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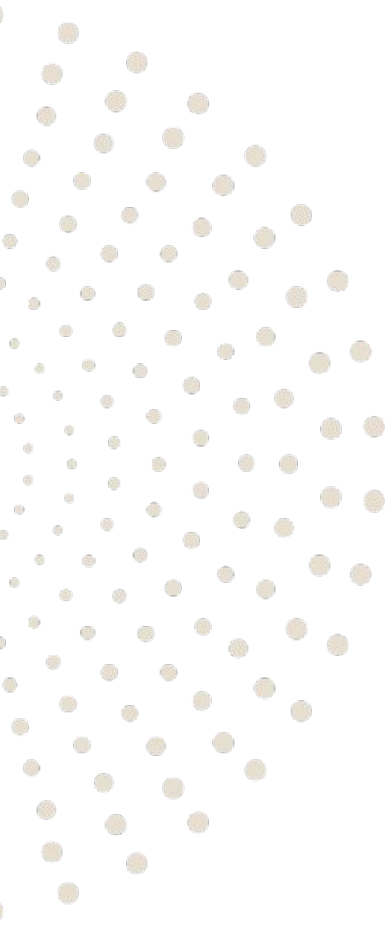
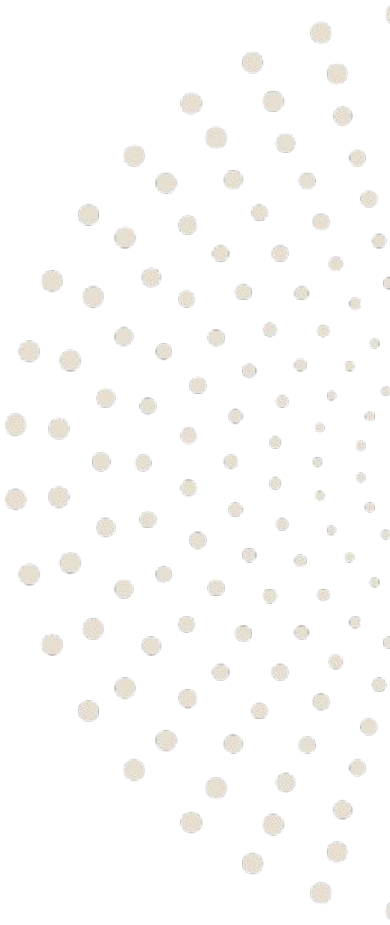
# How companies manage their product costs.

## An empirical investigation of the European industry

Study results





# Giving substance to reality.

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# Preface.

The development, production, and launch of new products is of crucial importance for companies in all industries, but especially in the manufacturing industry to ensure their continuous and sustainable growth.

Since increasingly intense competition in a globalised economy and increased cost pressure due to periods of economic weakness have already been presenting companies with enormous challenges for years, other influencing factors are gaining in importance for the competitiveness of companies. The continuously increasing proportion of software in a large number of technical products not only increases product complexity, but also raises the question of how the development and "production," or purchase, of software can be evaluated in terms of costs, and ultimately optimised. The question of greenhouse gas emissions associated with a product over its entire life cycle will also gain further relevance in the future. How can the carbon footprint of a product be optimised and thus increase sustainability, and what influence does this have on product costs?

This is the second study Strategy Engineers is conducting on product cost management. Compared to our previous study, we broadened the focus to provide an overview of the current and future relevance and application of product cost management in the European industry and identify the right levers to optimize product costs. The results enable companies to question their current cost situation and uncover potential for improving the fulfilment of customer needs, as well as support the achievement of product cost targets.

Munich, July 2021

Arne Petersen
Partner
Strategy Engineers GmbH & Co. KG

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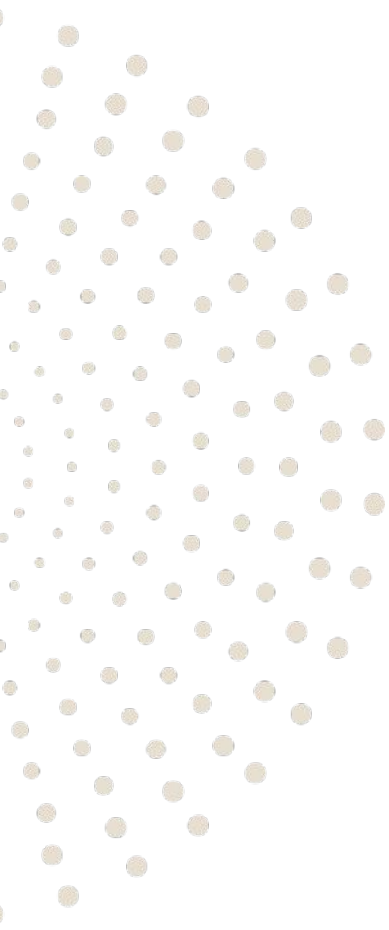


# Management summary.

Comprehensive and systematic product cost management is **essential for the development** of innovative, competitive, and market-oriented products in manufacturing industries with a high volume of series production and/or a high technical complexity. Companies using product cost optimisation (PCO) methods are less affected, and thus better prepared for **challenges in their competitive environment. Therefore, these companies** found their turnover and profit to be **positively influenced** by PCO.

This study shows that the majority of industries apply product cost optimisation throughout the entire product life cycle; however, companies still need to prepare for major future challenges. Among others, we identified that companies do not focus on the **EU emissions trading scheme** sufficiently, although the **financial impact of $CO_2$ emissions** is becoming a bigger part of total product costs. Additionally, it was shown that companies across all industries need to strengthen their focus on the **software part in their products** as this sector continues to grow dramatically. This was shown as the majority of companies still apply traditional PCO methods used for the hardware product life cycle and do not have experience in adapted PCO methods tailored to the significantly different software life cycle.

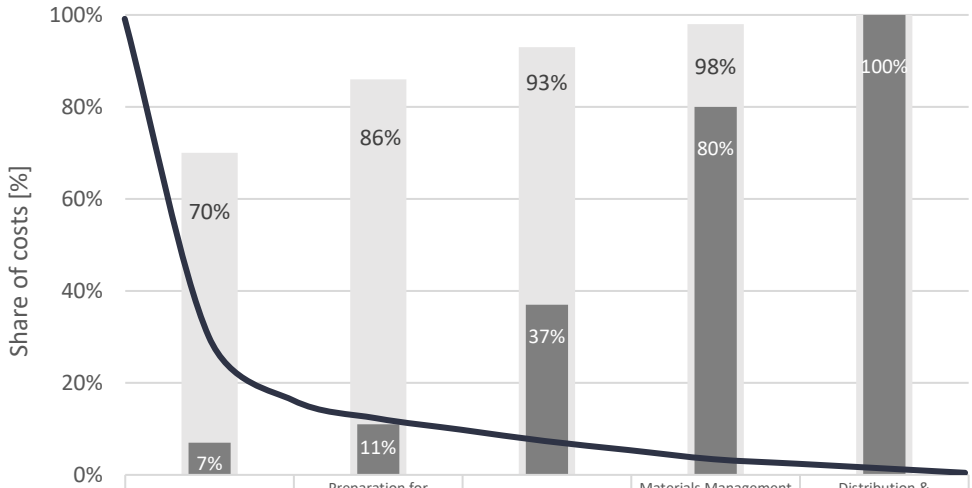
The biggest **possibility for influencing costs** is in the initial phases of the product life cycle, whereas in later phases (series production, purchasing, after sales) around 93 % of total costs are fixed, according to literature. Still, companies apply PCO methods throughout the entire product life cycle; however, ideas developed in late phases usually have a smaller impact on cost savings.

We advise companies to apply a broad spectrum of PCO measures and extend their focus on the identified **future trends**, as we see a strong need to apply **advanced PCO methods** on **software products**, for example. Additionally, future PCO measures need to incorporate not only the social and environmental, but also the financial impact of a product's $CO_2$ emissions, in addition to common financial saving potentials. The chance is now **to take the lead**, creating a major competitive advantage in the coming years.

# Introduction.

## Cost incurrence and locked-in costs

Costs incur throughout the entire product life cycle. However, from a cost reduction perspective special attention should be paid to the early phases of the product development process, as the product will not only be defined technically at this stage, but also a large part of the future costs is determined here. In the first phase, development and design, about 70 % of the product costs are already determined, although only about 9 % of the total costs are incurred, as Figure 1 illustrates (Groggert, 2019, p. 108; Tatarczyk, 2009, p. 26). Accordingly, with increasing progress in the product development process, the possibility of influencing costs continuously decreases, which means that in later phases of value creation, only about 30 % of the costs can be influenced. Thus, the demand for cost reduction and cost optimisation leads directly to the first phases of the product development process, which is often referred to as the "dilemma of product development" in literature (Reischl, 2000, p. 2). This also means that methods for minimising or optimising product costs must be applied primarily in the early phases, as this is where the greatest possibility of influencing costs lies.




| | Development & Design | Preparation for production | Production | Materials Management & Purchasing | Distribution & Administration |
|---|---|---|---|---|---|
| Cost determination (cumulative) | 70% | 86% | 93% | 98% | 100% |
| Cost incurrence (cumulative) | 7% | 11% | 37% | 80% | 100% |
| Possibility of influencing costs | 30% | 14% | 7% | 2% | 0% |

**Figure 1**: Cost determination, cost incurrence, and the possibility of influencing product costs throughout the product life cycle. Own illustration based on Binder (1998, p. 4), Groggert (2019, p. 108), Reischl (2000, p. 2) and Tatarczyk (2009, p. 26).

## Product cost management and optimisation as an instrument for influencing costs

Ecological, economical, and technical challenges, as well as international trade relationships, lead to changes in cost structures and to the necessity to rethink one's own cost management in order to stay competitive. Competitor products often differ only insignificantly in their performance characteristics, so that mature and efficient cost management can represent a significant competitive advantage in practice (Staiger et al., 2019, p. 164).

The optimisation of product costs is often summarised by the terms product cost management and product cost optimisation:

- The term **product cost management (PCM)** describes a cross-departmental creation of transparency about product costs. For this purpose, product cost management spans the entire product life cycle and thus begins even before product development.
- The term **product cost optimisation (PCO)** is a part of PCM and describes technical, process-related, and commercial optimisations on products with the aim of generating saving potentials and reducing the product costs, while satisfying customer needs optimally at the same time.

The topics of product cost management and product cost optimisation represent techniques of cost control in various industries, such as in mechanical and plant engineering, in the automotive industry, in aerospace technology, or renewable energies.

The goal of PCM and PCO is to offer products at marketable prices and to satisfy customer needs. For this purpose, PCM uses various methods and levers, such as target costing, benchmarking, or value analysis (Himme, 2009, p. 1055). Due to the fact that PCM leads to competitive advantage, PCM is often referred to as a "top management topic" in literature (Schröder et al., 2015, p. 57).

Product cost management is a

**top management topic**

# About this study.

## Objective

The current state of empirical research reveals that recent (< 5 years) literature on the topic of product cost optimisation is rare. It is noticeable that most of the published studies exclusively examined the status quo of cost management and that no study deals more closely with the future importance of product cost management. Future trends and other up-to-date topics of digitalisation in regards to PCO were also not discussed in detail in existing empirical contributions. Software is becoming increasingly important as a product component, but product cost management for software has also not yet been examined in studies (Binder, 1998, p. 11; Himme, 2009).

Therefore, the aim of this study is to examine the current and future importance of product cost management in the European industry. Industry-specific differences and an evaluation of successful and less successful companies in regard to PCO will also be carried out. This study will examine six thematic areas (sections) in more detail and answers the following research questions:

### 1. Application of product cost management

- In which technology-focused industries in European is product cost optimisation already in use and in which sectors is it not yet in use?
- How have the EU emissions trading scheme, current digitalisation technologies, and the Corona pandemic affected product cost management in companies?
- Are product cost management methods also applied to software?
- Which economic success indicators have been positively influenced by the use of product cost management or product cost optimisation?

### 2. Challenges in competition

- What specific challenges do companies face in the current competitive environment?

**3. Cost drivers and levers for cost reduction**

- Which cost drivers have been identified and which levers for cost reduction do companies use? What is the difference between the importance assigned to them and their actual use?

**4. Objectives, creating cost transparency, and detection of target deviations**

- What goals do companies assign to product cost management?

**5. IT tools**

- How do IT tools benefit the effectiveness of product cost management within the company?

**6. Management-related success factors**

- Which management-related aspects and measures for the implementation of identified potentials represent success factors for product cost management?

## Methodical approach and sample selection

To answer these research questions, an online survey was conducted with a target group of over 1,000 potential participants. The study was online for 5 weeks and could be accessed completely anonymously via a non-personalised URL. Potential study participants were chosen according to the following criteria:

- **Region:** Europe (in the geographic sense)
- **Sector**: Companies in the manufacturing industry with a high volume of serial production or high technical complexity (e.g. automotive manufacturers, suppliers, aerospace, off-highway, agriculture, maritime, new energy, heavy industry, mechanical engineering...)
- **Department**: Research & Development, Purchasing & Procurement, Management
- **Position**: Head of department, head of division, Vice President, C-level (especially CTO; CEO only in smaller companies with < 100 employees)

## Evaluation method

The dataset was analysed using the statistical software STATA and Microsoft Excel. In addition to univariate frequency analyses, bivariate methods, such as Pearson's correlation analysis, were used to measure the mutual influence of several variables. Significance level-tests were carried out using the Pearson Chi-square test and the established significance level of 0.05.

