Adaptation of the Presentation in a Multi-tenant Web Information System

Aivars Niedritis, Laila Niedrite

University of Latvia

The 18th International Conference on Information and Software Technologies
(ICIST 2012)
September 13th - 14th, 2012, Kaunas, Lithuania

This work has been supported by ESF project No. 2009/0216/1DP/1.1.1.2.0/09/APIA/VIAA/044

Introduction

- **Web Information System (WIS)**
  - is a hybrid between a hypermedia and an information system
    - Important requirement: dynamic adaptation of content structure, navigation primitives, and presentation styles.
- **WIS is adaptive if it is able to modify and personalize delivery of contents and services according to the context of the client.**
    - Personalization requires the adaptation of the applications as much as possible according to the preferences of the user and the context of the user.
- **WIS usage context**
  - is considered as a set of properties that describe the environment, where the user interacts with a WIS,
    - e.g. time, place, device, user, and environment.
- **Profile**
  - is a representation of an autonomous aspect of the WIS usage context.
- **Configuration**
  - is a specification how information has to be delivered to the user

Existing approaches

- Many architectures and approaches exist for the WIS adaptation
  - based on different understandings of context, profile, and configuration.
  - different properties of each notion are considered.
- The approaches to the development of flexible and cost effective systems should also be considered
  - Software product line approach (SPL)
    - based on predefined architecture and well known core functions. All reusable components are planned in advance.
    - architecture and configuration management is essential, because each new software product consists of numerous core components and variations.
  - Software as a service (SaaS)
    - defined as a “software deployed as a hosted service and accessed over the Internet”

Software as a service (SaaS) approach

- SaaS introduces a new way of providing the access to the software.
  - services provided to organizations of different size to support business processes common for these organizations
    - e.g. CRM applications.
  - organizations subscribe to use the software and pay for the usage.
  - service vendor hosts the SaaS application on their servers and maintains the software and infrastructure.
  - a cost efficient solution for small and medium size organizations.
- SaaS applications can be provided at four different maturity levels
  - e.g. customized application instance per each customer on the SaaS vendor's server.
  - More advanced way - configurable, multi-tenant single instance solution.
    - customization is performed using the metadata based configuration.
- The multi-tenancy
  - users from different organizations use the same application instance, but data are distinguished between tenants of the service.

Problems with multi-tenancy

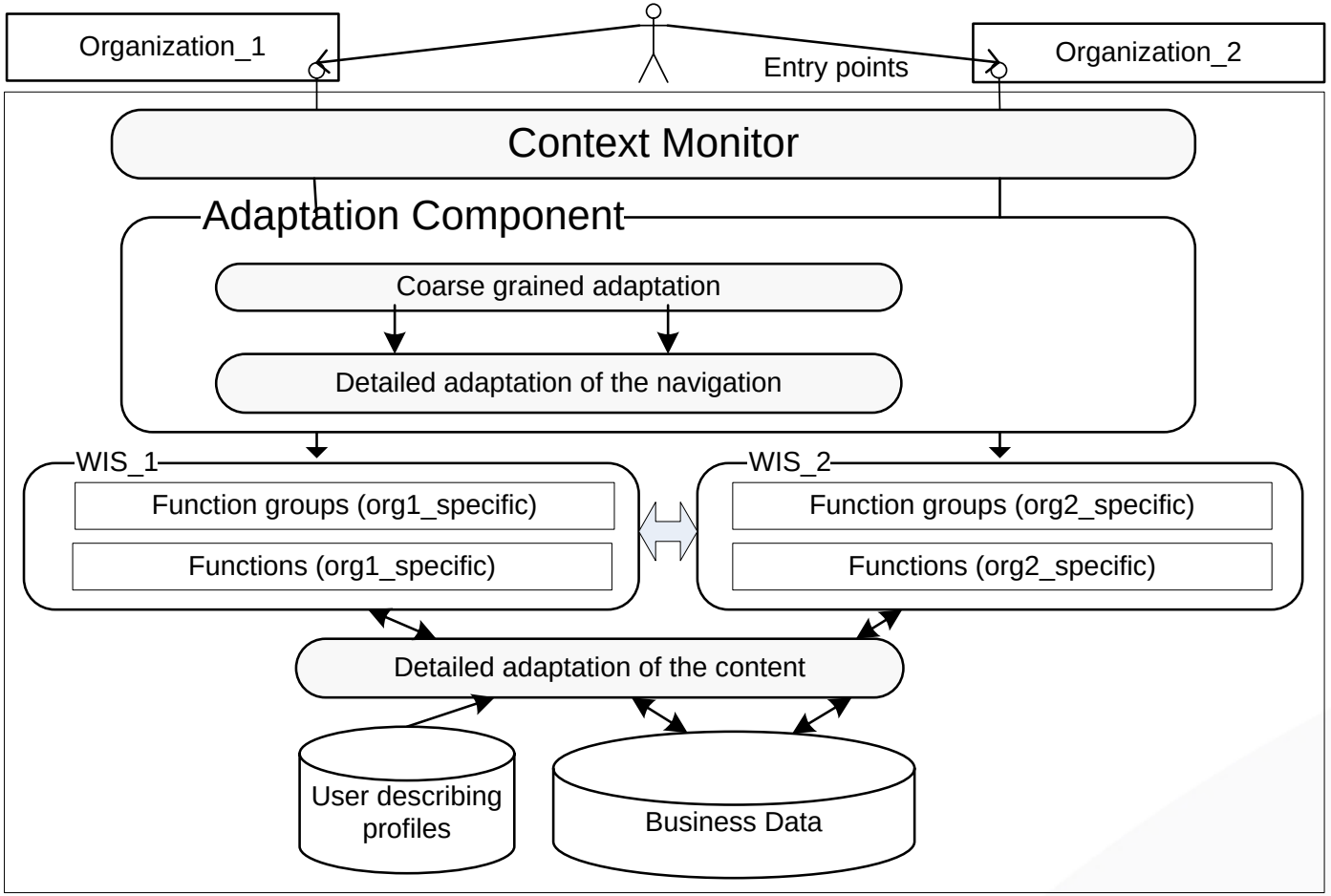
- The user could be a customer of more than one organization that uses the same SaaS approach based WIS.
- In case of multi-tenancy WIS meets with problems how to create, update and deliver consistent data to the organizations and users and how to present it in a user interface

