

Power-Charging Requirements Engineering with Artificial Intelligence (AI)

Dr. Bernd GRAHLMANN

Bernd@Grahlmann.net

www.grahlmann.net

+

Fernando VALERA

fvalera@visuresolutions.com

www.visuresolutions.com

Copyright © 2025 by Dr. Bernd GRAHLMANN and Fernando VALERA / Visure Solutions, Inc.

Agenda

1. Bio highlights;
2. Goals of the Presentation;
3. Basics of Artificial Intelligence (AI) & Generative AI;
4. Requirements Engineering Tasks;
5. Benefitting from Artificial Intelligence (AI) in Requirements Engineering;
6. Success Factors;
7. Important (potential) Issues: Confidentiality, Security, ...
8. Short **Visure Requirements ALM / Vivia** demo: **It's Reality – not Fiction** 😊
9. Questions & Answers (Q&A).

Dr. Bernd GRAHLMANN – Bio Highlights / Background ...



Dr. Bernd GRAHLMANN
Expert / Trainer / Consultant



25+ years in
Systems Engineering
(focus RE/RM + V&V + Safety ...)



Setup / developed processes and tools
worldwide in various industries
(medical devices, railway, automotive, space,
aviation, aerospace, defense, energy, banking,
pharma, semiconductors, software, elevators,
building, gaming, ...)



Trained thousands of
engineers worldwide
(SE + RE/RM + V&V + DOORS ...)

Fernando VALERA – Bio Highlights / Background ...



Fernando Valera

Visure CTO



20 years in the
Requirements
field



Deployed RM processes
and tools in Europe,
Americas and APAC



IREB CPRE
Certified Training
Provider



Trained over
1,000 people
worldwide in RM

Goals of the Presentation

- ✓ Spread ideas how Requirements Engineering can benefit from Artificial Intelligence;
- ✓ Convince that it is not 'just' fiction, but already reality



Artificial Intelligence (AI) & (Chat)GPT

- **What is Generative AI?**

Generative AI is a branch of artificial intelligence that focuses on creating new, previously unseen content. It learns from a given set of input data, understand its patterns, and then generate new content that closely resembles the original data.

- **What is an Agent?**

An AI agent is an autonomous system that perceives its environment and takes actions to achieve specific goals. It operates independently, making decisions based on rules or learned experiences, and adapts to dynamic environments. Examples include chatbots and autonomous vehicles.

- **What is RAG?**

RAG stands for Retrieval-Augmented Generation, an AI framework that combines traditional information retrieval systems with generative large language models (LLMs). RAG can help generate more relevant, accurate, and up-to-date text.

The LLM Race

- **GPT- 4 Turbo (Open AI) – Online (~1T -1.5T parameters)**

Advantage: Highly versatile and excels in complex reasoning and conversational tasks.

Disadvantage: Closed-source and relatively expensive for extensive use.

- **Claude 3 (Anthropic) – Online (~200-400B B parameters)**

Advantage: Focuses on AI safety, alignment, and long-context handling.

Disadvantage: Less performant in creative tasks compared to other models like GPT-4.

- **Gemini 1.5 (Google DeepMind) – Online (~1.5T - 2T parameters)**

Advantage: Strong in multilingual support and integrated into Google's ecosystem.

Disadvantage: Limited access outside of Google's proprietary platforms

- **LlaMA 3 (Meta) – Open Source (7B, 13B, and 70B parameters. 100B-400B expected mid-2025)**

Advantage: Highly customizable. Available in different sizes making it scalable for various needs.

Disadvantage: Requires more technical expertise to fine-tune and implement effectively.