## Description and structure of the dataset

**80**

evaluable questionnaires

During the survey period, 80 completed and evaluable questionnaires were received.. The response rate was 6.5 %.

The most strongly represented industry (18.0 %) is the "Off-Highway" industry, which includes vehicles that were not developed for road traffic (such as construction machines or agricultural machines). With 13 and 12 returned questionnaires, respectively, and thus a relative frequency of 14.8 % and 12.7 %, the automation sector and the automotive (cars and trucks) follow.

The least represented industry in the dataset is the electronics industry with a relative frequency of 4.2 % (cf. Figure 2).

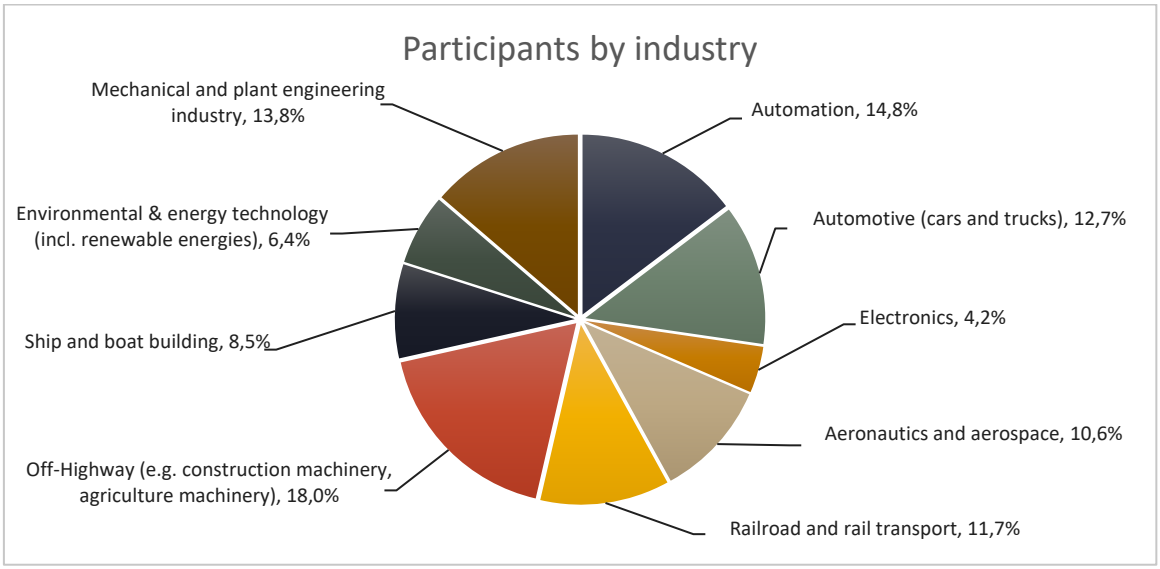



**Figure 2**: Distribution of the industry affiliation of the study participants with indication of the relative frequencies (%)

In terms of company size, 41.2 % of the participants work in companies with 500 - 10,000 employees. Participants from companies with less than 100 and between 100 - 499 employees are

represented with 20 % and 25 %, respectively. The smallest group is made up of participants who work in companies with more than 10,000 employees.

The survey was conducted in Europe (in the geographic sense). The distribution of the main development location of the companies surveyed, shown in Figure 3, reveals that 20 companies have their main development location in Germany. With 13 and 10 main development sites in Italy and Austria, respectively, these two countries are the second and third largest groups in the dataset.

**21**

different European countries are part of the dataset

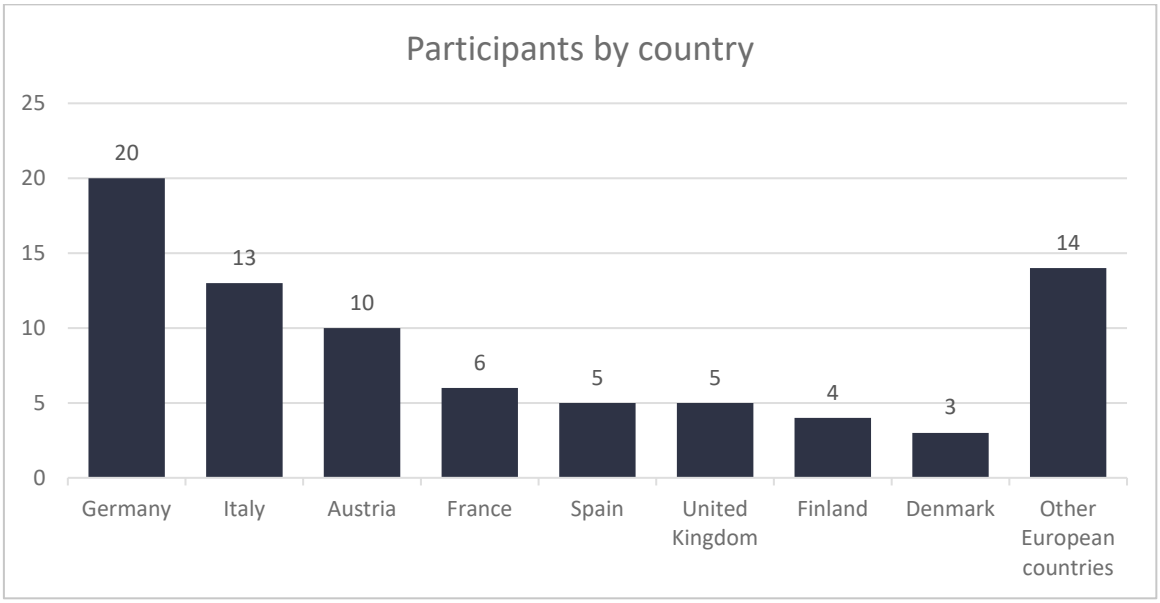



**Figure 3**: Distribution of the main development locations of the participating companies with indication of the absolute frequencies

The most frequently represented corporate division, with 38.7 %, is Research & Development, followed by Purchasing & Procurement (17.7 %), and Management (15.3 %), as shown in Figure 4. The corporate divisions Aftersales & Spare Parts Business and Marketing are not represented in the study sample. Since, according to Reischl (2000, p. 2), the greatest opportunity to influence costs is in the early phases of product development and since cost management is often assigned great strategic importance (e.g. by Schröder, 2012, p. 75), the relatively high response rate from the areas of Research & Development and Management is pleasing, since the highest response competence can be assumed here (Schröder et al., 2015, p. 43).

**38.7 %**

of the answers are from the corporate division of Research & Development

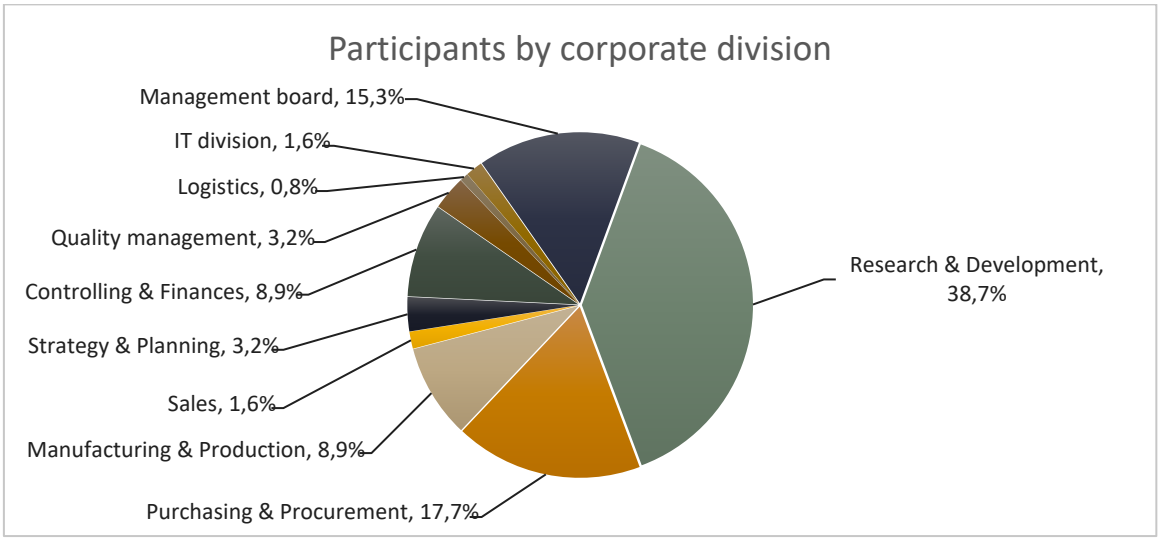



**Figure 4**: Business sectors in which study participants are active, with indication of relative frequencies (%)

An analysis of the positions of the participants in the study shows that the majority of them have decision-making powers and authority to issue directives. In the data sample, directors (27.5 %), head of departments (20 %) and members of the board (16.3 %) are most frequently represented, as shown in Figure 5.

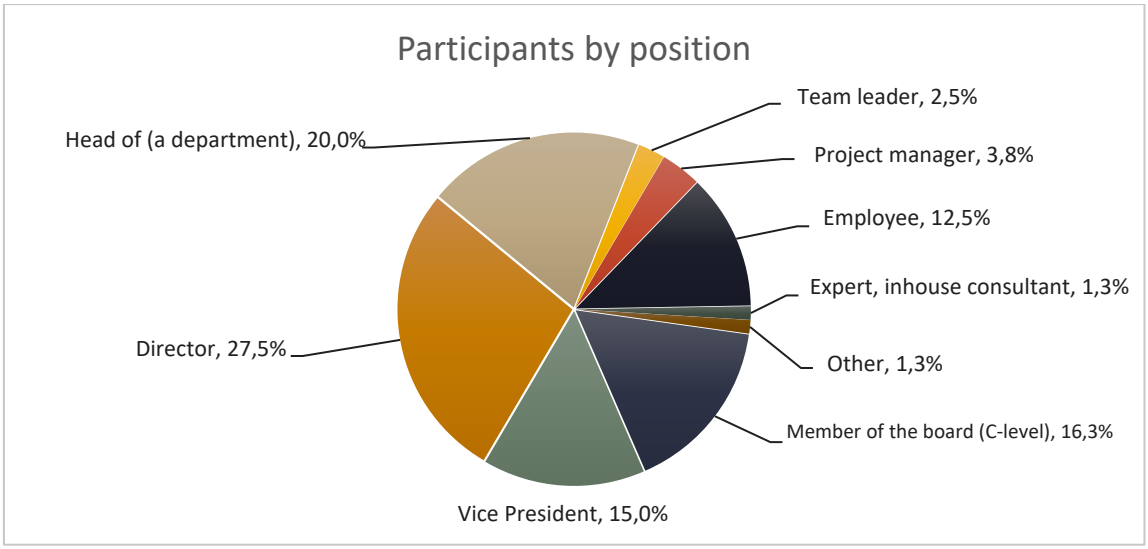



**Figure 5**: Position of the study participants in the company with indication of relative frequencies (%)

An evaluation of the position of the participants according to their companies' size shows a different distribution, as shown in Figure 6. As the size of a company increases, the percentage of department heads and board members becomes smaller, while the percentage of employees and team leaders increases. This circumstance is not particularly surprising, as upper-level managers in large companies are often better "shielded" by assistants, which makes it more difficult to establish contact. This was also shown by some of the reply e-mails to the invitation letters sent by assistants.

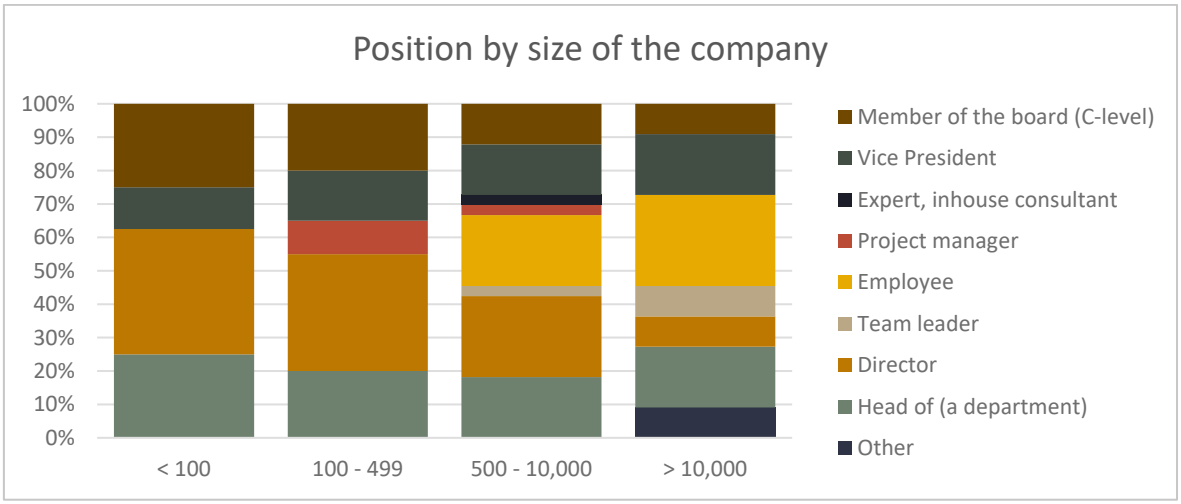



**Figure 6**: Evaluation of the position of the study participants (hierarchical level) according to company size

## Clustering of the study sample

In order to be able to make statements about the success effect of certain study variables such as product cost optimisation levers or applied methods, a study sample is often divided into two groups of companies in success factor research, which are classified as more or less successful on the basis of various success indicators (Herhausen, 2009; Binder, 1998, p. 108).

