

 **HOOD**
Experts in Requirements




Model-supported Risk Management

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- 3 SysML Risk Management Viewpoint
- 4 Using SysML Risk Modelling Enhancement
- 5 SysML Support for Risk Management
- 6 Summary

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Our Business



The usage of **Requirements Management & Engineering (RM&E)** and continuous process improvement initiatives like CMMI or SPICE are an essential part for big and world wide organisations to develop complex products, services and systems.



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Einige Kunden, die Vertrauen in HOOD setzen




- **Automobilhersteller**
 - Adam Opel GmbH
 - Audi AG
 - BMW AG
 - Daimler AG
 - Volkswagen AG
- **Automobilzulieferer**
 - Hella KGaA Hueck & Co
 - Robert Bosch GmbH
 - TRW
- **Logistik/ Transportation**
 - Deutsche Bahn AG
 - Schenker Logistics
 - Siemens Mobility
 - Thales Group
- **IT/ Software-Development**
 - BMW AG
 - Volkswagen AG
 - Deutsche Nationalbibliothek
- **Luft- und Raumfahrt**
 - EADS
 - Astrium
 - Airbus
- **Medizintechnik**
 - Drägerwerk AG & Co. KGaA
 - Siemens Healthcare
 - CareFusion (Viasys Healthcare)
- **Telekommunikation**
 - Alcatel-Lucent
 - NetCologne Gesellschaft für Telekommunikation mbH
 - O2 Germany GmbH & Co. OHG
- **Banken und Versicherungen**
 - AXA Konzern AG
 - BMW Bank GmbH
 - Interpolis

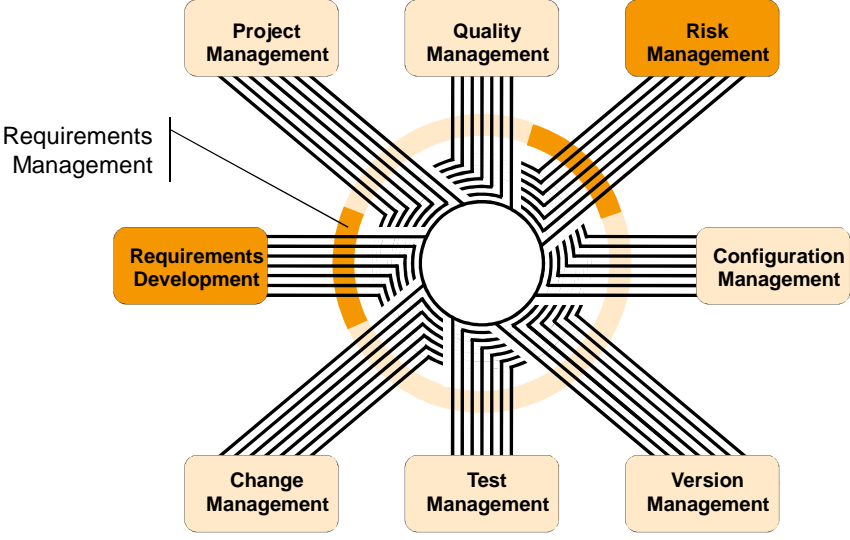
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Our Expertise 

Requirements Management is the interface between Requirements Development and all other Systems Engineering Processes



Requirements Management

Project Management

Quality Management

Risk Management

Configuration Management

Version Management


Test Management

Change Management

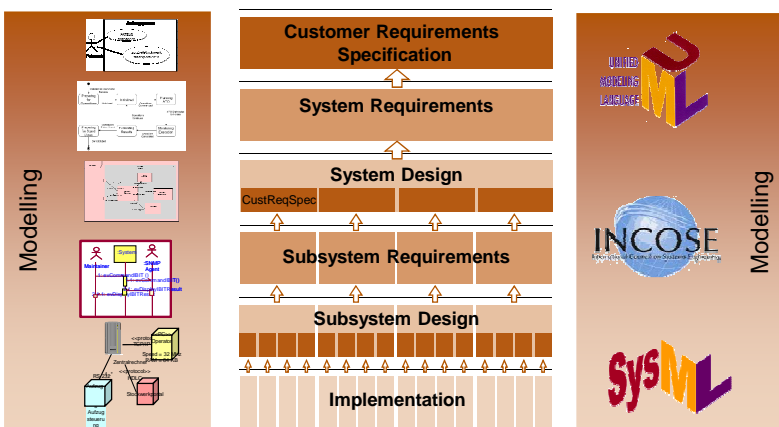
Requirements Development

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Model Based Systems Engineering (MBSE) Expertise 

