

Integrating virtual learning environments using a Service Oriented Architecture (SOA)

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Keywords

Integration, SOA, Virtual Learning Environment, process architecture.

1 EXECUTIVE SUMMARY

In 2007 the three Dutch universities of technology of Delft, Eindhoven and Twente founded the 3TU.Federation. In the area of education the universities work together in the 3TU.Graduate School. Until now five joint Masters degree programmes have been developed.

One of the ambitions of the 3TU Graduate School is to have a federated learning environment available by 2011. An IT collaboration programme was established in which several groups work together designing and implementing a federated IT infrastructure which supports the joint MSC programmes. The integration will be based on a Service Oriented Architecture, which will be developed during the next few years. In this paper we will present the results of the first step which consists of modelling the processes in the learning environment, and designing the application services needed to support these processes.

1.1 Background

The three universities each have their own, historically grown, IT Infrastructures, considerably different from each other. A Service Oriented Architecture makes it possible to integrate these infrastructures without having to discard many legacy applications, which would mean a great loss of capital as well as loss of managerial support. The 3TU Federation has adopted the SOA as the style of architecture which will be dominating in the near future.

1.2 Methods and Results

As a first step we identified a set of business processes representing the core of the virtual learning environment. The set of processes includes "apply for a learning event", "attend a course or other event", "online collaboration", "assessment", "supervision" and "information services". These processes were modelled using the Archimate modelling language. Attention was given to the different roles of the actors: teachers, students, administrative staff, managers, etc. The models were validated by a panel of teachers and students at each of the three universities. Subsequently the services were designed that are needed to support the processes.

The modelling and designing was carried out by BiZZdesign. They identified a set of approximately 80 services, which should be sufficient to implement the processes. They also identified approximately 80 objects, and gave indications for the use of standards, to enable the exchange of data objects between the institutions. As a tool they used "BiZZdesign Architect" which proved to be very useful not only for the modelling, but also for creating views for the different actors, tables for the use of objects by services, for the use of services by other services etc.

1.3 Follow-up

As a next step towards the federative learning environment we will investigate the availability of the services in the current infrastructures. If necessary, we will build new services on existing applications. One or two processes will be implemented in a proof of concept.

2 THE AMBITIONS OF THE 3TU.FEDERATION

3TU. The three universities of technology in the Netherlands (Delft, Eindhoven and Twente) have joined forces in the 3TU.Federation. Together they employ more than 9.000 staff. Almost 30.000 students are currently enrolled. This partnership, which started officially in february 2007, will enable the universities to strengthen their position, both nationally and internationally. In the area of research they work together in the "3TU.Institute of Science and Technology" (IST). The Dutch Ministry of of Economic Affairs has awarded the IST an award of 50 million Euros, which enabled them to found approximately 30 new chairs, organized in five Centres of Competence and six Centres of Excellence. In the area of knowledge valorisation the cooperation is known as "3TU.Innovation Lab". In the field of education the universities work together in the "3TU.Graduate School" (3TU.GS), which has been granted with 6 million Euros by the Dutch Ministry of Education.

The 3TU.GS has developed 5 joint master's degree programmes, four of which have been accredited by the Dutch Accreditation Authority (NVAO). These programmes consist of classes or other activities given in all three universities, with the consequence that students and teachers of the joint 3TU. programmes have to work in three different learning environments. One of the ambitions of the 3TU. Graduate School therefore is to have a federated learning environment available in 2011.

To support the joint master's programmes the IT departments of the three universities have established an IT collaboration programme containing several working groups. One of these groups is working on the architecture of the joint IT environment. A second group is designing the federative learning environment. This paper describes the first steps towards this goal.



3 METHODS

The three universities each have their own, historically grown, IT infrastructures, considerably different from each other. Discarding all existing systems (which together form the virtual learning environment, VLE) and thus creating a completely new environment would be unacceptable for several reasons. The first is the loss of capital, which would be the result of such an operation. It would also cause loss of support at the Executive Board level. Moreover, the individual universities are not "ready" to give up their own, independent infrastructures, mainly due to local sensitivities.

Integrating legacy systems is said to be a business case for the Service Oriented Architecture (SOA). Therefore it was decided to adopt the SOA principle and to start transforming the IT infrastructures towards a service orientation. This decision is in line with a general trend in Dutch Higher Education.

