

# **Lightweight Requirements Modeling as an Alternative to full-scale MBSE**

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Illustration in the New Mobility context

Dr. Michael Jastram





We are undergoing  
massive transformation.

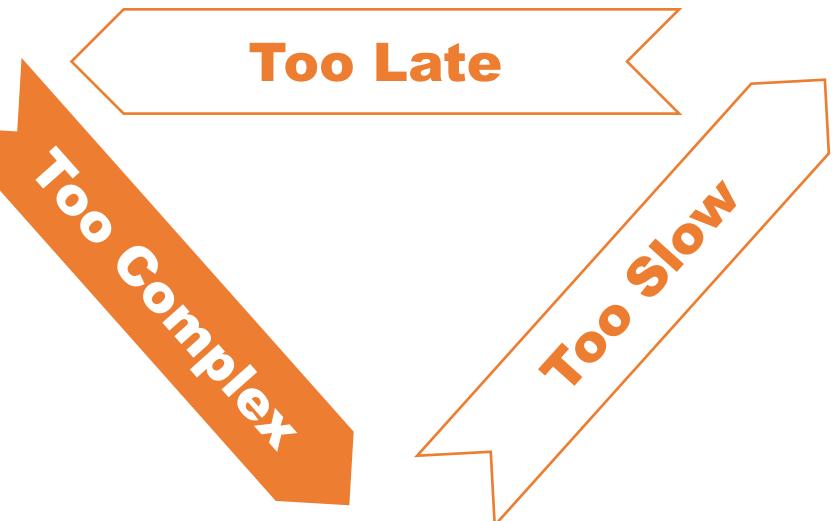
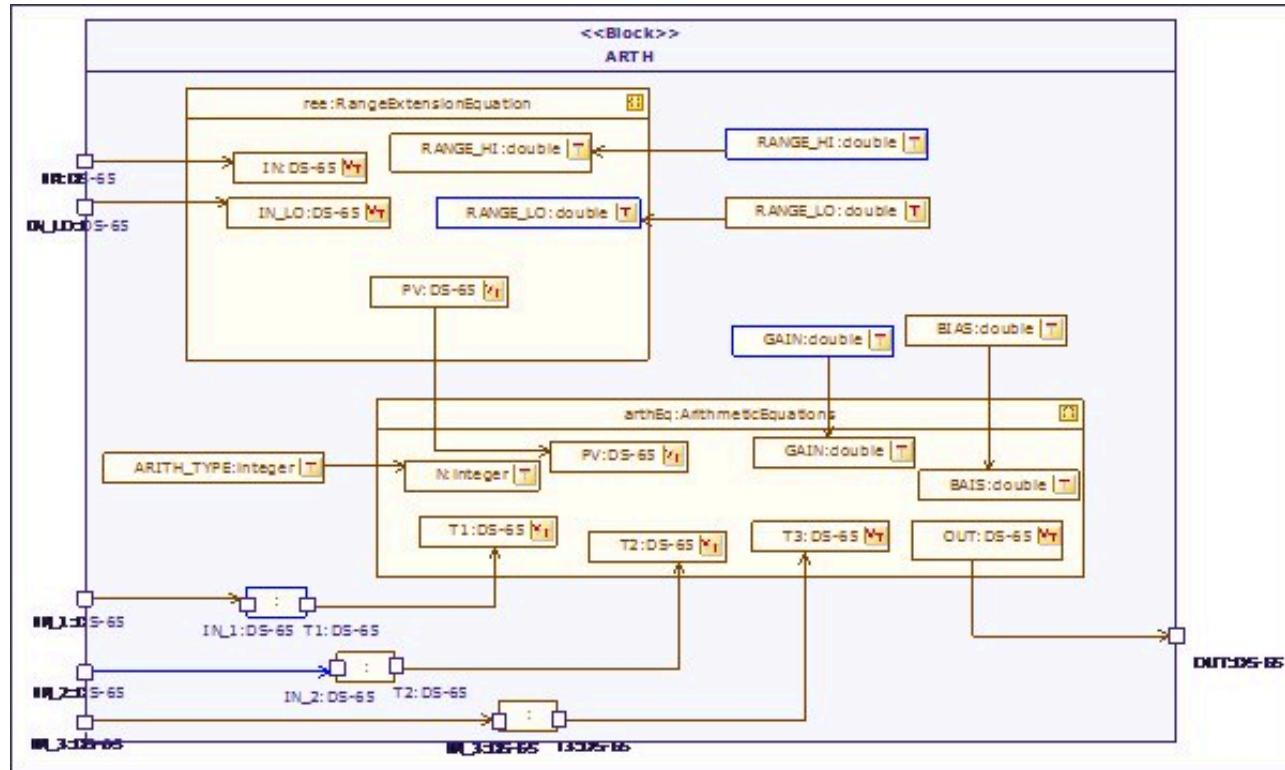
# Traditional Systems Engineering

BASED ON THE V-MODEL



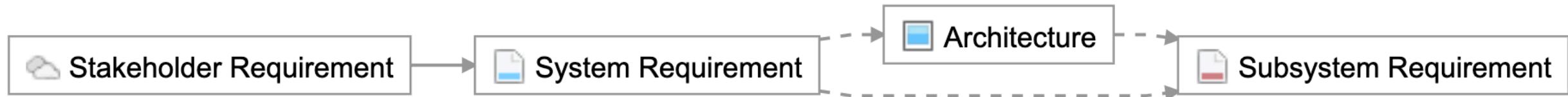
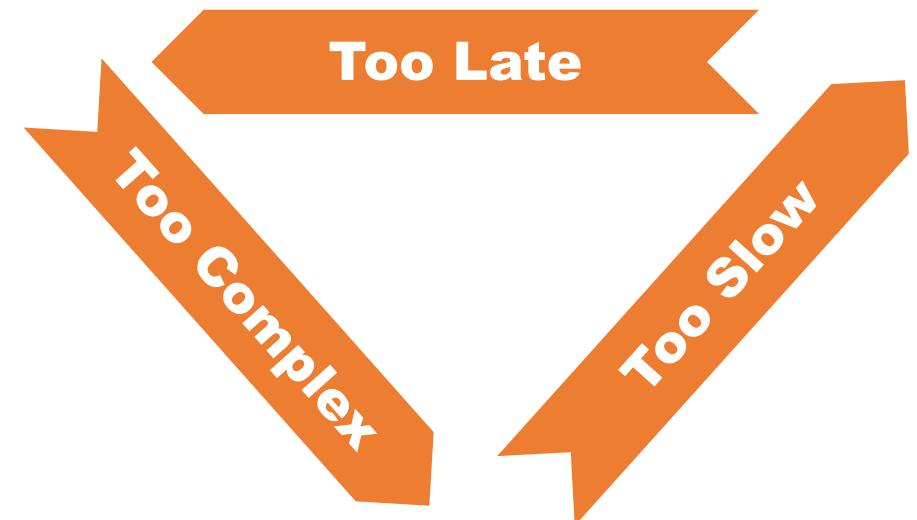
# Systems Modeling

