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WZL RWTH AACHEN

Fraunhofer IPT

Digital Value Networks in the Tool Manufacturing Industry

Understanding the impact of Digital

Content

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Preface

This study explores how manufacturing companies can address future business challenges through "Digital Transformation"[1] and, more specifically, how collaboration in digital value networks can be a success factor. In a joint project, the Laboratory for Machine Tools and Production Engineering (Werkzeugmaschinenlabor, WZL) of RWTH Aachen University, the Fraunhofer-Institute for Production Technology (IPT) and Capgemini Consulting investigated the German tool manufacturing industry as a representative example. In this setup, both comprehensive competencies in Digital Transformation and dedicated industry expertise formed the backbone of the study.

As the automotive industry represents collectively the most important customer for tool manufacturers, the tool manufacturing industry is highly dependent on the particular developments in the automotive industry. Tool manufacturing companies have to both respond increasingly to global competition and deliver their customers an improved price/service offering. For this purpose, a further development of competencies has to go hand in hand with an improvement in cost efficiency. A sole focus on the operational improvement of internal processes is no longer sufficient.

Considering this situation, Digital Transformation can be a key lever to improve productivity and enable collaborative value creation. Examples from other manufacturing industries show that intensified collaboration with partners and customers alike offers great potential to increase business performance.

A successful Digital Transformation always has its origin in changes to the business; it may affect the business model on the product and customer side as well as the operating model itself. At the beginning of the transformation process, business and IT need to jointly select and detail the strategy. This fact represents a conscious change of perspective, examining the business potentials in IT. The new digital economy goes beyond mere technology and gives rise to a wave of transformation of the way leading companies operate their businesses.

This study integrates the ideas of collaborative value creation and Digital Transformation into a holistic approach. The study thereby outlines how tool manufacturers can successfully collaborate in digital value networks in order to enhance their future competitiveness.

We hope this study offers valuable insights for your business, and wish you a successful collaboration in your digital value network.

Aachen/ Munich, March 2014.

Kind regards,

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Member of the Board of Directors of WZL and
Fraunhofer IPT

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Foot note: Digital Transformation is the application of digital technology to dramatically increase the performance or the operating range of organisations. Instead of merely implementing new technologies, it is about the change and further development of business processes, customer experience and business models (Refer also to www.de.capgemini-consulting.com/digital-transformation).

Executive Summary

The tool manufacturing industry is a key enabler for industrial mass production. Small and mid-sized companies manufacture tools as a unique item or small batch and then transfer these tools, as a basis for serial/ mass production, to the manufacturing facility of their customers. In Germany, the automotive industry is the largest customer group of the tool manufacturing industry. Thus, tool manufactures have to operate in the very demanding competitive environment of the automotive industry.

The requirements for tool manufacturers result from trends in the automotive industry – and these suggest that tool manufacturing will face a more and more complex and challenging business environment in the future. The sector will have to meet demands for very high quality standards, as well as a cost-effective, quick, on-time and flexible production. Moreover, the portfolio of offerings has to become characterised increasingly by innovative tool concepts, comprehensive system competency and consistent service orientation. In addition to this, customers demand onsite support internationally, requiring a global operating range from the tool manufacturing industry.

Tool manufacturing is traditionally characterised by job-shop production and a high real net output ratio of above 70%. This historically developed operational configuration hinders tool manufacturers to successfully compete in the future business environment. A paradigm shift towards intensive collaboration with partners and customers is required. Tool manufacturers have to drive business performance by leveraging the benefits arising from collaborative value creation. As the evidence from our empirical survey indicates, tool manufacturers have acknowledged this imperative: the majority of tool manufacturers either already closely collaborates with partners and customers or intends to develop into this direction.

In corporate practice, approaches to establish collaborative value creation with partners and customers frequently fail due to structural barriers in inter-company coordination. These barriers arise due to the improper integration with partners and customers.

The results of our empirical survey explicitly indicate that Digital Transformation is a key enabler to address the challenge of managing intensified collaboration with partners and customers, thereby forming a digital value network. Identifying the right kind of investment areas, selecting promising technologies and engaging as well as further developing the affected employees are prerequisites for a successful Digital Transformation.

The collaboration in value networks and their efficient coordination by leveraging digital technologies will be a key success factor in the tool manufacturing industry. An early and targeted development of the related competencies will enable tool manufacturers to generate a sustainable competitive advantage.

Introduction

Study design

The study is based on research of automotive industry trends, an empirical survey of tool manufacturers, the analysis of benchmarking data, and interviews with industry experts.

