Task analysis and modelling

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Task Analysis (Courage et al., 2012)

- Task analysis means **understanding users' work**.
  - ❖ Covers **users**, **tasks**, and **environments** (*contextual inquiry*).
- Task analysis requires *watching*, *listening to*, and *talking with* **users**.
- **Task** is what someone does to **achieve a goal**.
- **Products** are tools for users to **accomplish goals**.
- **Products** are all about **doing tasks**.

Task Analysis → Task Modeling

- **Task analysis** is meant to **identify user goals and tasks** when using an interactive system.
- **Task models** provide a mean for the analyst to **organize information gathered during task analysis**.

Task Models (Martinie et al., 2015)

- Task models can be represented in various forms, from informal textual descriptions until formal models.
- Task models can record in a **systematic**, **complete** and **unambiguous** way the set of **user goals** and the way those user goals can be performed on an interactive system.
- Reasoning about the task models supports the assessment of **effectiveness** of an interactive system (which is one of the most difficult dimensions of usability to assess).

Task Models: Uses and Benefits (Martinie et al., 2015)

- **Assessment of usability effectiveness** by identifying which tasks are supported by the interactive application and which ones are not.
- **Assessment of task complexity** in terms of perception, analysis, decision and motor action of users in order to reach a goal (Fayollas et al., 2014).
- **Assessment of operators' performance** to reach a goal (Sweargin et al., 2013), which can lead to predictive workload assessment (O'Donnell & Eggermeir, 1986).
- **Elaboration of training material** and training sessions for operators of complex systems (Martinie et al., 2011).

Task Models: Uses and Benefits (Martinie et al., 2015)

- Structuring and **elaboration of user documentation** (Gong & Elkerton, 1990).
- **Heuristic evaluation** of usability of interactive applications, not only for single user applications (Cockton & Woolrych, 2001), but also for multi-user applications (Pinelle et al., 2003).
- **Identification of user errors and their impact** on the overall performance for reaching the goals (Palanque & Basnyat, 2004), as well as preventing those user errors (Paterno & Santoro, 2001).

Task Models: Uses and Benefits (Martinie et al., 2015)

- **Identification of tasks that are good candidate for migration** towards an automation of the system (Martinie et al., 2001), but also towards other users in the context of collaboration (van Welie & van der Veer, 2003).
- Makes it possible to **provide users with contextual help** i.e., explicit information about how (which tasks to perform) to reach the goal both at design time (Pangoli & Paterno, 1995) and from the current state of interaction while interacting with the system (Palanque & Martinie, 2011).
- **Redesign of legacy systems** by analyzing extant task models and producing task models for the future system (Wilson et al., 1996).

Task Models *vs* Scenarios (Martinie et al., 2015)

Scenario	Task model
Concrete	Abstract
Flat (like a storyline)	Hierarchical (from more abstract to more concrete)
Incomplete (only represent one execution amongst many)	Exhaustive (represent all the tasks of interest)
Instances (scenarios contains the values)	Variables (only variable names are represented (possibly values on conditions))
Linear (only one story is described)	Branching (all the alternatives of activities are represented)
Explicit (all the relevant information is given)	Implicit (all details are abstracted away)
Quantitative (time, number of resources …)	Qualitative (ordering of activity, type of information needed, …)
Practical (time, number of resources,	Theoretical (errors are not represented)
Borderline (represent cases at the limit)	Mainline (represent the standard, usual activity)

Scenarios can be produced by the **execution of task models**.

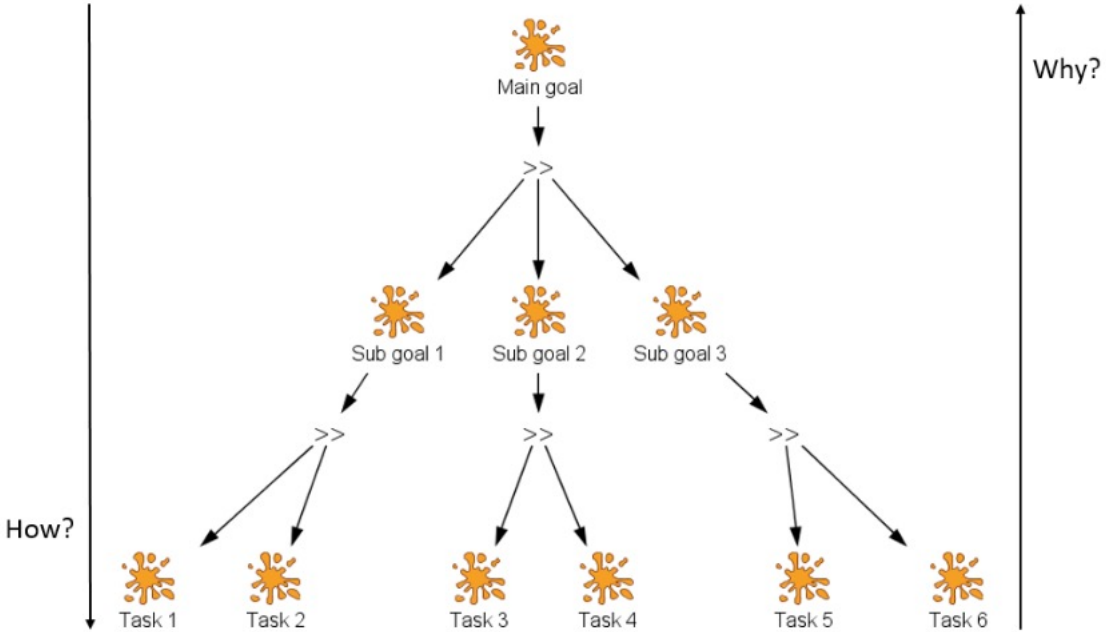
Task Modeling: Different Notations (Martinie et al., 2015)

- HTA (Meyer et al., 1967; Annett, 2004): providing support for **understanding the skills** required in complex non-repetitive operator tasks (for the steel production industry).
- CTTE (Greenberg, 2004; Mori et al., 2002): providing **support for task-centered system design**.
- GOMS (Kieras, 2004): estimating **human performance**.
- CTT (Paterno et al., 1998; Paterno & Santoro, 2002): **automatic generation** of interactive applications, and taking into account **potential human errors** at design time.

