FMEA as a Part of the Development Process

Create FMEAs worldwide, easily and in a team

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SOLUTIONS BY SOFTWARE

FMEA Definition

- **FMEA** = **F**ailure **M**ode and **E**ffects **A**nalysis

Preventive method for qualitative evaluation and avoidance of potential defects in products and processes.

Target:

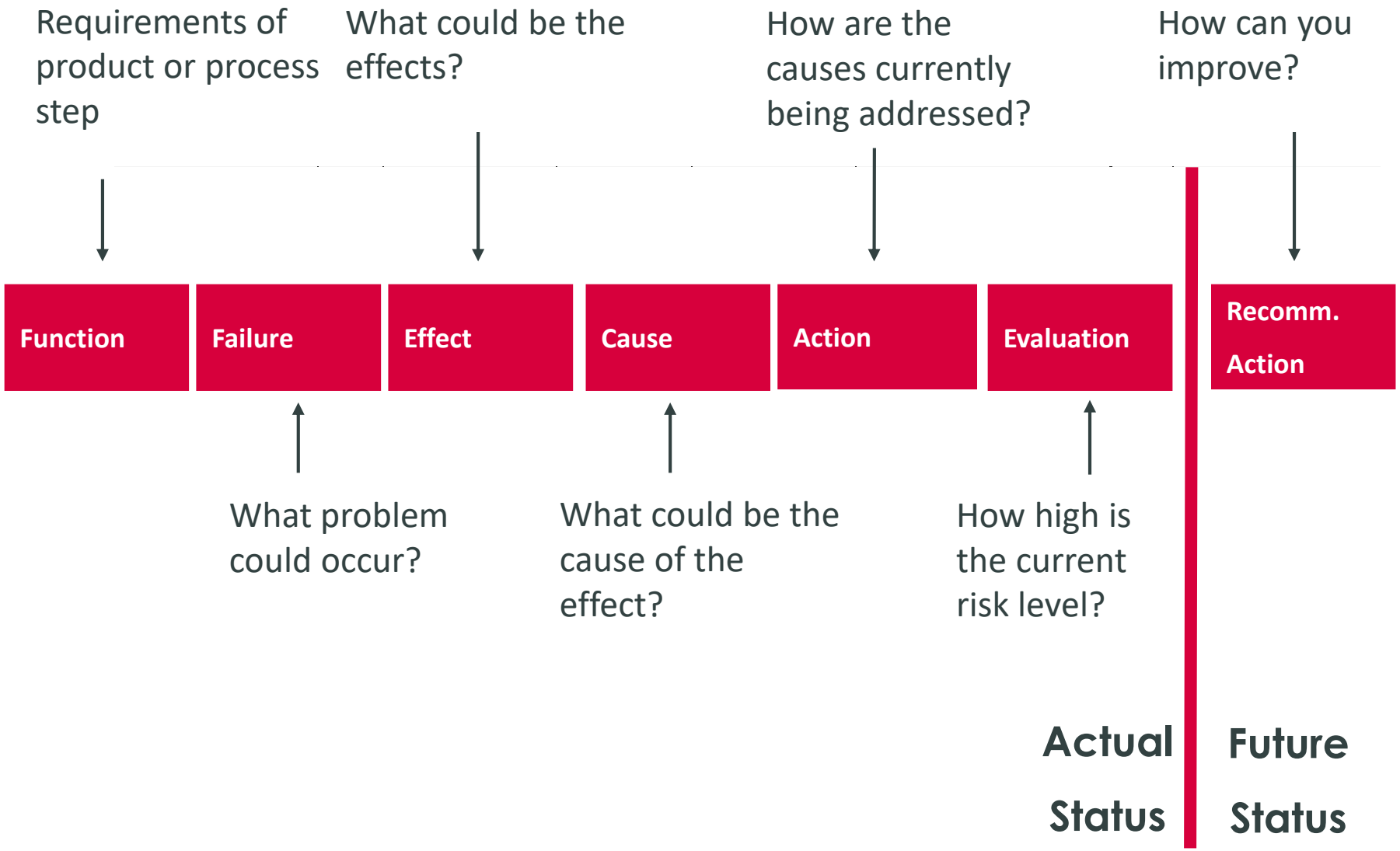
- Error prevention instead of error correction (early use!)
- Early detection of potential business interruptions
- Increased functional safety and reliability of products and processes
- Development of counteractions to avoid errors

FMEA - Important Part of the Development Process

FMEA - More than just a method

- Systematic and practical implementation of the FMEA methodology through the central database
- Connection to an integrated action management system for processing FMEA actions
- Storage of documents (e.g. risk management files) in the document management system
- Networking of engineering methods ensures optimal information exchange and automatically makes current data from the FMEA everywhere available
- Reuse of knowledge and use of existing FMEAs is provided by templates adapted to the needs of system analysis and risk management