FOR MASTERING COMPLEXITY



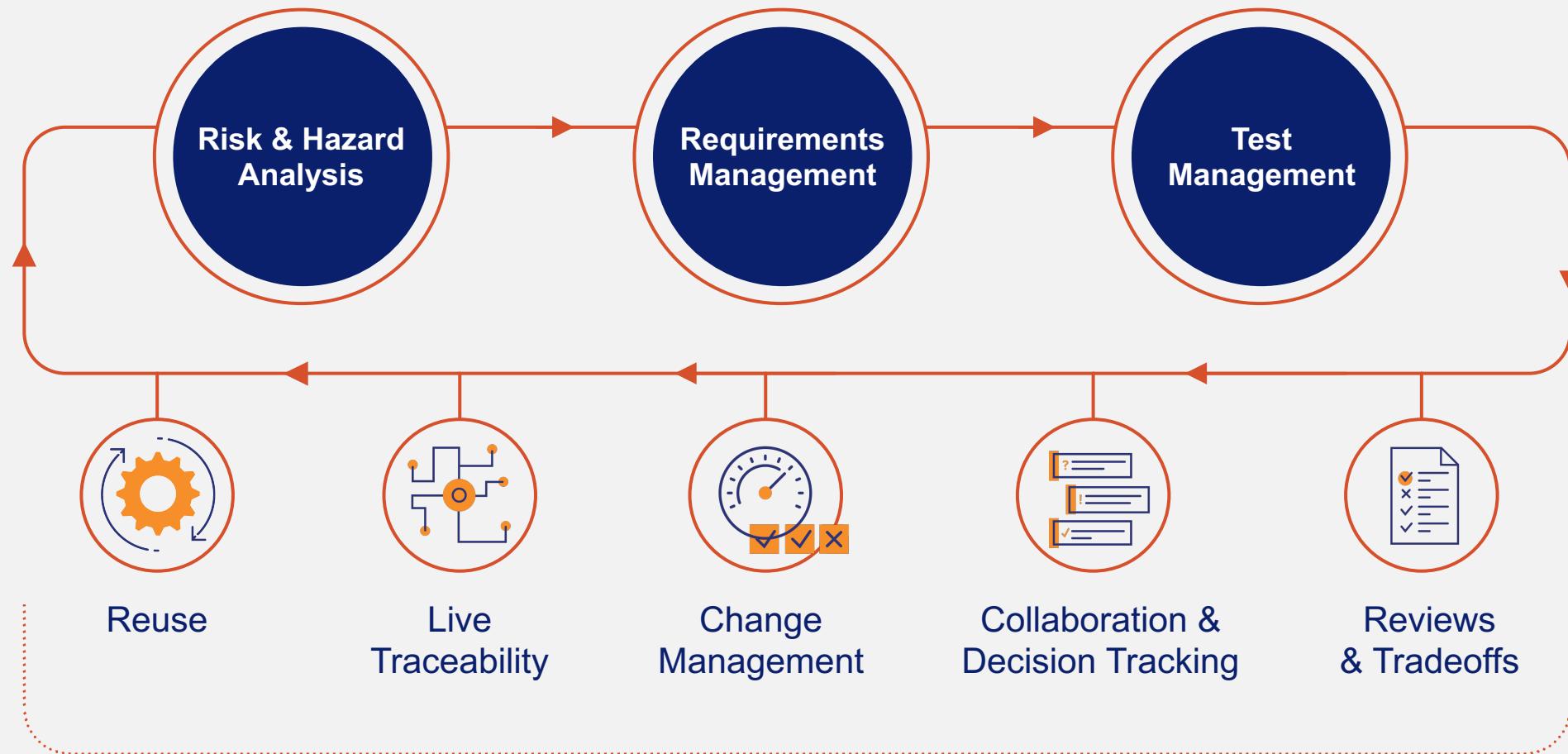
# Requirements Modeling

AS A STEPPING STONE



# Jama Connect™

## PRODUCT DEVELOPMENT PLATFORM





“

Before we used Jama and I rounded up people and collected everything in one place, it felt like everybody was pulling in their own direction, basically holding us in place. After we managed to collect everything in Jama, **it felt like everyone is suddenly pulling in the same direction.**

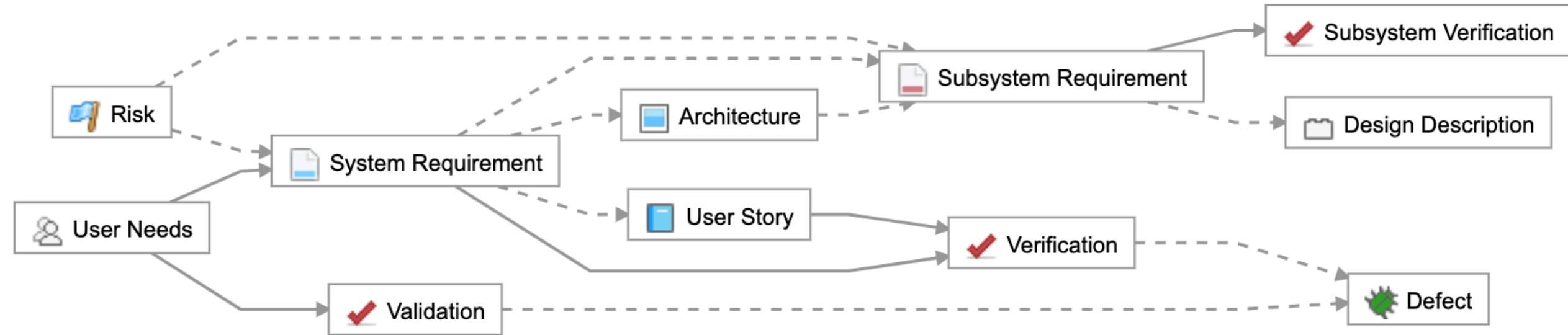
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**Marko Šustić**

