Successful Focusing and Segmenting in the Tool and Die Industry

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Imprint

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Design: Simona Neacsu

ISBN: 978-3-946612-42-1
Print: printclub, 1. Edition

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2019
In a globalized environment, Germany, a country with comparably high wages, is increasingly exposed to intense international competition. With high factor costs and similar quality standards, companies in high-wage locations can only compete in the long-term by optimizing their value creation processes. Especially companies involved in one-off and small batch production, such as toolmaking companies, often position themselves as generalists with a broad product and service spectrum. A wide range of products and services as well as a high degree of variance, some even with opposing target dimensions, result in a high degree of internal complexity. This complexity complicates efficient value creation.

In order to be able to meet the challenges of a heterogeneous range of products and services as well as opposing target dimensions, focusing and segmenting the value creation process of a toolmaking company is a suitable approach. The focusing of the product and service spectrum includes both the limitation to economically significant services of the respective tool shop and the strategic, organizational, and technological harmonization of product and service creation. However, merely focusing the value creation is not sufficient, as the targets that have to be achieved for different order types can diverge, such as the targets for new tool orders or repair orders. Segmentation enables the simultaneous achievement of opposing target dimensions through a physical or virtual separation of value creating activities. A successfully implemented focusing and segmentation thus forms the basis for an efficient production of products and services and thereby the long-term preservation of competitiveness.
Successful Focusing and Segmenting

71.3% ... is the current value creation depth in German toolmaking companies.

11 ... technologies are used in German toolmaking companies on average.

43% ... is the average share of plannable orders in toolmaking companies.

3/4 ... of sales are realized with orders that can be planned on average.
The Japanese railway is considered to be the most punctual in the world. Every year, the seven Japanese railway companies of the Japanese Railway Group carry a total of 580 million passengers on the Shinkansen high-speed train and on conventional local trains. The trains are so reliable that even a delay of a few seconds leads to an official apology from the railway companies to their passengers. Commuters in Japan are thus able to plan their daily commute to the second. Due to its high reliability, the train is the most popular means of transportation for many Japanese. What are the basic principles behind the success of the Japanese railway?

An important measure followed an economically difficult period in the eighties. At that time, the entire Japanese railway network was systematically evaluated with regard to the economic efficiency of entire routes and individual stops. This was carried out individually for the different train classes of the Japanese Railway Group. Non-profitable stops were closed and only sufficiently lucrative stops with high demand were connected using the appropriate train class. This profitability check ensured that the Japanese Railway Group’s services are consistently aligned with the customer demand nowadays. Another decisive factor is that the Japanese Railway Group’s routes are operated independently. This means that the high-speed Shinkansen train, as well as various local trains and even freight trains, have their own tracks. By clearly dividing the train network according to different train classes, problems caused by train classes with different speeds are eliminated. Each line is tailored exactly to the requirements of the respective train class. The Japanese Railway Group thereby accepts higher overall costs in favor of increased punctuality. The result of the orientation of the service offer on the customer demand on the one hand and the division of the train network according to the requirements of different train classes on the other hand is one of the most efficient railway systems in the world.

Many companies in the tool and die industry, which is mainly characterized by small and medium-sized enterprises, position themselves as generalists toward their customers. They provide solutions for a wide range of problems in order to enable an efficient series production.

Toolmaking companies rely on their comprehensive knowledge of the design and optimization of production processes and the corresponding tool technologies in order to create sustainable customer value. However, this „problem-solving mentality“ has led
many toolmaking companies to offer a broad spectrum of products and services which are characterized by a high degree of variance and complexity. This means, that individual companies offer tools in a wide variety of size and complexity, and in some cases even different types of tools. In addition to the production of new tools, the product and service spectrum also includes services that have to be carried out at short notice, such as maintenance, repairs, or modifications. These different types of orders have diverging targets, thus further increasing the complexity associated with creating the respective products and services. New orders, for example, require high efficiency in value creation and thus a high utilization of existing capacities, while repair orders require a quick reaction and thus free capacities.