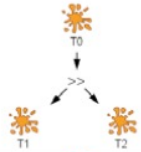
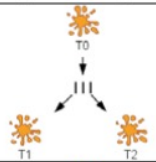
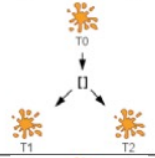
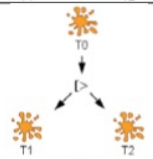
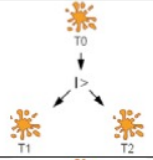
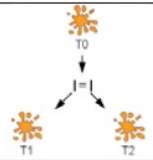
Task Modeling: HAMSTERS Notation and Tool

- HAMSTERS (**H**uman-centered **A**ssessment and **M**odeling to **S**upport **T**ask **E**ngineering for **R**esilient **S**ystems) is a **tool-supported graphical task modeling notation** for representing human activities in a **hierarchical** and **structured** way.
- A HAMSTERS task model is a **graphical tree of nodes** that can be **tasks** or **temporal operators**.
- Installation instructions are available at: https://www.irit.fr/ICS/tools/

HAMSTERS: Hierarchical Structuring



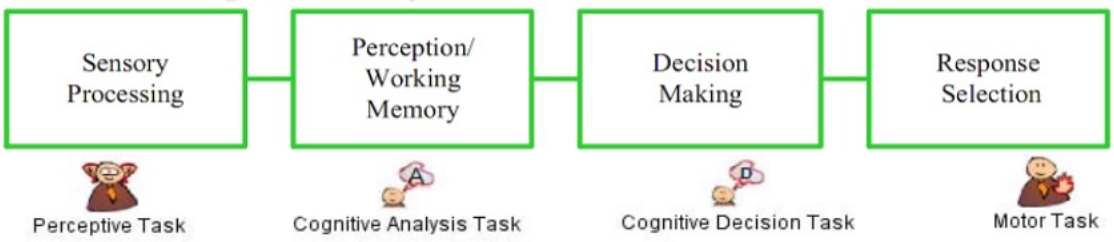
HAMSTERS: Temporal Operators

Temporal operator in a task model	Operator type	Description
	Enable	In order to accomplish T0, T2 is executed after T1.
	Concurrent	In order to accomplish T0, T1 and T2 are executed at the same time.
	Choice	In order to accomplish T0, T1 is executed OR T2 is executed
	Disable	In order to accomplish T0, execution of T2 interrupts the execution of T1
	Suspend - resume	In order to accomplish T0, execution of T2 interrupts the execution of T1, T1 execution is resumed after T2.
	Order independent	In order to accomplish T0, T1 is executed then T2 OR T2 is executed then T1

HAMSTERS: Basic Task Types

	Abstract	**Input**	**Output**	**I/O**	**Processing**
Abstract	 Abstract	Not Applicable	Not Applicable	Not Applicable	Not Applicable
User	 User abstract	 Perceptive	 Motor	 User	 Cognitive
Interactive	 Abstract interactive	 Input	 Output	 Input/Output	Not Applicable
System	 Abstract system	 Output	 Input	 Input/Output	 System

HAMSTERS: Cognitive User Tasks

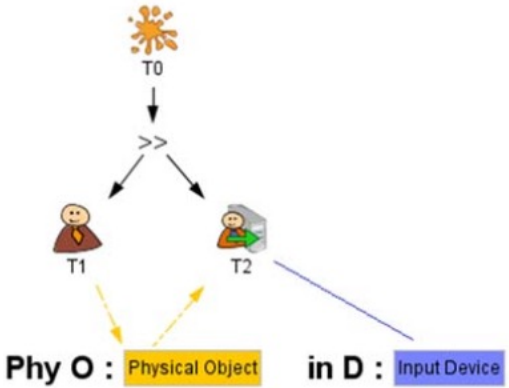


Refinement of **user tasks** according to Parasuraman et al. (2000)

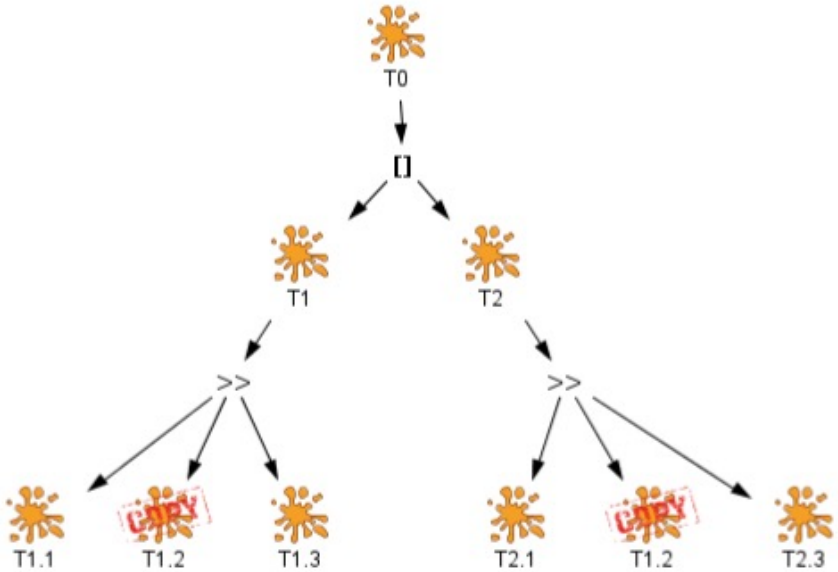
HAMSTERS: Task Properties

HAMSTERS: Information Representation

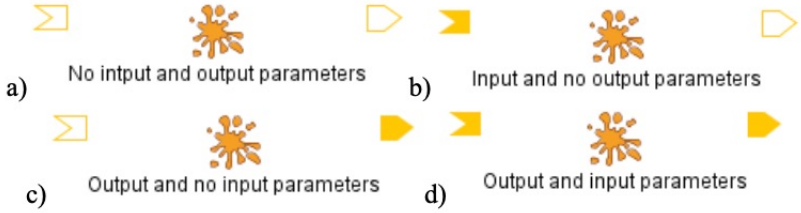
Inf :	Information (user side)	**i/o D :**	Input device
Phy O :	Physical object (user side)	**i/o D :**	Output device
Phy O :	Physical object (system side)	**i/o D :**	Input/Output device
Obj :	Object (system side)	**Sw A :**	Software Application