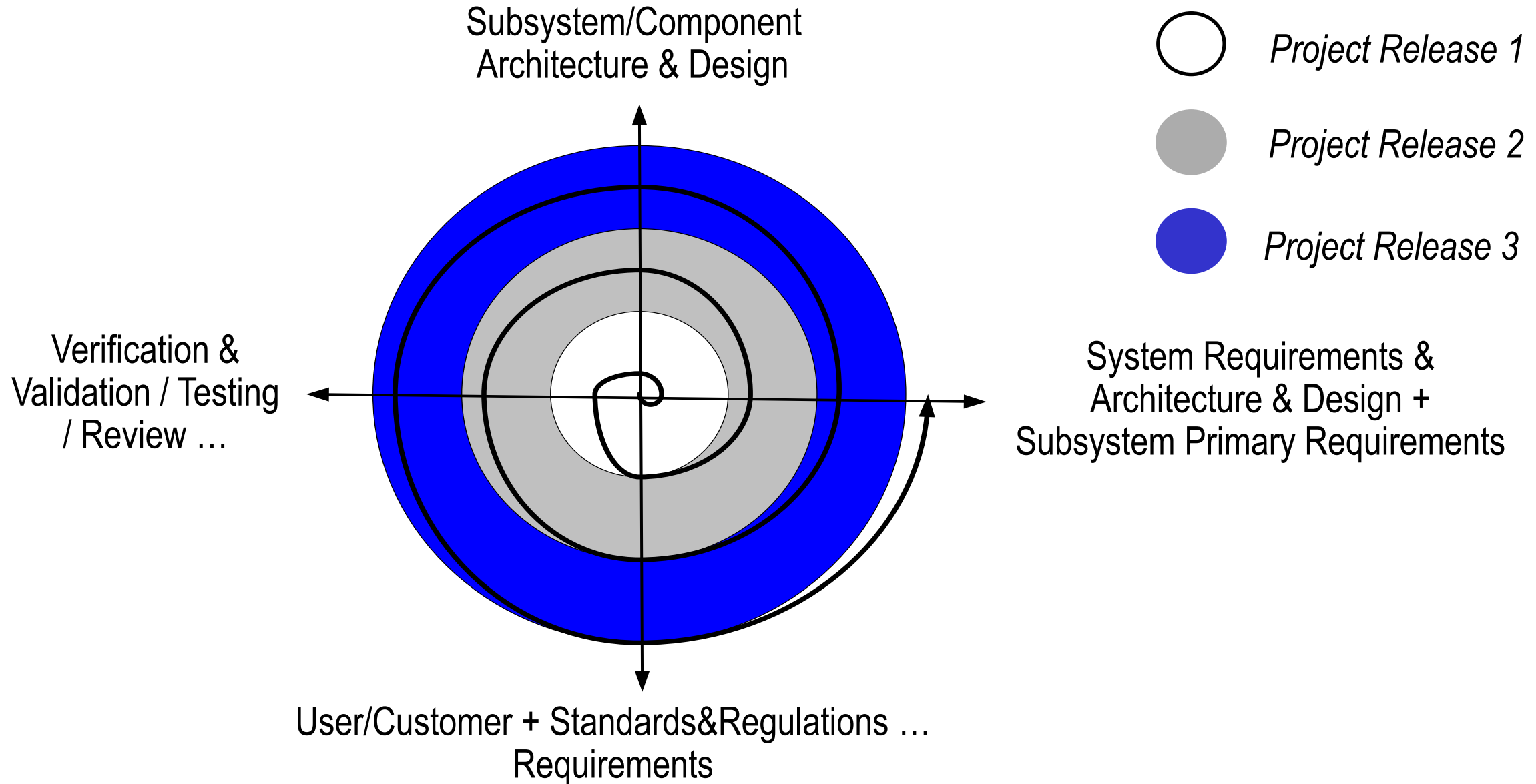
- **Mistral (Mistral AI) – Open Source (~7B parameters)**

Advantage: Efficient models, providing performance and flexibility.

Disadvantage: Still new to the market, with less community support and fewer proven use cases.

- **Other models (...): Grok (33B-70B), Deepseek (7B, 67B), etc.**

(Reminder) Systems Engineering Phases and Tasks



Benefitting from Artificial Intelligence in Requirements Engineering

AI can accelerate, in particular:

1. Gathering the (check)list(s) of standards®ulations that apply to a (safety-critical) system/development (e.g. IEC 62304, ISO 26262, DO-178C, DO-160, ...);
2. Creating specification templates for requirements, architecture, V&V / test, ... specifications (e.g. ISO/IEC/IEEE 29148:2018);
3. Generating the initial functional and non-functional requirements and user stories and extending them;
4. Generating related requirements and identifying traces / links;
5. Analyzing the quality of existing requirements (identifying ambiguities, missing requirements, conflicts, redundancies, inconsistencies, ...);
6. Generating V&V / test cases from requirements;
7. ...

@All: What else do you want AI to help you with ???

