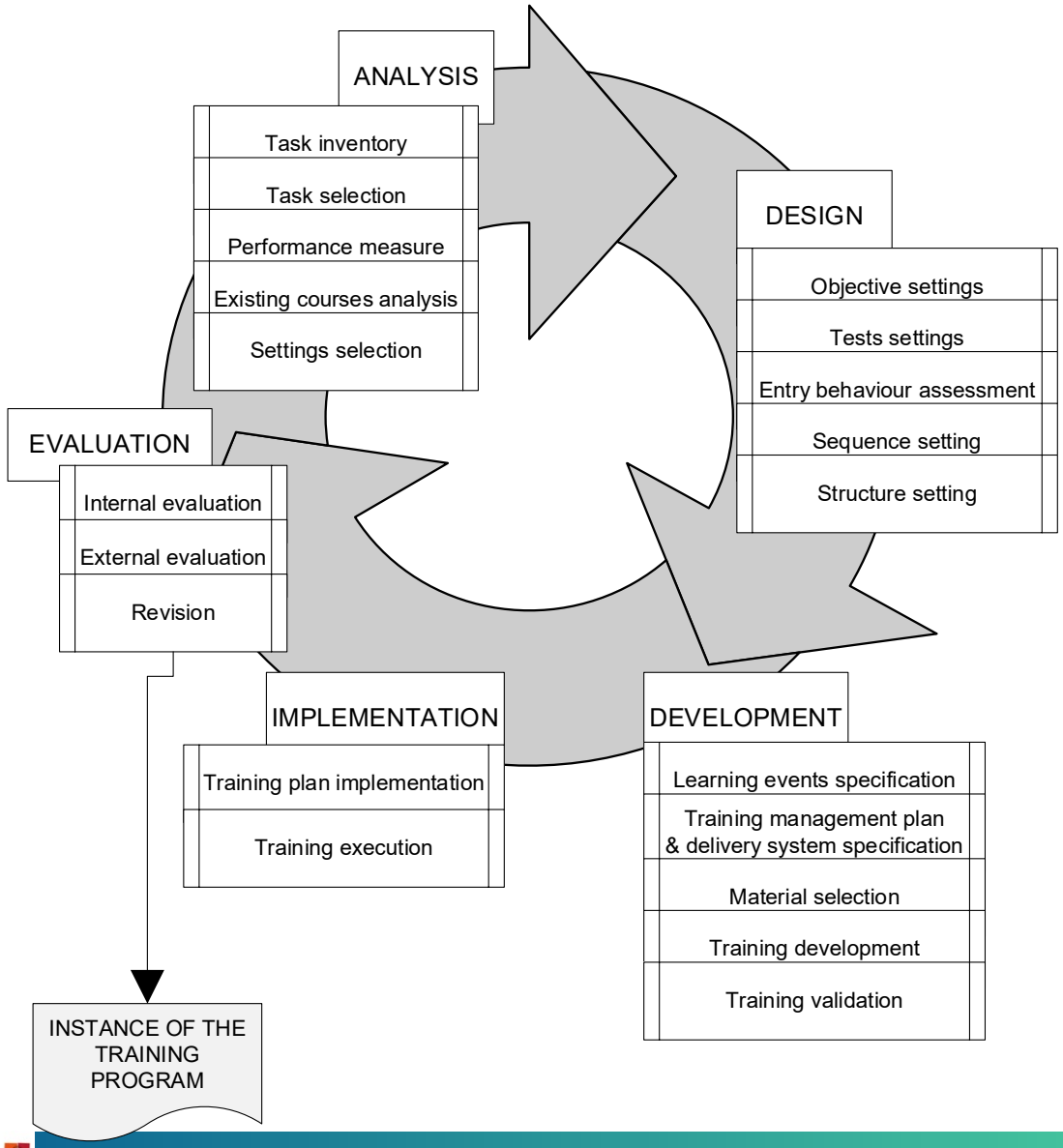
OTD = Other Training Devices
FTD = Flight Training Device
FS = Flight Simulator
A = Airplane

M = Mandatory

Joint Aviation Authorities (2006). JAR - FCL 1 - Flight Crew Licensing (Aeroplane).

Systematic Approaches to Training

1. Set of development phases
2. Iterative and incremental
3. Precise elicitation of training needs
4. Based on objectives and results
5. Highly rely on task descriptions



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U.S. Army Field Artillery School (1984). **A System Approach to Training** (Course Student textbook).

Operators' training - summary

1. Systematic

2. Requirements-based (training, devices, operator, instructor…)

3. Task-based (goals, tasks)

4. Competency-based (knowledge and skills acquired by level)

5. Rely a lot on computer-based training and simulators/simulations

6. Main targets of the training program are
   - Qualification (initial training)
   - Re-qualification (recurrent training) of the operators

ATR 600 Flight Simulator with Instructor Station, https://www.ainonline.com/

Limitations and problems

1. Incomplete and/or unrealistic training

2. Blocking on a given competency and thus no progress

3. Fidelity affects training transfer
   - Computer Based Training
   - Simulators
   - Digital twins

G1000 Part Task-Trainer, Flight1 Aviation Technologies

Myers, P. L., Starr, A. W., & Mullins, K. (2018). **Flight Simulator Fidelity, Training Transfer, and the Role of Instructors in Optimizing Learning**. International Journal of Aviation, Aeronautics, and Aerospace, 5(1).

Yngve Dahl, Ole A. Alsos, and Dag Svanæs. 2010. **Fidelity Considerations for Simulation-Based Usability Assessments of Mobile ICT for Hospitals**. International Journal of Human–Computer Interaction 26, 5 (2010), 445–476.

Limitations and problems

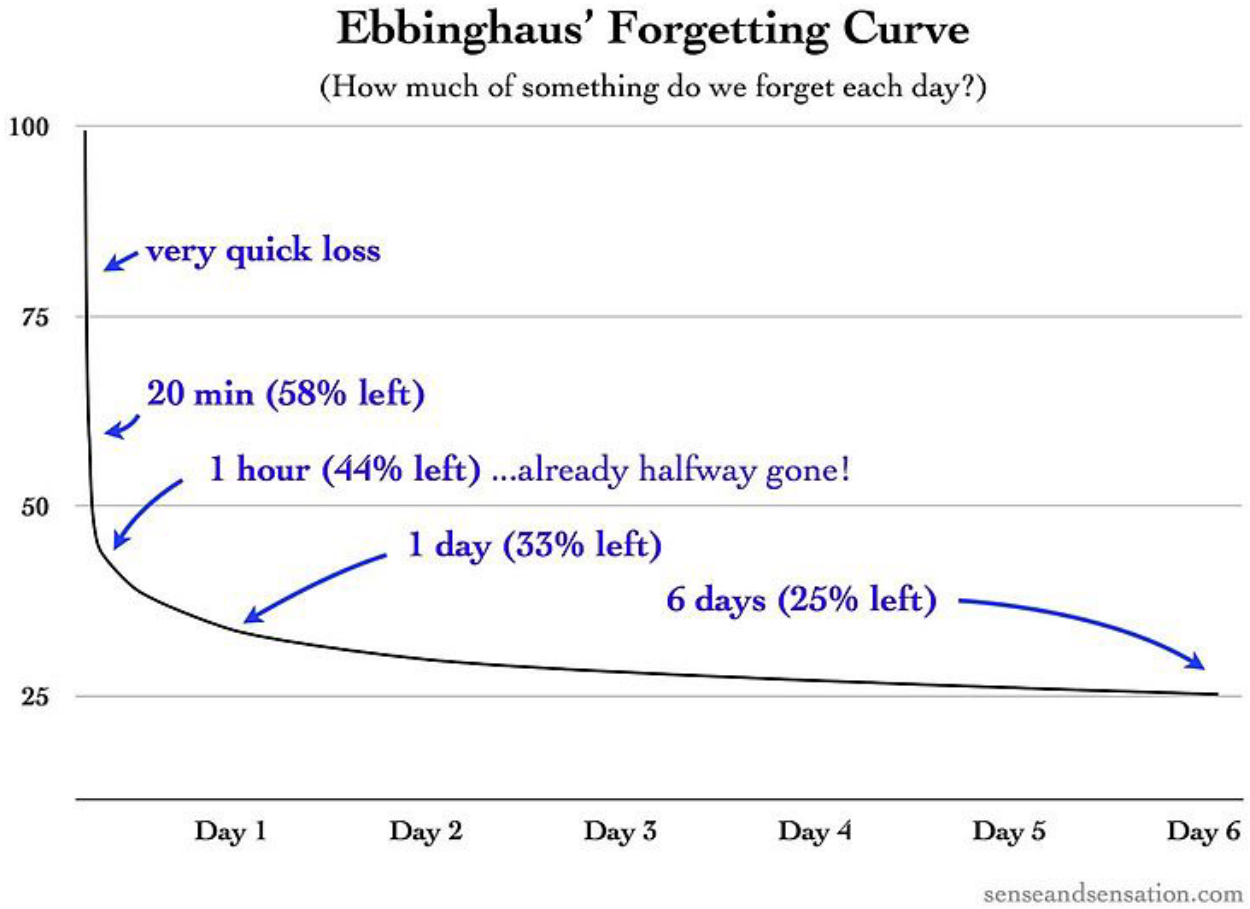
Incomplete and unrealistic training

- Fidelity affects training transfer

(Computer-Based Training, Simulators, Digital twins)

Unaware training

- Forgetting (each operator will evolve in a different context)
- Errors during operations (learning wrong procedure)



Ebbinghaus H. 1913. **Memory: A contribution to experimental psychology**. H. A. Ruger & C. E. Bussenius, Trans. (1913).

Limitations and problems

Incomplete and unrealistic training

- Fidelity issues with CBT and simulations

Unaware training

- Forgetting (each operator will evolve in a different context)
- Errors during operations

Over-expensive training

- Parts of recurrent training are useless
- Resources are booked whereas not always needed

Attribute	Manual	Training plan 1	Training plan 2
Training cost	$29.8 M	$27.1 M	$26.5 M
Pay protection	$2.3 M	$4.2 M	$0.2 M
New hires	$2.2 M	$2.5 M	$0.5 M
Cost without block hours	$34.3 M	$33.8 M	$27.2 M
Block-hour shortage	80,000 hrs	27,000 hrs	77,000 hrs
Block-hour-shortage cost	$11.2 M	$3.8 M	$10.8 M
Total cost	$45.5 M	$37.6 M	$38.0 M

Gang Yu, Julian Pachon, Benjamin G. Thengvall, Darryal Chandler, Al Wilson. **Optimizing Pilot Planning and Training for Continental Airlines**. Interfaces 34(4): 253-264 (2004)

Framework for operations-based training

Targets recurrent training & initial training

Systematic approach to training

Capitalizes on model-based training

- Task model based training (complements and supports each SAT phases)
- Simulation-based training (complements and supports each SAT phases)

Highlights

- Generic process to integrate
  - data from the operations (system logs, audio and video recording)
  - Training program data
- Tool support to handle a large amount of data

Engineering Operations-based Training

Initial training

- Task model-based training
- Trainer produces scenarios produced
- Operators trained with guidance of task models and scenarios

Operations

- System logging
- Video, audio, logbooks recording

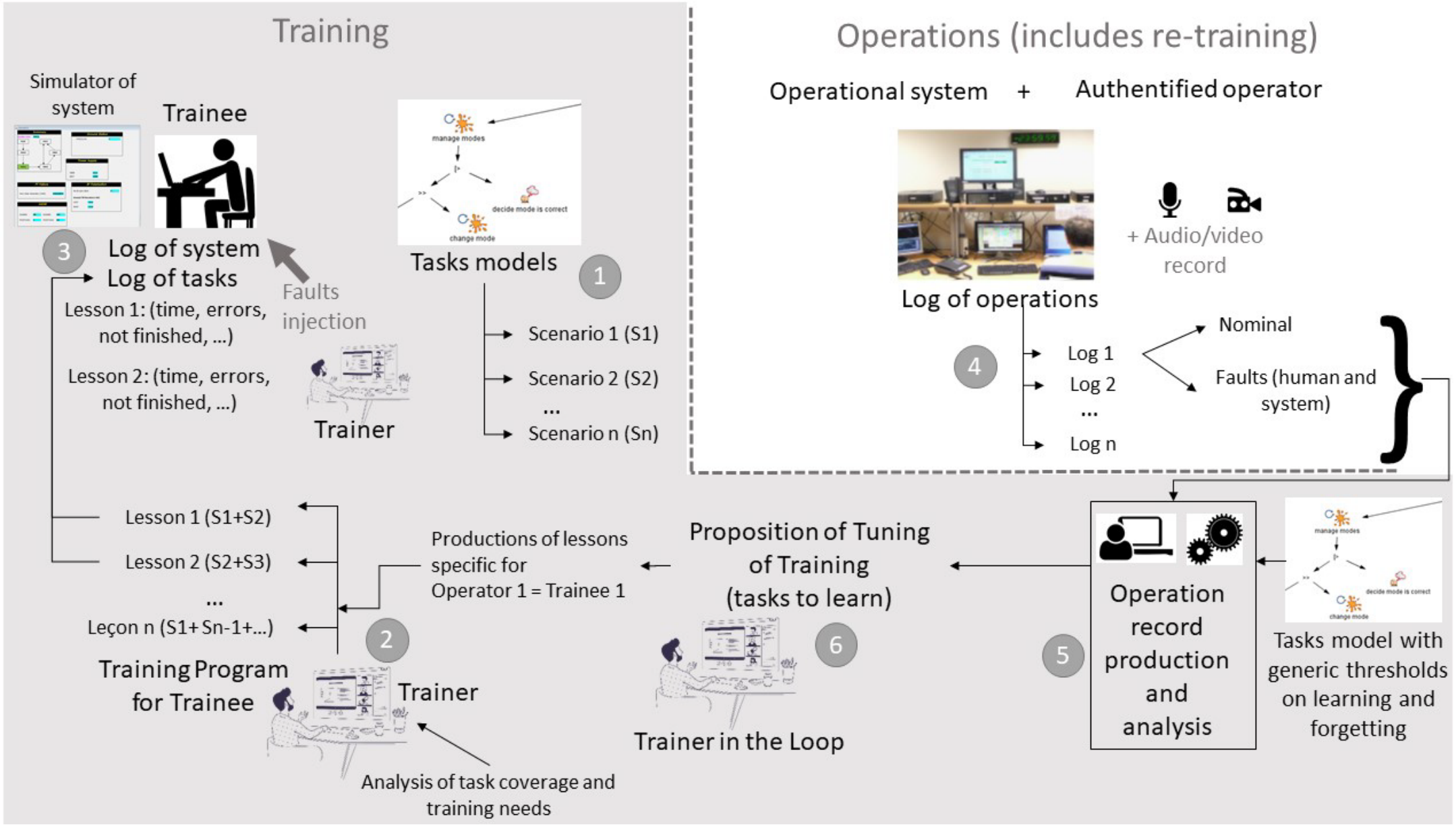
Specific task models

- Automated production of operation records
- Trainer accepts, mends and adds correspondences
- Automated production of specific task models