HAMSTERS: Structuring Mechanisms

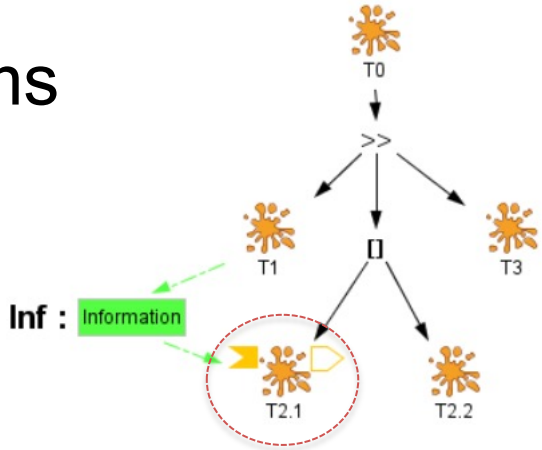


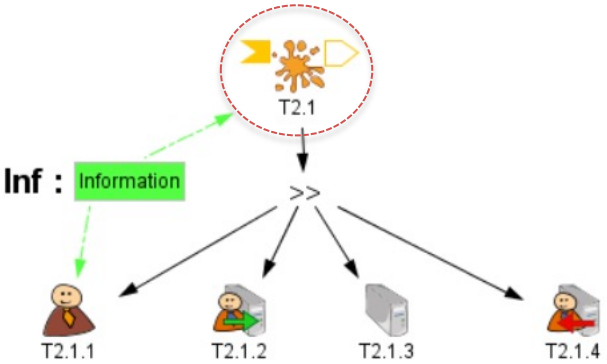
HAMSTERS: Structuring Mechanisms



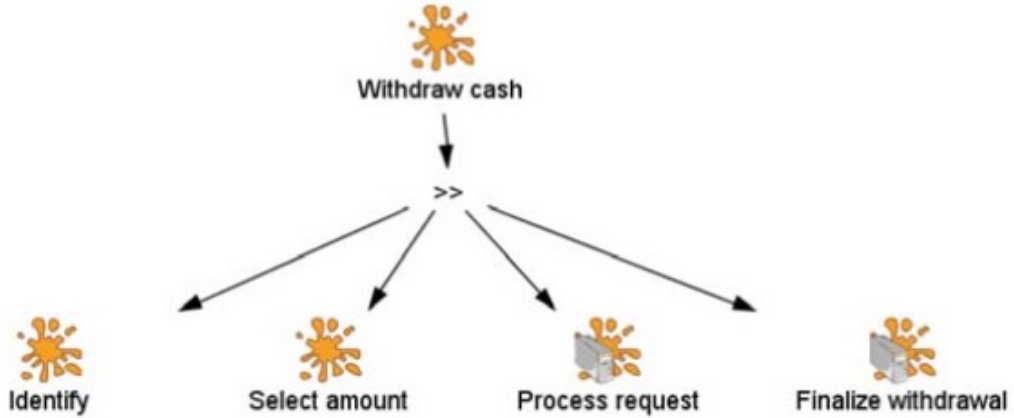
Subroutine

Component

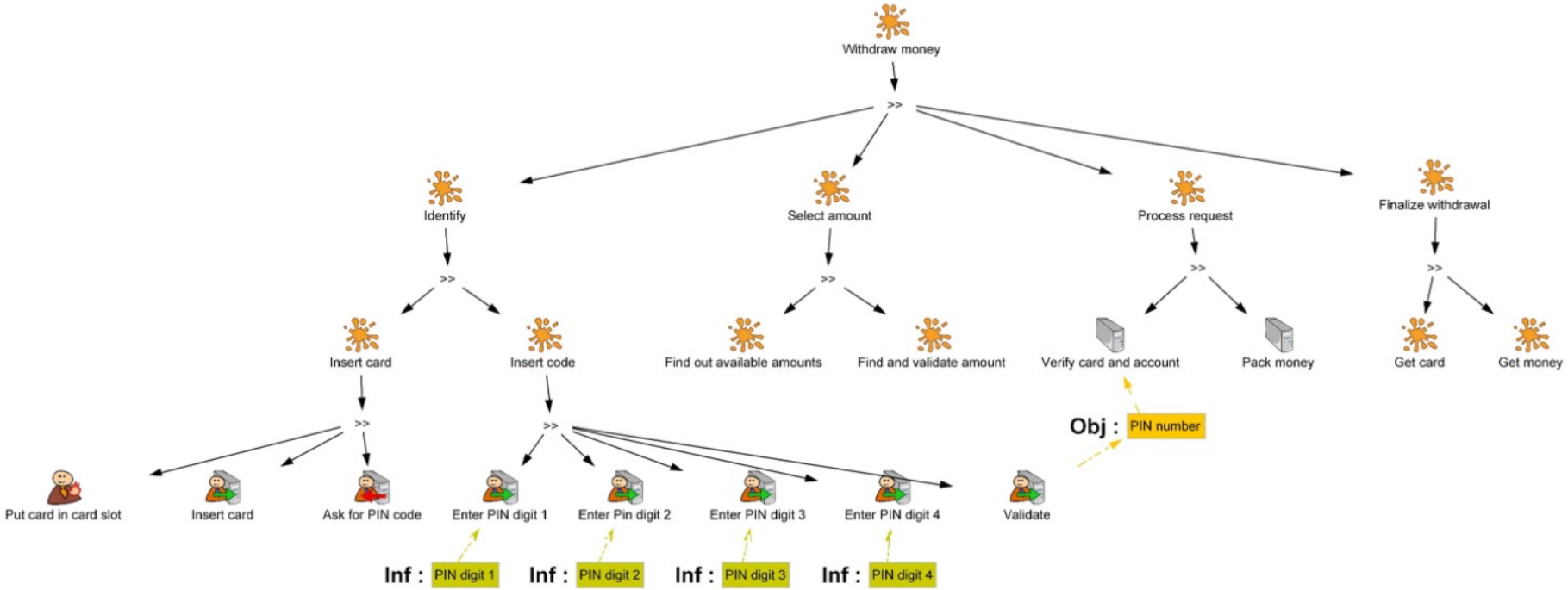




HAMSTERS: ATM Example



HAMSTERS: ATM Example



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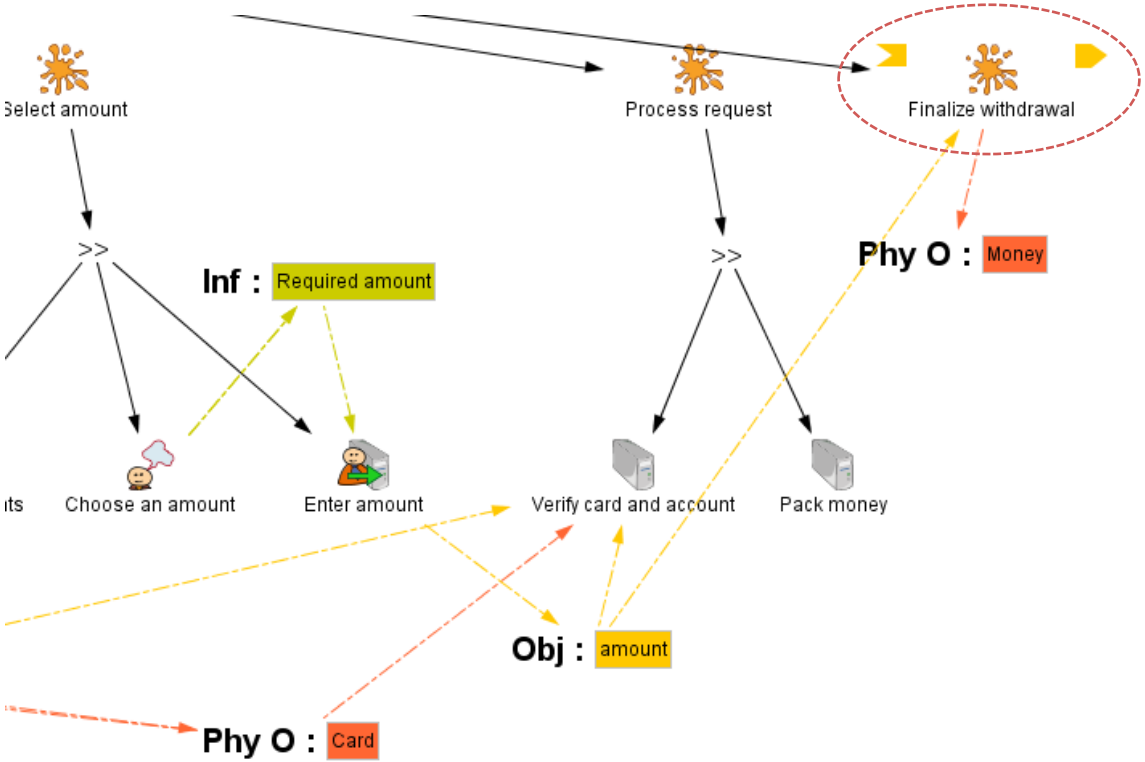

