DIGITAL TWIN READINESS ASSESSMENT

The Application of Digital Twins: What is the Current State of Industry?

Presentation of the main results - prostep ivip Symposium October 2020

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Markus Samarajiwa and David Salamon (msg)

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In Kooperation mit

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2020

Herausgeber: Markus Samarajiwa, Kai Lindow, David Salamon, Rainer Stark

DIGITAL TWIN READINESS ASSESSMENT

EINE STUDIE ZUM DIGITALEN ZWILLING IN DER FERTIGENDEN INDUSTRIE

Autoren: Theresa Riedelsheimer, Pascal Lünnemann, Sebastian Wehking, Lisa Dorfhuber

Eine kooperative Studie von:

Introduction - get to know us!

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Theresa Riedelsheimer is the deputy head of the department information and process control in the division of Virtual Product Creation. She is doing applied research on challenges in Product Lifecycle Management, Digital Twins and on the specific topic of sustainability in this context. Within the study on Digital Twins, she is responsible for the scientific planning and execution of the Digital Twin Readiness Assessment as well as the authoring of the study.
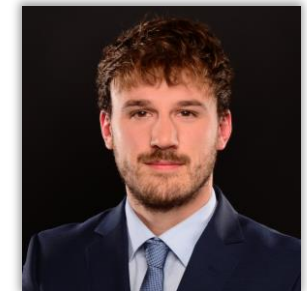
Pascal Lünnemann is a scientific researcher in the department information and process control in the division of Virtual Product Creation. His research projects focus on Product Lifecycle Management, Digital Twins and process control within the Engineering Environment with the support of Artificial Intelligence. Within the study on Digital Twins, he is responsible for the scientific planning and execution of the Digital Twin Readiness Assessment as well as the authoring of the study.

Markus Samarajiwa is a Lead Business Consulting at the IT and Service provider msg (Munich). In cooperation with David he is responsible for the Digital Twin in the Automotive division. He developed the idea for the study and provided important impulses for the concept and design.

David Salamon is a Senior Business Consulting at the IT and Service provider msg (Munich). He is a thought leader for Digital Twins within the automotive division. He triggered the idea of the maturity assessment and contributed to design and conception of the study as well as client interview conduction.

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The motivation for the study was triggered by the demand to assess the overall Digital Twin readiness of companies.

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5 core questions form the basis of the "Digital Twin Readiness Assessment":

"How does the Digital Twin influence business models?"

"What value should be gained by the Digital Twin?"

"What do current concepts for the Digital Twin look like?"

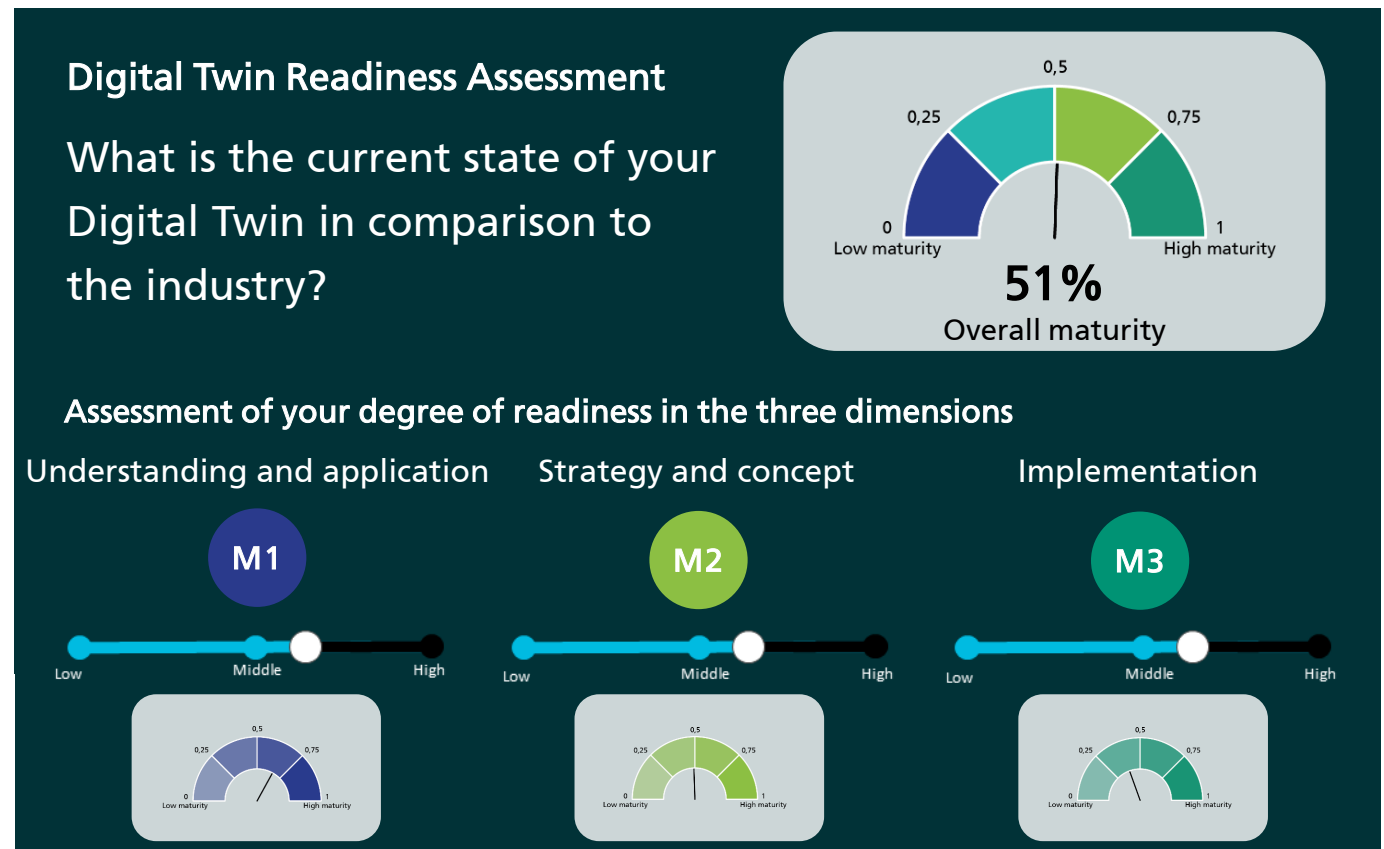"What kind of actions are necessary for the Digital Twin?"

"Which skills are required for the Digital Twin?"

