

# Improving the Quality of your Requirements with Artificial Intelligence (AI)



Dr. Bernd GRAHLMANN & Fernando VALERA

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



Dr. Bernd GRAHLMANN

Expert / Trainer / Consultant



25+ years of stories experienced 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



# Agenda

- 01 **Goals of the Presentation**

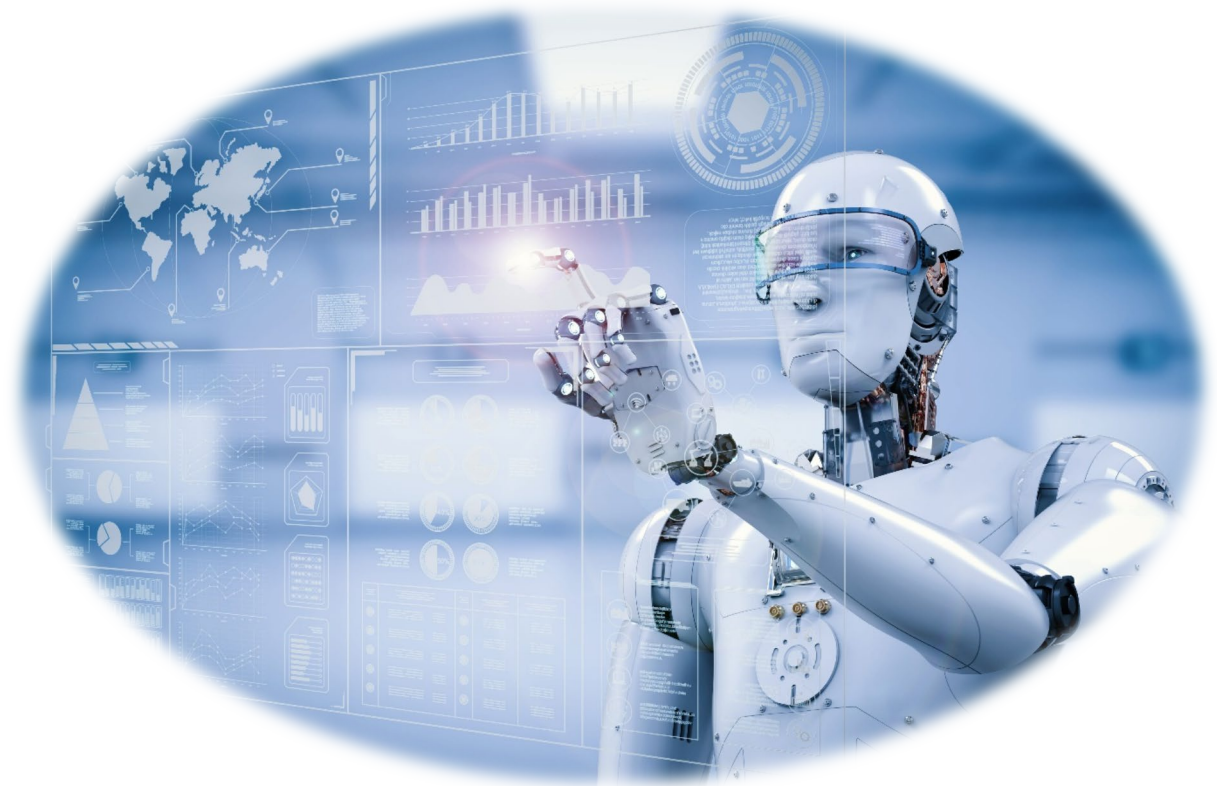
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- 02 **2 main SE challenges / stories experienced**

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- 03 **Low Quality versus high Quality Requirements**

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- 04 **2 key technical success factors**

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- 05 **Concrete ways how AI can improve the quality of your requirements**

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- 06 **Short demo of what's available**



# 4 Main Goals of the Presentation

## Understand Problems

- 2 main SE challenges / stories experienced

Raise awareness – wrt. **Low quality** versus **High quality** requirements:

1. Engineers struggle to write high quality requirements 😞
2. Tons of (legacy) low quality requirements exist 😞

+ On top: **higher quantity** and **quality** requested!



## Provide Solutions

- 2 key technical success factors

Elaborate on:

1. AI shall **use company and domain/industry/... expertise**
2. AI shall **be fully integrated / incorporated**

- What can AI do to improve the quality of your requirements?

**Present concrete ways in which AI can help:** spotting weaknesses, getting improvement proposals, applying re-writing proposals, ...  
**Spreading ideas**

- What's already available?