Training needs

- Trainer analyses of specific task models
- Trainer identifies individual training needs
- Trainer prepares new lessons

High-level process



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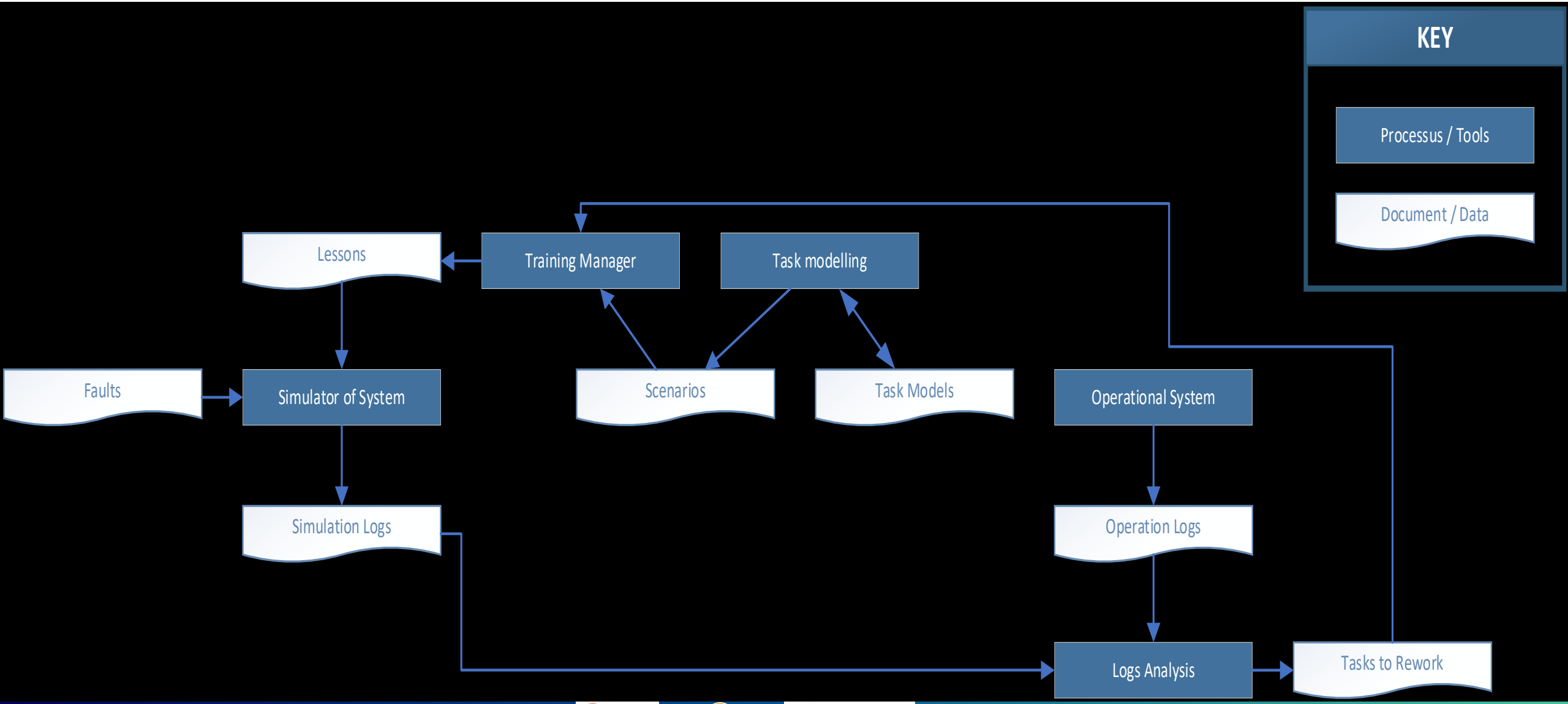
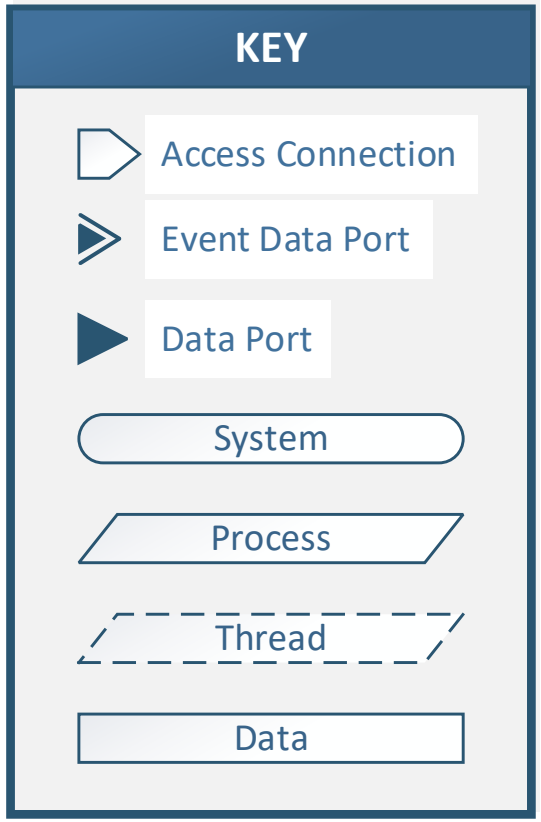
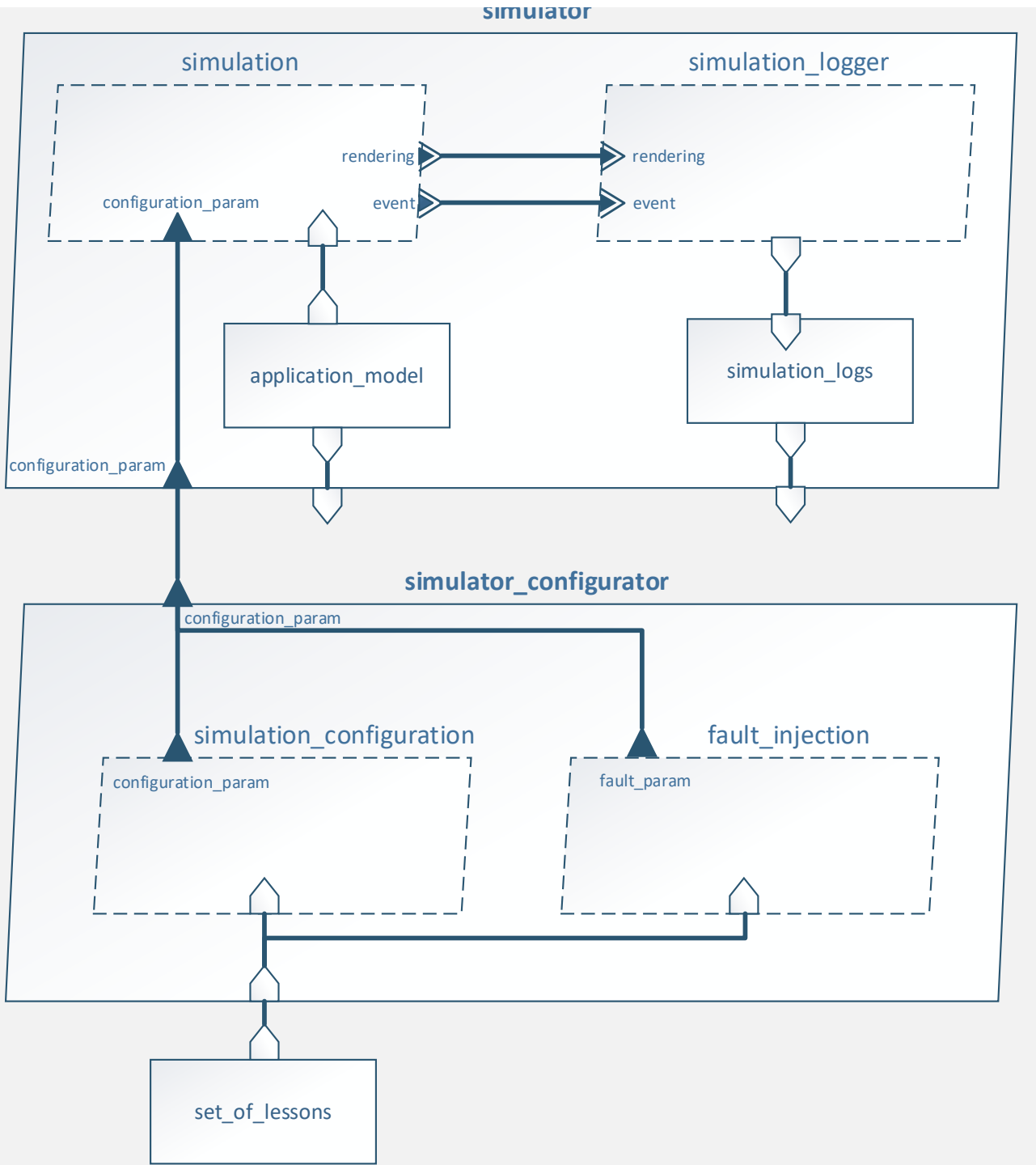
Generic Operation-Based and Task-Based Training Software Architecture

