

Exam Design Science Methodology

31th January 2014

Keep your answers short and informative

Problem	a	b	c	d	e	f	
1	3	3	3	3			12
2	3	3	4				10
3	6	3					9
4	3	4					7
5	3	3					6
6	4	4					8
7	3	3	3	3			12
8	3	3	2				8
9	3	3					6
10	3	3					6
11	3	3					6
							90

$$\text{Grade} = (10 + \text{points})/10$$

- For each of the following design problems, identify (1) the problem context, (2) the artifact, (3) the intended interaction of the artifact with the problem context, (4) some stakeholders. Some of this information is missing from the problem statement; in those cases, supply reasonable examples of the required items.
 - Our organization has a handbook of software engineering methods, but it is so large that no one uses it. Which set of methods and techniques from our "methods cookbook" are relevant for realizing IT-enabled business change?
 - Logistics in our organization is inefficient because it is still organized manually. Select and implement a logistic financial package with an eye to future IT developments
 - Design a database system for storing annotated sensor data for use in a dike monitoring system
 - Improve the scalability in number of documents of lookup algorithm of web services with distributed hash tables in a P2P network.
- Consider a database system for storing sensor data, annotated with time and data source information, for use in a dike monitoring system. The system should provide early warnings when there is a danger of dike collapse.
 - What is the application scenario for the database system?
 - Formulate the design problem for the database system (artifact) according to the design template.
 - Formulate the four knowledge questions of design science (effect, trade-off, sensitivity, contribution) for the database system.

3. In a thesis about data location compliance for cloud service providers (CSPs), the following research questions are listed.

RQ1 What are demands regarding data location compliance of the typical customers of a CSP?

RQ2 What technical solutions do CSPs currently have?

RQ3 What are the current limitations for CSPs to show compliance to customer demands regarding data location?

RQ4 How to make agreements about data location demands between customer and CSP?

RQ5 How can CSPs enforce security policies regarding data location?

RQ6 How can CSPs show compliance to customer demands regarding data location in public software-as-a-service cloud computing?

- (a) Each these questions is asked in some step of the engineering cycle. For each question, indicate to which step it belongs and reformulate it accordingly.
 - (b) Some questions essential to the engineering cycle are missing. Add these questions.
4. (a) Define what it means for desires to be in logical conflict, in physical conflict, and in technical conflict.
- (b) For each of the examples below, indicate whether there is a conflict between goals and if so, identify the goals, and explain whether the conflict is physical, logical or technical.
- Airports want a safe route and a fast route through the network
 - Airports want aircraft to behave in a predictable manner and respond dynamically to changing situations
 - Car owners want to equip their car with TV but have the same car battery life times
 - Car owners want to have a TV in the dashboard so that can watch during driving, and obey the law
5. (a) Define the concept of an architecture. Illustrate your definition with an example.
- (b) Discuss the difference between the concept of mechanism in an architectural model and a variable-based model. Illustrate the difference by means of an example.
6. Consider as artifact an application layer protocol used for wireless communication between medical observation devices in home care and a home care station. The base station relays the data to a back-end server, which in turn communicates with medical personnel in a care center. Figure 1 shows an architectural model of the environment of the protocol.
- Each of the following requirements contributes to a stakeholder goal and makes an assumption about the environment. (a) which assumption does it make, and (b) what should change about the requirement if the assumption is dropped?
- (a) The protocol must use low power.
 - (b) The protocol must be reliable.
 - (c) An observation device must wait for an acknowledgement from the care station before it starts transmitting data to the care station.

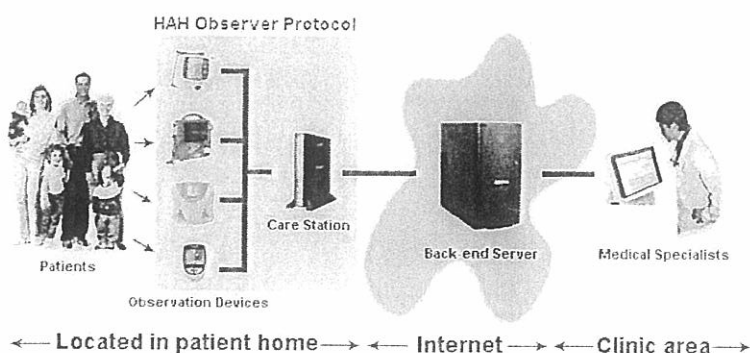


Fig. 1: Problem architecture of Health@Home

- (d) Observations relayed to the back-end server must be traceable to the sensor that generated them.
7. Consider again the protocol mentioned in the previous question. Classify the following requirements as (a) functional requirements, (b) quality requirements, and (c) constraints.
- The protocol must use low power
 - The protocol must be reliable
 - A medical device must wait for an acknowledgement from the base station before it starts transmitting data to the base station.
 - Observations relayed to the care center must be traceable to the sensor that generated them.
8. (a) What is the fundamental problem of validation? How can it be solved?
 (b) What is the similarity and what is the difference between technical action research and mechanism simulation? Give an example to explain the similarity and the difference.
 (c) One way to validate an artifact is by expert opinion. Explain why this is not statistical opinion research.
9. Scaling up to practice takes place along two dimensions.
- Describe these dimensions.
 - What role do mechanism simulation experiments and statistical difference-making experiments play in scaling up research?
10. (a) A conceptual framework cannot be true or false. Explain this.
 (b) Explain which questions we can ask to test a conceptual framework's usability, and which questions we can ask to test its usefulness.
11. The empirical cycle and engineering cycle are both instances of a rational problem-solving cycle. Describe the rational problem-solving cycle and show how the empirical and engineering cycles are instances of it.

