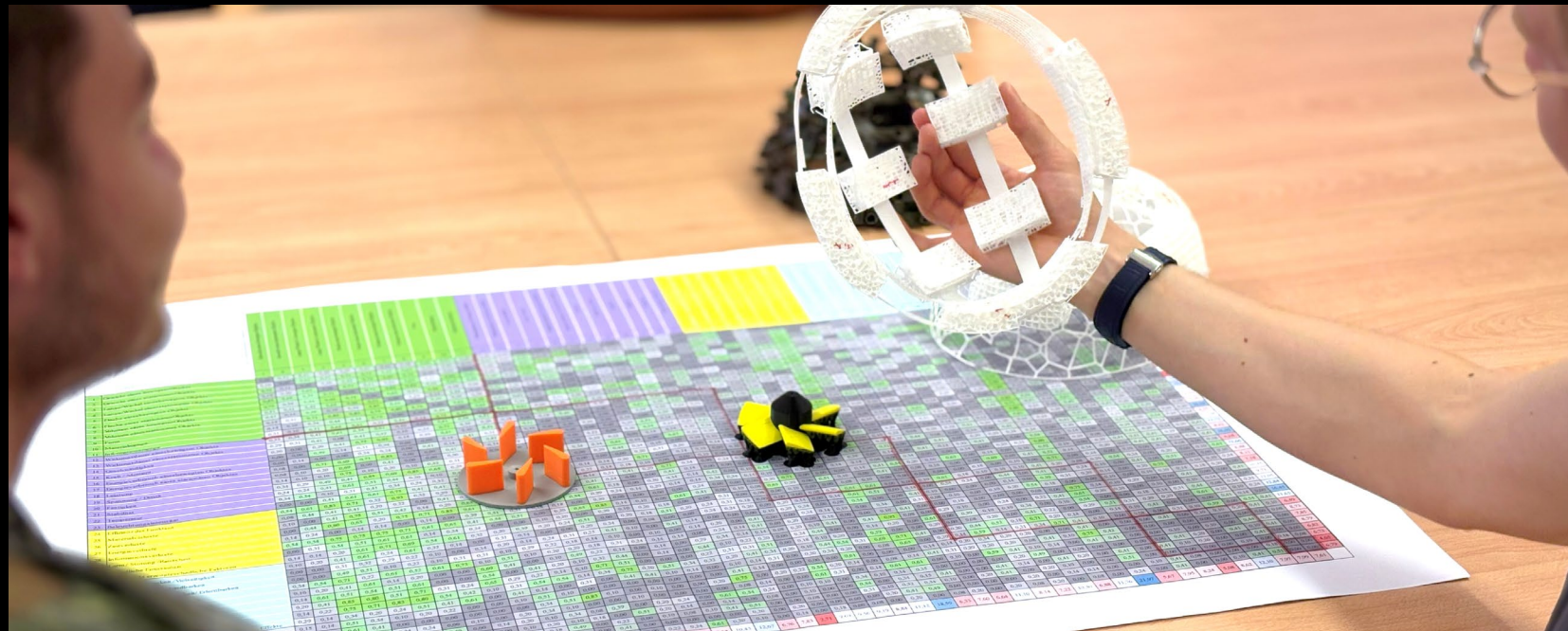
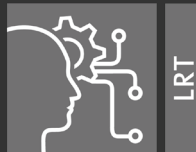




Additive Manufacturing in Industrial Practice: Insights from Leading Users



Universität der Bundeswehr München

Institut für Technische
Produktentwicklung



Executive Summary

This report presents the results of a survey on the industrial use of additive manufacturing (AM), conducted between 18 May and 28 June 2026. The survey items were derived from 15 expert interviews, analysed with Mayring's qualitative content analysis. The most frequently mentioned challenges and seven innovative practices in design for AM (DfAM) were selected as survey items. 37 AM practitioners participated, with 3 to 40 years of AM experience (mean 11.08 years). Respondents come primarily from mechanical engineering, contract manufacturing as well as research and consulting.

Challenges. The dominant issue is not technological capability but the distribution of knowledge: 68 % agree that DfAM expertise is concentrated in the hands of a few individuals. 47 % report difficulties in accounting for AM-specific capabilities and limitations during design and 43 % state that DfAM expertise is not integrated into product development in time. Organisational coordination is a comparatively mild constraint (38 % agreement), though management and R&D assess it very differently (25 % vs. 50 %). The claim that design expectations are not being met was significantly rejected (27 % agreement). Free-text answers add a recurring theme of missing experience and trust in AM parts, including on the customer side.

Innovative practices. All items on innovative DfAM practices received between 51% and 80 % agreement. 51 % employ a defined process for identifying components suited to AM, 60 % report explicit customer demand for additively manufactured parts, and 80 % use AM for further specific applications, most often prototyping (13 of 24 free-text answers) and tooling or operating supplies (12 of 24), ahead of serial production (end-use parts) (8) and spare parts (3).

Conclusion. Among experienced users of AM, the technology is mastered and organisationally anchored, but its scaling depends on making DfAM knowledge accessible throughout development: education, early involvement of AM experts, and documented selection processes are essential. The sample presented here includes not only prototyping users but also accounts from stakeholders who manufacture individual components (17) to fully commercialised products (7) using additive manufacturing, thereby providing valuable insights into this sector.

This study was conducted as part of a master's thesis at the Institute for Technical Product Development at the University of the Bundeswehr Munich between 18th May and 28th June 2026. The goal was to use a questionnaire to make the characteristics of DfAM-users measurable while gaining a current overview of the use of additive manufacturing in the industrial context.

The questionnaire was based on 15 prior interviews with experts in the field of additive manufacturing. These interviews were analysed and coded using Mayring's qualitative content analysis¹. Two evaluators examined the material with regard to current challenges as well as innovative solutions and processes.

In total, both evaluators found 314 challenges and innovations. When applicable, these were consolidated to minimize the number of different codes. The five challenges and seven solutions presented in the survey were developed from the most frequently mentioned responses.

Participants were recruited through manual analysis of trade show exhibitor directories (formnext, Rapid.Tech 3D), market studies, LinkedIn groups, and the personal network of the study's authors.