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Digital Twin Readiness Assessment:

Assessment of the Digital Twin maturity in manufacturing industry

0,5
0,25   0,75
0   1
Low maturity   High maturity

51%
Overall maturity
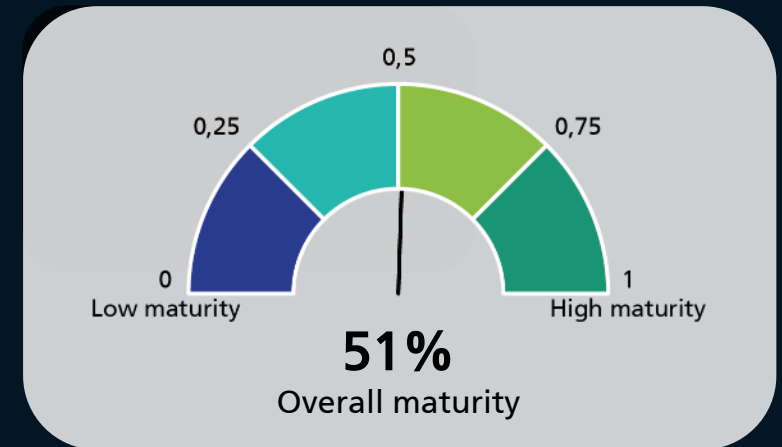
The Digital Twin Readiness Assessment is executed in three main steps and provides insights on your current state on the journey towards Digital Twins.

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1 **Expert Interview:**
Tracking current status
- Duration: approx. 2 h -

2 **Evaluation:**
Determine degree of Readiness and comparison to the industry

3 **Feedback Session:**
Presentation of results, recommendations for action
- Duration: approx. 2 h -

Digital Twin Readiness Assessment

What is the current state of your Digital Twin in comparison to the industry?

0,25   0,5   0,75
0   1
Low maturity   High maturity

51%
Overall maturity

Assessment of your degree of readiness in the three dimensions

Understanding and application   Strategy and concept   Implementation

M1   **M2**   **M3**

Low   Middle   High   Low   Middle   High   Low   Middle   High

The anonymized and consolidated knowledge derived from the individual Digital Twin Readiness Assessments is captured and published in the study.
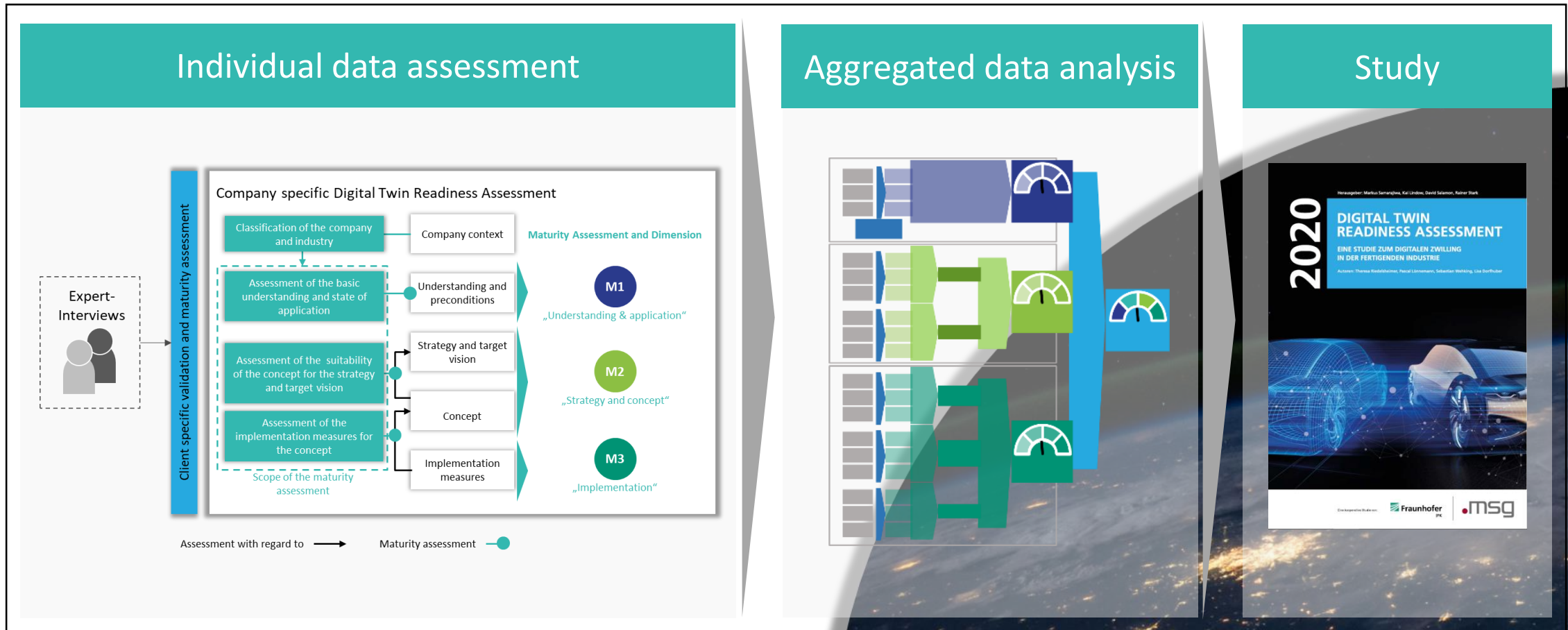
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DIGITAL TWIN READINESS ASSESSMENT

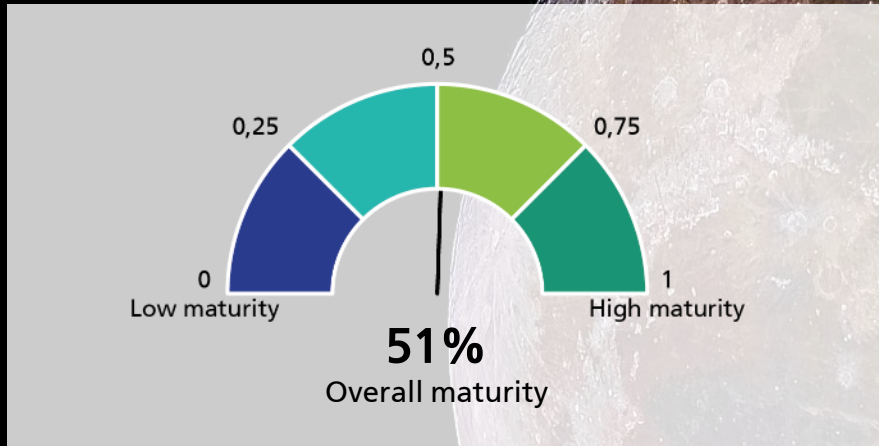Introduction

Motivation and approach

Main results and findings
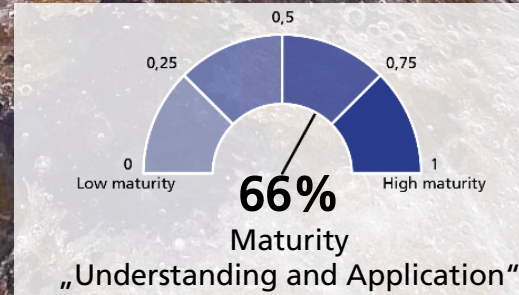
Outlook and conclusions

Questions and discussion

The study shows as an overall result: Digital Twins are on average still under development, but most companies are on the way towards implementation.

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51%
Overall maturity

66%
Maturity „Understanding and Application"

There is a good understanding of Digital Twins in general as well as first experiences from the application of Digital Twins.

