Welcome to the INESS training

7,8 & 9 March 2012

Day 3

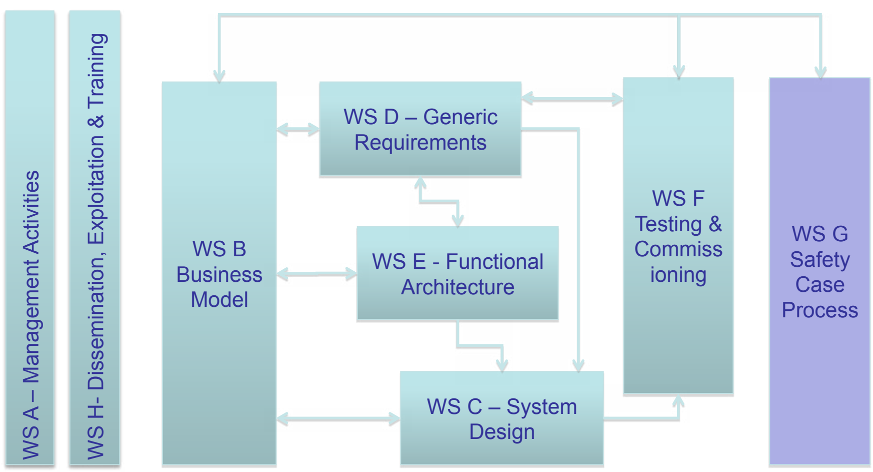
Welcome

- Please wear your badge at all times
  - Internet access info is on your badge!
- Please: No Food & Bevarage in meeting rooms
- Presentations available via:
  - Hardcopy of sheets available in lobby
  - Download via the www.INESS.eu webpage (Training)
  - The USB you got at registration
- Break-out room for parallel sessions:
  - WS-G: Safety Case tool demo: room 203
  - WS-B: workshop group2 for Buisiness model: Stephenson room
- Questions?...ask the people with GRAY banner on badges

WP H.3: Training (Day three)

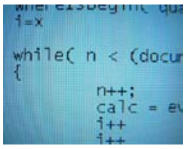
Agenda Item	Speaker	Time
1. Safety Case Process • Improving the safety case development: Workflow improvement by Tool support	WS G Geltmar von Buxhoeveden	09:00 – 10:00
• General Discussion		10:00 – 10:30
Coffee break		10:30 – 11:00
Workshop on how to use the Tool	(parallel sesion) Geltmar von Buxhoeveden	11:00 – 12:00 Stephenson Room
2. INESS Business Case • Presentation of the INESS Life-cycle approach and the INESS Business model • Business model • INESS LC-model and cost saving potentials • System Dynamics methodology for developing the business model • Cooperation plan • Examples based on DB experiences • Questions to be answered	WS B Thomas Hirsch Karsten Kamps Hirsch/Kamps/Hoffart	11:00 – 12:30
LUNCH BREAK		12:30 – 13:00
• Workshop on how to Apply the Business model. • Exercise on the Business model to understand it • Exercise to adapt the model	Thomas Hirsch Christian Hoffart	13:00 – 14:30 Plenary room, Stephenson Room
3. General Discussion and Wrap up of the whole programme	Emmanuel Buseyne	14:30 – 15:00

INESS Safety Case Process WS-G



WS G: Safety Case Process - Objectives

- Bring integrity to the Safety Case



- Develop Tool

- Save Time and Money

Understanding EN 5012x

Feedback: Who are you?

… and what do you know about the Safety Case?

EN 5012x misconceptions

- „You do the Safety Case for the INESS interlocking, don‘t you?“
- „When we are ready to deliver our product we write the Safety Case Report to get a certification“

WS G: Safety Case Process – CENELEC interpretation

Before

Written Norm

- EN 50126 (76 pages)
- EN 50128 (106 pages)
- EN 50129 (97 pages)


nsai

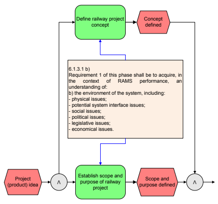
RAILWAY APPLICATIONS - THE SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS)

After

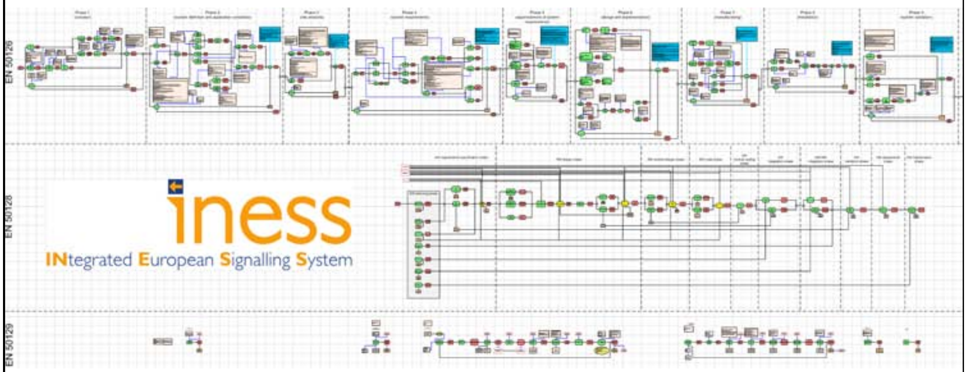
EPC Model of EN 5012x

- 185 states
- 192 activities
- 189 requirements
- 805 arcs
- 80 parallelisations

  and synchronisations



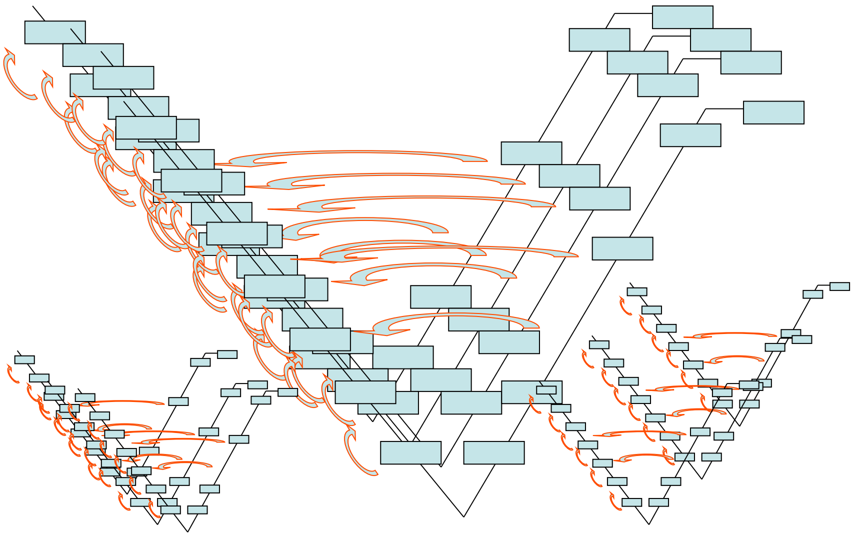
EN 5012x EPC Model



Transparency of the Safety Argumentation

- A safety case is “the documented demonstration that the product complies with the specified safety requirements.” [EN 50129]
- “The safety case is a line of argumentation, not just a collection of facts.”[Odd Nordland, SINTEF]
- A safety case is “A *structured argument*, supported by a *body of evidence* that provides a compelling, comprehensible and valid case that a system is safe for a given application in a given environment.” [UK Defense Standard]

Safety Case: who overviews the links?



