Project Management Based on Technology Modelling Applied in Transportation Safety

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Abstract

Transportation is a field where intelligent controls are intensively used. As many specialists, from various fields, are involved in the 'conception' of software according to business requirements, there is a need for technology independent modelling methods. Find out how we have applied project management using modelling of the business flows in projects like Coopers - Co-operative Systems for Intelligent Road Safety, RoRis - Vessel Traffic on Romanian part of Danube River, SafeSeaNet - System for the safety of maritime traffic on Black Sea (Romanian coast).

Key words: *project management, business flows, Unified Modelling Language (UML).*

Introduction

For all types of transportation, the producers and operators changed their focus from speed and comfort to safety, partly because the speed and comfort are already at high levels, but more important due to the general care for health and safety in all areas.

The implementation of measures needed for improving safety in transportation depends on different factors: transportation means, existing legislation, addressed individuals, local specific issues.

The need for a continuously improving infrastructure

Evolution in transport

Transport and its needs are continuously evolving. In recent years, the transport industry has been broadly evaluating security at its facilities and voluntarily taking actions to improve security. Safety and comfort is monitored, evaluated and enhanced by capturing data concerning participants to the traffic, geographic location, potential risks and the surrounding communities.

Several steps were taken in this evolution and nowadays comfort and safety is one key issue.

Step 1 – Only the vehicle was important (carts, boats, cars, ships…).

Step 2 – The infrastructure - roads, railways, airports, harbours…

Step 3 – The technology for comfort, safety and information.

The role of technology

The evolution introduces higher levels of technology in "everything". From the transportation vehicles, to the infrastructure elements, everything counts on technology now.

The technology can provide information in real-time, leading to knowledge, which leads to good decisions. The technology helps the protection of persons and goods. The technology helps preventing unpleasant events. But the technology is not easy to build.

Brief project presentations

There is a multitude of projects focused on development of transport infrastructure, increase of safety and comfort, development of the communication and so on. TeamNet was partner or provided solution in several projects such as Coopers, RoRis, Safe Sea Net.

Coopers – Co-operative Systems for Intelligent Road Safety

Coopers is a 48 months integrated project implemented by a team of more than 35 partners from 16 countries, co-funded by the European Commission – Information Society and Media – in the Information Society and Media – in the 6th Framework Programme [1]. It started in February 2006 and focuses on developing innovative telematics applications with the long term objective of enabling co-operative traffic management interfacing vehicles and road infrastructure, this enhancing road safety on European motorways.

Coopers plans to connect all vehicles on the motorway to the road infrastructure via continuous wireless communication. It provides vehicles and drivers with real-time location-based safety related information on the current traffic infrastructure status. This infrastructure to vehicle communication improves traffic management while simultaneously enhancing safety. Coopers also applies vehicle to infrastructure communication with vehicles being used as floating sensors to verify the data provided by infrastructure based sensors.

RoRis - Vessel Traffic Management and Information System on Romanian Danube

RoRis, having as beneficiary the Romanian Naval Authority, had as main objective to set up a VTMS (Vessel Traffic Management and Information System) for the Romanian Danube formed of 1 national, 4 regional and 22 local navigation centers in order to be coherent with the European RIS directives. The River Information Services (RIS) concept, which represents the most substantial change in the sector to date, is aimed at the implementation of information services in order to support the planning and management of traffic and transport operations.

The developed and implemented system had to be also integrated to the existing Inland ECDIS navigation system.

Safe Sea Net - System for Maritime Traffic Safety on the Black Sea (Romanian coast)

Safe Sea Net, having as beneficiary the Romanian Naval Authority is part of an integrated European Solution having as main objective the tracking of naval traffic and thus preventing and handling maritime accidents. The purposes of the project were to implement a system which was in accordance with the EMSA (European Maritime Safety Agency) standards, to integrate

the AIS (Automatic Identification System) information in the new system, to develop an integrate a GIS (Geographical Information System) module representing the targets with their associated information and to integrate with other existing affiliated systems.

Modelling the technology – from UML to DSL

Design, Model, Specify

As one can imagine, these projects involve a large variety of persons: engineers, business consultants, marketing specialists, politicians, managers, economists, legal specialists, architects and the list can continue. Each of the persons above has a list of documents that he or she can understand. They will understand technical descriptions, design, architecture, legislation, financial documents, strategies, but usually none of them can understand them all.