49%
Maturity „Strategy and Concept"

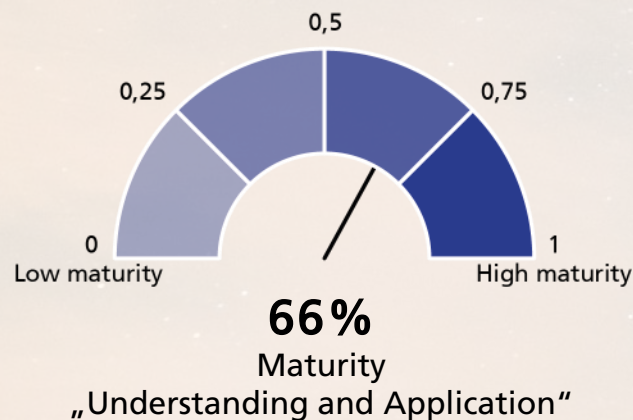The developed concepts have a medium maturity, whereby the strategies and target visions are more elaborated than the specific concepts.

39%
Maturity „Implementation"

The implementation of Digital Twins has the lowest level of maturity – especially with regard to data and information models as well as IT-systems.

Overall, Digital Twins are still in the conception phase, but there are many different approaches that reflect the diversity of the concept as a whole.

There is a good understanding of Digital Twins in general and first experiences from the application of Digital Twins exist.

- *What is the understanding of Digital Twins in industry?*

- *How far is the application of Digital Twins within the companies in general?*

0,5

0,25   0,75

0   1
Low maturity   High maturity

66%
Maturity
„Understanding and Application"

20% of the companies do **not have** a **uniform definition** of Digital Twins.
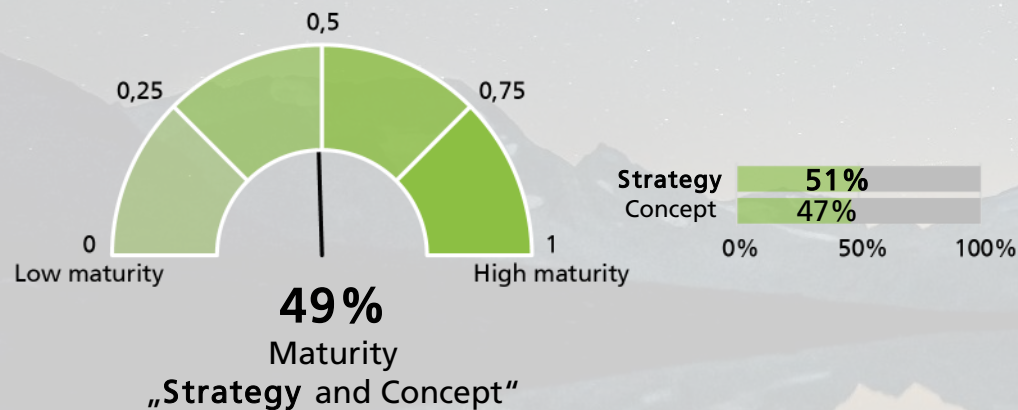
46% emphasize that the **Digital Shadow** is an integral part of a Digital Twin.

85% developed **concepts** for Digital Twins, but **only 54%** also developed a **strategy**.

8% already **apply Digital Twins**. 35% at least **started** their implementation.

The assessed concepts exhibit a medium maturity. Strategies and target visions are more elaborated than the specific concepts.

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- *How does the Digital Twin influence business models?*
- *What added value will be created by Digital Twins?*
- *How do products or systems have to change to be twinned?*

0,5

0,25   0,75

0   1

Low maturity   High maturity

49%
Maturity
„**Strategy** and Concept"

Strategy   **51%**
Concept   **47%**

0%   50%   100%

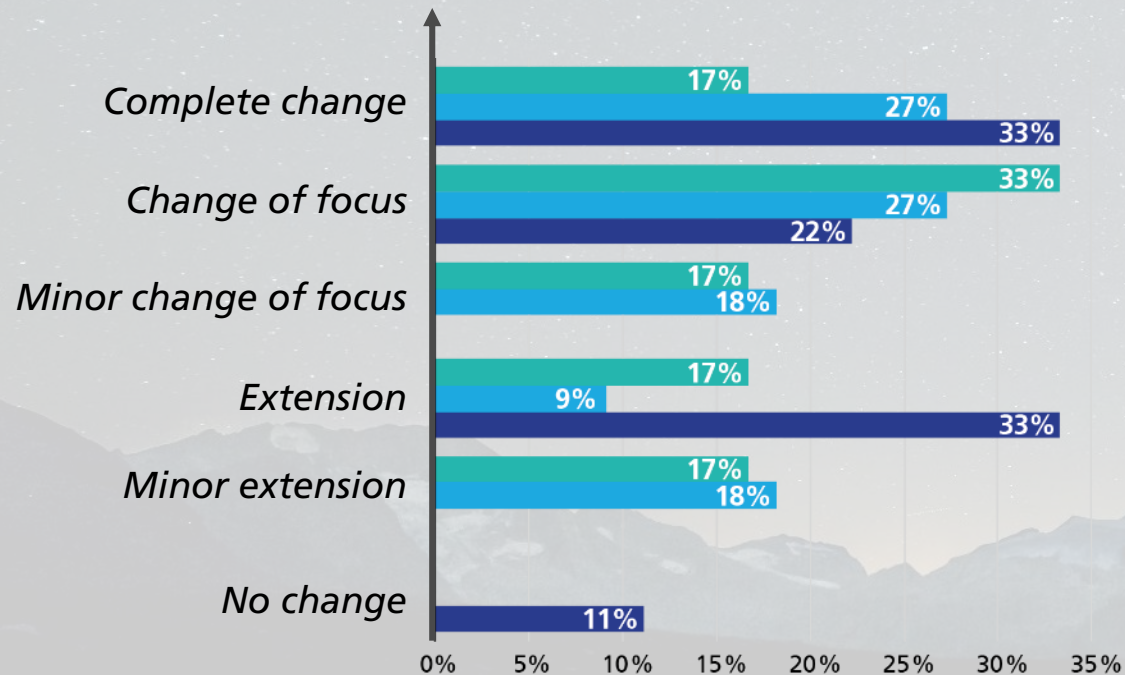**35%** intend to **change their business model** with the Digital Twin.

27% of respondents intend to **offer new products** using the Digital Twin.

15% specifically expect **no change** in their business model.

31% hope the Digital Twin will enable them to **accelerate internal processes** in the company.

Digital Twins will influence most business models. They bring new possibilities for a complete change or a change of focus.

