



28th Annual **INCOSE**
international symposium

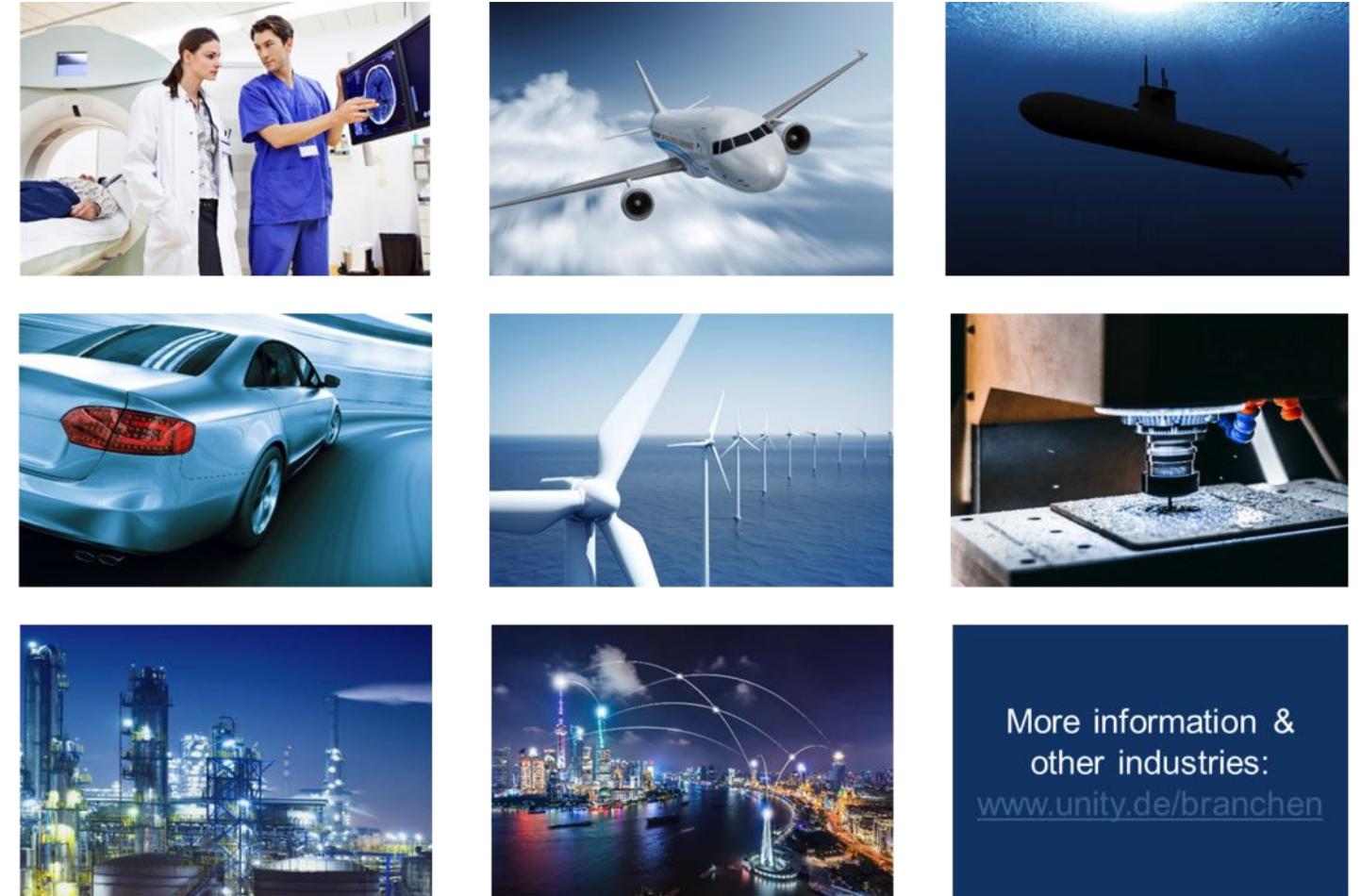
Washington, DC, USA
July 7 - 12, 2018

Systems Engineering Quick Check



Validation

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



More information &
other industries:
www.unity.de/branchen

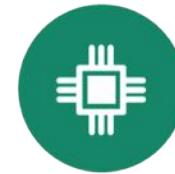
Drivers for Systems Engineering



- The complexity of products and system development projects is increasing enormously in nearly 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)