*Product Manager Rimac*

# A Simple Data Model

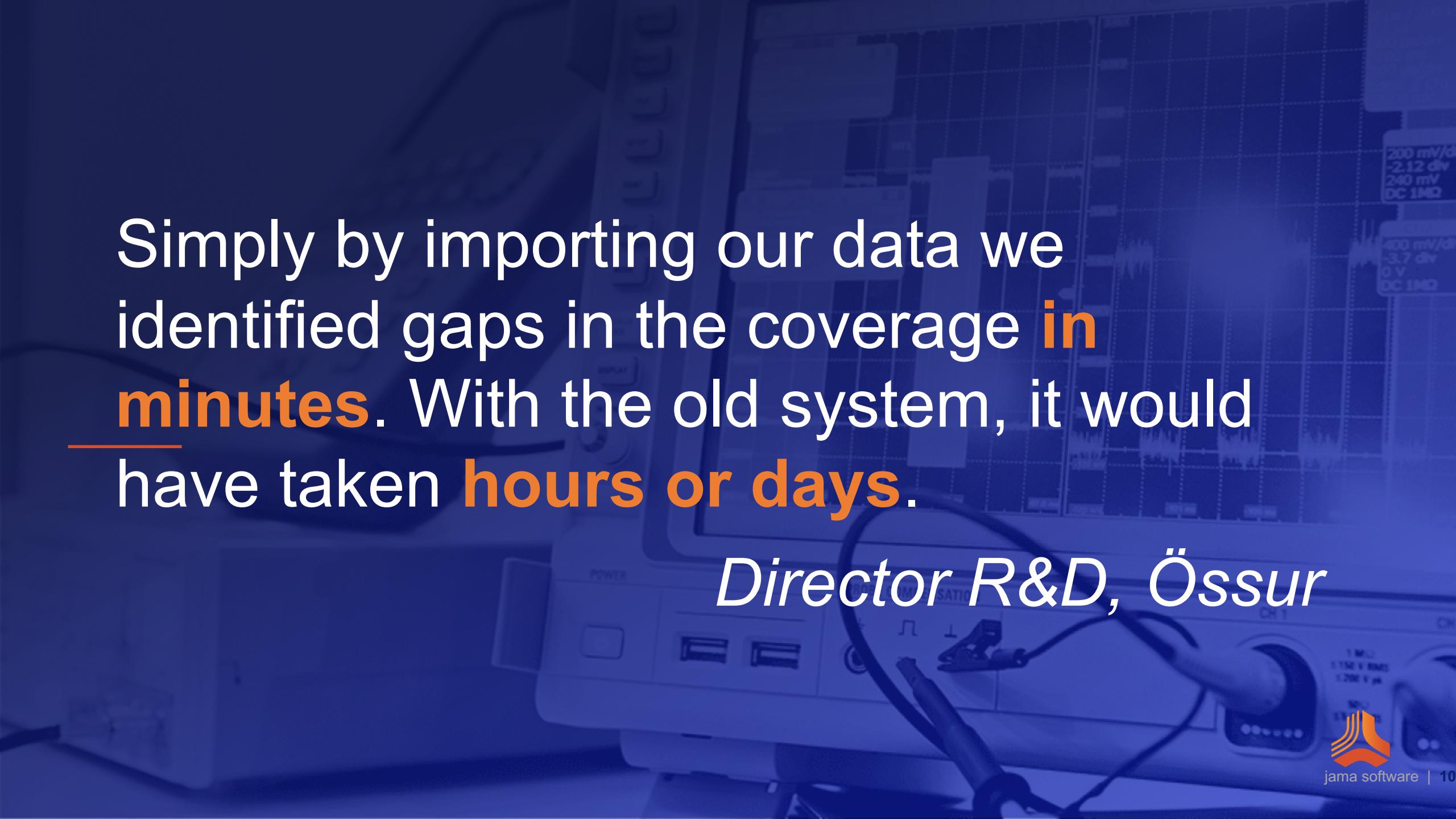
FOR AUTOMOTIVE DEVELOPMENT



# Detect Gaps in Coverage

## TRACE VIEW IN JAMA CONNECT

| SOURCE ITEMS               |            |                            |                                            | Filter items                           | Set columns | 1 LEVEL DOWN                          |                                             |  |           | Filter items                          | Set columns                                 |
|----------------------------|------------|----------------------------|--------------------------------------------|----------------------------------------|-------------|---------------------------------------|---------------------------------------------|--|-----------|---------------------------------------|---------------------------------------------|
| User Needs (9), Folder (2) |            |                            |                                            | System Requirement (9), Validation (4) |             |                                       |                                             |  |           |                                       |                                             |
|                            | ID         | Name                       | Description                                |                                        | ID          | Name                                  | Description                                 |  | ID        | Name                                  | Description                                 |
|                            | CL3-UN-10  | Low-Cost, High-Quality     | Off the shelf, our devices cost an aver... |                                        | CL3-SR-3    | Android Integration                   | Many hearing aids on the market requi...    |  | CL3-SR-4  | Durable                               | Hearing aids can be durable and stoc...     |
|                            | CL3-UN-12  | Waterproof                 |                                            |                                        | CL3-SR-5    | Haptic Feedback                       | There are times when our patients will ...  |  | CL3-VAL-1 | Underwater immersion                  |                                             |
|                            | CL3-UN-13  | Operate with Mobile Phones |                                            |                                        | CL3-VAL-4   | iOS Validation                        | In a focus group of 10 patients with iO...  |  | CL3-VAL-5 | Android Validation                    | In a focus group of 10 patients with An...  |
|                            | CL3-FLD-10 | Geography                  |                                            |                                        | CL3-VAL-6   | Windows Mobile Validation             | In a focus group of 10 patients with Wi...  |  |           |                                       |                                             |
|                            | CL3-UN-5   | Europe                     | Increase market share in Europe by 2...    |                                        | CL3-SR-1    | Waterproof while swimming and show... | A waterproof device is vital to increasi... |  | CL3-SR-2  | iOS Integration                       | Many hearing aid on the market requi...     |
|                            | CL3-UN-6   | Asia                       | Increased market share in Asia by 13...    |                                        | CL3-SR-3    | Android Integration                   | Many hearing aids on the market requi...    |  | CL3-SR-4  | Durable                               | Hearing aids can be durable and stoc...     |
|                            |            |                            |                                            |                                        | CL3-SR-7    | Windows Integration                   | Many hearing aids on the market requi...    |  | CL3-SR-1  | Waterproof while swimming and show... | A waterproof device is vital to increasi... |
|                            |            |                            |                                            |                                        | CL3-SR-2    | iOS Integration                       | Many hearing aid on the market requi...     |  | CL3-SR-3  | Android Integration                   | Many hearing aids on the market requi...    |
|                            |            |                            |                                            |                                        | CL3-SR-4    | Durable                               | Hearing aids can be durable and stoc...     |  |           |                                       |                                             |



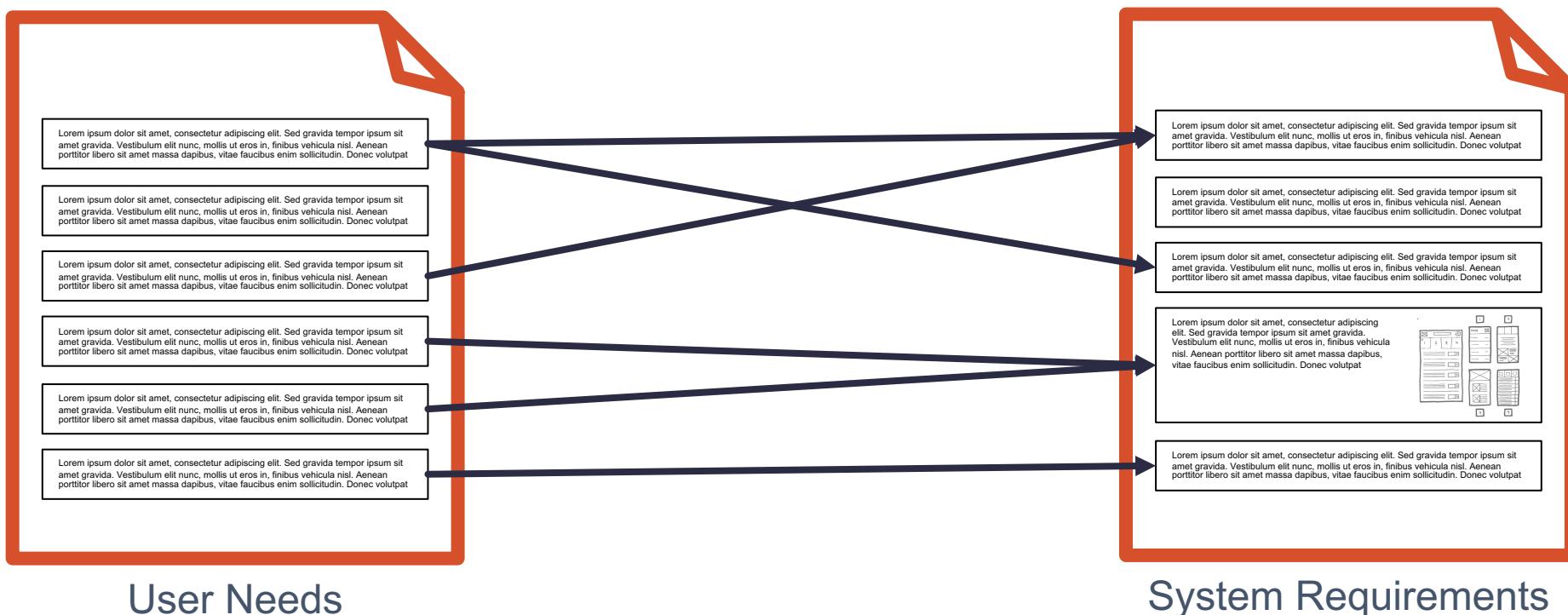
Simply by importing our data we identified gaps in the coverage **in minutes**. With the old system, it would have taken **hours or days**.