This is why, in large projects, the coordinators need to establish interfaces and 'translations' for the communication between various members of the team and stakeholders. The need for this sort of translation is an issue in most of the technical projects (industrial, software, constructions, etc), where the design combines business and technical know-how. This restricts the possibility for many of the stakeholders to understand the design of the final product before the start of production.

In some fields, this is solved by creating more deliverables. For example, an architect will generate a very detailed architecture plan used by constructors, a simple plan understood by the beneficiary and another plan required by the administration. Modern software tools help the architect generate all the documents from the same model.

Another method to fill the gap was the introduction of modelling languages. They can be understood by all individuals involved in the projects, as they usually consist of visual representations of the specifications. There is no "general solution", so we shall discuss about a modelling language that is very efficient in software design. This is the Unified Modelling Language (UML), which has become a standard in this field [2].

Beyond architecture – focusing on the business flow

So why is UML so used in IT projects?

Because it is not technical design. Because it is not the architecture of the system. Because it is not a cryptic language created for those technicians who spend all the time in front of a keyboard.

Because it can design the business flow in such a manner that it is understood by both the business and the technical persons. It can be used also for creation of test scenarios and test cases, it is used for the entire life cycle of the project. UML, or other modeling languages, gives the control to the business specialists.

Modelling a Project

This is how one can use UML modeling to accomplish important steps during the analyses and design of a project. Note that the use of UML doesn't stop here; it's used across the entire lifecycle of the project.

Table 1. Methods for accomplishing steps in modeling of a system

Step	Methods
Identification of stakeholders and other entities	Actors definition and actors diagram
Business process analyses	Business use cases
Requirement gathering	Requirements model
System analyses - functionalities	Use cases
Definition of testing methods and criteria	Test cases, derived from the use cases

Details – defining the blue-print of the system:
    Interactions.
    Data flow.
    Entity relationship (business entities, database entities, …).
    Workflows.
	Structural diagrams:
	    Components diagram, Class diagram, Package diagram, Object diagram.
	
	Behavior diagrams:
	    Use case diagram, Activity diagram, Sequence diagram, Collaboration diagram, State diagram, Communication diagram, Time diagram.
	    Structured information (non-visual), according to pre-defined templates.

Using an approach like the one briefly explained above, the team will make sure that it has full control over the project, by gaining traceability from requirement to implemented functionality.

UML modelling – results in Coopers Project

Find below a brief representation of the results from the modeling activities in Coopers Project.

We have created Actors (entities involved in the system – persons, institutions, devices…). The actors are hierarchically defined (specific actors linked to the generic ones) (Figure 1).

We have created the Use Cases – Each Use Case represents a single, repeatable interaction that a user or "actor" experiences when using the system. A use case typically includes one or more "scenarios" (Figure 2).

After that, for each Use Case, we have created different diagrams, depending on the type and properties of the activity that you model.

Activity diagrams are used to model the behaviors of a system, and the way in which these behaviors are related in an overall flow of the system. The logical paths a process follows, based on various conditions, concurrent processing, data access, interruptions and other logical path distinctions, are all used to construct a process, system or procedure (Figure 3).

A Sequence diagram is a structured representation of behavior as a series of sequential steps over time. It is used to depict work flow, message passing and how elements in general cooperate over time to achieve a result.