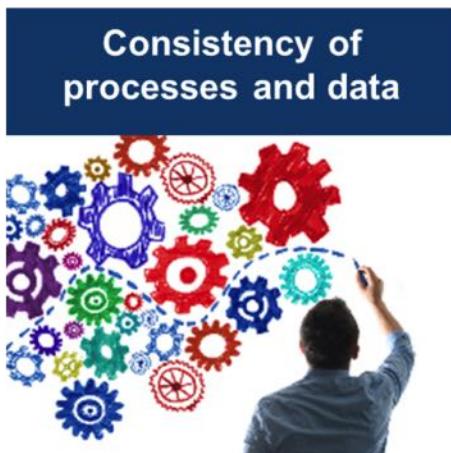
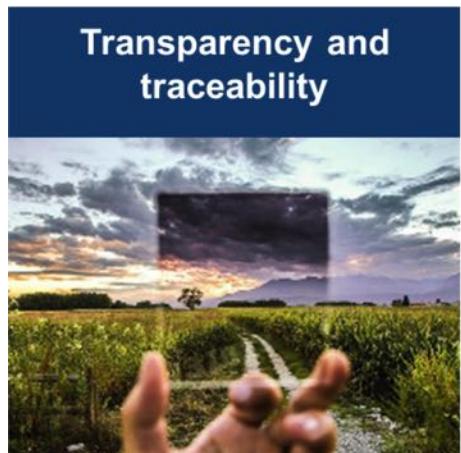
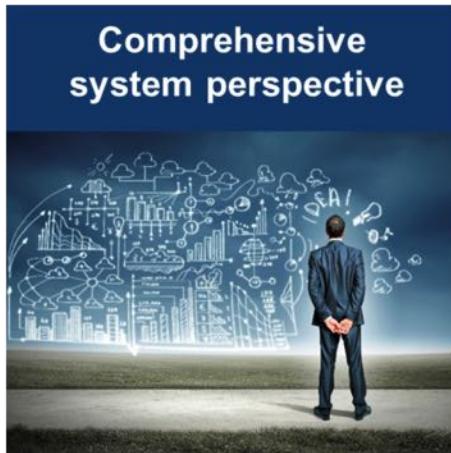


Variant diversity and individuality



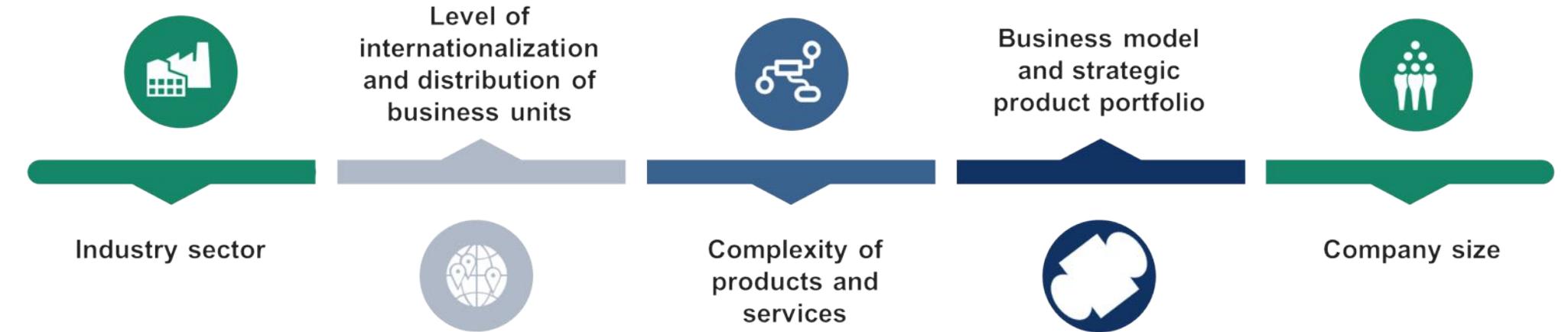
Safety & Security

Characteristics of successful Systems Engineering



- 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

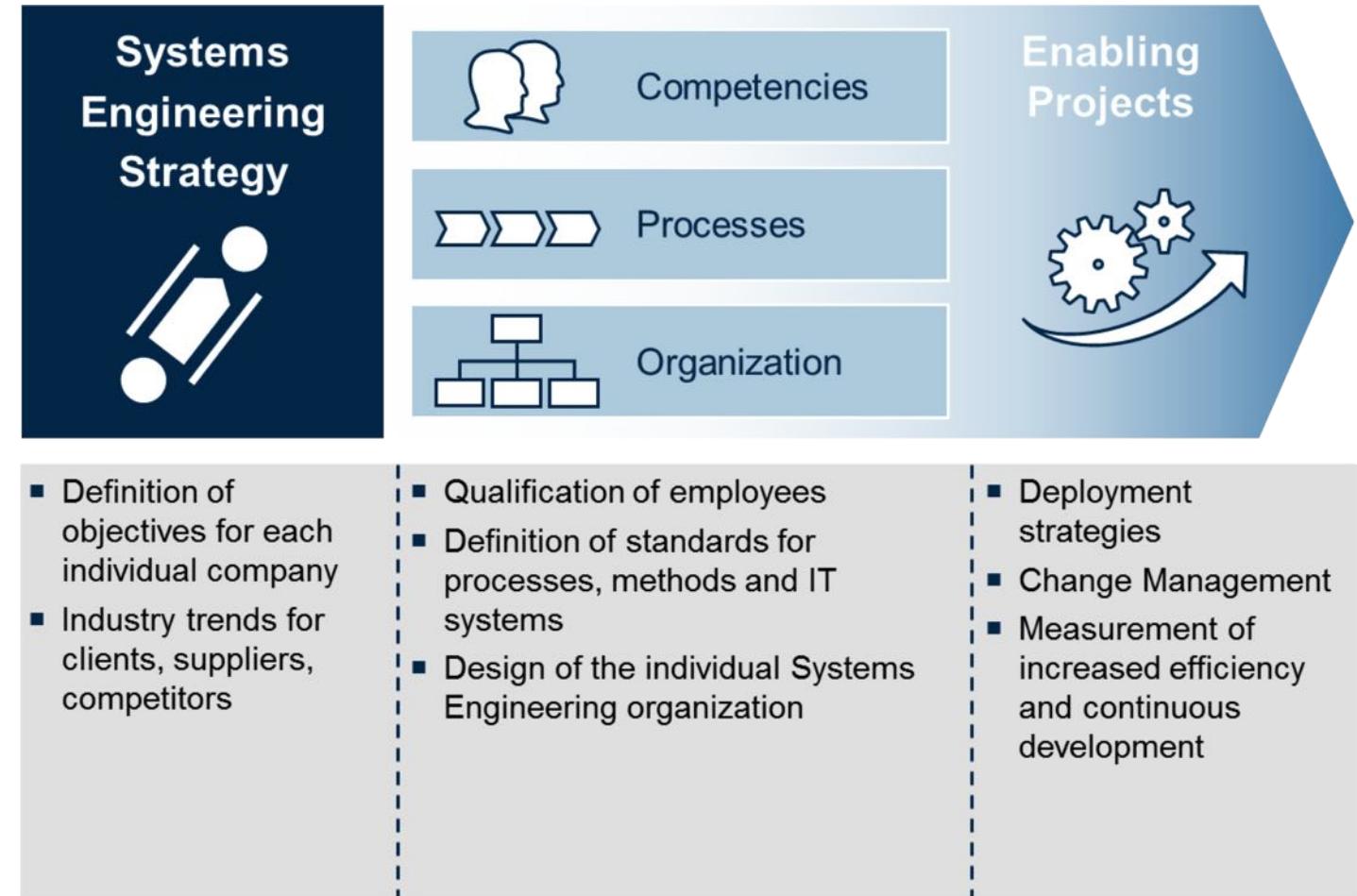
**It's not enough to do your best;
you must know what to do
and then do your best.**

