



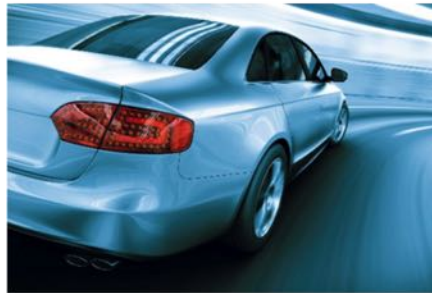
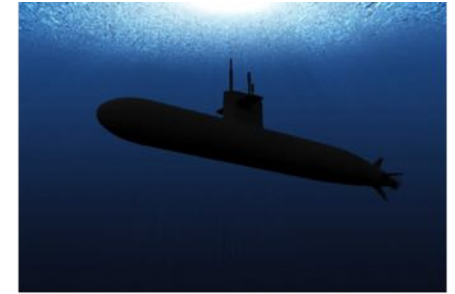
**28<sup>th</sup>** Annual **INCOSE**  
international symposium

Washington, DC, USA  
July 7 - 12, 2018

# Systems Engineering Quick Check

# Validation

- The Data are obtained from the UNITY industry knowledge.
- Contains data from SME up to DAX rated companies.



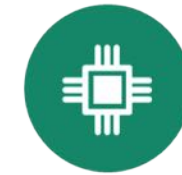


# Drivers for Systems Engineering

- The **complexity of products and system development projects is increasing enormously** in nearby all industry sectors.
- **Traditional development approaches** with discipline-specific processes are **reaching their performance limits**. Methods and processes of Systems Engineering.



Increasing complexity  
in development projects



Raising intertwining  
between hardware  
and software



International  
collaborative  
development



Networking of systems  
(Systems of Systems)



Variant diversity  
and individuality



Safety & Security

# Characteristics of successful Systems Engineering



**Responsibility for a technical solution**



**Comprehensive system perspective**



**Cross-discipline collaboration**



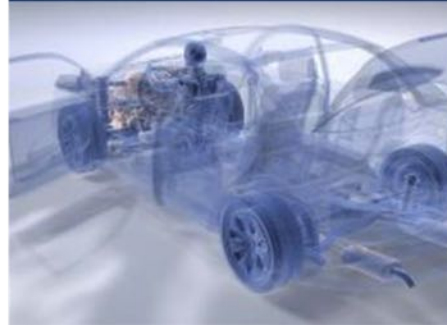
**Transparency and traceability**



**Consistency of processes and data**

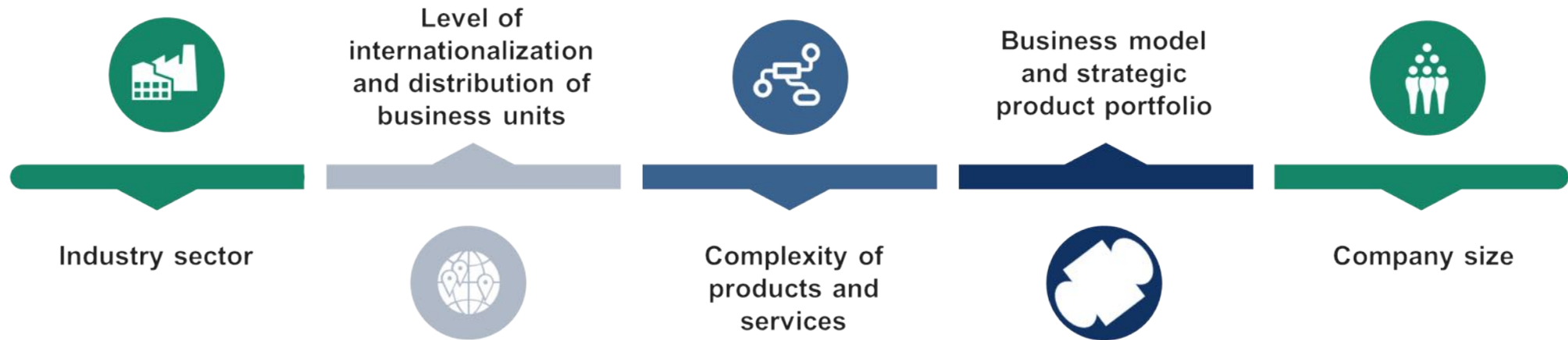


**Early virtual verification & validation**




- Systems Engineering enables developing complex solutions in large projects.
- A general framework for action is provided by ISO 15288.
- Systems Engineering is based on cross-industry best practices.

