

## Project "EURO-INTERLOCKING"

### Keywords

Executable UML (**xUML**), Business Rules Approach (**BRA**), Requirements Engineering

### The Customer

The **Euro-Interlocking Consortium** is an organization of **17 railway** and **12 supplier organizations** from across Europe, whose aim is to promote the aims, objectives and work on the **Euro-Interlocking project**. The organization of the consortium is carried out under the auspices of the **UIC (International Union of Railways)** and the consortium also works closely together with the European Union and the ERTMS Users Group in Brussels. The consortium's offices are located at the **Swiss Federal Railways (SBB) in Zurich**.



### The Project



The project "**Euro-Interlocking**" aims primarily to significantly reduce the life cycle costs of future interlockings for the participating railways. This is to be achieved by the **standardization of interlocking interfaces and the development of harmonised railway requirements for interlockings that meet the current and future needs of all participating railway** infrastructure owners and the train operators using the infrastructure. The project also aims at improving the reliability and availability of future interlockings as well as promoting the international cross-acceptance of products.

### The Challenges

Among others, the major challenges of the "Euro-Interlocking" project are:

- Based on their long history, different railway companies developed **different policies** for handling their trains. Thus, one of the goals of the project is to elaborate a "common core" of such policies.
- Due to the extremely long lifetime of their products, railway companies **adopt new approaches only reluctantly**. This requires very careful consideration when introducing new approaches.
- Since interlockings are **safety critical systems**, validation and formal verification of functional requirements are absolutely crucial. Leading-edge techniques and technologies are required to fulfill these requirements.
- Since the project includes 18 different railway companies from countries all over Europe, **completely different cultures** clashed on each other. This requires a huge amount of social as well as political skills.
- The **project team is distributed all over Europe**, which requires an IT infrastructure that supports concurrent access from distributed sites.

### The Approach

As a major result, the project developed the so-called Euro-Interlocking Formal Functional Requirements Approach (EIFFRA), which may be summarized as follows:

- Definition of a **common glossary** that precisely defines all relevant terms.
- Elaboration of **textual requirements stated as business rules** in structured natural language and maintain them in the requirements management tool DOORS.
- Development of a **precise UML model** reflecting the functional requirements in an implementation-independent way and maintain them in the CASE tool ARTISAN RtS.

- **Validation** of the functional requirements **through simulation** of the UML requirements model using the xUML simulator CASSANDRA/xUML.
- **Tagging** of textual requirements as well as of UML model elements **according to the applicability for the individual railways**.

**Our Contribution**

A number of employees of KnowGravity Inc. where (and still are) involved in the "Euro-Interlocking" project. Their major contributions include

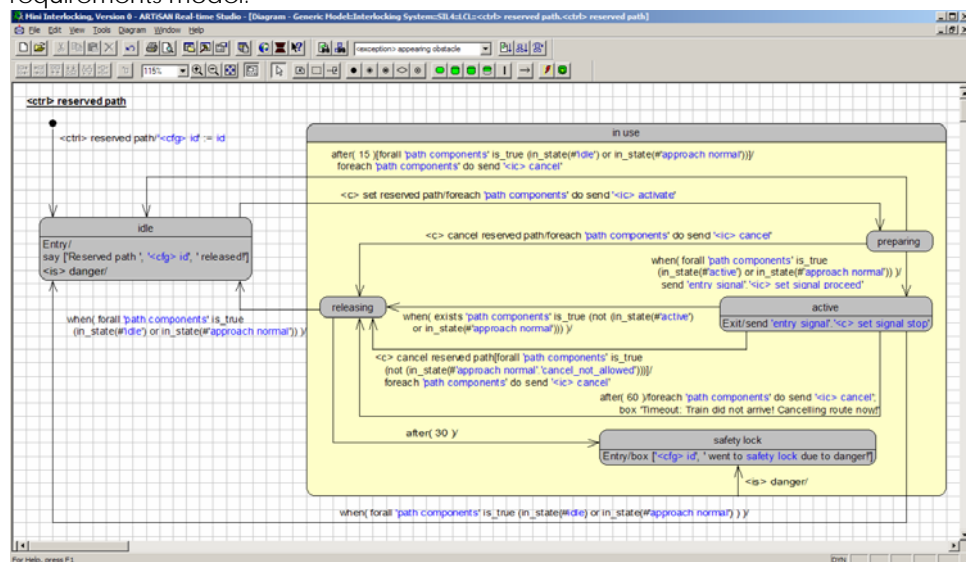
- Consulting in organizing and formalizing textual requirements based on business rules techniques.
- Provisioning of training in requirements modeling in UML for technical systems.
- Consulting in modeling implementation-independent functional requirements in a precise form of UML.
- Consulting in validating functional requirements by simulation through CASSANDRA/xUML.
- Research in formal verification of requirements models based on precise xUML.

**Examples**

The following example shows a textual requirement stated in a business rules style:

ID	Requirement	Rationale
...	...	...
Pt-299	<b>3.3.6 Detected undefined</b>	To detect a point which position cannot be defined.
Pt-579	The interlocking system shall detect a point that is not in a defined position, if one of the following conditions are fulfilled:	
Pt-580	- the point is not detected left or right	
Pt-581	- the point is not detected moving	
Pt-582	OR	
Pt-583	the time used to move a point from one position to another is greater than the defined switching time	
...	...	...

The screen shot below shows an executable UML state diagram that is part of the UML requirements model:



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