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2nd Quiz

GSN

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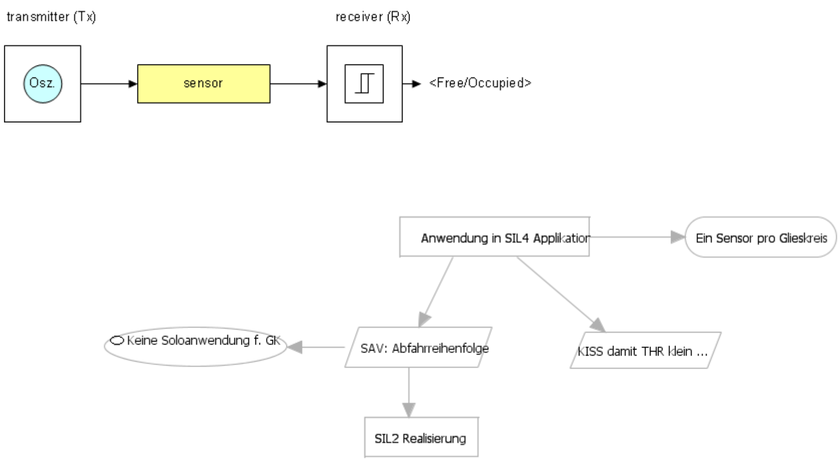
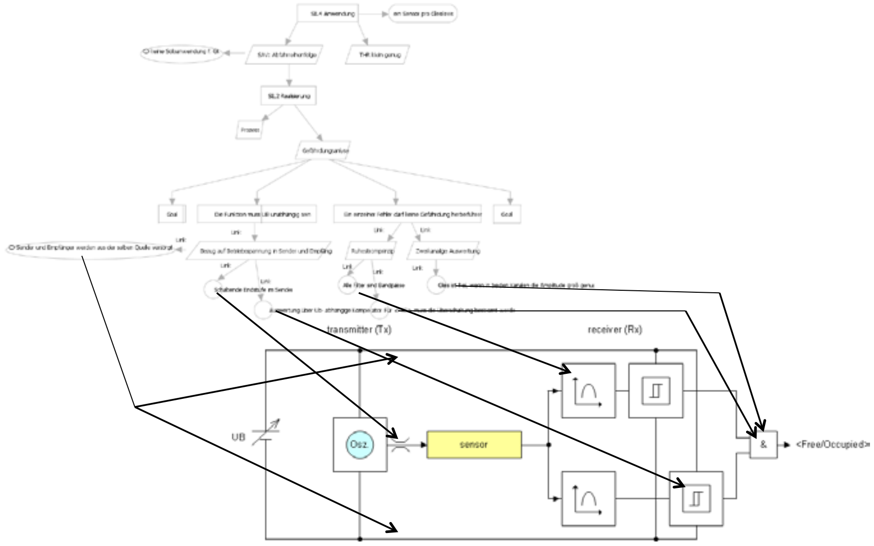
Goal Structuring Notation Elements

Element	Description
Goal	A goal is a requirement, target or constraint to be met by the system. The term goal hierarchy refers to the collection of goals produced by the hierarchical decomposition of goals into sub-goals.
Strategy	A goal (or set of goals) can be solved by a strategy, which breaks a goal into a number of sub-goals. The satisfactory solution of the sub-goals then entails the solution of the original goals. A strategy can be regarded as a rule to be invoked in the solution of goals.
Solution	Some goals may be solved directly by what we term solutions, rather than by decomposition into sub-goals. This is where the high level argument links to and uses the supporting evidence. Solutions will be individual pieces of analysis, evidence, results of audit reports, or references to design material including models. In fact we are not restrictive at all of the form that solutions can take.
Justification J	Strategies often need some justification for their use. It may be that the strategy is laid down in some standard followed by the developers: it may be common practice; or it may be a more elaborate argument as to the validity of the use of the strategy. Alternatively a justification may call upon evidence from analysis of the model or be a structured proof.
Assumption A	Any assumption on which the strategy or goal is being put forward as a solution to the parent goal.
Context	Additional contextual information to a goal, a strategy or any other element can be couched in a context element.

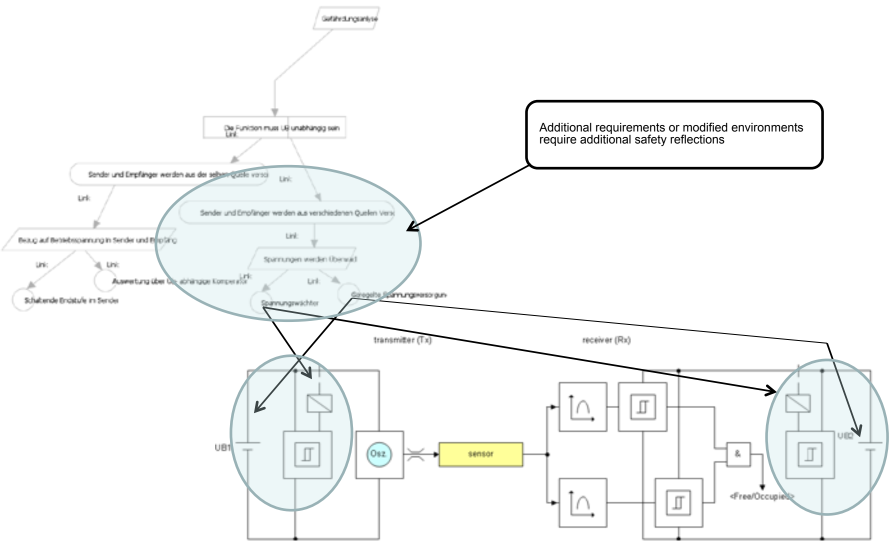
Using GSN in system architecture



Using GSN in system implementation



Changes in product use GSN



The Power of GSN

a) GSN is suitable to clarify the chain of arguments
b) The arguments focus on the essentials.
c) The GSN thus reduces the overhead
d) It improves the overview
e) facilitate the maintenance of durable Safety's case, since it gives a good summary.
f) If the security argument is well known and standardized, even larger development projects carried out in parallel.
g) contains implicitly the structure of the project schedule.