# Systems Engineering strategies require tailoring



Do I have to use the full blown space or military Systems Engineering approach

Which level and effort is good for our company to be successful in SE

A close-up photograph of two hands, one from the left and one from the right, holding two interlocking puzzle pieces. The hands are silhouetted against a bright, hazy sunset or sunrise sky. The sun is visible as a bright, glowing orb between the two puzzle pieces, creating a lens flare effect. The puzzle pieces are dark, and the hands are positioned as if they are about to snap the pieces together. The background shows a blurred view of a body of water and distant land under the warm light of the sun.

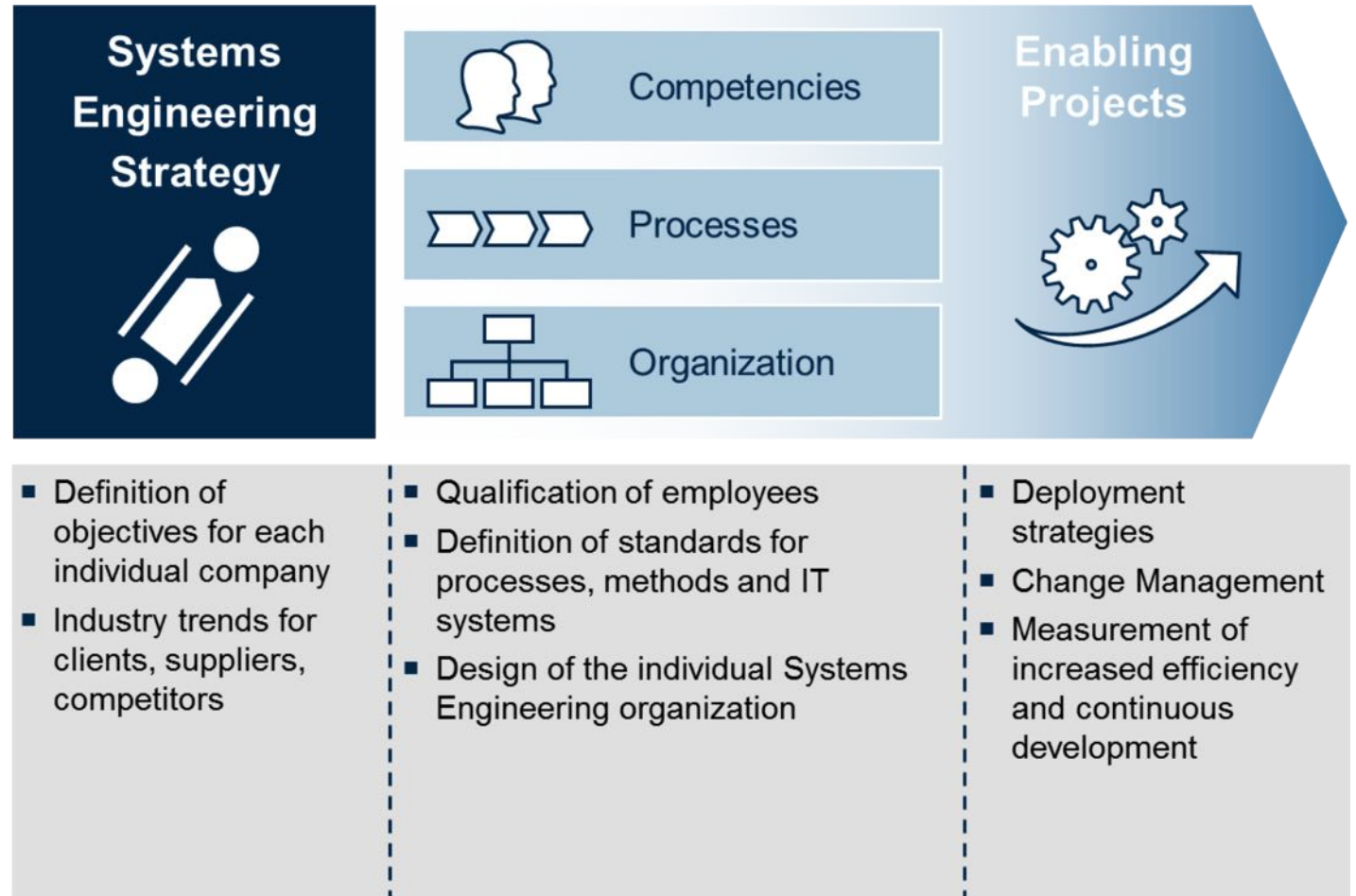
**It's not enough to do your best;  
you must know what to do  
and then do your best.**

