Using Ontology and Modelling Concepts to Develop Smart Applications: Example Dutch Railway

Bas Bach, NS Railway, Amsterdam, Netherlands
Mark von Rosing, Global University Alliance, Chateau Du Grand Perray, France
Henrik von Scheel, LEADing Practice, Ottawa, Canada

ABSTRACT

Innovating one’s organizations alongside the digital transformation that the industry 4.0 and with it the internet of things enables, is a complex undertaking. This case story covers the passage and stages that the Dutch railway transportation industry went through in applying standards from bodies like ISO, OMG and LEADing Practice to developing smart applications and solutions to fit customer needs. They used these the standards together with the Business Ontology, specific the role oriented modelling concepts and managed it all in the process and application lifecycle. The case story covers the aspects of smart application development with smart cards. Like the internet has revolutionised the world, smart cards have revolutionised the traveler’s world. Smart cards are secure portable storage devices enabling millions of users around the world for advanced and easy transport flow. This case story elaborates on the Dutch Railway process of cutting edge smart application development within advanced customer process handling through the role oriented processes and services. It elaborates on the Trans Link Systems, which was established by the various Dutch public transport companies to implement a single payment system for public transport, that together with the smart card system OV-chipkaart is made available to the people using public transport in the Netherlands. The case story was chosen not only for their leading practices applied in developing the Railway customer system of the future, but specific they way they did it. Their advanced role oriented processes and services modelling and role oriented architecture thinking in developing cutting edge smart applications. Interlinking the role oriented process lifecycle with the application lifecycle to support the 5 large transport organizations business model, service model, revenue model as well as the performance model.

KEYWORDS

Application Life Cycle Management, Business Innovation, Complex Migration Scenario, Optimization, Process Life Cycle, Railway 4.0, Role Oriented Modelling Semantics, Smart Applications, Solution Architecture

INTRODUCTION

Dutch Railways

Train transport finds its roots in 1765 when a steam engine on wheels was invented. The first Dutch railway was built and opened in 1839 and today the Nederlands Spoorwegen (English: Dutch Railways) or NS is the principal passenger railway operator in the Netherlands. Where they have one of the densest networks in the world—much denser than Germany and France (Road Density, 2014). About 13% of all distance is travelled by public transport, the majority of which by train (Ward et
al., 2012). The network is mostly focused on passenger rail services and connects virtually all major towns and cities. Trains are frequent, with one or two trains per hour on lesser lines, two to four trains per hour on average, and up to eight trains an hour on the busiest lines.

NS runs 4,800 scheduled domestic trains a day, serving 1.1 million passengers. In addition, NS provides international rail services from the Netherlands to other European destinations and carries out concessions on a number of foreign rail markets through its subsidiary Abellio.

**Introduction to the Dutch Railway Trans Link System**

Dutch Railways main business is operating trains in order to transport passengers from A to B. Since 1980 they have done several tests with advanced integrated electronic payment systems in the Dutch public transport. The development of the smart card system began in October 2001 with the establishment of Trans Link Systems (hereafter TLS). At the time, “smart card” transport systems were operational in few major cities around the world. The Dutch plan was different, however, because this would be the first time such a system was established across an entire country and for all modes of domestic transport, including train, tram, metro, bus and ferry (Helping Trans Link, 2010). What many countries in the world now have, an integrated smart card system across multiple modes of transport across their state/country, all started with this journey and development. In order to create a new customer experience with smart card and smart applications, also smart role oriented processes and services needed to be created. The principle was for all public transport companies in the Netherlands to be connected collaborative and real life to one joint system. The five largest public transport companies took the initiative to set up Translink. These shareholders are:

- Dutch Railway - Nederlandse Spoorwegen (NS) – 55%
- Connexxion – 20% (tot 2008)
- Rotterdamse Elektrische Tram (RET) – 10%
- Gemeentelijk VervoerBedrijf in Amsterdam (GVB) – 10%
- Haagsche Tramweg Maatschappij (HTM) – 5%

This initiative would revolutionize the way customer systems could be joined, where systems, processes and services are combined to provide integrated value offerings to the customer. So everything had to center around the role of the customer. Together, these public transport companies provide around 80% of public transport in the Netherlands. In 2002, the first gates were tested at RET in Rotterdam with the tournicard (name of the first electronic paying system for public transport) and in 2003 the NS did tests with gates at the Hoekse Lijn. In April 2005, the system was designed so that travelers in Rotterdam could try the smart card. Trans Link Systems (TLS) was established by the five largest Dutch public transport companies to implement a single payment system for public transport (Guah, 2009): Trans Link Systems works in partnership with the carriers involved to ensure the smart cards called the OV-chipkaart is made available to the people using public transport in the Netherlands. The OV-chipkaart can be used on the bus, metro, tram and train. The collaborative initiative of five large public transport operators in the Netherlands: the main rail operator NS, the bus operator Connexxion and the municipal transport operators of the three largest cities: GVB (Amsterdam), HTM (The Hague) and RET (Rotterdam), though all public transport operators in the Netherlands now use the system. It is operated through a joint venture named Trans Link Systems (TLS). After the first smart card implementation in the Rotterdam Metro in April 2005, the Amsterdam Metro followed suit in 2006 by accepting the card as an alternative method of payment. All trams and
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