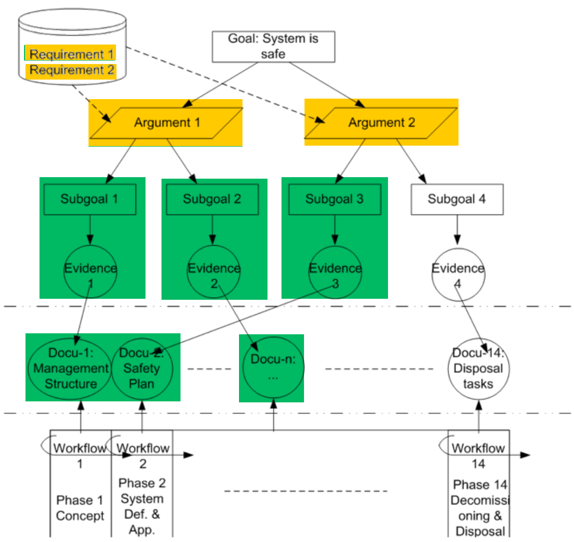
Goal Structuring Notation Example

"Goal Structure"
structured argument

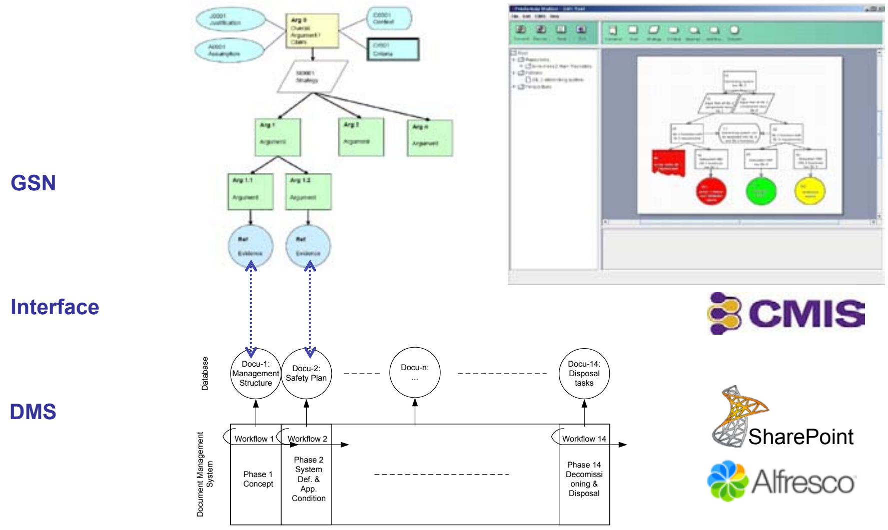
body of evidence

Database of Documents

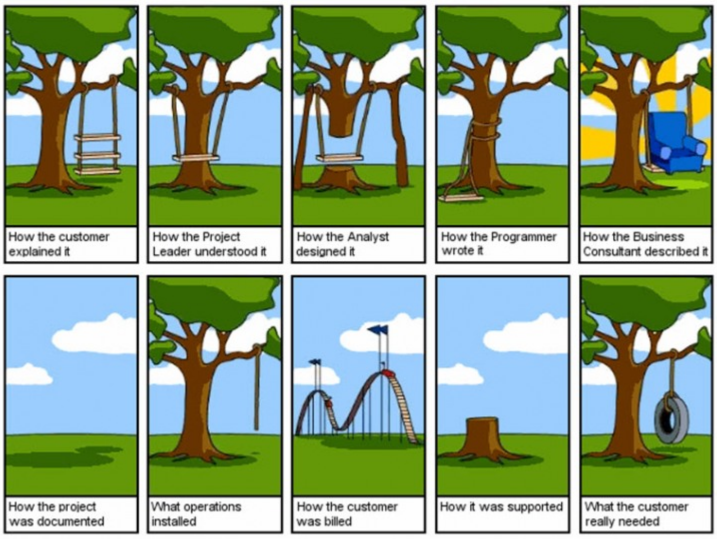
Document Management System



WS G: GSN & DMS implementation

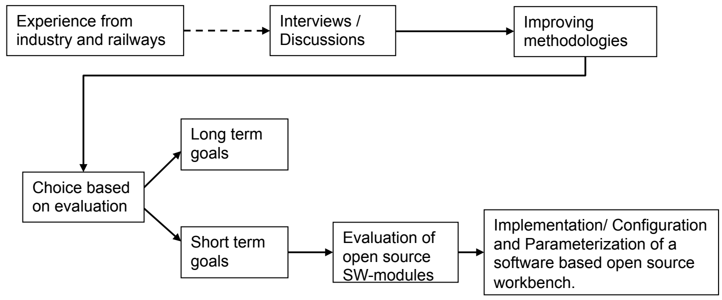


What we did not want …



Methodology (for the requirements)

The strategy of collecting and evaluating experiences, and developing and implementing the supporting methodologies



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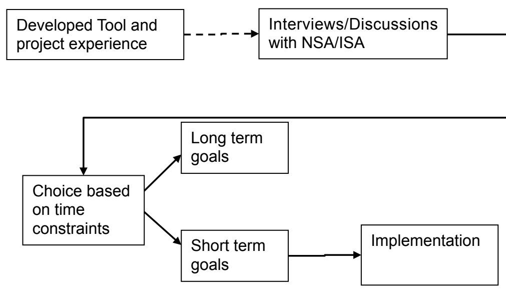
Methodology (for the external evaluation)

The strategy of collecting and evaluating experiences, and developing and implementing the supporting methodologies