The adaptation architecture

- To effectively solve the problems concerning scalability, configuration and multi- tenancy, the SaaS applications need architectures designed for these purposes.

- Our proposed architecture (in our previous research):
  - based on multi-tenancy, single instance approach
  - two level adaptation is introduced.
    - Organizations and also the users get their own adapted instance of the WIS

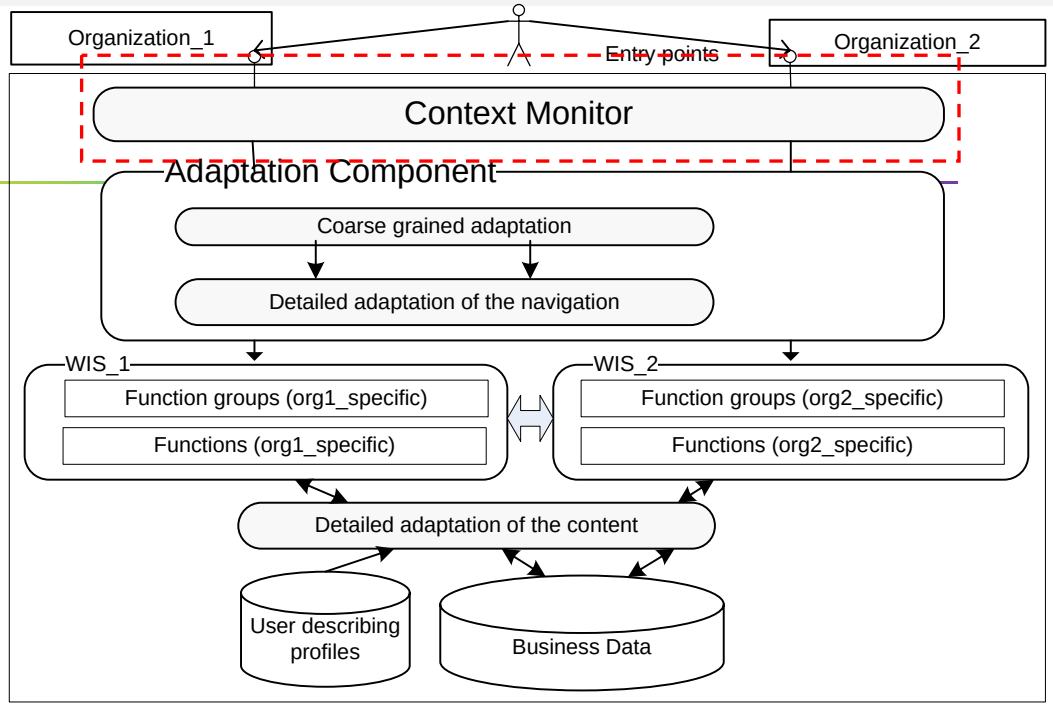
The adaptation architecture of WIS

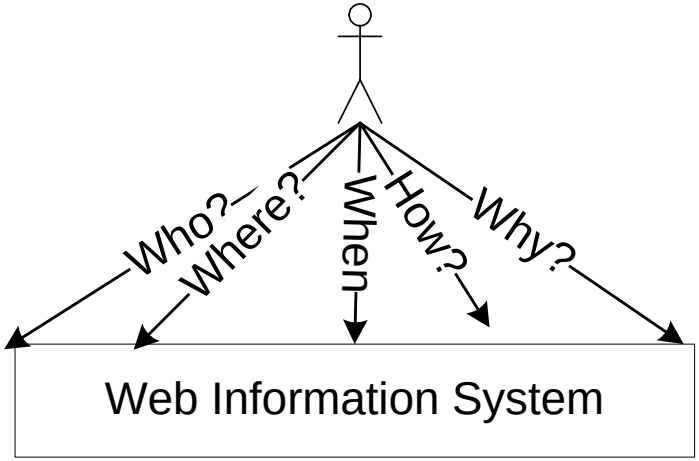


- Context monitor; Adaptation component
- Adapted instances of WIS; WIS data layer

Context monitor

- Context monitor identifies:
  - context properties of WIS usage
  - user, place, time, media used for the interaction