How can toolmaking companies learn from the success of the Japanese Railway Group? To answer this question, it is helpful to take a look at the basic principles that allow the Japanese Railway Group to operate a highly efficient railway system. The Japanese Railway Group was challenged to reduce an extremely broad range of services on the basis of customer demand in order to achieve the best possible adherence to schedules and cost-effectiveness in the remaining range of services. The problem of addressing diverging targets of different services is solved by the Japanese Railway Group by dividing the train network into independent sub-areas. Transferred to toolmaking, this means that focusing by discontinuing unprofitable services as well as segmentation through the organizational separation of order types with different targets represent a possibility for sustainable optimization of value creation. This study presents a methodology for successful focusing and segmentation, which serves as a guideline for the practical implementation in the tool and die industry.
Successful Focusing and Segmenting

Objectives and requirements

As early as in the middle of the 18th century, Adam Smith demonstrated in his famous pin example that the efficiency of production can be increased sustainably by focusing on special activities. If one employee carries out all 18 steps required in the pin production, he produces a maximum of 20 pins per day. If individual employees carry out the work steps in a specialized manner, 10 employees achieve a daily output of 48,000 pins. The basic idea of increasing efficiency by focusing on specific work contents was widely implemented in industrialization at a company level by standardizing products and processes.

The implementation of product and process standardization is much more difficult in the tool and die industry than in other industries as the products are almost uniquely manufactured according to the individual requirements of customers. In order to meet these requirements in the best way possible, various types of tools are manufactured in a wide variety of sizes and complexity classes. Also, toolmaking companies are required to carry out urgent repair orders in addition to new orders that can be planned. A wide range of products and services and the processing of different types of orders have led to an extremely low level of standardization of tools and manufacturing processes at many toolmaking companies. This means that toolmaking companies are forced to set up their resources extremely broadly in terms of capacities and technologies in order to be able to manufacture different tool components in the required time and flexibility.

As a result, toolmaking companies are faced with a dilemma. The production of various tools in one off and small series production as well as the handling of different types of orders require an open, flexible configuration of resources, which is contrary to the demand of an efficient production through standardization of products and processes. One way out of this dilemma is to focus and segment individual areas of toolmaking companies. In accordance to the basic principles of industrialization, value creation is specialized in two sub-steps for specific products and services. Focusing means concentrating the range of products and services on those that make the greatest economic contribution to the company’s results. Non-lucrative products and services should be discontinued. By taking this step, the complexity and variance of the product and service spectrum can be reduced considerably. Afterwards a segmentation enables addressing different targets by dividing toolmaking companies into separate segments. This allows resources, processes, and organizational structures within the individual segments to be precisely aligned with the respective requirements of the products and services contained in the segment. Thereby enabling toolmaking companies to implement product and process standardization and to sustainably increase the efficiency of the production of products and services while at the same time ensuring a high speed of reaction.
**Approach for focusing and segmenting**

*Laying the focus on the right things is the foundation of an efficient and successful segmentation.*

A systematic approach is crucial for the successful implementation of focusing and segmentation in the tool and die industry. The approach presented in this study is a six-step methodology. The first three steps describe how to focus the spectrum of products and services, while the last three steps describe how segmentation can be implemented. A focused product and service spectrum is a basic prerequisite for successful segmentation, as only the homogenization of the product and service spectrum within the scope of focusing enables an efficient segmentation with regard to the respective targets.

The first step and starting point of the methodology is the documentation of the product and service spectrum of the toolmaking company and its subdivision into distinguishable product and service categories. The subdivision is done on the basis of customer as well as production-relevant characteristics. Products and services must then be evaluated in terms of strategy and profitability. For this purpose, both the share of sales as well as the customer benefit generated by the individual product and service categories are considered. The second step of the methodology is to determine the focusing potential for the product and service categories of high economic and strategic importance. The focusing potential is assessed on the basis of the tool and production-related homogeneity of the relevant processes. This is determined, for example, on the basis of the tool size or the technologies required in production. The third step of the methodology contains the focusing decision and the formulation of a segmentation hypothesis. The focusing decision defines which processes will continue to be performed internally. In addition, the interaction of the requirements of the processes performed internally must be taken into account before a final decision can be made as to which product and service categories are kept internal. On this basis, the segmentation hypothesis is formulated in order to allow additional focusing of production by the allocation of resources. In this step, it is analyzed whether the division of the toolmaking company into independent areas enables an optimized processing of different order types with diverging targets.