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Tool presentation

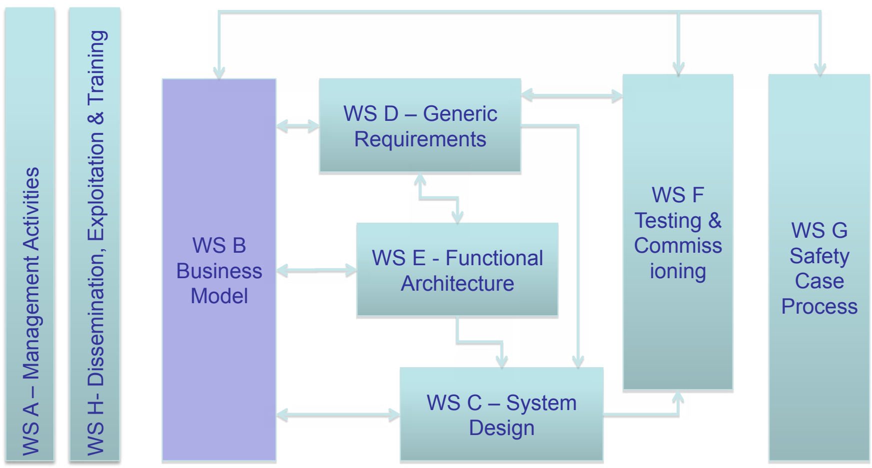
- Document Management System
- GSN Tool
- Notes on installation requirements
- Notes for developers (CMIS interface implementation)
- Use Cases, experiences, benefit

Q & A

Topics for discussion
• The use of open source software modules for implementation of SaCaPro support tool. • Experiences with the developed tool in a real environment • The way from proprietary standardized/unified SaCaPros (on the basis of templates, workflows etc.) to an harmonized Safety Case (Process).

Discussion

INESS Business Model WS-B



Training Session WS B

Presentation of the INESS Life-cycle approach and Business model

Dipl.-Ing. Karsten Kamps
DB Netz AG
Frankfurt, Germany

Dipl.-Kfm. Christian Hoffart
Research Institute for Operations Management (FIR),
Aachen, Germany

Thomas Hirsch, M.A.
Research Institute for Operations Management (FIR),
Aachen, Germany

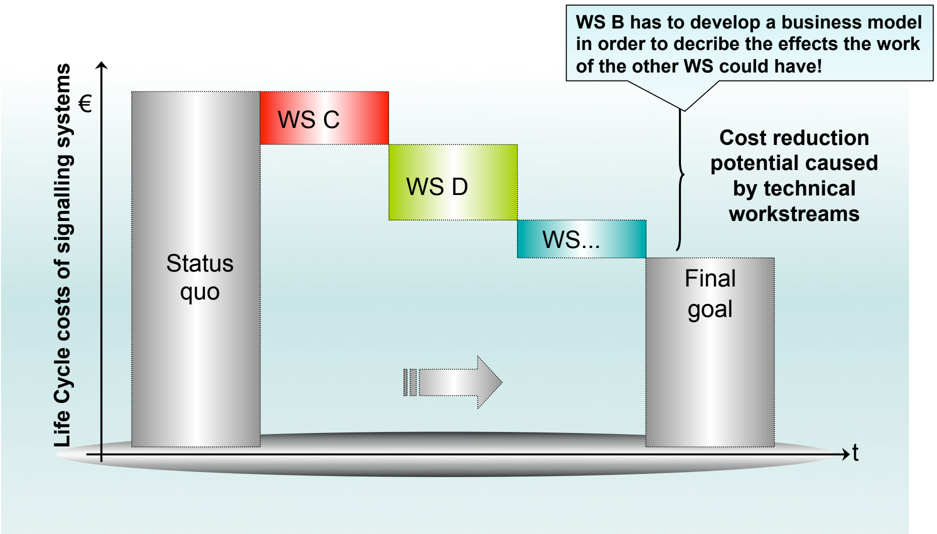
Agenda

1. **Objectives of WS B**
2. **LC-Model and Cost driver analysis**
3. **Cost saving potential of technical work streams**
4. **Business Model development**
5. **Cooperation plan**

Objectives of Work stream B

- Analysis of the cost structure within the entire life cycle of a signalling system
- Identification and estimation of the cost saving potential per technical work stream
- Identification of different approaches for the development of a business model
- Selection of one concept of a business model development process
- Cooperation plan …

Final goal of INESS and WS B



Agenda

1 Objectives of WS B

2 **LC-Model and Cost driver analysis**

3 Cost saving potential of technical work streams

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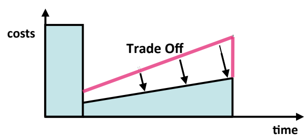
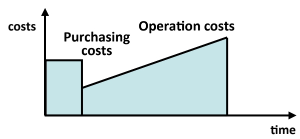
Motivation for Life Cycle Costing in Today's Business

Investment Option A



Investment Option B



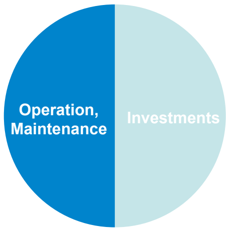
- **Higher investment costs can reduce all following costs**
- **Investment decisions should not only be based on purchasing costs**

- Today's investment decisions often solely based on purchasing costs
- Even though approx. 50% of total investment costs arise after the purchase, common practice to only consider acquisition costs
- Life Cycle Costing (LCC) holds opportunity to come to more sophisticated decisions, since all costs of investment are considered

  → Life Cycle Costing is economical for long term investment decisions

Motivation for LCC in the European Railway Industry

Total Life Cycle costs



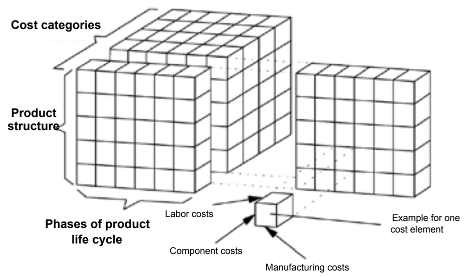
Characteristics of Railway Industry:

- Long-term investment cycles
- High safety level
- High capital intensity
- High public and political interest
- Partly monopoly and subject to regulation
- Guaranteeing high availability

Implication for Railway Industry:

- LCC considers all costs connected with an investment project
- Due to financial impact of long-term investment decisions LCC holds opportunity of massive cost savings

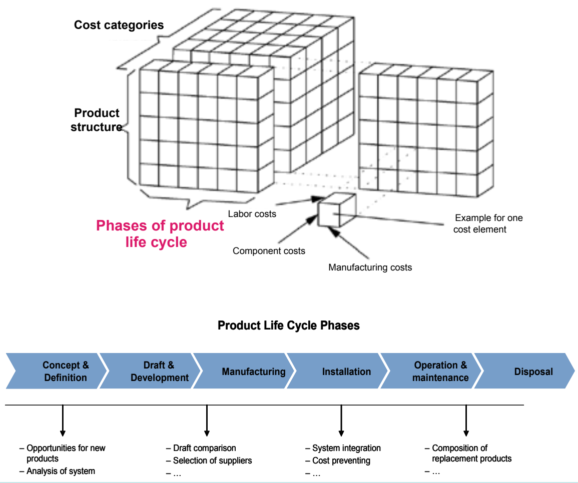
Key Characteristics of LCC based on DIN EN 60300-3-3