FMEA Analysis Principle



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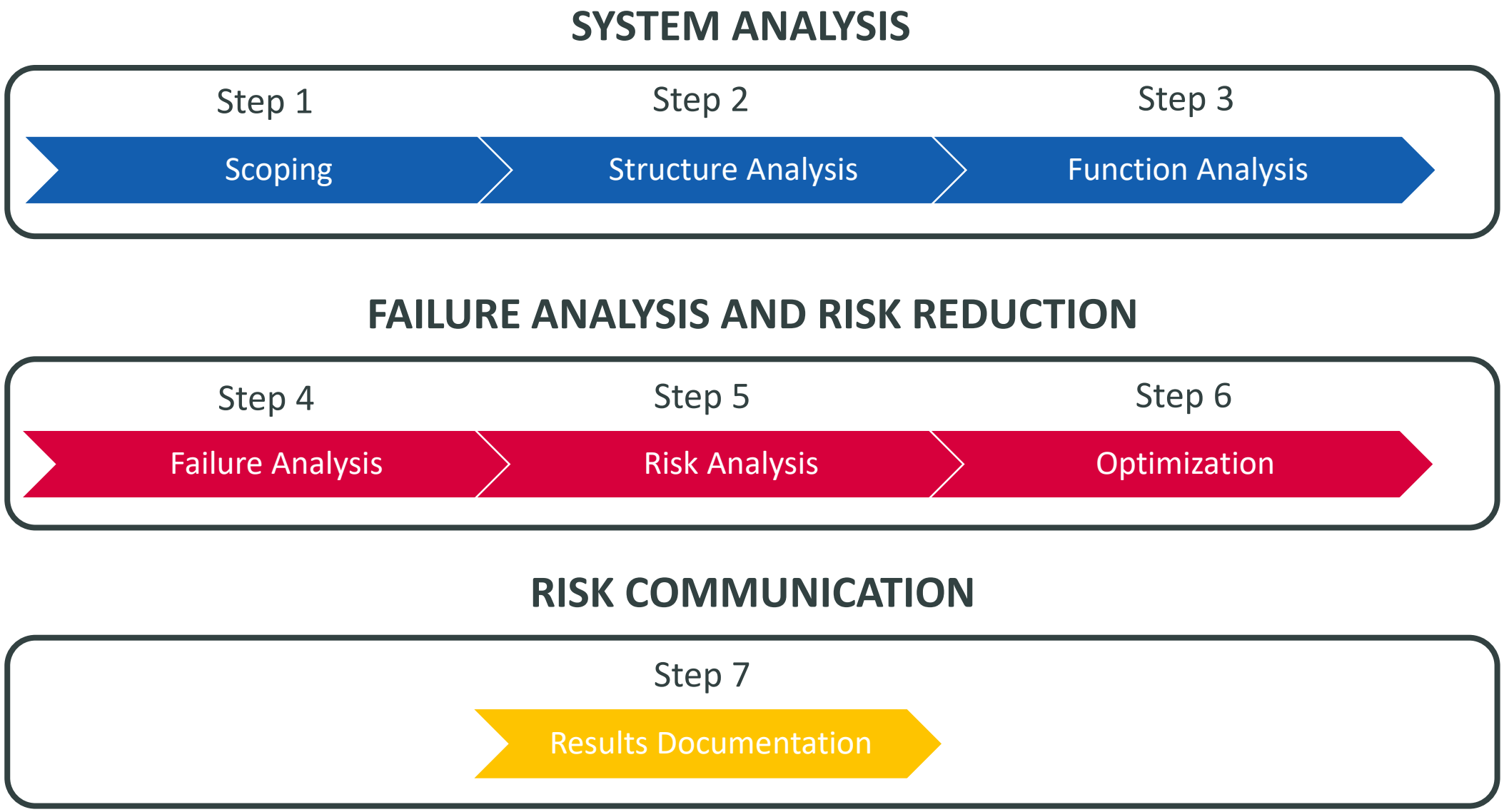
7 Steps of FMEA according to VDA-AIAG