Benefitting from Artificial Intelligence in Requirements Engineering

AI can accelerate, in particular:

1. Gathering the (check)list(s) of standards®ulations that apply to a (safety-critical) system/development (*e.g. IEC 62304, ISO 26262, DO-178C, DO-160, ...*);
2. Creating specification templates for requirements, architecture, V&V / test, ... specifications (*e.g. ISO/IEC/IEEE 29148:2018*);
3. *Creating lists of stakeholders, glossaries of terms, ...;*
4. *Extracting requirements, architecture elements, V&V / test cases, ... from unstructured text data;*
5. Generating the initial functional and non-functional requirements and user stories and extending them;
6. *Complementing specifications with use models such as state, sequence, class, ER diagrams, ...;*
7. Generating related requirements and identifying traces / links;
8. *Finding missing traces / links;*
9. *Prioritizing requirements based on the impact;*
10. Analyzing the quality of existing requirements (identifying ambiguities, missing requirements, conflicts, redundancies, inconsistencies, ...);
11. Generating V&V / test cases from requirements;
12. *Generating additional project assets (such as lists of hazards, risks, control measures, ...);*
13. ...

Note: **Quality of existing requirements, architecture elements, V&V / test cases, ... is (too) often far from perfect ☹**

Success Factors

A clever and transparent integration is key to success:

1. Offering relevant systems engineering tasks;
2. Allowing the systems engineers to give guidance in systems engineering terms;
3. 'Hiding' the backbone communication with AI / ChatGPT ...;
4. Incorporating results properly in the tools' database structure:
 - a) In the correct specifications;
 - b) Using the correct templates with attributes ...;
 - c) Controlled by the traceability schema / data models ...;
5. Giving full context with all your company and domain expertise, knowledge, ...;
6. Allowing for an iterative approach;
7. Ensuring proper documentation;

Important (potential) Issues: Confidentiality, Security, ...

There are, however, a number of **important (potential) Issues**:

1. Communicating proprietary and often highly **confidential** company data to the outside world vs. terms of each individual LLM, dealing with updates,...
2. Trusting AI 'results' **without proper review, adaptation,**
 - a) which may be 'hallucinations' or otherwise 'incorrect';
 - b) which may not be fully applicable in the project;
 - c) which may need to be adapted;
 - d) which may not be complete;
 - e) which may be difficult to understand;
3. Copyright of results – USPTO “Patents on AI creations require 'significant' human input”;
4. ‘Missing’ on innovation, ... by ‘only’ considering **existing Internet information**;
5. AI hacking through the insertion of misleading data and agents
6. Underusing the potential of AI, not fully understanding the capabilities, creating a loss of competitiveness

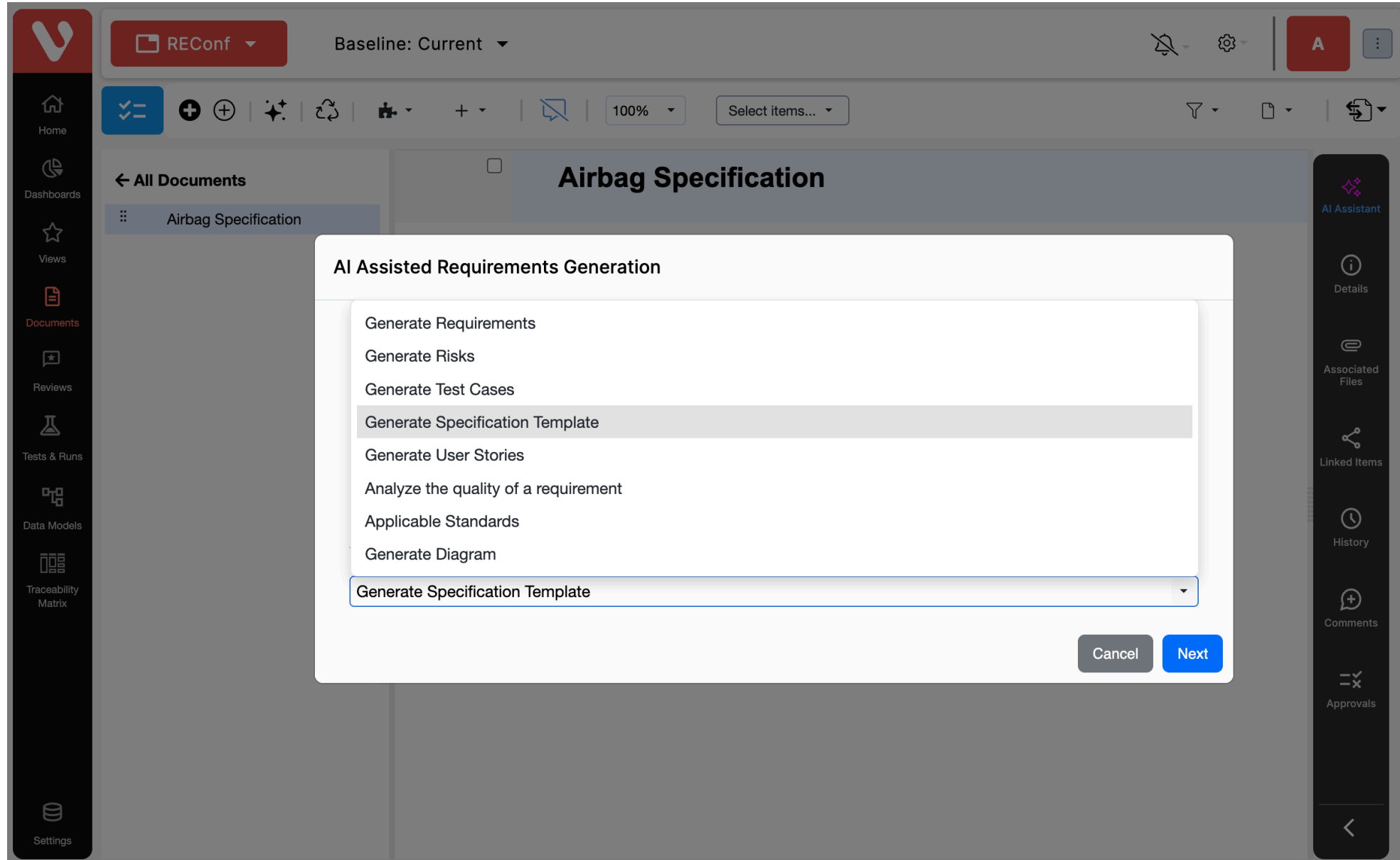
Short Visure Requirements ALM & Vivia Demo: It's Reality – not Fiction 😊