*Director R&D, Össur*



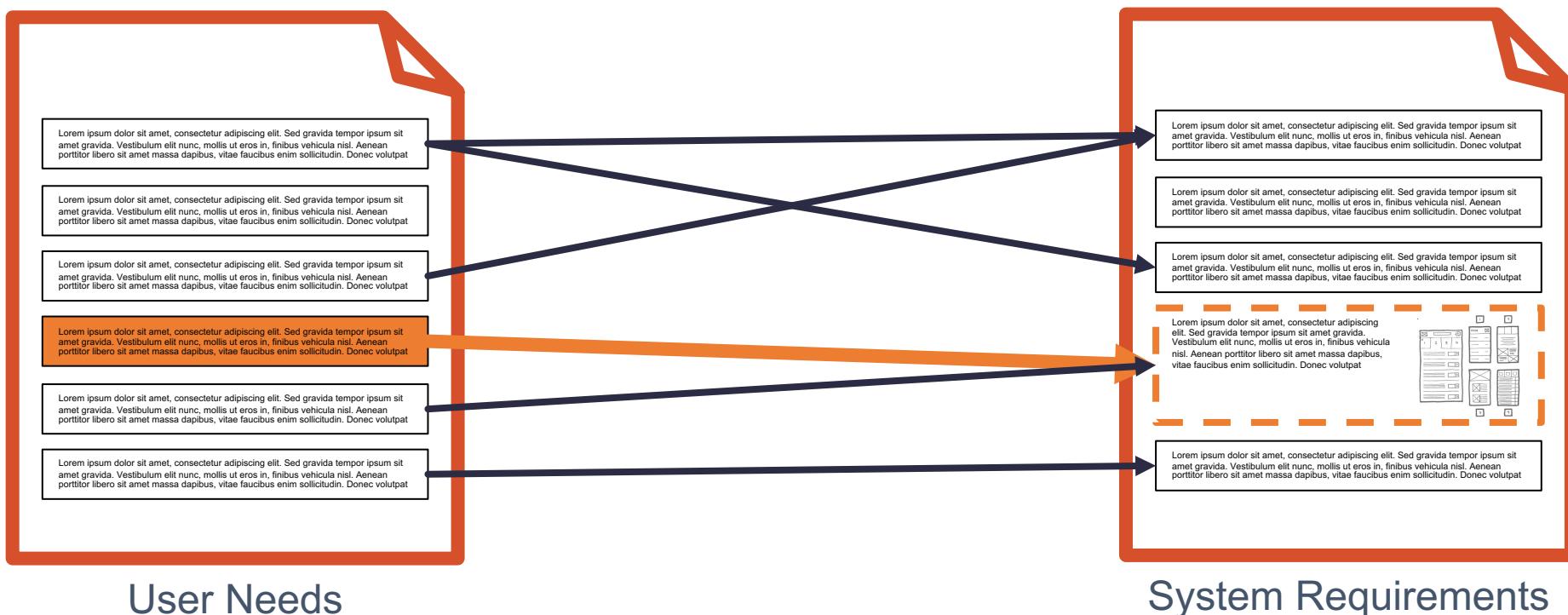
# Change Management

REDUCE EFFORT OF REWORK



# Change Management

## REDUCE EFFORD OF REWORK



# Accelerating Rework



- Suspects
- Impact Analysis
- Change Requests

Too Late  
Too Complex  
Too Slow

| System Requirements <a href="#">View</a> |           |                                    |  |  |   |  |  |        |          |               |           |
|------------------------------------------|-----------|------------------------------------|--|--|---|--|--|--------|----------|---------------|-----------|
| 13 items <a href="#">Filter Items</a>    |           |                                    |  |  |   |  |  |        |          |               |           |
|                                          | ID        | System Req                         |  |  |   |  |  | Status | Priority | # of Upstr... | # of D... |
| <input type="checkbox"/>                 | CL3-SR-1  | Waterproof while swimming and...   |  |  | 1 |  |  | Draft  | High     |               |           |
| <input type="checkbox"/>                 | CL3-SR-4  | Durable                            |  |  | 4 |  |  | Draft  | High     |               |           |
| <input type="checkbox"/>                 | CL3-SR-5  | Haptic Feedback                    |  |  | 0 |  |  | Draft  | Medium   |               |           |
| <input type="checkbox"/>                 | CL3-SR-8  | Surgical Installation              |  |  | 0 |  |  | Draft  | High     |               |           |
| <input type="checkbox"/>                 | CL3-SR-9  | Hearing Gain in Free Field Pure... |  |  | 0 |  |  | Draft  | Medium   |               |           |
| <input type="checkbox"/>                 | CL3-SR-10 | Suprathreshold Speech Percep...    |  |  | 0 |  |  | Draft  | Medium   |               |           |
| <input type="checkbox"/>                 | CL3-FLD-3 | Device Integration                 |  |  | 0 |  |  |        |          |               |           |
| <input type="checkbox"/>                 | CL3-SR-3  | Android Integration                |  |  | 0 |  |  | Draft  | High     |               |           |
| <input type="checkbox"/>                 | CL3-SR-2  | iOS Integration                    |  |  | 0 |  |  | Draft  | High     |               |           |
| <input type="checkbox"/>                 | CL3-SR-6  | SymbianOS Integration              |  |  | 1 |  |  | Draft  | Low      |               |           |
| <input type="checkbox"/>                 | CL3-SR-7  | Windows Integration                |  |  | 0 |  |  | Draft  | Low      |               |           |
| <input type="checkbox"/>                 | CL3-SR-20 | Implant                            |  |  | 0 |  |  | Draft  | -        |               |           |
| <input type="checkbox"/>                 | CL3-SR-21 | Abutment                           |  |  | 0 |  |  | Draft  | -        |               |           |