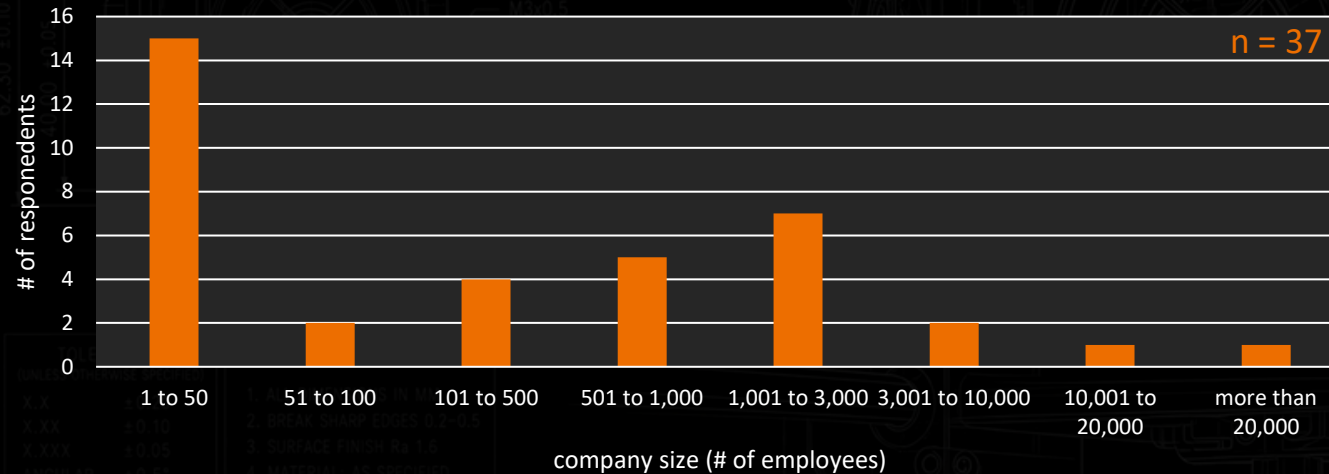
¹:Mayring, P., & Fenzl, T. (2019). Qualitative Inhaltsanalyse. In N. Baur & J. Blasius (Hrsg.), *Handbuch Methoden der empirischen Sozialforschung* (S. 633–648). Springer Fachmedien. https://doi.org/10.1007/978-3-658-21308-4_42



demographics

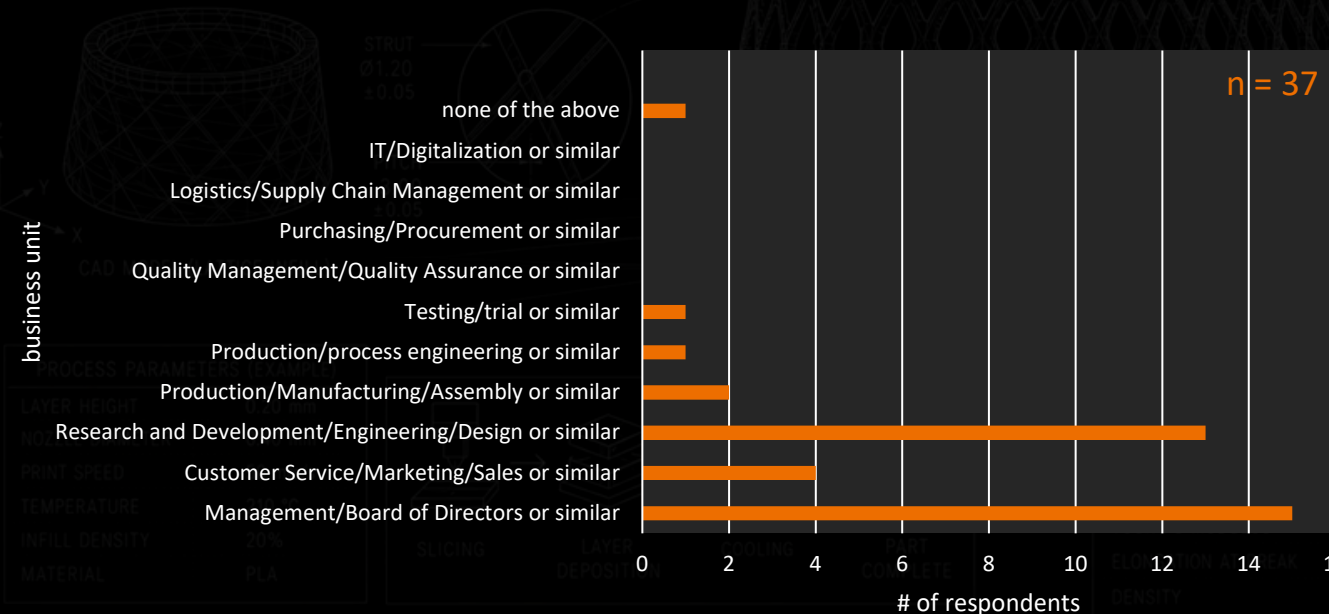
- demographic data and general information about the survey participants



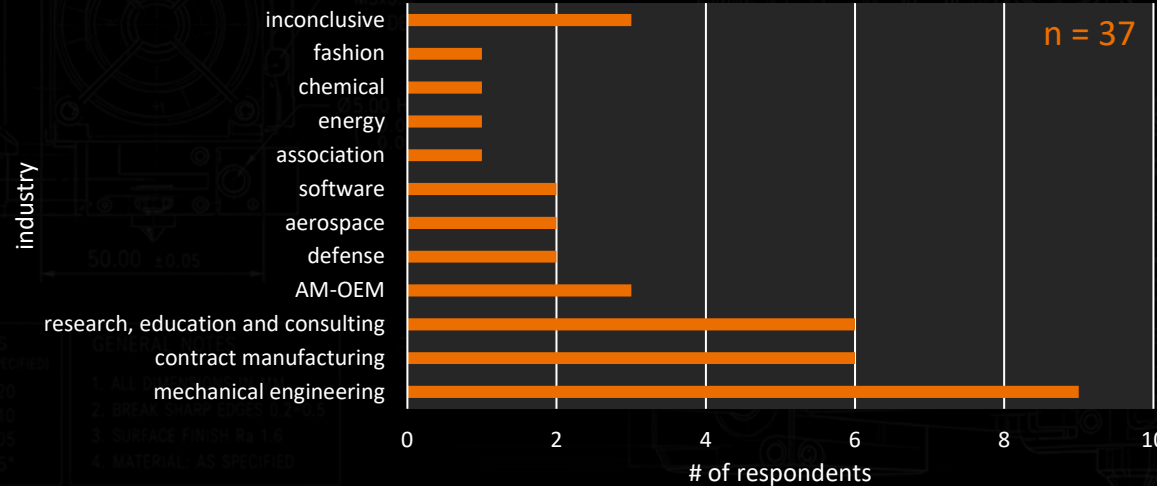


37 participants:
36 German speaking,
1 English speaking

experience with AM
between 3 and 40 years,
on average 11 years



25 of 37 respondents
state an involvement in
AM-specific communities
or associations