FMEA as a Part of the Development Process

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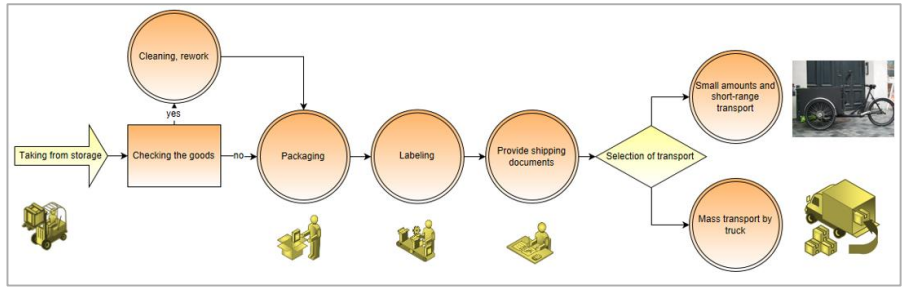
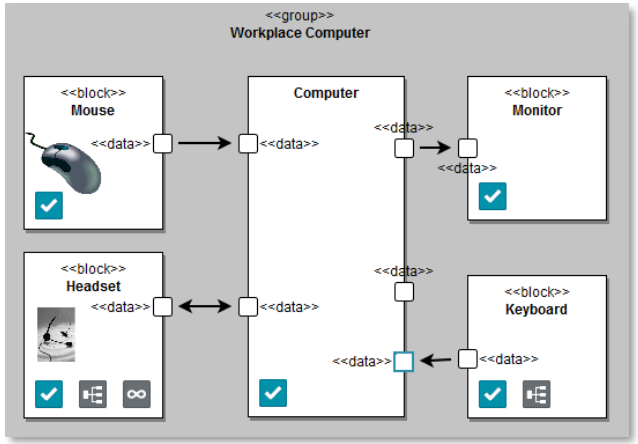
Scoping | Structure Analysis | Function Analysis

Development of products and processes

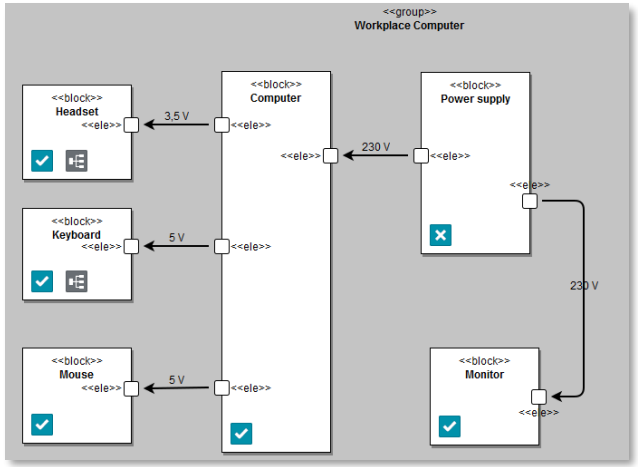
- Definition of tasks and scope of investigation
- Differentiation of the considered system
- Modeling an architecture
- Visualization of system behavior
- Uniform system representation
- View as block structure diagram
- Use of the SysML standard

Separate process modeling via flow diagrams:





Software



Electrics

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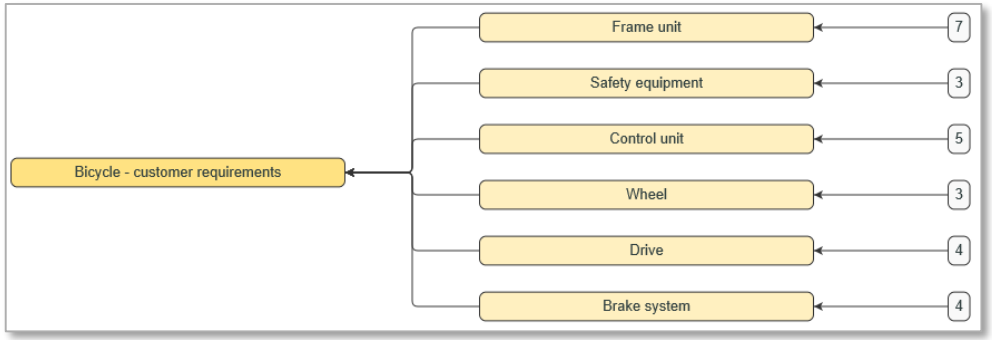
Scoping | Structure Analysis | Function Analysis

- System construction in structure depths (QFD approach)
- Linking design and process
- Visualization via a structural net
- Linking of functions and elements

Linking requirement and element

Bicycle - customer requirements	Provide transport of one person minimum	Allow adjusting the bike on the driver's Body	Ensure visibility day and night	Carry additional loads
Row filter... / Column filter...	10	20	30	40
Frame unit	☑	☑	☐	☑
Safety equipment	☐	☐	☑	☐
Control unit	☑	☑	☐	☐
Wheel	☑	☑	☑	☐

Link field



View as system strucure

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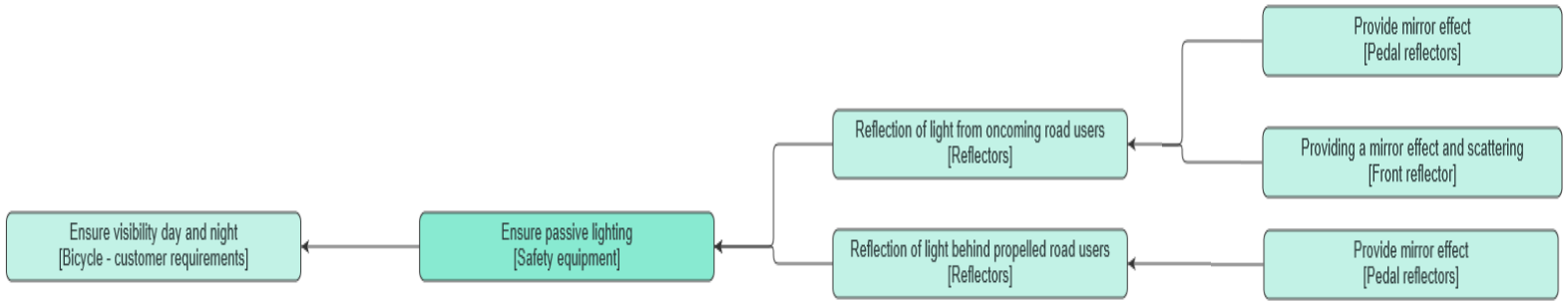
Scoping | Structure Analysis | **Function Analysis**