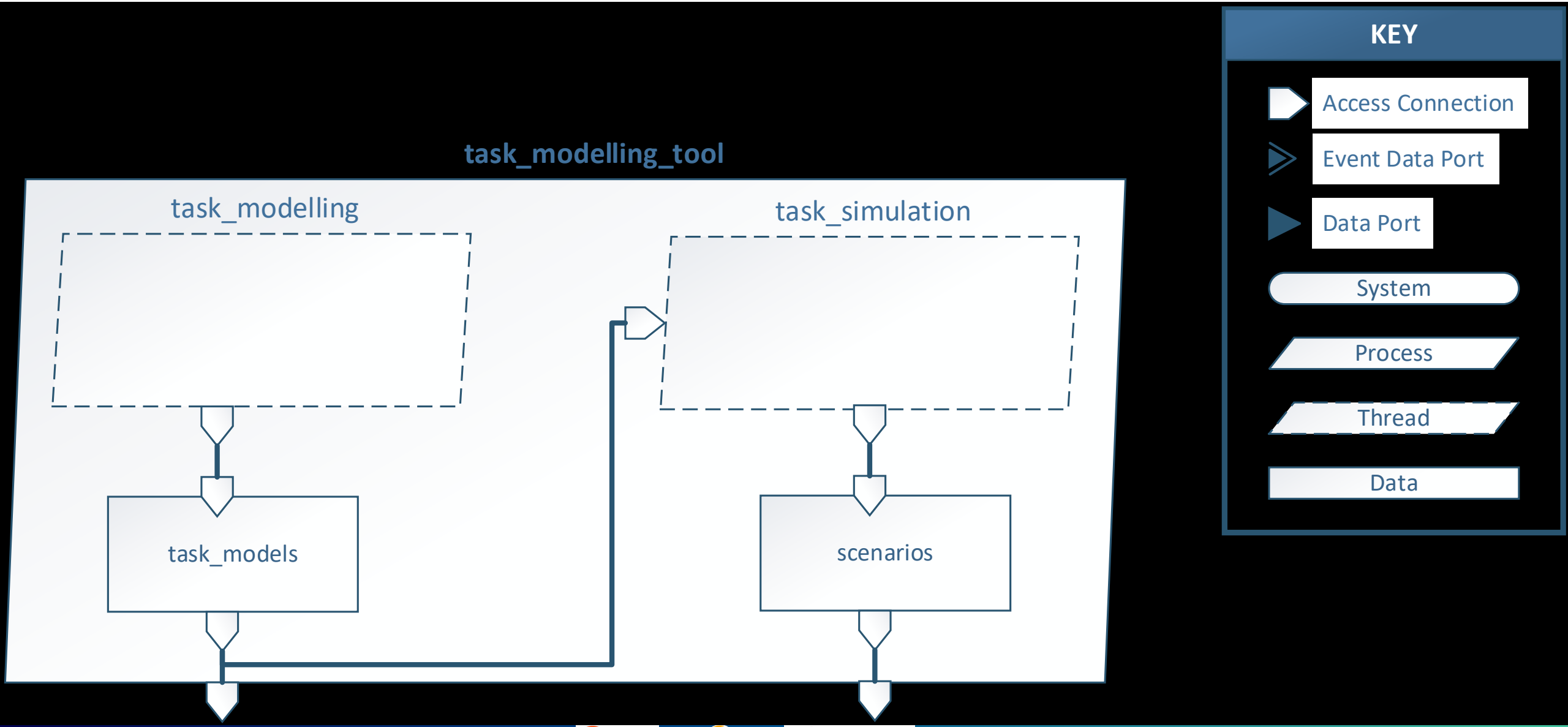


Simulator of the System

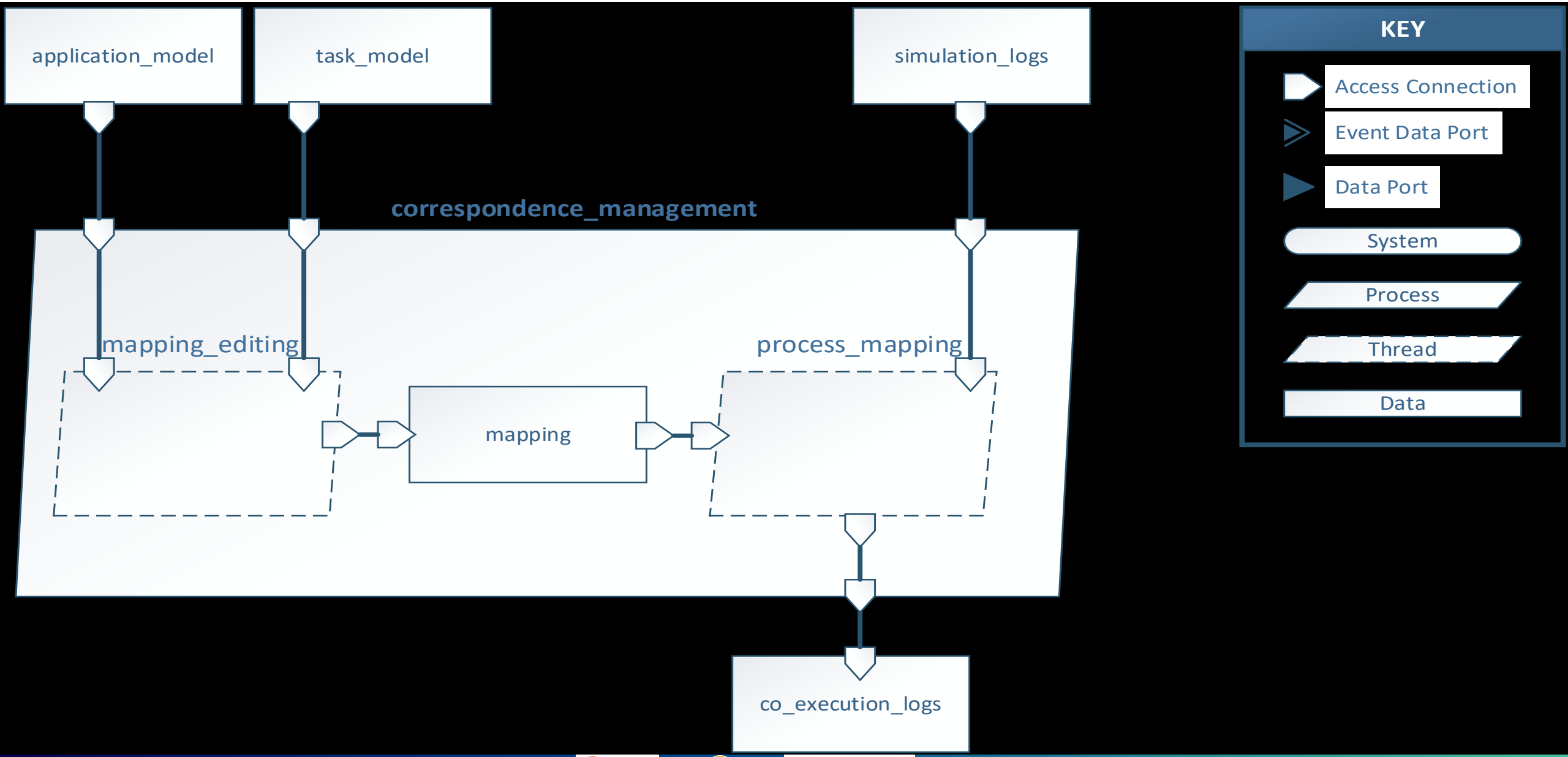




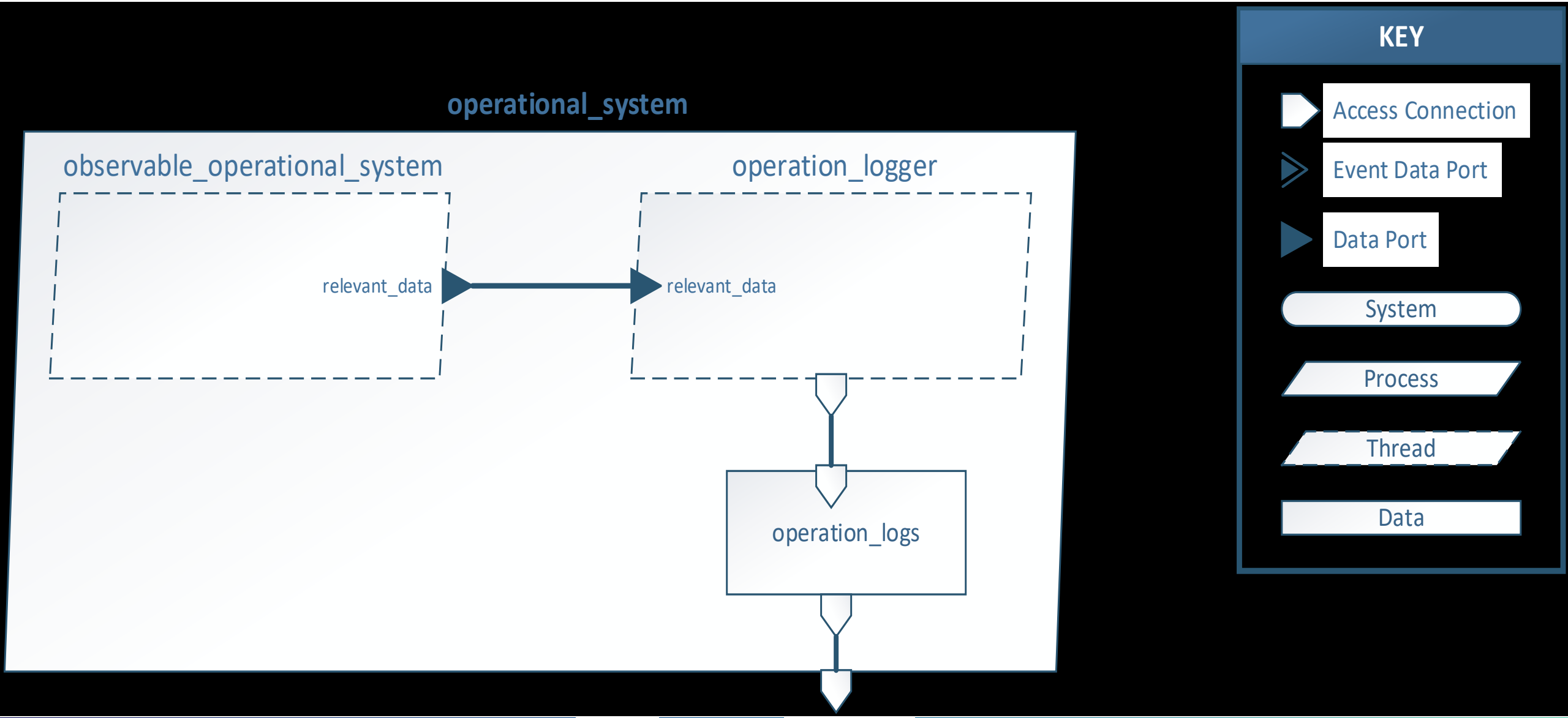
Task Modelling and Scenario Building



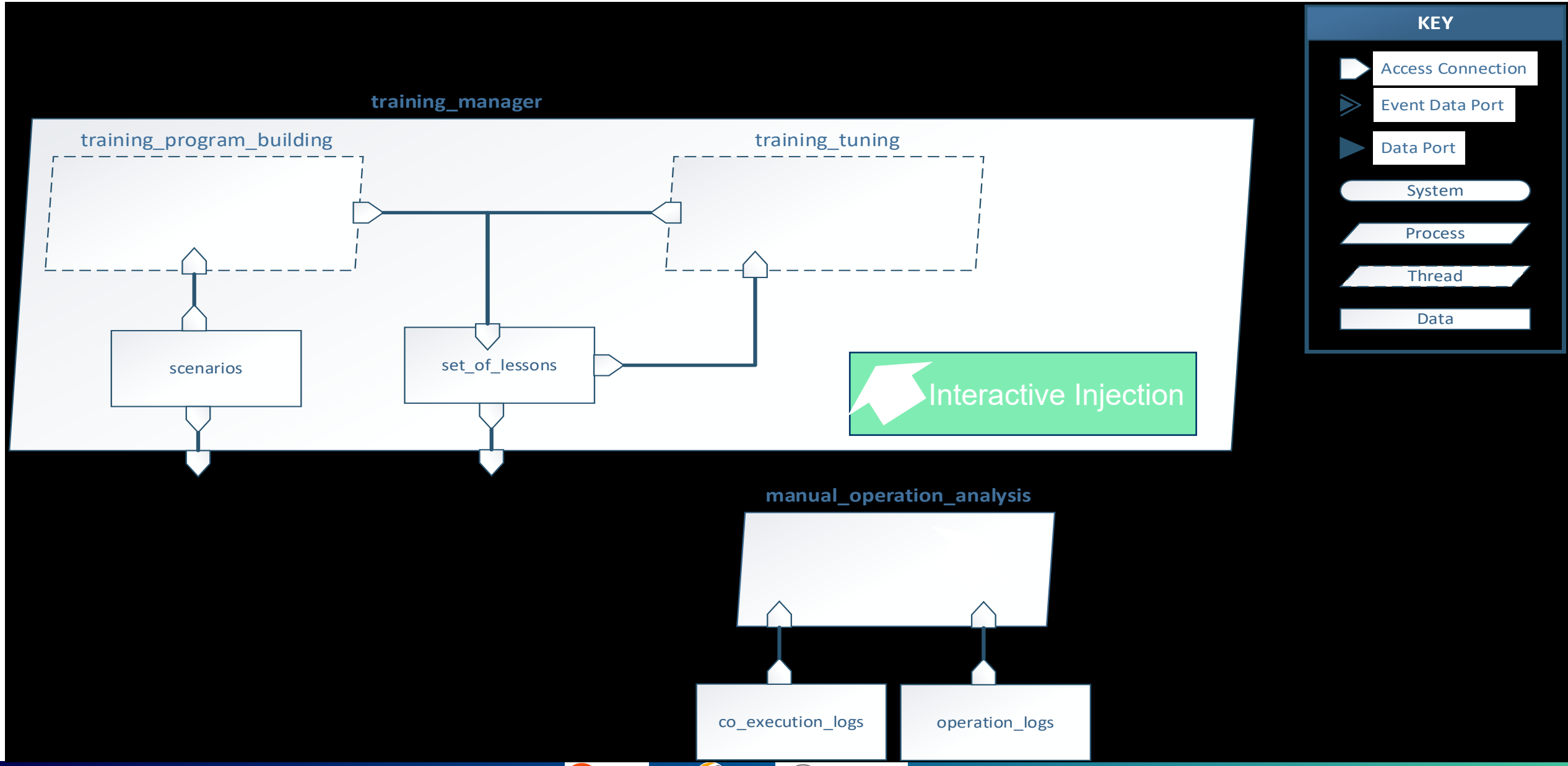
Co-execution Management



Operational System

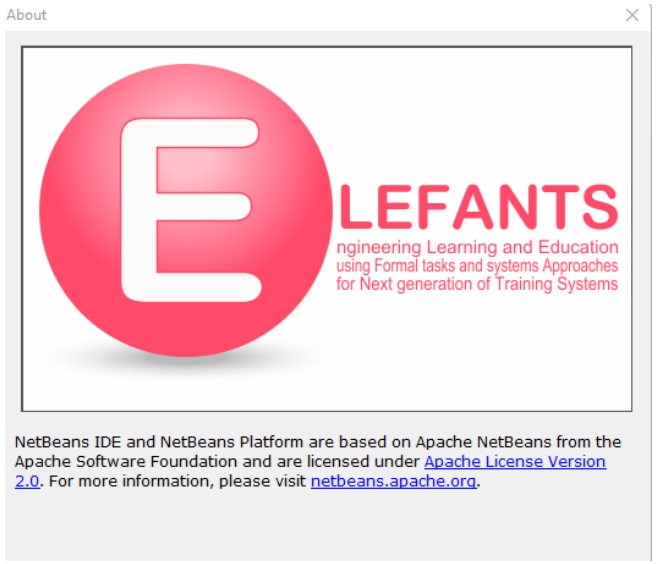


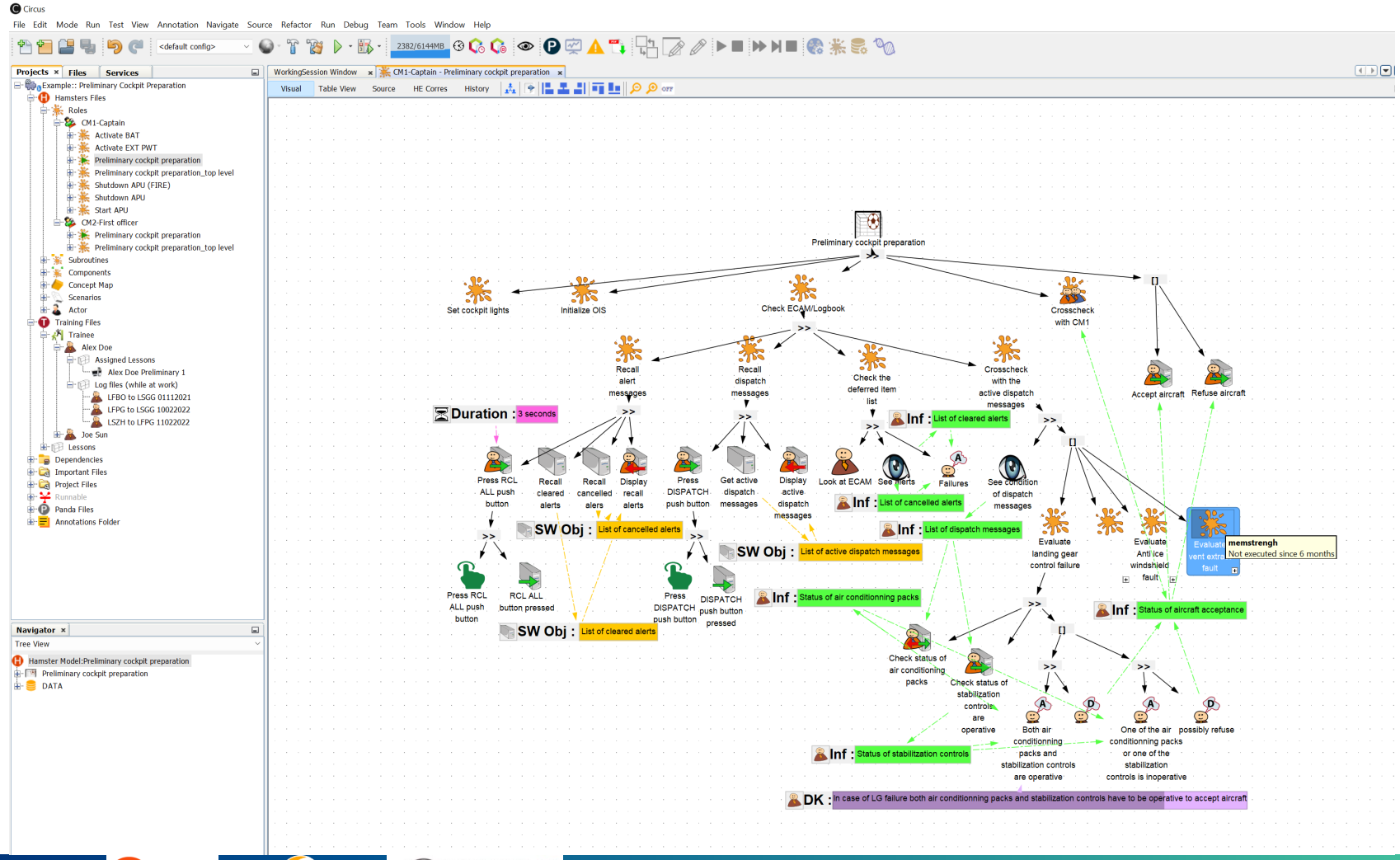
Tool Supported Training Management (partly automated)



ELEFANT

Engineering Learning and Education using Formal tasks and systems Approaches for Next generation of Training Systems





ECSS-Q-20B
8 March 2002

Space product assurance

Quality assurance

nel training and certification

4.5.1

The supplier shall establish a documented training programme for QA personnel and all other personnel whose performance determines or affects product quality.

4.5.2

Operators performing critical processes (as defined in ECSS-Q-70) shall be trained and certified by internal or external training programmes accepted by the customer, or can demonstrate a regular and satisfactory use of the related skills.

4.5.3

Those inspecting or controlling critical processes, or performing non-destructive testing and evaluation, shall be trained and certified according to national or international training programmes and standards accepted by the customer, or can demonstrate a regular and satisfactory use of the related skills.

ECSS Secretariat
ESA-ESTEC
Requirements & Standards Division
Noordwijk, The Netherlands

Approaches to connect task models to interactive applications

Approach	Widgets and/or interactors	Development effort	Learning environment architecture	Impact in learning environment
Dedicated API for developer to implement activation and rendering functions	Any + new instances at runtime	Medium to high	Modified	No