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Change in business models

Complete change
- 17%
- 27%
- 33%

Change of focus
- 33%
- 27%
- 22%

Minor change of focus
- 17%
- 18%

Extension
- 17%
- 9%
- 33%

Minor extension
- 17%
- 18%

No change
- 11%

0% 5% 10% 15% 20% 25% 30% 35%

Legend
- ■ OEM (mobility: road, rail, air)
- ■ Supplier (mobility: road, rail, air)
- ■ Machine construction, mechanical and instrument engineering
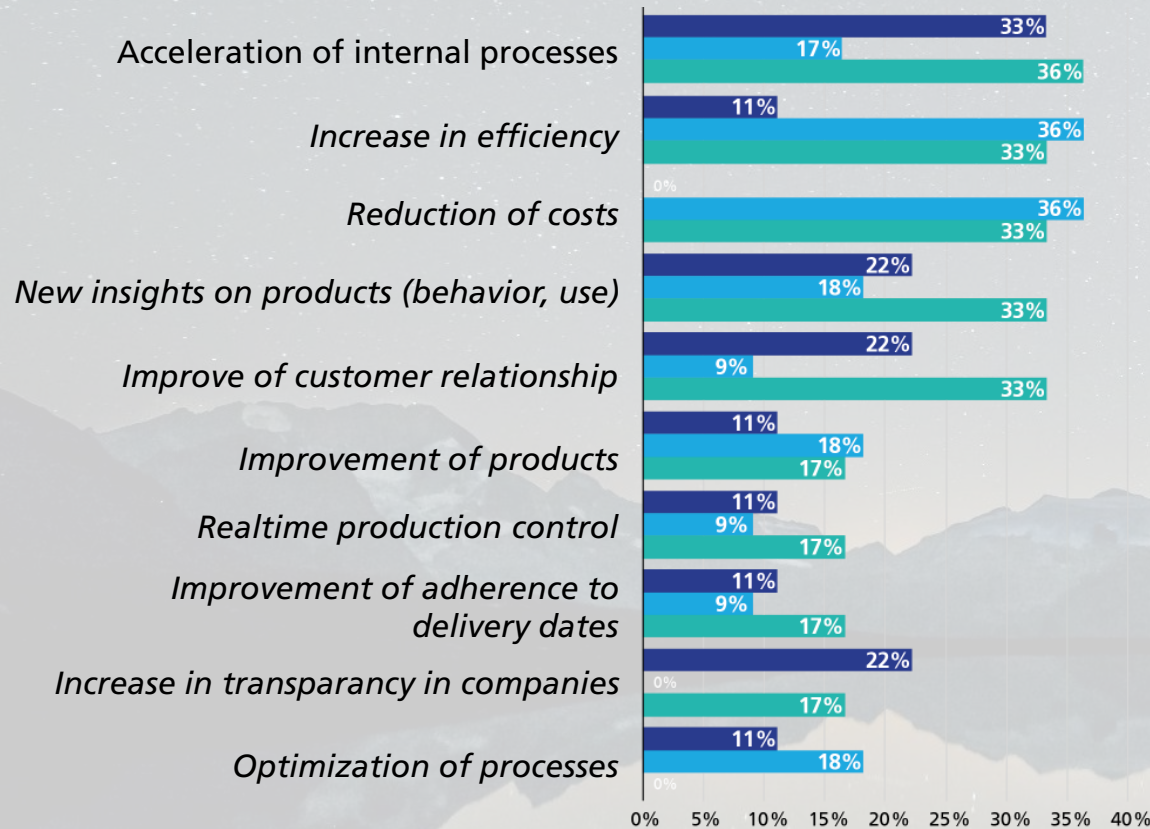
Key aspects:

Many companies assume that Digital Twins will transform their business models significantly or at least allow for an extension.

- Most **OEMs** expect a *complete change* or an *extension* to their business model, but 11% also expect no change at all.

- **Suppliers** expect a complete conversion or change of focus

- **Machine manufacturers** assume that the focus will change.

The primary benefit of Digital Twins is seen in the acceleration of internal processes, increase in efficiency as well as cost reduction.

Expected benefits

Key aspects:

Expected benefits from the Digital Twin mainly focus on internal aspects:

- Accelerated processes (31%)

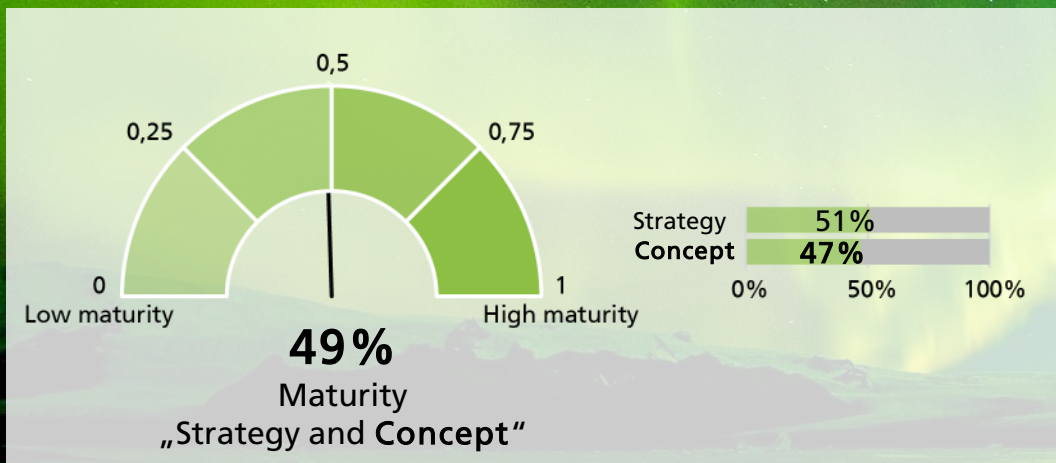- Increased efficiency (27%)

- Cost reduction (27%)

In detail: Specifically **OEM**s and **machine construction** companies focus on the acceleration of processes, **suppliers** on the increase in efficiency and the reduction of costs.

Legend

■ OEM (mobility: road, rail, air)　　■ Supplier (mobility: road, rail, air)　　■ Machine construction, mechanical and instrument engineering

The assessed concepts show a great diversity with regard to system in focus, related tasks and product life cycle phases.

- *Which tasks will be executed by Digital Twins?*

- *How are Digital Twins applied and which capabilities are necessary?*

- *Which technologies are necessary for Digital Twins and their interconnection?*

0,5

0,25   0,75

Strategy   51%
Concept   47%

0   1   0%   50%   100%

Low maturity   High maturity

49%
Maturity
„Strategy and **Concept**"

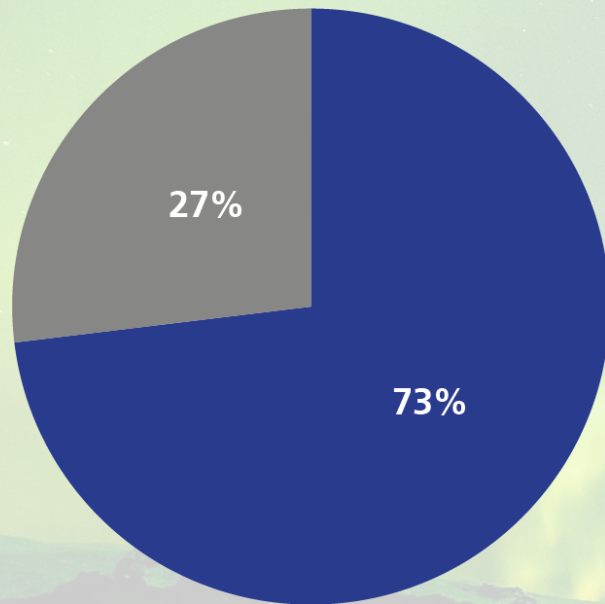**73%** of the interviewed companies focus on **product systems**.