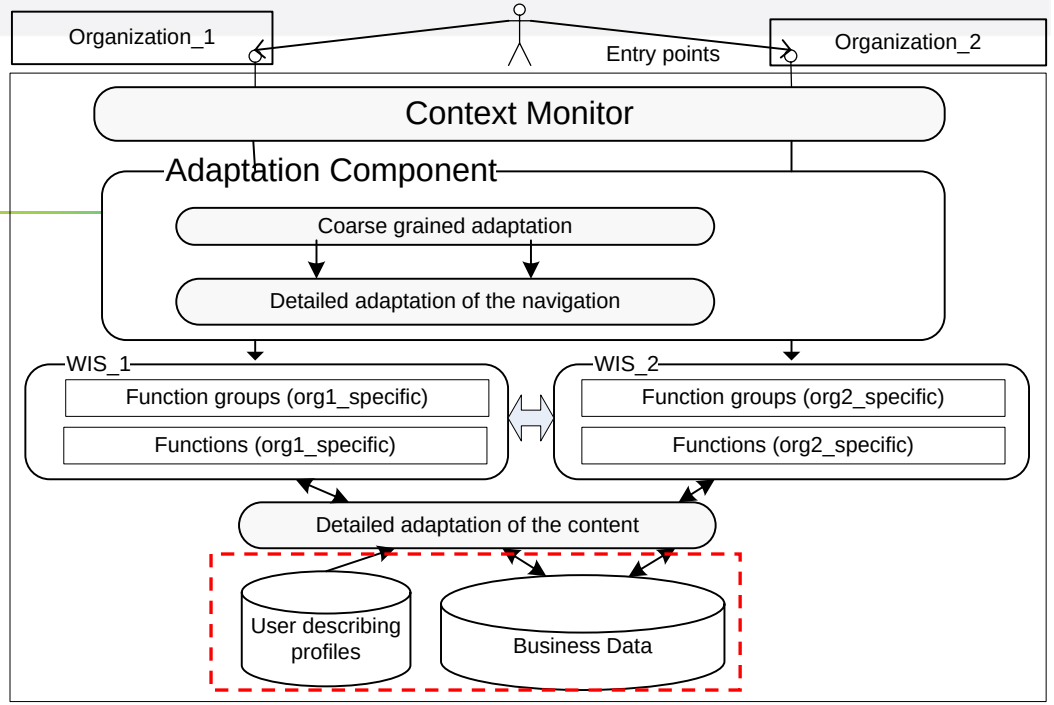




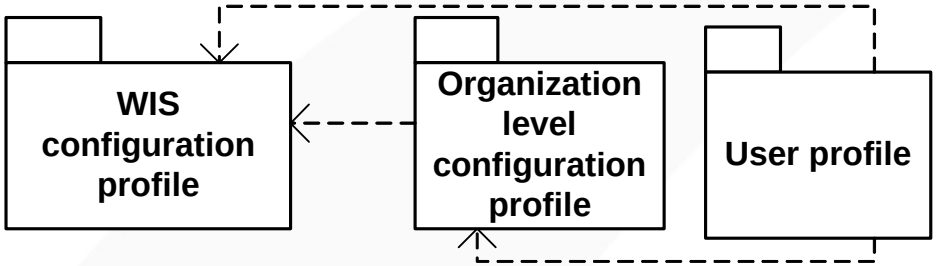
Who? -user properties- identity, professional characteristics
Where? - place, which identifies the systems accessibility
When? - time - date, clock
How? - media used and its properties e.g. mobile devices
Why? - the goal of the performed action

WIS data layer

- WIS data layer contains:
  - profiles used in both adaptation levels
  - business data

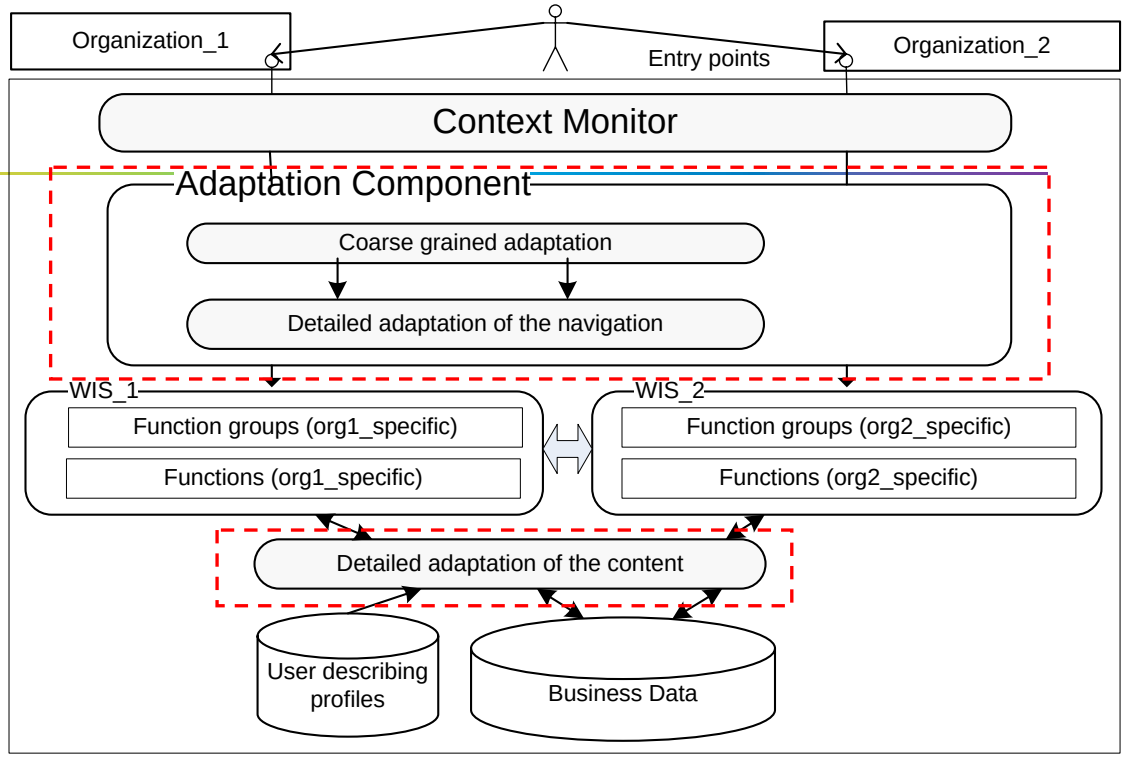


- Profiles in the proposed architecture describe:
  - WIS configuration profile
    - existing components of WIS
  - Organization level configuration profile
    - organization and WIS configuration, specific for each organization
  - User profile
    - user and his access rights