According to common practice (e.g. in Binder, 1998), turnover and profit in the past 3 years of the surveyed companies are used as success indicators for this study. Where exactly the dividing lines between successful and less successful companies is, can be determined by a cluster analysis, a so-called structure-discovering statistical procedure. "*This clustering is done in such a way that companies are combined into groups that are as homogeneous as possible with regard to the examined characteristics of turnover and profit development and at the same time as clearly distinguishable from each other as possible.*" (transl. from Binder, 1998, pp. 108-109).

**43**
successful and

**21**
less successful companies were identified in our dataset

The cluster analysis was carried out using the algorithm "K-Means-Cluster" in the statistical software STATA. Figure 7 illustrates that the mean values of the two clusters are clearly different from each other: with a mean value of 3.6 for turnover and 3.5 for profit, the cluster of successful companies saw both variables increasing in the past 3 years. Respectively, companies in the less successful cluster saw their turnover and profit decreasing in the past 3 years.

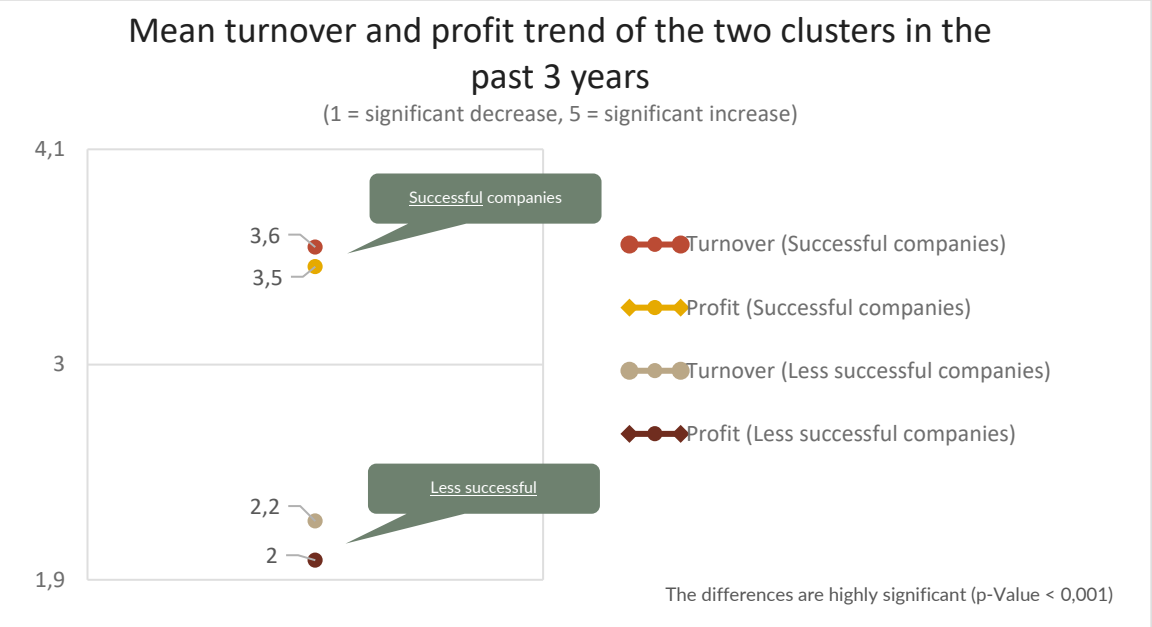



**Figure 7**: Division of the study sample into successful and less successful companies according to turnover and profit as a result of a cluster analysis

# Results.

The following chapter presents the results of the analysis of the research sample with regard to the previously defined research questions. The results and further analyses are structured according to six thematic areas of the research questions (sections). At the end of each section, the main statements are summarised and conclusions are drawn.

## 1. Application of product cost management

This section covers the following topics:

1.1. Industry-specific differences in the application of PCO
1.2. Influence of the EU emissions trading scheme
1.3. Digitalisation technologies and their introduction to support PCM
1.4. Influence of PCM and PCO on profit and turnover
1.5. Product cost management during the Corona pandemic
1.6. PCM for software

### 1.1. Industry-specific differences in the application of PCO

There are industry-specific differences in the application of product cost optimisation and its methods. Figure 8 shows the application of product cost optimisation broken down by industry (companies that are active in several industries were summarised under "several industries"). Based on our study results, 100 % of the companies in the industries "environmental and energy technology," “Off-Highway,” and “Aeronautics and aerospace” apply product cost optimisation, while only 50 % of the companies in the industries "ship and boat building,", "electronics," and "automation" apply product cost optimisation. However, these results must be interpreted with caution, especially in the case of industry groups with a small basic population (especially the "electronics" industry), as it does not allow any conclusions to be drawn about the entire industry due to the small number of participants in the respective group. Nevertheless, a clear industry-specific difference can be recognised. Using the Pearson chi-square test, a significant correlation between industry and application could be determined.

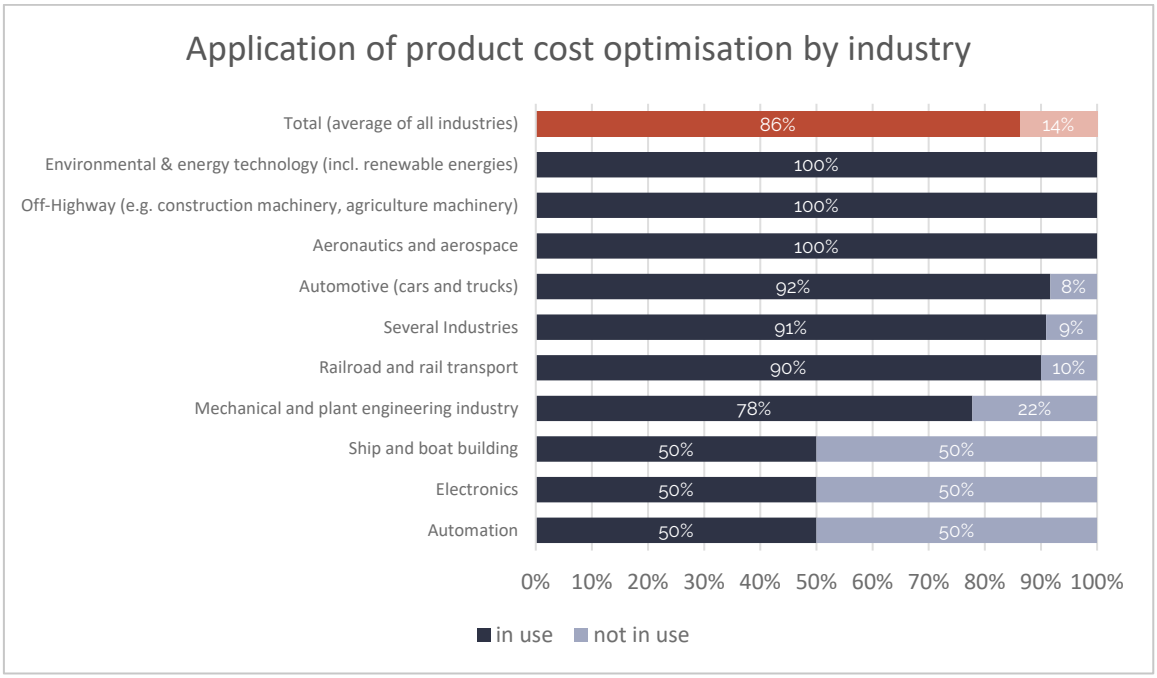



**Figure 8**: Application of product cost optimisation in participants' companies by industry (with indication of absolute frequencies)

### 1.2. Influence of the EU emissions trading scheme (EU ETS)

The EU emissions trading scheme, with the goal of lowering greenhouse gas emissions, is a prevailing topic. As we expect the financial impact of $CO_2$ on products to rise, the EU ETS is an area of interest for reducing costs and therefore for PCO. Figure 9 graphically illustrates that from a financial as well as from an environmental & social perspective, the majority of the participants rate the influence of the EU ETS ("$CO_2$ price") on the profitability of their products as high (with a rating of 4 on a 5-point scale). Almost all companies see themselves influenced by the EU ETS (with a rating of 2 or higher).

**72 %**

of the surveyed companies have not yet introduced $CO_2$ reduction systems

While a majority of the participants indicate an impact of the EU ETS on the profitability of their own products, the question arises whether systems to reduce greenhouse gas emissions have been introduced in the companies. It is noticeable, as shown in Figure 10, that only 16 companies have already introduced systems to reduce greenhouse gas emissions from a financial point of view, while 20 companies have already introduced systems due to their environmental & social responsibility. 51 companies, or 72 %, have not yet introduced $CO_2$ reduction systems (neither from a financial nor from an environmental & social perspective) despite of its big influence on the profitability of products.

Conclusion (at the end of this 1.2

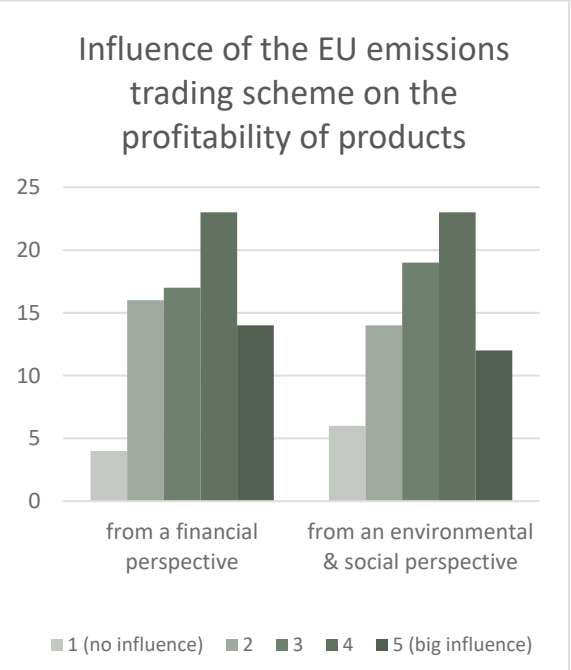



**Figure 9**: Participants' assessment of the impact of the EU ETS on the profitability of their products

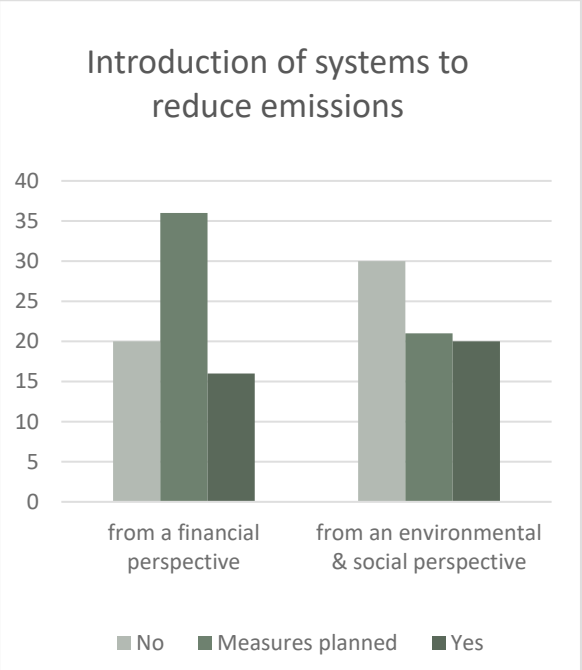



**Figure 10**: Introduction of systems to reduce greenhouse gas emissions in participants' companies

### 1.3. Digitalisation technologies and their introduction to support PCM

Apart from the EU emissions trading scheme, current trends in digitalisation represent another prevailing topic. The following three digitalisation technologies can play a key role for product cost management in the following areas and are investigated in more detail:

- **Augmented Reality**: e.g. for displaying a virtual parts table, for visualising components
- **Artificial intelligence**: e.g. automated finding of optimisation potentials and evaluation of whether their implementation is worthwhile
- **Use of Big Data analyses**: e.g. analysing raw material prices and purchasing at the optimal time or evaluating real-time data

**> 50 %**

of the surveyed companies have not yet introduced digitalisation technologies to support product cost optimisation

whereas participants' rate these technologies as

**important**

As seen in Figure 11, only a small proportion of the participants rate current digitalisation technologies as unimportant for product cost management. Big Data analyses are assigned with the greatest importance, followed by Artificial Intelligence and Augmented Reality. The adoption of these technologies differs significantly from their assigned importance, as Figure 12 illustrates. All three technologies are predominantly not used in companies. With 34 companies in which Augmented Reality has already been introduced or will soon be introduced, this trend is the most widespread one among those analysed. Augmented Reality is followed by Big Data analyses with 25 and Artificial Intelligence with 23 planned or already implemented introductions.