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

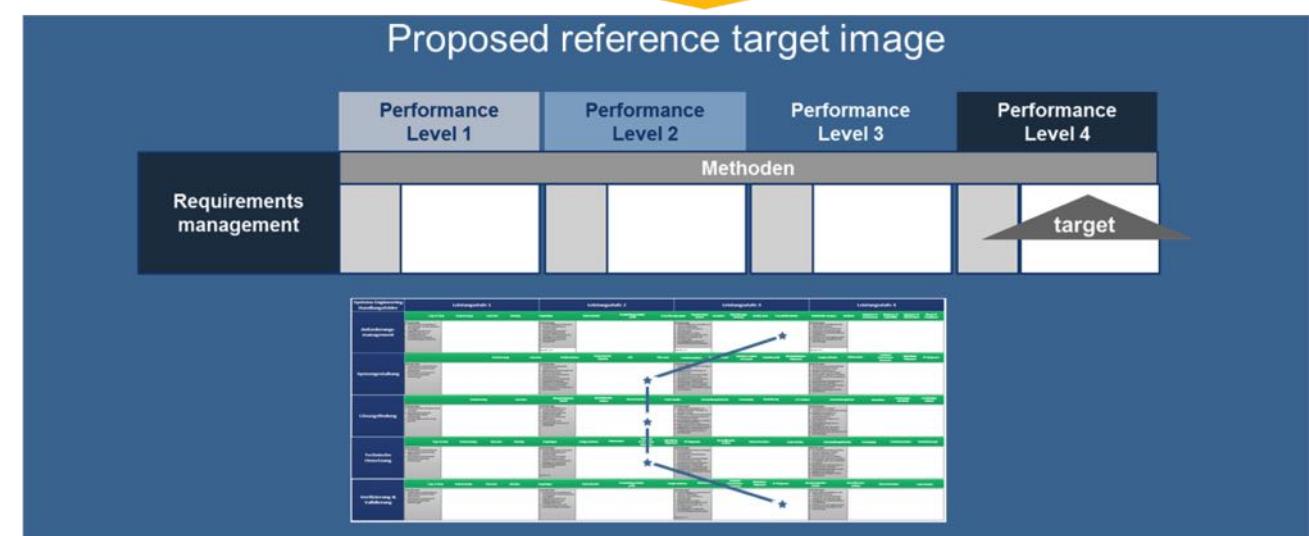


Perform an interview with key stakeholder

- **What** are the **changes** the company faces?

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

To determine the
„Reference Target
Image“ based on the
UNITY 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

Development sites

Size of the development department

Ø As-Is-Time:

Core markets

Certification effort/ burden of proof

Value type

- 1 Single or contiguous countries

Market type

Market strategy

- 2 Individual continents / economic communities

Product portfolio

- 3 Several Continents / Worldwide

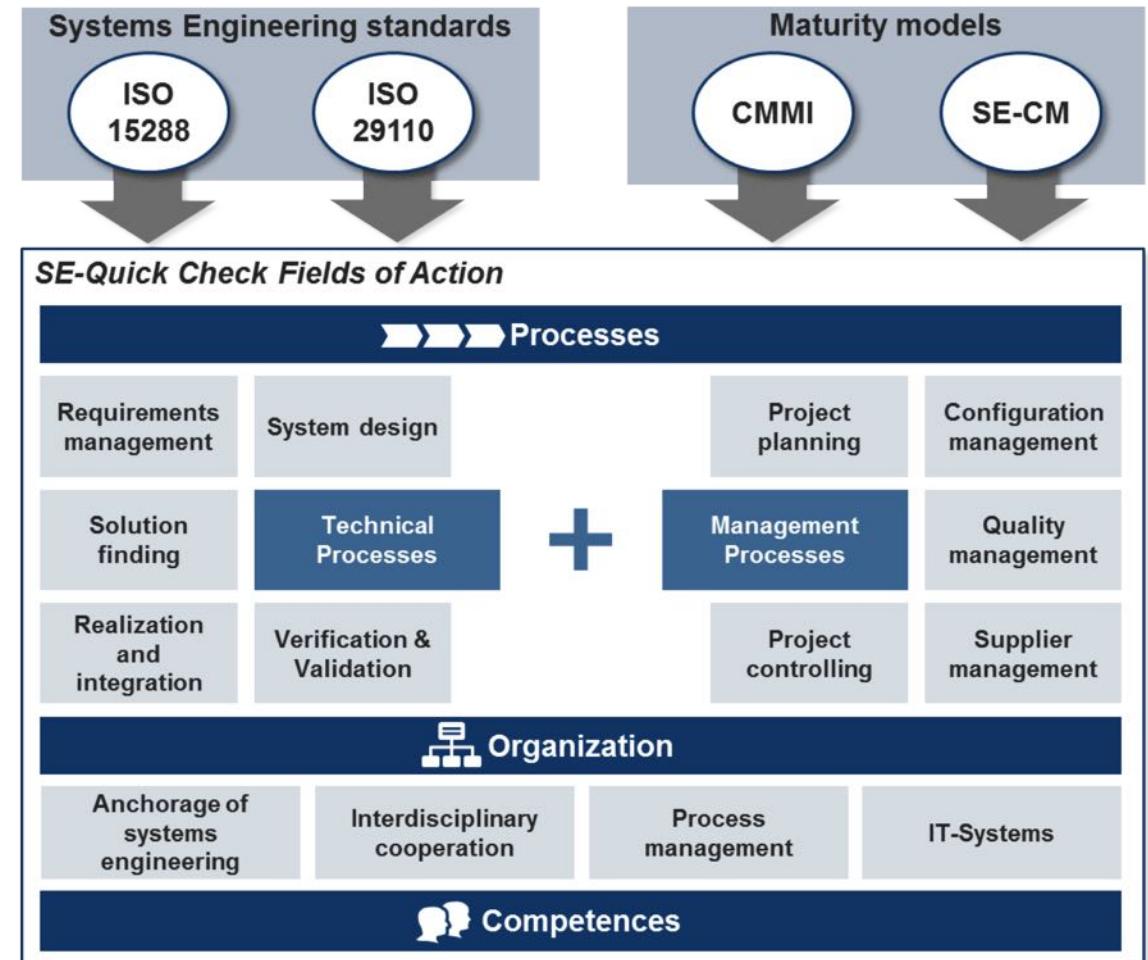
Manufacturing type



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.