A short demo of Visure Requirements ALM and its Virtual AI Assistant 'Vivia' will show that some of the 'power-charging' of Requirements Engineering is already available.

The following screenshots may give more concrete ideas to those having missed our demo at the REConf.



Short Visure Requirements ALM Demo – Screenshots (I)



Short Visure Requirements ALM Demo – Screenshots (II)

The screenshot displays the REConf ALM demo interface. The top navigation bar includes the REConf logo, a 'Baseline: Current' dropdown, a search bar with the text 'Products requirements, System requirements...', and several utility icons. A left sidebar contains navigation links: Home, Dashboards, Views, Documents (highlighted), Reviews, Tests & Runs, Data Models, Traceability Matrix, and Settings. The main content area shows the 'Airbag Specification' document with a table of contents on the left and the document body on the right. The document body contains four sections: 1 Purpose, 2 Scope, 3 Stakeholders, and 4 Standards and References. A right sidebar contains a vertical menu with icons for AI Assistant, Details, Associated Files, Linked Items, History, Comments, Approvals, and a back arrow.

REConf Baseline: Current Products requirements, System requirements...

All Documents

- Airbag Specification
- 1 Purpose
- 2 Scope
- 3 Stakeholders
- 4 Standards and References
- 5 Glossary of Terms
- 6 Functional Requirements
- 7 Non-Functional Requirements

Airbag Specification

1 Purpose

The purpose of this document is to define the requirements for the Airbag System of an automotive vehicle, ensuring occupant safety in the event of a collision. This document outlines the functional and non-functional requirements necessary to ensure the proper operation, reliability, and regulatory compliance of the airbag system.

2 Scope

The scope of the requirements includes the deployment mechanism, sensor integration, system reliability, compliance with automotive standards, and user safety. These requirements apply to both front and side airbag systems for passenger vehicles, ensuring consistent performance across different scenarios.

3 Stakeholders

- Automotive Manufacturers
- System Engineers
- Safety Analysts
- Quality Assurance Teams
- Regulatory Agencies
- End Users (Vehicle Owners/Drivers)

4 Standards and References

- ISO 26262: Road Vehicles – Functional Safety
- FMVSS 208: Occupant Crash Protection
- UNECE Regulation No. 94: Uniform Provisions Concerning the Approval of Vehicles with Regard to the Protection of the Occupants in the Event of a Frontal Collision
- SAE J211/1: Instrumentation for Impact Test – Part 1: Electronic Instrumentation

AI Assistant Details Associated Files Linked Items History Comments Approvals

Short Visure Requirements ALM Demo – Screenshots (III)