Accordingly, a clear discrepancy can be observed between the assigned importance and actual introduction of digitalisation technologies in companies: Digitalisation, in the area of PCO, is recognised as important by the majority, but is not in use in most companies.

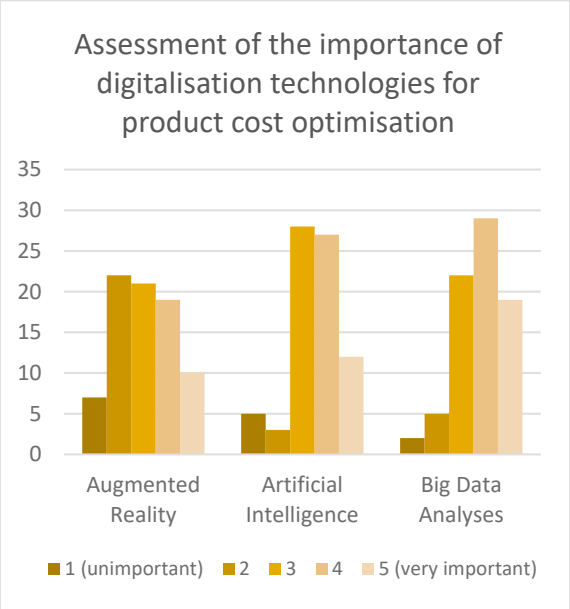



**Figure 11**: Participants' assessment of the importance of current digitalisation technologies in relation to product cost management

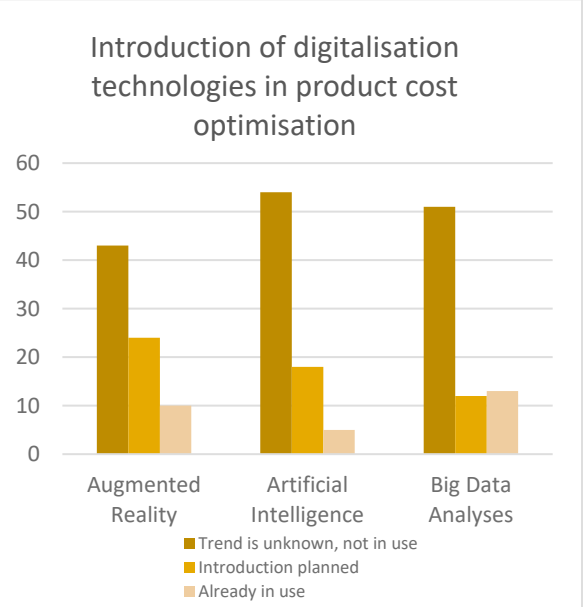



**Figure 12**: Introduction of digitalisation technologies to support product cost management in surveyed companies

The introduction of digitalisation technologies in PCO within the surveyed companies is strongly dependent on the industry as shown in Figure 13. Augmented reality in PCO is predominantly used by companies in the aerospace, mechanical & plant engineering as well as in the environmental & energy technology sectors. Artificial intelligence and big data analyses in PCO are also used by the majority of companies in the environmental & energy technology sector. If the frequencies of all three technologies are added up, it becomes apparent that both in absolute and relative frequencies the following sectors have the greatest degree of maturity with regard to digitalisation technologies:

- Mechanical & plant engineering,
- Environmental & energy technology and
- Automotive (cars, trucks).

In our data sample, the ship- & boatbuilding industry has no digitalisation technology in use. Artificial intelligence and big data analyses are also currently not in use in the automation and electronics sectors.

There are
**major**
industry-specific differences in the use of digitalisation technologies.

This analysis shows that there are major industry-specific differences in the use of digitalisation technologies to support product cost optimisation. Furthermore, it was examined whether there is a connection between successful and less successful companies with regard to the use of digitalisation technologies. However, no significant difference was found between these two groups.

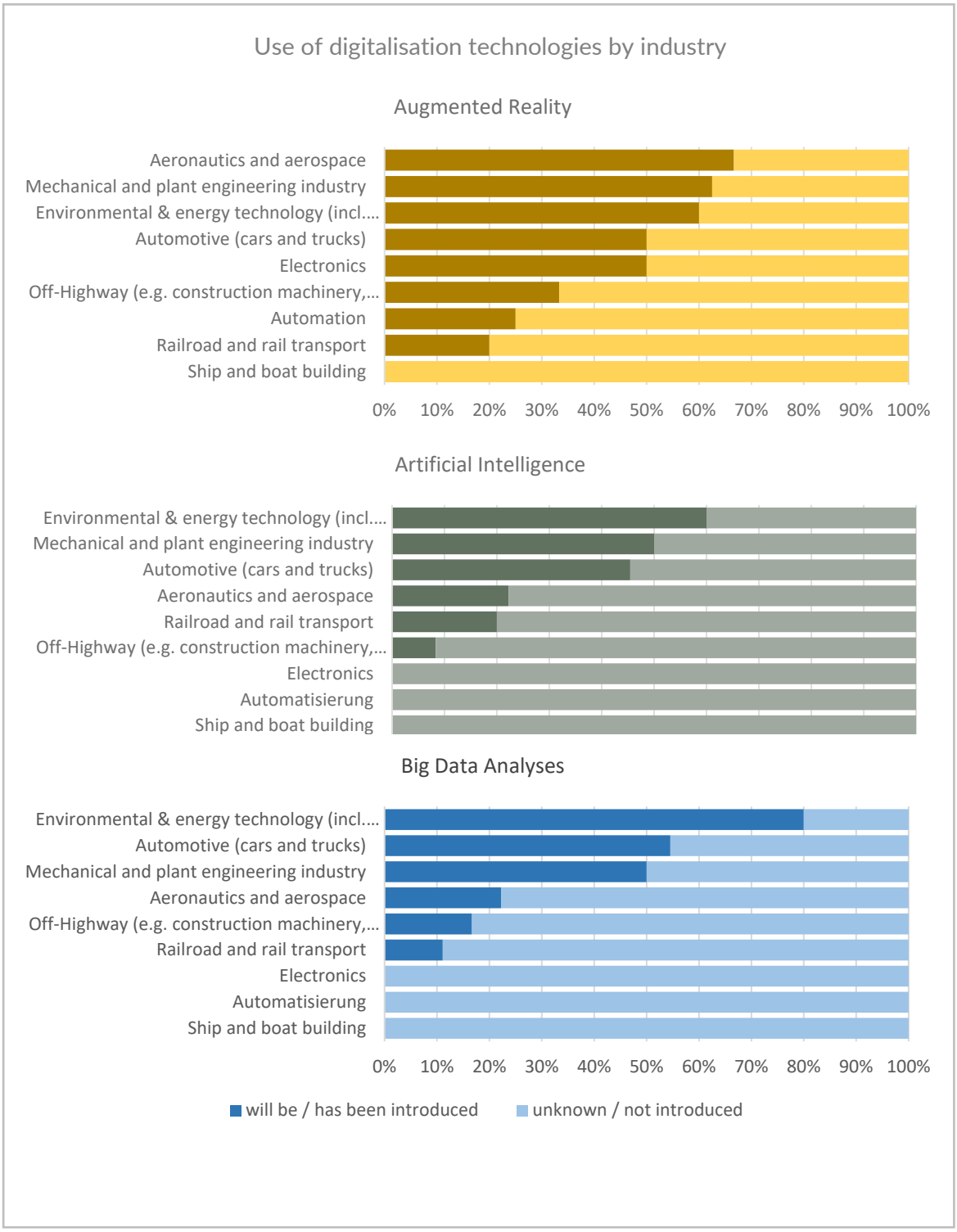



**Figure 13**: Use of digitalisation technologies to support product cost management by industry with indication of relative frequencies (%)

### 1.4. Influence of PCM and PCO on profit and turnover

Our survey revealed a positive influence of product cost management or product cost optimisation on the profit and turnover of the participants' companies. As Figure 14 illustrates, the majority of the participants rate this influence with “4” on a 5-point scale. Only one person indicates that product cost management or product cost optimisation has no influence on profit and return on sales. With a mean of 3.4 for profit and 3.5 for turnover, these two performance indicators were on average positively influenced by product cost management and product cost optimisation. Most participants also state that the effort put into product cost optimisation initiatives is lower than the savings achieved.

Product cost management and product cost optimisation increase

**profit and turnover**

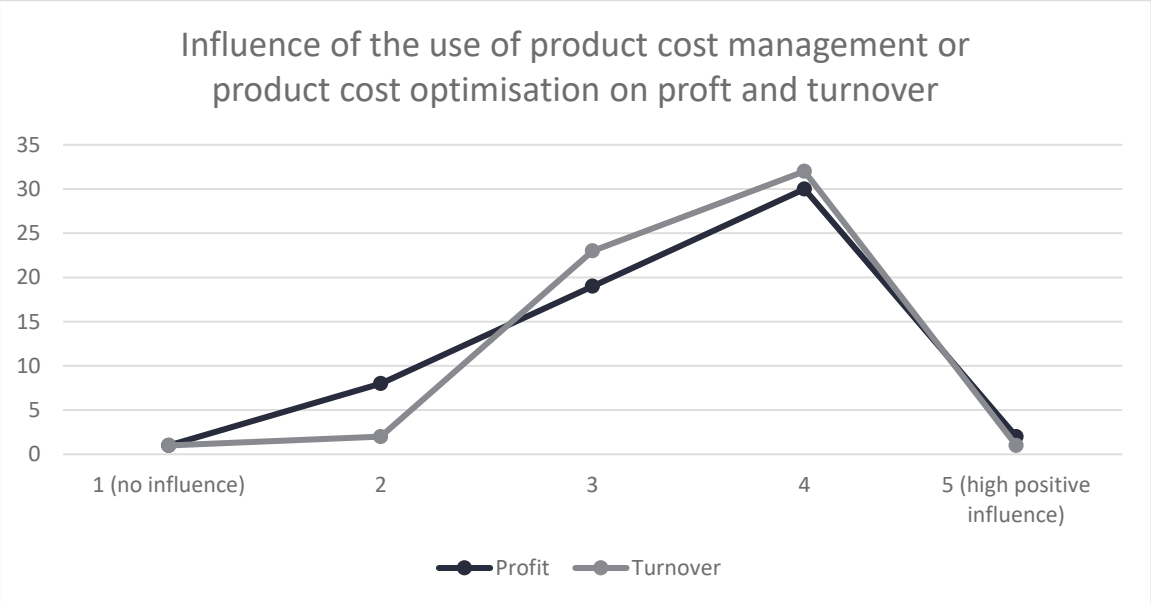



**Figure 14**: Influence of profit and turnover through the use of product cost management and product cost optimisation measures in the participants' companies (with indication of the absolute frequencies)

### 1.5. Product cost management during the Corona pandemic

The Corona pandemic posed a major challenge for companies around the world. The participants were asked whether their product cost management activities had changed as a result of the Corona pandemic. On a scale of 1 (activities strongly reduced) to 9 (activities strongly expanded), the participants could select this accordingly. With a mean of 5.6, it can be stated that on average the activities in product cost management have been slightly expanded due to the Corona pandemic. However, the influence on PCO was

Companies expanded their product cost management efforts slightly during the

**corona pandemic**

less than one may expect, as especially in periods of economic weakness companies are considered to expand their PCO efforts.

There were no significant differences between the clusters of successful and less successful companies.

### 1.6. PCM for software

Nowadays, there is hardly an industry sector in which software does not play a key role. The automotive software market, for example, is supposed to grow by over 148 % between 2020 and 2026 (from $17 bn to $42 bn) (Allied Market Research, 2021). Since software is becoming an increasingly important component of products, the question arises whether product cost management is also applied to software.

**67 %**

of surveyed companies do not use PCO in software development

As Figure 15 shows, product cost management is currently not applied to software in 67 % of the companies. In 24 % of the cases, an introduction is planned, and in only 9 % of the cases, product cost management is already used for software. In the latter two cases, 72 % of the participants state that product cost management is applied according to the same methods and processes as for hardware, while in the other 28 %, other PCM methods and processes are applied to software.

Conclusion 1.6
(at the end of this

We see a big potential to introduce adapted PCM methods and processes for software in companies, as 91 % of the surveyed companies are not yet using product cost management for software.

