



# Requirements Management: Using a Software Engineering Tool to Help Coordinating Accelerator Projects

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Seminar Computing in High Energy Physics  
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## Agenda

- Why Requirements Management helps in planning projects
- Preparing Plan Approval Documents for TESLA
  - ▶ Project Challenges
  - ▶ Benefits from Requirements Management
- Lessons Learned from Software Engineering
- Conclusion and Discussion



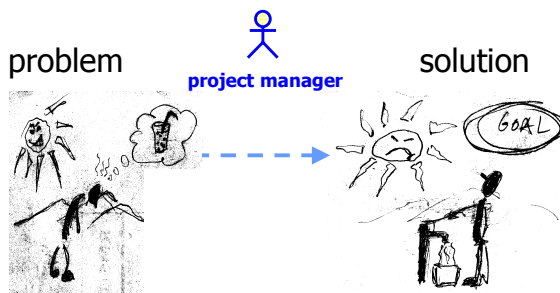


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# The Specification Pitfall

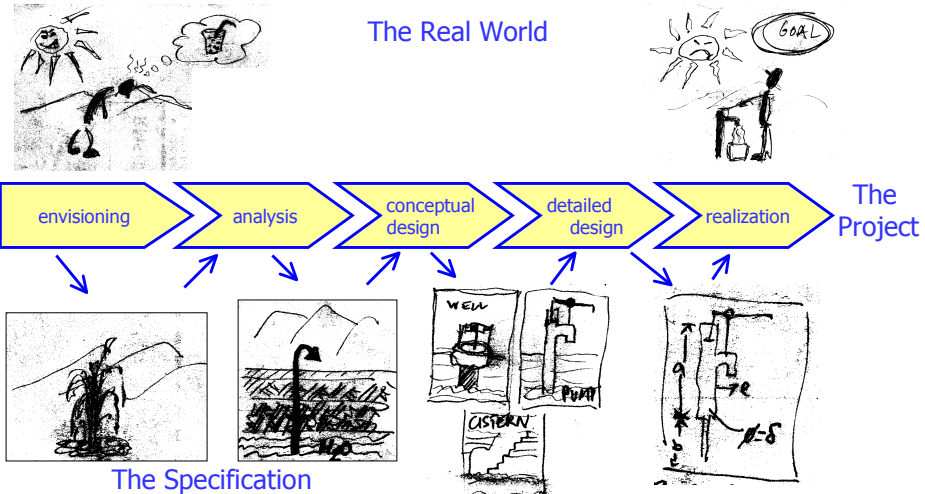


- projects want to produce solutions
- careful specification takes time and effort
- at first going directly for realization seems more effective
- later a lack of specification results in improper solutions

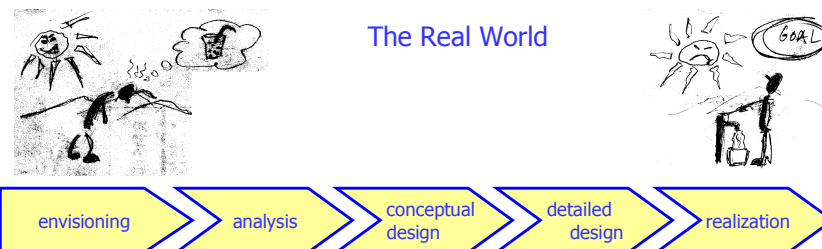




# The Specification Procedure



# Projects and Specifications



- such projects need more formal specification:
  - ▶ many participants
  - ▶ distributed team
  - ▶ long time scale
  - ▶ frequent changes
  - ▶ limited resources





# Specification Benefits

- translates vision into working instructions
- is basis for discussion within the project team
- provides checklist to test results against
- stores information for later use during operation and maintenance
- keeps track of changing requirements and constraints



# Key Terms

- **Specification Procedure** (Requirements Engineering)
  - ▶ is the formal procedure that leads from an initial vision to its realization
- **Requirement**
  - ▶ is a constraint or a desired feature
- **Specification Document**
  - ▶ is a formal collection of requirements
- **Requirements Management**
  - ▶ is a set of tools and methods for writing and maintaining specifications





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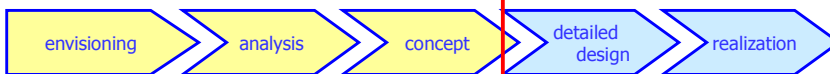
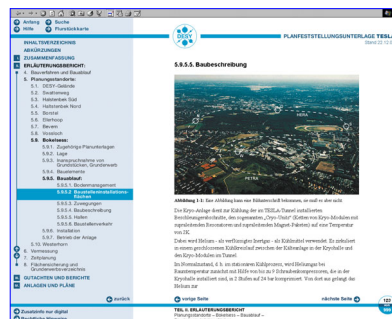
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# Plan Approval Procedure