The screenshot displays the REConf ALM interface. On the left is a dark sidebar with navigation icons for Home, Dashboards, Views, Documents, Reviews, Tests & Runs, Data Models, and Traceability Matrix. The main area shows a document hierarchy under 'All Documents' with items like 'Airbag Specification', '1 Purpose', '2 Scope', '3 Stakeholders', '4 Standards and References', '5 Glossary of Terms', '6 Functional Requirements', and '7 Non-Functional Requirements'. The '6 Functional Requirements' item is selected. A modal dialog titled 'AI Assisted Requirements Generation' is open in the foreground. It contains a text input field with the prompt: 'Enter an idea you want to automatically generate requirements for:'. Below the input field is a large text area containing the text: '"Automotive Airbag", including at least 30 requirements. For each requirement referring to the airbag, include the reference "Automotive Airbag system" instead of only "airbag"'. At the bottom of the dialog are 'Back', 'Cancel', and 'Next' buttons.

REConf

Baseline: Current

Products requirements, System requirements...

100%

1 items selected

← All Documents

- ⋮ Airbag Specification
- ⋮ 1 Purpose
- ⋮ 2 Scope
- ⋮ 3 Stakeholders
- ⋮ 4 Standards and References
- ⋮ 5 Glossary of Terms
- ⋮ 6 Functional Requirements
- ⋮ 7 Non-Functional Requirements

6 2600 Functional Requirements He...

AI Assisted Requirements Generation

Enter an idea you want to automatically generate requirements for:

"Automotive Airbag", including at least 30 requirements. For each requirement referring to the airbag, include the reference "Automotive Airbag system" instead of only "airbag"

< Back Cancel Next

Short Visure Requirements ALM Demo – Screenshots (IV)

AI Assisted Requirements Generation

☒	1. The Automotive Airbag system shall deploy the airbag within 30 milliseconds after detecting a frontal collision.
☒	2. The Automotive Airbag system shall deploy the airbag at a pressure of 200 kPa ± 10%.
☒	3. The Automotive Airbag system shall include sensors capable of detecting collisions at speeds greater than 15 km/h.
☒	4. The Automotive Airbag system shall not deploy during roll-over events unless the sensors detect a significant impact.
☒	5. The Automotive Airbag system shall be designed to withstand temperatures ranging from -40°C to 85°C without degradation of performance.
☒	6. The Automotive Airbag system shall self-diagnose and report any malfunction within 5 seconds of system start-up.
☒	7. The Automotive Airbag system shall illuminate a warning light on the dashboard if a malfunction is detected.
☒	8. The Automotive Airbag system shall have a minimum lifespan of 15 years without requiring replacement.
☒	9. The Automotive Airbag system shall accommodate passengers of varying sizes, from the 5th percentile female to the 95th percentile male, without risk of injury upon deployment.

< BackCancelGenerate Requirements

Short Visure Requirements ALM Demo – Screenshots (V)

The screenshot displays the Visure Requirements ALM interface. At the top is a toolbar with various icons for document management, including a blue 'Z' icon, a plus sign, a magnifying glass, a star, a lock, an open lock, a trash can, a refresh icon, a puzzle piece, a plus sign, a speech bubble, a zoom dropdown set to 100%, a folder icon, and a filter icon. Below the toolbar, on the left, is a sidebar titled '← All Documents' containing a tree view of documents: 'Airbag Specification', '1 Purpose', '2 Scope', '3 Stakeholders', '4 Standards and References', '5 Glossary of Terms' (highlighted in blue), '6 Functional Requirements', and '7 Non-Functional Requirements'. The main content area on the right is titled '6 Functional Requirements' and contains four numbered requirements, each preceded by a blue ID number:
2660 1. The Automotive Airbag system shall deploy the airbag within 30 milliseconds after detecting a frontal collision.
2670 2. The Automotive Airbag system shall deploy the airbag at a pressure of 200 kPa ± 10%.
2680 3. The Automotive Airbag system shall include sensors capable of detecting collisions at speeds greater than 15 km/h.
2690 4. The Automotive Airbag system shall not deploy during roll-over events unless the sensors detect a significant impact.