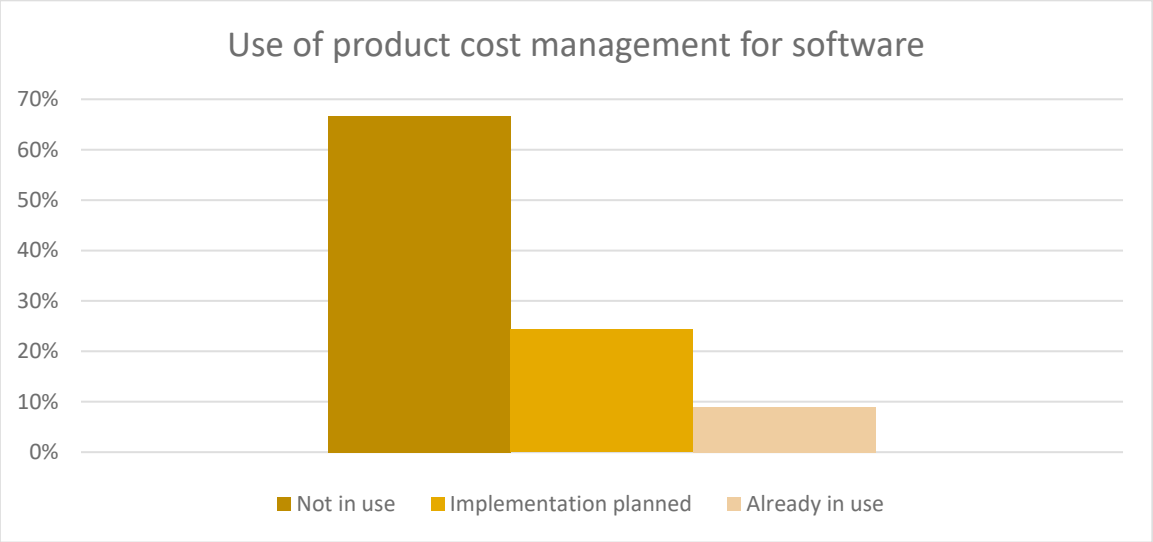



**Figure 15**: Application of product cost optimisation to software (with indication of the relative frequencies, %)

## Conclusions

1.1 There are clear **industry-specific differences** in the application of product cost optimisation.

1.2 Companies assess the influence of the **EU emissions trading scheme** on the profitability of their products as medium to high. The majority (72 %) of the surveyed companies have not yet introduced systems to reduce greenhouse gas emissions.

The cap of the EU emissions trading scheme represents the maximum amount of greenhouse gases that can be emitted over a year. This cap is reduced over time and will force companies to either reduce their emissions, switch to sustainable forms of production or buy extra $CO_2$ certificates from other emitters (European Commission, 2016). Other countries outside of the EU are developing similar emissions trading systems as well. Additionally, the declining cap of available emission certificates within the EU will further push companies to reduce their emissions and invest in sustainable forms of production to stay competitive.

Therefore, future PCM and PCO projects need to focus not only on the monetary savings of individual measures, but must also analyse potential negative impacts on $CO_2$ emissions resulting in extra costs.

1.3 A clear discrepancy can be observed between the assigned importance and actual introduction of PCO **digitalisation technologies** in companies. All the questioned technologies are attributed a high level of importance by the participants, but the actual digitalisation technologies have only been introduced in a few companies. Hardly any companies in the automation, electronics, and ship- and boatbuilding sectors use digitalisation technologies to support their PCM.

1.4 Companies state that the use of product cost management has positively influenced their **profit and turnover** in the past 3 years.

1.5 Companies **expanded** their product cost management efforts **slightly during the Corona pandemic**

1.6 The **software market** will grow dramatically over the next years as the software portion of classic products (e.g. ADAS features in vehicles) will increase significantly (Germany

Trade & Invest, 2021). Most companies are not using product cost management on software yet as stated by 66 % of the participants in our study. As software development itself is still not fully incorporated in engineering companies, the focus currently lies in building up knowledge and organisational structures. However, increasing necessity of software related products in all areas and pressure from high-tech IT companies entering the market will make it inevitable to focus also on software cost management and optimisation soon.

Software does not follow the “classical” product life cycle of hardware products, as most of the development costs arise in the initial Development & Design phase (cf. Figure 1). In software development, there is no "hardware" on the basis of which, for example, raw materials can be calculated. That is why conventional methods are difficult to apply to software. 9 % of surveyed companies apply PCO in software development. Of those companies, 73 % still use the same PCO methods and processes as used in hardware development. Only 6 companies in our sample are using adapted methods and processes tailored to software. This results in the need for adapted PCM methods and processes to be developed and introduced for software to use available resources in software cost management efficiently and effectively.

## 2. Challenges in competition

This section covers the following topics:


2.1 Challenges in competition by successful and less successful companies

2.2 Challenges in competition by the use of PCO


### 2.1. Challenges in competition by successful and less successful companies

Figure 16 illustrates the distribution of responses by challenge and by successful and less successful companies. When ranking the different challenges according to their mean value, we were able to identify the four biggest challenges (in descending order):

- Impact of the Corona pandemic
- Products not properly designed for production (e.g. complicated manufacturing processes, complex geometries and undercuts, only low level of automation possible...)
- Too long of "time-to-market" for innovations
- Quality problems

In contrast, the sustained decline in demand and the fact that customer needs in terms of quality and function are not met were identified as the smallest problems on average.

Successful companies face **less challenges** in competition

As stated above, we distinguished between two groups in our data sample: successful and less successful companies. Almost all challenges represent a greater challenge for less successful companies than for successful companies (cf. Figure 16). Especially for the two challenges “Effects of the Corona pandemic” and “Lasting decline in demand,” a significant difference between both groups could be proven: successful companies are less often confronted with these external problems. Nearly all other challenges pose smaller problems for successful companies compared to less successful ones as well, but with a smaller difference between both groups. There is only one challenge that poses a greater problem for successful companies: the impact of the EU emissions trading scheme.

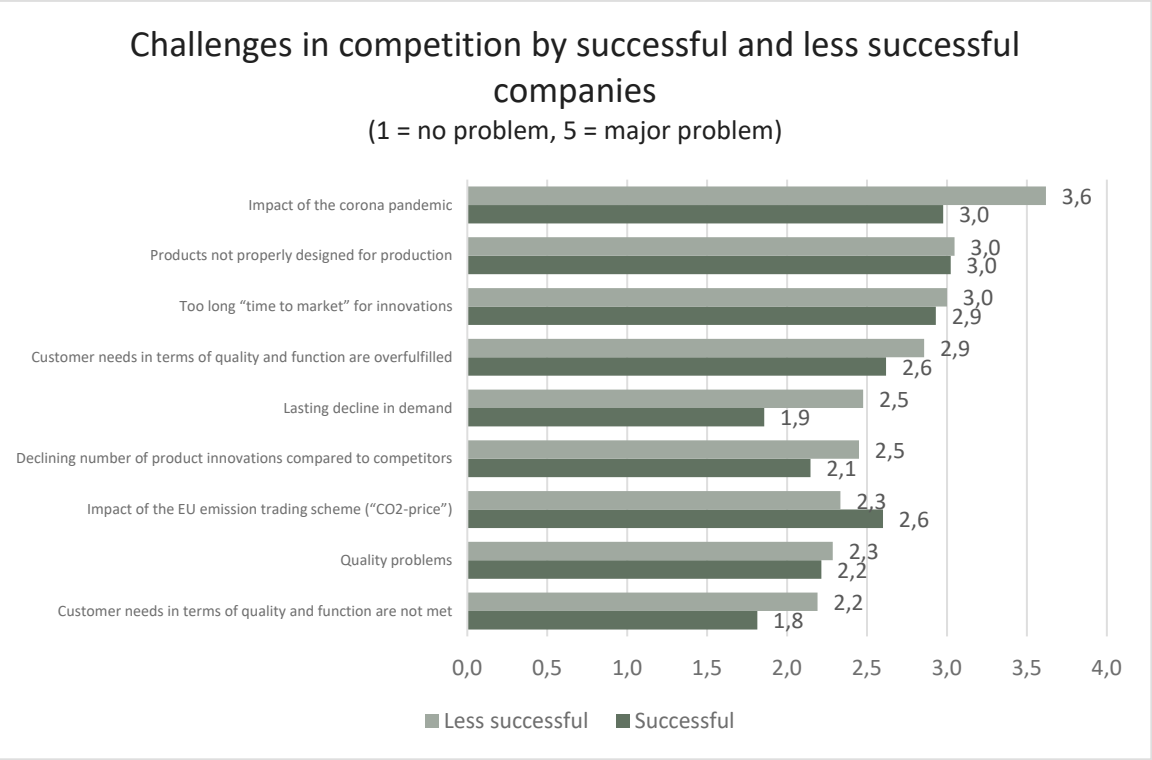



**Figure 16**: Mean values of various competition problems subdivided into successful and less successful companies

## 2.2. Challenges in competition by the use of PCO

Companies using PCO face

**less challenges**

in competition

While different challenges in competition pose a smaller problem for successful companies, we also investigated the influence of the use of PCO on challenges in competition. There is a difference in the extent of challenges in competition between companies using PCO and those that do not, as Figure 17 suggests.

The following four challenges in competition pose a smaller problem for companies using PCO on average:

- Impact of the Corona pandemic
- Too long of "time to market" for innovations
- Customer needs in terms of quality and function are overfulfilled (Overengineering)
- Lasting decline in demand

On the other hand, companies using PCO are more often confronted with products that are not properly designed for production, a declining number of product innovations compared to competitors, and quality problems.

Conclusion (at the end of this 2.2)

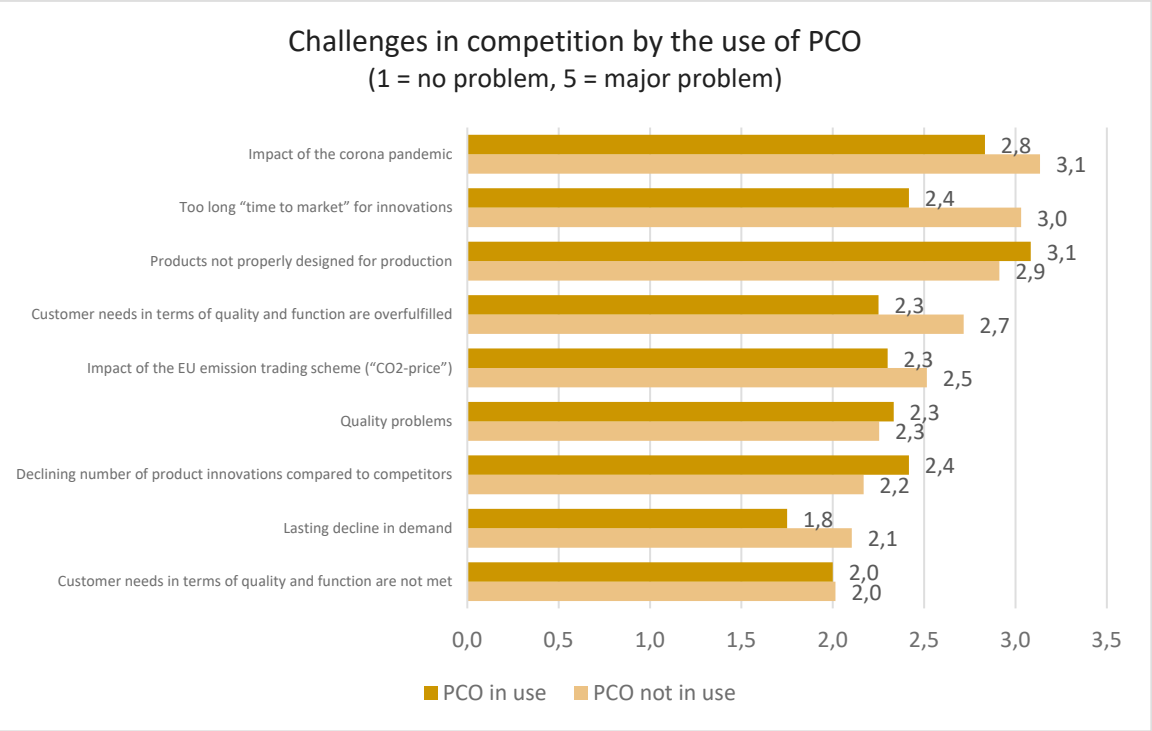



**Figure 17**: Mean values of various competition problems subdivided by to the use of PCO in the company

## Conclusions

2.1 According to our survey results, companies applying PCO are **less affected by strong competition** compared to companies who do not apply PCO methods yet. It's important to note that we see those companies not confronted with less competition, but they are rather better prepared for competitive challenges. Therefore, it can be concluded that PCO methods have a positive impact on tackling challenges in a highly competitive environment.

2.2 Our results outlined three **competitive challenges** that affect companies using PCO more:

- Declining number of product innovations compared to competitors
- Products are not properly designed for production
- Quality problems

This observation might be surprising at first glance, as we didn't expect the application of PCO to be the root cause of the above mentioned challenges. From our experience, we see the following explanations:

1. Companies using PCO might bind too many resources in PCO related tasks which usually work on product innovation and design topics.
2. Companies using PCO might be under severe financial pressure and therefore are forced to take out costs without having subsequent implications in both quality and production in focus.

Companies experiencing similar issues when using PCO in their organisation might consider bringing in external expertise that help generate a holistic view on measures.