Adaptation component

- Adaptation component:
  - determines the initial configuration of WIS
  - performs adaptation in two levels:
    - Coarse level (organization level)
    - Detailed level (user level)



- Organization level instances of WIS are created during coarse level adaptation.
- The detailed adaptation performs:
  - navigation adaptation
  - detailed adaptation of content
    - user's data from all WIS instances, available to the particular user, is integrated into one user interface of WIS

Two level adaptation

- Coarse level adaptation
  - recognizes the groups of functions that are accessible to the user:
    - according to the usage context, e.g. access point, time, and organization.
  - According to the profiles (e.g. time, organization) defined in the system, this process establishes an organization level instance of WIS.

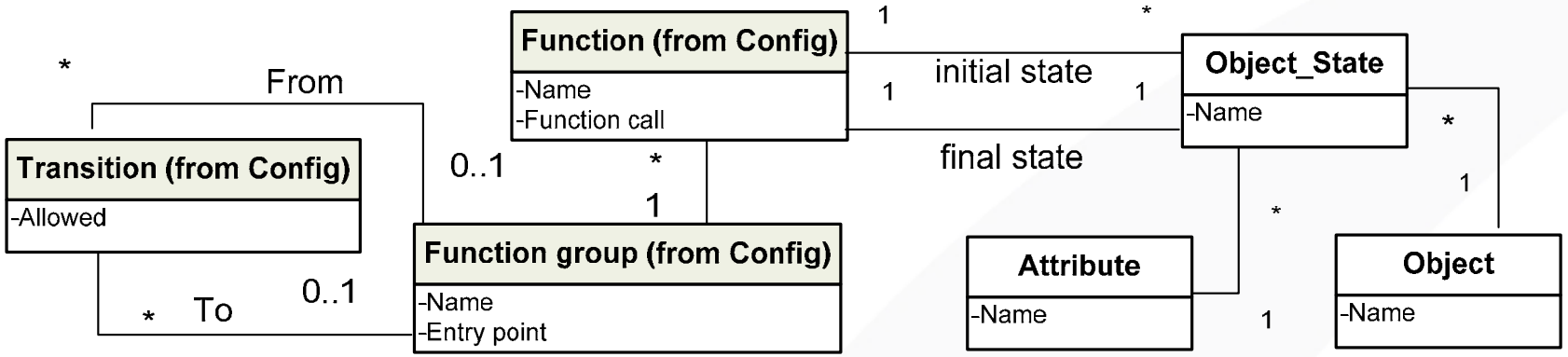
- Detailed level adaptation
  - is based on the information stored in the user profile. The detailed adaptation consists of two steps:
  - Detailed adaptation of the navigation
    - uses the profile information about the functions accessible to the particular user
    - within the framework of the organization level instance of WIS, provides an adapted navigation between all user functions.
  - Detailed adaptation of the content
    - constructs an instance of WIS for the particular user according to the user profile, which describes the data accessible to the user, and to the user functions identified previously.

Problem and proposal

- In our previous research we focused on constructing different adapted instances of web information system from the set of all functions that form the whole WIS
- Problem arises - how to present the different adapted WIS instances to users
- Proposal:
  - extend the adaptation profiles with presentation elements
  - introduce the presentation model of WIS
  - define a procedure for construction of a metamodel-based and adapted user interface