W. Edwards Deming



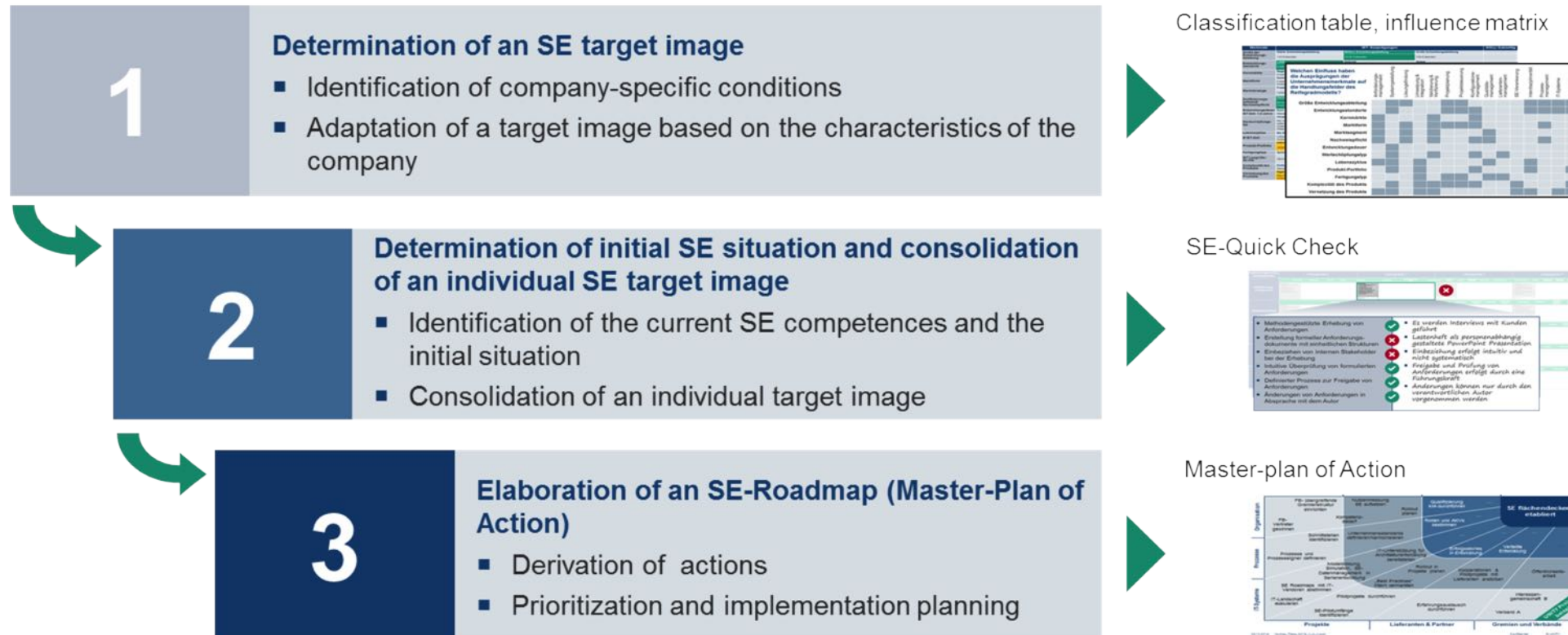
# Do you have all prerequisites in place?