- Requirements and functions are specified
- Functional relationships are identified
- Influence of process steps on product functionalities becomes comprehensible
- Creation of the function net



Function net

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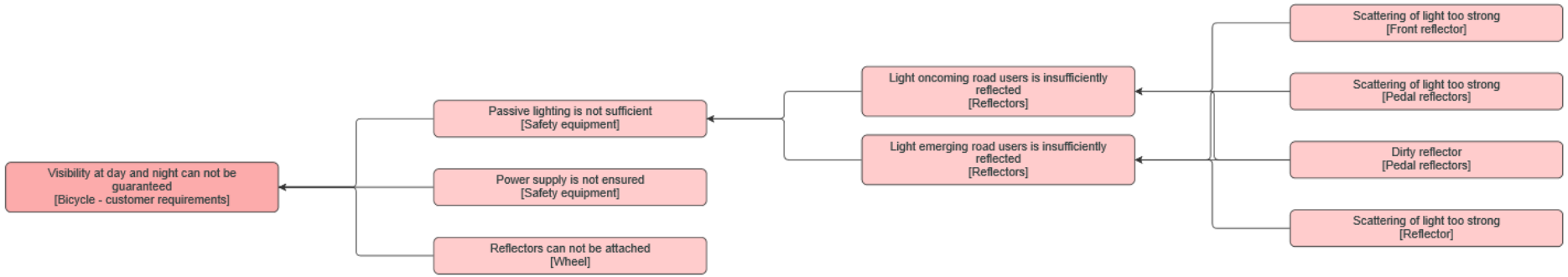
Failure Analysis | Risk Analysis | Optimization

- Each requirement is examined for non-compliance.
- The system uses the failure net to check for potential system failure.
- Failure nets provide data for the **FMEA**.
- Safety functions (Functional Safety) are defined and linked in a comprehensible way for failures.



Failure net

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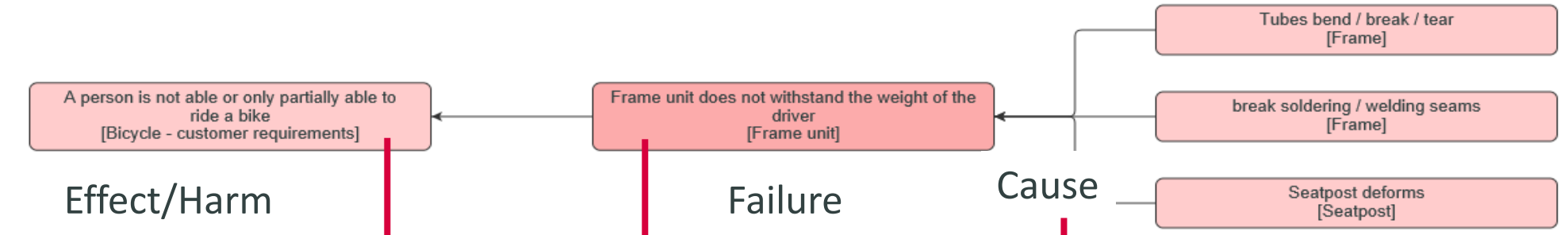
Failure Analysis | Risk Analysis | Optimization

- Failure net and functional analysis automatically fills the **FMEA** form.
- Failure, effect and cause are entered from the structure into the form.



Frame unit

Requirements		Risk Analysis					Current Design					
Item / Function	Requirements	Failure Mode	Failure Effect	S	Class	Potential Failure Causes	Preventive Action	O	Detection Action	D	RPN	Risk
Carry weight of the driver	1: Maximum weight Driver > 115 kg (+150)	Frame unit does not withstand the weight of the driver	A person is not able or only partially able to ride a bike [Bicycle - customer requirements]	10		Tubes bend / break / tear [Frame]	Numerical simulation of the component under load	3	Load test on a test stand	1	30	R
						break soldering / welding seams [Frame]	Numerical simulation of the component under load	4	Load test on a test stand	1	40	R
						Seatpost deforms [Seatpost]	none	2	Load test on a test stand	1	20	Y

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Failure Analysis | Risk Analysis | Optimization

Evaluation / Notification

- The system uses the failure net to check for consistent evaluations.
- Persons responsible are informed about conflicts (Notifications).