42% apply Digital Twins within the **product development phase**.

64% see **data provision** as a major task for Digital Twins.

36% did not yet define the **interconnection** between physical system and Digital Twin.

The assessed concepts focus on the digital representation of the whole product or the related sub-systems.

Main groups of assessed Digital Twin concepts

27%

73%

Legend

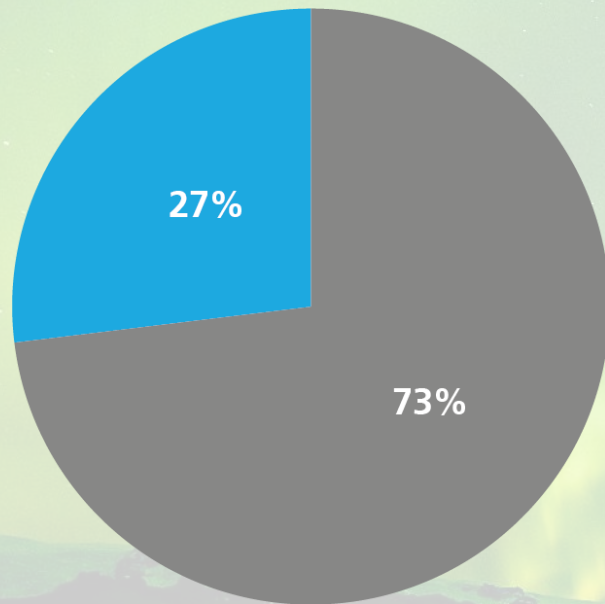■ Product context   ■ Production and assembly context

Key aspects:

The assessed concepts mainly focus on product systems, rather than on the production context. The stated relevant information for the **product context** are:

- Status and condition

- Performance

- Behaviour

- Components in use

- Functions and their usage

- As well as geometry.

The assessed concepts focus on the digital representation of the whole product or the related sub-systems.

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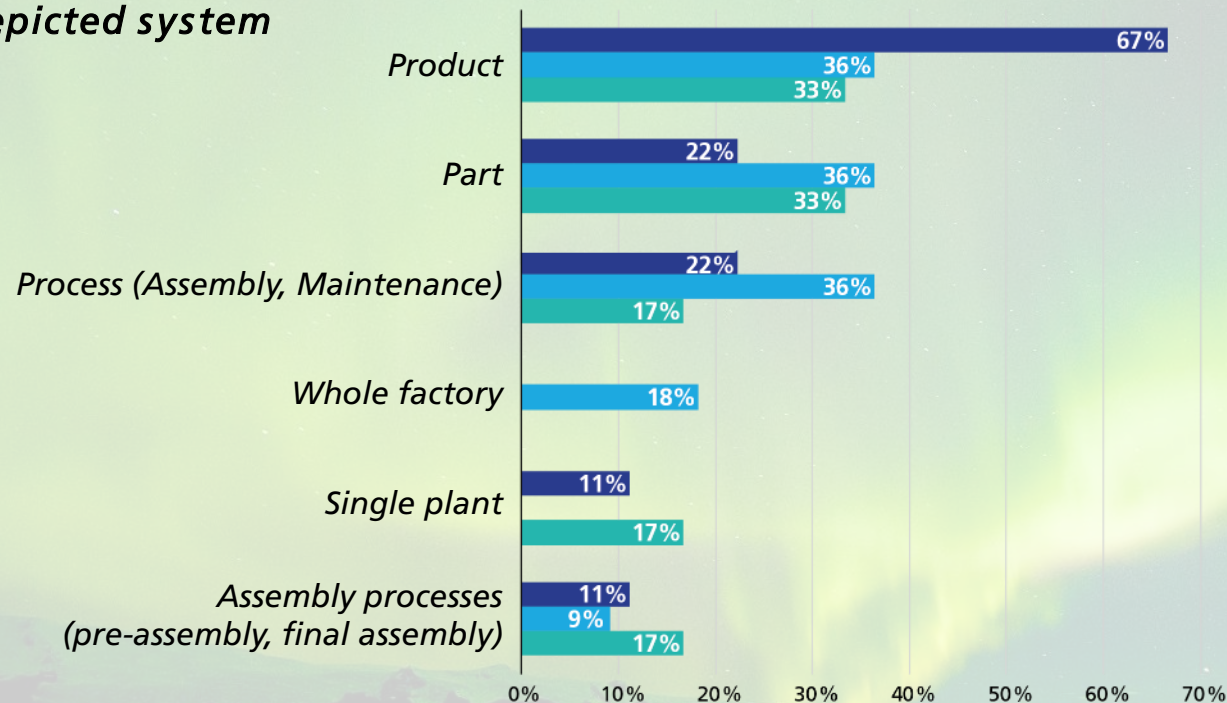## Main groups of assessed Digital Twin concepts

27%

73%

Key aspects:

Within Digital Twins in the **production and assembly context** the following information is depicted:

- Tolerances,

- Control behaviour,

- Functions,

- Kinematics,

- Geometry,

- Conditions,

- Material flow,

- As built status and KPIs.

Legend

■ Product context

■ Production and assembly context

Digital Twin Readiness Assessment

Especially OEMs of the mobility industry aim at depicting entire product systems within their Digital Twin concepts.

Depicted system

Chart data:

Depicted system	OEM	Supplier	Machine construction
Product	67%	36%	33%
Part	22%	36%	33%
Process (Assembly, Maintenance)	22%	36%	17%
Whole factory		18%	
Single plant	11%		17%
Assembly processes (pre-assembly, final assembly)	11%	9%	17%

Legend

- OEM (mobility: road, rail, air)
- Supplier (mobility: road, rail, air)
- Machine construction, mechanical and instrument engineering
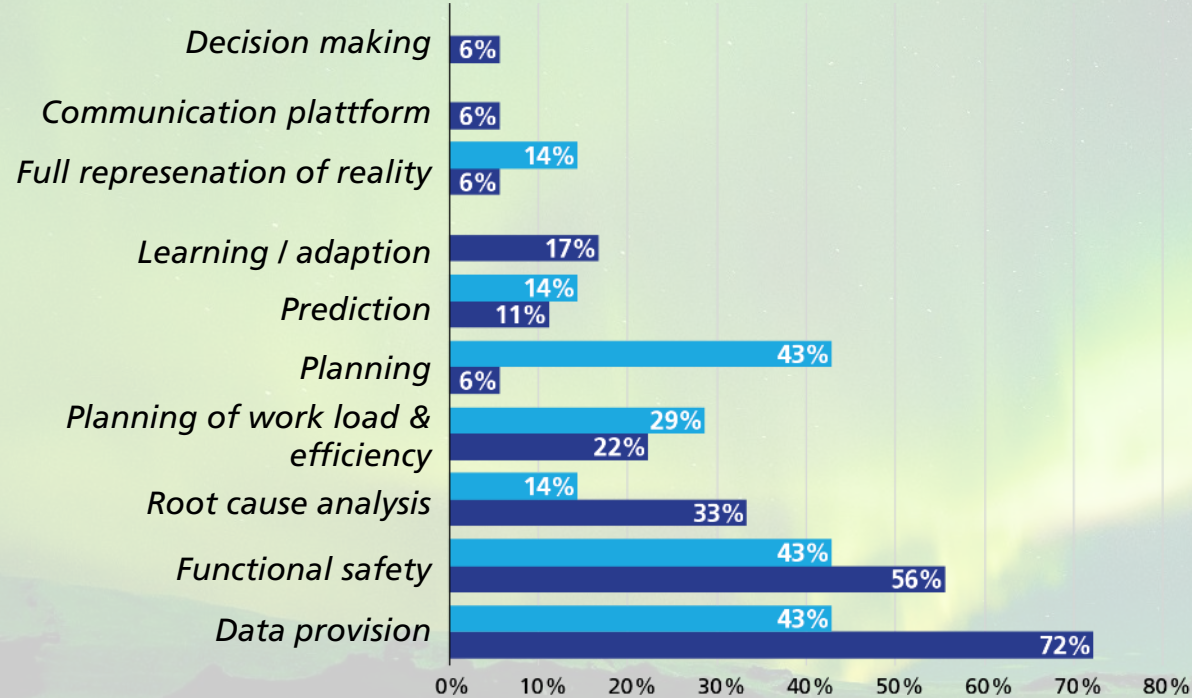
Key aspects:

The comparison between the industry groups shows further differences:

- Products as a whole are the main focus of **OEMs**

- **Suppliers** see also Digital Twins of parts of the product system or processes as relevant

- **Machine construction** companies exhibit a wide spectrum of answers.

The main tasks of Digital Twins are data provision and to ensure functional safety.

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Main tasks

Key aspects:

The concept of Digital Twins allows for a wide range of functions which is also reflected in the answer spectrum.

- In the **product context** a Digital Twin is supposed to provide data and to ensure functional safety

- In the **production context**, production planning tasks are additionally relevant.

Room for impovement: More complex tasks such as prediction and automated planning could be considered.

The implementation of Digital Twins exhibits the lowest level of maturity – especially with regard to data and information models as well as IT-systems.

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- *Which implementation measures are necessary on organisational, process, model and IT-system level?*

- *Which skills are necessary for the Digital Twins?*
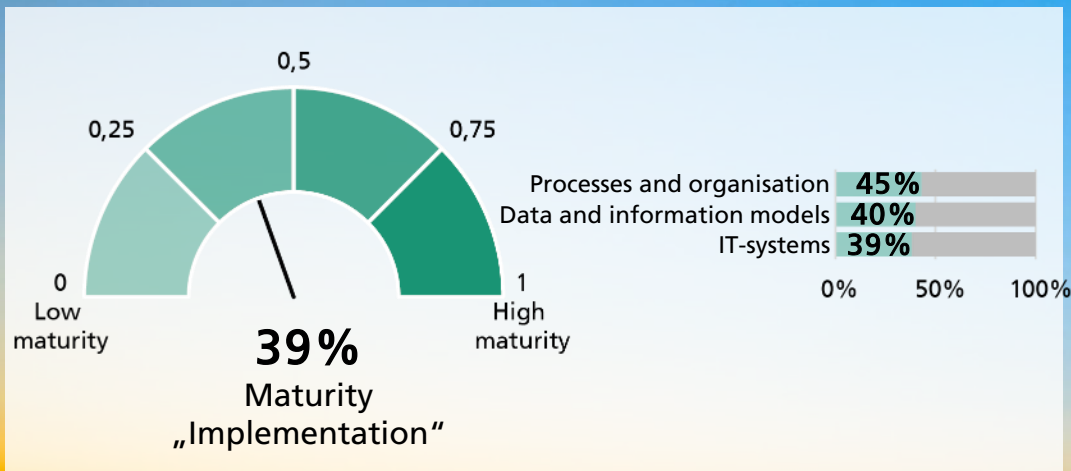
85% expect a **change** in the **organisational structure** of their company for the implementation of Digital Twins.

55% state that the **responsibilities** for a change of the processes for Digital Twins are **unclear**.

24% use **internal IT-solutions** for the implementation of Digital Twins.

72% of the interviewed companies need **new and more IT-skills** to implement and operate Digital Twins.

0,5
0,25
0,75
0
Low maturity
1
High maturity

Processes and organisation **45%**
Data and information models **40%**
IT-systems **39%**

0%   50%   100%

39%
Maturity „Implementation"

The way of change of the business processes is for nearly half of the companies uncertain, but most expect organisational change.
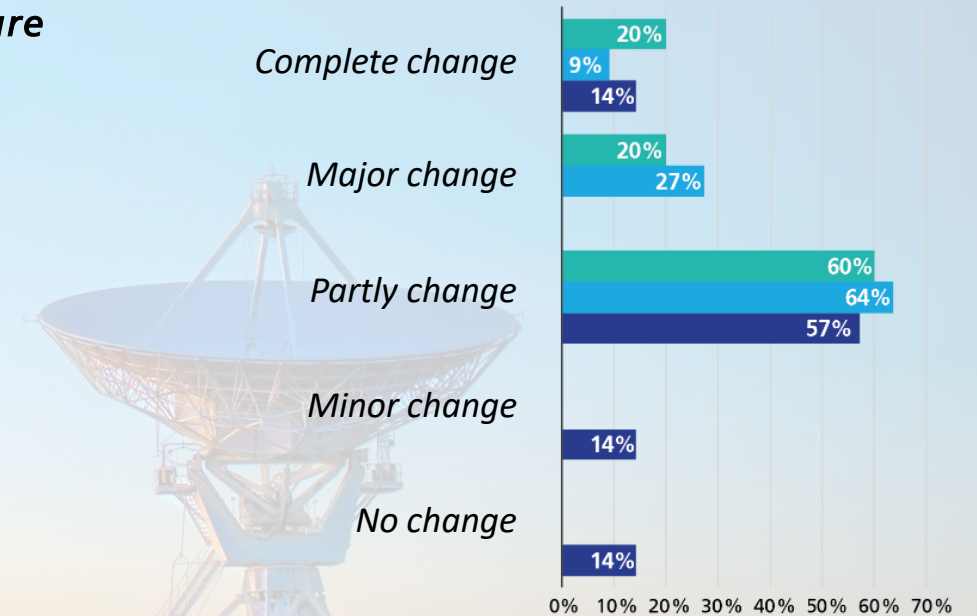
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Key aspects:

Processes will partly change for **supplier** companies in the mobility sector and **machine construction** companies, whereas **OEMs** expect a complete change in processes. The necessary organisational changes are not seen as urgent or are already executed.