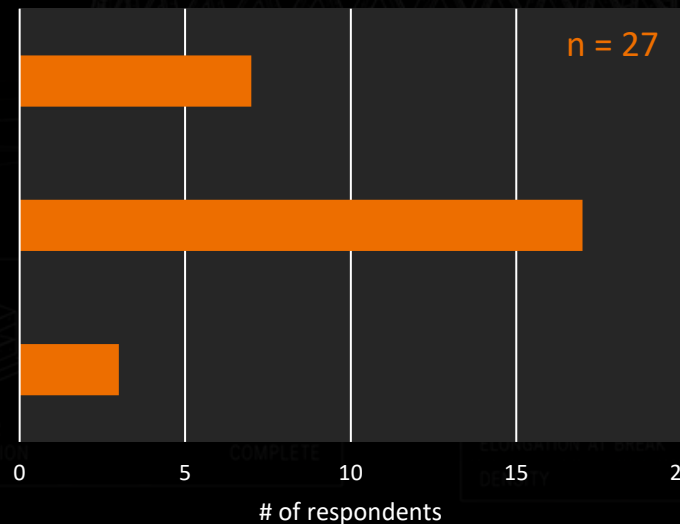
- Clustering of industry sectors through given free-text answers

Does the final product you develop or distribute contain additively manufactured parts?

Yes, the final product is entirely manufactured using additive manufacturing (all essential physical components of the product).

Yes, the final product contains parts manufactured using additive manufacturing (individual components/assemblies; other parts are manufactured conventionally or purchased).

No, the final product does not contain any additively manufactured parts.

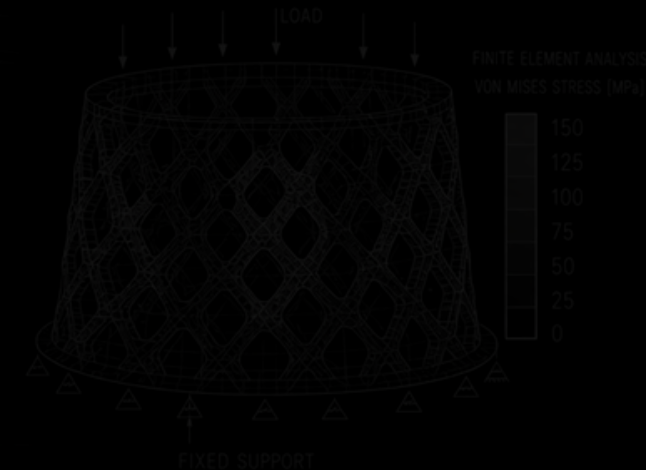
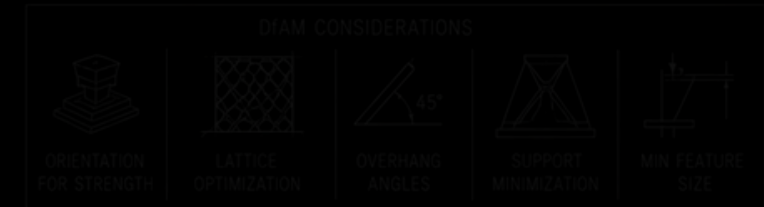


- reduced number of respondents because of sectors research, education and consulting (6) and software (2), which do not development or produce (physical) products, further 2 respondents ended their participation early

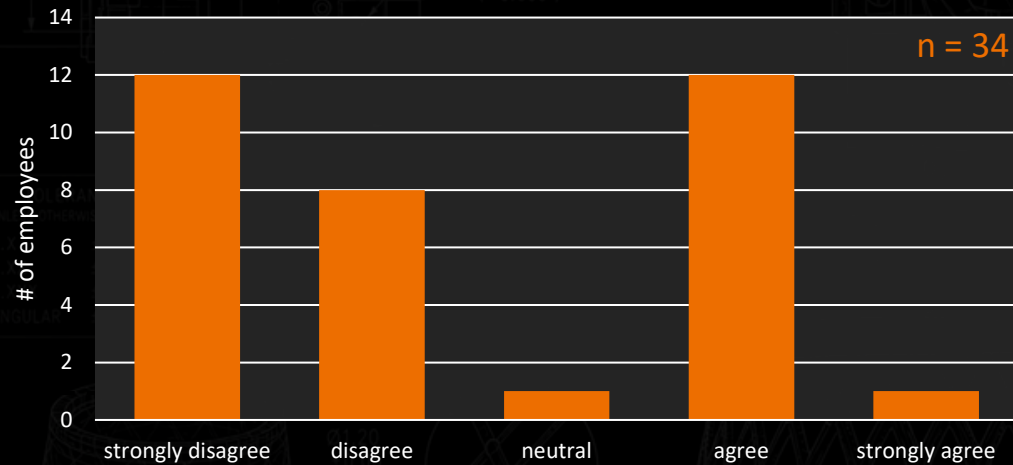


current challenges

- At first, participants were shown 5 questions on current challenges when employing AM in an industrial context. At the end of this part, they were asked to describe further challenges using free-text.
- Throughout this first set of questions the number of responses will vary between 34 and 37.

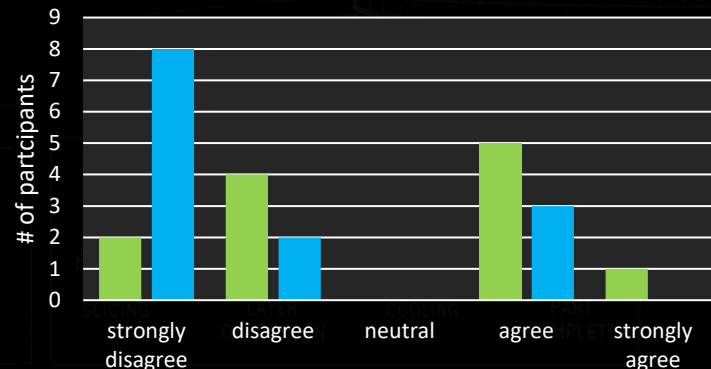


The potential of additively manufactured components is significantly limited in our company due to a lack of coordination among the relevant organizational units.



