Functional specifications

Functional specification – methodology

When talking about functional requirements it is important to note that

- there is a lot of confusion about 'what is functional'
- there are several levels of functionality and requirements

Methodology – types of requirements

When is a requirement a functional requirement?

- often all requirements that do not specify a technical solution are called 'functional'
- however as a functional requirement is a specification of the functionality for which the object or system is created (e.g. carrying traffic), many solution – free requirements appear to be non – functional
- so the environmental requirement that the pavement materials should not pollute the ground water is non - functional (it is a constraint rather than a functional requirement) because this is not a functionality for which we would create a pavement

Methodology – types of requirements

- so we never have only functional specifications
- there always are (usually much more) non – functional specifications which describe how the system or object must function or be. These requirements can concern many aspects
- as the term 'non – functional' does not sound too attractive, these requirements are called 'aspect requirements' in the Netherlands
- furthermore there are requirements that are imposed by surroundings; these are called 'interface requirements'.
- these can overlap aspect requirements (e.g. noise requirements)

Methodology – types of requirements

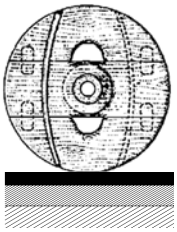
In the Systems Engineering approach used in the Netherlands, distinction is made between the following requirements:

- Functional requirements (what should the system do)
- Aspect requirements (how should the system do it)
  - reliability - availability
  - maintainability - safety
  - sustainability - health
  - ergonomics - aesthetics
  - environment - demolition
  - future proofness
- Interface requirements

Methodology – generating requirements

Functional requirements follow from function analysis (what should the system do)

- why do we make pavements?
- because we invented the wheel
- a very useful invention
- however it had one bad habit
- it tended to 'dig in'
- this called for a next invention



Methodology – generating requirements

- so the functional requirement which a pavement fulfils is
  - a 'provision' over which wheels can roll freely
- therefore the bearing capacity requirements in the contract are the only functional requirements

Methodology – generating requirements

Aspect requirements (how should the system fulfil its function) follow from considering the various aspects and related possible issues

- availability -> without frequent maintenance
- safety -> with a certain level of skid resistance
- sustainability -> without polluting subsoil and ground water
- sustainability -> with minimum CO_2 emission at construction
- health ->without producing too much noise
- etc

Methodology – generating requirements

Interface requirements (what requirements follow from interfaces with other objects) follow from an inventory of project interfaces and possible problems arising from these

- bridges -> pavements under them may not be too high

Functional specification – methodology

Functional specification – methodology

Interface requirements (what requirements follow from interfaces with other objects) follow from an inventory of project interfaces and possible problems arising from these

- bridges -> pavements under them may not be too high
- bridges - > pavements over them may not be too heavy

Functional specification – methodology

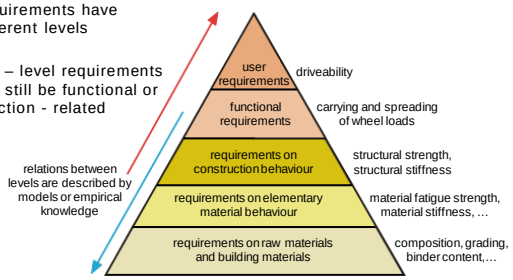
Functional specification – methodology

Interface requirements follow from an inventory of project interfaces and possible problems arising at these interfaces

- bridges -> pavements under them may not be too high
- bridges - > pavements over them may not be too heavy
- bridges - > pavements should protect these from salt e.d.
- existing pavements -> new pavements must connect to them without height or slope differences
- etc.