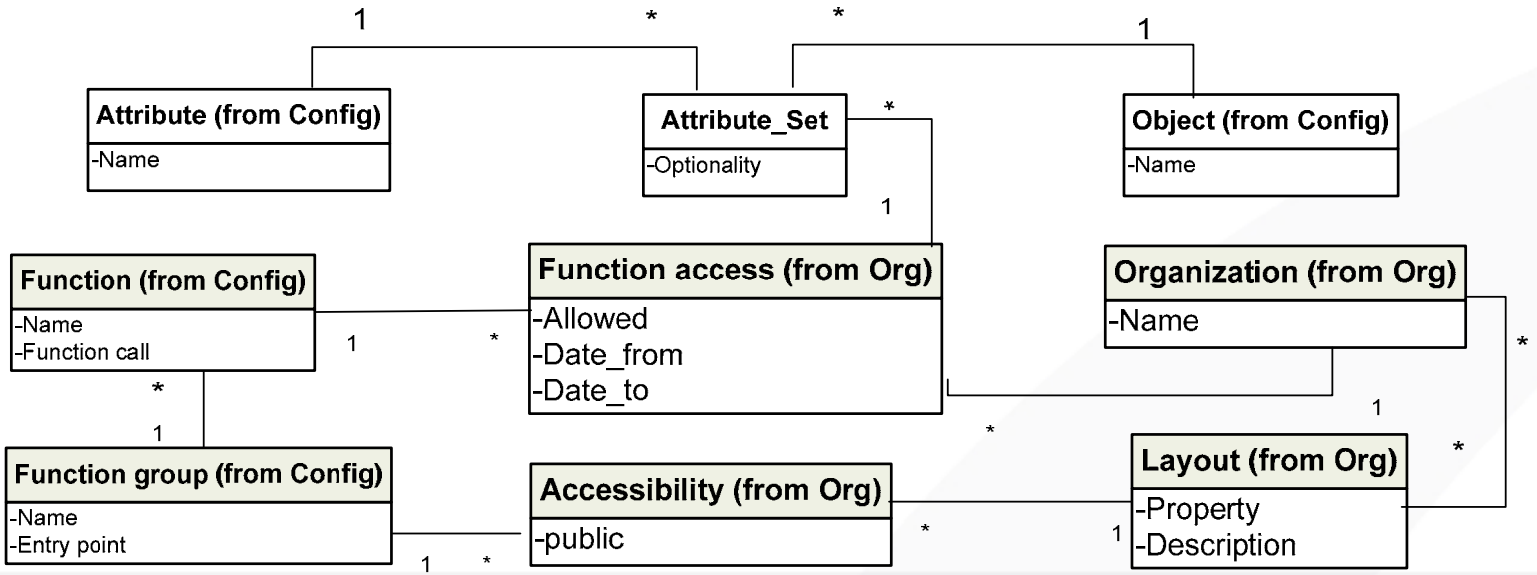
Configuration profile

- WIS configuration profile
  - *Function group* consists of many *Functions* implemented in WIS to support business functions of the organization.
  - The function groups have *Transitions* defined between different instances of these groups.
- Extension
  - Class *Object State* represents the situation where functions can be state dependent. A function may be allowed in some definite states and forbidden in others.
  - The state in our proposed architecture is introduced as an *Attribute* or set of attributes of an *Object*.



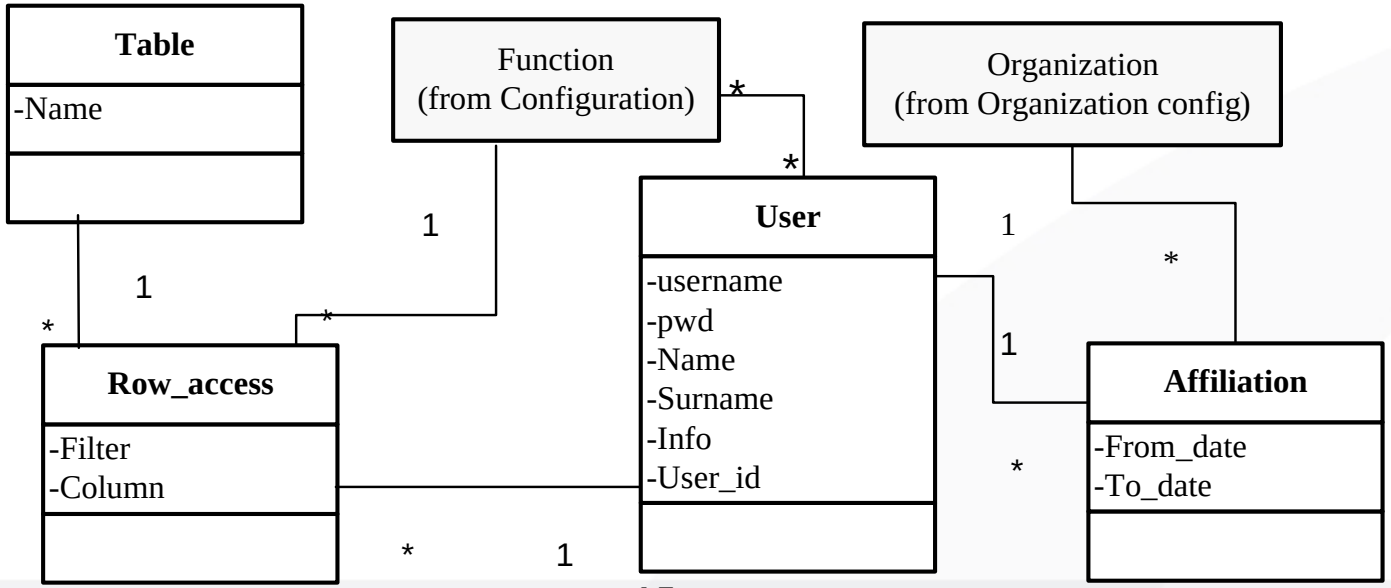
The configuration profile for the organization

- Organization profile of WIS
  - describes the individual properties essential for an organization for organization level instance of the WIS (e.g. local configuration, layout etc.).
  - The elements of the model are *Organization, Function access, Accessibility,* and *Layout*. The model uses also classes from configuration profile of WIS (*Function* and *Function group*).
- Extention
  - allows definition of an *Attribute Set* different from the initial attribute set used by a function in original configuration of WIS. The *Attribute Set* has associations with Attributes and Objects from the configuration profile