Resource introspection (ex: xml layout files...)	Any, but not new instances at runtime	Low to medium	Not modified	Parser, notifications
Runtime environment introspection	Predefined list	High	Not modified	Widget tree exploration, graphical identification of widgets, notifications
Modification of runtime environment	Predefined list	High	Not modified	Widget list retrieval, graphical identification of widgets, notifications
Code instrumentation	Any plus new instances at runtime	Medium to high	Not modified	Parser, notifications

Martinie, C., Navarre, D., Palanque, P., & Fayollas, C. (2015). A generic tool-supported framework for coupling task models and interactive applications. In Proceedings of the 7th ACM SIGCHI Symposium on Engineering Interactive Computing Systems (pp. 244–253). ACM.

ACT-R equations to predict memory strength

Declarative memory strength

$$B_i = \ln \sum_{j=1}^{n} t_j^{-d} \quad \text{(Base-Level Equation)}$$

Procedural memory strength

$$S_p = \ln \sum_{j=1}^{n} t_j^{-d} \quad \text{(Production Strength Equation)}$$

John R. Anderson and Christian D. Schunn. 2000. Implications of the ACT-R learning theory: No magic bullets. Advances in instructional psychology: Educational design and cognitive science (2000), 1–33.

Session visu et automation

Faire le lien

- **Quelles taches du trainer on automatise**
- **Quelles visu on lui propose**

Concrete example of application of the framework

Specific task: “Preliminary cockpit preparation”

Example for a specific task: “Preliminary cockpit preparation”

Initial training

- Task model-based training
- Trainer produces scenarios produced
- Operators trained with guidance of task models and scenarios

Opera-tions

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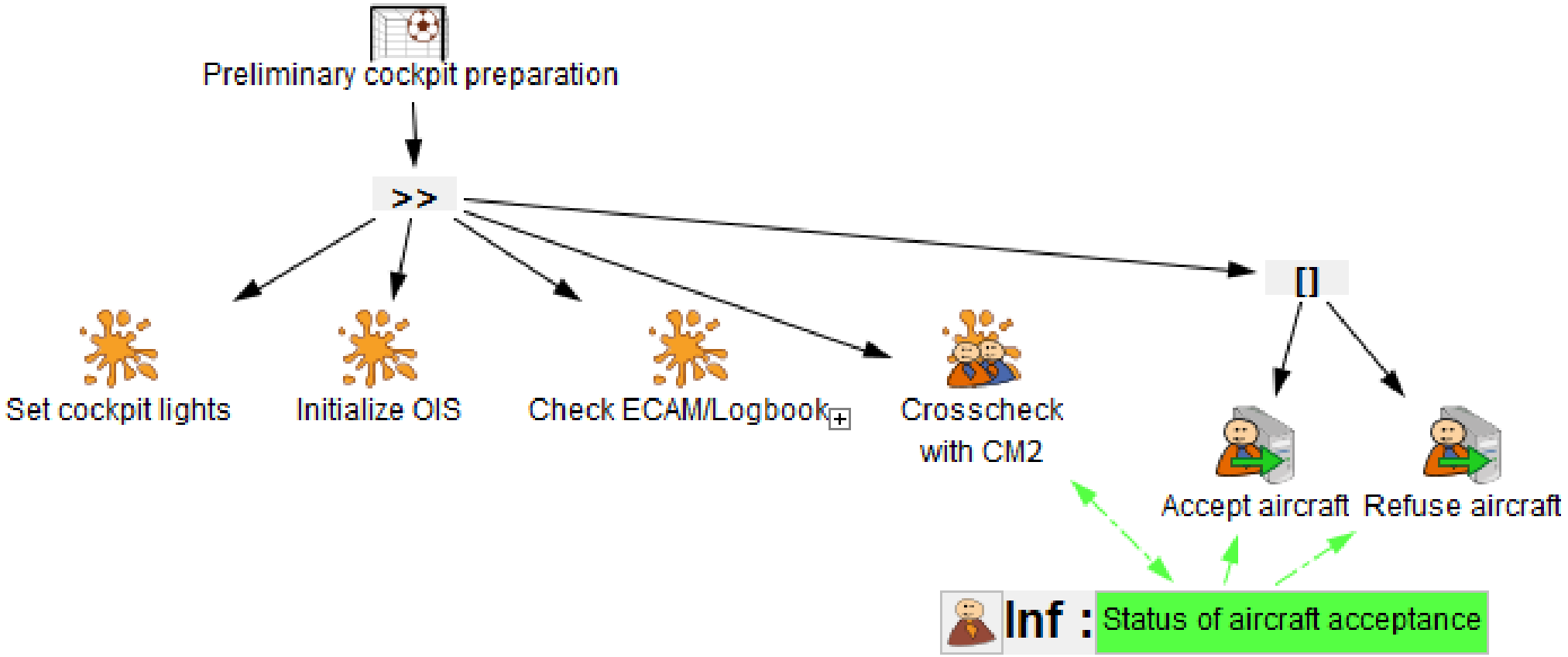
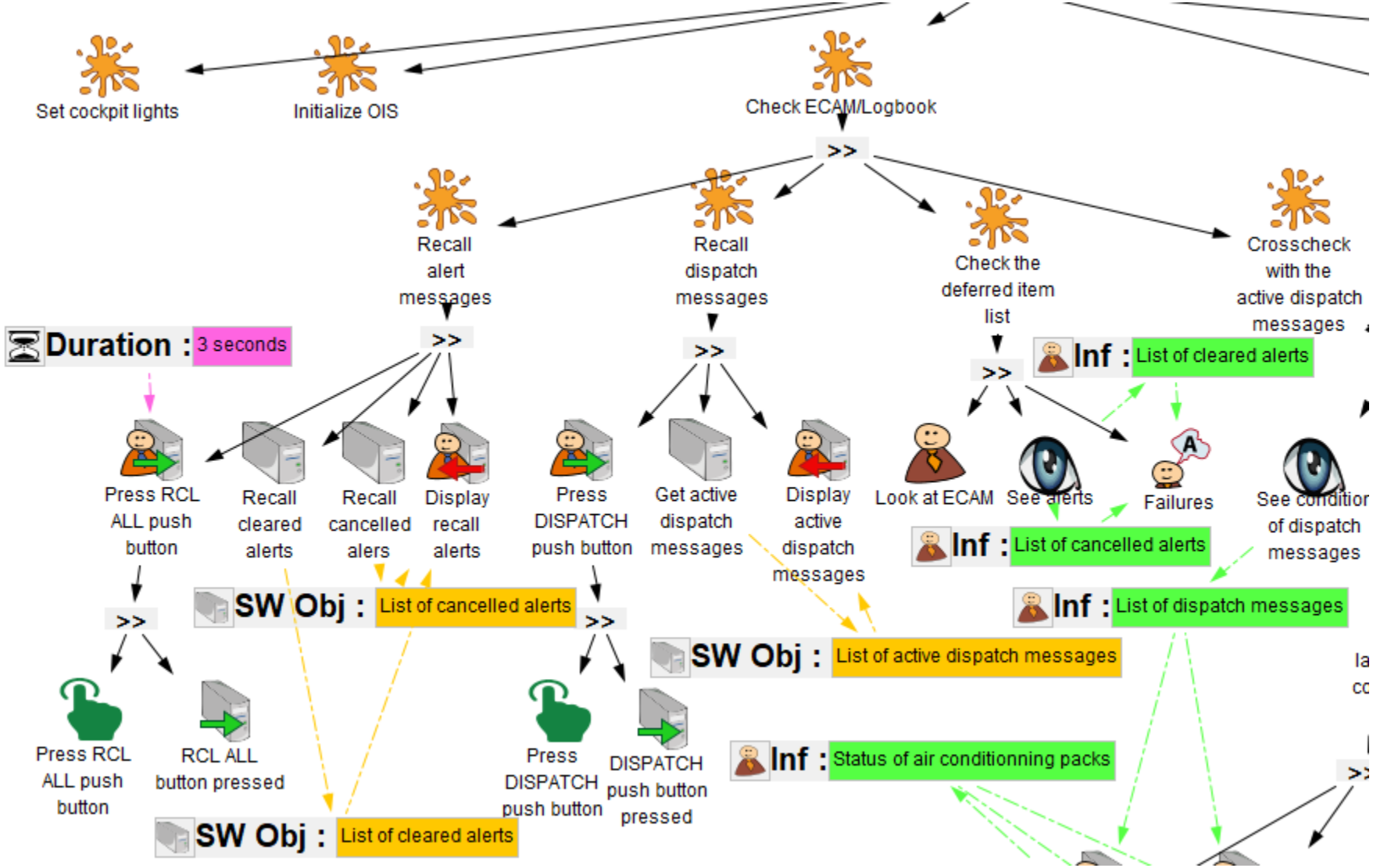
Initial training (task model-based)