- 38% of the participants agree to a constraint in AM potential due to lack of coordination
- lacking organisation in a business seems to only mildly hinder AM-potential

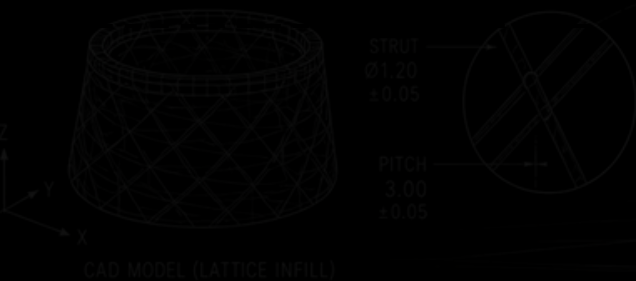
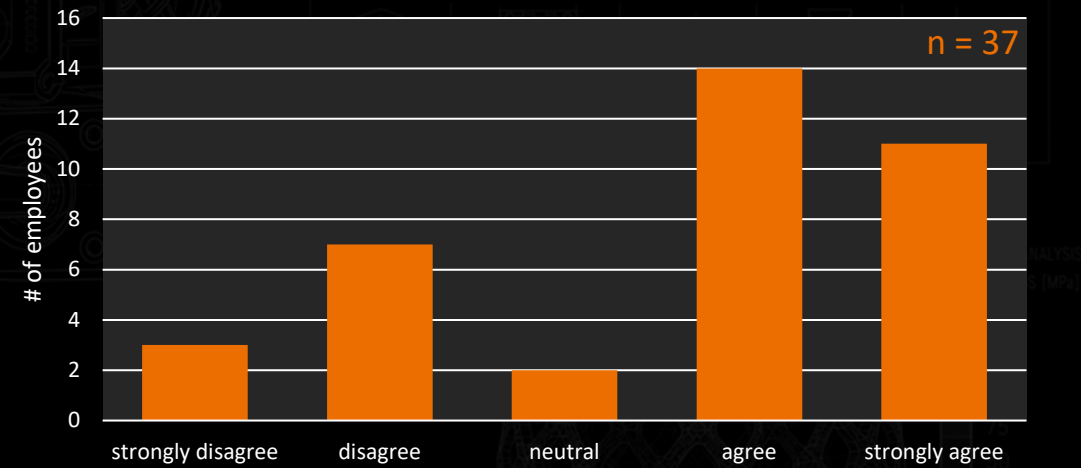
blue: management (n = 13) – green: R&D/engineering/design (n = 12)



- strong disparity between R&D and management:
 - R&D agrees by 50%
 - management agrees by 25%

Expertise in component design for additive manufacturing is concentrated in the hands of just a few individuals.

- 68% of the participants agree that knowledge in DfAM is concentrated to only a few experts²
- predominantly the concentration of AM-expertise is seen as a challenge



PROCESS PARAMETERS (EXAMPLE)	
LAYER HEIGHT	0.20 mm
NOZZLE DIAMETER	0.40 mm
PRINT SPEED	50 mm/s
TEMPERATURE	210 °C
INFILL DENSITY	20%
MATERIAL	PLA

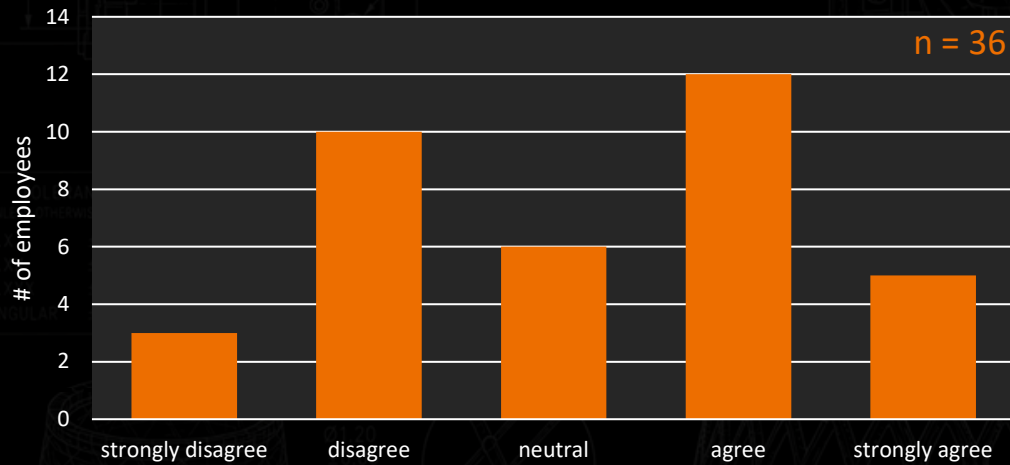


TYPICAL MECHANICAL PROPERTIES (PLA EXAMPLE)	
TENSILE STRENGTH	60 MPa
YOUNG'S MODULUS	3.5 GPa
ELONGATION AT BREAK	6%



²: statistically significant agreement with this item is observed (95% CI [51.4%; 80.4%])

During the design process, those involved find it difficult to design components that take into account the specific capabilities and limitations of additive manufacturing.



- 47% of the respondents agree that persons involved in the design process find it hard to keep specific capabilities and limitations of AM in mind

“Too little knowledge of AM is taught in vocational training programs.”

– research, education and consulting; 1 to 50 employees

“A lack of education, both on an academic level as well as in vocational training.”

– mechanical engineering; 1.001 to 3.001 employees

“In particular, there is a lack of expertise in additive manufacturing technology regarding the individual processes, especially with regard to design guidelines.”

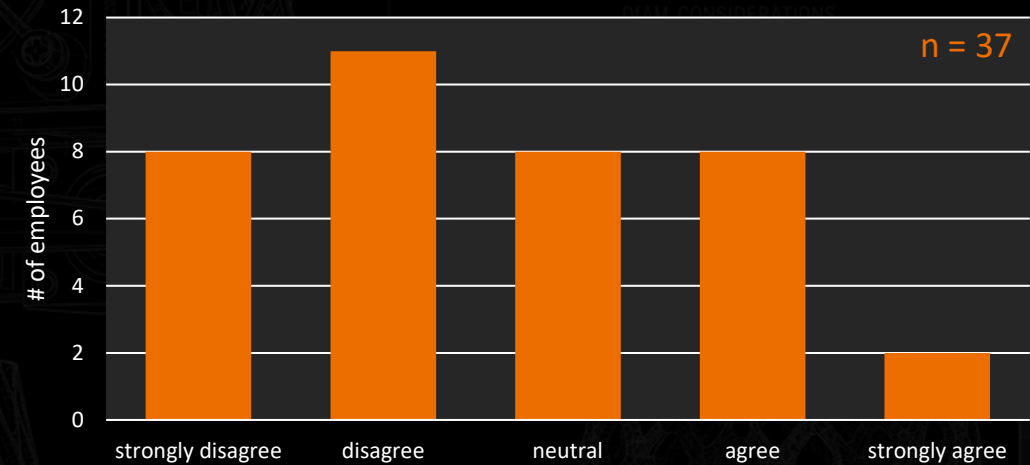
– association, 101 to 500 employees

The expectations regarding the design potential of additively manufactured components are not being met.