- SE Quick check can help to start SE and improve it.
- A need for change is a prerequisites to start!





# Methodology and procedure in 3 steps



- SE Quick Check is a **maturity model** that supports its own procedure for **introducing, tailoring and optimizing** Systems Engineering.
- Companies can elaborate **interdisciplinary processes** and **methods** adapted to their constraints

- Business model,  
regulations, distribution  
of work, new disciplines,  
portfolio, ....

1

[illegible]

## Knowledge database





# Interview

## Development duration

- 1 Less than 1 year
- 2 1 – 3 years
- 3 More than 3 years

## Product complexity

- 1 Less than 50 elements
- 2 50-250 system elements
- 3 L>250 system elements

Ø As-Is-Time:

Life cycle

Lot size

Development sites

Size of the development department

Value type

Core markets

Certification effort/ burden of proof

Product connectivity

- 1 Single or contiguous countries

Market type

Market strategy

- 2 Individual continents / economic communities

Product portfolio

- 3 Several Continents / Worldwide

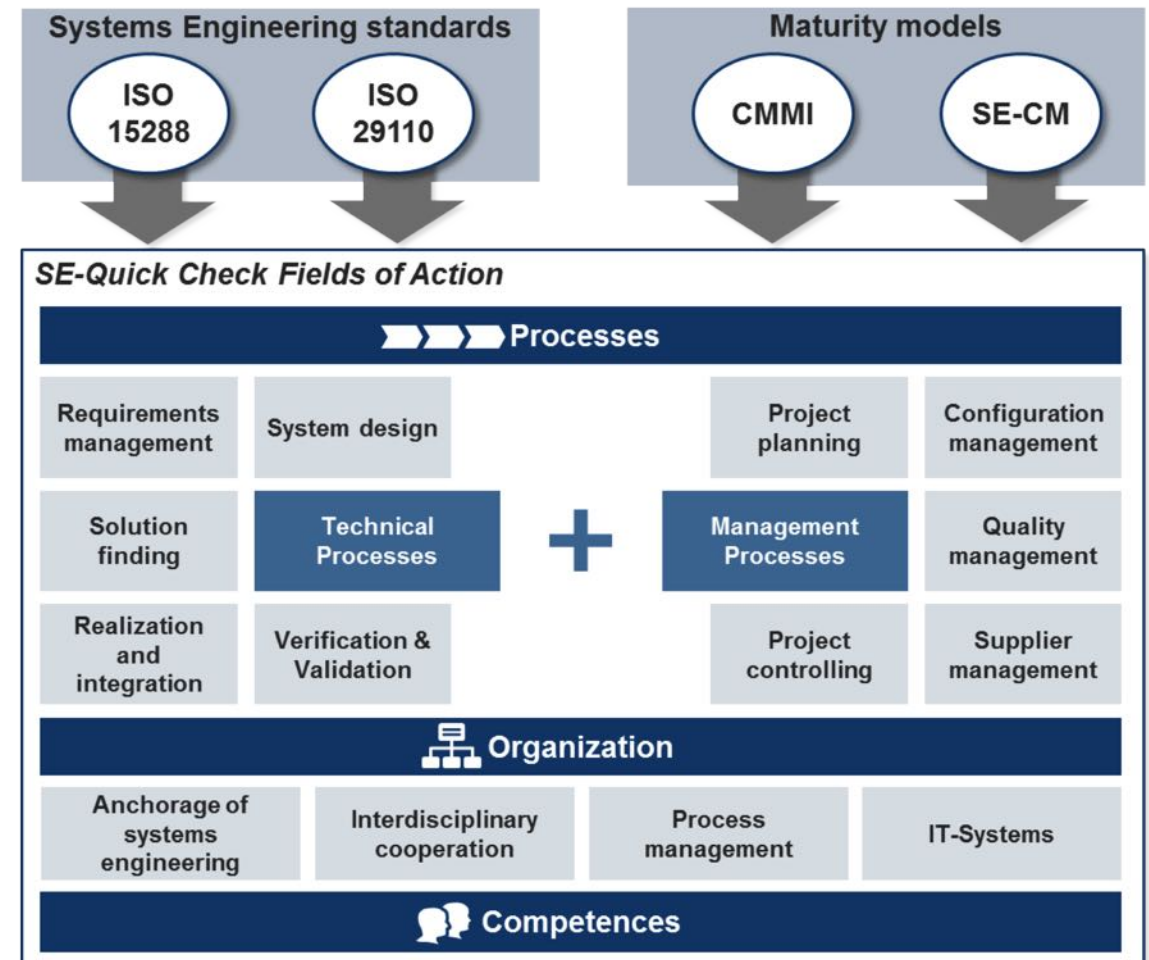
Manufacturing type



# Fields of action

- The SE **Quick-Check fields** of action are assigned to three categories and based on existing standards, such as ISO 15288 and ISO 29110.

At the **center of the model** are the **process** areas of development.





# Performance levels

## Practice-oriented description of characteristics in each field of action

- The performance level descriptions can be regarded as **requirements** that must be fulfilled in order to achieve a certain level of performance.
- They are based on best practices from **project experiences in a wide range** of industries and common standards.

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4
Requirements Management	Methods			
System	Requirements Management - Performance Level 2			
	<b>Characteristics:</b> <ul style="list-style-type: none"><li>▪ Method-supported collection of requirements</li><li>▪ Creation of formal requirements documents with uniform structures</li><li>▪ Involvement of internal stakeholders in the survey</li><li>▪ Intuitive review of formulated requirements</li><li>▪ Defined process for releasing requirements</li><li>▪ Changes to requirements in consultation with the author</li></ul> <b>Best Practice Examples</b>		Description of the company situation	

# Workshop based evaluation with a team of stakeholders



## Requirements

Performance level 1:	Performance level 2:	Performance level 3:	Performance level 4:
<ul style="list-style-type: none"> <li>Include the requirements specified by the (internal) client</li> <li>Unauthorized recording of requirements (e.g. from predecessors)</li> <li>Unstructured collection of various documents</li> <li>No release process</li> <li>Changes to requirements are made by calling</li> </ul>	<ul style="list-style-type: none"> <li>Method-based collection of requirements</li> <li>Creation of formal requirements documents with uniform structures</li> <li>Include internal stakeholders in the survey</li> <li>Intuitive review of formulated requirements</li> </ul>	<ul style="list-style-type: none"> <li>Defined process from collection to release of requirements</li> <li>Identification based on application scenarios</li> <li>Derive requirements in interdisciplinary teams</li> <li>Verification of requirements on the basis of uniform criteria</li> </ul>	<ul style="list-style-type: none"> <li>Identification and development of requirements based on life cycle concepts</li> <li>Ensure a consistent understanding of the requirements</li> <li>Systematic identification and integration of all stakeholders</li> </ul>



?

**1 How do you evaluate the current performance (As Is - Situation)?**  
→ Please raise the corresponding performance level card!

**2 Do you agree with the "target reference"?**  
→ Let's discuss!

## Competencies

Performance level 1:	Performance level 2:	Performance level 3:	Performance level 4:
<ul style="list-style-type: none"> <li>Competencies are only expanded when tasks with existing competencies can not be solved</li> <li>Employees develop their skills independently</li> <li>Training does not take place</li> </ul>	<ul style="list-style-type: none"> <li>Expansion of competences is regularly discussed</li> <li>Competencies are built on the basis of short-term requirements</li> <li>Experienced employees look after new employees</li> <li>Training provides important positions for selected employees</li> </ul>	<ul style="list-style-type: none"> <li>Identification and planning of future skills</li> <li>Clear description of competence profiles for roles in the project</li> <li>Training of relevant employees in systems engineering</li> <li>There are uniform SE process trainings for all relevant employees of the development</li> </ul>	<ul style="list-style-type: none"> <li>Analysis of existing and future skills</li> <li>Building a Competence Strategy</li> <li>Responsibility for the implementation and development of competences is defined</li> </ul>



?