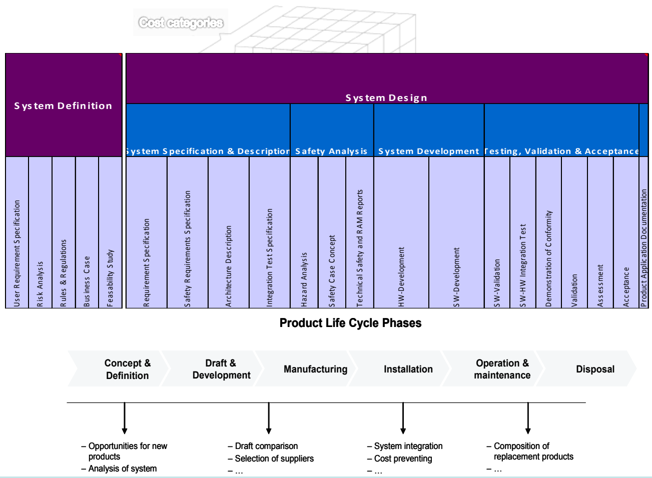
- LCC model, according to DIN EN 60300-3-3, consists of 3 dimensions:
  - Product structure
  - Life cycle phase
  - Cost categories

- Life cycle phases predetermined by the model
- The generic model has to be adjusted to the project-specific structure and cost categories

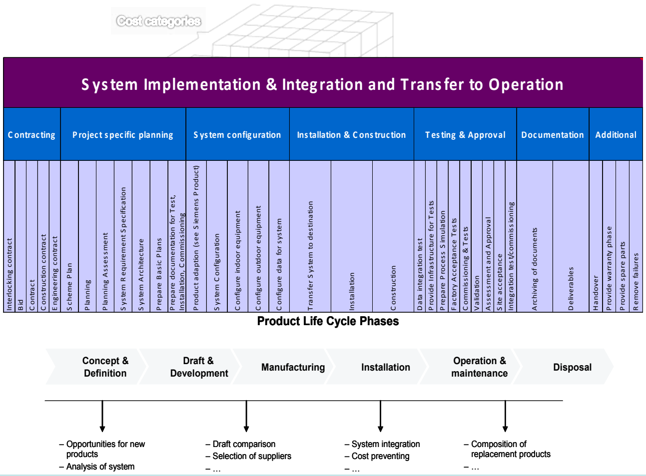
LCC Phases



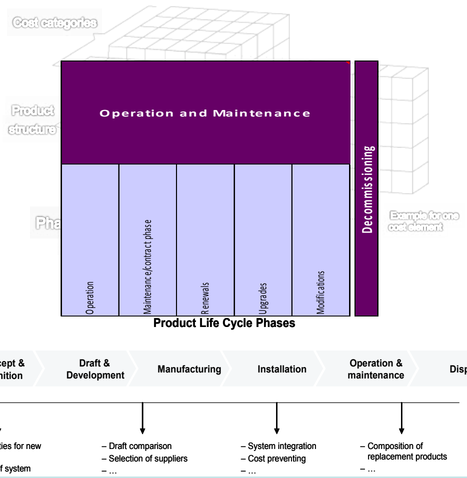
LCC Phases for the INESS LC-model (I/III)



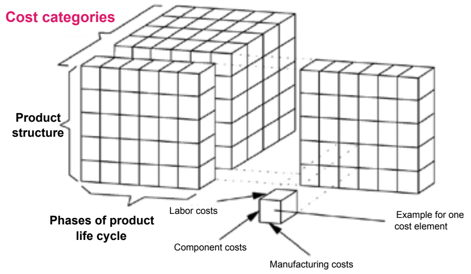
LCC Phases for the INESS LC-model (II/III)



LCC Phases for the INESS LC-model (III/III)



LCC Cost Structure



- **Acquisition costs:** generally visible ahead of acquisition, sometimes include installation costs
- **Costs of ownership:** often main cost drivers, not directly visible and difficult to calculate
- **Disposal costs:** can be major cost part, depending on legislation
- LCC = Costs $_{Acquisition}$ + Costs $_{Ownership}$ + Costs $_{Disposal}$

LCC Cost Structure for the INESS LC-model

Material [€]
Costs of any Raw materials (i.e. steel, copper, concrete)
Costs of any supllies auxilary materials (i.e. screws, bolts)

Equipment [€]
Costs of Interlocking components (i.e. Signal, point machine, etc. …)

Labour [hours + €/h]
Personnel cost (i.e. maintenance workforce, engineers, etc. …)

Energy [kWh + €/kWh]
Provision of electricity in each phase (i.e. air conditioning, energy consumption of computers and field elements, etc. …)

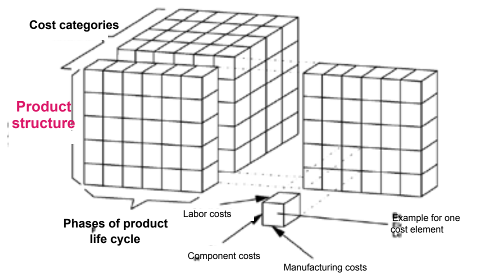
Capital [€]
Costs for financing (i.e. bank loan interests, charges/ fees)

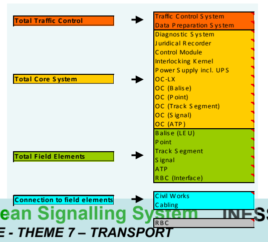
Service disruptions [minutes]
Delay minutes due to interruptions of interlocking components

Other costs esp. [€]
(i.e. insurances, logistic costs, etc. …)

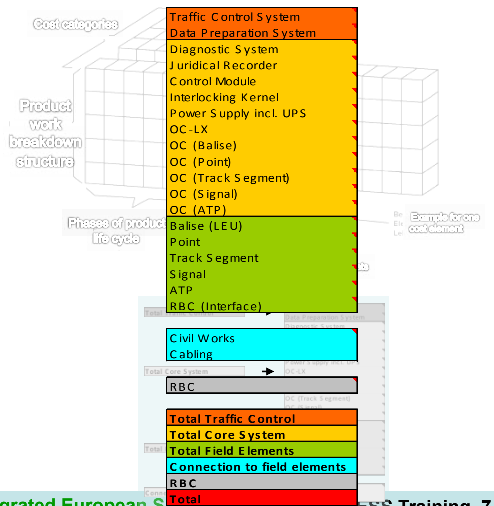
- Acquisition costs: generally visible ahead of acquisition, sometimes include installation costs
- Costs of ownership: often main cost drivers, not directly visible and difficult to calculate
- Disposal costs: can be major cost part, depending on legislation
- LCC = Costs $_{Acquisition}$ + Costs $_{Ownership}$ + Costs $_{Disposal}$