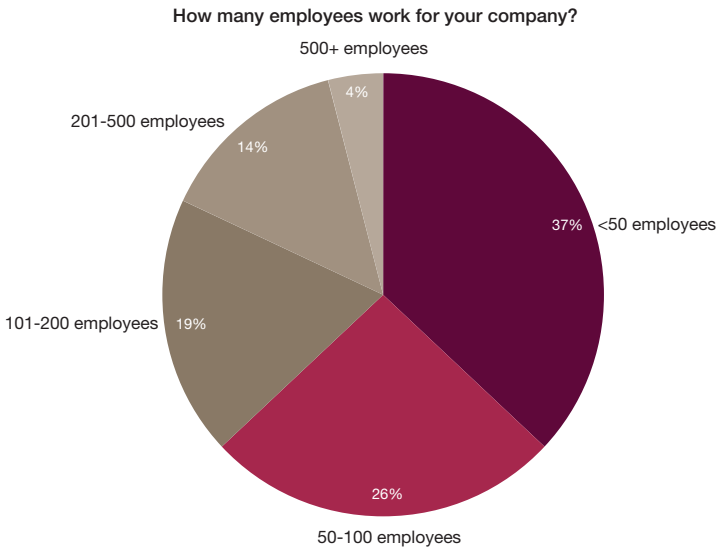
Trends research

We derived the requirements for the tool manufacturing industry from those latest trends in the automotive industry, which are specifically relevant for the current industry situation.

Empirical survey

In total, 110 German tool manufacturers participated in the survey. The survey includes a broad industry cross-section with respect to company size and tool range, ensuring that the results are representative.

Figure 1: Structure of the German tool manufacturing industry



Analysis of benchmarking data

In order to identify long-term developments, key figures of the general database for the tool manufacturing industry were analysed and integrated in the study by WZL and IPT, as well as key figures of the competition “Excellence in Production”.

With 191 current data records, the joint database of the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen and of Fraunhofer-Institute for Production Technology in Aachen (IPT) is the world’s largest database of its kind for this industry. The data is based on the competition-oriented benchmarking jointly introduced in 1993 for performance measurement and analysis of the tool manufacturing industry.

Interviews with industry experts

In order to validate the results and messages provided by this study, we conducted interviews with industry experts (mostly executives of leading tool manufacturers).

The tool manufacturing industry

The tool manufacturing industry in Germany holds a key position in industrial production between product development and serial production. As a result, the tool manufacturing business has a significant impact on the innovativeness and productivity of the manufacturing industry.

Industry

The tool manufacturing industry consists of a large number of small and mid-sized companies and is thereby characterised by its heterogeneity and strong fragmentation (see Figure 1). Depending on the market access, the companies are either referred to as internal or external tool manufacturers (see Figure 2). An internal tool manufacturer is integrated in the structural organisation of the parent company, while an external tool manufacturer is a legally independent company. With an estimated annual turnover

Figure 2: Market access of German tool manufacturers

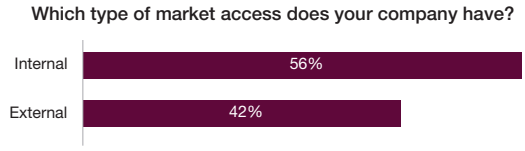
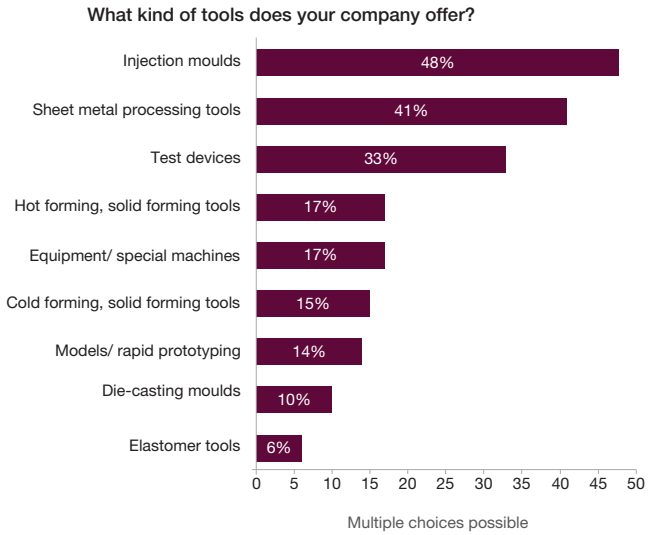


Figure 3: Tool range of German tool manufacturers



of EUR 4.58bn and approx. 54,000 employees, the industry is comparatively small given its strategic relevance.

Product and service range

Tools are complex products manufactured as unique items or in small batches. Today, industrial production is impossible without the use of pre-manufactured, complex tools. They are used in all areas of the manufacturing sector. The tool range varies considerably and comprises primarily forming, injection, compression and die-casting moulds (see Figure 3). Services complement the portfolio in line with the offered tool range. Services in the tool manufacturing industry comprise tool maintenance and repairs, consulting of customers in respect to the manufacturing-specific design of serial parts or the complete takeover of product-related engineering scope.