**1 How do you evaluate the current performance (As Is - Situation)?**  
→ Please raise the corresponding performance level card!

**2 Do you agree with the "Target"?**  
→ Let's discuss!

	Performance Level 1		Performance Level 2		Performance Level 3		Performance Level 4	
Requirements management	Methoden							
				As Is			To Be	target
System design	Methoden							
						To Be	As Is	target
...	Methoden							

2



# Example: V&V in a Workshop

Performance level 1:	Performance level 2:	Performance level 3:	Performance level 4:
<ul style="list-style-type: none"><li>• No uniformly defined approach for V &amp; V</li><li>• V &amp; V measures start following the development</li><li>• Tests are carried out as required</li><li>• There are only real tests, no simulation</li><li>• An acceptance test does not take place</li></ul>	<ul style="list-style-type: none"><li>• Early development of a uniform test plan on system level</li><li>• Intuitive selection of test cases</li><li>• Simulations are disciplined</li><li>• Not all requirements are verified</li><li>• Approval-relevant tests are carried out</li></ul>	<ul style="list-style-type: none"><li>• Development of test plans at all levels of the system</li><li>• Defined process and uniform methods for V &amp; V</li><li>• All requirements are verified</li><li>• Early validation of requirements</li><li>• V &amp; V activities take into account the future deployment environment</li><li>• Review of the V &amp; V results with relevant stakeholders</li></ul>	<ul style="list-style-type: none"><li>• Uniform standards for the selection of V &amp; V activities</li><li>• Coordinate a V &amp; V strategy with all relevant stakeholders at the beginning</li><li>• Formal reviews for the analysis of results with clearly distributed roles</li><li>• Regular audits and development of V&amp;V</li></ul>



- 1 How do you evaluate the current performance (As Is - Situation)?**  
→ Please raise the corresponding performance level card!
- 2 Do you agree with the “proposed To-Be”?**  
→ Let’s discuss!

# Example: V&V questions to evaluate “As-Is” interview / mailing



## UNITY SE Quick Check Validation and verification

Status: September 2017

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	Comments
<b>A1 – Timing V&amp;V: How are the V&amp;V activities planned?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A2 – Verification: Which requirements are verified?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A3 – Tests: How are test cases defined?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A4 – Test procedures: What happens to the V&amp;V results?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A5 – V&amp;V Systems: How is the function of the system validated?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A6 – Test procedures/simulations: Which test methods are used? How and where are simulations used?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>A7 – Further development of V&amp;V: Are the V&amp;V methods developed further on a regular basis?</b>  Current position: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<b>Methods/resources:</b> tests    inspection    analysis    X-in-the-loop visual inspection    FEM    virtual prototyping    V&V Strategy demonstration    prototyping    modelling    test database	