Initial training (task model-based)



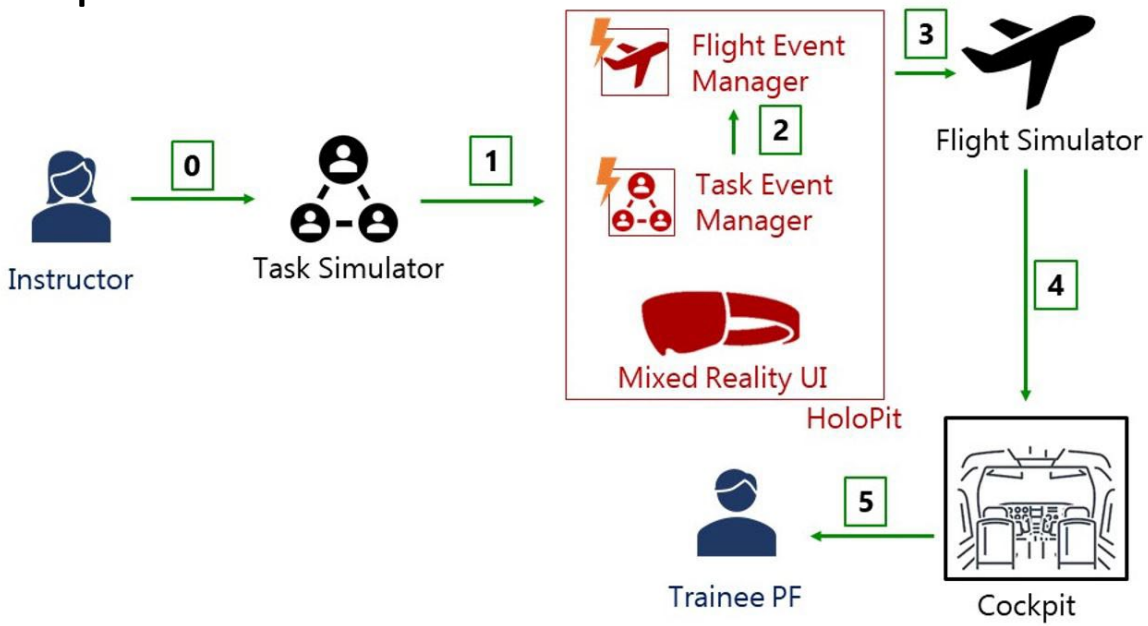
Initial training (task model-based)

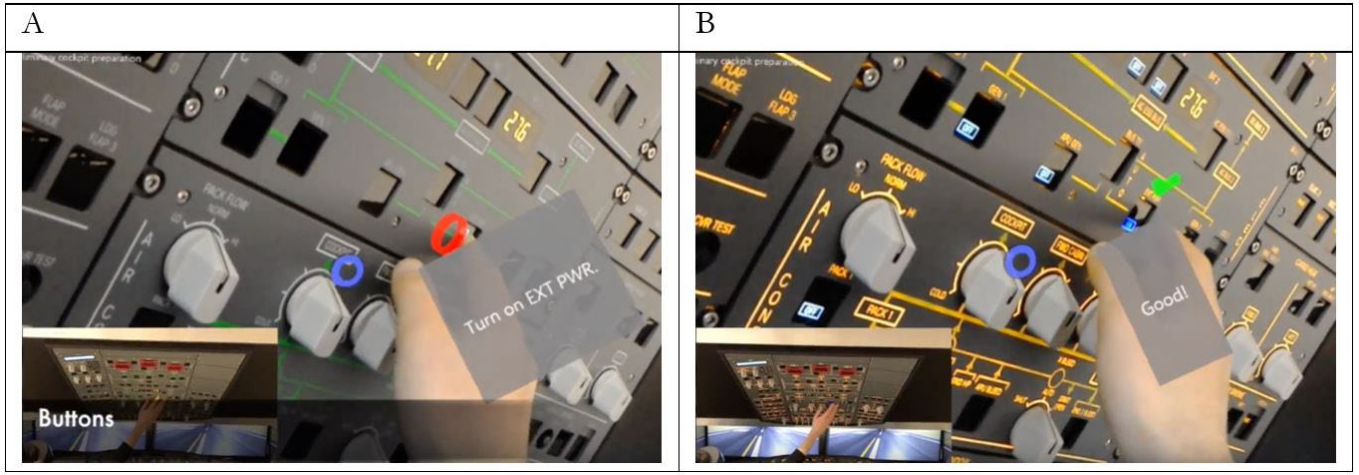
Task models are part of the training program development

Training scenarios produced by trainers

Coupling of task models with Computer Based Training applications and simulators

Operators trained with guidance of task models and scenarios

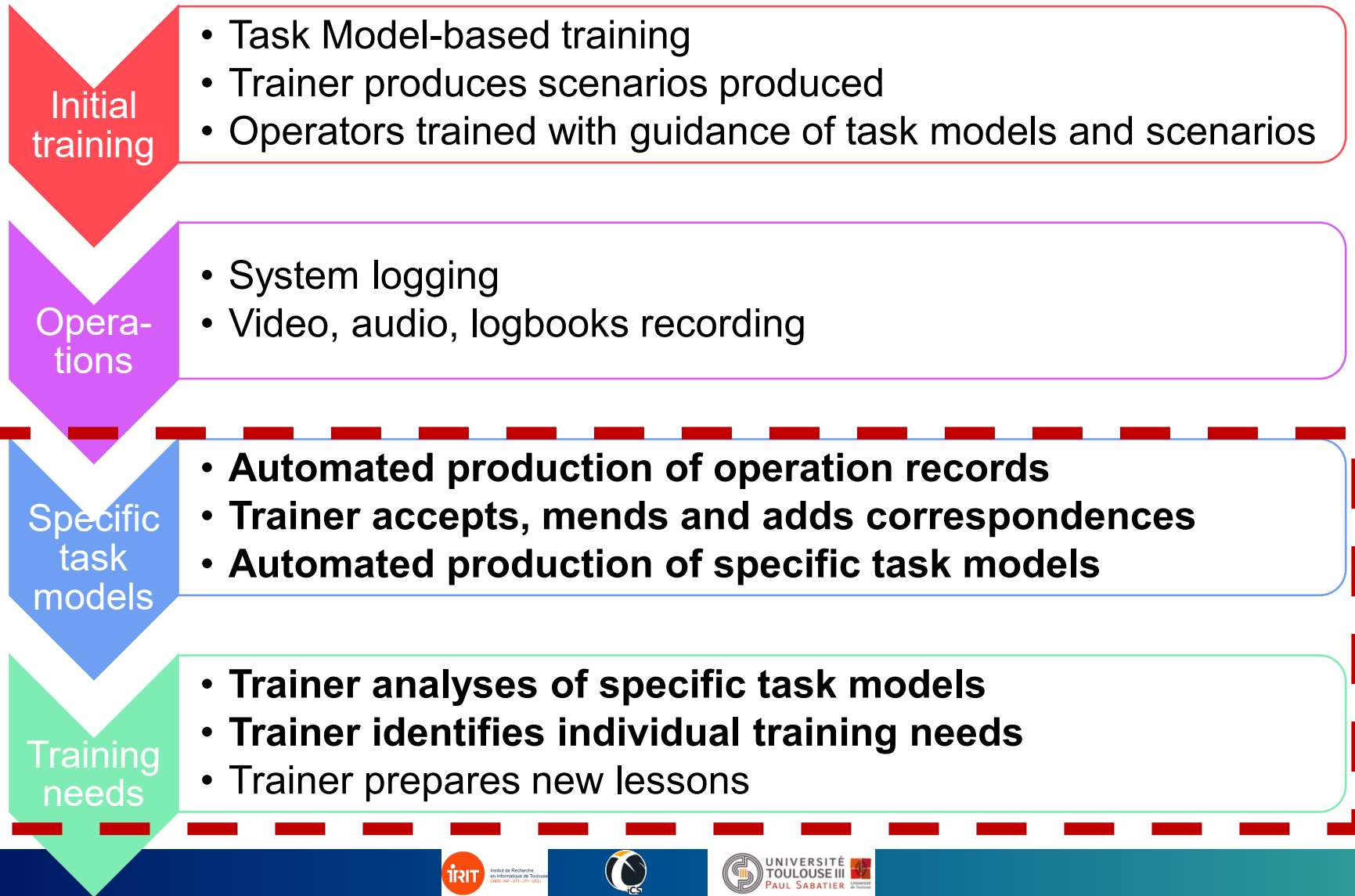




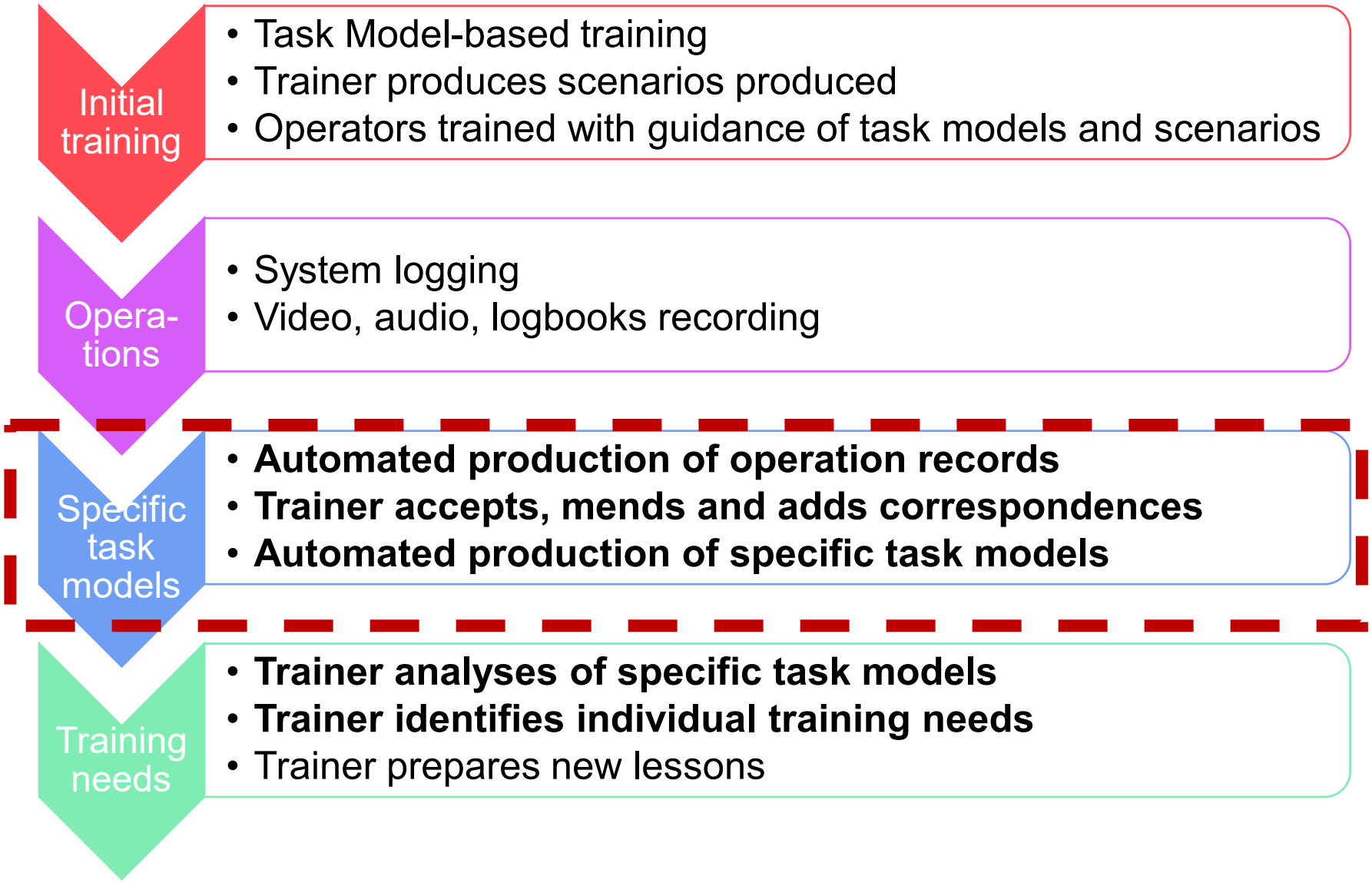
G. Lallai, G. L. Zedda, C. Martinie, P. Palanque, M. Pisano L. D. Spano. **Engineering Task-based Augmented Realit Guidance: Application to the Training of Aircraft Flight Procedures**. Interact. Comput. 33(1): 17-39 (2021)

