

1st Seminar – Requirement analysis, exploratory data analysis

1 Requirement analysis of train protection system

We are designing a train protection system. The main goal of the system is to prevent the collision of trains. The key to building a proper system is a requirement specification of good quality, since the test cases and other control mechanisms will be built based on these requirements.

Table 1: Train protection system requirements (partial)

R1	Safety	Trains mustn't collide on the supervised track system.
R2	Operation	It must be ensured that the trains reach their destination.
R3	Optimality	The travel time of trains must be minimized.
R4	Track sections' supervision	The track must be divided into sections and maximum one train can be on a section.
R5	Dividing into sections	The track must be divided into sections.
R6	Occupancy	Maximum one train can be on a section.
R7	Detecting occupancy	We have to detect somehow whether there is a train on a section or not.
R8	Fault tolerance	We have to be prepared for the malfunction of components.
R9	Occupancy sensors	Occupancy of a section must be detected in a redundant manner, based on multiple types of sensors.
R10	Rail sensor	Rail sensors must be installed in every section that signal whether there is a train on the section or not.
R11	Camera system	Cameras must be installed on the sections where it is possible for observation purposes.
R12	Positioning	Trains must continuously signal their positions towards the central control unit.
R13	GPS subsystem	The trains must be equipped with a GPS subsystem.
R14	Wireless connection	It must be ensured that the trains can provide their positions to the central control unit via a wireless network.
R15	Train control	It must be ensured that a train can be stopped before driving onto an occupied section.
R16	Stopping trains	The central control unit must be able to immediately stop a train.
R17	Support of train types	The system must support every type of trains capable of travelling on rails.
R18	Unmodifiable trains	We mustn't use methods that require to change the control system of trains.

- Gather the participants that are involved (or affected) when building a system like this (so called *stakeholders*), that is, they can make demands for the system in form of requirements!
- After identifying the stakeholders we gathered their requirements, a part of which can be seen in Table 1. Construct a graph that shows the dependencies between the requirements! Draw a directed arc in the graph from A to B if (1) requirement A is part of requirement B (*composition*), (2) requirement A *refines* requirement B , or (3) requirement A can be *derived* from requirement B . The exact relations between the requirements are not important, only that there is a relation.
- From the above requirements which are functional requirements? What type of extra-functional requirements can we find in the table (safety, performance, reliability, etc.)?
- Are the gathered requirements consistent? If not, then show an example of a contradiction.
- From the gathered requirements give examples for directly verifiable requirements!