- 27% of the interviewees stated that expectations regarding the design potential of AM-components are not being met³

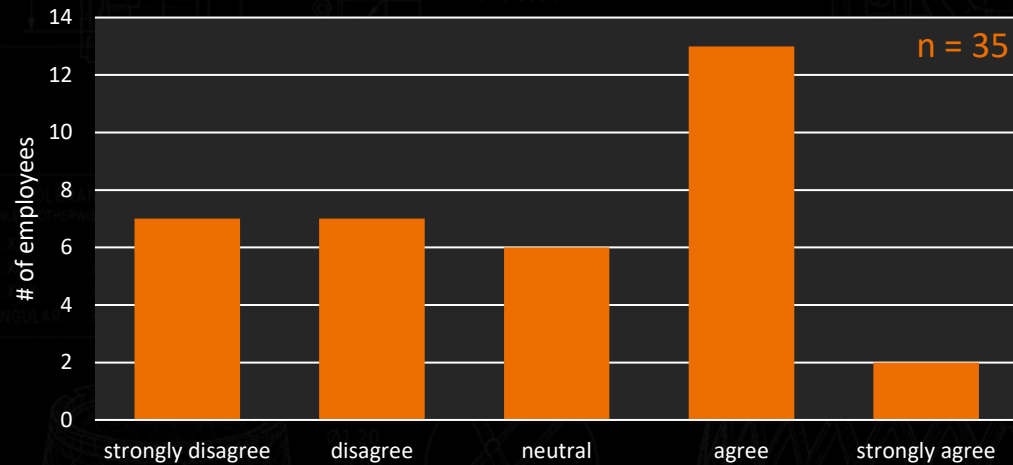
“[Lack of] End-User/Customer acceptance of 3D Metal Printing”
– energy industry; 1 to 50 employees

“Prejudices against AM: not reliable, just a gimmick, etc.”
– research, education and consulting; 1 to 50 employees



³: item is statistically significant rejected (95% CI [15.4%; 43.0%])

Specialized expertise in Design for Additive Manufacturing (DfAM) is never incorporated into product development in a timely manner.

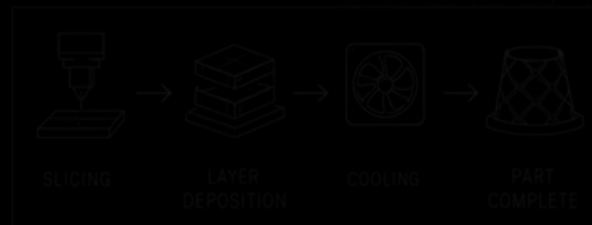


- 43% of the participants agree that DfAM-knowledge is never timely integrated into the product development process

“Lack of early involvement of AM experts in product development.”

– AM-OEM; 3.001 to 10.000 employees

PROCESS PARAMETERS (EXAMPLE)	
LAYER HEIGHT	0.20 mm
NOZZLE DIAMETER	0.40 mm
PRINT SPEED	50 mm/s
TEMPERATURE	210 °C
INFILL DENSITY	20%
MATERIAL	PLA

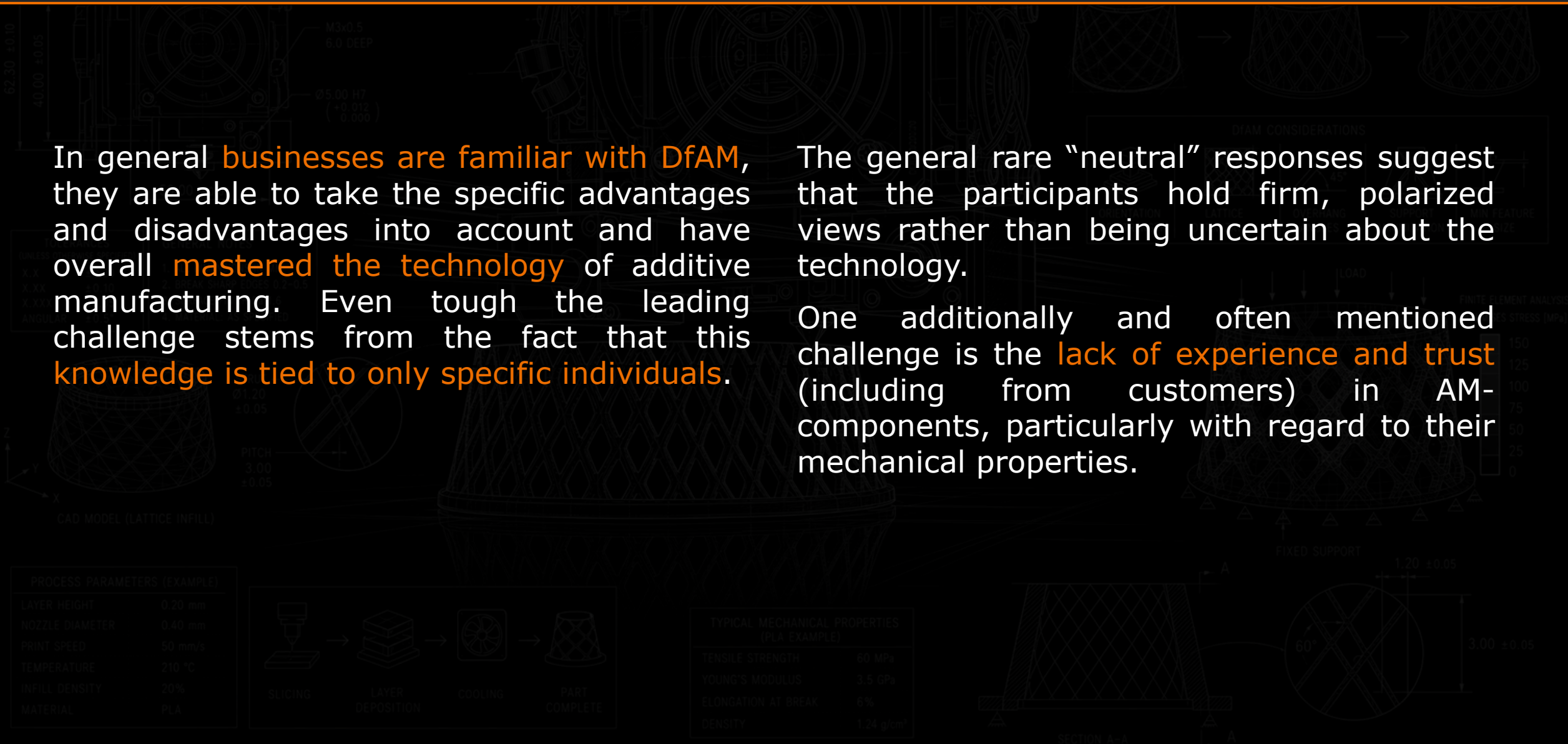


TYPICAL MECHANICAL PROPERTIES (PLA EXAMPLE)	
TENSILE STRENGTH	60 MPa
YOUNG'S MODULUS	3.5 GPa
ELONGATION AT BREAK	6%
DENSITY	1.24 g/cm³

In general **businesses are familiar with DfAM**, they are able to take the specific advantages and disadvantages into account and have overall **mastered the technology** of additive manufacturing. Even though the leading challenge stems from the fact that this **knowledge is tied to only specific individuals**.