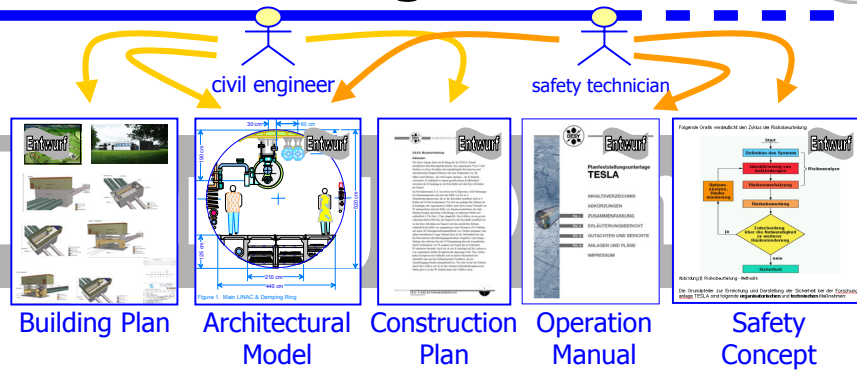
- mandatory by law for large construction projects
- approves construction and operation of whole project
- requires rough design of constructions
- describes their impact on the environment



Plan approval



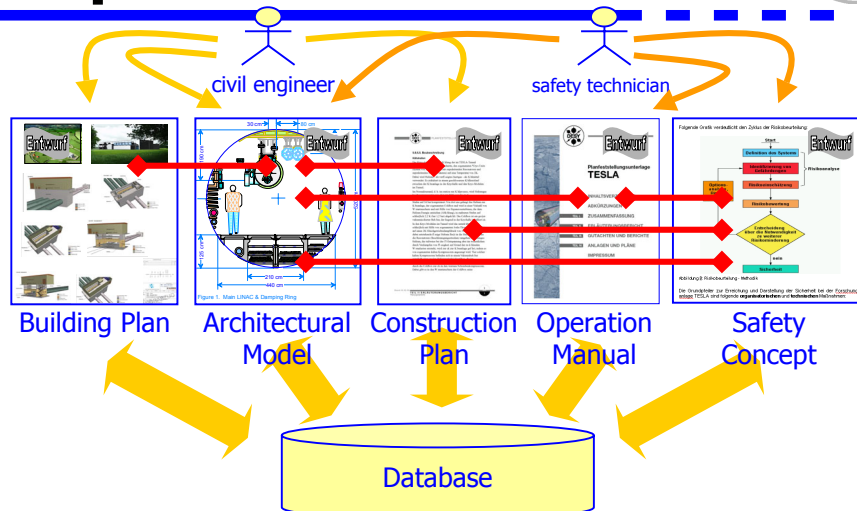
# Objective TESLA Planning Documents



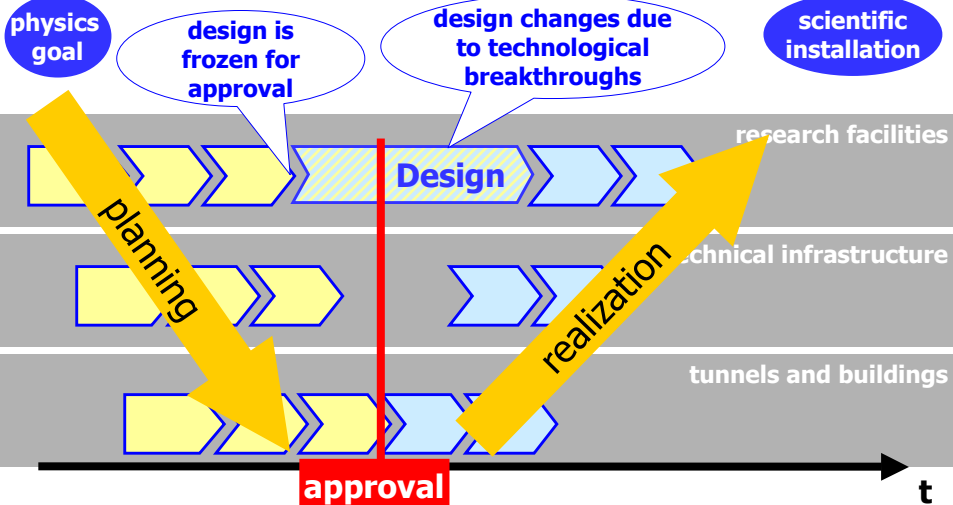
- collect information from different experts
- describe the installations consistently