Change in processes

Complete change	17% / 27% / 33%
Partly change	67% / 73% / 22%
Minor change	— / — / 11%
No change	— / — / 11%
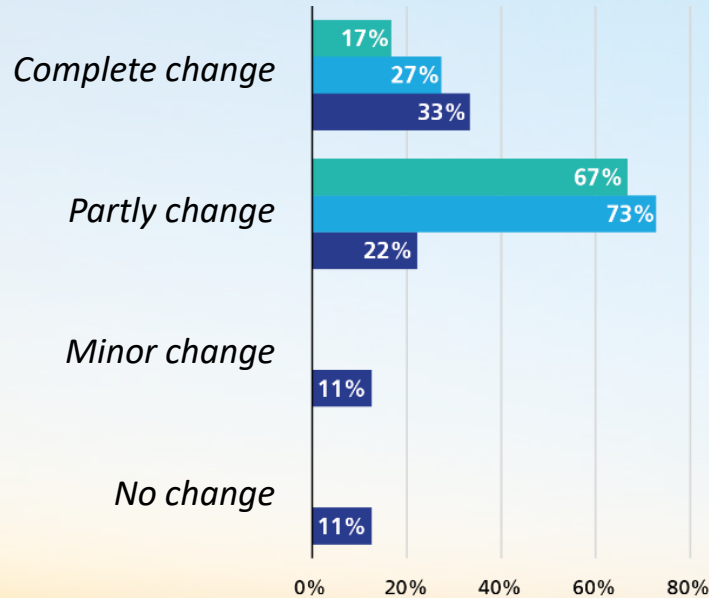
Change in organisational structure

Complete change	20% / 9% / 14%
Major change	20% / 27%
Partly change	60% / 64% / 57%
Minor change	14%
No change	14%

Legend

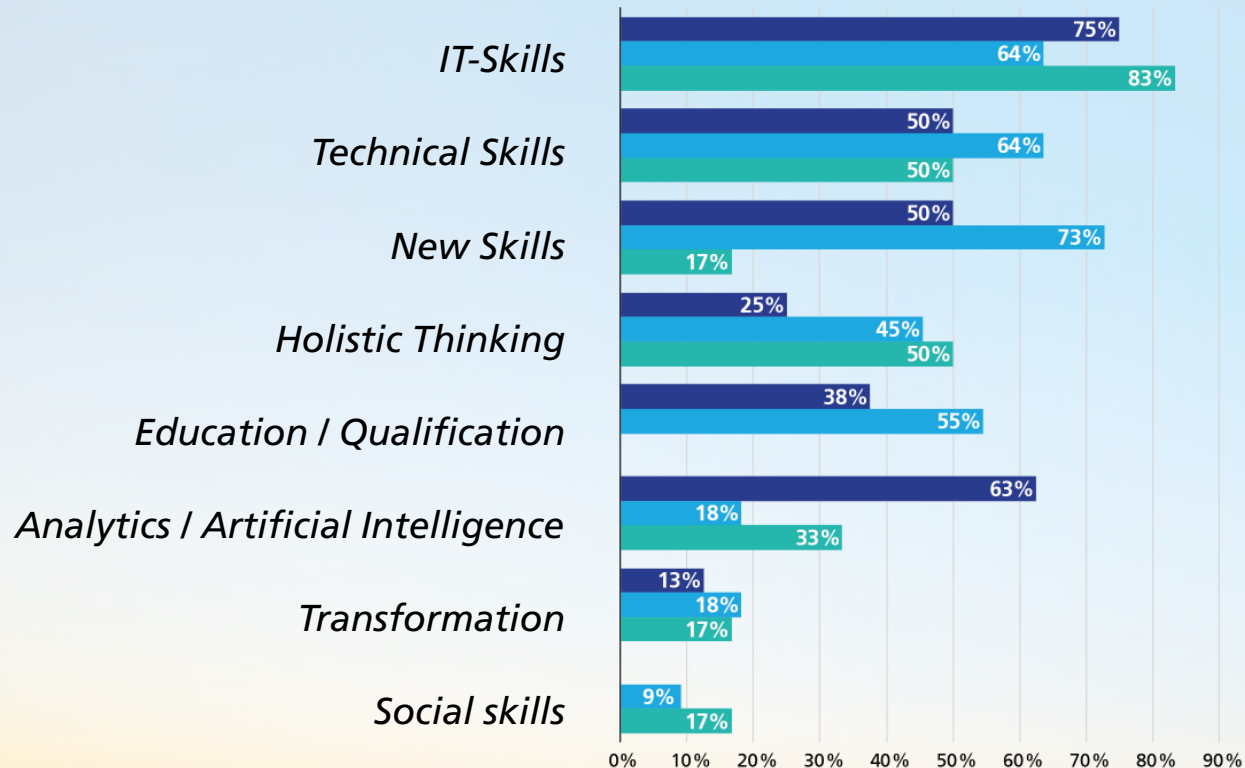■ OEM (mobility: road, rail, air)   ■ Supplier (mobility: road, rail, air)   ■ Machine construction, mechanical and instrument engineering

For the implementation of Digital Twins companies need to acquire IT- and technical skills. Most companies are not equipped with the necessary skill set.

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Necessary skills

Skill	OEM	Supplier	Machine construction
IT-Skills	75%	64%	83%
Technical Skills	50%	64%	50%
New Skills	50%	73%	17%
Holistic Thinking	25%	45%	50%
Education / Qualification	38%	55%	
Analytics / Artificial Intelligence	63%	18%	33%
Transformation	13%	18%	17%
Social skills		9%	17%

Key aspects:

The necessary skill set for Digital Twins shows the relevance of Systems Engineering, Data Science and IT as well as technical sets. Most companies will need to attract new personnel or invest in qualification.

- **OEM**s are in need of IT-skills and emphasize Data Analytics and AI

- Most **Suppliers** will need new skills next to current capabilities

- **Machine construction** companies mainly focus on IT- and technical skills as well as holistic thinking.

Legend

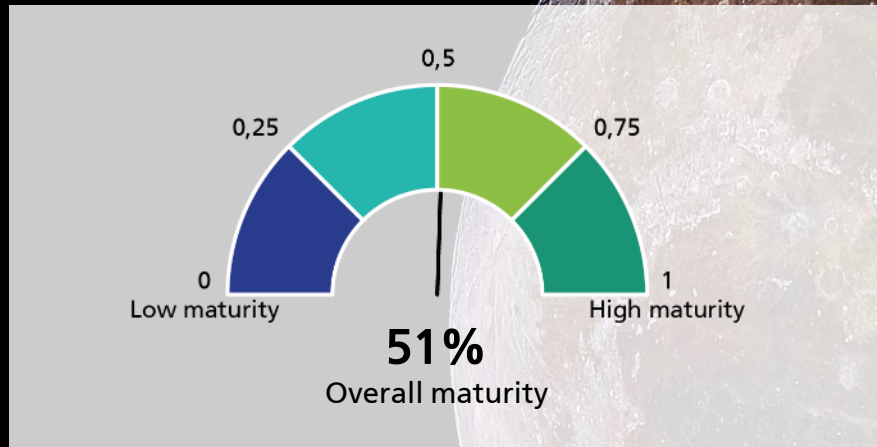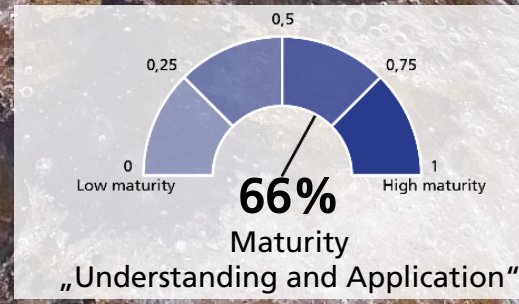■ OEM (mobility: road, rail, air)   ■ Supplier (mobility: road, rail, air)   ■ Machine construction, mechanical and instrument engineering

All in all, the maturity analysis shows a great diversity of Digital Twin concepts and future challenges with regard to implementation.