The general rare “neutral” responses suggest that the participants hold firm, polarized views rather than being uncertain about the technology.

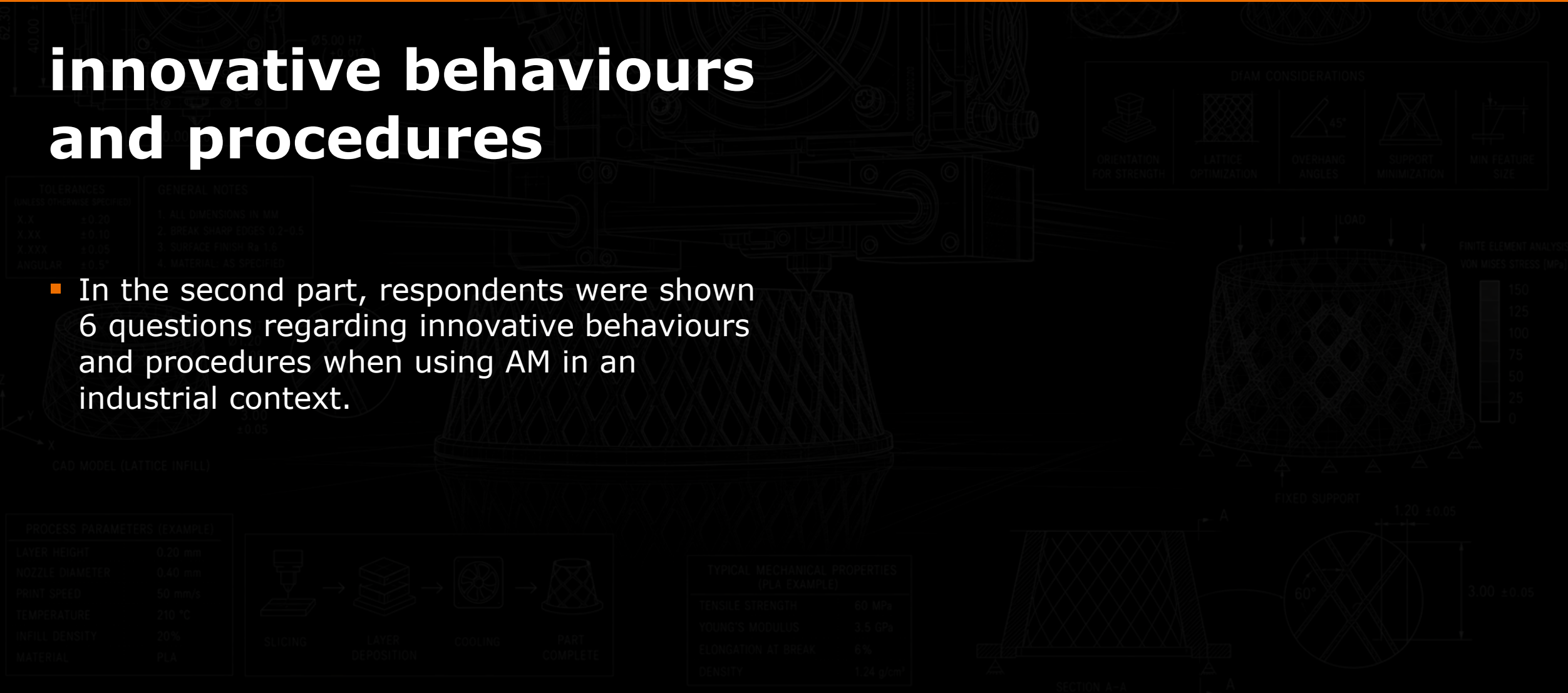
One additionally and often mentioned challenge is the **lack of experience and trust** (including from customers) in AM-components, particularly with regard to their mechanical properties.





innovative behaviours and procedures

- In the second part, respondents were shown 6 questions regarding innovative behaviours and procedures when using AM in an industrial context.



Do you have a defined process for identifying components or products that are well-suited for additive manufacturing?

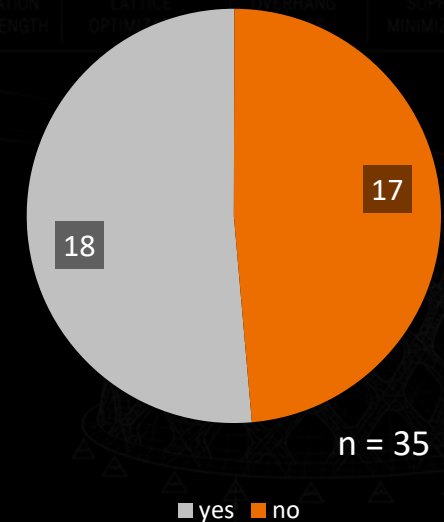
- 51% of the participants state a defined process identifying AM-potential in products

“We offer our customers a systematic component screening process. [...] Components are first filtered based on various criteria, such as component size, quantity, material requirements, price, complexity, and many others. [...]”

– contract manufacturing; 1 to 50 employees

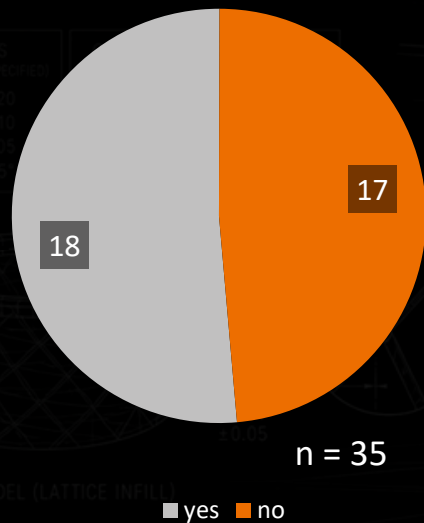
“Selection via a component database, filtered by component size, function, complexity, quantity, etc.”

– chemical industry; 3.001 to 10.000 employees



Is the procurement of additive manufacturing equipment linked to a planned expansion of expertise?

- 51% of the interviewees report a connection between procurement of AM equipment and planned expansion of knowledge



“The in-house additive manufacturing portfolio follows an 8-year strategic plan that is reviewed annually. [...]”

– contract manufacturing; 1 to 50 employees

Has your company established its own methods to provide appropriate support to those involved in component design?