# Challenge Dependencies



# Challenge Changes over Time



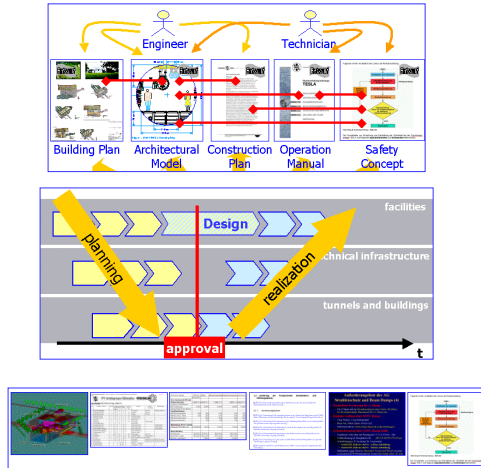
# Challenge Cultural differences



- Different documentation formats
  - ▶ visual, tabular, verbalized, schematic
- Mixing up requirements and solutions
- uncertainty about level of detail



# Summary of Challenges



- large number of experts
- cultural differences
- dependent planning documents
- variety of methods and tools
- long project life-span



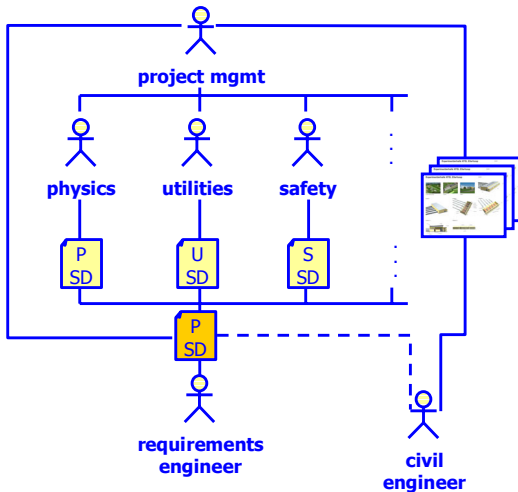
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# Coordinating the Experts



- organize experts in interest groups
- map expert tasks to specification topics
- nominate responsible person for every specification topic
- set up specification document for every topic
- appoint requirements engineer to detect and resolve conflicts
- extract agreed specification
- hand specification to civil engineer for design



# Specification Guidelines

## guideline

1. Describe important **tasks** and applications.
2. Describe scenarios for each task and identify **key objects**.
3. Determine required **floor space**.
4. Determine required **facilities**.
5. Describe procedures for **provision of resources**.
6. Check for external **constraints**.
7. ...

*excerpt*

## specification result

1. The experimental hall is used to **conduct experiments**.
2. It shall house the **detector**.
3. The detector shall have a **size** of 16\*26\*16 m<sup>3</sup>.
4. For operation the detector needs **gases**. Gas facilities include a **mixer and a gas store**.
5. Gases should be inserted to the mixer through a **separate shaft**.
6. The gas installations should be kept in a **separate building** for security reasons.





# Requirements Classification

## Requirement R6

Gas installations should be kept in a separate building.

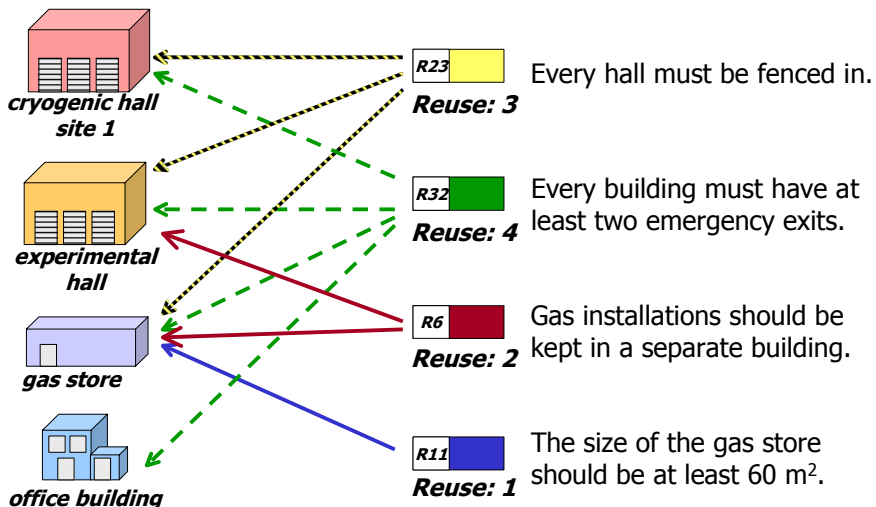
type	building	site	group
floor space	experiment. hall	site #1	physics
usability	cryogenic hall	site #2	civil engineering
safety	gas store	site #3	safety
cost	office building	site #4	utilities
other			

Author:	Author-1	Version:	R23.0.14
Status:	Approved	Last Changed:	2003-06-21
Priority:	Essential	Last Change:	status [appr.]