Order range

Tool manufacturers handle both new orders of complete tools as well as maintenance work orders in their capacity plans. Change orders for customising tools and repair orders for addressing unexpected defects are mostly assigned within very short notice and have to be processed with high priority to secure the continuation of serial production for their customers. The order volume in the tool manufacturing industry is subject to high volatility.

Process chain

The process chain of tool manufacturing ranges from sales, engineering, production planning, manufacturing, assembly to the try-out/ testing of tools (see Figure 4). In terms of simultaneous engineering, the processes of tool manufacturing typically start in parallel to the product development of their customers. The order processing of tool manufacturing ends after the completion of the try-out when customers start their serial production. Based on the unique characteristics of the products, the order processing is characterised by a high process variance and hence few repetitions and a low level of standardisation.

Customers

Tool manufacturing in Germany serves the entire manufacturing industry with a focus on Germany and Europe. The automotive industry represents the primary customer group of German tool manufacturers (see Figure 5). Further important customer groups are the electronics, medical technology, appliances and consumer goods industries.

Figure 4: Process chain of tool manufacturers

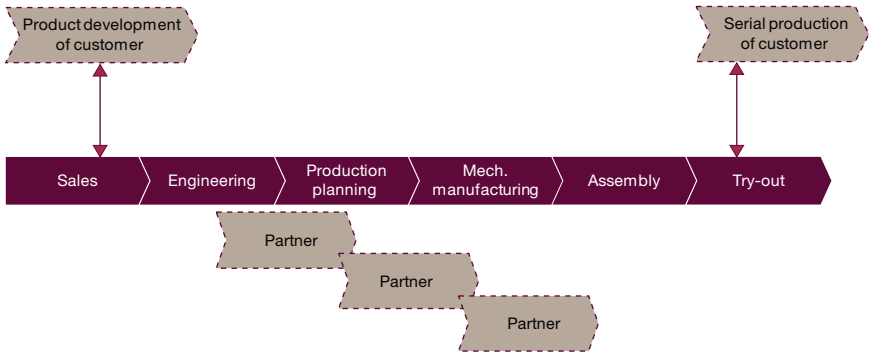
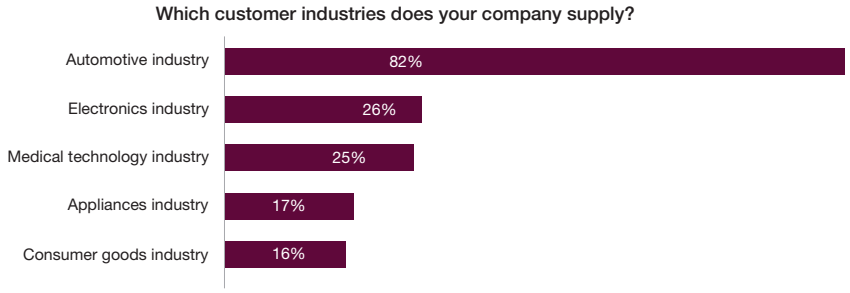


Figure 5: Customer industries of German tool manufacturers



Manufacturing companies have to comprehensively determine the requirements emerging from the changing business environment

The globalisation of the manufacturing sector has entered a stage where the last remaining **national niche markets are about to disappear**. Consequently, even **small and mid-sized manufacturing companies** have to engage in **global competition**, thereby competing with global players for global customers. This simple principle strongly influences the business model of many small and mid-sized companies: they have to **reconsider their way of doing business, as well as identify and comply with new business requirements** based on the expected **demand and behaviour of global customers**.

The German tool manufacturing industry represents the paramount example of an industry that is on the edge of being **entirely globalised** and thereby transformed. In this context, tool manufacturers are increasingly confronted with **new business requirements**. In this study, we demonstrate how a strictly customer-orientated approach can be applied to **comprehensively identify these requirements**. While some of the described requirements are rather industry-specific, others apply to the manufacturing sector as a whole.

Business requirements

The automotive industry is of special importance to the tool manufacturing industry, as it is its primary customer group. Tool manufacturers thus face the challenge of analysing global developments in the automotive industry, evaluating the relevance of these developments and identifying the resulting business requirements.

The trend analysis was focused on those trends concerning the tool manufacturing industry (see Figure 6). The direct connection of tool manufacturing to the product development and serial production in the automotive industry determined the relevance of the trends in the dimensions product and production. In addition, the market environment was considered as a dimension to assess the overall developments and their effects on tool manufacturing. Trends related to automotive end customers were not in focus.