## 3. Cost drivers and levers for cost reduction

This section covers the following topics:


3.1 Levers for cost reduction

3.2 Usage of PCO methods in phases of the product life cycle

3.3 Cost drivers


### 3.1. Levers for cost reduction

We investigated three groups of cost reduction levers: commercial, process-related, and technical levers. Each group consists of several individual levers, split by their use and importance in successful and less successful companies.

It turns out that there is no lever which is not used in surveyed companies. In particular, less successful companies use levers more frequently on average than successful companies, as Figure 18 illustrates. For some levers, the discrepancy between less successful and successful companies was particularly high. The following levers are significantly more often used by less successful companies:

- Commercial levers
  - Elimination of intermediate suppliers
  - Make-or-buy decisions
- Process-related levers
  - Activity-based costing
  - Consolidation of services (shared services)
- Technical levers
  - Reduction of complexity
  - Optimisation of product packaging

In comparison, the following three levers are used least often on average in all surveyed companies:

- Consolidation of services
- Standardisation of the service offer
- Reduction of greenhouse gas emissions

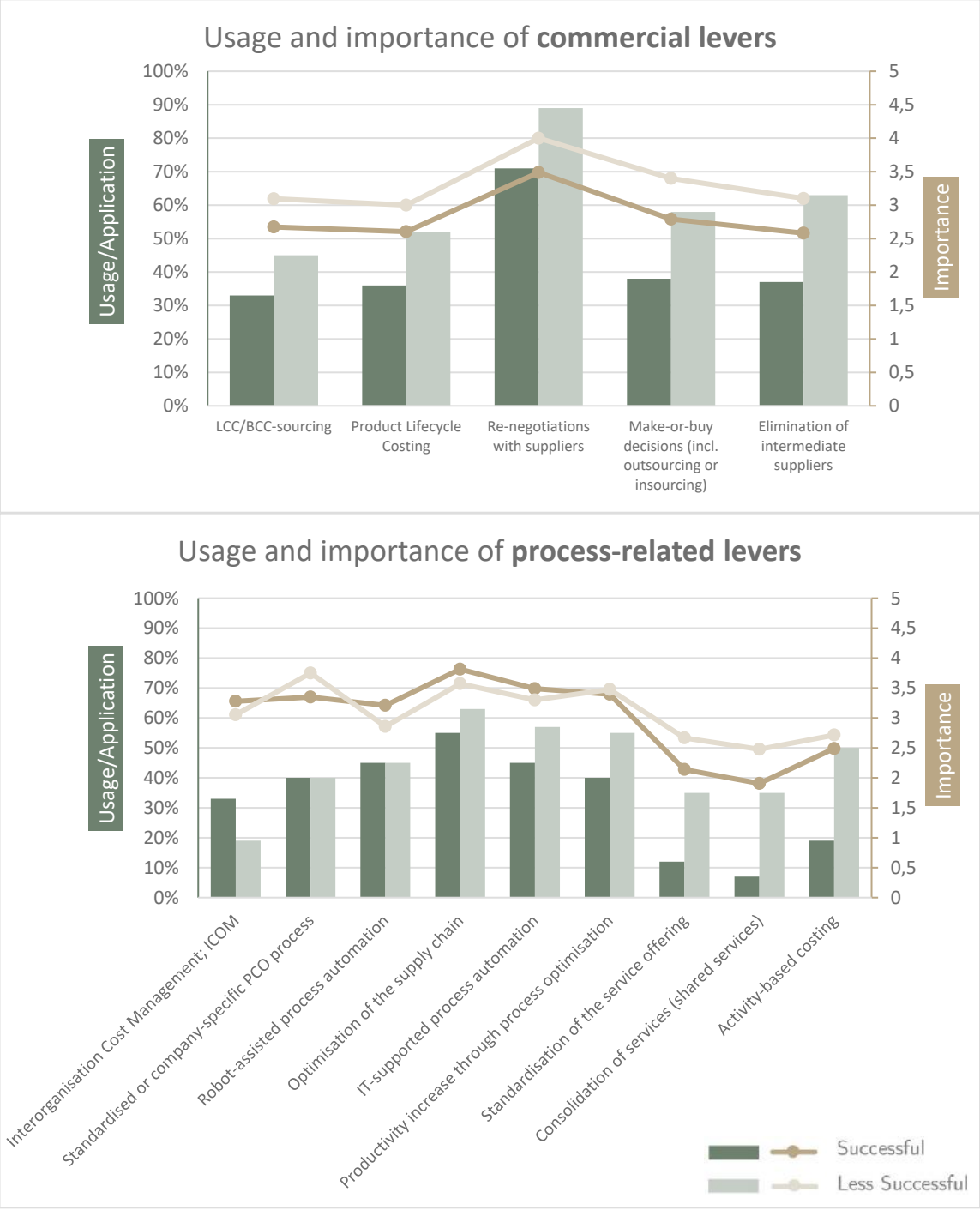
The only lever that is significantly more often used by successful companies is ICOM (Interorganisational Cost Management), which aims to apply cost optimisations methods across company boundaries in the entire value chain (Uddin, 2013, p. 89-90).

Successful companies use

**ICOM**

more often

Apart from solely looking at the application of levers, the participants were also asked to rate their importance for reducing costs in general. We found that "reduction of greenhouse gas emissions" is only used by less than 20 % of the successful and less successful companies, but was recognised as a high importance for cost reduction. The levers “establishing a modular product architecture” and “reduction of variants” also shows a high importance but rather low usage.



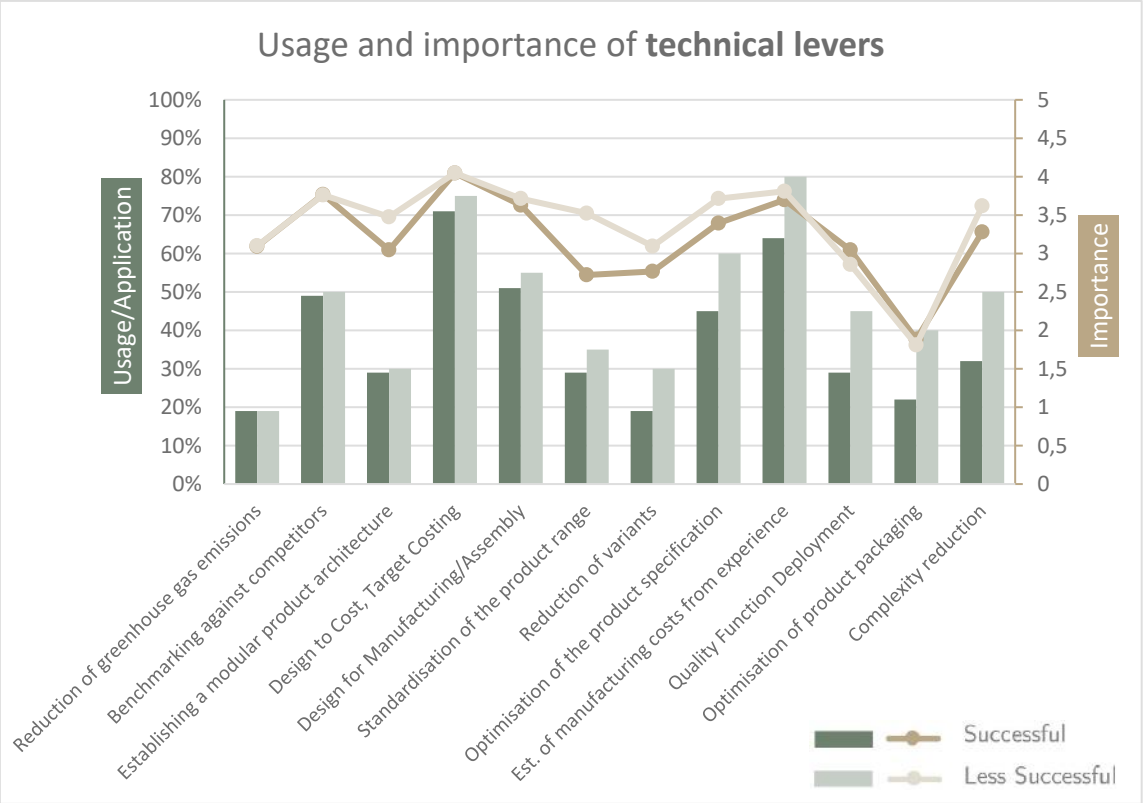



**Figure 18**: Overview of the use of cost reduction levers (mean values) and their importance assigned by the participants (mean values), broken down by successful and less successful companies

### 3.2. Usage of PCO methods in phases of the product life cycle

The call for cost reduction and cost optimisation leads directly to the first phases of the product development process, as **Figure 20** illustrates. Figure 19 shows, that on average a majority of the companies surveyed have product cost optimisation measures in place in nearly all phases of the product life cycle and cost deviations are detected predominantly in the detailed construction and production start-up phase. In detailed construction and series development, the highest application of PCO methods can be observed, while around 40 % of companies detect target deviations. 50 % of companies detect target deviations in the production start-up phase, but only about 30 % of companies apply PCO methods in this phase. This discrepancy may look surprising at a first glance, but as the production start-up phase is comparatively the shortest phase, Figure 19 shows that companies start applying PCO methods in the subsequent phase to a much greater extent.

In all phases, except detailed design, series development, and the purchasing and procurement phase, PCO methods are used to a greater extent in less successful companies.

**64 %**

of the surveyed companies use PCO methods in series production, while only

**7 %**

of total product costs can be influenced here anymore

Conclusion 3.2
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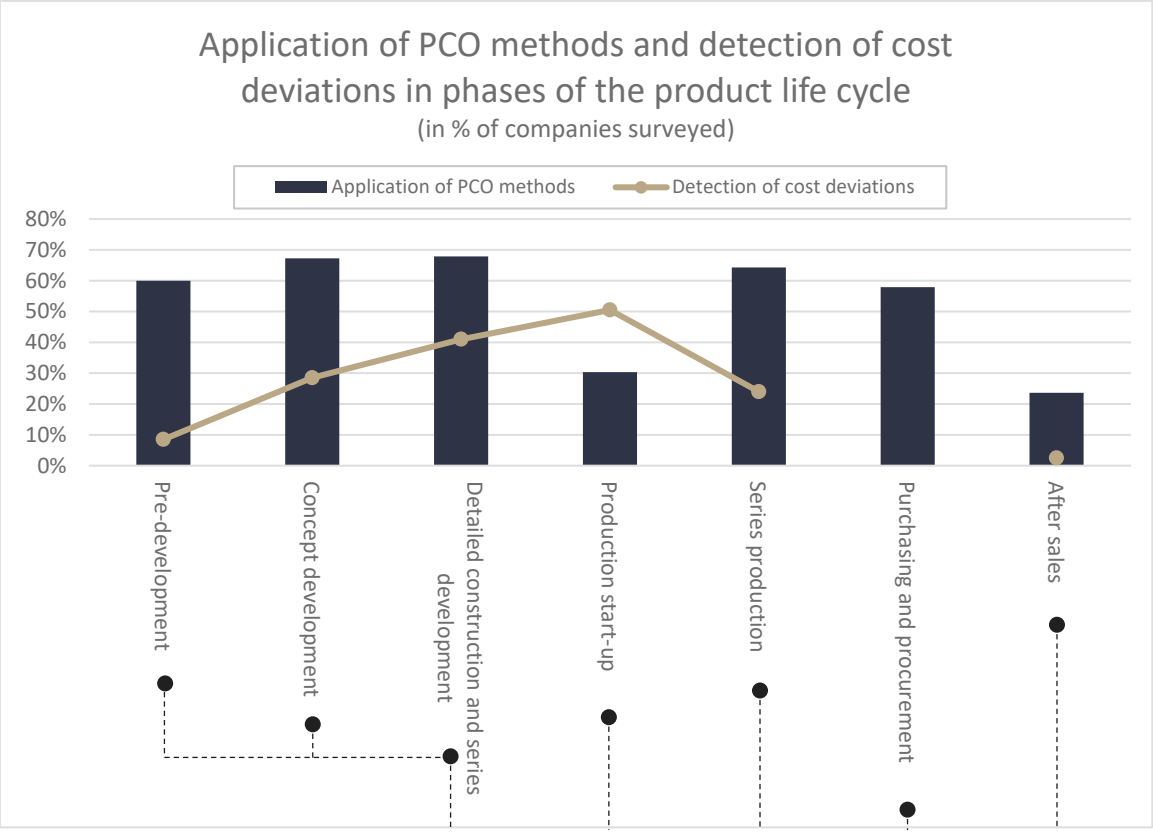



**Figure 19**: Application of PCO methods and detection of target deviations (with one missing value in the purchasing and procurement phase) by phases of the product life cycle