- Modelling is a central element in the HOOD Requirements Specification Process and in the derivation of requirements
- HOOD actively works on INCOSE “Model Based Systems Engineering vision 2020”



Customer Requirements Specification

System Requirements

System Design

Subsystem Requirements

Subsystem Design

Implementation


Modelling

Modelling

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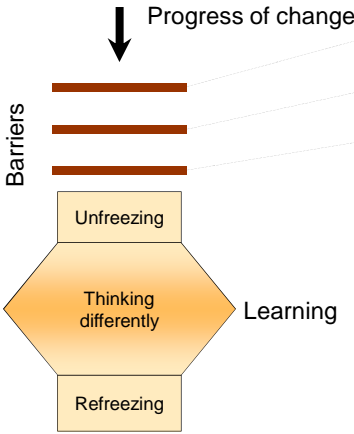
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HOOD Guideline: Structure of Change



Process Improvement is not just a technical challenge.

Progress of change



Learning

- Lack of discomfort/anxiety with present system
- Ignoring information that does not fit with the past
- Lack of psychological safety in the change, fear of loss of identity or integrity

Recognising the barriers to change and helping people to overcome their anxiety, is necessary for successful change


Source: Colin Hood 1997
Model of change based on work by Lewin 1947 and Schein 1961-1965

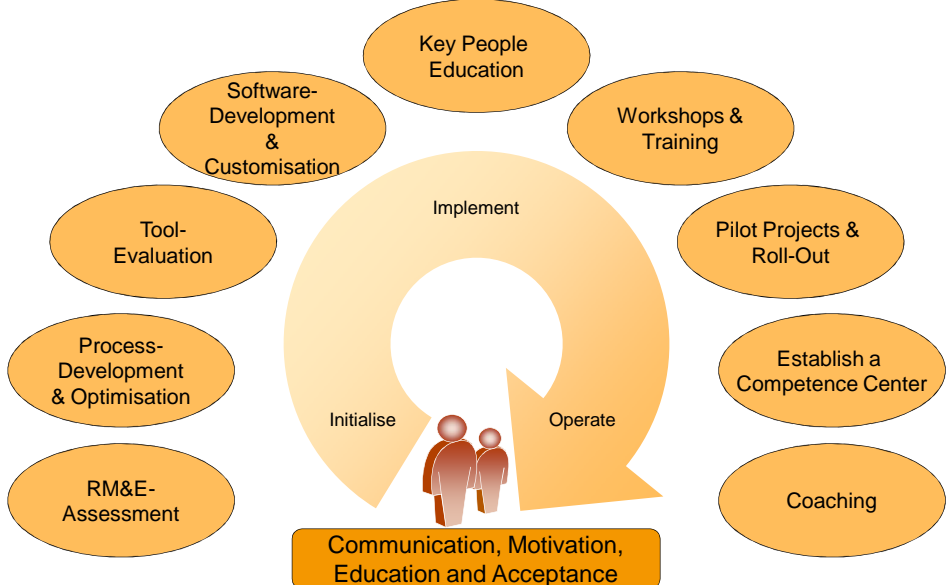
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Services - Overview






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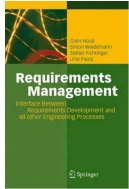
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HOOD- Excellence in Requirements
