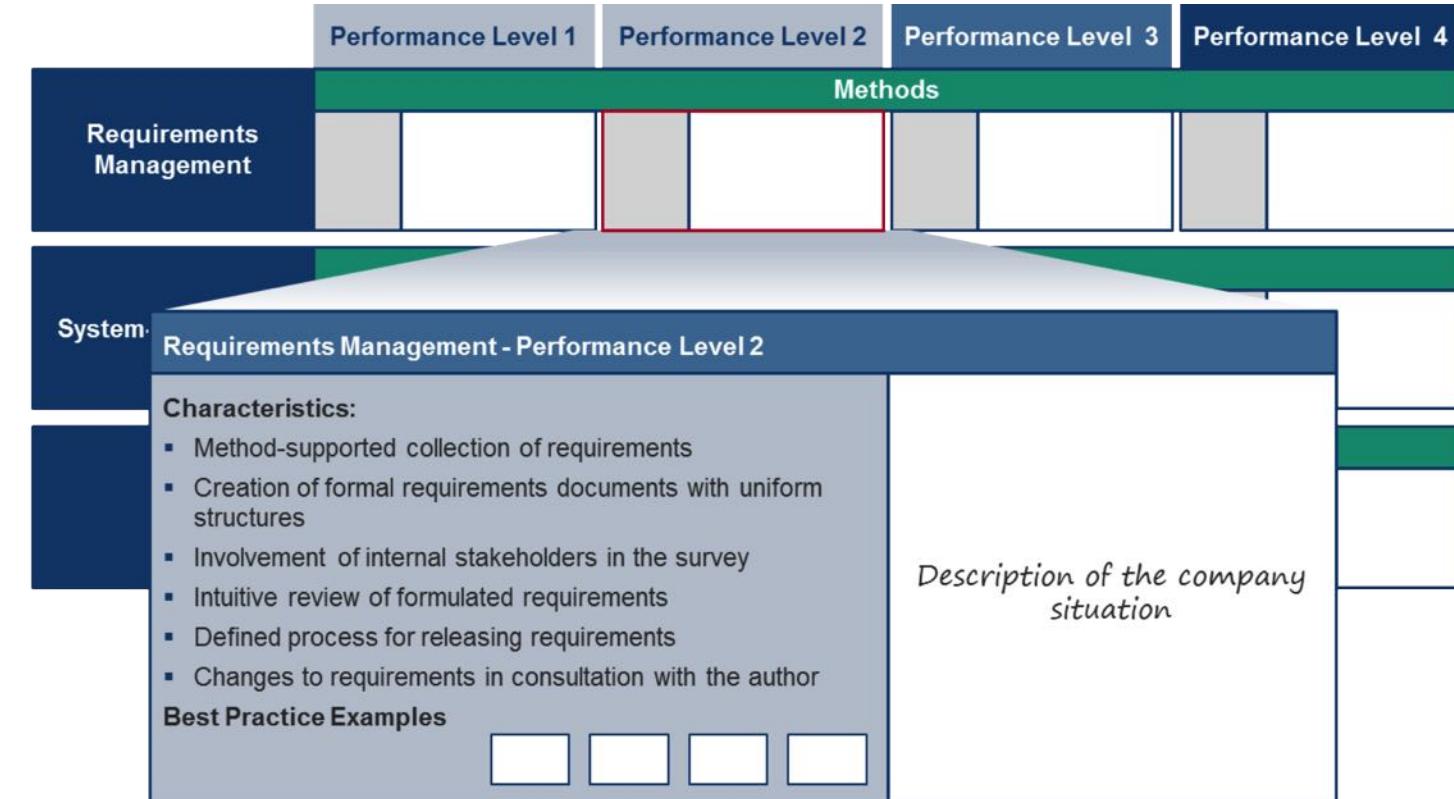




Performance levels

Practice-oriented description of characteristics in each field of action

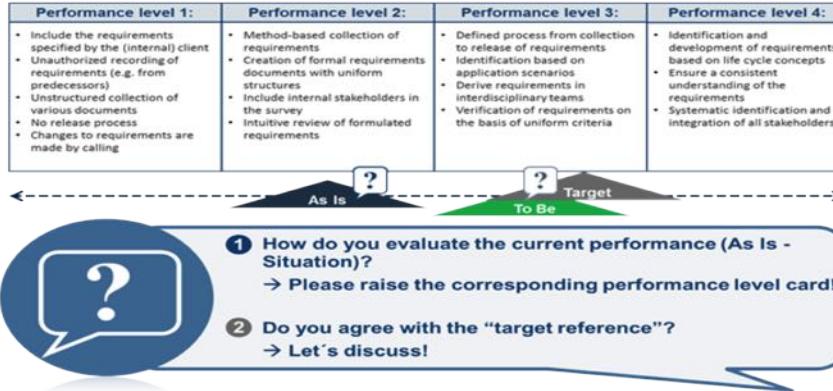
- The performance level descriptions can be regarded as **requirements** that must be fulfilled in order to achieve a certain level of performance.
- They are based on best practices from **project experiences in a wide range** of industries and common standards.



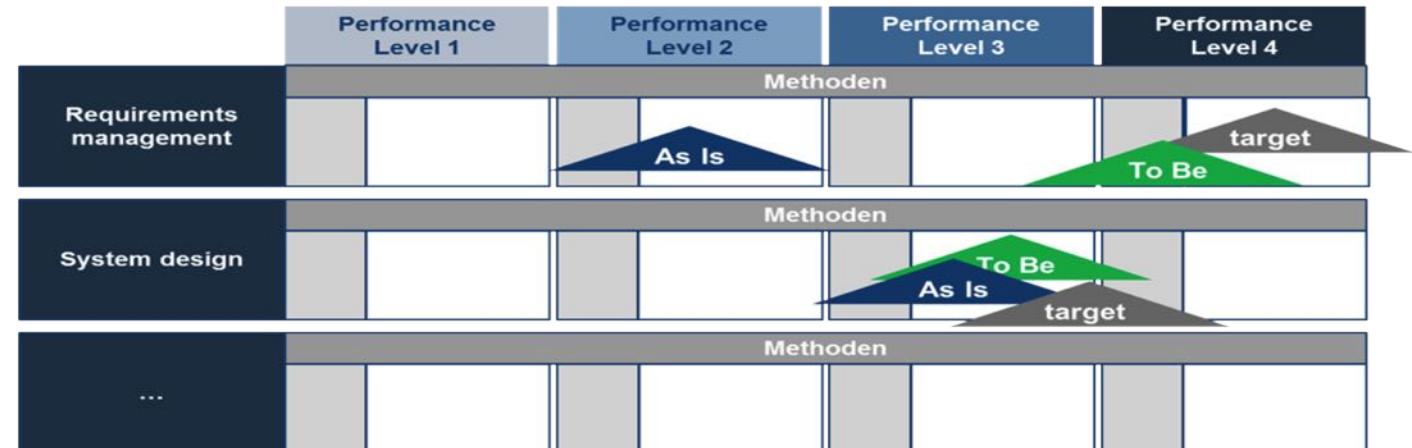
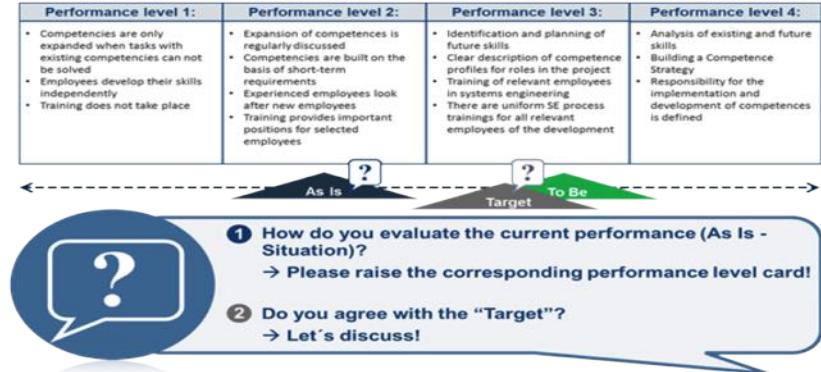
Workshop based evaluation with a team of stakeholders