One important and necessary condition for the implementation of a SOA within the institutions is to focus on the management of processes. In accordance with the majority of the universities in the Netherlands the 3TU.Federation decided to adopt the Archimate modelling language to describe the processes in the virtual learning environment. See Lankhorst et al. for a description. Archimate stakeholders in the Netherlands are organized in the Archimate foundation.

To establish some form of IT governance the three CIO's have joined forces. Forming the 3TU.IT Trojka. Together they decide about those parts of the new architecture that are relevant to the working of the 3TU.Federation. They report to the 3TU.Managing Committee for Business Operations.

Finally, to provide some guidance as well as constraints to the designers and developers of the new learning environment twelve high level architecture principles have been defined. Among those are principles about integration solutions, about ownership of services or processes, about separation of user interface and functionality, about avoiding customization, "buy before make" etc.

Recent experience of other, similar collaboration projects in the Netherlands suggests that, although institutions may differ widely regarding the content of their educational programmes, the processes in the learning environment show great, sometimes complete similarity. A project was conceived consisting of the following activities. The results of activities a) to d) belong to the scope of this paper.

- a) Modelling the **processes** that should be represented in the virtual learning environment, giving attention to the viewpoint of students and teachers, as well as supporting staff and management.
- b) Designing the “external application services”, also known as “**functional services**”, needed to support the processes in the VLE. The typical structure of the layers in an Archimate model is shown in figure 1. The idea behind this approach is that functional services can be designed independently from the applications that provide the services.
- c) Identifying the **objects** that form the passive structure of the business layer in the Archimate Business model.
- d) Suggesting the use of **standards** and application profiles to enable the exchange of these objects between the three universities of the 3TU.Federation and possibly other institutions.
- e) **Mapping** the services on the existing application landscape.
- f) **Implementation** of a federated virtual learning environment, using existing services and building new ones if necessary.

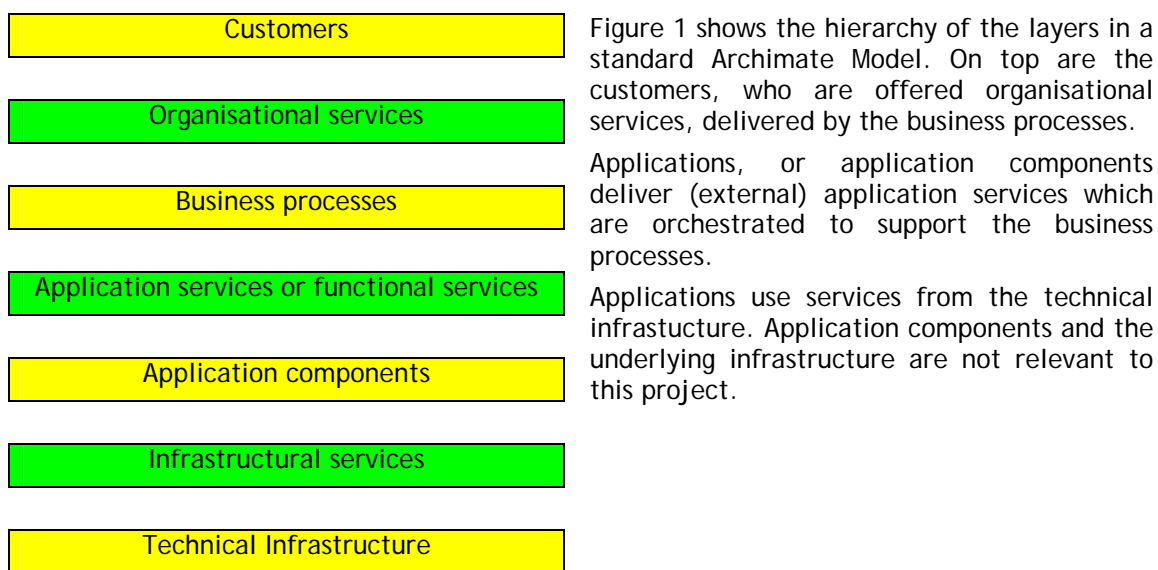


Figure 1: Layers of Archimate models

The modelling and designing was carried out by enterprise architects from BiZZdesign. They were involved in this project because Enterprise Architecture is a relatively unknown phenomenon in the 3TU.Federation. As a modelling tool they used “BiZZdesign Architect” to produce models, views, lists, tables, cross-tables etc. In view of its importance for a larger audience this work was co-funded by SURF, the collaborative organisation of institutions of Higher Education and Research in the Netherlands. As a consequence, the results obtained so far have been made available to the Dutch HE community as a whole.