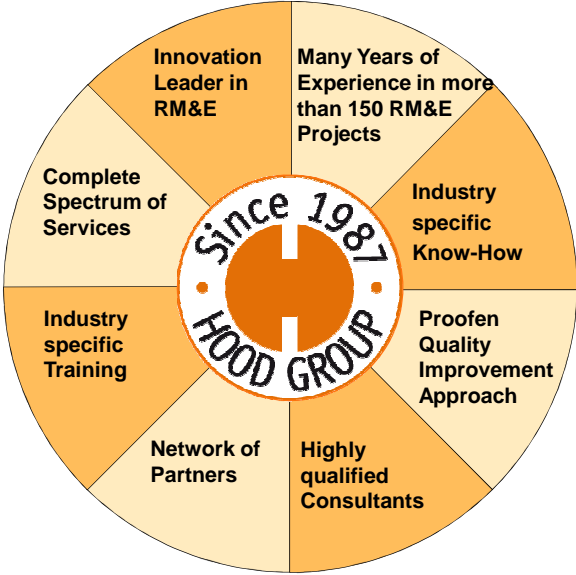
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The benefits of working with HOOD





The diagram is a circular infographic with a central logo that says "Since 1987 HOOD GROUP". Surrounding the logo are eight segments, each representing a benefit:

- Innovation Leader in RM&E
- Many Years of Experience in more than 150 RM&E Projects
- Industry specific Know-How
- Proven Quality Improvement Approach
- Highly qualified Consultants
- Network of Partners
- Industry specific Training
- Complete Spectrum of Services

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HCMs – Requirements Management & Definition



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Motivation

- There are a lot of risks
 - Financial
 - Contractual
 - Legal
 - Too late to market
 - Supplier
 - **Technical**
 - There are a lot of technical risks
 - New/unknown technique
 - Very high performance
 - Very high availability
 - Very high safety requirements
 - Very high security requirements
 - ...
 -




International Space Station
Probability of No Impacts From ≥ 1 cm \emptyset Debris

Impact Risk


Low High

(from Wikimedia commons)

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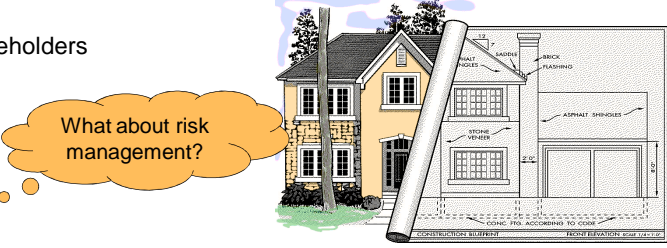


Motivation

Development of technical systems is not easy!

- Modeling is a well-established engineering technique
- Using models for problem area and solution area
 - **reduces** complexity
 - **facilitates** communication
 - **eases** re-use
 - **reduces** development risks
- Benefits for different stakeholders
 - Customers
 - Project management
 - Development
 - Quality assurance
 - Other stakeholders






(Von Rational Websources)

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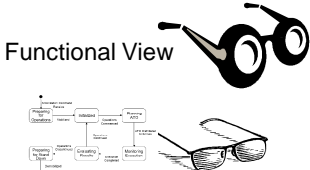
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Views, models and diagrams



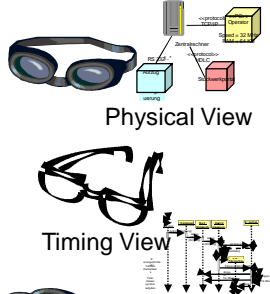
- Different types of diagrams show different aspects of the system
- Aspects complement and overlap one another
- Architecture frameworks guide the creation of models
- Consistency of the model must be established




Functional View




Physical View




Timing View




Requirements View



Operational View



Safety View




Risk View

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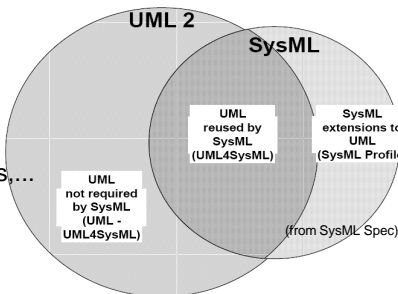
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Why UML/SysML



- UML/SysML includes:
 - notation (graphical), concepts and semantics, guidelines
- Aims:
 - mature notation on formal basis
 - extensible (stereotypes)
 - support for established well-tryed concepts
 - i.e. state charts, message sequence charts,...
- Advantages
 - Well-known
 - Simple to understand
 - Standardized, state-of-the-art
- Not included:
 - Method
 - Elements for risk identification & management