Briefly **showing** that **tools can already address the 2 main SE challenges successfully** 😊

## First Story experienced over and over again

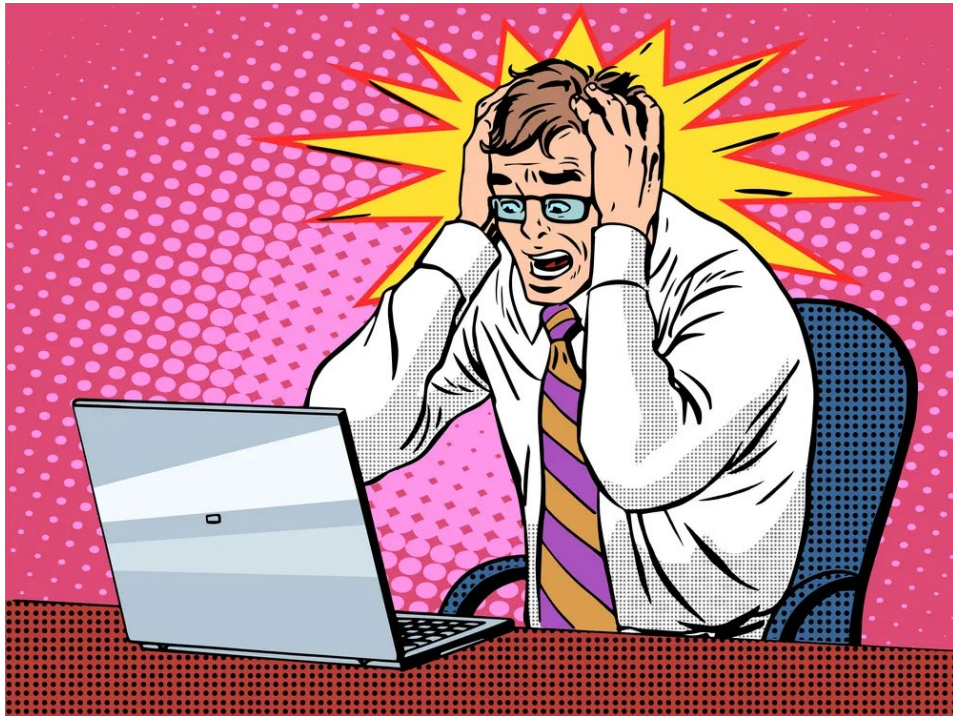


Engineers struggle to write high quality requirements from scratch 😞:

- Few being **trained** 😞
- Not knowing about **guidelines, rulesets, trainings, boilerplates, criteria, checklists, approaches, ...** – like, **INCOSE, IREB, EARS, ...** 😞
- Not having **boilerplates** (integrated in the tool) 😞
- Not having **good examples** 😞
- Few being **coached** 😞
- Often under **time pressure** 😞
- ...

Even **higher quantity and quality needed**, due to technology advancements, increased complexity, more iterative SE, more standards & regulations, ...

## Second story experienced over and over again



Companies have tons of (legacy) requirements 😞:

- From older projects
- A lot being itself badly written 😞
- Sets of them often having (additional) problems 😞
- A lot not adhering to **guidelines, rulesets, trainings, boilerplates, criteria, checklists, approaches, ...** – like, **INCOSE, IREB, EARS, ...** 😞
- Most of them not written for re-use (with versions/variants in mind) 😞
- Often (almost) **no time for clean-up** 😞
- ...

# Usual Suspects



A lot well-known problems may need less explanations

An individual requirement may:

1. be ambiguous 😞
2. have a bad structure 😞
3. not being testable 😞
4. not following boilerplates 😞
5. contain multiple imperatives 😞
6. ...

A set of requirements may:

7. have conflicts and inconsistencies 😞
8. have duplications 😞
9. ...



## Less obvious



## Some problems are trickier

The 'system' which needs to fulfill the requirement may be wrong, unclear, ...:

1. Huge difference between requirements being on whole 'fighter jet' vs only 'engine' vs even 'pilot' 😞
2. Worse when showing (out-of-context) in traceability 😞

Use of universal quantifiers (all, always, none, never, ...)

Normalization (e.g., a complex process like 'Initialization'/'Startup' is substituted with a noun – without explaining what 'Initialization'/'Startup' is)

# 2 key technical success factors

## ■ Company and domain/industry/... expertise

State of the art LLMS like ChatGPT are already 'pre-trained' on all guidelines, rulesets, trainings, boilerplates, criteria, checklists, approaches, ... – INCOSE, IREB, EARS, ...