Requirements



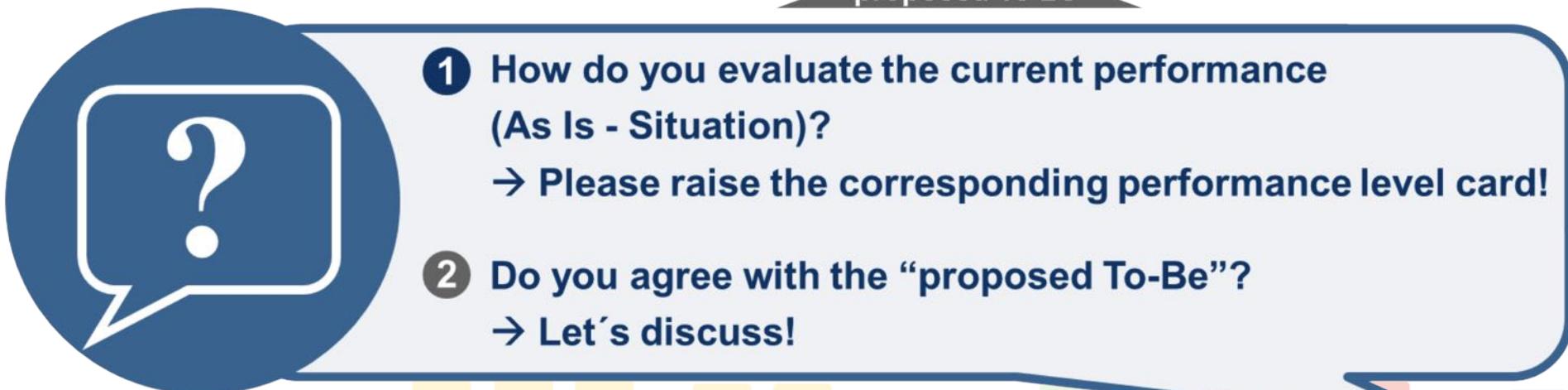
Competencies





Example: V&V in a Workshop

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



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



UNITY SE Quick Check Validation and verification

Status: September 2017

| Comments | | | |
|---------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------|---------------|
| A1 – Timing V&V: How are the V&V activities planned? | | | |
| Current position: | | | |
| 1 V&V measures start at the end of development and are not planned in advance. | | | |
| 2 Early development of a uniform test plan at system level. | | | |
| 3 Development of test plans at all levels of the system. | | | |
| 4 Coordination of a V&V strategy with all relevant stakeholders at the beginning. | | | |
| A2 – Verification: Which requirements are verified? | | | |
| Current position: | | | |
| 1 Requirements are not verified. | | | |
| 2 Isolated requirements are verified. | | | |
| 3 All requirements are verified. | | | |
| 4 All requirements are verified at an early stage. | | | |
| A3 – Tests: How are test cases defined? | | | |
| Current position: | | | |
| 1 Tests are carried out if required, test cases are not defined in advance. | | | |
| 2 Test cases are selected intuitively. | | | |
| 3 A defined process and uniform methods are used to select the test cases. | | | |
| 4 Uniform standards exist for the selection of all V&V activities. | | | |
| A4 – Test procedures: What happens to the V&V results? | | | |
| Current position: | | | |
| 1 V&V activities and results are very incompletely documented, no reviews of the results do not take place. | | | |
| 2 V&V activities and results are fully documented, reviews of the results do not take place. | | | |
| 3 After documentation, the results are consistently checked with the relevant requirements. | | | |
| 4 There are formal reviews to assess the results with clearly defined roles. | | | |
| A5 – V&V System: How is the function of the system validated? | | | |
| Current position: | | | |
| 1 Validation of the main functions. | | | |
| 2 Validation of functions by means of production-ready prototypes. | | | |
| 3 Validation of the functions by means of prototypes ready for series production, including essential maintenance and disposal. | | | |
| 4 Validation of all functions. | | | |
| A6 – Test procedures/simulations: Which test methods are used? How and where are simulations used? | | | |
| Current position: | | | |
| 1 There are only test tests, no simulations. | | | |
| 2 Simulations are discipline specific. | | | |
| 3 Simulations are multidisciplinary. | | | |
| 4 Entire system can be tested virtually using validated methods. | | | |
| A7 – Further development of V&V: Are the V&V methods developed further on a regular basis? | | | |
| Current position: | | | |
| 1 V&V activities are carried out intuitively, no planned further development possible. | | | |
| 2 V&V activities are only adapted and further developed in exceptional cases. | | | |
| 3 Regular further development of V&V activities according to demand. | | | |
| 4 Regular audits and continuous development of V&V activities. | | | |
| Methods/resources: | | | |
| tests | inspection | analysis | X-in-the-loop |
| visual inspection | FEM | virtual prototyping | V&V Strategy |
| demonstration | prototyping | modelling | test database |