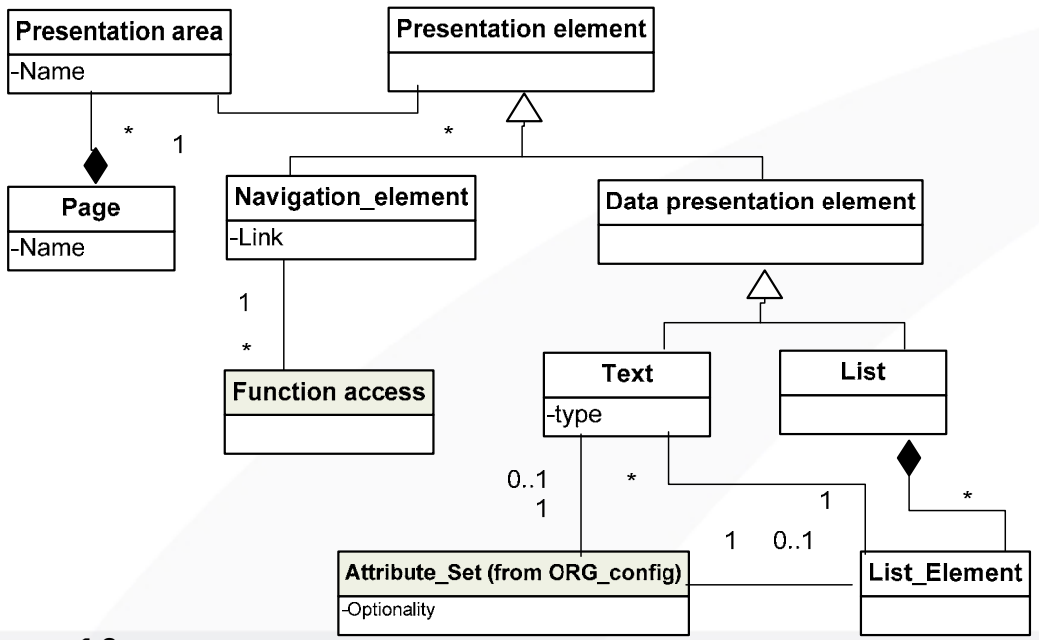
User Profile

- User profile
  - describes affiliation of the user in the particular time period in one or more organizations that are tenants of WIS
  - define user's access rights to functions and data.
  - The elements of the user model are *User*, *Affiliation*, *Table*, and *Row_Access*.
  - *Function* and *Organization* are used from other profiles.



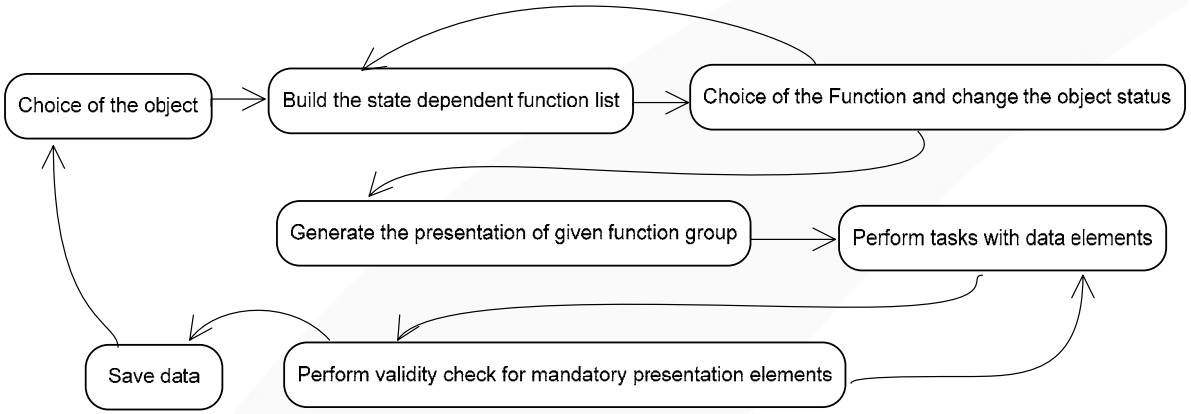
Presentation Metamodel for WIS

- *Page class* is the main presentation element.
  - Page class presents the Function group from the WIS basic configuration that is described with the configuration profile.
- Page consists of at least one *Presentation area*
  - it is provided for grouping of *Presentation elements.*
- A presentation element can be *Navigation element* or *Data presentation element*.



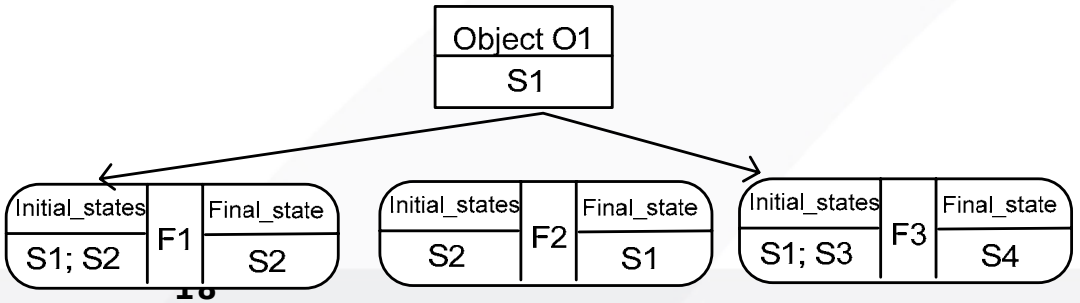
Construction of a Metamodel-Based and Adapted User Interface

- How the metamodel based and adapted user interface is build?
- Method consists of several steps
- the user interface construction depend on statuses of an object that is a focus of activities during business process completion.
- We will consider each step of the process to describe the usage of profiles