Top Element

Bicycle

Requirements		Risk Analysis					
Item / Function	Requirements	Failure Mode	Failure Effect	S'	S	Class	Potential Failure Causes
Ensure visibility day and night		Visibility at day and night can not be guaranteed	Does not meet safety requirement	9	9		Power supply is not ensured [Safety equipment]

Person responsible

1

Severity changed for **Visibility at day and night can not be guaranteed** from 1 to 9.
By PLATO 5 minutes ago

Checking the failure net

Sub Element

Safety equipment

Requirements		Risk Analysis					
Item / Function	Requirements	Failure Mode	Failure Effect	S'	S	Class	Potential Failure Causes
Ensure energy supply	Voltage Dynamo = 6 V	Power supply is not ensured	Visibility at day and night can not be guaranteed [Bicycle] (10)	1	1		none
	Rated Power Dynamo = 3 W						
	Efficiency Dynamo at 20km / h >= 50 %						

Person responsible

1

The meaning for the top system element "Bicycle" has changed from 1 to 9, which affects **driving not possible**.
By PLATO 3 minutes ago

FMEA as a Part of the Development Process

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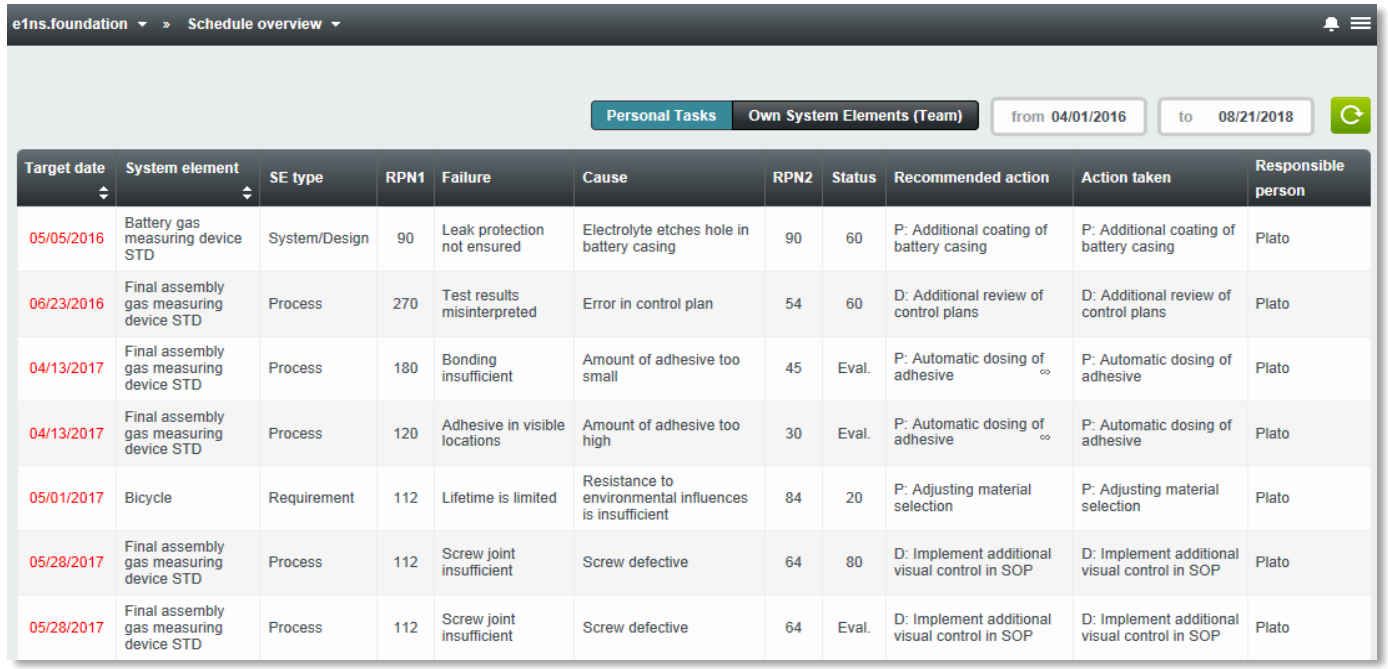
Failure Analysis | Risk Analysis | Optimization

- A newsletter provides regular information on open actions.
- Easy access via an action portal. The FMEA software does not need to be started (installed).
- Each user has his own scheduling overview.