4 RESULTS

The results of the study are presented in Blom and Peters (2008). The report covers the following business processes, representing the core of the educational process: “apply for a learning event”, “attend a course or other event”, “online collaboration”, “assessment”, “supervision” and “information services”. Modelling these processes lead to a list of functional services (or application services), as well as a list of objects, to be used by the processes and the services.

Table 1: the use of objects by the processes in the general information services

Processes:	Learning activity	List of attendees per activity	regulations	announcements	News messages	List of students enrolled in a programme	Profile information	results	Workflow information
get information	R	R				R	R	R	R
modify information	R, U					R, U		R, U	
publish information			R	R	R				
Formulate messages				C, R, U, D	C, R, U, D				

As an example Table 1 gives a cross-reference of the objects in the general information services versus the processes using them. Objects can be created (C), read (R), modified (U) or deleted (D). The blue processes belong to the administrative staff.

Table 2: short list of standards and corresponding objects

Table 2 gives a short list of the most important standards or specifications, followed by some of the corresponding objects. So far no decisions have been made about which standard will be applied to which object. However all standards must comply to the 3TU. Architecture principle about the use of standards which implies that the 3TU.Federations prefers to use *existing or de facto* standards.

Most work on the further detailing of standards or specifications will be done in the next step of the project.

Standard or specification	Object
IMS Question and Test Interoperability, OKI grading OSID	Assessment Feedback Test Results Test content
IMS Learner Information Profile	Student Status of student enrollment
XCRI CAP	Course Catalogue Roster
OKI workflow OSID, BPEL	Workflow information
IMS Resource List interoperability	Information on materials, needed in courses

As a last example Figure 2 gives a view, created by the BiZZdesign Architect tool which was used in this study. It contains the core process “Event-related Information Services”, its subprocesses and the corresponding application services. Such views can easily be constructed for all processes in the Archimate model. They proved to be very useful for communication with the different stakeholders.

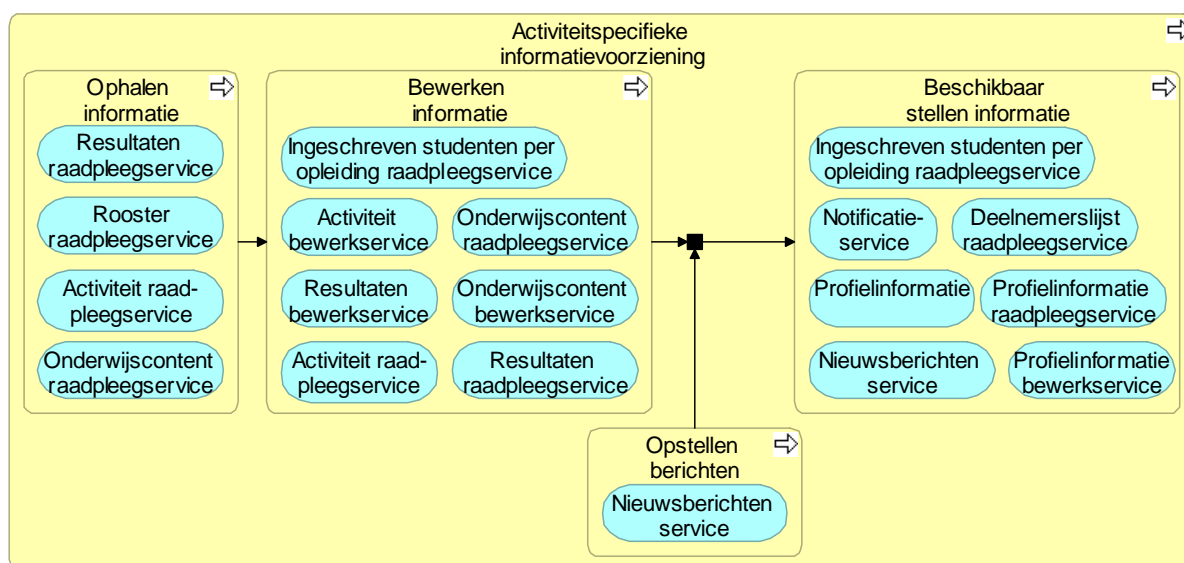


Figure 2: Subprocesses and application services in the core process “Event-related Information Services”.