Dimension I: Market environment

In the past, the **competitive dynamics** in the automotive industry were characterised by continuing consolidation.

Today, globalisation as well as product and process innovations open new possibilities for market entries. In particular, the consistent use of factor cost advantages by new entrants from emerging countries such as China, India and Brazil, as well as the development of solely e-mobility-based business models are of high importance.

Profound product innovations lead to the development of a **new ecosystem** in the automotive industry. This change is due to new market participants, such as providers of drive train technology in the area of e-mobility as well as companies whose core business is not related to the automotive industry. Thus, traditional automotive companies collaborate, for example, with electricity suppliers and charge carrier providers in establishing e-mobility. Together, new market participants and new approaches in e-mobility increase the complexity of the automotive ecosystem.

Due to the rapidly growing cost and environmental awareness, particularly in the urban population of industrialised nations, **innovative revenue models and sales channels** are established. Examples for this development are emerging car sharing models as well as the online sales of new cars.

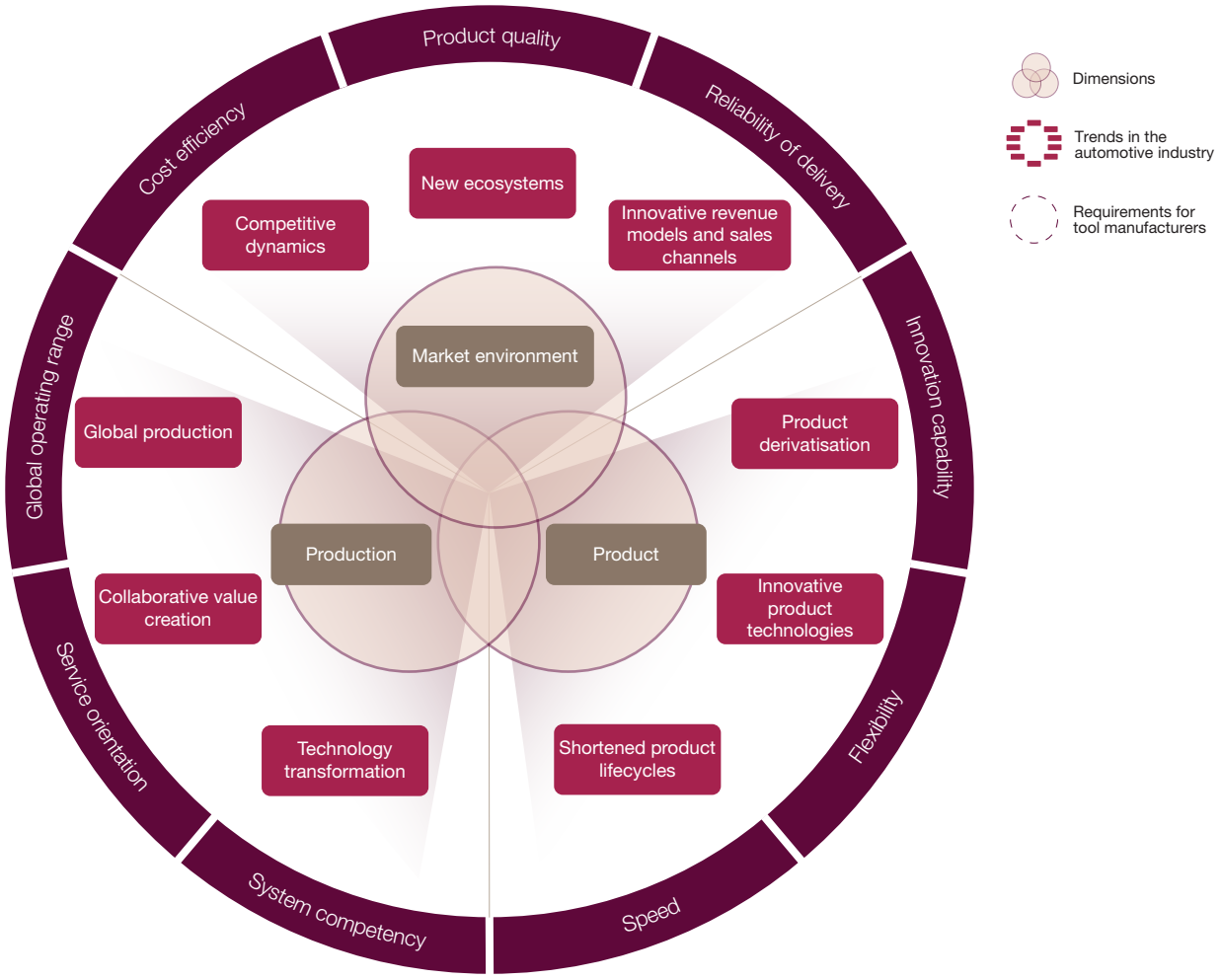
Requirements for tool manufacturers

The trend of competitive dynamics is also strongly influencing the tool manufacturing industry. The most important target value of tool manufacturers remains the **reliability of delivery**. A delay in the start of serial production due to a failure to deliver tools on time is not acceptable in the highly dynamic and efficiency-driven environment of the automotive industry.