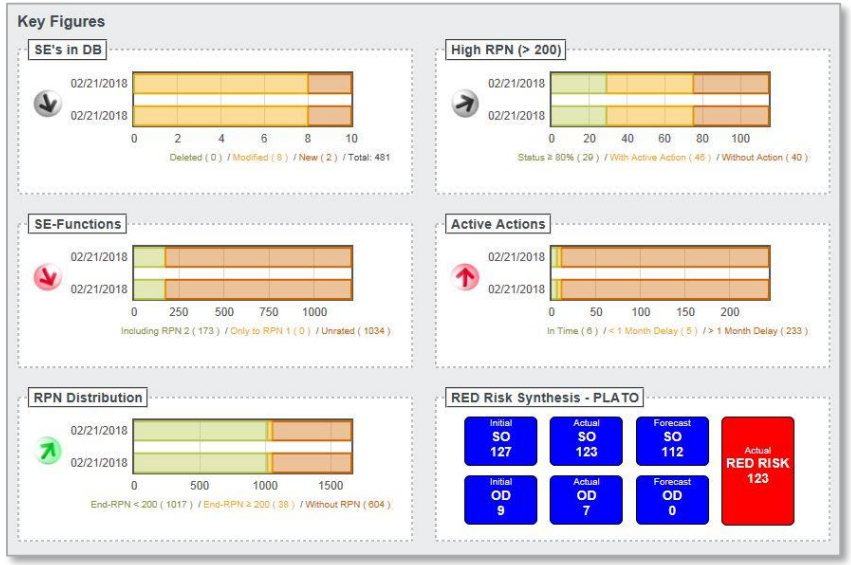
Target date	System element	SE type	RPN1	Failure	Cause	RPN2	Status	Recommended action	Action taken	Responsible person
05/05/2016	Battery gas measuring device STD	System/Design	90	Leak protection not ensured	Electrolyte etches hole in battery casing	90	60	P: Additional coating of battery casing	P: Additional coating of battery casing	Plato
06/23/2016	Final assembly gas measuring device STD	Process	270	Test results misinterpreted	Error in control plan	54	60	D: Additional review of control plans	D: Additional review of control plans	Plato
04/13/2017	Final assembly gas measuring device STD	Process	180	Bonding insufficient	Amount of adhesive too small	45	Eval.	P: Automatic dosing of adhesive ∞	P: Automatic dosing of adhesive	Plato
04/13/2017	Final assembly gas measuring device STD	Process	120	Adhesive in visible locations	Amount of adhesive too high	30	Eval.	P: Automatic dosing of adhesive ∞	P: Automatic dosing of adhesive	Plato
05/01/2017	Bicycle	Requirement	112	Lifetime is limited	Resistance to environmental influences is insufficient	84	20	P: Adjusting material selection	P: Adjusting material selection	Plato
05/28/2017	Final assembly gas measuring device STD	Process	112	Screw joint insufficient	Screw defective	64	80	D: Implement additional visual control in SOP	D: Implement additional visual control in SOP	Plato
05/28/2017	Final assembly gas measuring device STD	Process	112	Screw joint insufficient	Screw defective	64	Eval.	D: Implement additional visual control in SOP	D: Implement additional visual control in SOP	Plato

FMEA as a Part of the Development Process

Results Documentation

Reports for communication with management and customers

- Company-specific layout of the documentation (FMEA file)
- Summarized report
- Scope of FMEA results
- S/O/D rating tables
- Action priority
- Results and conclusions of the analysis
- …



FMEA connected

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FMEA Connected

100% web-based

System model on one data basis

Collaboration/ Communication

Method toolbox

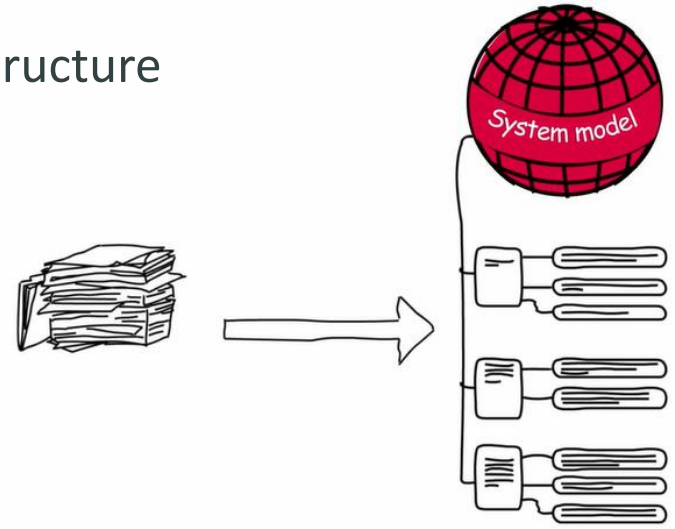
Lessons Learned

- Reduced IT effort - No local installation necessary
- Instant access to current data in the private cloud across all locations for every team member
- Work anytime and from anywhere
- Changes are applied consistently
- No compatibility problems (e.g. through operating systems)
- High data security
  - Authorized access to the system (access rights, role concept, password)

FMEA - System Model on One Database

- 100% web-based
- **System model on one data basis**
- Collaboration/ Communication
- Method toolbox
- Lessons Learned