For the implementation of the segmentation, the current capacity requirements and the current capacity supply in the segments previously defined in the segmentation hypothesis are analyzed in the fourth step. For this purpose, the production hours worked in a representative period are documented in order to determine the capacity requirements in the various segments. The determined capacity requirements are then compared with the available capacity in the segments. Building upon this, the fifth step of the methodology determines the optimal allocation of resources per segment. Taking into account the specific capacity limits, the average capacity utilization, and the capacity requirement over time, the available resources are allocated to the individual segments specifically for each production technology.

After the allocation of resources, the segmentation hypothesis formulated in the third step of the methodology is reviewed. If the hypothesis is rejected, the methodology must be repeated iteratively from the third step onwards. If the assessment is positive, the sixth and final step is the implementation of the segmentation. This takes place in the two
categories layout and organization. Initially, a layout is developed which realizes the physical separation of the defined segments. In addition, for the organizational implementation both the organizational structure and the process organization are adapted according to the chosen segmentation.

In the following, the six steps of the methodology are presented in detail. In each step, the approach for the practical application in a toolmaking company is described and the results achieved in the single steps are defined.

Methodology for successful focusing and segmenting in the tool and die making industry
**Determination of product and service spectrum as well as turnover status quo**

The starting point of a successful focusing and segmentation in the tool and die industry is a detailed analysis of the product and service spectrum offered by the analyzed company. In this context, the product and service spectrum includes products and services offered to internal and external customers. This includes both tools as the main product of toolmaking companies as well as supplementary services.

Initially, the offered tools are divided into categories and – if required – subcategories according to technical characteristics. The division into categories should be carried out based on characteristics that can be defined from the customer’s point of view. Furthermore, it should be considered that the categories have homogeneous requirements regarding the internal value creation, like the production processes or the required resources. For example, the category injection molds could be subdivided into the subcategories open-close molds, slide molds, stack molds, and cube molds; each of which in turn could be further subdivided into complex and non-complex molds. The categorization of molds is complemented by upstream and downstream services, such as component optimization or mold qualification for production start-up. On the other hand, these services can be represented in the form of independent categories. On the other hand, offered services can be integrated into existing categories or subcategories. This is useful when there are no distinguishable characteristics or when the requirements for internal value creation correspond to those of an already existing category.

**Categorization of product and service spectrum**

![Diagram of product and service spectrum]

* Share of total product or service spectrum
When tools and services were categorized, an assessment has to be made with regard to economic and strategic aspects. This is done by determining the sales and frequency distribution of the defined categories. The aim is to identify categories that have a high influence on the economic result of the company. At the same time, the product and service categories should be highlighted, which have a limited contribution to the turnover of the company and thus increase the complexity of the value creation process without contributing to the company’s economic success. The ABC analysis is a useful tool for this purpose. It divides a number of objects into the categories A, B, and C according to their descending importance. The product and service categories are sorted according to turnover and then cumulated. The largest product and service categories according to turnover, which represent a cumulative turnover share of 80% of the total turnover of the company, form category A. The largest remaining categories according to turnover, which together make up a share of 15%, are grouped together in category B. Category C contains the last product and service categories, which together account for 5% of turnover. In many companies, just a few tools or accompanying services generate a large part of the turnover, while the remaining products and services marginally contribute to the economic success of the company.

The economic perspective must be supplemented with a strategic perspective to complete the analysis. Despite a small economic contribution to the company’s success, the strategic contribution of a certain product or service category can be very high, for example through a unique technological position. When assessing strategic relevance, the customer benefit generated by the respective category or the future development of a certain business segment serve as a guideline. Examples of instruments for assessing the strategic relevance are the evaluation of customer feedback for past orders and the market analysis with regard to the range of specific products or services on offer.

**Results:**

- Categorized current product and service spectrum based on technical characteristics
- Evaluated product and service spectrum with regard to the economic and strategic relevance
**Successful Focusing and Segmenting**

**Determination of focusing potential**

Following the analysis of the current range of products and services, the focusing potential is determined. This is carried out for those product and service categories with a high economic and strategic contribution to the company’s success. The focusing potential indicates how suitable product and service categories are for internal focusing. Categories with a high focusing potential allow the respective company to design the value creation as efficiently as possible by focusing accordingly. The focused tool and die components are very similar in terms of product architecture and required manufacturing processes. Categories that require a high proportion of special components have a low focusing potential and should be outsourced to external partners if possible. The focusing potential of product and service categories is determined in the two dimensions tool-specific focusing potential and production-specific focusing potential. A high tool-specific focusing potential indicates a high potential for standardizing the produced tools or the individual tool components. Indicators for evaluating the tool-specific focusing potential are, for example, tool size, component dimensions, and tool complexity. The categories that have to be focused should allow the standardization of a high proportion of tool components. The evaluation of the production-specific focusing potential supplements the tool specific focusing potential with an examination of the required production steps. Information about the production-specific focusing potential of a product or service category is provided on the one hand by the required technologies and on the other hand by the sequence and time required for the individual process steps in production.