C. Martinie, P. Palanque, D. Navarre, M. Winckler, E. Poupart. Model-based training: an approach supporting operability of critical interactive systems. EICS 2011: 53-62

Engineering Operations-based Training



Engineering Operations-based Training



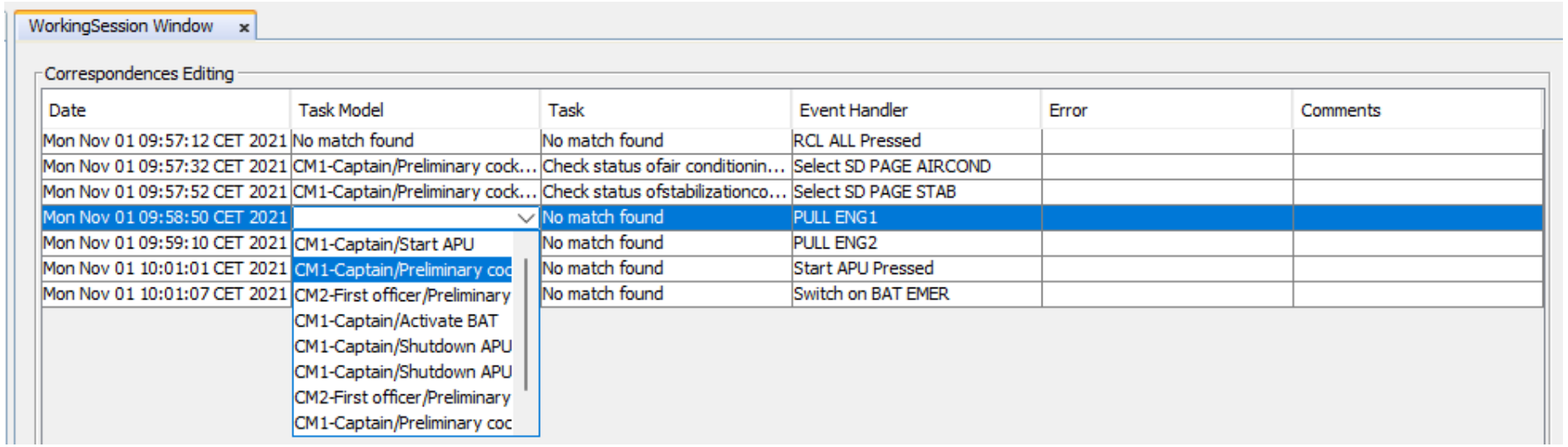
Production of an operation record for an individual operator

Operation record is a systematic mapping between interactive system logged events while operator was on duty and operator's tasks (from the task models)

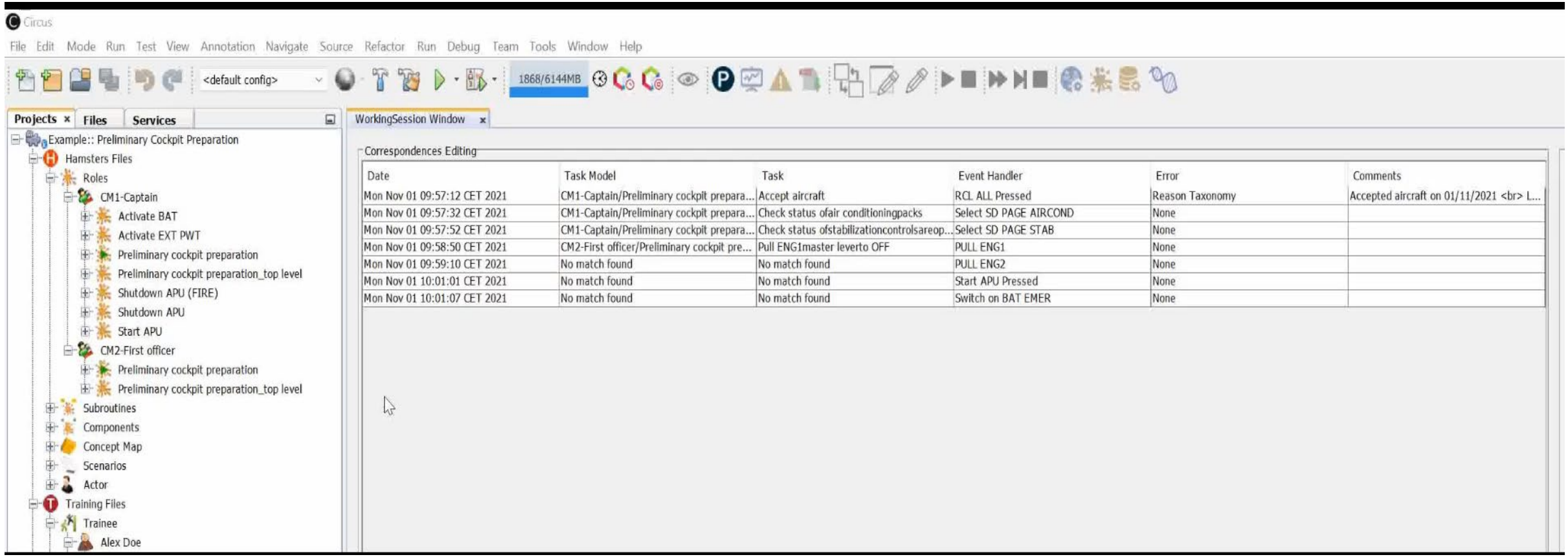
Production of the mapping is automated

Trainer has to check the mapping, with tool support

- **reviews correspondences that have been automatically performed**
- **modifies correspondences if needed (adding/completion)**

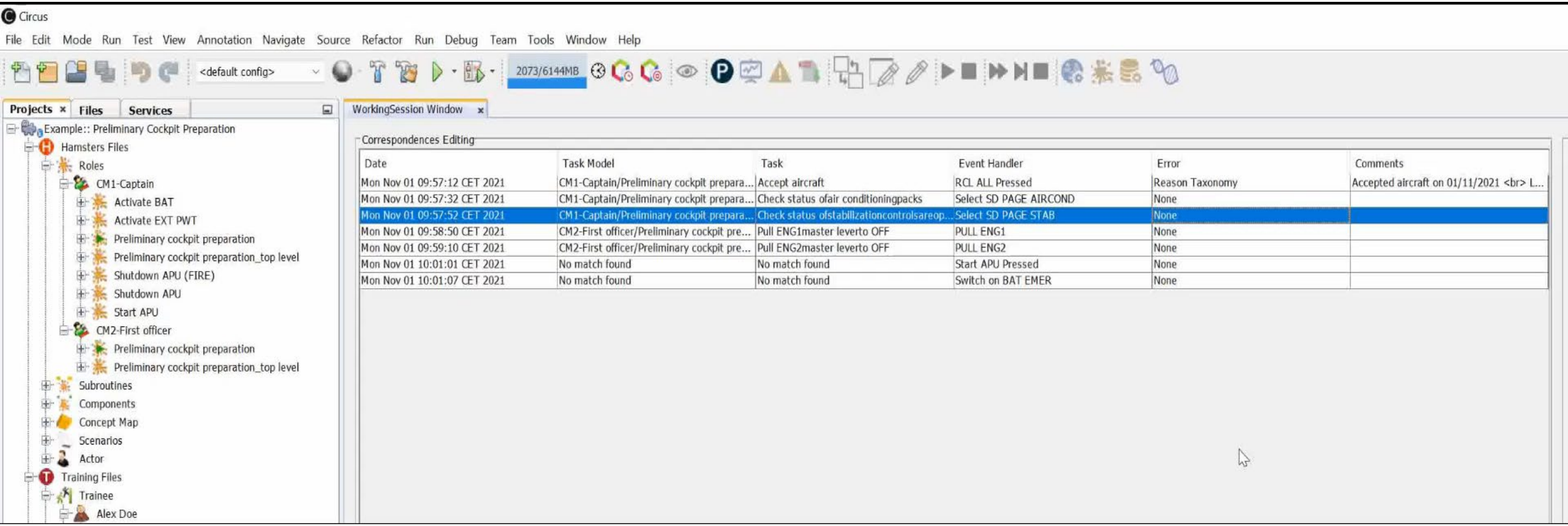


Review automatically produced correspondences
Trainer perform modifications if needed



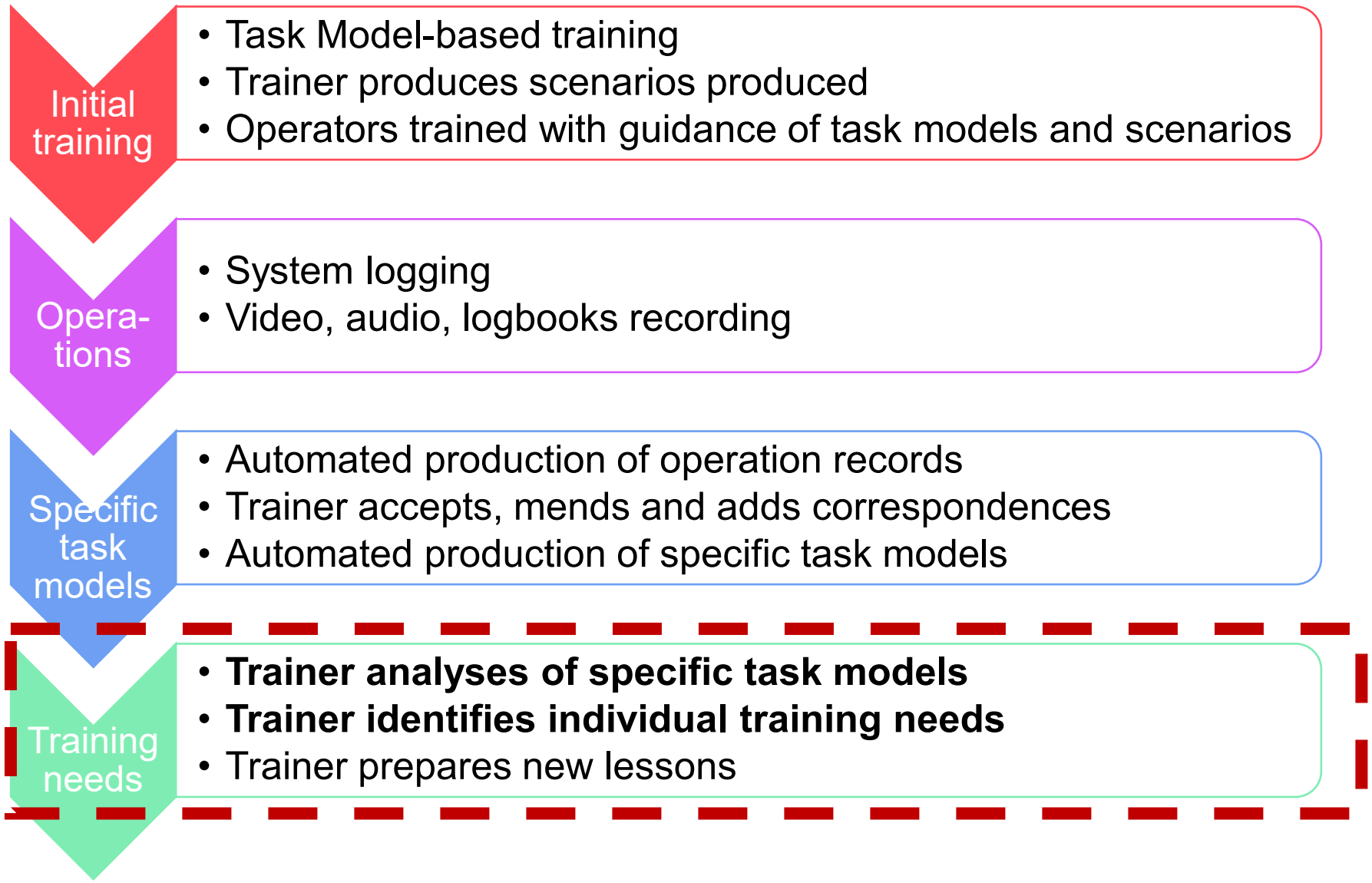
Date	Task Model	Task	Event Handler	Error	Comments
Mon Nov 01 09:57:12 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Accept aircraft	RCL ALL Pressed	Reason Taxonomy	Accepted aircraft on 01/11/2021 L...
Mon Nov 01 09:57:32 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Check status ofair conditioningpacks	Select SD PAGE AIRCOND	None	
Mon Nov 01 09:57:52 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Check status ofstabilizationcontrolsareop...	Select SD PAGE STAB	None	
Mon Nov 01 09:58:50 CET 2021	CM2-First officer/Preliminary cockpit pre...	Pull ENG1master leverto OFF	PULL ENG1	None	
Mon Nov 01 09:59:10 CET 2021	No match found	No match found	PULL ENG2	None	
Mon Nov 01 10:01:01 CET 2021	No match found	No match found	Start APU Pressed	None	
Mon Nov 01 10:01:07 CET 2021	No match found	No match found	Switch on BAT EMER	None	

Trainer points out errors that were found in the operation records (audio, video, reports…)