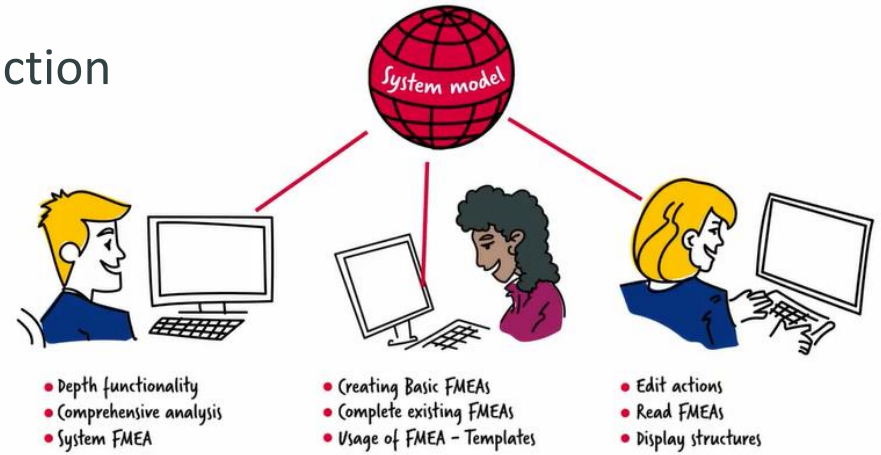
- System model is the basis for all activities in development and process planning
- Central structure for anchoring requirements, risk analyses, tasks, documents, proofs...
- Different departments work simultaneously on the model and have the same system understanding
- Up-to-dateness and consistency are guaranteed
- Easy orientation due to known structure
- All data have one “data pool”



FMEA - Worldwide, Simple and in a Team

- 100% web-based
- System model on one data basis
- **Collaboration/ Communication**
- Method toolbox
- Lessons Learned

- All employees work at the FMEA at any time and from any location - worldwide
- Everyone has the same understanding of the system - knowledge is immediately available to everyone
- Each employee has his own perspective on the data and contributes their knowledge
- Notification concept informs the team about changes
- High acceptance through intuitive handling
- Workflows can be controlled by action hierarchies



FMEA - Flexible Method Toolbox

- **100% web-based**
- **System model on one data basis**
- **Collaboration/ Communication**
- **Method toolbox**
- **Lessons Learned**

- Ensuring quality in accordance with legal requirements through standard methods
- Individually adaptable to company requirements
- Flexible form design according to VDA and AIAG
- Own calculation models and catalogs
- Interconnecting methods for optimal information exchange
- Familiar working method in tabular and network view
- Simple analysis in matrices
- Trigger workflow for avoidance actions directly from the FMEA

FMEA - Lessons Learned

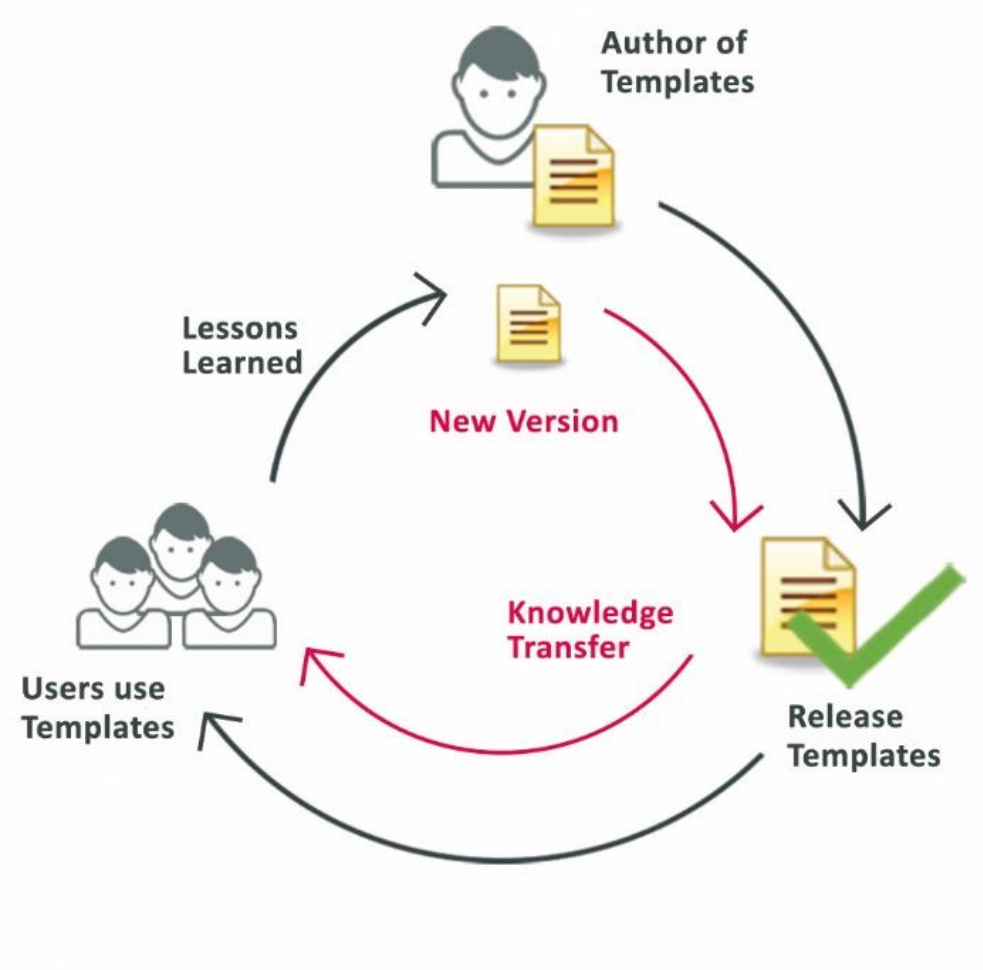
- 100% web-based
- System model on one data basis
- Collaboration/ Communication
- Method toolbox
- **Lessons Learned**