### Tool-specific focusing potential

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<tr>
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<td>up to 1000 x 1000 mm²</td>
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Categories with a high focusing potential with regard to both tool-specific and production-specific characteristics should be produced internally. In the future, categories with a low focusing potential should be sourced from external partners. When selecting the categories to be produced internally, it has to be ensured that the existing production capacities are utilized sufficiently. Focusing on categories with a high tool-specific and production-specific focusing potential allows the effective and efficient configuration of the internal value creation processes, as categories with specific, individual requirements are outsourced. This leads to a reduction in complexity, which results in an increase in efficiency and productivity of the internal value creation processes.

### Results:

- ✔ Evaluated product and service spectrum with regard to the tool-specific focusing potential
- ✔ Evaluated product and service spectrum with regard to the production-specific focusing potential
Successful Focusing and Segmenting

Focusing decision and formulation of segmentation hypothesis

The third step of the methodology begins with the definition of a focusing decision, which concludes the sub-area of focusing. Consequently, a segmentation hypothesis is formulated based on the structure of the order types and the requirements of the focused product and service categories.

In order to be able to make the focusing decision, a final consideration of the product and service categories that were evaluated with regard to their focusing potential is necessary. For this purpose, the level of focusing potential that indicates internal or external production of the respective categories needs to be defined. In addition, the interaction of the internally produced categories must be taken into consideration before a final decision can be made. However, even after focusing on product and service categories which make a significant contribution to the company’s economic result and have a high focusing potential, different types of orders can prevent the existing efficiency potentials from being fully realized. While economies of scale and efficiency are the main goals for new orders, the most important prerequisites for fast processing of repair orders are high flexibility and high availability. In addition, product and service categories can have a high focusing potential in subgroups, but not in their entirety, leading to the failure to find an optimal configuration of the internal value creation.

Segmentation according to plannability and similarity

1. **Segment 1: Product and service category 1 plannable**
   - Tool type A-B
   - Target: Utilization

2. **Segment 2: Product and service category 2 plannable**
   - Tool type C-E
   - Target: Utilization

3. **Segment 3: Not plannable**
   - All product or service categories
   - Target: Reaction speed
A way out of such dilemmas is to subdivide the toolmaking company or certain parts of it into different segments. This creates largely independent areas which can be aligned to specific target dimensions.

The segmentation can be carried out virtually or physically, depending on the existing company conditions. In the case of virtual segmentation, the existing capacities are only divided by allocating capacities in planning. For example, it is conceivable to reserve two hours a day for unscheduled repair orders instead of new orders. A physical segmentation, however, is a real and in many cases areal subdivision of the toolmaking company into different segments, so that each segment has its own production resources and employees. The different segments can thus act completely independent from each other and can be optimized with regard to their individual targets. A virtual segmentation is advantageous if one of the segments has low resource requirements so that none of the machines can be fully utilized by the segment. In addition, virtual segmentation allows a flexible adjustment of the allocated capacities according to the current order situation.

The segmentation takes place on the basis of the criterion that causes the inhomogeneity in the focused product and service spectrum. The inhomogeneity can be caused by different types of orders which might have diverging targets due to different levels of plannability. Repair orders require a high degree of flexibility and thus free resources. However, an optimal alignment to the requirements of new orders leads to high efficiency and thus to high resource utilization. The focused product and service categories can also cause inhomogeneity due to different requirements for production resources or production processes. If the product and service categories differ with regard to the required production machines, a corresponding segmentation leads to homogeneous production-related requirements in the individual segments. Consequently, the product and service categories that are produced internally must be analyzed with regard to their homogeneity. For example, the types of orders occurring in the product and service categories or the respective requirements for resources and processes should be considered. A segmentation hypothesis must then be formulated so that a possible inhomogeneity is resolved, and homogeneous segments are created.