# Impact Analysis

- Suspects
- Impact Analysis
- Change Requests

| Source Item(s)          |              |                                        |                       |          |              |                                                        |
|-------------------------|--------------|----------------------------------------|-----------------------|----------|--------------|--------------------------------------------------------|
| Project                 | ID           | Name                                   | Type                  | Assigned | Type         | Path                                                   |
| Clear 3 Hearing Aid     | CL3-UN-10    | Low-Cost, High-Quality                 | User Needs            |          | Source Item  | CL3-UN-10                                              |
| Direct Relationship     |              |                                        |                       |          |              |                                                        |
| Project                 | ID           | Name                                   | Type                  | Assigned | Type         | Path                                                   |
| Clear 3 Hearing Aid     | CL3-SR-3     | Android Integration                    | System Requirement    |          | Related to   | CL3-UN-10 --> CL3-SR-3                                 |
| Clear 3 Hearing Aid     | CL3-SR-4     | Durable                                | System Requirement    |          | Related to   | CL3-UN-10 --> CL3-SR-4                                 |
| Clear 3 Hearing Aid     | CL3-SR-5     | Haptic Feedback                        | System Requirement    |          | Related to   | CL3-UN-10 --> CL3-SR-5                                 |
| 2 Degrees of Separation |              |                                        |                       |          |              |                                                        |
| Project                 | ID           | Name                                   | Type                  | Assigned | Type         | Path                                                   |
| Clear 3 Hearing Aid     | CL3-STY-113  | Bass Profile                           | User Story            |          | Related to   | CL3-UN-10 --> CL3-SR-5 --> CL3-STY-113                 |
| Clear 3 Hearing Aid     | CL3-STY-115  | Android User                           | User Story            |          | Related to   | CL3-UN-10 --> CL3-SR-3 --> CL3-STY-115                 |
| Clear 3 Hearing Aid     | CL3-RISK-1   | Bacterial infection                    | Risk                  |          | Caused by    | CL3-UN-10 --> CL3-SR-4 --> CL3-RISK-1                  |
| Clear 3 Hearing Aid     | CL3-ARCH-1   | Implant                                | Architecture          |          | Allocated to | CL3-UN-10 --> CL3-SR-5 --> CL3-ARCH-1                  |
| Clear 3 Hearing Aid     | CL3-ARCH-3   | External Abutment                      | Architecture          |          | Allocated to | CL3-UN-10 --> CL3-SR-4 --> CL3-ARCH-3                  |
| Clear 3 Hearing Aid     | CL3-VER-31   | Durability Impact test                 | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-4 --> CL3-VER-31                  |
| Clear 3 Hearing Aid     | CL3-VER-32   | Durability compression test            | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-4 --> CL3-VER-32                  |
| Clear 3 Hearing Aid     | CL3-SUBSS-22 | Environmental Resistance               | Subsystem Requirement |          | Derived from | CL3-UN-10 --> CL3-SR-4 --> CL3-SUBSS-22                |
| Clear 3 Hearing Aid     | CL3-VER-33   | Durability Scuffing test               | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-4 --> CL3-VER-33                  |
| Clear 3 Hearing Aid     | CL3-VER-34   | Feedback at 40 db threshold            | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-5 --> CL3-VER-34                  |
| Clear 3 Hearing Aid     | CL3-VER-35   | Feedback at 100db Threshold            | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-5 --> CL3-VER-35                  |
| 3 Degrees of Separation |              |                                        |                       |          |              |                                                        |
| Project                 | ID           | Name                                   | Type                  | Assigned | Type         | Path                                                   |
| Clear 3 Hearing Aid     | CL3-VER-17   | Android Phone Call                     | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-3 --> CL3-STY-115 --> CL3-VER-17  |
| Clear 3 Hearing Aid     | CL3-VER-18   | Android Games                          | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-3 --> CL3-STY-115 --> CL3-VER-18  |
| Clear 3 Hearing Aid     | CL3-VER-19   | Android Music                          | Verification          |          | Verified by  | CL3-UN-10 --> CL3-SR-3 --> CL3-STY-115 --> CL3-VER-19  |
| Clear 3 Hearing Aid     | CL3-DES-1    | Sound Processor                        | Design Description    |          | Allocated to | CL3-UN-10 --> CL3-SR-4 --> CL3-SUBSS-22 --> CL3-DES-1  |
| Clear 3 Hearing Aid     | CL3-SUBSS-6  | Diameter                               | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-5 --> CL3-ARCH-1 --> CL3-SUBSS-6  |
| Clear 3 Hearing Aid     | CL3-SUBSS-7  | Implant Stability Quotient (ISQ) Range | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-5 --> CL3-ARCH-1 --> CL3-SUBSS-7  |
| Clear 3 Hearing Aid     | CL3-SUBSS-8  | Interface Requirements                 | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-5 --> CL3-ARCH-1 --> CL3-SUBSS-8  |
| Clear 3 Hearing Aid     | CL3-SUBSS-9  | Length                                 | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-5 --> CL3-ARCH-1 --> CL3-SUBSS-9  |
| Clear 3 Hearing Aid     | CL3-SUBSS-11 | Abutment Shoulder                      | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-4 --> CL3-ARCH-3 --> CL3-SUBSS-11 |
| Clear 3 Hearing Aid     | CL3-SUBSS-12 | Skin Contact                           | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-4 --> CL3-ARCH-3 --> CL3-SUBSS-12 |
| Clear 3 Hearing Aid     | CL3-SUBSS-13 | Skin Movement                          | Subsystem Requirement |          | Allocated to | CL3-UN-10 --> CL3-SR-4 --> CL3-ARCH-3 --> CL3-SUBSS-13 |

Too Late

Too Complex

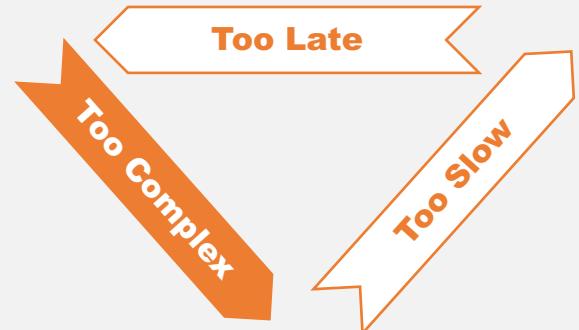
Too Slow

„The impact analysis helps with  
**understanding change**, decisions now  
have a solid foundation”