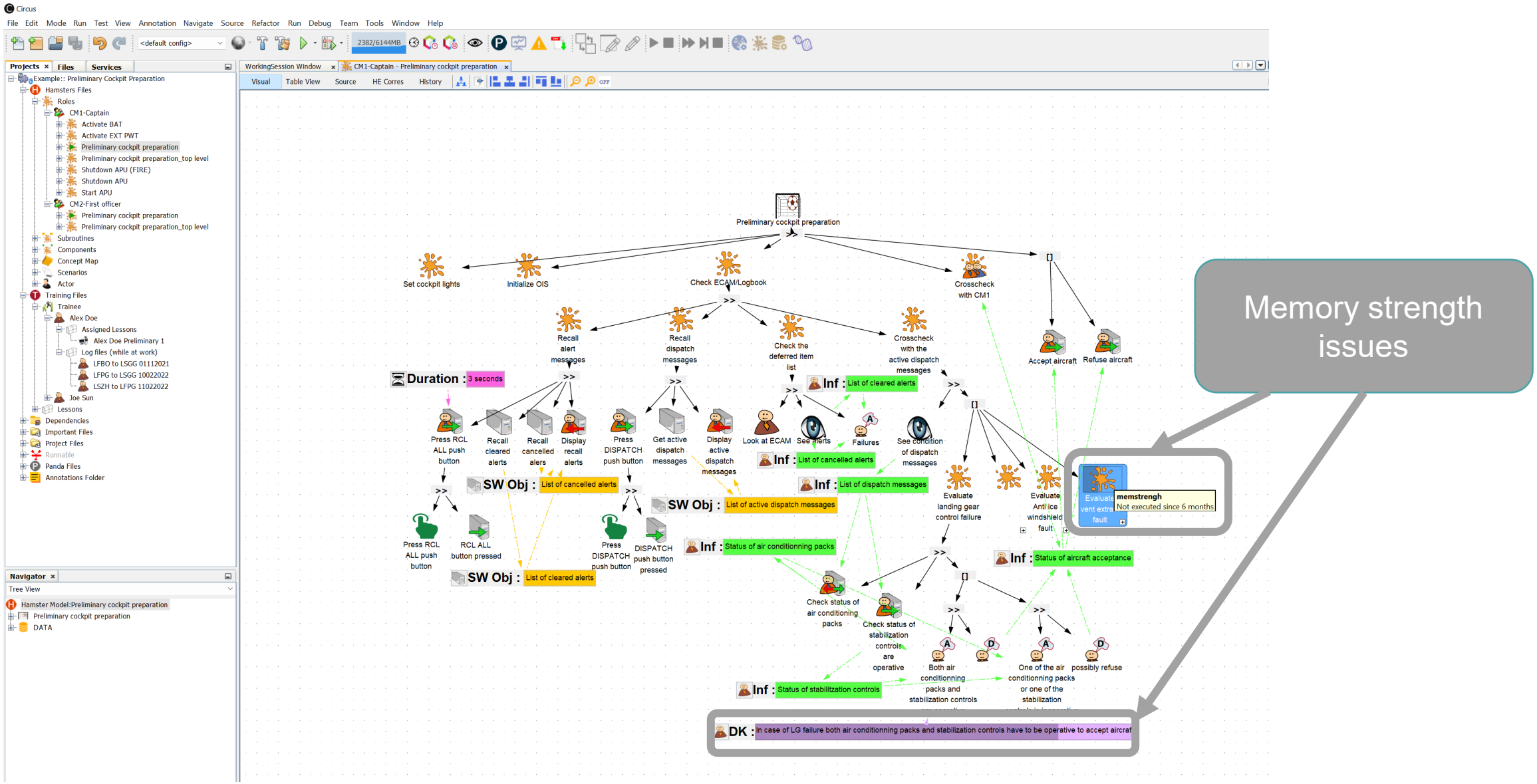


Date	Task Model	Task	Event Handler	Error	Comments
Mon Nov 01 09:57:12 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Accept aircraft	RCL ALL Pressed	Reason Taxonomy	Accepted aircraft on 01/11/2021 L...
Mon Nov 01 09:57:32 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Check status ofair conditioningpacks	Select SD PAGE AIRCOND	None	
Mon Nov 01 09:57:52 CET 2021	CM1-Captain/Preliminary cockpit prepara...	Check status ofstabilizationcontrolsareop...	Select SD PAGE STAB	None	
Mon Nov 01 09:58:50 CET 2021	CM2-First officer/Preliminary cockpit pre...	Pull ENG1master leverto OFF	PULL ENG1	None	
Mon Nov 01 09:59:10 CET 2021	CM2-First officer/Preliminary cockpit pre...	Pull ENG2master leverto OFF	PULL ENG2	None	
Mon Nov 01 10:01:01 CET 2021	No match found	No match found	Start APU Pressed	None	
Mon Nov 01 10:01:07 CET 2021	No match found	No match found	Switch on BAT EMER	None	