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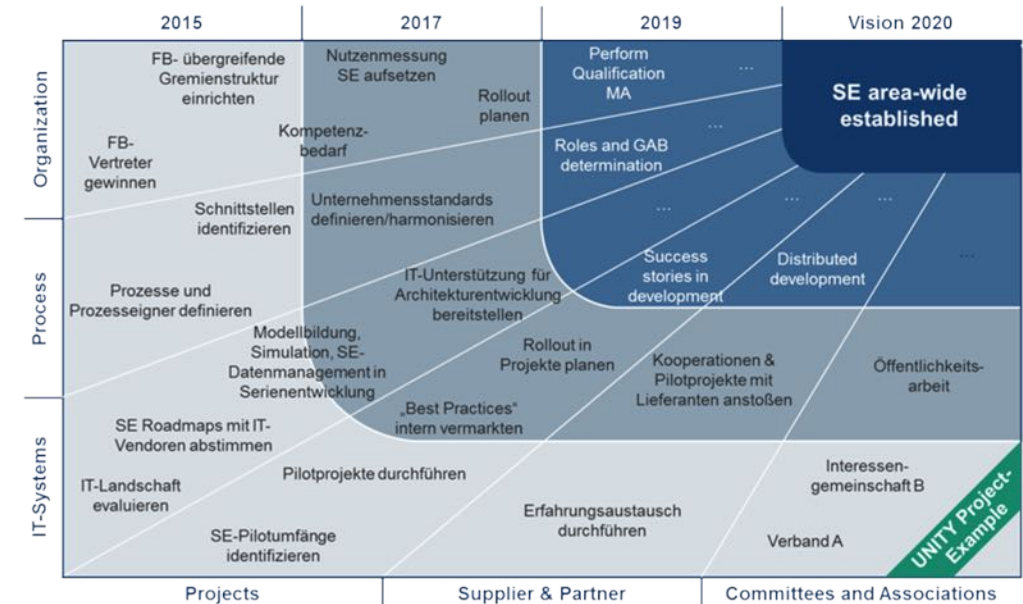
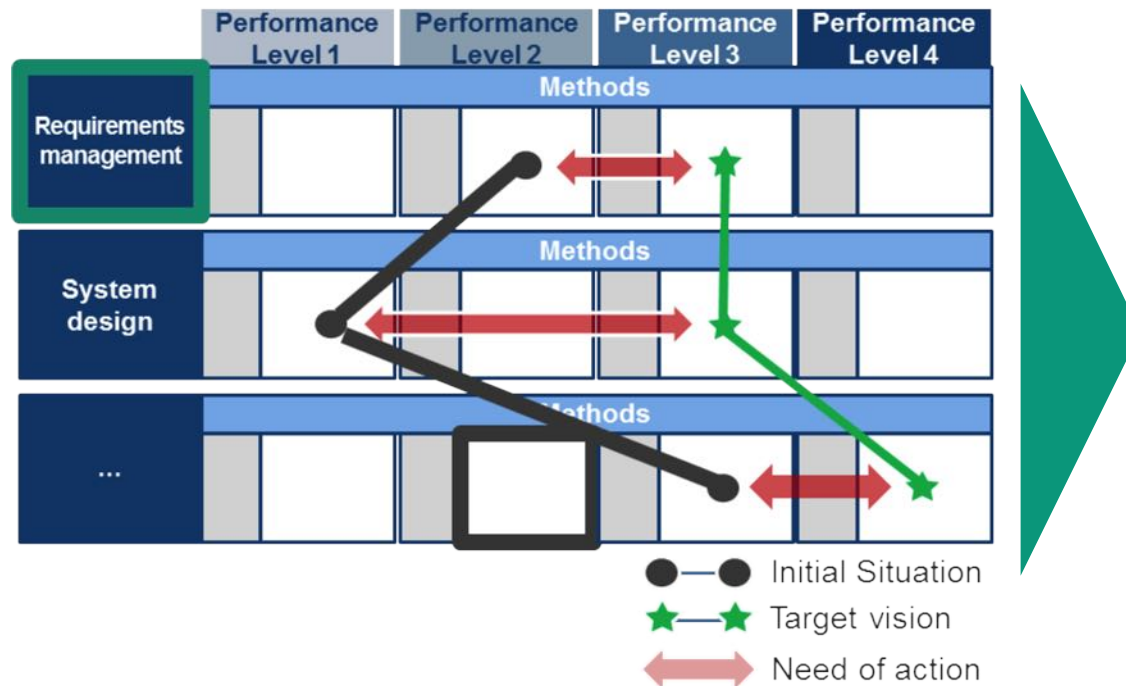
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<b>A4 – Test procedures: What happens to the V&amp;V results?</b>	

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# Initial situation and individual target