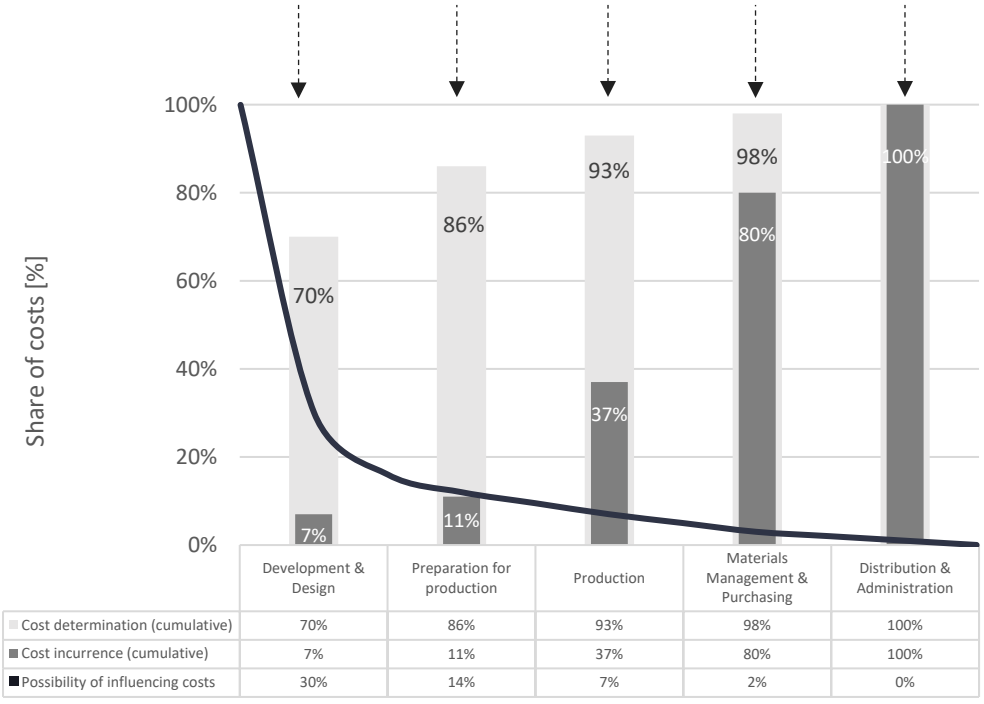



**Figure 20**: Cost determination, cost incurrence and possibility of influencing product costs throughout the product life cycle. Own illustration based on Binder (1998, p. 4), Groggert (2019, p. 108), Reischl (2000, p. 2) and Tatarczyk (2009, p. 26).

### 3.3. Cost drivers

Beside the cost reduction levers and the examination in which phases PCO methods are used, cost drivers are another important aspect when investigating potentials for cost reduction.

The three biggest cost drivers are materials, personnel, and production. Variants, standards & regulations, and changes are only a cost driver for about 20 % of the companies. Logistics, warranty, and service represent a cost driver for only less than 10% of the companies. It is interesting to compare these results with the results of Behncke et al., (2016), which examined exactly the same 10 cost drivers in 2016. Basically, the course of the curve is similar in both studies (cf. Figure 21). However, it is noticeable that in the last 5 years, personnel in particular has become a cost driver for significantly more companies. According to our results, manufacturing and materials also represent a greater cost driver than was the case 5 years ago.

Workforce and labor is

**20 %**

more often considered to be a cost driver compared to 2016

The cost drivers were also examined for a correlation between successful and less successful companies. However, no significant correlation was found.

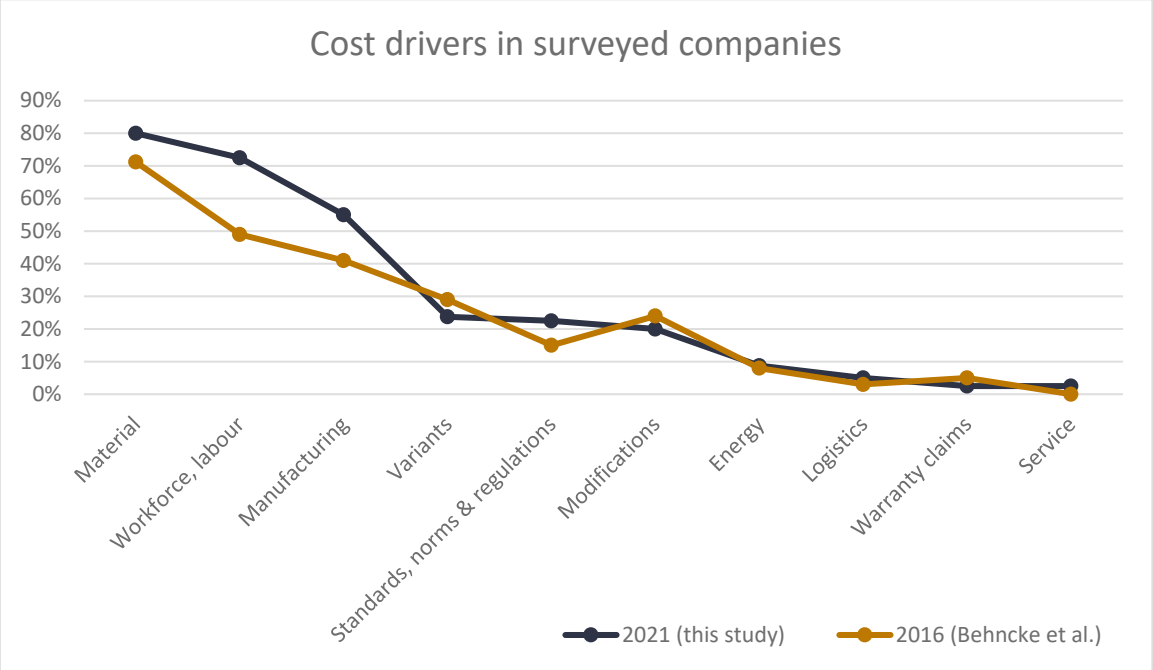



**Figure 21**: Cost drivers in surveyed companies of this study with comparison to the results of Behncke et al. (2016)

## Conclusions

3.1 As expected, our results show that less successful companies **apply most levers** more frequently as these companies have a stronger need of improving their own financial situation.

As mentioned before, the EU emissions trading scheme will have a significant impact on company profitability. This is also reflected by the high importance participants assign to the need for reducing greenhouse gas emissions. In addition to classic PCO methods, we suggest companies to start developing and implementing $CO_2$-related levers now.

The application of cost down measures across the entire value chain seems to have a positive impact on profitability as successful companies more often use the lever ICOM (Interorganisational Cost Management).

3.2 Our results show that companies **apply PCO methods** in all phases of the product life cycle, except in production start-up and after sales. As already mentioned, this does not reflect the higher potential of influencing costs in the earlier phases of the product life cycle according to Figure 20. Applying PCO methods in early phases requires more complex and fundamental changes to realise technical optimisation potential.

In later phases (series production, purchasing, after sales), as seen in Figure 20, only 7 % of total costs can be influenced. Therefore, we propose companies to shift their PCO activities mainly to earlier phases in the product life cycle to improve efficiency and effectiveness of the identified optimisation measures. A shift from reactive to pro active cost management should be anticipated.

3.3 Material, personnel, and production are the three biggest **cost drivers** in the companies surveyed. In the last 5 years, personnel in particular faced the highest percentual change. According to Eurostat (2021), the total nominal labour costs in the EU increased since 2016, which also reflects our findings. Further, this study has a broader industry focus compared to the 2016 study, which could have also influenced the different findings.

## 4. Objectives, creating cost transparency, and detection of target deviations

This section covers the following topics:

4.1 Objectives of PCM
4.2 Methods for creating cost transparency
4.3 Detection of target deviations

### 4.1. Objectives of PCM

The majority of existing literature assigns product cost management the single objective of cost reduction. Our findings also show that over 90 % of surveyed companies mention a continuous cost reduction (> 6 months) as an objective of product cost management. In addition to goals related to cost reduction, we investigated further possible objectives: 30 % mention flexibilisation of costs and 36 % mention refining of cost awareness as an objective of product cost management.

**> 90 %**

of surveyed companies name continuous cost reduction as an objective of product cost management.

There is a discrepancy between successful and less successful companies, as Figure 22 illustrates. It is noticeable that less successful companies more often mention deepening and refining of internal cost awareness as an objective while successful companies focus more on cost reduction. The same pattern can be seen for the objective of cost flexibilisation.


**Figure 22:** Objectives and tasks of product cost optimisation, subdivided into successful and less successful companies (in % per cluster)

### 4.2. Methods for creating cost transparency

Besides defining the objective of PCM within the company, creating cost transparency is another fundamental basis for effective PCM.

A comparison of the methods used to create cost transparency reveals that some methods are used more often by participants in this survey sample compared to a study sample from 2016 (cf. Figure 23). This mainly concerns the methods:

- Total cost of ownership-analysis
- Top-down cost calculation
- Bottom-Up Cost Calculation
- Competitor benchmarking

The method of competitor benchmarking faced the largest relative increase, which speaks for an increasing importance of this method in the European industry. We identified two methods, which are significantly more often used by successful companies: Top-down cost calculations and best practice analyses. These three methods refer to direct material cost, whereas the total cost of ownership-analysis covers a broader range of topics.

The dataset of the 2016 study had a focus on the automotive industry while our dataset is more diversified in terms of covered industries. This allows us to have a holistic view of used methods across different industries.

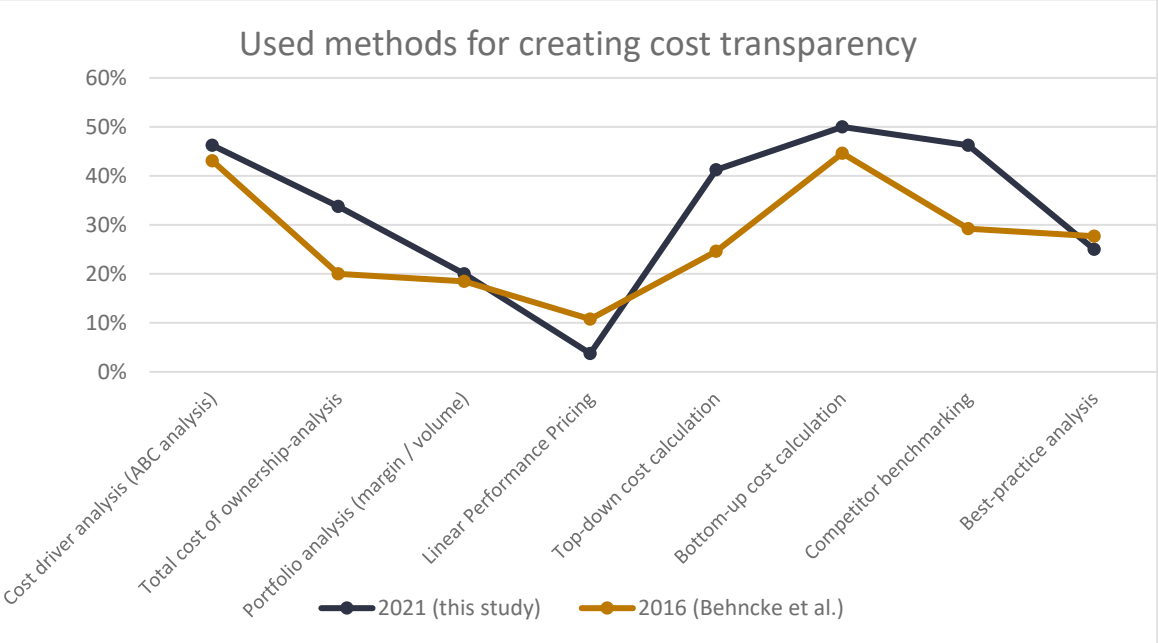



**Figure 23**: Methods used to create cost transparency compared to Behncke et al. (2016) relative to the respective sample size (%)

### 4.3. Detection of target deviations

The detection of target deviations can be one trigger for introducing PCM. To investigate different target deviations in more detail, a distinction was made between deviations in costs, quality and product maturity.

Speaking about costs, less successful companies identify target deviations in costs in more phases of the product life cycle compared to successful companies. Even in series production, 20 % of the successful companies identify cost deviations, while only 10 % of successful companies identify a cost deviation in this phase.