# Change Requests

- Suspects
- Impact-Analyse
- **Change Requests**



# Variants and Reuse

**Products typically contain**

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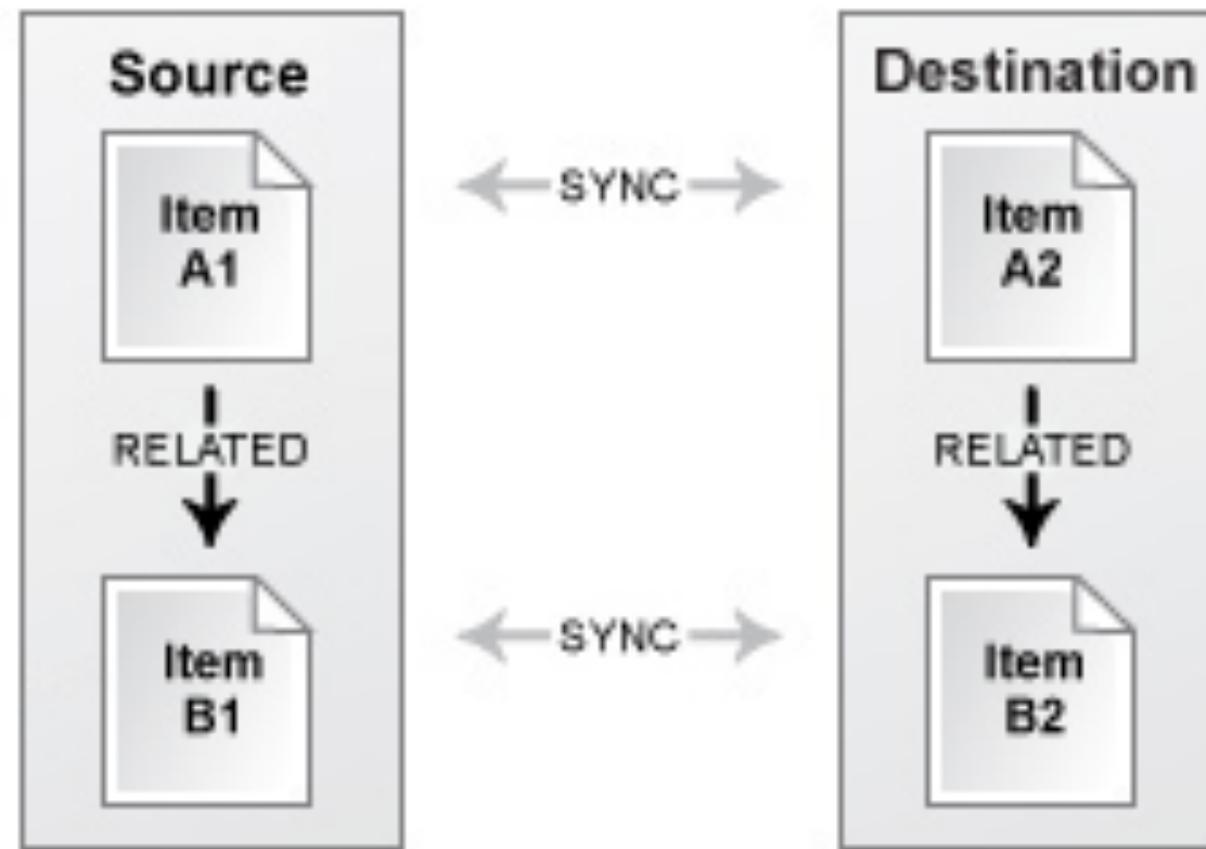
**60%-70%**