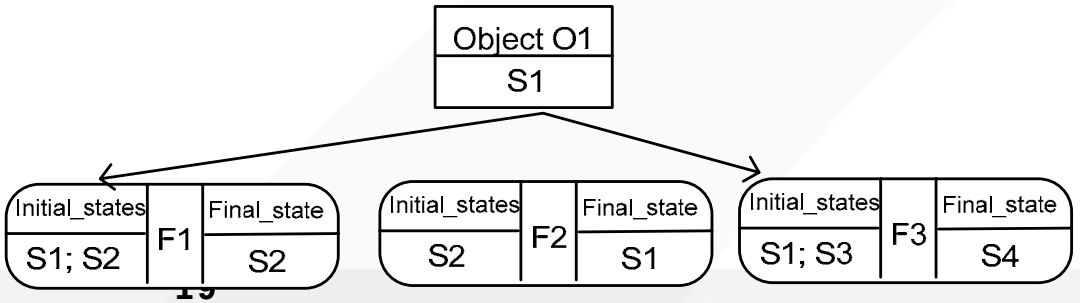
Workflow of construction procedure (1)

- **Choose the object.**
  - User selects an object
    - For example, user finds an existing vehicle to perform later a number of operations with it.
- **Build the state dependent function list.**
  - The initial state of the object determines the available operations that can be applied to the object.
    - For example, object O1 has state S1, list of allowed functions F1, F2, and F3 with defined initial and final states; user can then select either a function F1 or F3 whose description by a parameter 'Initial_state' also contains S1 among other allowed states.
  - The list of functions allowed for the object is based on configuration profile of WIS.
  - The function list is presented in a presentation area as navigation presentation elements.



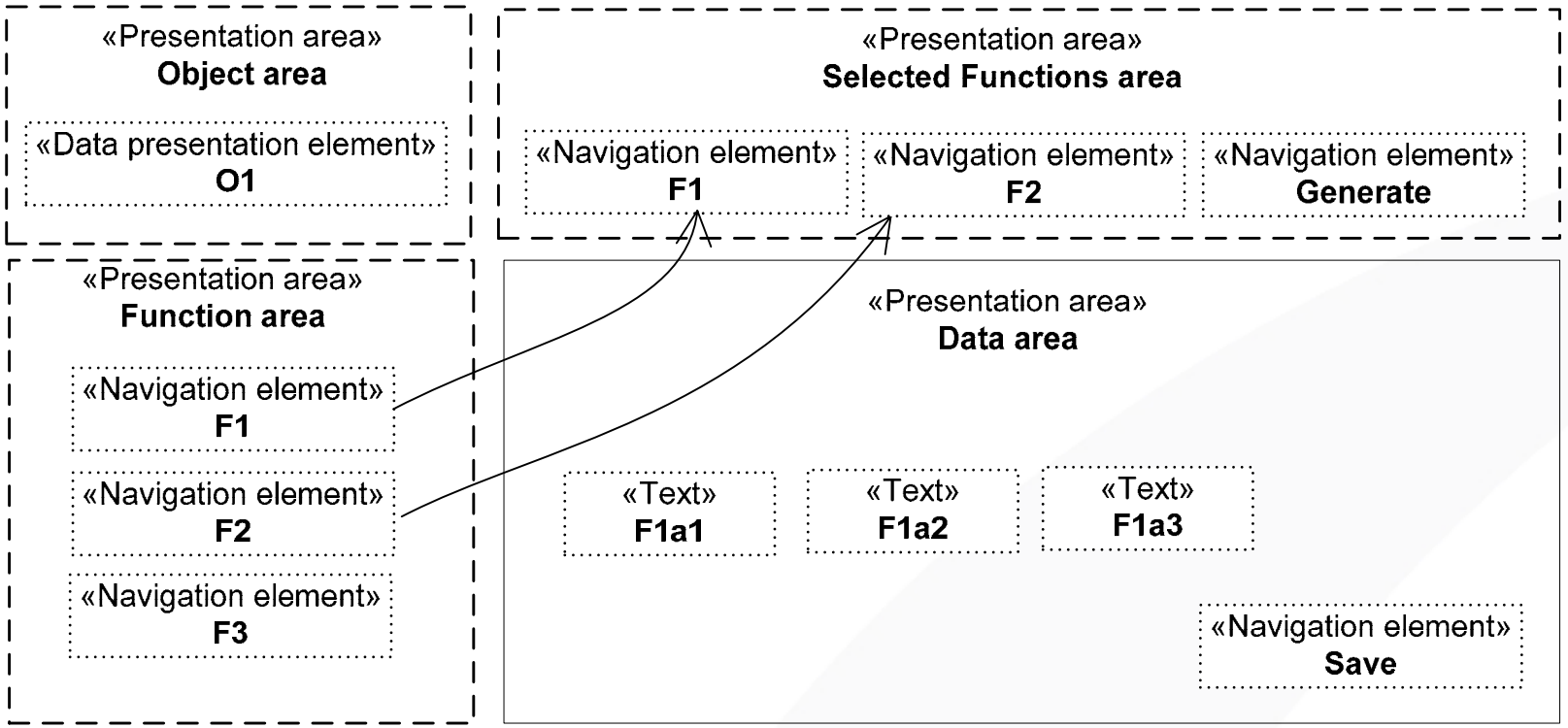
Workflow of construction procedure (2)