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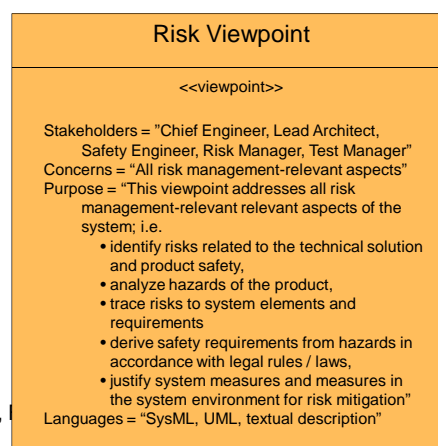


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SysML Safety Viewpoint



- Properties
 - risk severity
 - risk likelihood
 - hazard severity
 - hazard likelihood
 - criticality
 - ...
- Stereotypes
 - Class <<Risk>>
 - Class <<Hazard>>
 - Class <<Threat>>
 -
- Views
 - System hazards, threads and risks
 - Safety mechanisms (Fault Tree Analysis, ...)
 - Risk tracing
 - Risk mitigation measures



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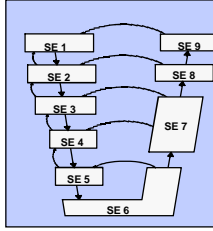
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Using UML/SysML for Risk & Safety Aspects



- Same examples of SysML capabilities to capture risk & safety aspects
 - Along the V-Model System development process
- SD-1.3 „Definition of Criticality and Quality Requirements “


```
<<block>>
FireControlManager
{ criticality = high }
```
- SD-1.6 „Threat and Risk Analysis “: Consider safety, security and risk aspects



```
<<hazard>>
Unintentional Missile Launch
{ severity = Catastrophic }
```

```
<<endangers>>
```

```
<<block>>
Launcher
```

```
<<risk>>
Wrong Target Identification
{ likelihood = remote }
```

```
<<trace>>
```

```
<<block>>
Radar
```

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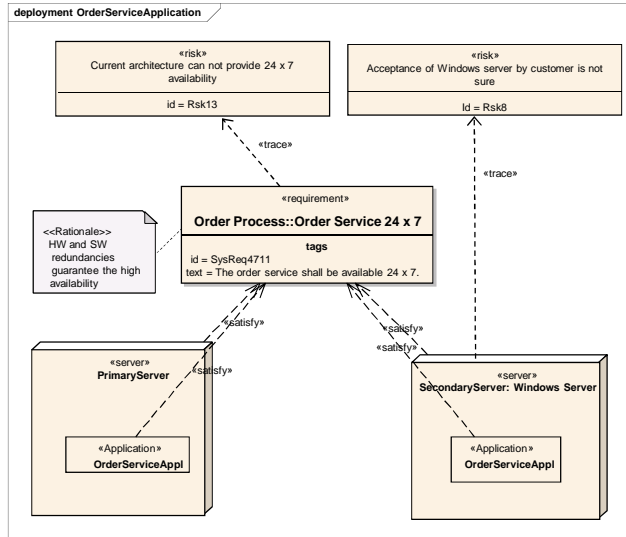
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Using UML/SysML for Risk & Safety Aspects



- risk tracing to requirements and system elements is essential
- <<risk>> visualization of impact improves understanding
- Combining risk management with requirements and system engineering



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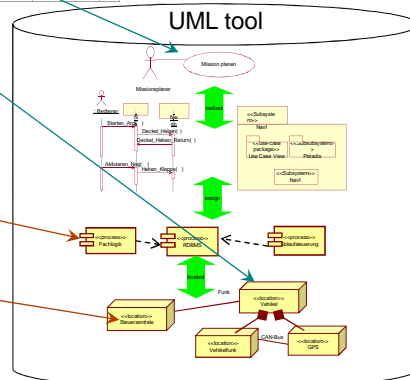
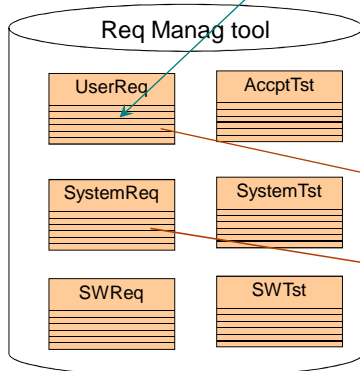
Risk Traceability