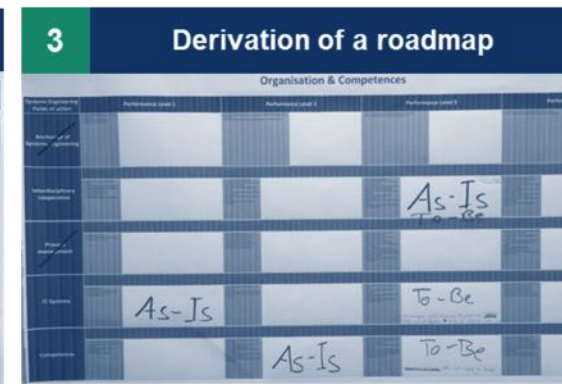
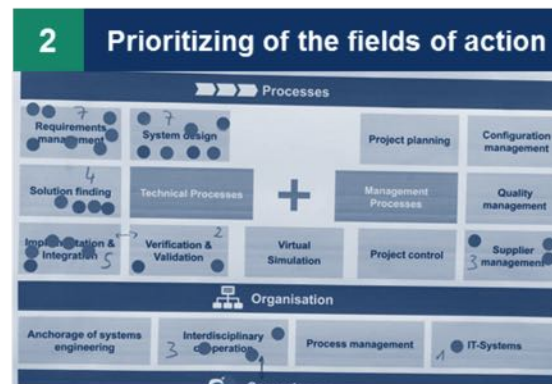
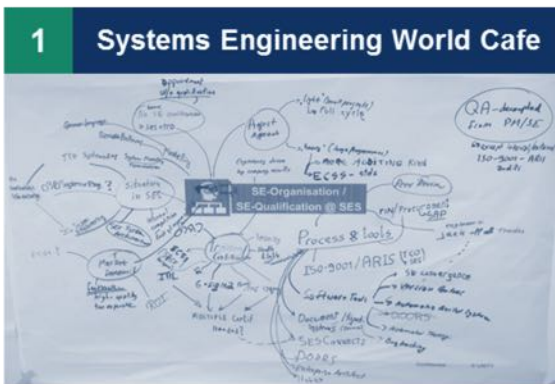
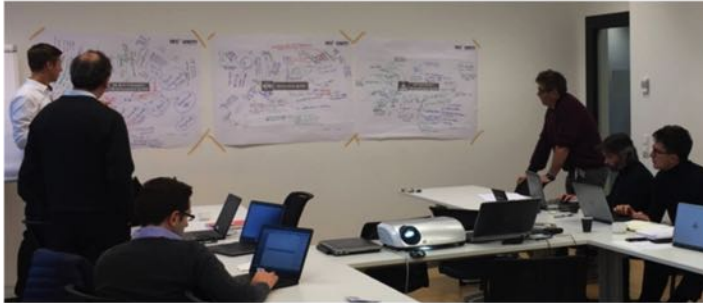


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The characteristics are used both to assess the initial situation and to determine an individual target performance level. The sequence and timing of implementation can be transferred to a strategic roadmap.



# Workshop impressions from a project



# Conclusion



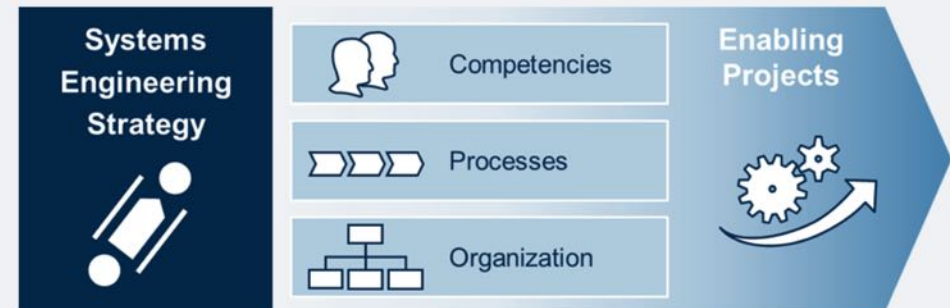
## Drivers for Systems Engineering



## Company-individual constraints



## SE Quick-Check



- Tailored strategy to individual constraints
- Holistic approach
- Assessment, strategy development and transformation aspects included
- ...
- ...



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[www.incose.org/symp2018](http://www.incose.org/symp2018)

Presented by Sven-Olaf Schulze & Dr. Daniel Steffen

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