5 CONCLUSIONS AND FOLLOW-UP

The enterprise architects involved in the project have spent approximately 5 months to model the core processes mentioned above. The processes were reviewed and validated by students and teachers in several workshops. They identified objects and services in a generic way, i.e. they did not use names or functionality of existing applications. They constructed a list of standards or specifications to be used to enable the exchange of data objects. Applying the different views produced by the tooling they were able to communicate the results of the study to the steering committee of the project. Several conclusions can be drawn from the results so far:

- i. Complex processes can be modelled in a relatively short time using the right tools.
- ii. Complex process models can be communicated to non-experts using the right views.
- iii. Most of the processes and application services in the federated virtual learning environment of the 3TU.Federation can be described on a generic level. These descriptions apply to all three universities in the federation.
- iv. Standards or specifications are even now available for many objects in the model.

Much work remains to be done. On the short term following actions have been planned.

- A committee will be installed to oversee the further detailing of standards and functional services. This committee will report to the 3TU.IT Trojka and will have the authority to “enforce” the standards and services in the three universities.
- In a parallel project, the universities of Delft and Twente have chosen a new Student Information System. Process descriptions originating from this project will be added to the model.
- One or two simple processes will be validated and implemented in a proof of concept.
- The list of services, needed to support the processes in the VLE, will be mapped on the current application landscape. Missing services will be designed and built.
- Developers in the three universities will be trained to use Archimate concepts and tools.

Finally, Figure 3 shows the target Architecture for the 3TU.VLE. Note that the middleware connects the three universities both to each other and to other institutions. Also note that there is no “3TU. Portal”! The individual branding of the three universities remains intact. All functionality can be accessed from individual websites of the three partner universities. Data can be retrieved from underlying sources, located at the 3TU’s.

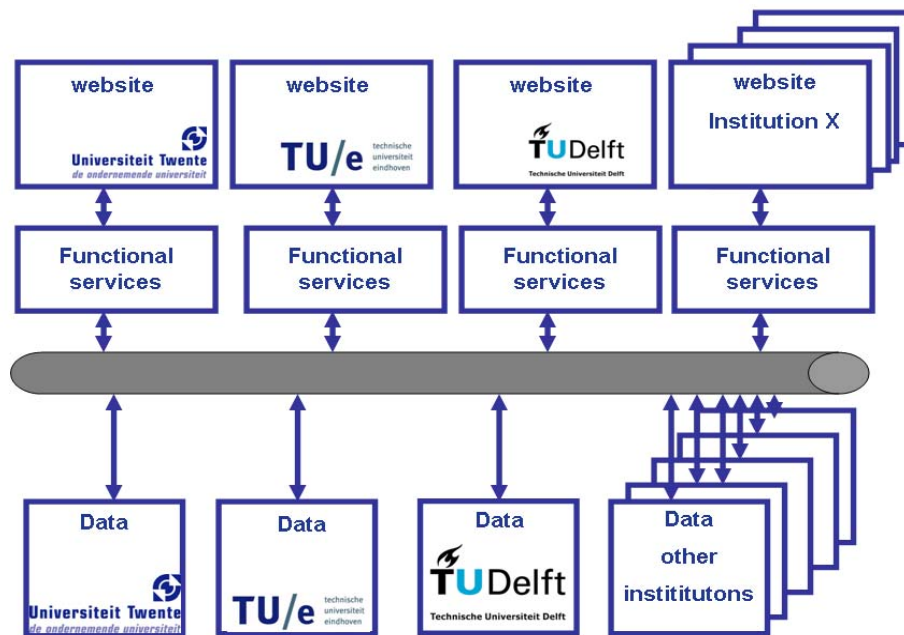


Figure 3: 3TU. Target Architecture

6 Acknowledgements

This work was funded by the 3TU. Federation and by SURF, which is the collaborative organisation for institutions for Higher Education en research in the Netherlands. The modelling and designing was carried out by BiZZdesign.

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