Engineering Operations-based Training

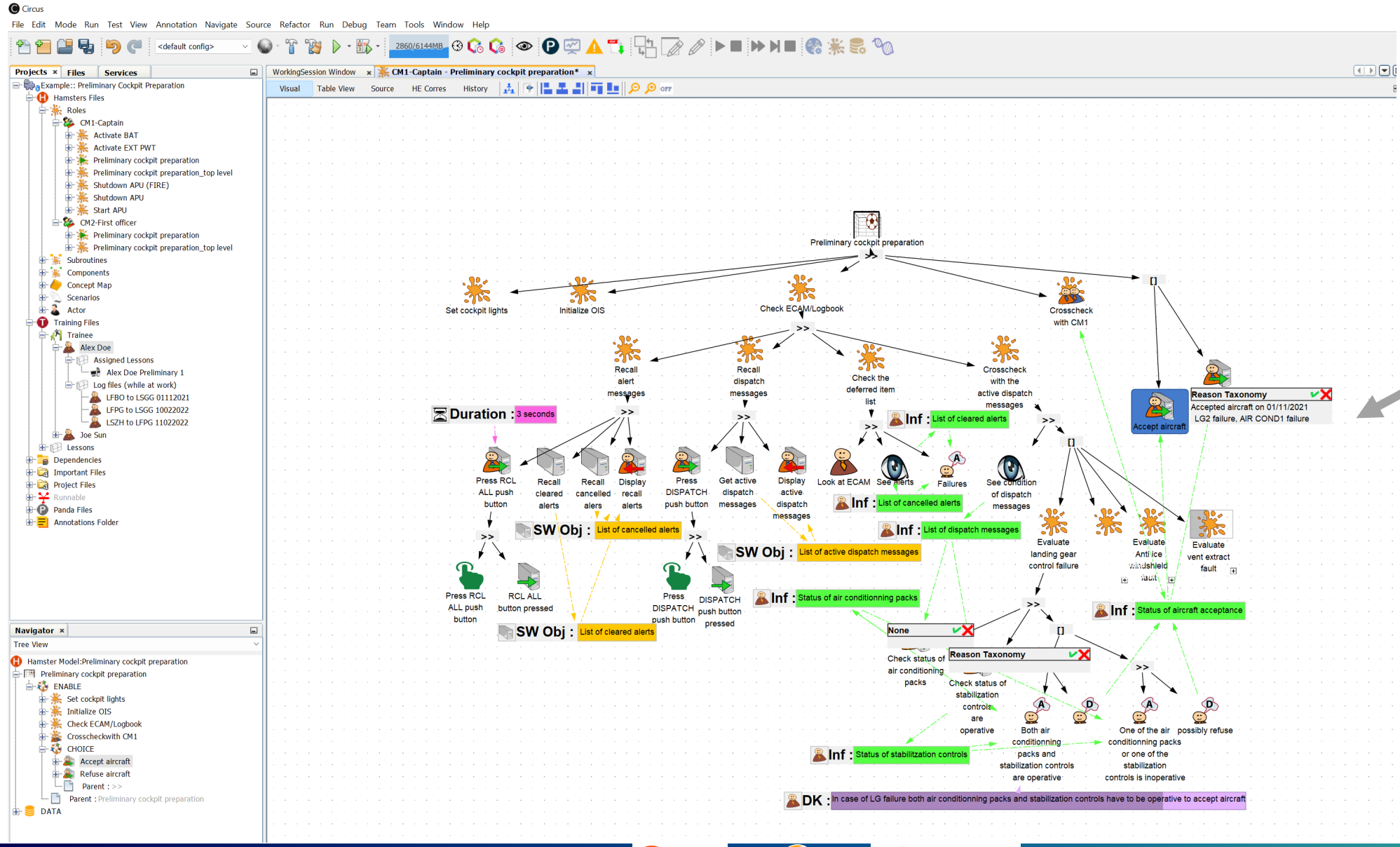


Specific task model for an individual operator



Memory strength issues

Specific task model for an individual operator

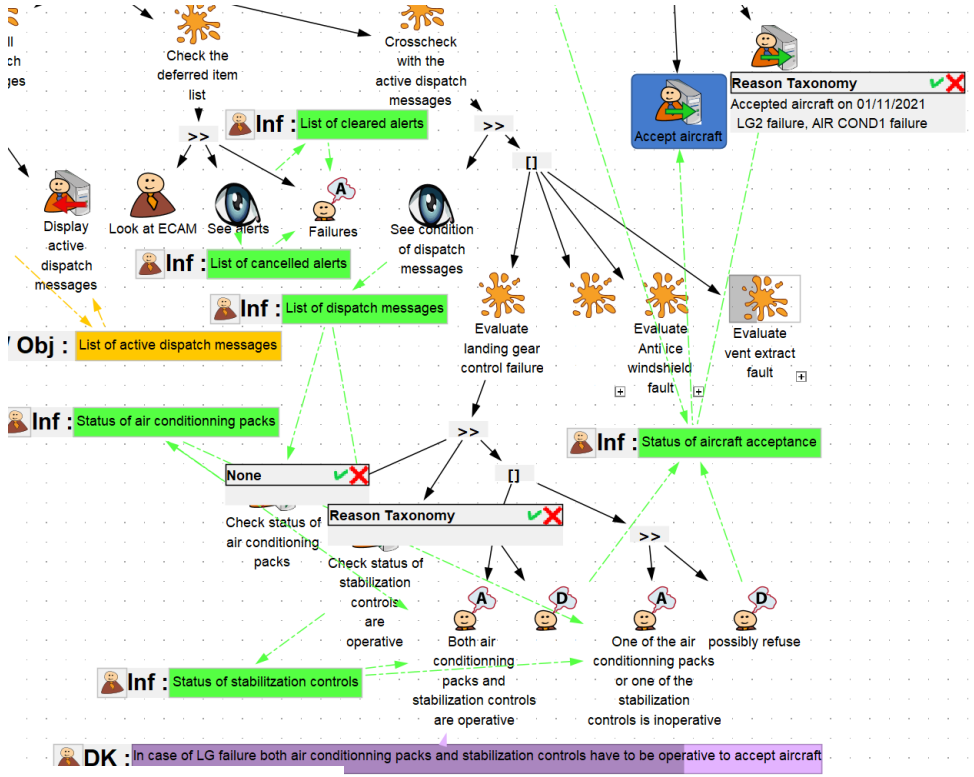


Operator error

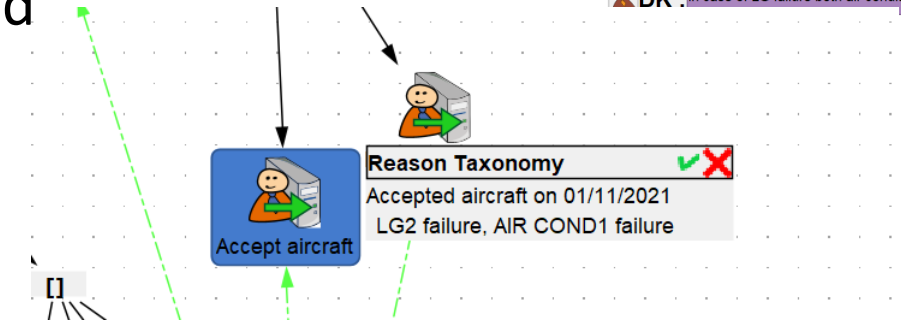
Analysis of task models

The trainer visualizes task models with customized information about

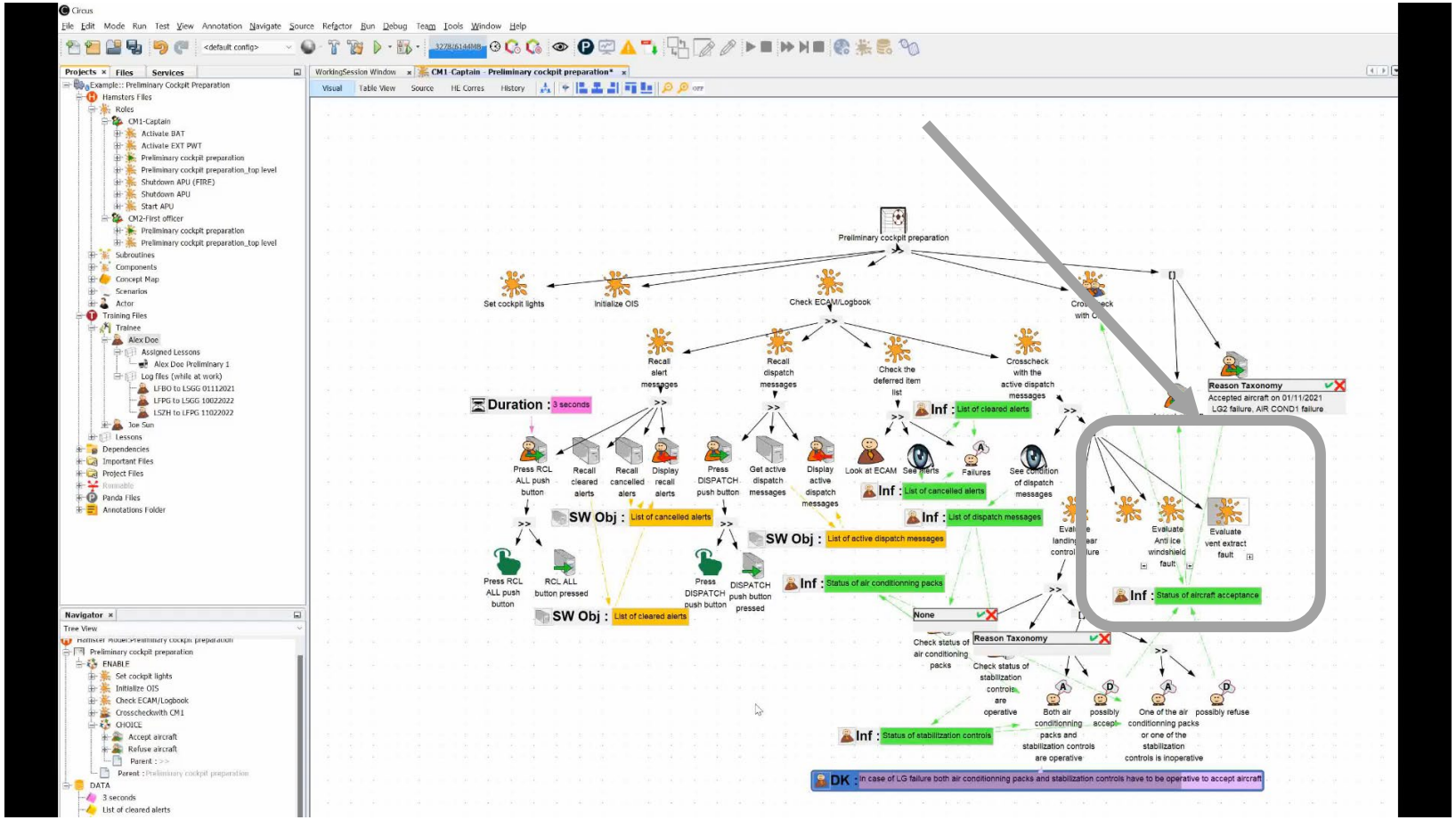
- **the memory strength of an individual operator (for each task)**
- **the errors that an operator made during operations**



The trainer identifies tasks for which the operator needs to be re-trained



Support to ensure that trainer noticed the error in the specific task model



Logs Spreadsheet example

	class	type	name	action	time	data1	data2
605	mouse_transducer	transition	mousePress_t1	fire	8000		1*{evt:{mId=>1}}
			...				
609	mouse_transducer	transition	mouseRelease_t1	fire	9900		1*{evt:{mId=>1}}
			...				
613	mouse_transducer	transition	timerExpired	fire	10500		1*{evt:{mId=>1}}
			...				
617	mouse_transducer	transition	click	fire	10700		1*{evt:{mId=>1}}
			...				
650	mouse_transducer	transition	click	fire	10950		1*{evt:{mId=>2}}
			...				
752	mouse_transducer	transition	mousePress_t1	fire	12000		1*{evt:{mId=>1}}
			...				
758	mouse_transducer	transition	mousePress_t1	fire	12010		1*{evt:{mId=>2}}
			...				
761	mouse_transducer	transition	mouseRelease_t1	fire	12020		1*{evt:{mId=>2}}
			...				
774	mouse_transducer	transition	timerExpired	fire	12220		1*{evt:{mId=>2}}
			...				
781	mouse_transducer	transition	click	fire	12420		1*{evt:{mId=>2}}
			...				
794	mouse_transducer	transition	mouseRelease_t1	fire	13010		1*{evt:{mId=>1}}
			...				
1425	CombinedClick_Delete_File	transition	combinedClick	fire	20300		1*{evt:{x1=>40,x2=>400,y1=>40,y2=>400},presentationFrame=>javax....}
1426	CombinedClick_Delete_File	place	testIcon	tokenAdded	20300	1	Icon1,Trash
1427	CombinedClick_Delete_File	place	Frame	tokenRemoved	20300		
1428	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	20300		1*{Icon2,Trash}
			...				
1435	CombinedClick_Delete_File	transition	combinedClick	fire	22100		1*{evt:{x1=>40,x2=>400,y1=>80,y2=>400},presentationFrame=>javax....}
1436	CombinedClick_Delete_File	place	testIcon	tokenAdded	22100	1	Icon2,Trash
1437	CombinedClick_Delete_File	place	Frame	tokenRemoved	22100		
1438	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	22100		1*{Icon1,Trash}
			...				
1699	CombinedClick_Delete_File	transition	combinedClick	fire	23450		1*{evt:{x1=>290,x2=>400,y1=>40,y2=>400},presentationFrame=>javax....}
1700	CombinedClick_Delete_File	place	testIcon	tokenAdded	23450	1	null,Trash
1701	CombinedClick_Delete_File	place	Frame	tokenRemoved	23450		
1702	CombinedClick_Delete_File	transition	fileIconAndTrashNotSelecte	fire	23450		1*{null,Trash}
			...				
2897	CombinedClick_Delete_File	transition	combinedClick	fire	40340		1*{evt:{x1=>120,x2=>400,y1=>120,y2=>400},presentationFrame=>javax....}
2898	CombinedClick_Delete_File	place	testIcon	tokenAdded	40340	1	Icon6,Trash
2899	CombinedClick_Delete_File	place	Frame	tokenRemoved	40340		
2900	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	40340		1*{Icon6,Trash}

Computed Tasks with warnings

	class	type	name	action	time	data1	data2
605	mouse_transducer	transition	mousePress_t1	fire	8000		1*{evt:{mId=>1}}
			...				
609	mouse_transducer	transition	mouseRelease_t1	fire	9900		1*{evt:{mId=>1}}
			...				
613	mouse_transducer	transition	timerExpired	fire	10500		1*{evt:{mId=>1}}
			...				
617	mouse_transducer	transition	click	fire	10700		1*{evt:{mId=>1}}
			...				
650	mouse_transducer	transition	click	fire	10950		1*{evt:{mId=>2}}
			...				
752	mouse_transducer	transition	mousePress_t1	fire	12000		1*{evt:{mId=>1}}
			...				
758	mouse_transducer	transition	mousePress_t1	fire	12010		1*{evt:{mId=>2}}
			...				
761	mouse_transducer	transition	mouseRelease_t1	fire	12020		1*{evt:{mId=>2}}
			...				
774	mouse_transducer	transition	timerExpired	fire	12220		1*{evt:{mId=>2}}
			...				
781	mouse_transducer	transition	click	fire	12420		1*{evt:{mId=>2}}
			...				
794	mouse_transducer	transition	mouseRelease_t1	fire	13010		1*{evt:{mId=>1}}
			...				
1425	CombinedClick_Delete_File	transition	combinedClick	fire	20300		1*{evt:{x1=>40,x2=>400,y1=>40,y2=>400},presentationFrame=>javax....}
1426	CombinedClick_Delete_File	place	testIcon	tokenAdded	20300	1	Icon1,Trash
1427	CombinedClick_Delete_File	place	Frame	tokenRemoved	20300		
1428	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	20300		1*{Icon2,Trash}
			...				
1435	CombinedClick_Delete_File	transition	combinedClick	fire	22100		1*{evt:{x1=>40,x2=>400,y1=>80,y2=>400},presentationFrame=>javax....}
1436	CombinedClick_Delete_File	place	testIcon	tokenAdded	22100	1	Icon2,Trash
1437	CombinedClick_Delete_File	place	Frame	tokenRemoved	22100		
1438	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	22100		1*{Icon1,Trash}
			...				
1699	CombinedClick_Delete_File	transition	combinedClick	fire	23450		1*{evt:{x1=>290,x2=>400,y1=>40,y2=>400},presentationFrame=>javax....}
1700	CombinedClick_Delete_File	place	testIcon	tokenAdded	23450	1	null,Trash
1701	CombinedClick_Delete_File	place	Frame	tokenRemoved	23450		
1702	CombinedClick_Delete_File	transition	fileIconAndTrashNotSelecte	fire	23450		1*{null,Trash}
			...				
2897	CombinedClick_Delete_File	transition	combinedClick	fire	40340		1*{evt:{x1=>120,x2=>400,y1=>120,y2=>400},presentationFrame=>javax....}
2898	CombinedClick_Delete_File	place	testIcon	tokenAdded	40340	1	Icon6,Trash
2899	CombinedClick_Delete_File	place	Frame	tokenRemoved	40340		
2900	CombinedClick_Delete_File	transition	fileIconAndTrashSelected	fire	40340		1*{Icon6,Trash}

Current Work: Enhance Tool Support

Support analysis of logs

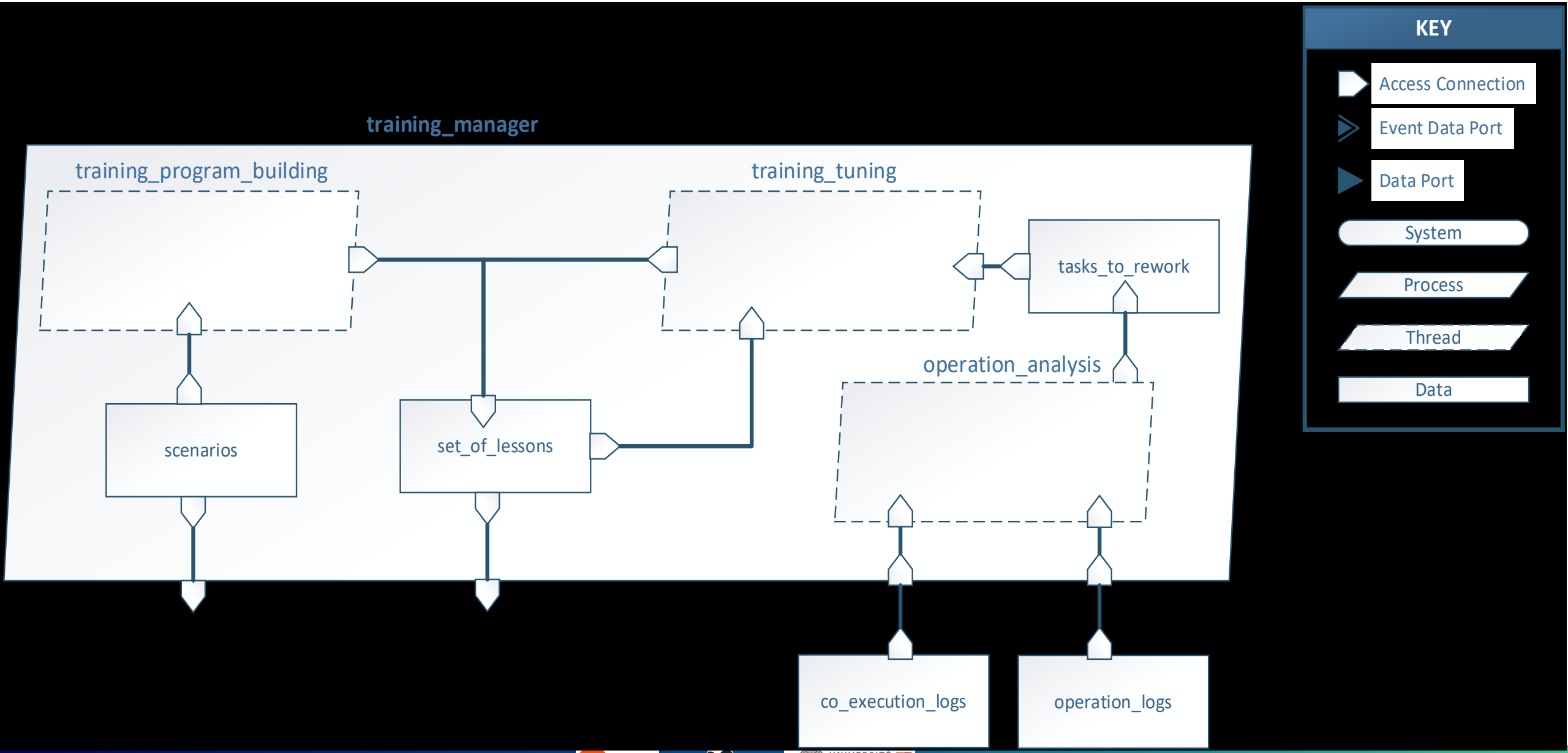
Identify tasks that must be prioritized in future training sessions

Suggest lessons improvements

Tune training to each individual based on experience during operations

Tune training to each individual based on frequency and time of occurrence of training

Future Tool Supported Training Management



Summary and future work

Recurrent model-based training: go beyond model-based (initial) training

Overcome existing limitations (incompleteness, fidelity issues, operations unawareness, cost issues)

Individual operator record and customisation of training for an individual

Support the trainer using automation

- Mapping of operation system logged events with operator's tasks
- Process indicators of memory strength, task deviations wrt. training scenarios

Support the trainer using visualizations in task models

- Completeness and consistency of the mapping
- Memory strength, errors

Supplier selection for developing the CDO ground segment development (summer 2023)

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Questions

THANK YOU FOR YOUR ATTENTION