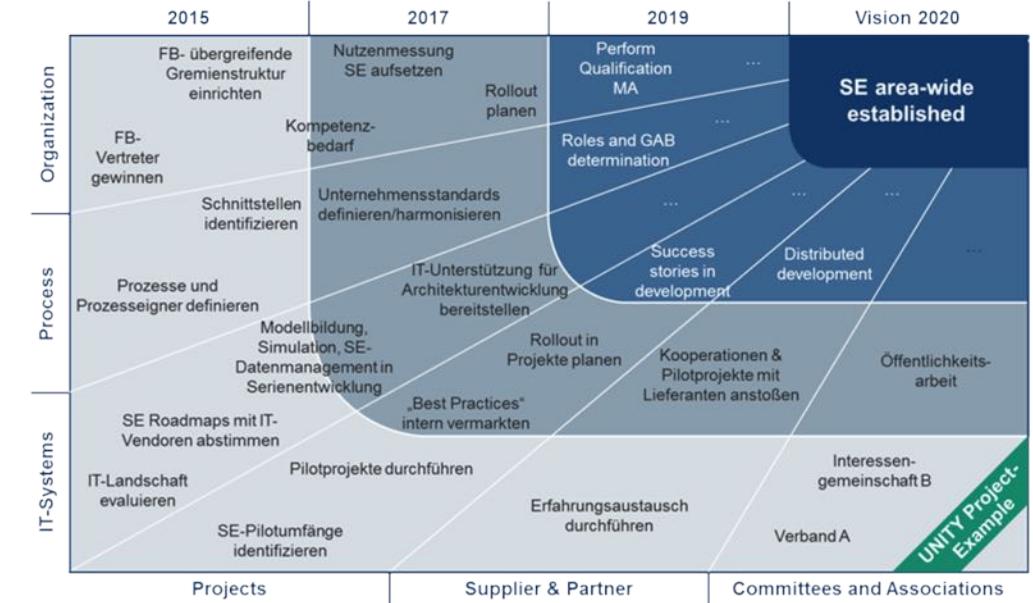
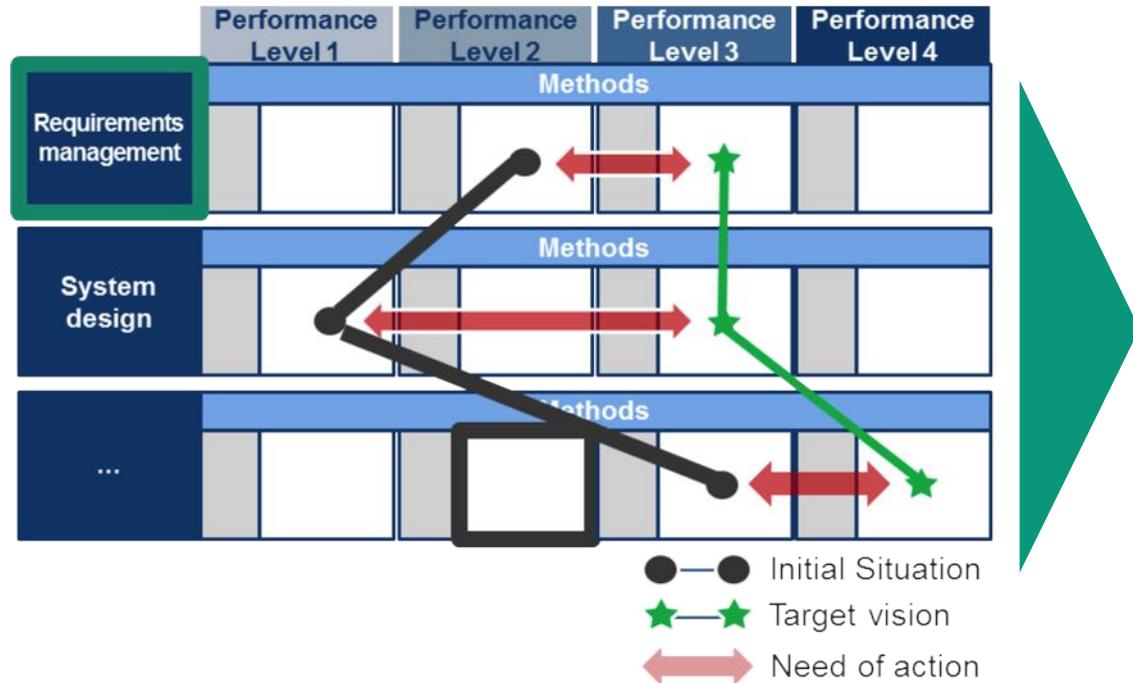
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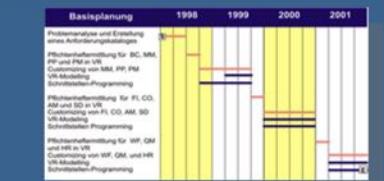
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Initial situation and individual target