LCC Product-structure

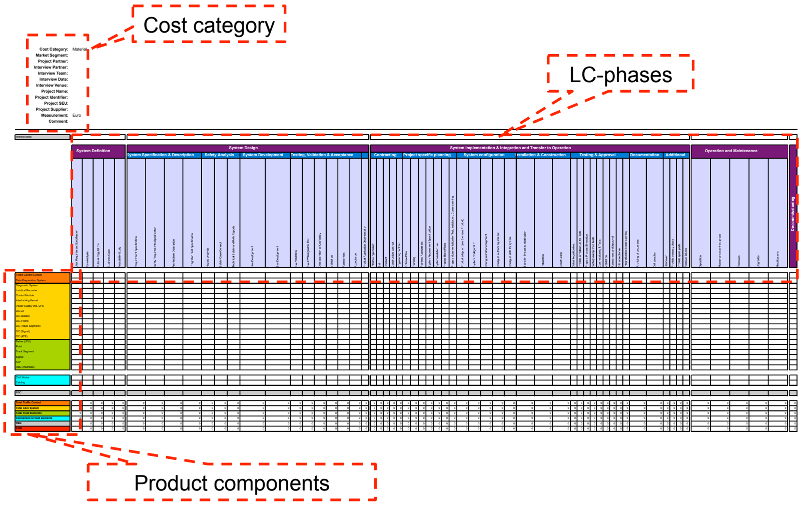




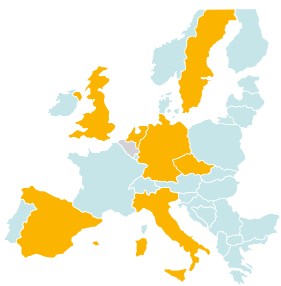
LCC Product-structure of the INESS LC-model



Structure of the LCC data collection template



Data collection process allover Europe

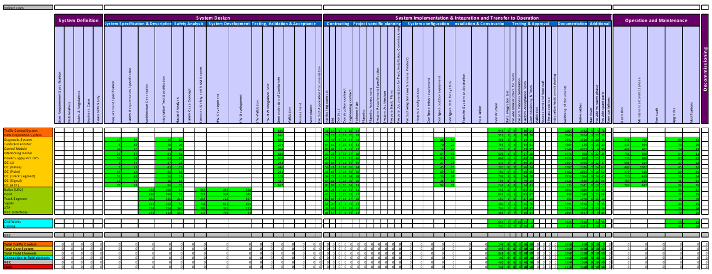


Railway and Industry participants in LCC-Data Collection:

ADIF	-	**Spain**
Trafikverket	-	**Sweden**
DB Netz AG	-	**Germany**
Network Rail	-	**Great Britain**
ProRail	-	**Netherlands**
RFI	-	**Italy**
Ansaldo	-	**Italy**
AZD	-	**Czech Republic**
Bombardier	-	**Germany**
Invensys	-	**Great Britain**
Siemens	-	**Germany**
Thales	-	**Germany**

- Meetings have been arranged with all partners from the railway and the industry side
- Each partner identified two representative interlocking projects
- On-site interview with railway/ industry partner to fill the data collection template
- LCC Data Analysis based on the collected datasets

Data Collection



Filling of templates

- Request of highly detailed cost information in order to gain valid results through LCC
- Consideration of company-specific information regarding e.g. project size, project duration, architecture, etc.

Data Analysis

LCC Data Analysis

- Consolidation and analysis of collected data with the following objectives
  - Identification of cost drivers
  - Establishment of transparency over distribution costs within the life cycle
  - Measurement of relationship between acquisition, ownership and disposal costs
- Clustering of identified cost items into different cost categories and sublevels
- Visualization of data clusters in form of a pie chart

Allocation of investment costs to defined market segments

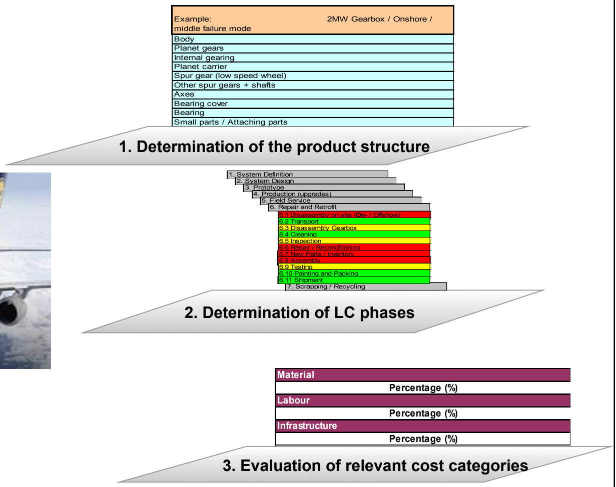
- Analysis of the cost structure within the entire life cycle of a signalling system

		Segment I	Segment II	Segment III	S…
	Criteria	High speed TEN	Conventional TE… High deman…		…way
Operational requirements	Speed	> 190 km/h (acc. to TS…	Sp…	…eter for distinction …m demand or domestic	
	No of train movements / day / track	40…		50 … 100	< 50
	No of train movements within hour of maximum traffic / track		> 10	6 … 10	3 … 4
	Mixed passenger & fr…		Yes	Yes	Yes
…nical …ments	ETCS (perspec… installed)	Level 2 / 3	Level 1 / 2 / 3	Level 1 / 1LS / 2	Optional
	Lev…	SIL 4	SIL 4	SIL 4	SIL 3 / 4
		1,5 … 4,5	15 … 45	4 … 15	< 6
	…contractual downtime	figures gathered from data collection			
	…vailability A [%]	figures gathered from data collection			
	Maintainability M [% /time]	figures gathered from data collection			

Non-safe features will be part of textual description of circumstances of the projects.