**identical core requirements**



# Reuse

WITH BRANCHING AND MERGING



# Use Cases for Branching & Merging

- Library
- Versions
- Productlines

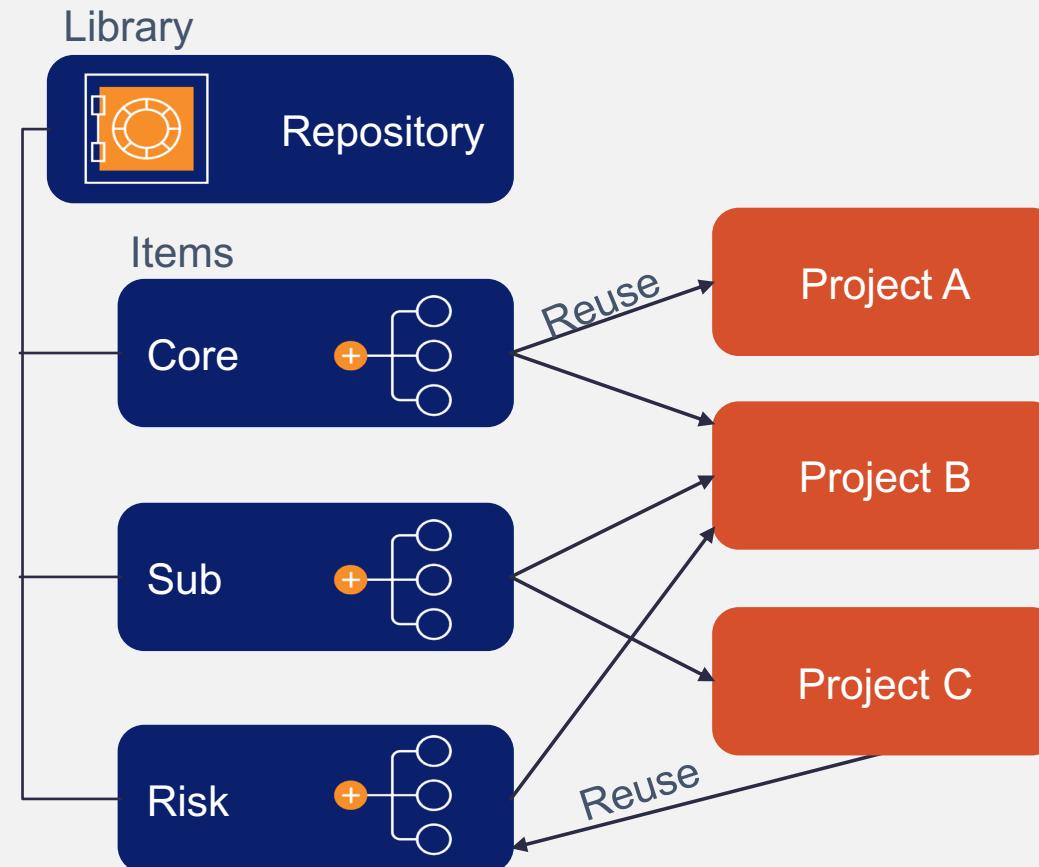
# Branching & Merging: Library

- Library
- Versions
- Productlines

Too Late

Too Complex

Too Slow



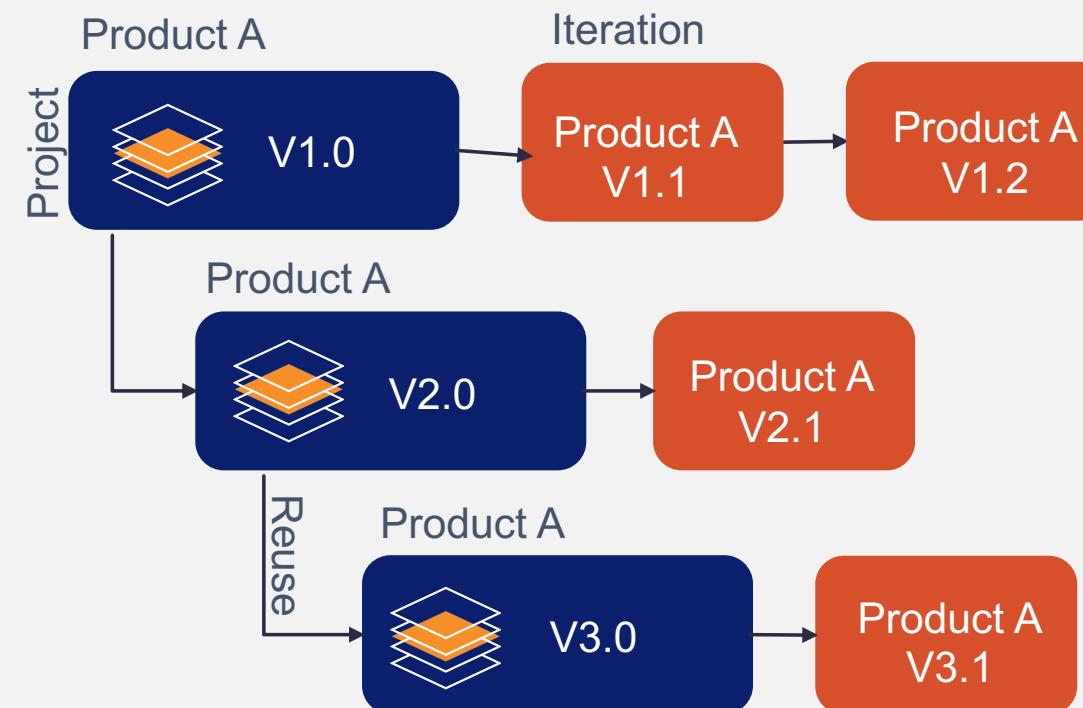
# Branching & Merging: Versions

- Library
- **Versions**
- Productlines

Too Late

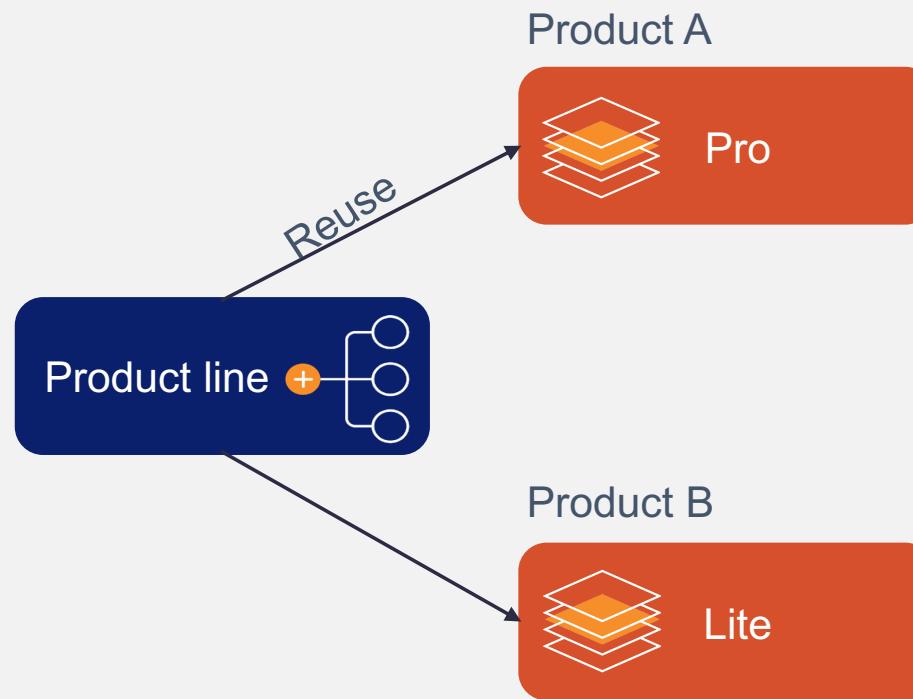
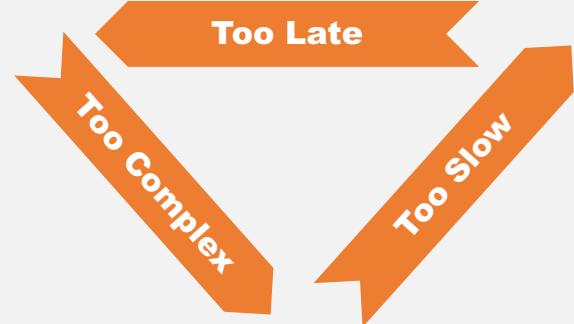
Too Complex

Too Slow



# Branching & Merging: Product Lines

- Library
- Versions
- **Productlines**



Products typically have  
**60%-70%**  
identical core requirements

## Effort when reusing content

 Reuse of requirements prevents traps like scope creep

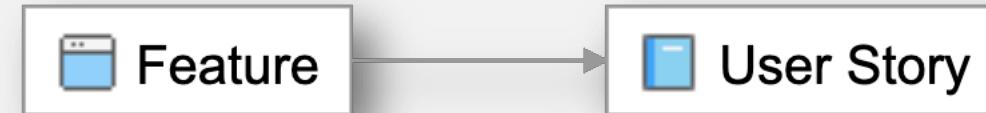
A wide-angle photograph of a control room. The top half of the image is dominated by a massive wall of computer monitors displaying complex industrial control software. The screens show various data panels, including flowcharts, graphs, and numerical readouts. Below this main wall of screens, there is a curved desk with several smaller computer monitors and keyboard/mouse units, likely for operators. The overall atmosphere is one of a high-tech monitoring facility.

# Stay in Control

# Compliance requires Managerial Oversight

Realtime reporting for:

- Progress and Development
- Test Coverage
- and much more



All Features [Edit](#)  
8 items [Filter Items](#)

| <input type="checkbox"/> | ID           |    | Name                                   | Release | Completed Stories ▾                  |
|--------------------------|--------------|---------------------------------------------------------------------------------------|----------------------------------------|---------|--------------------------------------|
| <input type="checkbox"/> | SAFE-FEAT-3  |    | Home Screen voice activation           | R1      | <div style="width: 100%;">100%</div> |
| <input type="checkbox"/> | SAFE-FEAT-5  |    | Continuous sync with connected devices | R1      | <div style="width: 100%;">100%</div> |
| <input type="checkbox"/> | SAFE-FEAT-7  |  | Support for 5 devices                  | R1      | <div style="width: 100%;">100%</div> |
| <input type="checkbox"/> | SAFE-FEAT-6  |  | Link to social media                   | R2      | <div style="width: 25%;">25%</div>   |
| <input type="checkbox"/> | SAFE-FEAT-10 |  | WCDMA support                          | Backlog | <div style="width: 0%;">0%</div>     |
| <input type="checkbox"/> | SAFE-FEAT-11 |  | GSM support                            | Backlog | <div style="width: 0%;">0%</div>     |
| <input type="checkbox"/> | SAFE-FEAT-8  |  | 3D touch                               | R3      | <div style="width: 0%;">0%</div>     |
| <input type="checkbox"/> | SAFE-FEAT-9  |  | On demand music                        | R3      | <div style="width: 0%;">0%</div>     |