The quality improvement of tools from low-cost countries in recent years causes an increased cost pressure on tool manufacturing businesses; the tool manufacturing industry is required to continuously increase the **cost efficiency** of its operations.

To realise cost efficiencies, attempts are made to leverage factor cost advantages, driving an increase in global fragmentation. At the same time, the **product quality** of tools has to meet increasing demands. Due to the ongoing

Figure 6: Trends in the automotive industry and requirements for tool manufacturers



Leveraging factor costs advantages results in fragmented operations – cost efficiency means successfully managing a global value network.

Günter Sprecher,
Head of Production Facilities and Tool Manufacturing, Daimler AG

harmonisation of global quality standards, the product quality of the tools is a fundamental requirement rather than a mere differentiating factor.

Dimension II: Product

The increasing **product derivatisation** is a response to the divergence of individual and regional end-customer requirements. Typically, we can see cannibalisation effects between derivatives, whereby the vehicle sales per derivative decrease. To avoid negative consequences for the cost structure, modular product and process construction systems increasingly gain importance.

The innovation focus of the automotive industry currently and in the medium term lies on drive trains, security and driver assistance systems, networked cars and lightweight designs. **Innovative product technologies** in combination with a high innovation speed offer enormous growth opportunities. Simultaneously, they put high demands on the innovativeness of

> *Without the innovation capability of tool manufacturing, lightweight designs will not reach the mass market*
>
> **Josef Peter Gallenberger**,
> Head of Tool Manufacturing,
> BMW AG

> *The system competence for tools and serial production plants enables smooth processes worldwide*
>
> **Michael Breme**,
> Head of Tool Manufacturing,
> Audi AG

the automotive industry. While there is a vast growth potential in the mid- and long-term, the technological barriers are still significant.

The trend for **shortening product lifecycles** can be observed in many product segments. Due to this reduction, sales figures decrease across the entire lifecycle. The proportional development costs per vehicle grow and the pressure on product and process development increases along with a shorter time-to-market. Therefore, shortening the product lifecycle puts a considerable demand on the efficiency of innovation processes in the automotive industry.

Requirements for tool manufacturers

Tool manufacturing enables the automotive industry to efficiently make new products on an industrial scale. In this respect, the **innovation capability** of the tool manufacturing industry has a direct influence on the market success of new vehicle technologies. Furthermore, innovative tool concepts offer the possibility to increase the productivity of serial production and thus face the increasing cost pressure in the automotive industry.

For reducing the time-to-market, product and process development will increasingly happen simultaneously. For the tool manufacturing industry, this means that changes in product design still have to be considered after finalising the tool development or even during tool production. In this respect, **flexibility of operations** is a key requirement towards the tool manufacturing industry.

The **product derivatisation** in the automotive industry confronts tool manufacturers with the challenge of having to produce a higher number of tools in a shorter timeframe. As a part of the development process in the automotive industry, tool manufacturing has a significant impact on the time-to-market. Thus, the speed of tool delivery is decisive for the market launch of new products.

Dimension III: Production

The **global production** in the automotive industry is a result of rapidly growing sales markets in the emerging markets as well as the global factor cost differences. In order to ensure access to the new sales markets and to benefit from the factor cost advantages, not only OEMs but also suppliers build production capacities in emerging markets.

The automotive industry traditionally has a leading role in applying **collaborative value creation**. Therefore, the real net output ratio of OEMs is typically below 40%. As companies progressively focus on their core competencies, this percentage is likely to further decrease in the future. This applies to both the area of physical product manufacturing as well as product and process development. Thus, the extent and complexity of the individually outsourced scopes will continue to increase.

Technology transformation in the automotive industry takes place across the entire process chain and allows companies to successfully address specific operational challenges. Paramount examples are the use of simulation technologies during product and process development, the establishment of consistent CAx chains, the robot-based automation of production and the comprehensive aggregation of product lifecycle data.

Requirements for tool manufacturers

The aspiration of automotive companies to outsource comprehensive, complex engineering and production scopes translates into a strong demand for a comprehensive **system competence**. The ability to deliver complete production systems rather than individual tools is a significant differentiation factor.

To benefit additionally from the trend towards a stronger collaborative value creation, a very promising option for tool manufacturers is the continuous expansion of the range of services offered in line with a consistent **service orientation**. Competitive service offerings include product design consulting or serial production support through proactive maintenance services.