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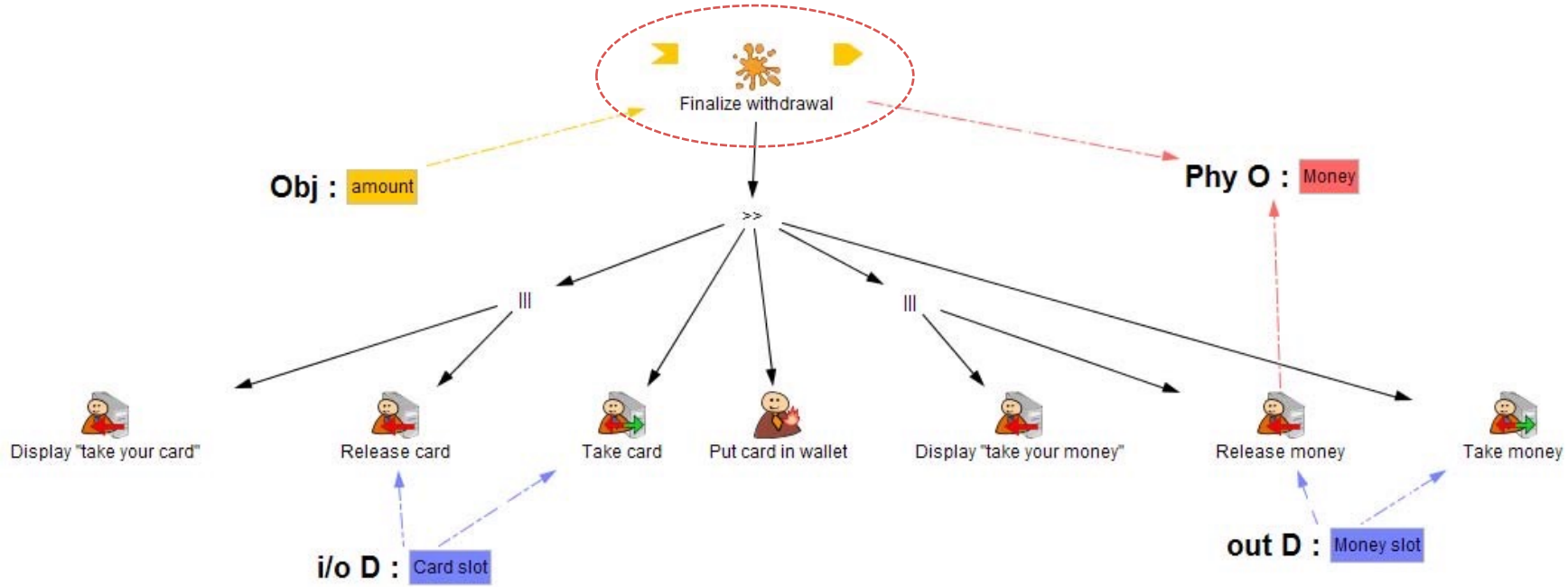

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