

Solution guidelines

Exam Software Modeling (401016)

27 March 2014

Part of this exam is based on the following case study:

Company CoolBuildings (CB) wants to develop a set of software services that gather data from metering devices and monitor the electricity consumption and heating of university buildings. They plan to sell a “dashboard” that will be installed in small screens distributed in the building, for the users (students and employees) to know how energy efficient the building is. The dashboard application will provide the following information:

- Electricity consumption: per room, per department, per floor, and for the whole building. The dashboard will also show if electricity is consumed for IT equipment, for teaching equipment (like intelligent whiteboards, beamers etc.) or for lighting. The user will be able to group electricity consumption in different clusters, like rooms for teaching, rooms for research employees, rooms for data centers, rooms for supporting personnel.
- Heating supply: temperature and consumption per room, per department, and for the whole building.

The system will also allow special users (that must be authenticated) to control building consumption. There will be two types of users: *employees* that will be able to tune consumption in the room they use (their own office or the teaching room they are using at a certain point in time); and *administrators* that will be able to “configure” electricity consumption and heating for the whole building.

- Employees can tune the temperature of a room, and use the dashboard to find out that e.g. some equipment is unnecessarily left on, and switch it off.
- Administrators can define the “default” configuration of the building, reset the whole building to this default, and switch on/off heating and/or electricity for either the whole building or selected areas. The latter might come in handy during e.g. National holidays.

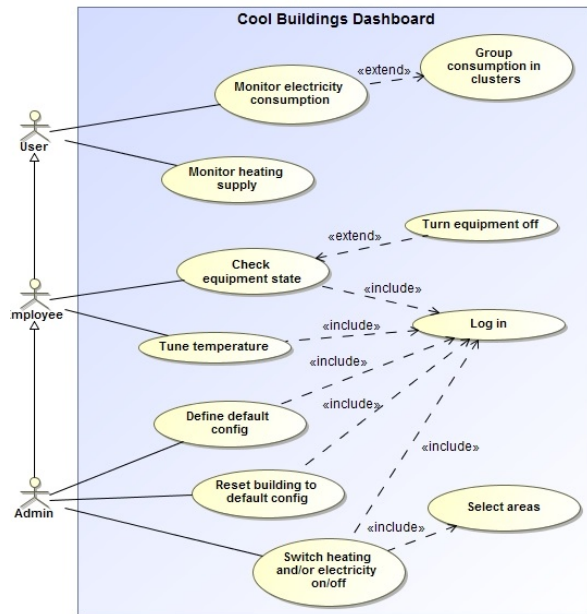
Note: this problem description may be ambiguous and incomplete. In answering the questions, you are free to complete it (if needed) and briefly motivate your assumptions.

Questions about the theory

1. Explain the different types of “maintenance” in software engineering. [1 point]
See Book van Vliet, section 1.3 + lecture slides: perfective, corrective, adaptive and preventive.
2. By using the five decision points characterizing software life cycle models, explain the differences and similarities between heavyweight and lightweight models. [1 point]
See slides lecture 1, #21 provides a summary of differences and similarities.
3. What is the typical distribution of maintenance activities in the software life cycle? [0.5 point]
See slides lecture 1, #19 for an overview + Book van Vliet page 17.
4. Enlist and define the four major types of activity in requirements engineering? [0.5 point]
See slides lecture 2, #5 for an overview + Book van Vliet, chapter 9.
5. Define procedural abstraction and data abstraction. Also, provide an example for both. [0.5 point]
See slides lecture 4 + Book van Vliet chapter 12.
6. Illustrate and explain with an example how ‘service discovery’ works. [1 point]
See slides lecture 5 + Book van Vliet chapter 19.

Questions related to the case study

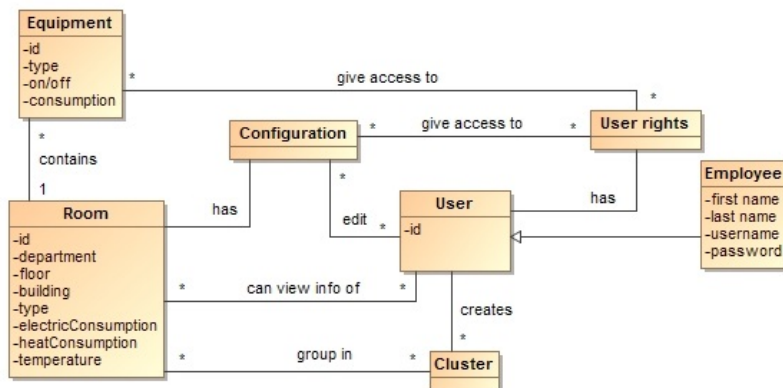
7. For the case study, specify the functional requirements with an UML use case diagram. Use additional text to describe your model and your assumptions where needed. [2 points].



Assumptions:

-For all use cases, except "Define default config", "Select areas", "Log in", and "Group consumption in clusters", there is some interaction with an external actor: the heating- and electric equipment. This is left out of the diagram to avoid clutter.

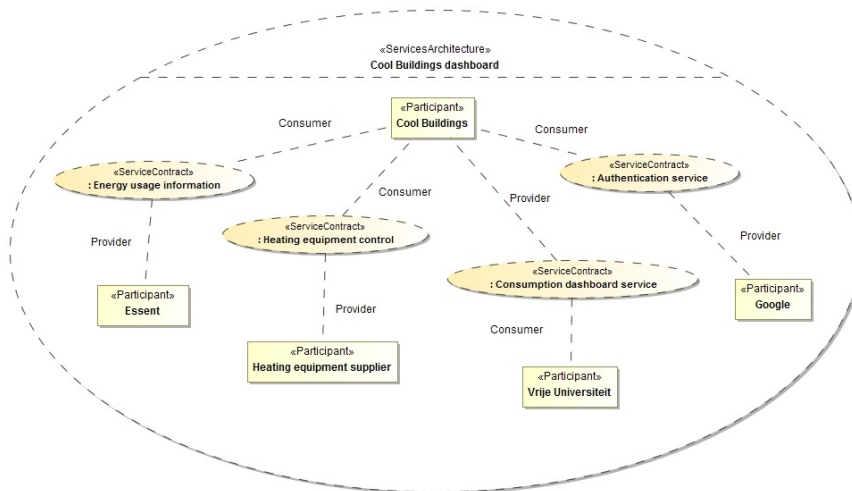
8. Complement your specification with a UML class diagram that models the data managed by the case study. Use additional text to describe your model and your assumptions where needed. [1.5 point].



Assumptions:

-Students/anonymous users use a general user account.
 -Admins are Employees with a different set of user rights.
 -Controlling the consumption of a building is in fact controlling a set of rooms (all rooms with the same building attribute).

9. Create a service oriented software design for the system given in the case description. Illustrate the service architecture using a SoaML services architecture diagram, showing all participants and service contracts. Briefly explain your diagram and briefly discuss the roles participants have in the service contracts. [2 point].



Energy usage information: An energy supplier can provide Cool Buildings with access to energy usage information used within the services.

Heating equipment control: Service provided by the supplier of the heating equipment that gives access to information from the heating equipment, which Cool Buildings need.

Consumption dashboard service: The Cool Buildings dashboard, which is delivered as a software service to universities.

Authentication service: Cool Buildings can use a third party service to handle authentication, for example by using Google accounts.

Exam rules:

- No books or reference material.
- No calculator, mobile phones or other electronic device.