For the German tool manufacturing industry, the trend towards a global distribution of production means having to enhance its global presence. The continuous availability of tools has to be ensured for global production locations. In this respect, a **global operating range** is an increasingly important success factor for tool manufacturers.

Inter-company collaboration enables manufacturing companies to ensure a competitive edge in a challenging business environment

The **transformation of inter-company relationships** in the manufacturing sector is triggered by steadily changing business requirements. We have witnessed how manufacturing companies have largely replaced **strongly hierarchical supplier-customer relationships** by **collaborating with partners and customers**.

Collaboration with partners is mainly driven by the need for **improving bottom-line performance**. It enables manufacturing companies to focus on core competences and to settle fluctuations in order volumes. In turn, collaboration **with customers** is **driven by top-line performance considerations** – it targets the **dissolution of traditional boundaries of responsibility** between manufacturing companies and customers. Customers are no longer passive recipients of products and services but rather **active players along the entire product lifecycle**.

In the past, large companies led the trend towards intensive collaboration. Investigating the example of **tool manufacturing** now explores the **potentials of inter-company collaboration** for **small and mid-sized manufacturing companies** that produce **highly individualised goods**. In the following chapter we outline how collaborating with **partners** enables the **transformation of a job-shop production into an industrialised flow production**. Furthermore, the potential of extending the product offering as well as the global operating range without large investments is analysed. Concerning **customers**, we describe how close collaboration enables **efficient development processes** and extensive service offerings and offers the opportunity to leverage **innovation capabilities**. As tool manufacturers are typically deeply integrated into the process chain of customers, they are an excellent example in this context.

Collaboration as a business performance driver

As illustrated in the previous chapter, the developments in the automotive industry are closely associated with requirements for tool manufacturers. To cope with these requirements, tool manufacturers need to develop solutions that go beyond the sole focus of optimising internal operations. In this chapter, we provide insights into how tool manufacturers drive their business performance through collaboration with partners and customers.

Collaboration with partners

Tool manufacturing is traditionally characterised by a job-shop production. The production process still has a high real net output ratio of above 70%. Due to the changes in the competitive environment, the industry is undergoing a paradigm shift from a job-shop to industrial tool manufacturing. This change process is ultimately reflected in a continuously decreasing real net output ratio, which indicates an increasing collaboration with partners (see Figure 7).

For tool manufacturers, four key potentials to drive business performance emerge from the collaboration with partners (see Figure 8):

- Focusing the range of resources.
- Increasing the capacity flexibility.
- Expanding the product and service offering.
- Exchanging knowledge with partners.

Collaborative value creation allows **focusing the range of resources** to core competencies. This is an important prerequisite for adapting the principles of industrial production. It enables the reduction of process variances and, as a result, can significantly increase cost efficiency as well as speed of operations. A focused range of resources further promotes product quality and innovativeness by increasing specialised skills. Although the tool manufacturing industry has recognised this potential, only one in three tool manufacturers maintains a focused range of resources.

Collaboration with partners increases the **capacity flexibility.** A high degree of volatility of order volumes typically leads to capacity bottlenecks. Access to the capacities of partners allows the resolution of these capacity bottlenecks and, at the same time, helps to maintain a competence-oriented range of resources. As a result, the adherence to delivery dates as well as the speed of order processing can be increased. In addition to this, available capacities make tool manufacturers flexible by enabling a quick response to customer requests.

A **targeted expansion of the product and service offering** can be achieved through collaboration with competent partners without having to develop own capabilities, which would be cost-intensive and time-consuming. This holds true for technological capabilities as well as for the ability to deliver products and services globally. The ability to integrate external and own competencies into a holistic product and service offering will be of crucial

importance in line with the increased demand for system competence and a global operating range. The majority of tool manufacturers already expand their offering today by utilising external competencies; this percentage will further increase in the future.

Knowledge exchange with partners provides the opportunity both to expand existing and add new knowledge. Moreover, similar problems can be resolved collaboratively, and a repetition of errors can be avoided. Continuous knowledge exchange supports the tool manufacturing industry in increasing its speed and flexibility in resolving problems for its customers. However, the mutual knowledge exchange between tool manufacturers and partners involves the risk that the provided information may be misused. Therefore, knowledge and information exchange implies a strong relationship and mutual trust within the framework of a close collaboration.

To comprehensively assess the collaboration with partners, we conducted the collaboration intensity assessment; it describes the interaction level with partners in addition to the specific real net output ratio. In line with the growing importance of the above potentials, it shows that the collaboration intensity with partners will continuously increase in the future (see Figure 9).