- **Choose the function and change the object status.**
  - According to the business needs, the user selects iteratively all necessary operations that should be performed with the object from the list of allowed operations displayed to him
  - the status of the object is changed according to the value of the parameter ‘Final_state’ of the function.
  - For example: one possible scenario of workflow composition is: F1→F2→End; The ‘End’ in this case denotes that the user finishes the selection process.
  - The chosen functions are presented in a separate presentation area as navigation presentation elements



Workflow of construction procedure (3)

- **Generate the presentation of the given function group**
  - Example – Object O; user selects the following functions: 2) F1→F2→End;

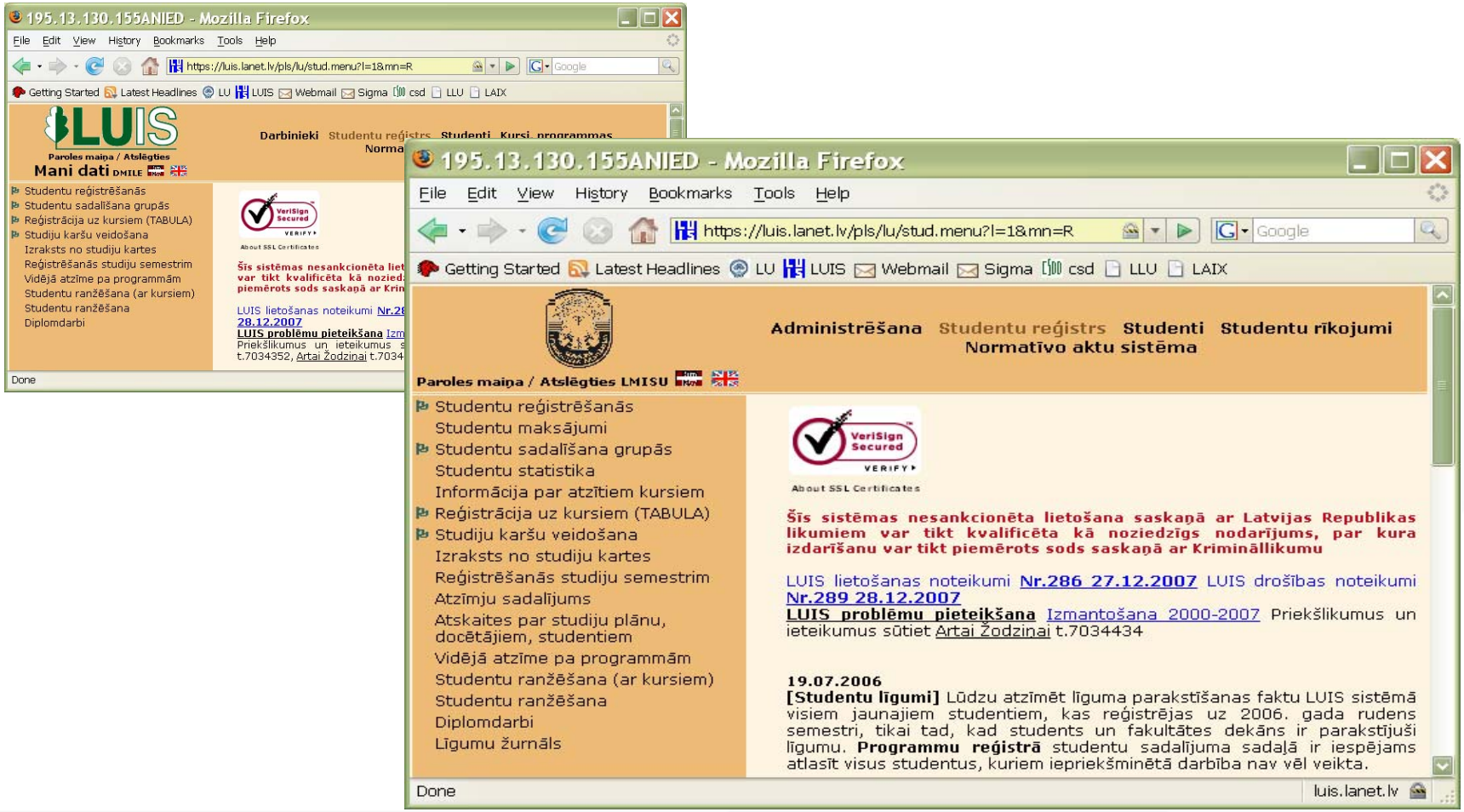


Workflow of construction procedure (3)

- **Perform tasks with data elements.**
  - This step does not influence the user interface and can only influence the values of object's attributes.
- **Perform validity check for mandatory presentation elements.**
  - Validity check performs evaluation, if all mandatory presentation elements have received their values,
- **Save data.**
  - user can save changed data elements and start constructing a new workflow by selecting a new object.

The Case Study of WIS Adaptation

- The proposed architecture of WIS adaptation is used in the project, where 12 universities are using each an adapted instance of the system



Results, Conclusion and Further Work

- We consider in our approach a specific type of business information systems - WIS
  - We consider specific way of performing business processes when the workflow starts with a choice of an object whose state determines the later steps of performing business activities.
- The construction of the user interface in our approach is based on a presentation metamodel and uses the configuration and organization profiles of WIS adaptation architecture.
- The interface is generated with involvement of the user
  - The choice of the user and the interface construction depends on state of an object that is a focus of activities during business process completion.
  - The user gets an interface of WIS that is suitable for the specific business situation.
- The described architecture and user interface construction is implemented and is being used in two different WIS;
  - WIS for the universities in Latvia
  - WIS for the car registration in Latvia

Thank You!