Results:

- Selected product and service categories for internal production
- Formulated segmentation hypothesis
**Determination of capacity requirements and available capacity**

In this step, the current capacity requirements and the currently available capacity are determined. The objective is the derivation of future production hours for employees and machines based on the hours performed in a previous period. Accordingly, the product and service spectrum in the toolmaking company has to be analyzed in a representative period and the production hours must then be allocated to the various organizational units such as milling, turning, or grinding. A representative period is a period for which the demand for the products and services of the toolmaking company is considered to be typical. It has to be ensured that the period is sufficiently long, so that any internal capacity bottlenecks or external economic fluctuations can be compensated. Furthermore, the effort required to collect and evaluate data for the selected reference period should not be disproportionately high. An observation period of one to three fiscal years is typically reasonable. After determining the reference period, all order data are derived from corresponding data sources, simple excel solutions, or intelligent planning systems, and are assigned to the organizational units and segments determined in the segmentation hypothesis. Capacity requirements can be visualized in a bar chart over the time (e.g. on a daily basis) so that order peaks and lows are visible over the reference period.

In addition to the current capacity requirements, the maximum available resources in the reference period are determined independently of the segments. For this purpose, the available resource capacity per day has to be determined in relation to the available employee and machine hours. Starting from a total working time of for example 8 hours, reduced by an average absence per employee and day due to indirect activities, the productive time per day of an employee is calculated. The productive time per day multiplied by the number of employees in an organizational unit results in the total employee capacity available.

**Analysis of order spectrum**

![Graph](image-url)
When determining the available machine capacity, the maximum possible machine running time per year is determined first. The maximum machine running time then has to be multiplied with an individual factor for each organizational unit, which represents shift models, machine maintenance, multi-machine operation, and machine failure. The result is the actual available machine capacity.

In order to ensure a sufficient future supply of resources for the organizational units and segments, the future demand has to be estimated. For this purpose, the development of demand in the individual product and service categories (e.g. increased demand for 3K tools), changes in tool concepts (e.g. a changed tool design), and new manufacturing processes (e.g. use of 3D printing) have to be taken into consideration and derived from the current supply of resources by extrapolation (or projections). Extrapolation should include a period of at least five years in order to be able to initiate possible investments in human resources and machines in time.

**Analysis of resource capacities**

<table>
<thead>
<tr>
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<td>Reported time [minutes]</td>
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</table>

**Results:**
- Prognosed capacity requirements per organizational unit and segment
- Maximum available capacity per organizational unit and segment
In step five, the optimal allocation of resources per organizational unit and segment is determined. The mean square error (MSE)* method is used to calculate the number of resources required per organizational unit and segment. The result of the calculation is rounded to the nearest integer in order to define a capacity limit for different resources.

The segments should be evaluated using capacity limit, average capacity utilization, and order coverage. The capacity limit results from the available resources per organizational unit and segment. The average capacity utilization is calculated by dividing the capacity requirements by the total available capacity. The order coverage indicates how often capacity requirements exceed the available capacity. When the capacity requirements temporarily exceed the available capacity, external partners are needed to compensate the capacity shortage. The determination of the evaluation criteria described above has to be carried out for all organizational units and segments.

For easier understanding, the concrete segments „plannable“ and „not plannable“ are described in the following. For the plannable segment consisting of new and maintenance orders, the most cost-effective tool manufacturing and maintenance processes along with the target “cost efficiency” have to be addressed.

As a result, a high average capacity utilization has to be achieved. Order peaks and lower profitable orders have to be outsourced. The capacity utilization in plannable segments is generally between 85% and 95% for successful toolmaking companies. For the unplannable segment, which usually comprises repair and change orders in the tool and die industry, the decisive target is reaction speed. This can only be achieved to a limited extent with a high average workload. Therefore, in this case the average capacity utilization is significantly lower compared to the plannable segment and is typically between 55% and 65%. Accordingly, the order coverage is almost 100%.

MSE: The mean squared error (MSE) is a term and a process used in the field of statistics for the determination of variables.
In the event that resources cannot be allocated to the segments formulated in the segmentation hypothesis, virtual segmentation can offer an alternative, for example due to a limited number of machines or employees in certain organizational units. This involves allocating a certain percentage of existing resources to the respective segments. Virtual segmentation can be implemented for both employees and machines. Also, a combination of physical and virtual segmentation is possible.