Collaboration with customers

The consistent alignment to the needs of customer leads to an increasing service orientation in the tool manufacturing industry. Innovative service offerings typically result in the dissolution of traditional boundaries of responsibility between the tool manufacturing industry and customers. This development requires a close collaboration with customers.

Due to the interface function of tool manufacturing, collaboration with customers' product

Figure 7: Development of the real net output ratio

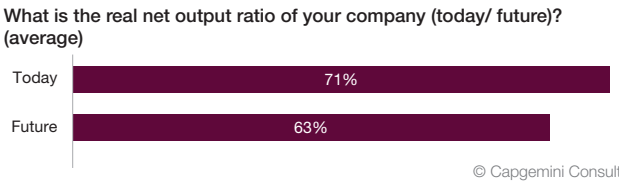


Figure 8: Potentials of collaboration with partners

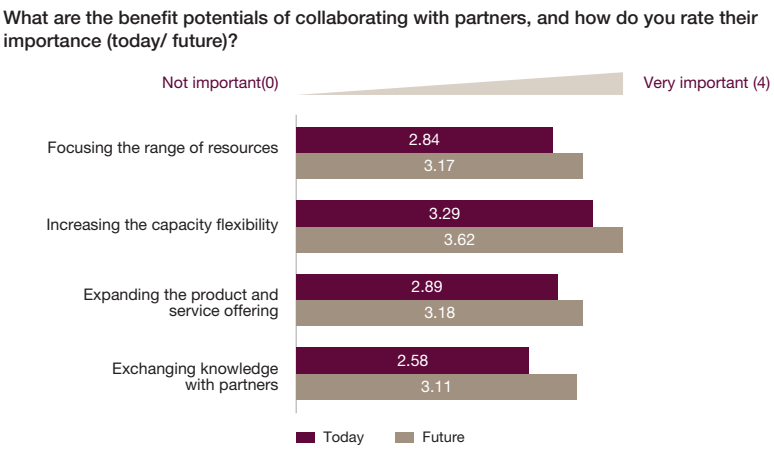
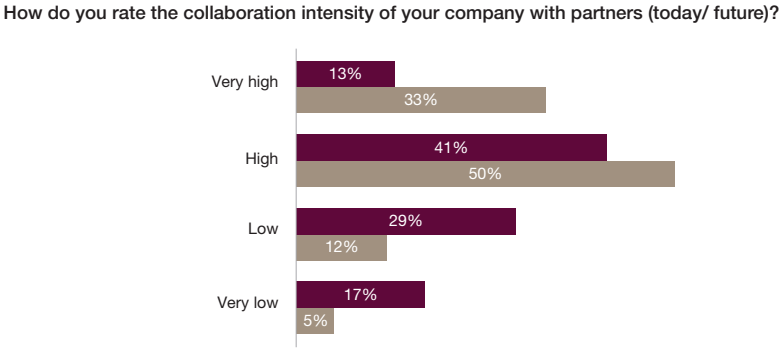


Figure 9: Collaboration intensity with partners



development represents an integration in the upstream customer processes. Collaborating with customers' serial production represents an integration into the downstream customer processes. Fully realising the potentials of collaboration with customers requires a comprehensive upstream and downstream collaboration.

Upstream customer processes

The growing demand of customers for innovative services in the area of integrated product and process development leads to an increasing integration of upstream customer processes. Tool manufacturers already offer services to customers which are not part of the original core business. A primary example of this is the provision of consulting services with respect to customers' product design. In addition, tool manufacturers offer to take over the design of entire product components. Thus, the upstream integration enables tool manufacturers to act on the product design and enable the efficient serial production of innovative product concepts. Upstream integration ensures that all relevant data and information for tool manufacturing is available for order processing.

A dissolution of the traditional boundaries of responsibility between tool manufacturing and the upstream customer processes can be observed. Consequently, the collaboration intensity with customers in this area will increase significantly in the future (see Figure 10).

Downstream customer procsses

In order to provide a holistic system competence for tool and serial production systems and maximise service orientation, tool manufacturers are requested to integrate into the downstream customer processes of serial production. In addition to traditional maintenance and repair services, many tool manufacturers thus take over the try-out of tools as well as the start-up of serial production, including the corresponding adjustment measures. The complete takeover of batch production on own production systems expands the service range of many tool manufacturers.

The systematic re-transition of acquired expertise from serial production to product and tool development allows tool manufacturers to leverage their innovation capabilities. Hence, the combination of upstream and downstream integration is essential to produce tools for customers in line with their specific requirements.

The integration in the down-stream customer processes causes traditional boundaries of responsibility to dissolve. Consequently, collaboration intensity with the downstream customer processes will increase (see Figure 11) almost to the same extent as for upstream processes.