Methodology – requirements decomposition

- requirements have different levels
- low – level requirements can still be functional or function - related



Methodology – requirements decomposition

- requirements on raw materials and building materials
- this was the approach before the introduction of the functional contracts
- was condensed in Standard Contract Requirements
- these were not unilaterally developed, but jointly between public authorities and private sector

Methodology – requirements decomposition

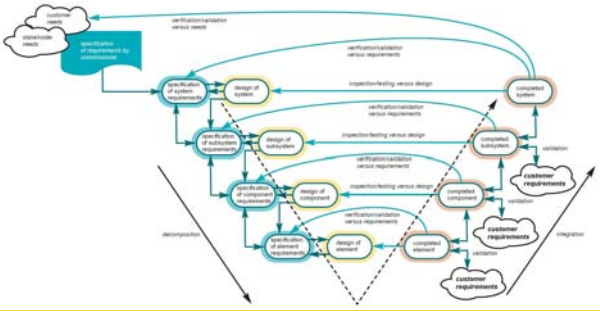
- requirements decomposition by the client should be no deeper than necessary in the contract
- the contractor should perform further decomposition towards the details of the design
- decomposing too deep will limit the possible solutions because the decomposition is usually more or less solution dependent
- however if the decomposition is not deep enough the client may be unable to control his risks

Methodology – requirements decomposition

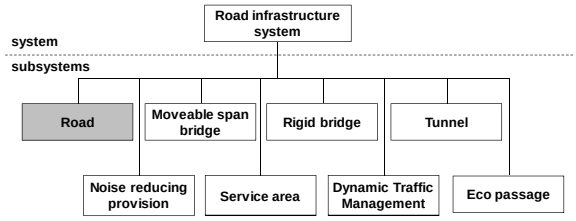
Typical risks that remain with the client are

- Political risks
  - reliability and availability of road network
- Social risks
  - safety
  - health
  - sustainability
  - aesthetics
- Financial risks
  - long term maintenance costs
  - demolition costs

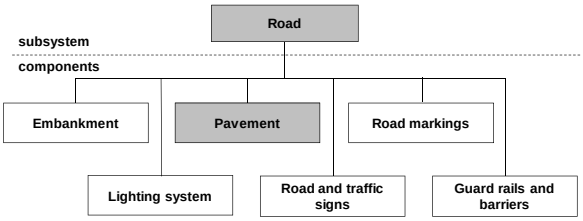
Methodology – system decomposition



Methodology – system decomposition



Methodology – system decomposition



Component specifications

- For each component of the road, DVS has Component Specifications
- These are separate documents that contain the non – project specific requirements
- The requirements are formulated in solution – independent terms as much as possible
- For each requirement a verification method is given
- however verification methods are often solution specific; e.g. the design verification for asphalt roads is different from that for concrete roads

Component specifications - example

BO VH 02 SAFETY - breaking deceleration	Overlying requirements	Underlying requirements
Each wearing course or temporary wearing course must enable a breaking deceleration of 5,2 m/s².		
Verification method		
Design verification Demonstrate according to Protocol G that the proposed wearing course can meet the requirement **Product verification** Braking tests according to Annex I		

Component specifications - example

BO DV 02 CARRYING TRAFFIC - bearing capacity of new pavements in continuously reinforced concrete on embankment	Overlying requirements	Underlying requirements
New pavements in continuously reinforced concrete must be able to carry the traffic loads according to Appendix A of the Output Specification during the design periods according to Appendix B of the Output Specification.		
Verification method		
Design verification According to Concrete Pavement Design Specification [4] **Product verification** Evidence that the pavement as installed complies with the design, based upon production quality registrations, layer thickness measurements and drilling core information.		

Methodology - contract management approach

- System Oriented Contract Management
- Principle of this approach: check if the Quality System of the contractor is effective (contractor has to have a certified quality management system, based on NEN-EN-ISO 9001 Quality Management)
- This is done by a mix of system checks, process checks and product checks

Contract management approach

- System check: check if the integral quality management system of the contractor is correct
- Process check: check during realisation of a project if the contractor follows his own process instruction of a specific process
- Product check: check the reliability of the quality control results of the contractor
- Risk based approach
- Balance in mix of checks adapted if necessary