- 54% of the respondents describe the establishment of own methods to provide adequate support to those involved in the design process

6x

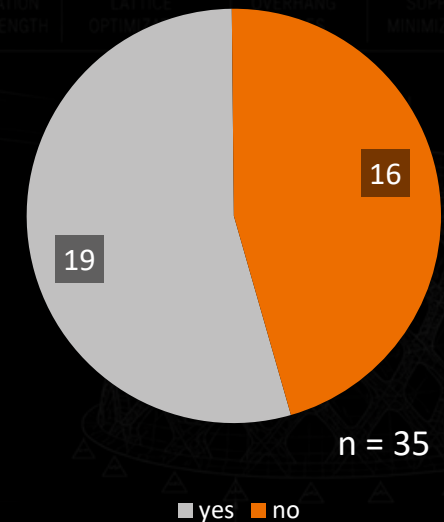
6 mentions of
*internal training or
education programs*

4x

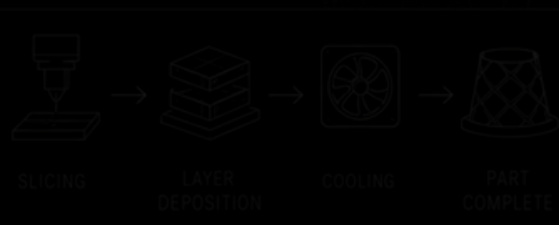
4 mentions of a
*development of
design guidelines*

3x

3 mentions of
customer training



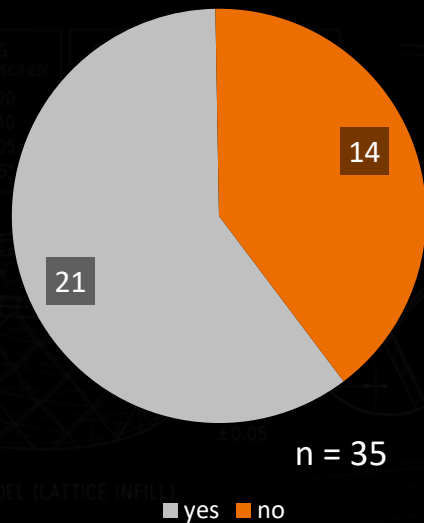
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LAYER HEIGHT	0.20 mm
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TYPICAL MECHANICAL PROPERTIES (PLA EXAMPLE)	
TENSILE STRENGTH	60 MPa
YOUNG'S MODULUS	3.5 GPa
ELONGATION AT BREAK	6%
DENSITY	1.24 g/cm³

Have customers expressed a need for components specifically manufactured using additive manufacturing to you?

- 60% of the participants say that costumers have expressed a need specifically for AM-components



“[...] Mainly due to design complexity, customization, or weight reduction requirements”

– inconclusive industry; 1 to 50 employees

“Primarily housings and mounts, replacement parts, structural components”
– defense industry; 1 to 50 employees

“Functionally integrated components or complex geometries”
– mechanical engineering; 1.001 to 3.000

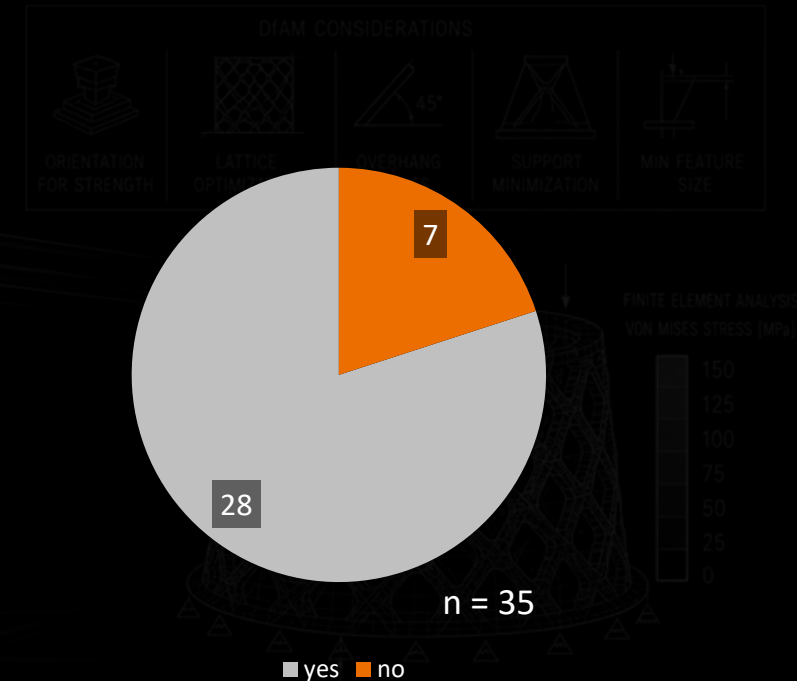
Are you taking full advantage of the ability to produce components more quickly and frequently through additive manufacturing?

- 80% of the respondents report taking advantage of the chance to produce components more rapidly and often through AM

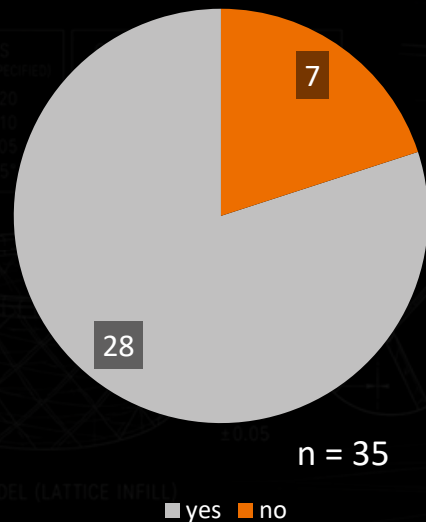
“Rapid prototyping of fixtures for mechanical component testing”
– research, education and consulting; 51 to 100 employees

“At my former company: production time and costs for operating supplies significantly reduced”
– software; 1 to 50 employees

“To accelerate development initiatives.”
– mechanical engineering; 1.001 to 3.000 employees



Is additive manufacturing used in your company for any other specific applications?