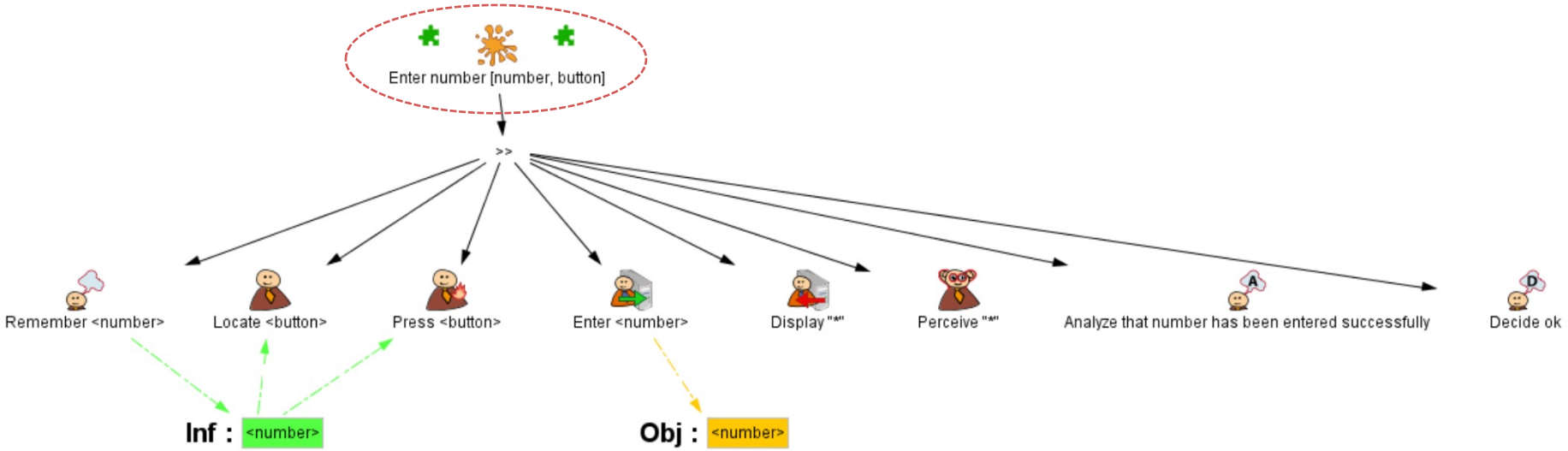
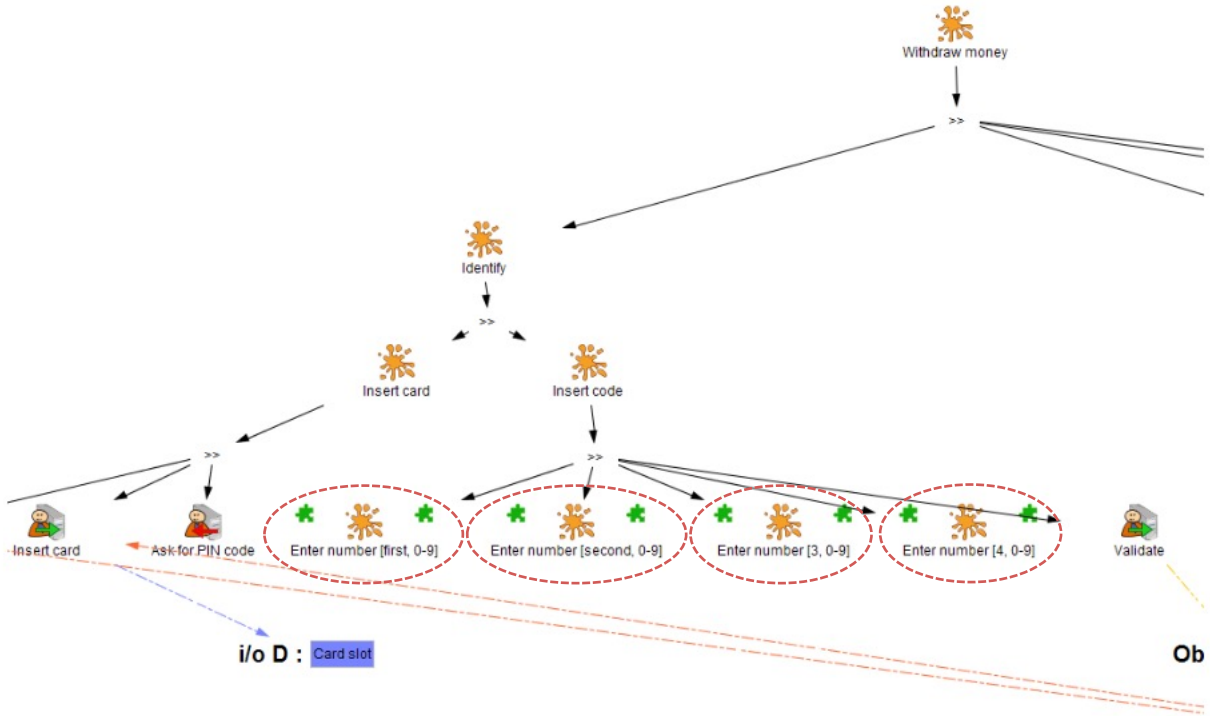
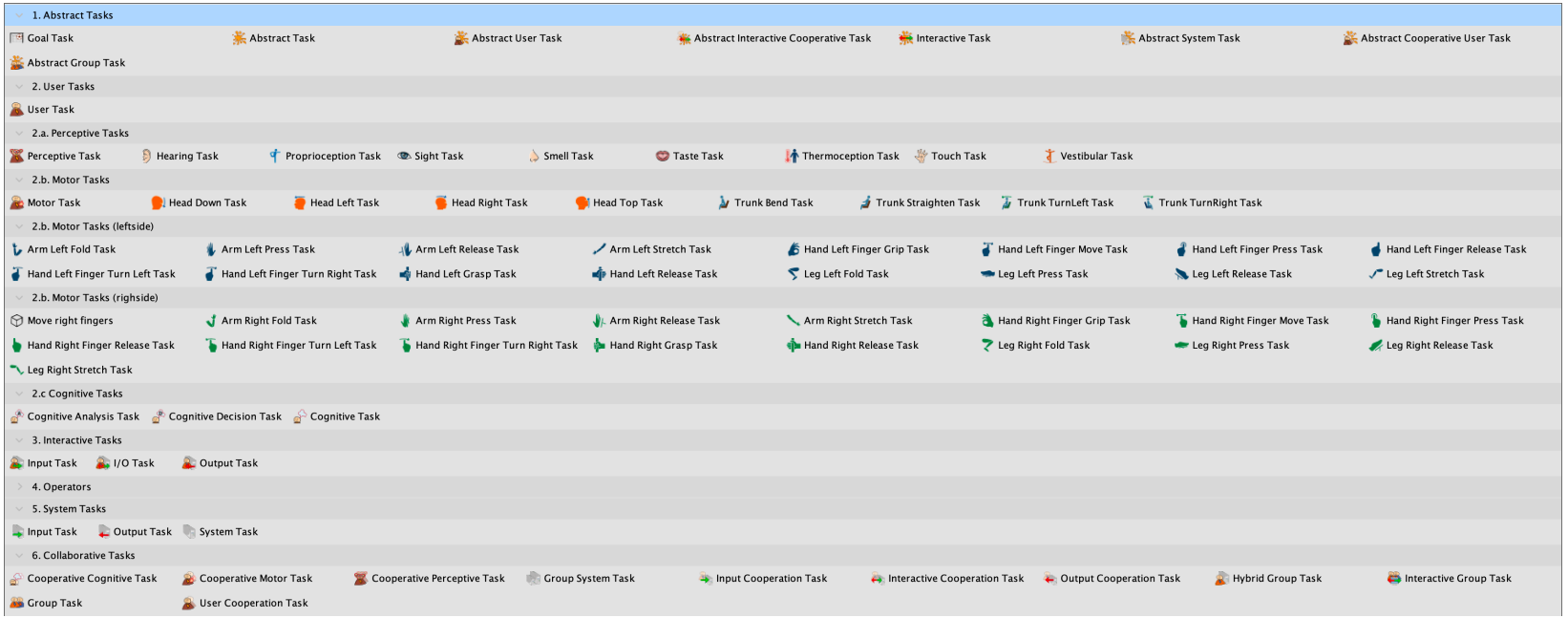