At the end of step five, the segmentation hypothesis formulated in step three has to be evaluated. The sixth step follows if the resources allow a reasonable segmentation considering the defined evaluation criteria. If the segmentation hypothesis is rejected because the defined targets of the segments cannot be achieved, the methodology has to begin again with step three.
Successful Focusing and Segmenting

Realization and implementation

After successfully evaluating the segmentation hypothesis and allocating the resources to the organizational units and segments, the segmentation is implemented in the two dimensions organization and layout.

The realization and implementation of segmentation is a major change and must, therefore, be carried out for the defined segments both in terms of process and the structural organization. While structural organization determines the framework, i.e. which tasks are performed by which employees, the process organization regulates the work and information processes that take place within this framework. With regard to the structural organization, the extent to which the segments or units have to be separated from each other has been determined. The separation can be realized up to a complete separation in form of two entities. This is accompanied by financial reporting, disciplinary management, and the definition of responsibilities and representation rules within the segments or units and across segment boundaries.

Design fields of physical segmentation

[Diagram showing the layout and organization of two segments with tasks such as design, programming, turning, milling, grinding, and wire-EDM, and targets like utilization and reaction speed.]
Furthermore, within the framework of employee development and qualification, it should be answered whether and in which cycles employees rotate between the segments in order to ensure an exchange of experience and learning effects. As part of the process organization, the order processing, the joint use of machines and the production planning in the segments have to be defined. The achieved specialization in the segments allows the targeted optimization of the value creation. Furthermore, it is advisable to support the production planning using an appropriate computer system. It is possible, to plan in a separate system for each segment or to use a joint planning and scheduling system. The full potential of segmentation can only be realized through the clear areal separation of resources and through the visualization of the segments in the layout. Designing a new layout is conducted in the form of a step-by-step, iterative process, which gradually details the layout. The rough layout contains information about the space requirements of individual organizational units as well as the consideration of logistic and warehouse areas. Based on resources, machines, and employees assigned to the organizational units, the necessary space requirements per segment can be derived. While creating the rough layout, the space requirements per organizational unit are planned first. In addition to space requirements, general framework conditions of a structural, process-related, or occupational safety nature must also be taken into account. Common examples are cranes, escape routes, or inbound and outbound deliveries. The detailed layout is a detailed version of the rough layout in which the position and alignment of machines, workbenches, barriers, and storage areas are taken into account. The detailed layout is usually designed according to the material flow in order to minimize unnecessary transportation routes and to ensure efficient component and tool logistics on the shop floor.

Results:

- Implemented segmentation in structural and process organization
- Physical segmentation in layout
Globalized competition presents small and medium-sized toolmaking companies in high-wage countries with the challenge of competing with international competitors in the target dimensions time, costs, and quality. With comparable tool quality and unequal factor costs, differentiation can only be achieved by optimizing the process of value creation.

As generalists, toolmaking companies mostly offer a wide range and variety of products and services, some of them with diverging target dimensions. This inevitably leads to high internal complexity, which complicates the efficient production of tools. By applying focusing and segmenting, the efficiency of tool and die making can be increased significantly.

Conclusion

This study presents a methodology consisting out of six steps. Focusing describes the concentration on those products and services that have the highest economic and strategic contribution to the performance of the company. The following segmentation enables the alignment of organization, processes, and resources within the defined segments exactly to the respective requirements. By implementing focusing and segmentation, toolmaking companies lay the foundation for securing long-term competitiveness.
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Our studies – Corporate Tooling

- Digital Transformation
  2019

- Intelligent Tools And Databased Business Models
  2018

- Corporate Tooling – Agile Tool Development
  2017

- Corporate Tooling – Flexible Tooling Organisation
  2017

- Corporate Tooling – Intelligent Tool Manufacturing
  2017

- Smart Tooling
  2016

- Fast Forward Tooling
  2015

- F3 Fast Forward Factory
  2015
### Our Studies – Successful …

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<tr>
<td>Successful Motivation of Employees</td>
<td>2016</td>
</tr>
<tr>
<td>Successful Calculation</td>
<td>2015</td>
</tr>
<tr>
<td>Successful Planning and Scheduling</td>
<td>2015</td>
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Our Studies – Tooling in ...