Short Visure Requirements ALM Demo – Screenshots (VI)

The screenshot displays the REConf ALM demo interface. The top navigation bar includes the REConf logo, a 'REConf' dropdown, a 'Baseline: Current' indicator, a search bar with the text 'Products requirements, System requirements...', and various utility icons. A left sidebar contains navigation links: Home, Dashboards, Views, Documents, Reviews, Tests & Runs, Data Models, Traceability Matrix, and Settings. The main content area is titled 'Airbag System Requirements' and contains five sections: 1 Purpose, 2 Scope, 3 Stakeholders, 4 Standards and References, and 5 Glossary of Terms. To the right of the document is an 'AI Assistant' panel. At the top of this panel is a green box asking 'are there inconsistencies in this document?'. Below this, the AI Assistant provides a detailed analysis of the document for inconsistencies, mentioning established standards like INCOSE, EARS, and IREB. It identifies three main areas of concern: 1. Redundancy in Requirements (citing AIR_1780 and AIR_2080), 2. Ambiguity in Descriptions (citing AIR_2010), and 3. Inconsistent Terminology (citing 'deployment' and 'inflation'). At the bottom of the AI Assistant panel are buttons for 'Hello', 'What can you do?', 'Analyze the requirements for inconsistencies', and 'New Chat', along with a text input field and a 'Send' button.

Airbag System Requirements

1 Purpose

The purpose of this requirement specification is to outline the design, development, and testing of an automotive airbag system to ensure passenger safety during vehicular collisions. It serves as a foundation to guide the project stakeholders towards achieving a reliable, safe, and effective airbag system that maximizes passenger protection and minimizes deployment time.

2 Scope

The scope of this specification covers the engineering, manufacturing, testing, and deployment of an automotive airbag system. It includes requirements for integration with other vehicle safety systems, regulatory compliance, and non-functional requirements such as performance, reliability, and maintenance.

3 Stakeholders

- Automotive Manufacturers
- Safety Engineers
- Regulatory Bodies (e.g., National Highway Traffic Safety Administration)
- Vehicle Dealers and Resellers
- End Users (Vehicle Owners and Passengers)
- Maintenance and Service Technicians

4 Standards and References

- ISO 26262: Road vehicles – Functional safety
- FMVSS 208: Occupant Crash Protection
- GB 8410: Flammability of Automotive Interior Materials
- IEC 61508: Functional Safety of Electrical/Electronic/Programmable Electronic Systems

5 Glossary of Terms

- Airbag Module: A unit consisting of the airbag cushion, inflator, and related components.

AI Assistant

are there inconsistencies in this document?

To evaluate the "Airbag System Requirements" specification for inconsistencies, I will review the requirements against established standards such as INCOSE, EARS, and IREB. Let me retrieve the requirements from this specification first.

Upon reviewing the "Airbag System Requirements" specification, I have identified several areas that may present inconsistencies or require clarification:

- 1. Redundancy in Requirements:**
 - There are two requirements related to the deployment time of the airbag system:
 - "The Automotive Airbag system shall deploy within 30 milliseconds of a collision detection." (AIR_1780)
 - "The Automotive Airbag system shall deploy within 30 milliseconds of detecting a collision." (AIR_2080)
 - These requirements appear to be duplicates and should be consolidated to avoid redundancy.
- 2. Ambiguity in Descriptions:**
 - Some requirements lack specific details or context, which may lead to different interpretations. For example:
 - "The Automotive Airbag system shall include algorithmic adjustment capabilities based on historical crash impact data." (AIR_2010)
 - It would be beneficial to specify what kind of adjustments are expected and how they will be implemented.
- 3. Inconsistent Terminology:**
 - The use of terms such as "deployment" and "inflation" should be consistent across all requirements.

Buttons: Hello, What can you do?, Analyze the requirements for inconsistencies, New Chat

Type your message... Send

Short Visure Requirements ALM Demo – Screenshots (VII)

The screenshot displays the Visure Requirements ALM Demo interface. On the left, a list of functional requirements is shown, each with a blue ID number and a description. The requirements are:

- 2660 1. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2670 2. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2680 3. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2690 4. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2700 5. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2710 6. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2720 7. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.
- 2730 8. The Automotive Airbag system shall ensure that the system is able to detect and respond to a crash event.