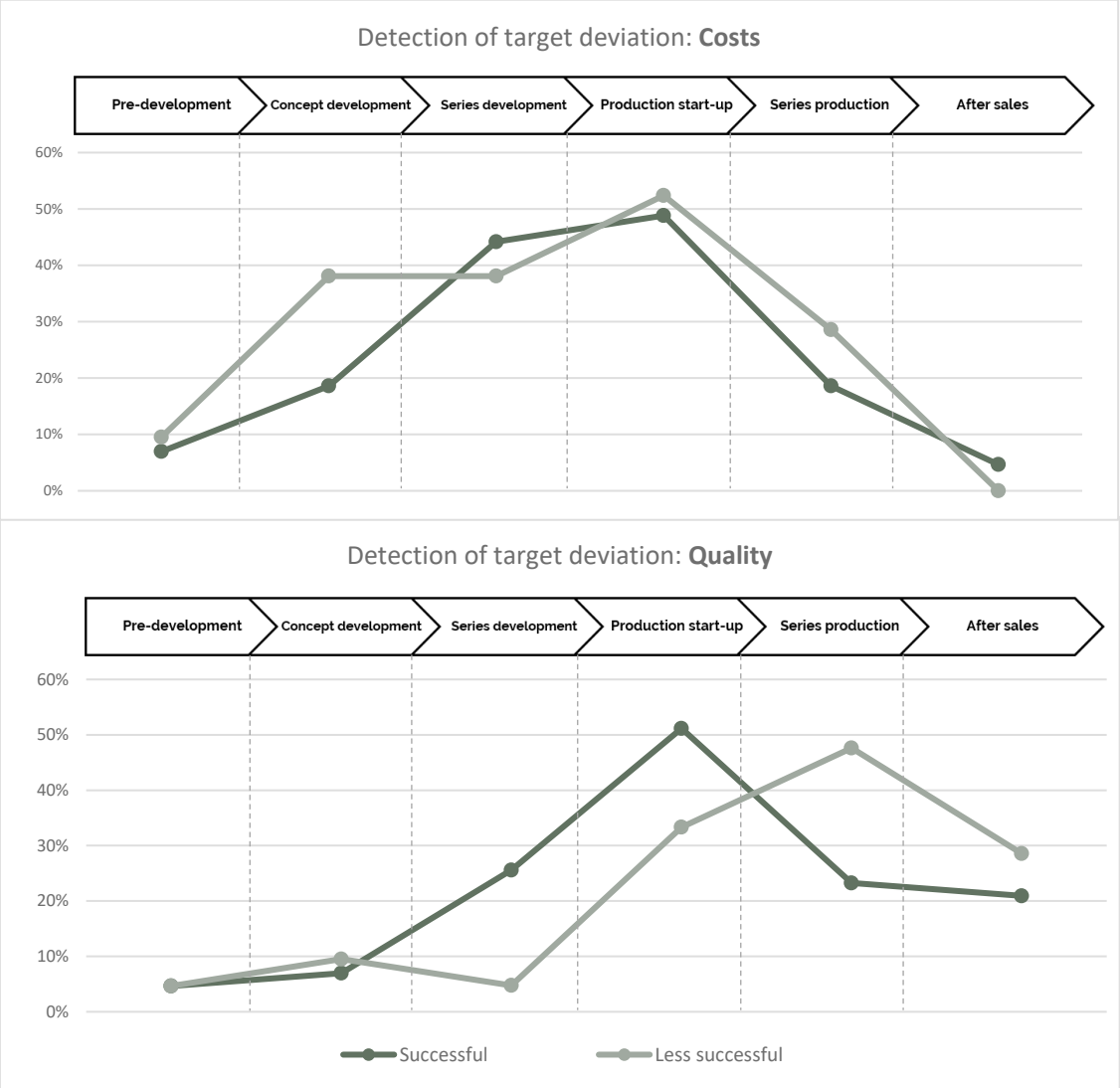
Speaking about quality and product maturity, one can see that successful companies identify quality and product maturity deviations approximately one product life cycle phase earlier.

Successful companies identify target deviations

**earlier**

than less successful companies

Conclusion (at the end of this 4.3



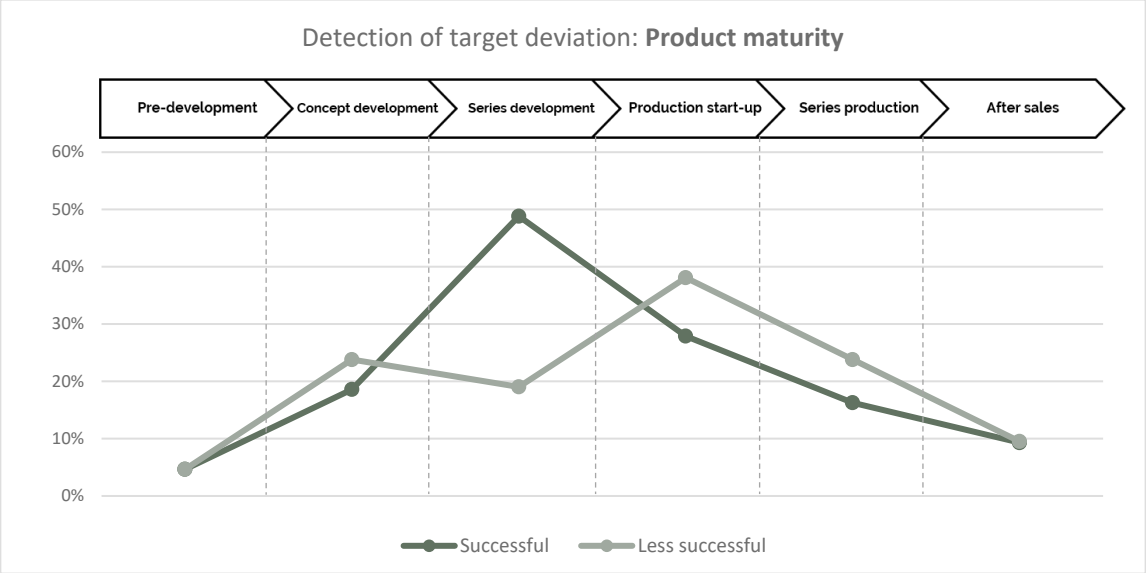



**Figure 24**: Detection of target deviations in costs, quality, and product maturity in % of the respective

## Conclusions

4.1 Less successful companies more often indicate basic changes in cost structures as an **objective of product cost management,** whereas successful companies state short- and long-term cost reduction as an objective more often. As basic changes in cost structures, such as raising internal cost awareness, is a requirement for cost reduction, one can conclude that successful companies already implemented such a cost awareness culture and now focus on actual cost reduction.

4.2 The method of **competitor benchmarking** faced the largest relative increase since 2016, which speaks for an increasing importance of this method in the European industry. Possible explanations for this increase could be more easily accessible benchmark vehicles or increasing price pressure within the industry, for example. Top-down cost calculations are more often used by successful companies, while bottom-up calculations are more often used by less successful companies.

4.3 While the biggest potential for influencing costs is in the initial phases of the product life cycle (cf. Figure 1), more than 50 % of the surveyed companies detect **target deviations** in quality at the production start-up phase.

Less successful companies find cost deviations in more phases of the product life cycle. In chapter 2, we found that less successful companies are more often confronted with quality problems, but the majority do not detect them until the series development phase, where no big margin for cost reduction is available.

Successful companies manage to detect target deviations approximately one development stage earlier compared to less successful companies. With the shrinking potential of influencing costs in later product life cycle phases according to the “cost incurrence and locked-in costs” scheme (cf. Figure 1), this can be a major competitive advantage. But even successful companies should shift the detection of target deviation into earlier development stages to be able to have a broader margin of influencing costs.

## 5. IT Tools

Software tools are considered to have a positive impact on business processes and the simplification of tasks. Technology focused industries especially rely on different IT tools to support a product's design, development, and manufacturing.

In this study, 4 different IT tools where investigated in detail:

- Comprehensive PLM solution (e.g. Siemens PLM, Dassault 3DExperience, SAP PLM...)
- Product cost calculation using special tools (e.g. Siemens TcPCM, Facton EPC...)
- Spreadsheet programs (e.g. Excel...)
- Customised software developed specifically for the company

Our analysis shows, that over 90 % of surveyed companies use spreadsheet programs to support their PCO activities. Special tools are used by about 40 % of companies and comprehensive PLM solutions are used by about 37 % of companies. It is interesting, that nearly 30 % of companies use customised software, as such tailored developments are not only costly in development and maintenance, but also only make sense if there is no suitable solution available on the market.

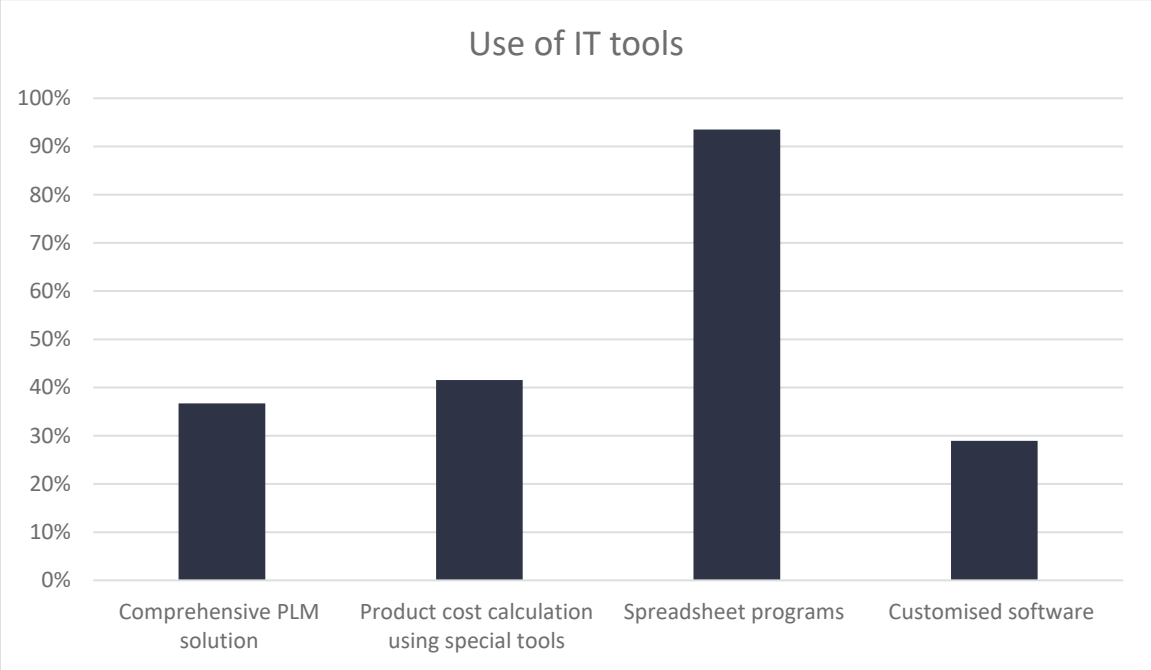



**Figure 25:** Use of IT tools to support product cost management (with indication of the relative frequencies)

## Conclusions

5 Spreadsheet programs are currently the basis to apply PCO effectively. Spreadsheet PCO tools are already field tested and work well. They can be implemented quickly in companies and also offer a satisfactory range of functions and automations thanks to macros. Advanced software (special tools and comprehensive PLM solutions) is mainly used by companies that have been doing PCO for a longer period of time and by companies in need for automating their internal workflows (hardness grade, decisions from committees and stakeholders). Customised software is a efficient way to conduct PCO as it is customised to the company's internal processes and workflows. However, custom software is very expensive to develop and therefore only worthwhile for larger companies or companies, that have been doing PCO for a long time.

## 6. Management-related success factors

We looked at three different management-related aspects and analysed their importance to support PCO:

- Acceptance and awareness of "cost-conscious behaviour" among managers and employees
- Top management ensures general focus on cost control and cost transparency
- Top management supports with constructive feedback and suggestions for improvement

**88 %**

of companies with a high presence of management-related aspects also demonstrate a high effectiveness in PCO

On average, the study participants rated the importance of all management-related aspects to support PCO as high. In particular, acceptance and awareness of "cost-conscious behaviour" among managers and employees is rated as the most important aspect with an average importance of 4.1 on a 5-point scale. The management-related aspects "top management supports with constructive criticism and suggestions for improvement" and "top management ensures a general focus on cost control and cost transparency" were also rated as quite important with an average importance of 4 and 4.1 respectively.

High top management commitment

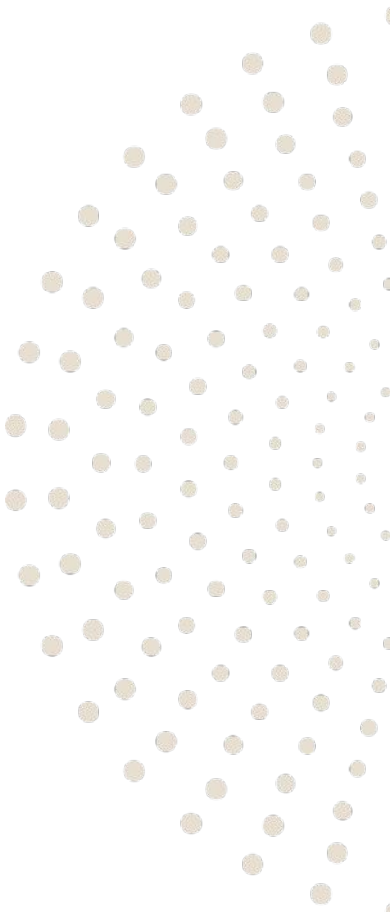
**very positively**

influences the effectiveness of product cost management

We also found that 88 % of companies with a high presence of the above management-related aspects also demonstrate a high effectiveness in product cost optimisation measures. On the contrary, companies with a low presence of management-related aspects within the company only demonstrate a high effectiveness in product cost optimisation measures in 14 % of the cases.

## Conclusions

6 The hypothesis that companies should focus on a strong involvement of the top management in PCO was confirmed by our study results. Management-related aspects were not only assigned a high importance by participants, but a high level of top management commitment also has a highly positive effect on the effectiveness of PCO measures. Therefore, management-related aspects are a big success factor in PCO.



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