The Timing diagram defines the behavior of different objects within a time-scale. It provides a visual representation of objects changing state and interacting over time.
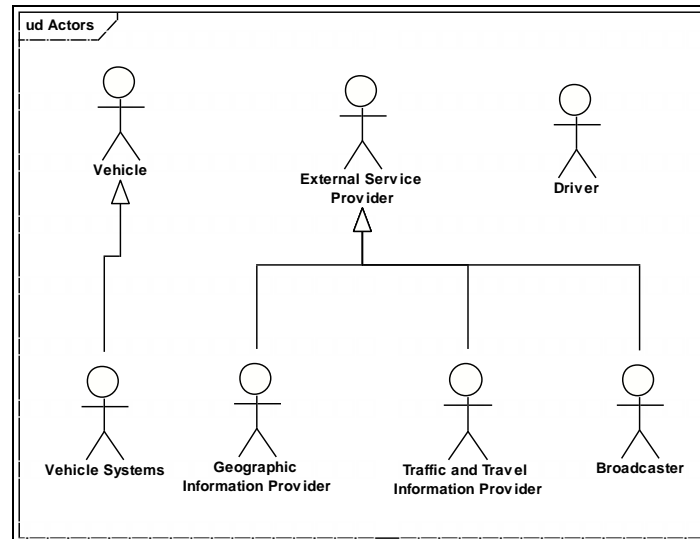
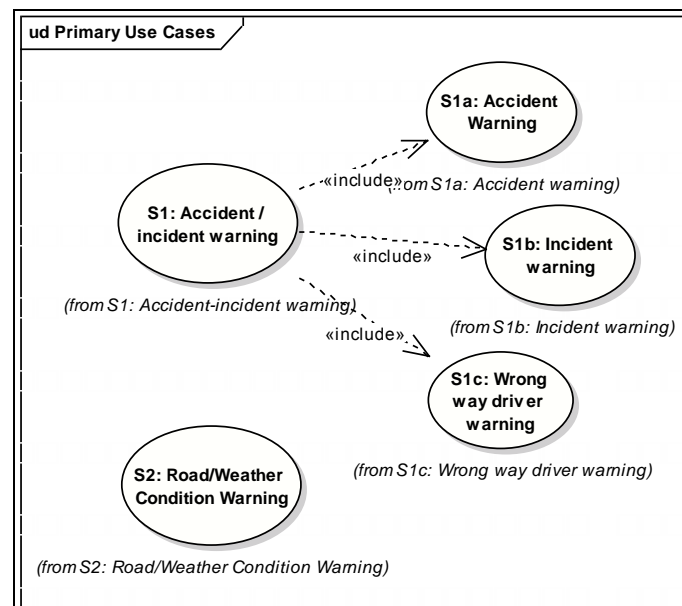**Fig. 1.** Example of UML Actors from Coopers Project.

Fig. 2. Example of UML Use Cases from Coopers Project.

A Communication diagram shows the interactions between elements at run-time in much the same manner as a Sequence diagram. However, Communication diagrams are used to visualize inter-object relationships, while Sequence diagrams are more effective at visualizing processing over time.

After the design of high level business flow, more technical details can be designed in UML using State Machine diagrams, Class Diagrams and other components.

The UML model can then be used for the generation of Test Cases (documents that will be used for testing of the system) and also for code generation.

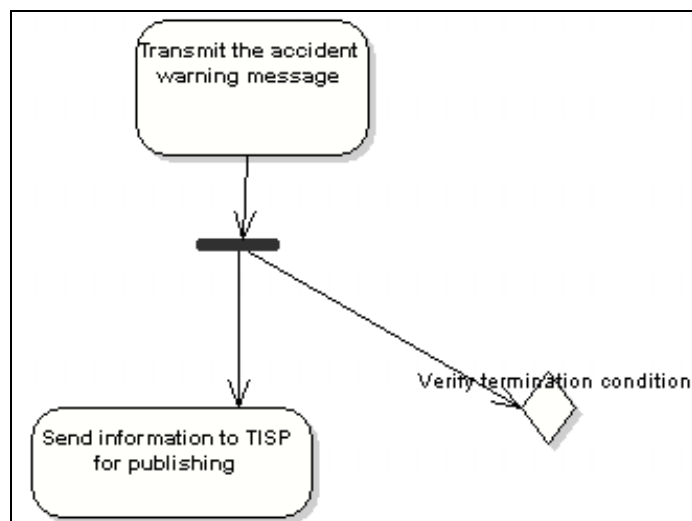The creation of Test Cases assures you that after the development, you will test the same thing that you designed.

Fig. 3. Fragment of UML Activity Diagram from Coopers Project.

Conclusions

This article presents the use of UML in complex projects, where a large variety of experts from various fields of expertise are involved. A concrete example of UML in project management of projects in the field of transportation safety was explained. UML, focusing on design of business flows and processes, proved to be an extremely useful tool capable to be understood by all stakeholders of complex IT projects.

References

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Managementul proiectelor bazat pe modelarea fluxurilor tehnologice – Aplicație în transporturi

Rezumat

Transporturile sunt un domeniu în care controlul inteligent este folosit intens. Datorită numărului mare de specialiști implicați în partea de "concepere" software a proceselor este nevoie de o metodă de modelare independentă de tehnologie. Aflați cum am modelat procesele în proiecte precum Coopers – Sisteme cooperative pentru siguranța inteligenta a drumurilor, RoRis – Traficul naval pe porțiunea românească a Dunarii, SafeSeaNet – Sistem pentru siguranța traficului maritim din Marea Neagră (litoralul romanesc).