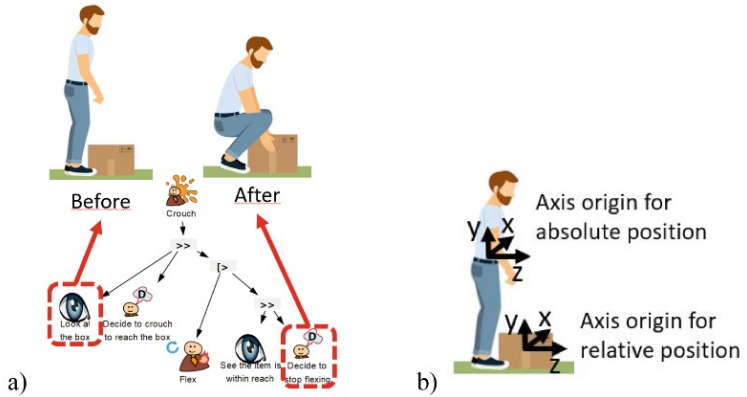
HAMSTERS: ATM Example

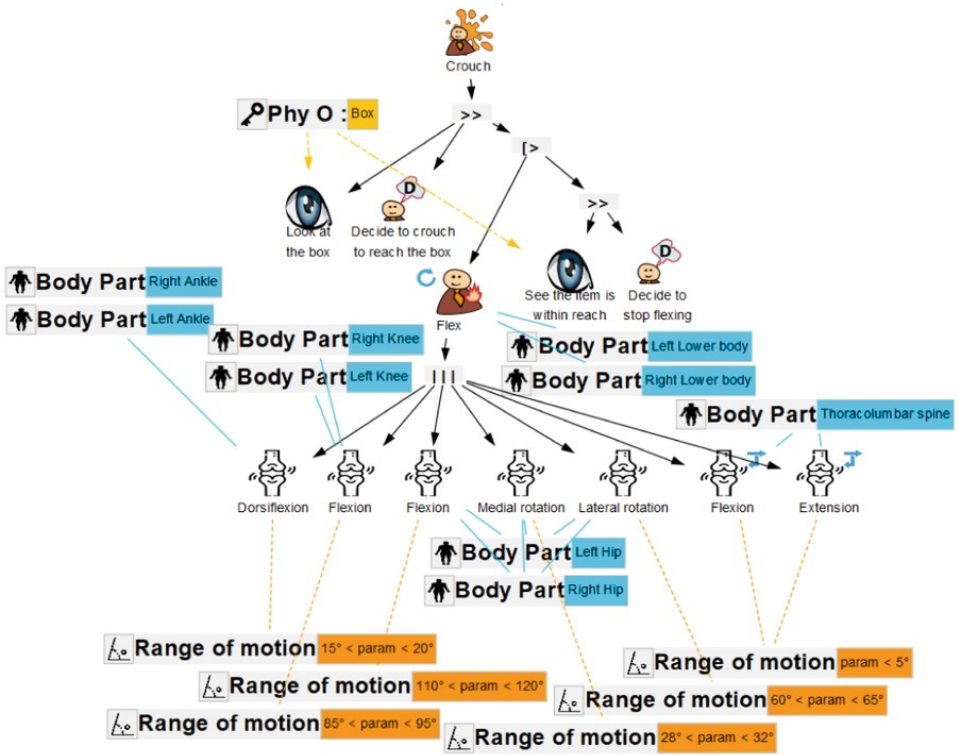


HAMSTERS: Very comprehensive set of task types



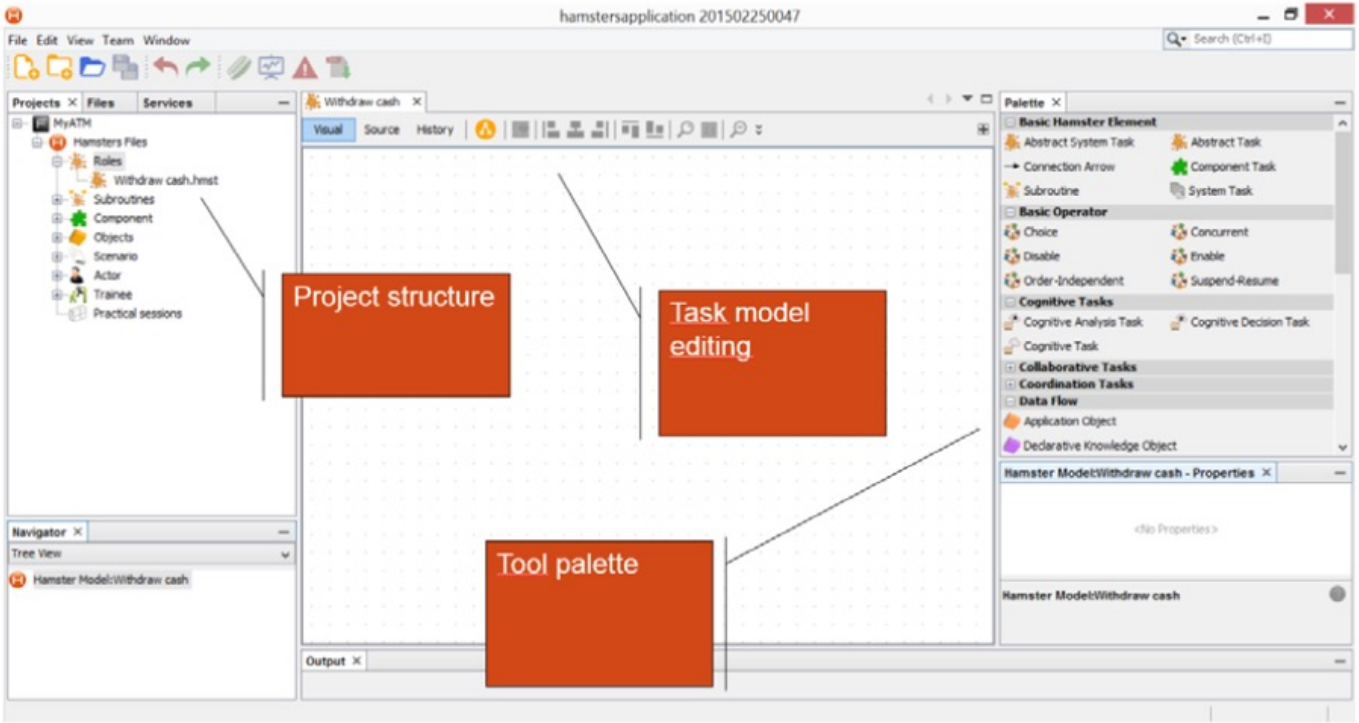
HAMSTERS: Recent example (Carayon et al., 2023)





Axel Carayon, Célia Martinie & Philippe Palanque (2023), “I Perform My Work with My Body Too: Integrating Body Representations in and with Task Models”, In: INTERACT 2023, LNCS vol 14143. Springer, Cham.