On the right, a chat window is open, showing a conversation with an AI Assistant. The assistant has responded to a query about additional requirements for the "Airbag System Requirements" specification, focusing on safety, usability, and compliance. The response includes five categories of requirements:

- 1. Environmental Compliance:**
 - "The Automotive Airbag system shall comply with environmental regulations for hazardous materials, ensuring that all components are free from substances restricted by the RoHS directive."
- 2. User Interface and Feedback:**
 - "The Automotive Airbag system shall provide a user-friendly interface for service personnel, including clear diagnostic codes and troubleshooting steps accessible via the vehicle's onboard display."
- 3. Data Security:**
 - "The Automotive Airbag system shall implement data encryption for all stored and transmitted data to protect against unauthorized access and ensure data integrity."
- 4. Maintenance and Serviceability:**
 - "The Automotive Airbag system shall include a modular design to facilitate easy replacement of components, reducing vehicle downtime during maintenance."
- 5. Advanced Safety Features:**
 - "The Automotive Airbag system shall incorporate adaptive deployment technology, adjusting the deployment force based on occupant size and seating position to"

The chat window also includes a sidebar with navigation options: Details, Associated Files, Linked Items, History, Comments, and Approvals. At the bottom of the chat window, there are buttons for "Hello", "What can you do?", "Analyze the requirements for inconsistencies", and "New Chat", along with a text input field and a "Send" button.

Short Visure Requirements ALM Demo – Screenshots (VIII)

The screenshot displays the Visure Requirements ALM Demo interface. On the left, a list of functional requirements is shown, each with a blue ID number and a description. The requirements are:

- 2660 1. The Automotive Airbag system shall meet all applicable global safety standards, including UNECE regulations, to ensure international market compatibility.
- 2670 2. The Automotive Airbag system shall comply with environmental regulations for hazardous materials, ensuring that all components are free from substances restricted by the RoHS directive.
- 2680 3. The Automotive Airbag system shall provide a user-friendly interface for service personnel, including clear diagnostic codes and troubleshooting steps accessible via the vehicle's onboard display.
- 2690 4. The Automotive Airbag system shall be designed to withstand vibration and shock without degradation of performance.
- 2700 5. The Automotive Airbag system shall be designed to withstand vibration and shock without degradation of performance.
- 2710 6. The Automotive Airbag system shall be designed to withstand vibration and shock without degradation of performance.
- 2720 7. The Automotive Airbag system shall be designed to withstand vibration and shock without degradation of performance.
- 2730 8. The Automotive Airbag system shall be designed to withstand vibration and shock without degradation of performance.

On the right, the detailed view of requirement 2670 is shown. It includes a section for '8. Regulatory Compliance' with a list of requirements. Below this, there is a green box with the text 'can you create them?'. The main content area shows two requirements being created:

- Requirement 1:**
 - Name: Environmental Compliance
 - Description: The Automotive Airbag system shall comply with environmental regulations for hazardous materials, ensuring that all components are free from substances restricted by the RoHS directive.
- Requirement 2:**
 - Name: User Interface and Feedback
 - Description: The Automotive Airbag system shall provide a user-friendly interface for service personnel, including clear diagnostic codes and troubleshooting steps accessible via the vehicle's onboard display.

At the bottom, there is a chat interface with buttons for 'Hello', 'What can you do?', 'Analyze the requirements for inconsistencies', and 'New Chat'. A text input field and a 'Send' button are also present.

Short Visure Requirements ALM Demo – Screenshots (IX)

6 Functional

2660

1. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2670

2. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2680

3. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2690

4. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2700

5. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2710

6. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2720

7. The Automotive Airbag system shall ensure that the deployment force is adjusted based on occupant size and seating position to minimize injury risk.

2730

AI Assistant

i

Details

📎

Associated Files

🔗

Linked Items

🕒

History

💬

Comments

🗑️

Approvals

>

technology, adjusting the deployment force based on occupant size and seating position to minimize injury risk.

Requirement 6:

Name: Integration with Vehicle Systems

Description: The Automotive Airbag system shall seamlessly integrate with the vehicle's advanced driver-assistance systems (ADAS) to enhance overall vehicle safety and performance.

Requirement 7:

Name: Testing and Validation

Description: The Automotive Airbag system shall undergo rigorous testing under various environmental conditions, including extreme temperatures and humidity, to validate performance and reliability.

Requirement 8:

Name: Regulatory Compliance

Description: The Automotive Airbag system shall meet all applicable global safety standards, including UNECE regulations, to ensure international market compatibility.

Proceed?