- 80% of the participants claim the use of further specific AM-applications
- out of 24 free-text answers:

prototyping is mentioned 13 times

13x

operating supplies and tooling is mentioned 12 times

12x

serial production is mentioned 8 times

8x

spare parts are mentioned 3 times

3x

- single mentions include:

optimization of process workflows

1x

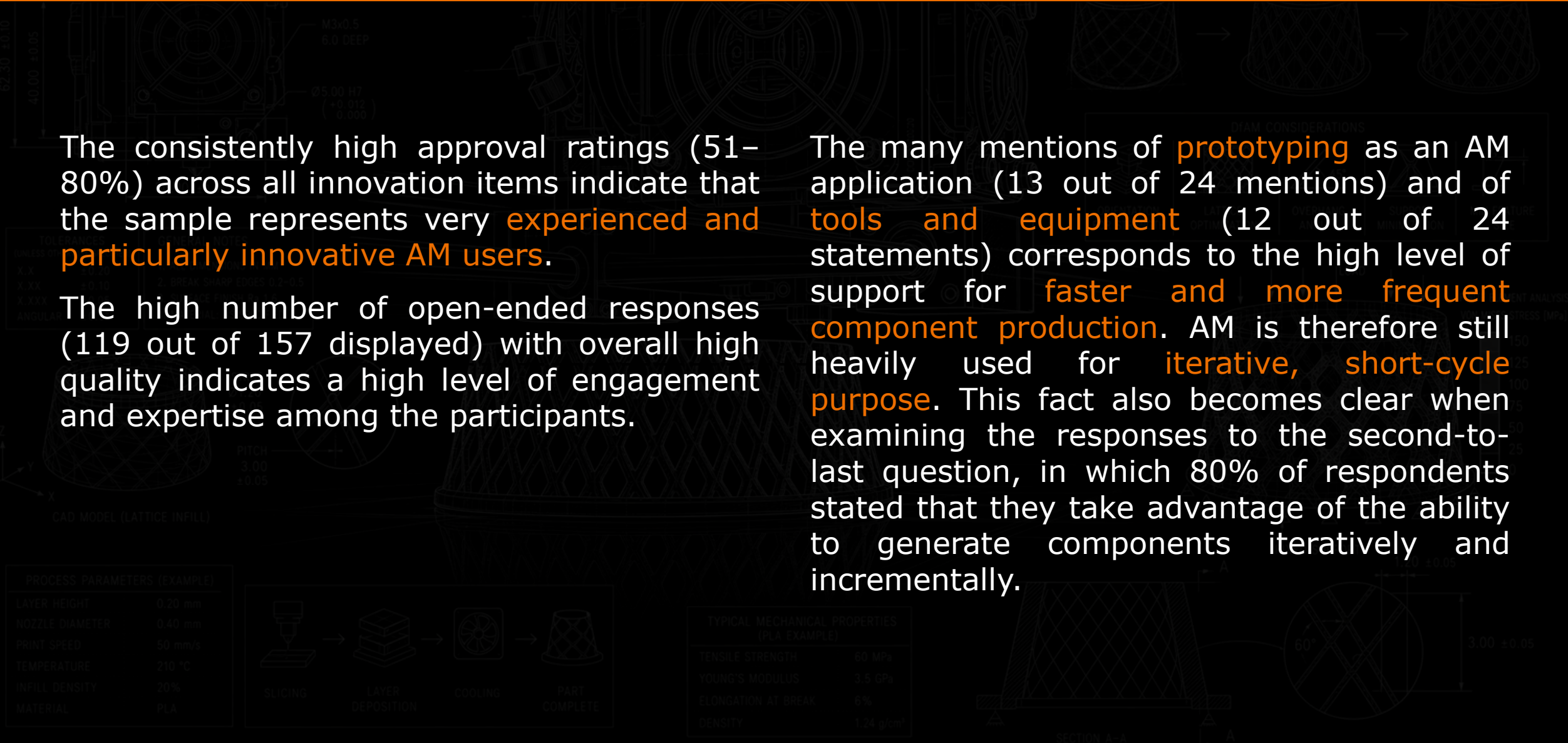
use as *sample components for teaching*

1x

The consistently high approval ratings (51–80%) across all innovation items indicate that the sample represents very **experienced and particularly innovative AM users**.

The high number of open-ended responses (119 out of 157 displayed) with overall high quality indicates a high level of engagement and expertise among the participants.

The many mentions of **prototyping** as an AM application (13 out of 24 mentions) and of **tools and equipment** (12 out of 24 statements) corresponds to the high level of support for **faster and more frequent component production**. AM is therefore still heavily used for **iterative, short-cycle purpose**. This fact also becomes clear when examining the responses to the second-to-last question, in which 80% of respondents stated that they take advantage of the ability to generate components iteratively and incrementally.



Surprised by the results? Interested in solutions for the presented challenges?

Reach out to us!

We're happy to cooperate with companies to jointly develop new insights and bring them into practical application across all our research areas.

Überrascht von den Ergebnissen? Interessiert an Lösungen zu den dargestellten Herausforderungen?

Kontaktieren Sie uns!

Wir freuen uns Kooperationen mit Unternehmen aus der Industrie einzugehen, um neue Erkenntnisse zu entwickeln und in den praktischen Einsatz zu bringen.



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Head of Institute

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[External Collaborations — Institute for Technical Product Development](#)



used methods and metrics

- The answers to the presented items were given through multiple different response types.
- Almost all shown quotes were translated from German.
- For the five shown challenge-items, the participants were asked to indicate their agreement using a 5-point Likert-scale (*strongly disagree, disagree, neutral, agree, strongly agree*). A following sixth item was asking for additional challenges not earlier presented through free-text.
- For the innovation-items agreement was indicated through a binary question with the response options “yes” and “no”. Upon answering with “yes” the participants were shown a free-text field to further describe their implementation of the innovation illustrated.
- The Wilson score interval was used to estimate the confidence intervals (CI) for the observed proportion values, as it provides a more accurate coverage probability than the other intervals, even for small samples or proportion values close to 0% or 100%. All intervals were calculated at a 95% confidence level.

Lead-User theory

In addition to the goal of obtaining a current snapshot of sentiment, the questionnaire was used to identify so-called Lead Users, with the aim of conducting a workshop based on the Lead-User method. This workshop is intended to support the further development and validation of a development framework for AM that is currently under development.

Further literature on the Lead-Users method on which this master's thesis is based:

- Schmidt, T. S. (2019). *Towards A Method for Agile Development in Mechatronics [Dissertation]*. Universität der Bundeswehr München.
- Churchill, J., von Hippel, E., & Sonnach, M. (2009). [Lead User Handbook: A practical guide for lead user project teams](#). Massachusetts Institute of Technology.

Current State of Additive Manufacturing Application in Industrialised Countries (2025)

Already in 2025, a survey was conducted on current challenges in the application of AM at the Institute for Technical Product Development. This study focused in particular on the opinions of engineers and designers, as well as on the application of agile product development principles for additive manufacturing.



[link to last year's study](#)

Thank you! – Vielen Dank!

We would like to thank all respondents for their participation and for providing valuable insights into current innovative practices and challenges related to additive manufacturing in the industry.

Wir bedanken uns bei allen Befragten recht herzlich für Ihre Teilnahme und den wertvollen Einblick auf aktuelle innovative Verhaltensweisen und Herausforderungen im Umgang mit der additiven Fertigung in der Industrie.



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