HAMSTERS: CASE Tool



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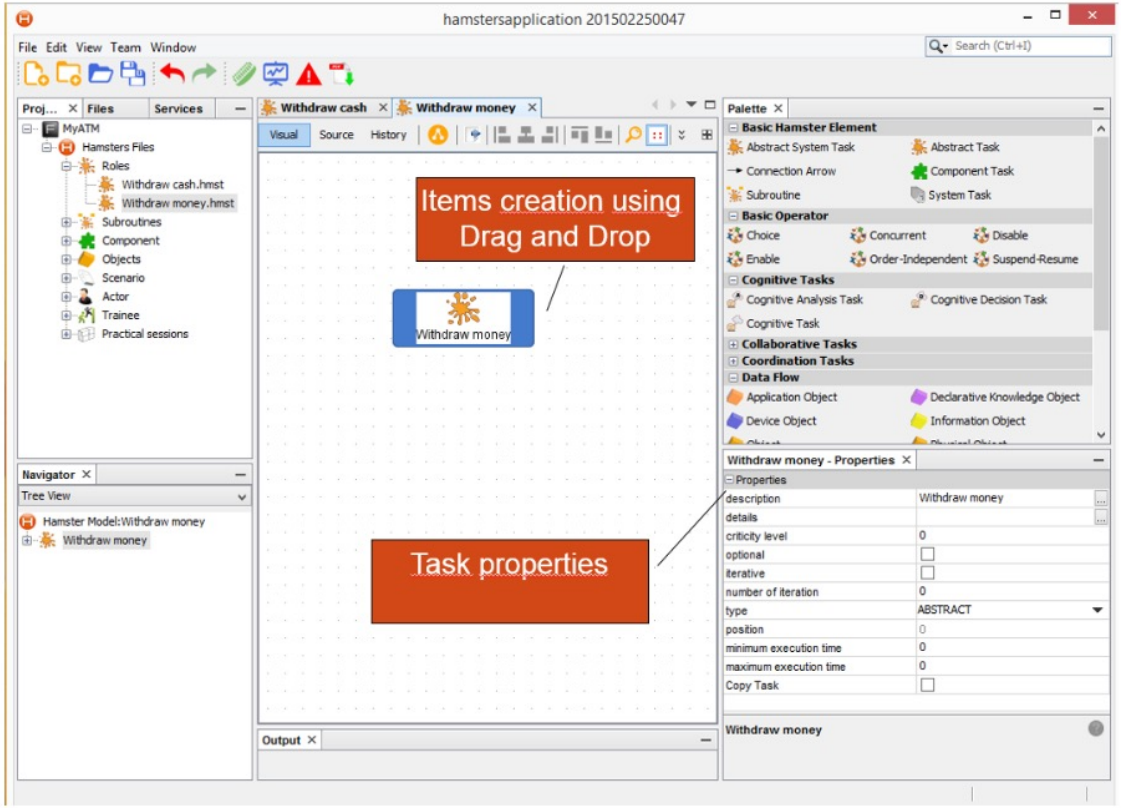
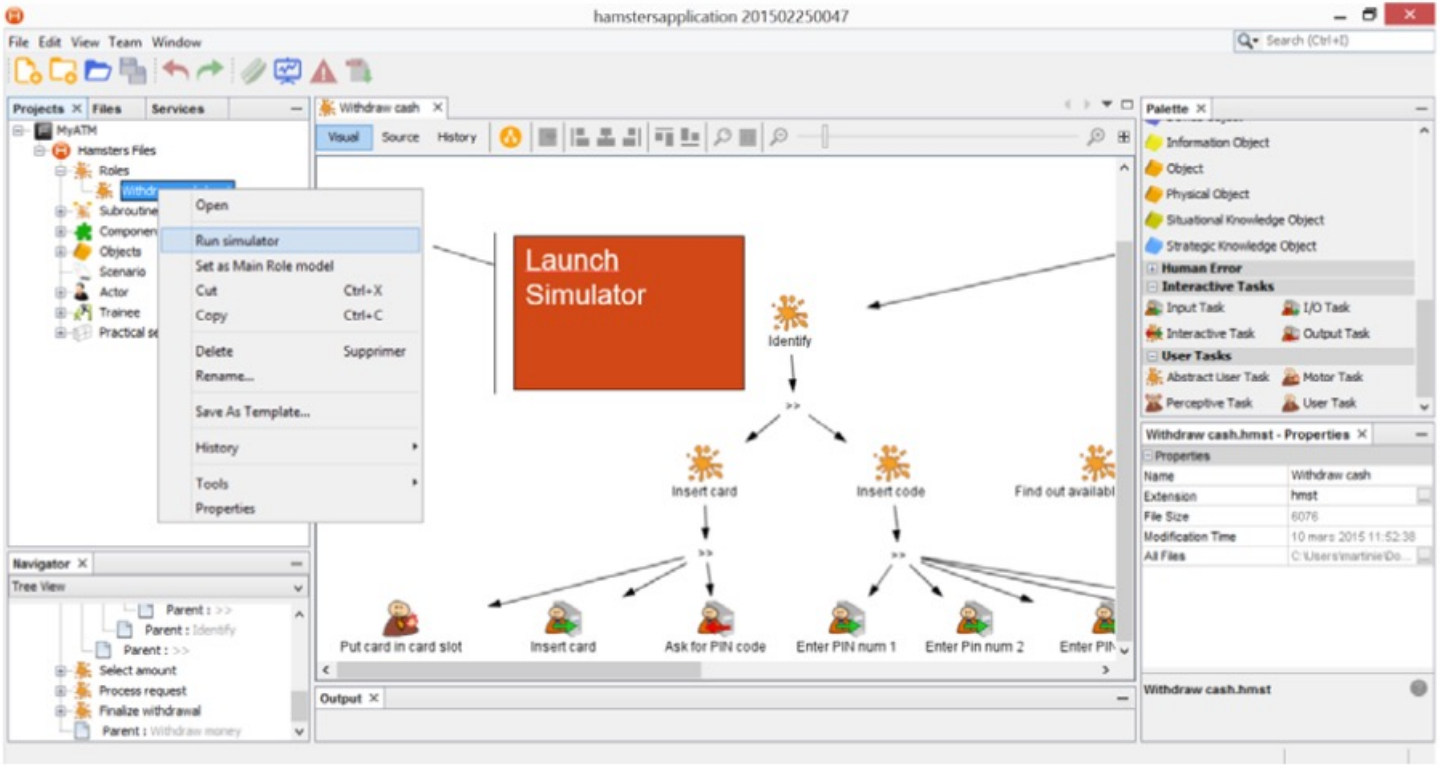
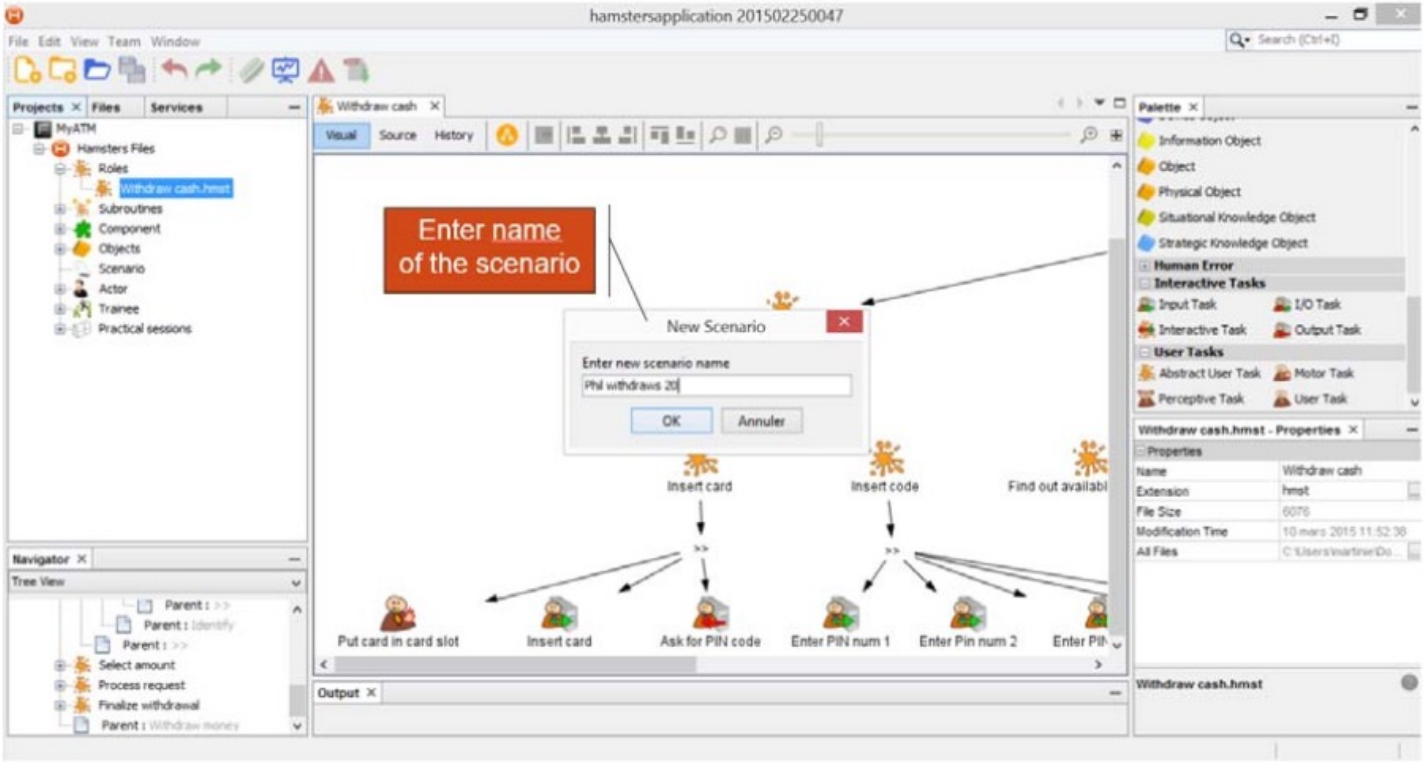