[1)] Homogeneity of traffic operated on one line

Exploitability – FIR LCC Approach can be adopted to other industries



Agenda

1 Objectives of WS B

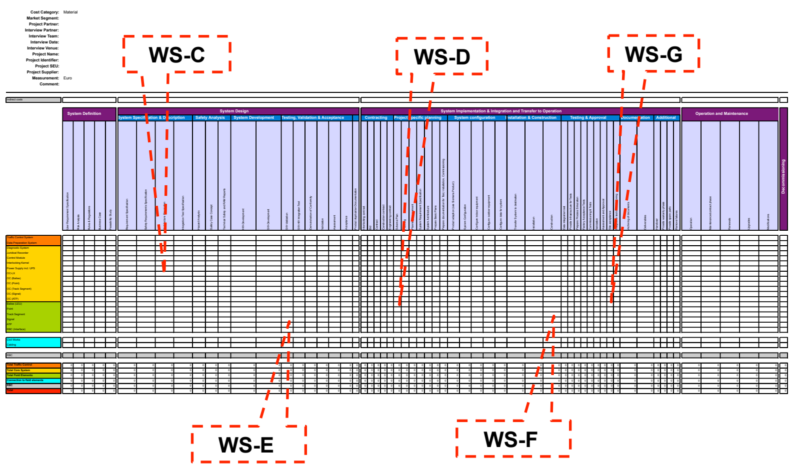
2 LC-Model and Cost driver analysis

3 **Cost saving potential of technical work streams**

4 Business Model development

5 Cooperation plan

Task for the evaluation of cost saving effects of the technical work streams



Results of effect evaluation regarding the work of the technical work streams

C. System Design

Identification of cost saving potentials in the following phase of the life-cycle of an signalling system: system configuration; testing, validation & acceptance; system design.

D. ... **quirements**

... potentials regarding: ... language for describing ... rement and cost saving ... mpact on system definition and design phase.

- Identification and estimation of the cost saving potential per technical work stream

Identification of cost saving potential of the following standardization activity: R... interface

E. Functional architecture and interfaces

Cost reduction in the CENELEC-process will be reached by reducing labour costs by implementing document management support tool. The estimated cost reduction potential is 0,75% of the total LCC.

G. Safety case process

Agenda

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Business Model development approach(es) – company oriented view

Approach

0. Customer´s/ company´s benefit:

   Defines the benefit for the customer and the company

1. Value proposition:

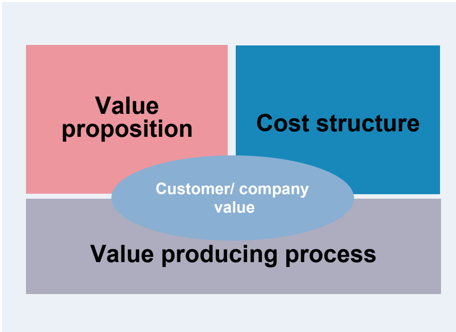
   Describes the bundle of products and services that create value for a specific market segment – This is input from WS …..

2. Value producing process:

   Describes how products and services should be developed.

3. Cost structure:

   Describes all costs incurred to develop and operate a product or service.



„A business model describes the rationale of how an organization creates, delivers, and captures value.“

Business Model development approach(es) – market oriented view

Qualitative models

- Definition of parameters
- Demonstration of raw … between the para…
- General sta…
- Enab… corre… … of important
- Causal … diagrams

…uantitative models

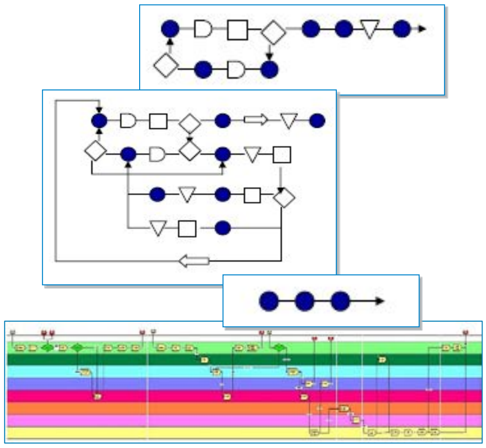
- Different influences
- Giving practical results
- Detailed statements
- Selection of variables and numbers is crucial
- Stock-flow-diagrams

▪ Identification of different approaches for the development of a business model

An integration of the qualitative and the quantitative model provides the basis for a business model that helps to simulate future investment projects!

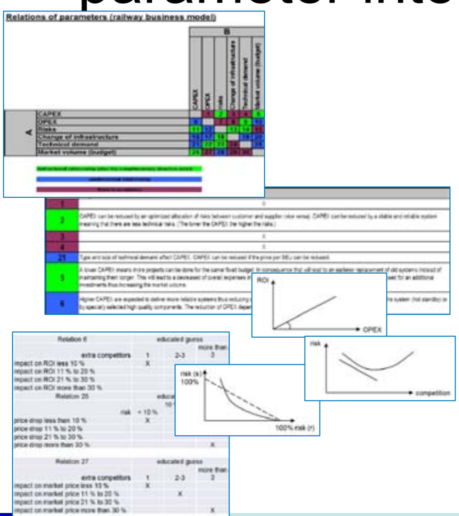
Identification of relevant business model parameters

- Process assimilation concerning a signalling system project
  - Identification of stakeholders
  - Identification of relevant process steps
  - Identification of inserted resources



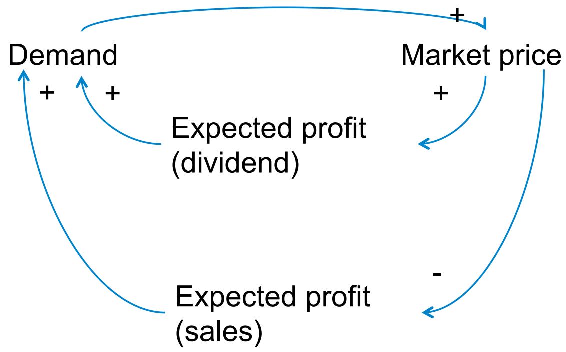
Identified and described business model parameters