Risk Manag tool

Risk Title	Risk Description	Impact	Severity	Occurrence Class	Class	Input	Output	Priority	Analysis Measure	Mitigation Measure	Residual	Owner
Risk 1	High
Risk 2	Medium
Risk 3	Low

Calculation of risks and impact



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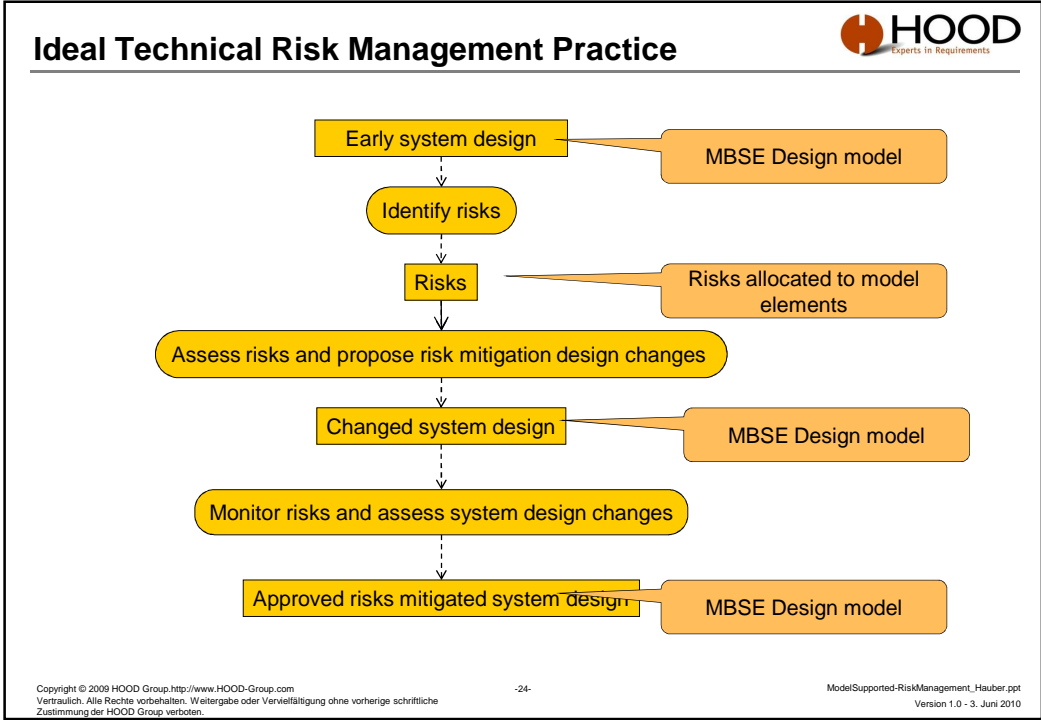
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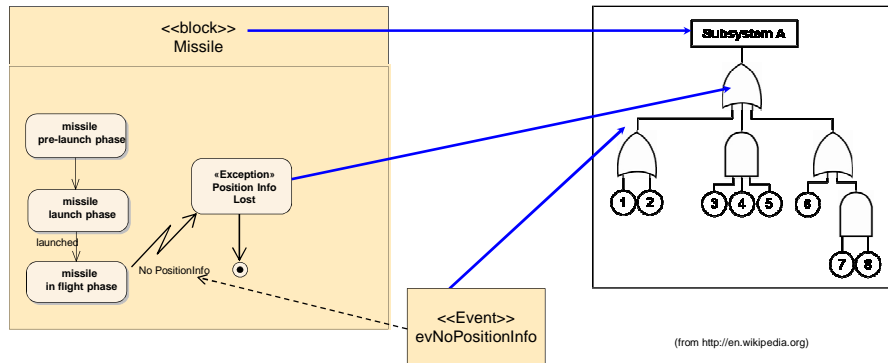