Too Late

Too Complex

Too Slow

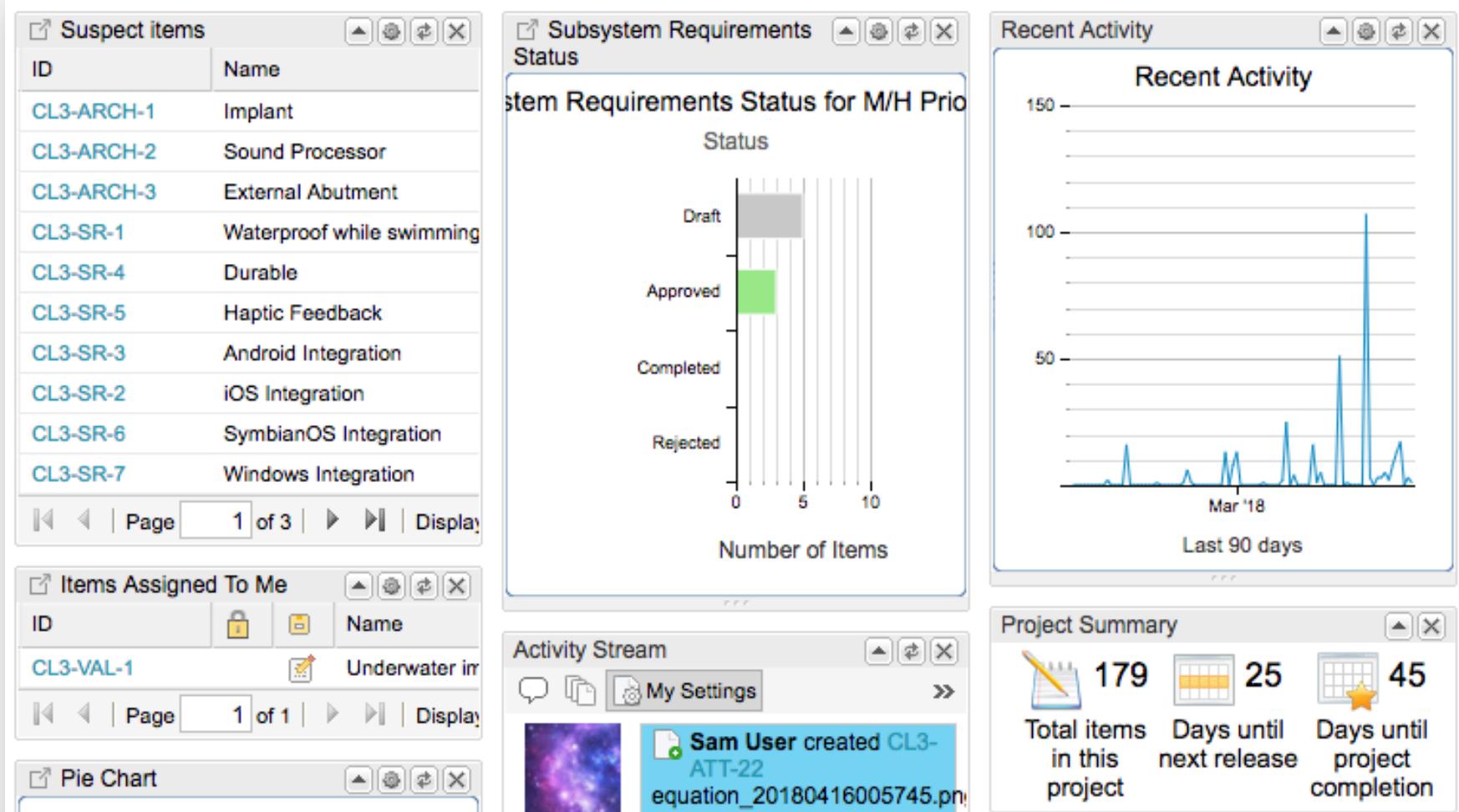
# Managerial Oversight

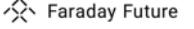
THROUGH DASHBOARDS

Too Late

Too Complex

Too Slow



| Automotive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Semiconductor & Industrial Technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Aerospace & Defense                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Medical & Life Sciences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mission Critical Software Systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><br><br><br><br><br> | <br><br><br><br><br> | <br><br><br><br><br><br> | <br><br><br><br><br><br><br> | <br><br><br><br><br> |

# Industry Services: **Automotive**

Automotive Tier 1, Tier 2 companies or OEMs can get ramped up quickly with Jama Connect based on a process tightly aligned to ISO 26262, Automotive SPICE, and Systems Engineering Body of Knowledge (SEBoK)



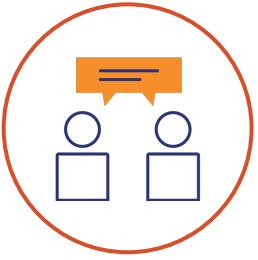
## What's included:



Out of the box configuration of Jama Connect for Automotive Development



Standard process documentation detailing how Jama Connect should be used to facilitate alignment with relevant objectives in ISO26262, Automotive SPICE, and SEBoK



User training within the context of automotive processes to speed user adoption



Up to six document export templates such as requirements specifications and traceability matrices, configured in Jama Connect

# Modeling in Little Steps

FROM LIGHTWEIGHT REQUIREMENTS MODELING TO MBSE

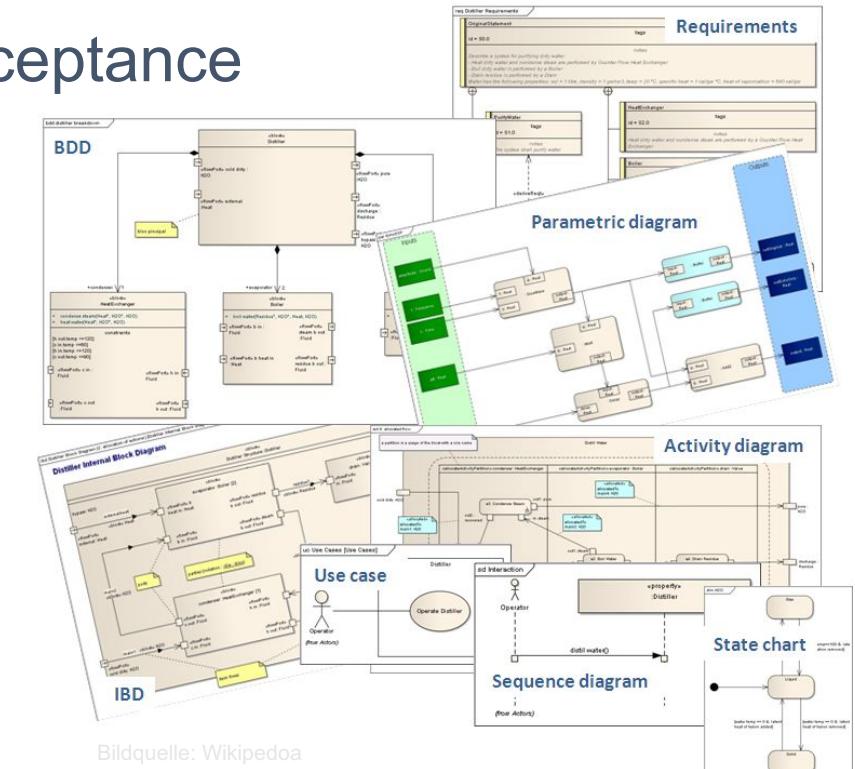
## Requirements Modeling



- Easy to use
- Easy to understand
- Great benefit for cost
- Used for decades

## (Semi-) Formal Modeling

- UML, SysML, FMC, etc.
- Many organization are not ready
- Moderate acceptance
- Hard to learn



Bildquelle: Wikipedoa

# **Lightweight Requirements Modeling as a Stepping Stone to MBSE**

IN AUTOMOTIVE

# Thank you for Your Attention