Project plan for the first year



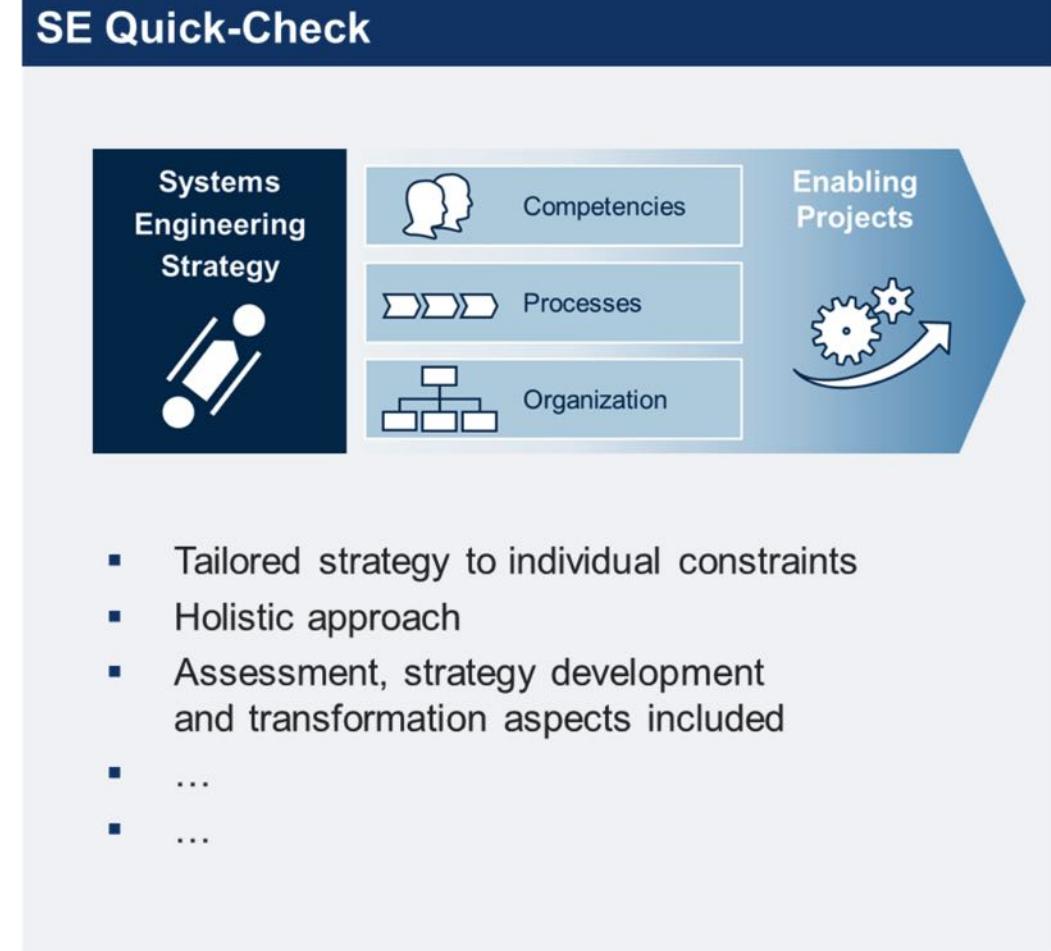
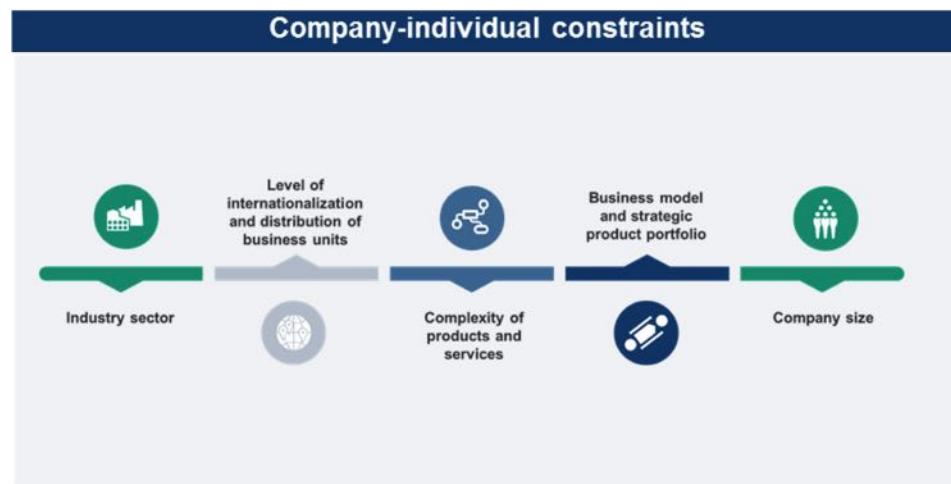
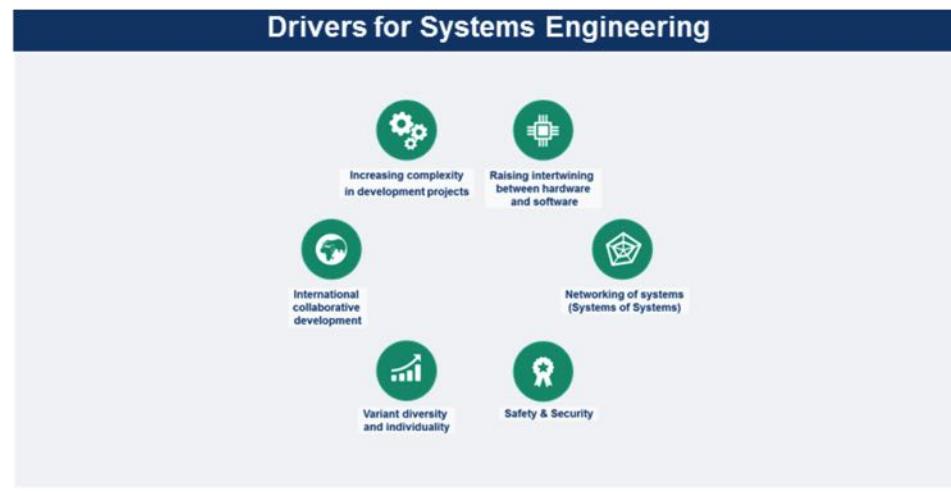
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The characteristics are used both to **assess the initial situation** and to determine **an individual target performance level**. The sequence and timing of implementation can be transferred to a strategic roadmap.



Workshop impressions from a project

Conclusion





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www.incos.org/symp2018

Presented by Sven-Olaf Schulze & Dr. Daniel Steffen

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