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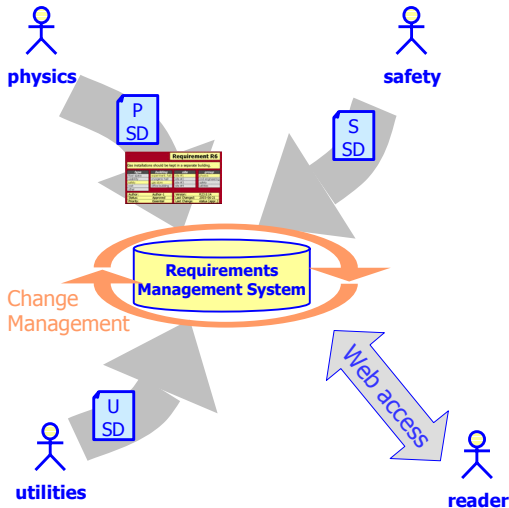


# Requirements Reuse



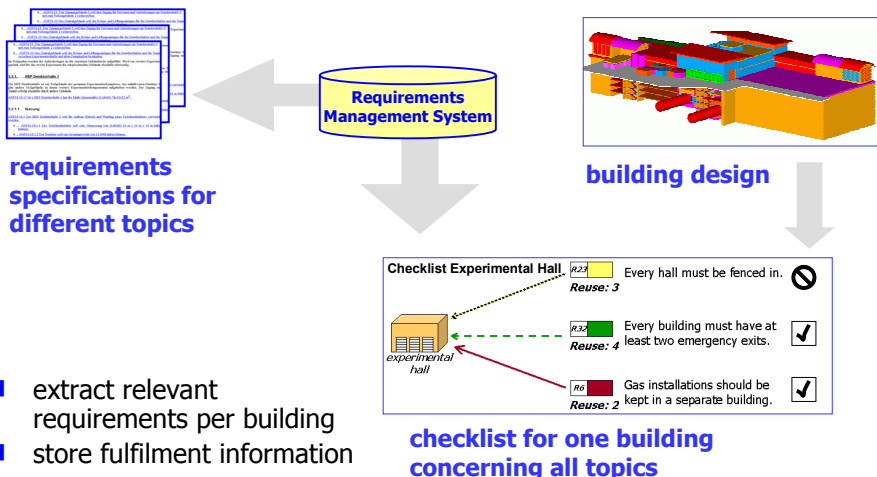


# Requirements Management Tool



- Commercial RMS stores specification documents and requirements index cards.
- Specifications documents are written in MS Word.
- In every document requirements are marked and classified.
- The index cards are stored in the Oracle database.
- A Web interface gives access to the specification documents and enables querying the requirements index cards.

# Checklists for Design Approval



- extract relevant requirements per building
- store fulfilment information

## checklist for one building concerning all topics



# Requirements Management Achievements

- ✓ information from all interest groups accessible for everybody
- ✓ common platform with up-to-date information
- ✓ guidelines for complete specifications
- ✓ additional information on requirements (e.g. status) in the database
- ✓ queries for information exchange
- ✓ checklists for design approval



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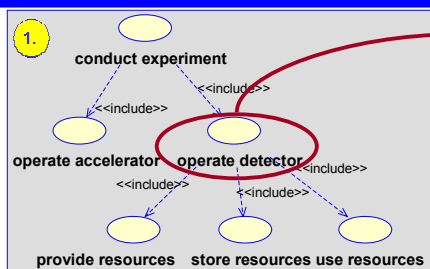


# Software Engineering

- provides methods and tools to manage complex projects with many participants
- defines (specification) activities, their responsibilities and outcome in software projects
- makes extensively use of modeling for specification
- advises the use of Requirements Management Tools



# Specification through Modeling

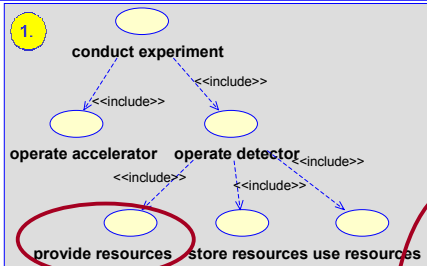


- For conducting experiments the experimental hall shall **house the detector**.
- For operation the detector needs **gases**.
- For gas provision a **mixer** is required on site.
- Gases are delivered in containers.
- Gases should be inserted to the mixer through a **separate shaft**.
- Before usage the gas mix has to be **stored**.
- The gas store requires a **control room** of 30 m<sup>3</sup>.