HAMSTERS: Simulation



SDU

HAMSTERS: Simulation



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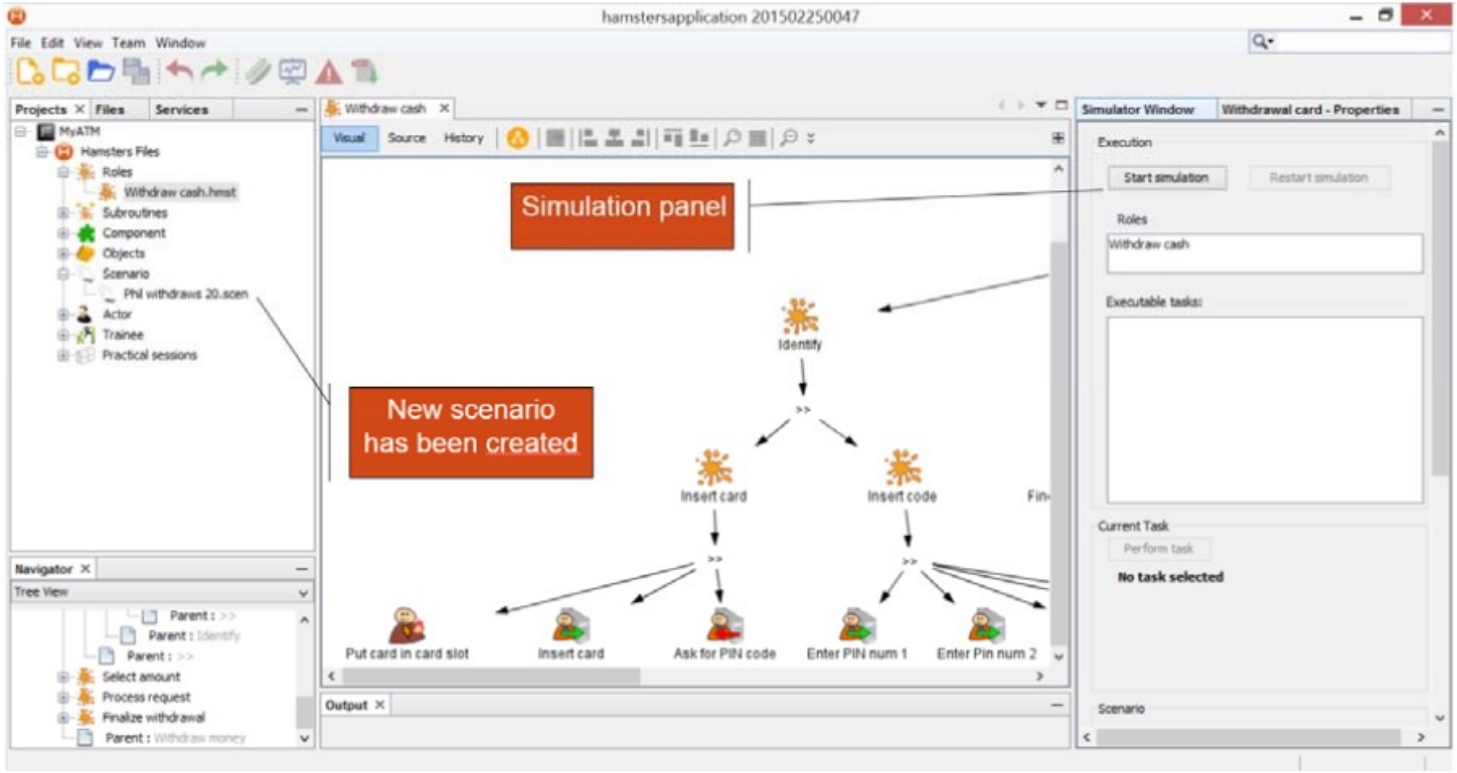
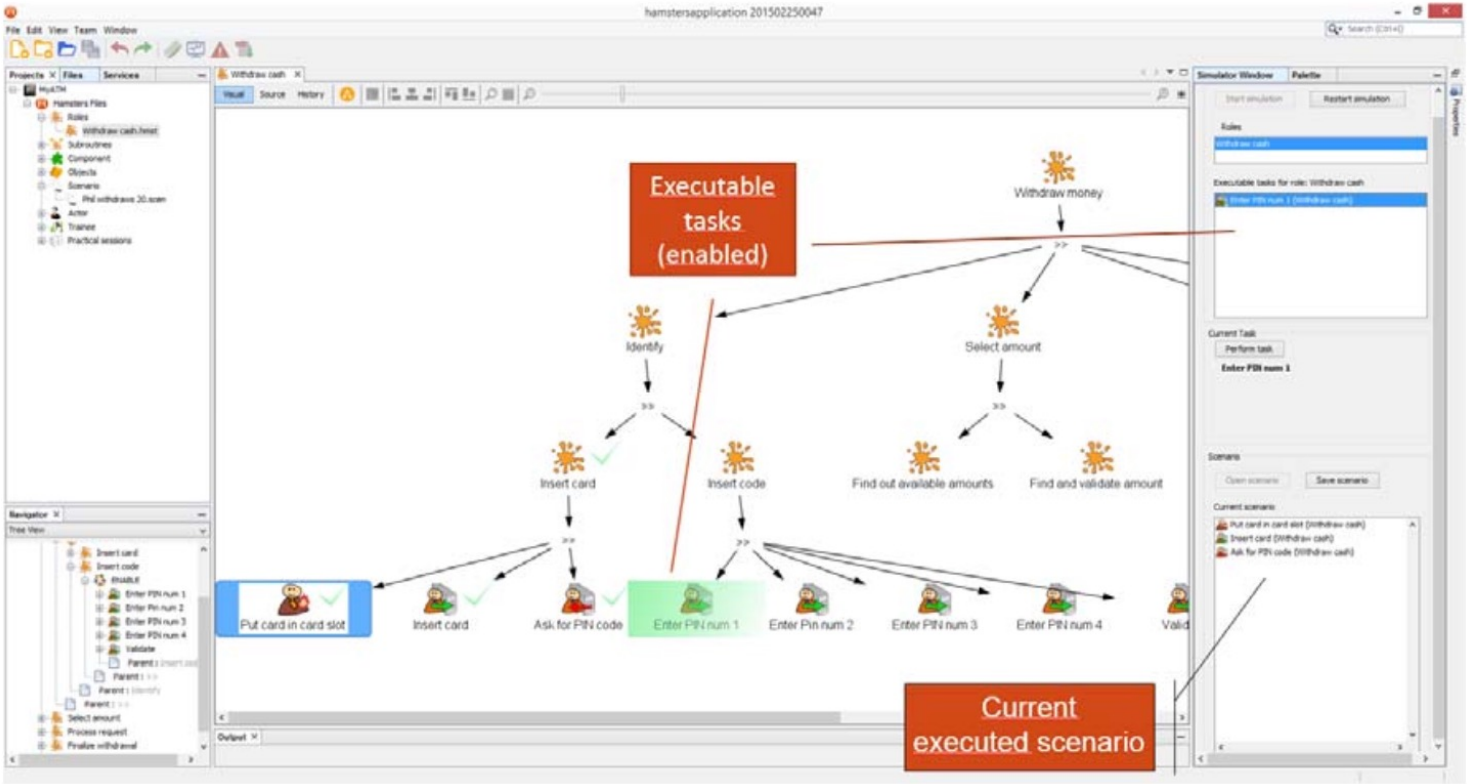


HAMSTERS: Extracting Scenarios



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