Identification of relevant parameter interrelationships

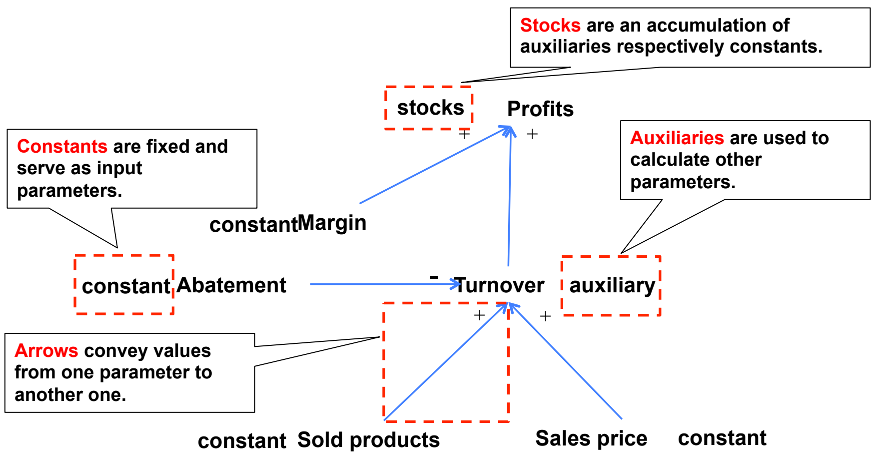


- Identification of Business model parameter interrelationships
- Description of relevant interrelationships
- Defining the interrelationships by the use of graphs
- Expressing the interrelationships by the use of equations

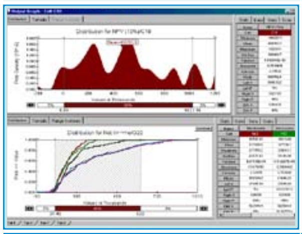
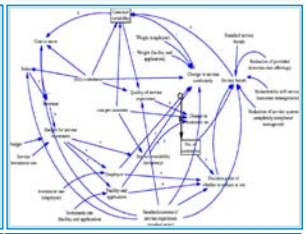
Example: Qualitative model



Example: Quantitative model



Different simulation approaches

Statical simulation	Dynamic simulation	System Dynamics
Point of time-simulation	Discreet event-simulation	Status-based simulation
		
Monte-Carlo-simulation	**Bonapart**	**VenSim**
Used for simulating natural and mathematical systems (i.e. weather forecasting)	Process oriented approach (i.e. work flow optimization of a material flow system)	Explanation of system behaviour by demonstrating functional interrelationships (i.e. variation of global market interrelationships)

System dynamics and VenSim - example of use: World 3 Model

Analysis of world´s economic system by using system dynamics ... im:

- Industry
- Population increase
- Food production
- Exhaustible raw materials
- Environmental pollution

Future developments of the ... omic and ecosystems could have been forecasted:

- Explosive ... ulation → hunger crises
- Industri... eases exponentially → lack of exhaustible raw materials, high env... ntal pollution

▪ Selection of one concept of a business model development process

Conclusion: (Ecological) limits to growth

Agenda

1 Objectives of WS B

2 LC-Model and Cost driver analysis

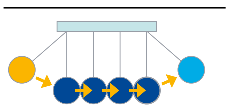
3 Cost saving potential of technical work streams

4 Business Model development

5 **Cooperation plan**

Can we accelerate the migration to ERTMS using standards and finding win-win-situations?

INESS project partners



Cost reduction for signalling systems?

Pros

- Cost reduction potential through standardisation
- Faster innovation cycle
- Open markets

Cons

- High development costs
- High migration cots
- No clear business case

How can future cooperation look like to create positive business cases for both, railways and industry?

Which cooperation model generates benefit for both market sides

Current situation

- Current cooperation models require high investments for development and approval on supplier side
- Railways pay for development via product price
- Each supplier has to pay for development and approval separately
- Risk of supplier dependencies by different "flavours" of interface implementations
- Testing is done in different ways, thus complicate cross acceptance of signalling systems
- Each supplier faces massive costs on market entry due to unclear or incomplete specifications

Conclusion

- Development costs and time need to be reduced
- Railways need to specify their requirements in a formal way
- Development and approval costs should not be payed via product price
- Different "flavours" of interfaces should be avoided
- Common tests should be used to prove product conformity towards the standard

Perspective of a railway – Is there a realistic chance to change the cooperation model?

Findings from a railway perspective

- To fulfil customer expectations, signalling systems need to have **much lower LCC** and more **intelligent architectures**
- **Obsolescence management** should be much easier and **without** the need for a **new approval**
- There is a **clear business case for railways for standards** and it is up to the railway companies to set those standards

and

- We have clear statements **from industry**, that **standardisation** in general **is no business case for them**
- The initial **investments for develop**ing a standardised interface as well as increased competition **are major obstacles or even threads** to almost all industry partners
- The overall signalling **market is more or less constant and competition is growing**

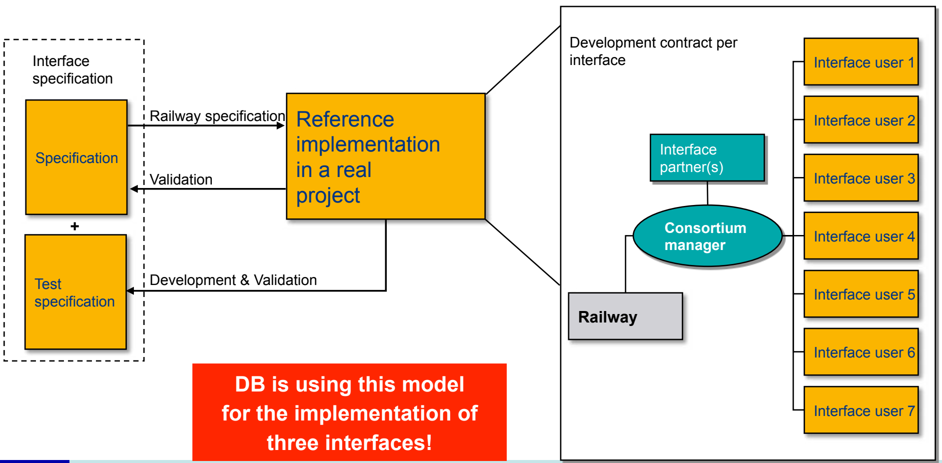
But we also know that only innovation will keep technological leadership!

Which key findings did WS B identify and how can a new cooperation model benefit from these?

- The results of INESS demonstrate, that **standardisation** provides the opportunity to
  - make signalling **products cheaper**
  - **engineering faster**
  - **testing and approval** processes **easier**
- Railways have to take the lead in a change process by taking the responsibility for **defining functional requirements and interface standards**
- Using **formal methods** to describe system requirements seems to be a key success factor for standardisation
- We can archive standardised interfaces as well as a harmonised set of core functions. But to reach a win-win situation we need **a new cooperation model** where all partners **share risks**

Proposal for a new cooperation plan – Closer cooperation during development…

An example of common development to ensure interoperability and openness



Thank you for your attention!

Questions???

Discussion

INESS Wrap-up Discussion
Emanuel Buseyne