AI needs to 'learn' YOUR company and domain/industry/... expertise:

1. Your internal guidelines
2. Your specific product(s)
3. Your system architecture
4. Your naming conventions, abbreviations, ...
5. ...

➔ RAG (Retrieval-Augmented Generation)

## ■ Full integration / incorporation

Engineers won't copy/paste, ... between the RE tools and AI tools forever ☹️

AI really improves quality when:

1. Addressing your problems / challenges
2. Reading, fully understanding and using all your data
3. Allowing your guidance and iterations
4. Incorporating results properly in your tools' database structure (correct specifications, correct templates with attributes, respecting traceability schema / data models ...;
5. ...

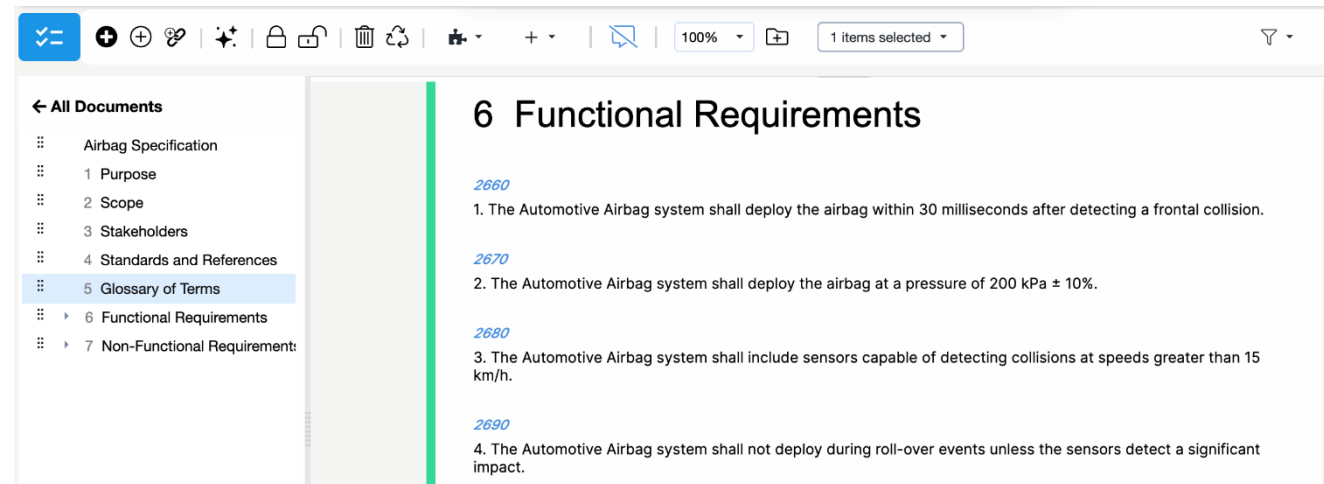
➔ Agentic AI



# AI 'from scratch' help

## Getting started quicker

1. **Gathering the (check)list(s)** of standards&regulations that apply to a (safety-critical) system/development (e.g. IEC 62304, ISO 26262, DO-178C, DO-160, ...) ✓
2. **Creating specification templates** for requirements specifications (e.g. ISO/IEC/IEEE 29148:2018) ✓
3. **Generating the initial functional and non-functional requirements** and extending them ✓
4. **Generating related requirements** and identifying traces / links ✓
5. ...



# AI help improving existing data

## Repair your 'legacy'

1. Identifying **conflicts** / **inconsistencies** and **duplications**, proposing and applying **solutions**
2. Identifying problems with individual requirements, proposing and applying **rewrites**:
  - a) ambiguity ✓
  - b) bad structure ✓
  - c) testability ✓
  - d) accordance to boilerplates ✓
  - e) multiple imperatives ✓
  - f) ...

Applying all expertise



### 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 the foundation to guide the project stakeholders towards achieving a reliable, effective, and safe airbag system that maximizes passenger protection and minimizes deployment time.

#### 2 Scope

The scope of this specification covers the engineering, manufacturing, testing, and validation of an automotive airbag system. It includes requirements for system architecture, component specifications, integration with other vehicle safety systems, regulatory compliance, and non-functional performance, 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.

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

[Hello](#) [What can you do?](#) [Analyze the requirements for inconsistencies](#) [New Chat](#)

Type your message... [Send](#)



# Short demo / screen recordings

A lot is already available:

- [info@visuresolutions.com](mailto:info@visuresolutions.com)
- [fvalera@visuresolutions.com](mailto:fvalera@visuresolutions.com)



# Questions & Answers

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- ,Siemens Polarion' <https://www.linkedin.com/groups/12004818/>

## Thanks a lot 😊