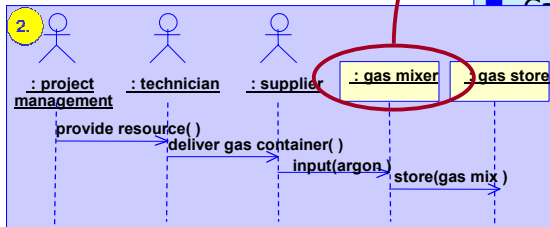




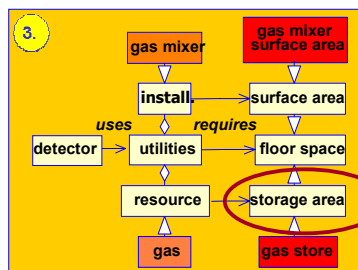
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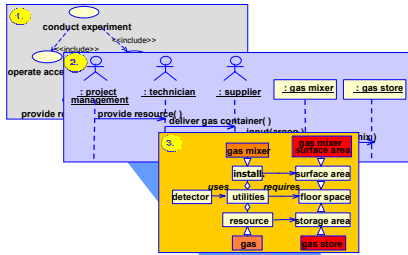


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# Specification through Description



- Software Engineering provides formal modeling procedure for specification.

- guideline**
1. Describe important tasks and applications.
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  3. Determine required floor space.
  4. Determine required facilities.
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  7. ...
- excerpt*

- This procedure was reduced to simple guidelines.



# Requirements Management in a Software Project

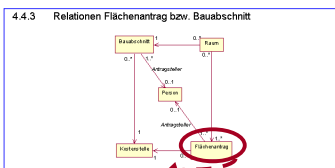


Abbildung 55: Relationen Flächenantrag bzw. Bauabschnitt

[ANF27.2.7] Einem Raum soll eine Menge von Flächenanträgen zugeordnet werden können.

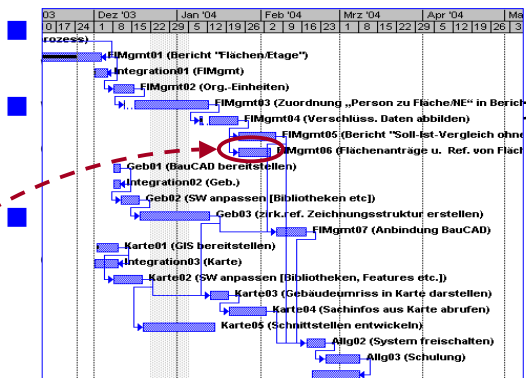
[ANF27.2.8] Einem Flächenantrag soll eine Menge von Bauabschnitten zugeordnet werden können.

[ANF27.2.9] Einem Flächenantrag soll eine Person als Antragsteller zugeordnet werden können. (vgl. 4.1.4)

Leistungsversicherungskatalog Version 2.2 vom 23.07.2004

Id	Regel im Pflichtheft	Anforderungsummer	Realisierung
466	5.4.6	38.6	
467	5.4.6	38.6.1	
468	5.4.6	38.6.2	
469	5.4.6	38.6.3	
470	5.4.6.1	38.6.3.1	
471	5.4.6.1	38.6.3.2	

Das Formular Flächenantrag soll den Datenatz eines Flächenantrags darstellen. Das Formular Flächenantrag soll über Funktionen und Knöpfe verfügen, um die mit dem dargestellten Datensatz verknüpften Räume in einer Raumliste anzuzeigen. Das Formular Flächenantrag im interaktiven Vollzugriff soll Drop-Down-Menüs zum Zuordnen verknüpfter Datensätze zur Verfügung stellen, insbesondere zur Zuordnung einer Person als Antragsteller, um den dargestellten Datensatz mit Personen zu verknüpfen.



- assign requirements to work packages





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# Conclusion

- Requirements Management methods and tools can be successfully applied to accelerator projects.
- Benefits
  - ▶ enable parallel specification of components by several working groups
  - ▶ provide a central platform for communication and documentation
  - ▶ generate criteria for comprehensive checklists
  - ▶ ensure long-term availability of emerging knowledge
- Requirements Management can help to coordinate complex projects.

– for more info consult [www.desy.de/ipp](http://www.desy.de/ipp) or  
email to [ipp-info@desy.de](mailto:ipp-info@desy.de)