Fault Tree Analysis



Fault Tree Analysis (FTA) to model and analyse failure processes

1. undesired effect is taken as root ('top event')
2. each situation that could cause that effect is added as series of logic expressions
3. trees are labeled with failure probabilities
4. calculate failure probabilities from fault trees



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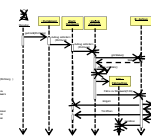
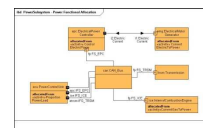
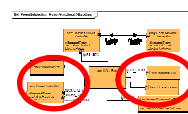
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Failure Modes and Effects Analysis



1. Identify system components/ structure
 - Exists in IBDs of DoDAF SV-1
2. Define functions of components
 - Exists as result of DoDAF SV-10c
3. Analysis failures
 - a. Allocate possible failure to components
 - b. Analyse failure impact based on data/material flows
 - DoDAF SV-10c + DoDAF SV11
4. Asses risks
 1. Failure impact
 2. Failure occurrence probability
 3. Failure detection probability
 - Risk priority number (RPN)
5. Improve system design
 - Model based

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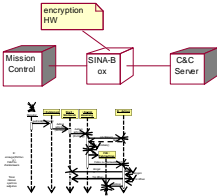
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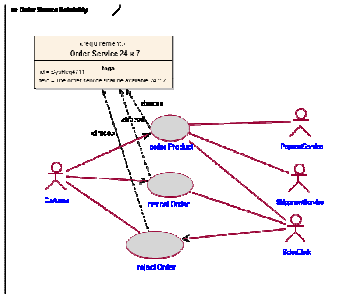
Reliability Availability Maintainability Sustainability (RAMS)

Identify system items failures/ out of order
 → IBDs of physical architecture/ deployment diagrams

1. Identify local impact
 → Collaboration of physical items
2. Identify site impact
3. Identify impact on overall system functionality
4. Check reliability/ availability requirements
5. Calculate RAMS based on
 - Mean Time Between Failure (MTBF)
 - Cycle replacement time
 - ...








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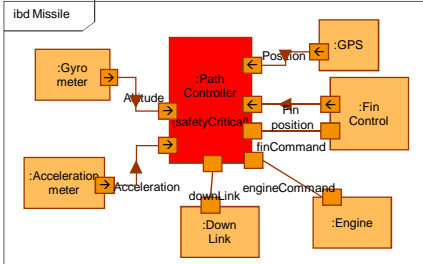
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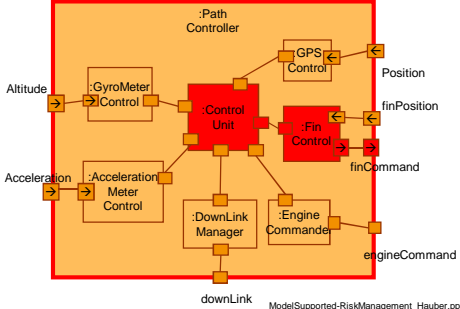
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Safety Criticality Analysis

1. Identify safety critical system components
 - Based on system structure
2. Analyze „propagation“ of safety critical parts
 - Model based analysis
3. System design improvement under safety aspects








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Summary		 HOOD Experts in Requirements
<ul style="list-style-type: none"> ▪ MBSE SysML out of the box: No specific risks or safety & security view ▪ Enhancement of SysML by risk management profile <ul style="list-style-type: none"> ▪ Viewpoint, stereotypes, properties, etc. ▪ Process: embedded in overall engineering process ▪ SysML can be used to capture and trace risk aspects <ul style="list-style-type: none"> ▪ Main benefit: enhanced tracing from requirements and system architecture to risks ▪ SysML can be used in an MBSE approach for <ul style="list-style-type: none"> ▪ Risk identification ▪ Hazard analysis ▪ Fault tree analysis ▪ Failure mode and effects analysis (FMEA) ▪ Criticality assessment ▪ Risk assessment ▪ SysML Risks profile should be standardized ▪ Tool-interfaces should be standardized 		

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Discussion



Thanks for your attention!

Questions & Discussion



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