Working with released standard templates

- Use of templates reduces the work and time required to create and maintain FMEAs
- Company-wide and uniform way of working
- Newly acquired knowledge is quickly transferred into current and future projects
- Defined release workflows ensure that only released templates are available
- Template users are notified about updates

FMEA - Lessons Learned

- 100% web-based
- System model on one data basis
- Collaboration/ Communication
- Method toolbox
- **Lessons Learned**



Lessons Learned: Provides findings for the template

Knowledge Transfer: Provides new knowledge to users

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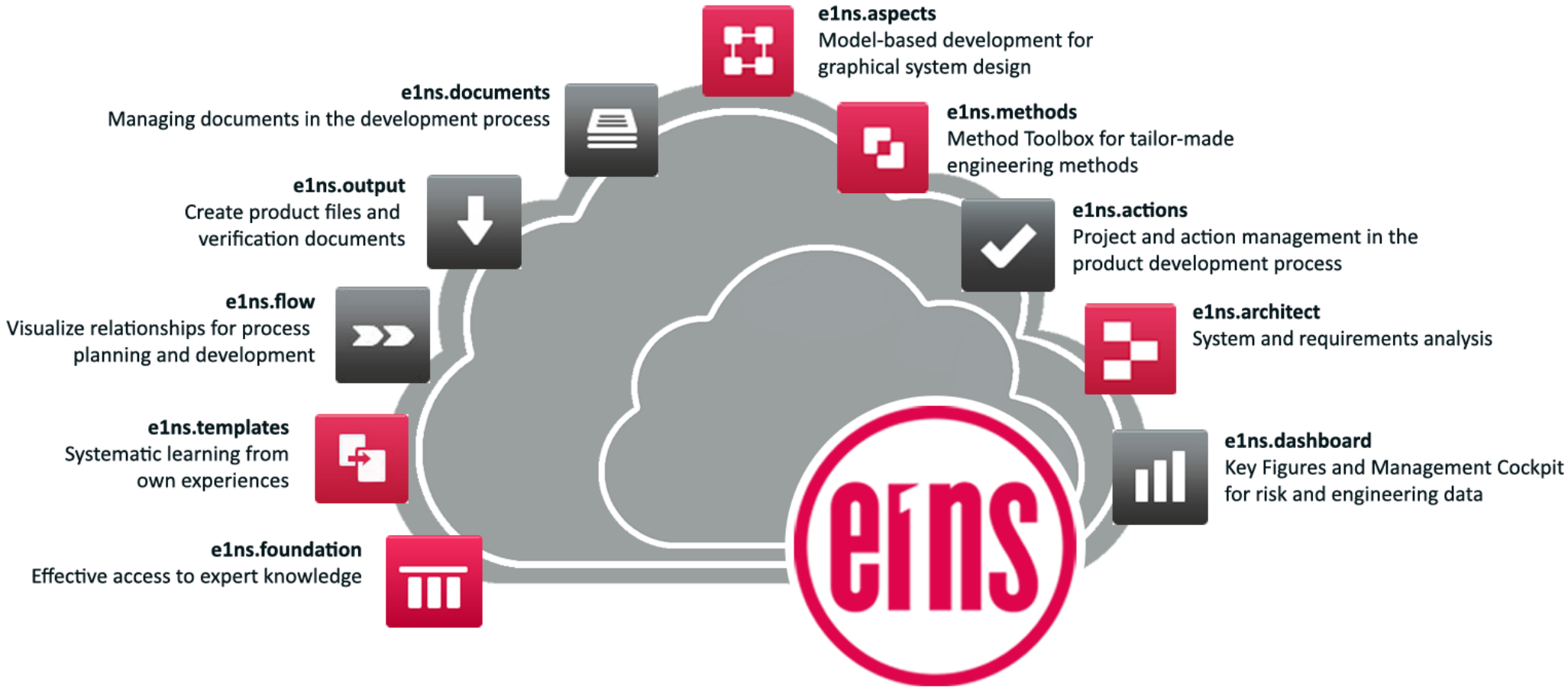
All modules in the cloud of your company



Questions?

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