Yes

No

Hello

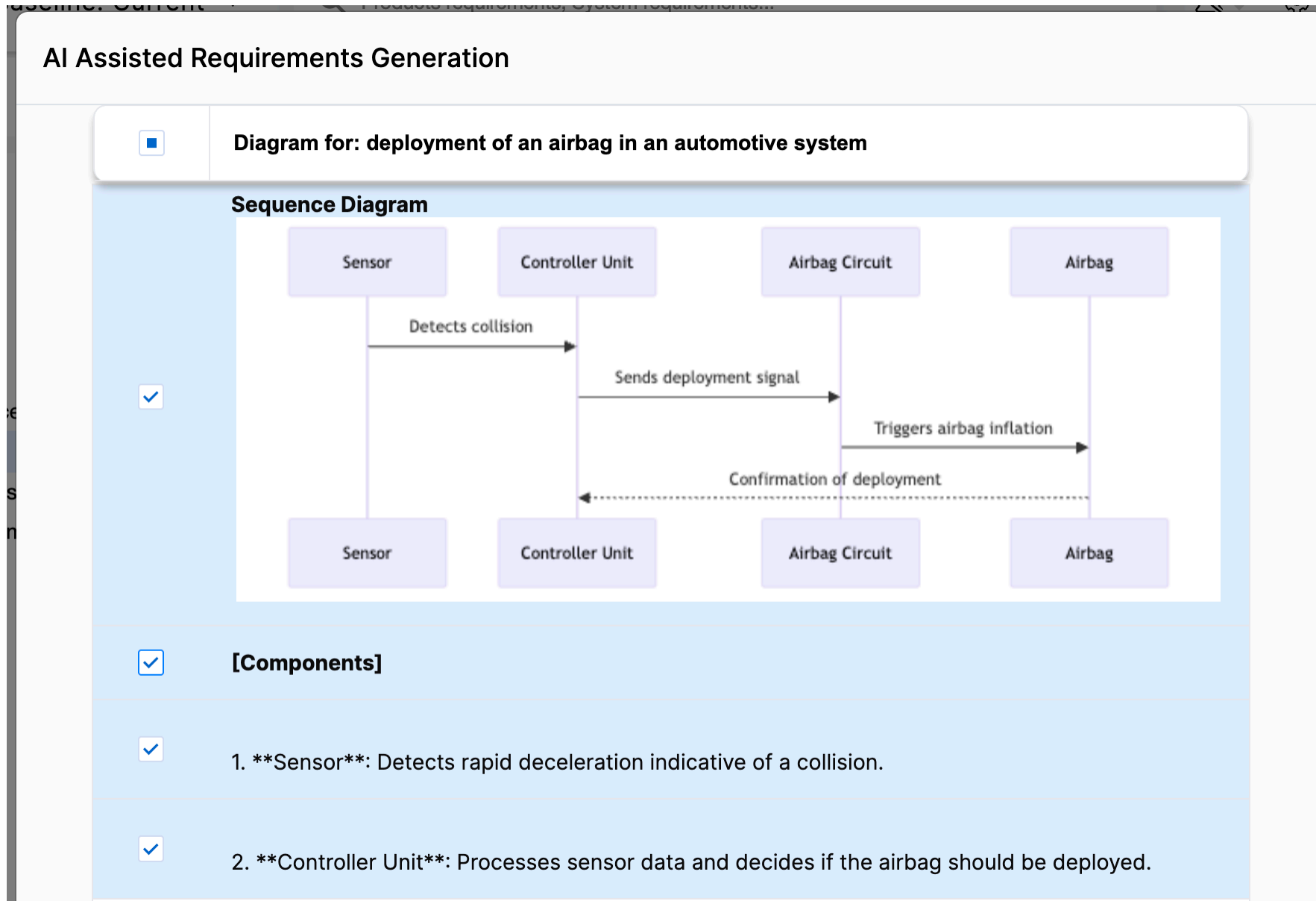
What can you do?

Analyze the requirements for inconsistencies

New Chat

Send

Short Visure Requirements ALM Demo – Screenshots (X)



Thank You for your attention!

info@visuresolutions.com
fvalera@visuresolutions.com

Questions & Answers

Contact me via email: **Bernd@Grahlmann.net** or phone **+41 792967651**

or check via https://www.grahlmann.net/doors_requirements_management_training_overview.htm

or LinkedIn: <https://www.linkedin.com/in/grahlmanndoorstelelogic/>

or Xing: https://www.xing.com/profile/Bernd_Grahlmann/

or join ,my' LinkedIn groups:

- ,Requirements Engineering Tools' <https://www.linkedin.com/groups/12821233/>
- ,IBM Rational DOORS and DOORS Next Generation - DNG (ex Telelogic DOORS) User Group' <https://www.linkedin.com/groups/769057/>
- ,Siemens Polarion' <https://www.linkedin.com/groups/12004818/>

Thanks a lot 😊