There is a good understanding of Digital Twins in general as well as first experiences from the application of Digital Twins.

The developed concepts have a medium maturity, whereby the strategies and target visions are more elaborated than the specific concepts.

The implementation of Digital Twins has the lowest level of maturity – especially with regard to data and information models as well as IT-systems.

Overall, Digital Twins are still in the conception phase, but there are many different approaches that reflect the diversity of the concept as a whole.

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The future vision for Digital Twins reflects in the hope for new digital services and new business by 2040 with a high potential for sustainability evaluation.

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- *What is the future vision of Digital Twins?*

- *How relevant is the Digital Twin for ecological and social sustainability?*
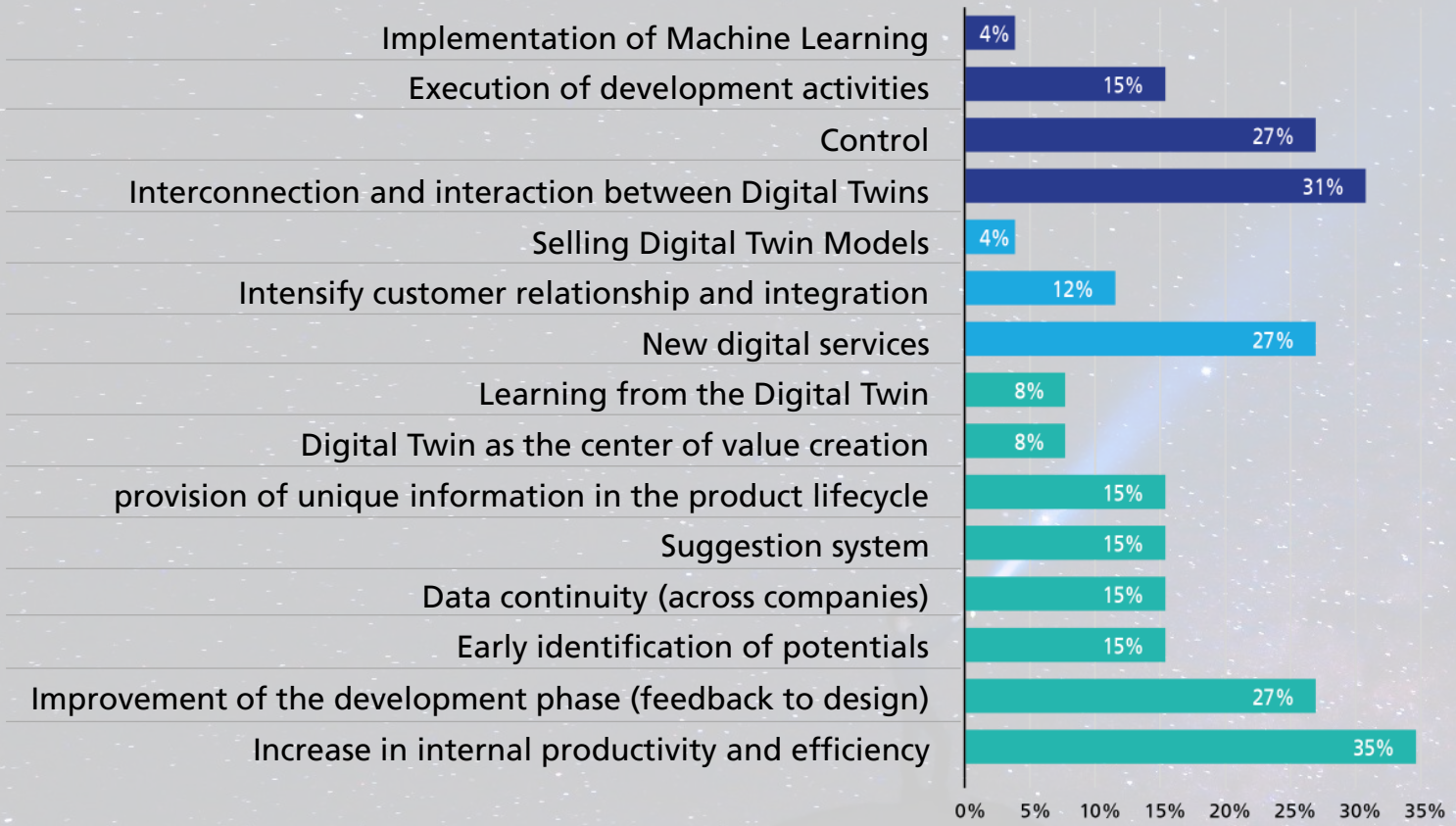
35% expect their Digital Twin to depict the **"full system"** including their environment until 2040.

38% hope for **new business models** by means of the Digital Twins until 2040.

27% expect their Digital Twin to be **in use much earlier** than 2040.

63% see a very high potential that Digital Twins can also execute **sustainability assessment** in the future.

Summary and conclusions

5 core questions form the basis of the "Digital Twin Readiness Assessment":

"How does the Digital Twin influence business models?"	There are great expectations regarding **data driven services** or **business models**. However, the strategy for the future focuses rather on **improving existing products, processes or services**.
"What value should be gained by the Digital Twin?"	The **value** is seen mostly in the **internal optimization of the products, systems or processes** around quality optimization, cost reduction and increase in efficiency.
"What do current concepts for the Digital Twin look like?"	The assessed **concepts are divers and vary** according to the company vision. **Depending on the expected benefits**, the Digital Twin focuses on a product, its sub-systems or production.
"What kind of actions are necessary for the Digital Twin?"	Introducing Digital Twins is **transforming** an enterprise and requires a **holistic or overall approach** in order to utilize the benefits.
"Which skills are required for the Digital Twin?"	New responsibilities will be needed with a strong focus on a **cross-domain thinking** as well as IT and data analytics skills. **Solid engineering skills will not be enough in the future** to develop and operate Digital Twins.

Our five key learnings and recommendation to you: Make the Digital Twin a part of your digitization strategy and align your processes and organization.

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Recommendations

Break down data silos and ensure the **availability** of relevant **data along the product life cycle** to support your use case and value

Utilize the **full potential** of the Digital Twin and take **all elements of the Digital Twin definition** into consideration

Focus on the your **specific use case** and the expected value

Accompany the change through targeted change management

Establish the necessary **support structures**, organization and processes for the implementation of your Digital Twin vision

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Digital Twin Readiness Assessment

What is the current state of your Digital Twin in comparison to the industry?

0,25   0,5   0,75
0   1
Low maturity   High maturity

51%
Overall maturity

„Digital Twin for Predictive Maintenance"*

Your degree of readiness in the three dimensions

Understanding and application	Strategy and Concept	Implementation
M1	M2	M3
Low Middle High	Low Middle High	Low Middle High

Determine the specific maturity for your company and get recommendations for action.

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Any questions?