Figure 10: Upstream collaboration intensity with customers

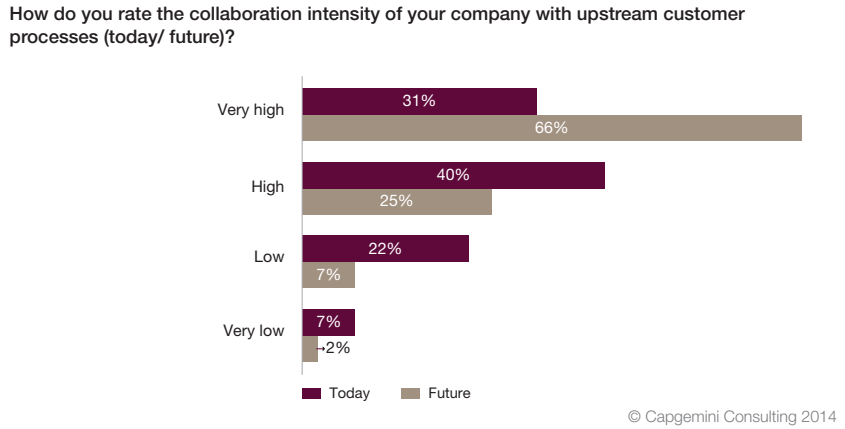
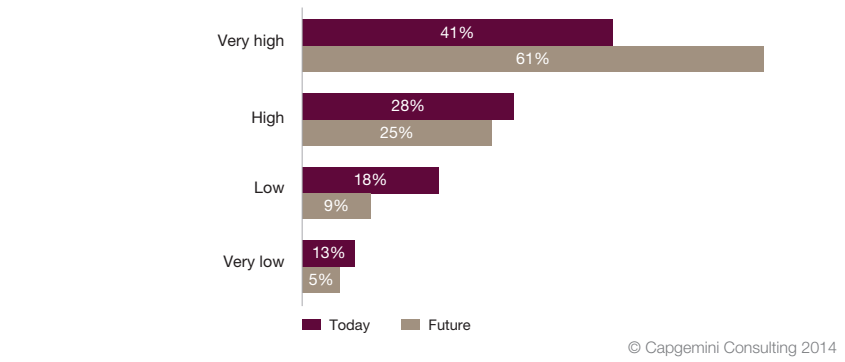


Figure 11: Downstream collaboration intensity with customers



Characteristic collaboration types

Depending on their collaboration intensity with partners as well as customers, tool manufactures can be differentiated by four collaboration types. As our empirical survey illustrates, each of the following four collaboration types is currently represented by a significant share of the tool manufacturers located in Germany (see Figure 12).

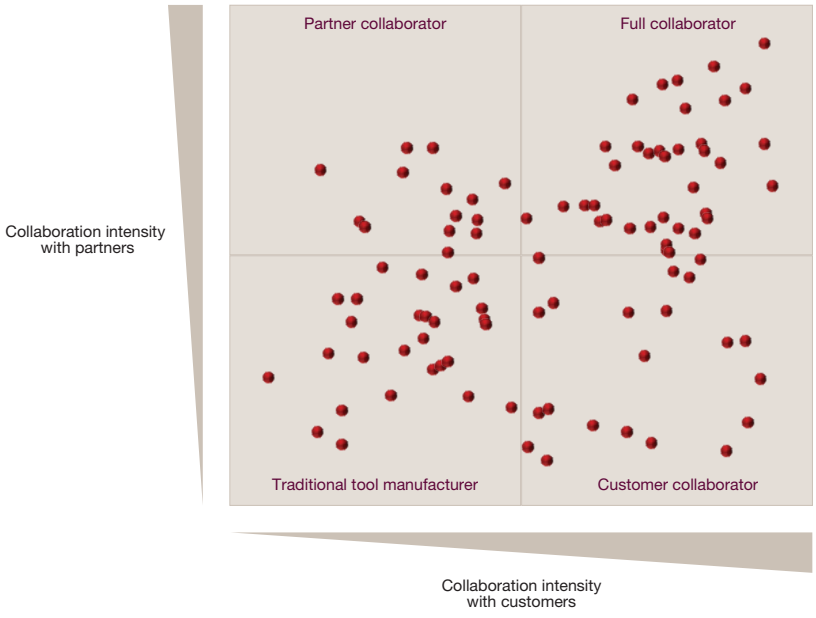
The **traditional tool manufacturer** is characterised by a low collaboration intensity with partners and customers. Partners are merely approached depending on operational needs such as capacity stretches. Therefore, traditional tool manufacturers typically interpret the collaboration with partners as a hierarchical supplier-customer relationship. Regarding the collaboration with customers, traditional tool manufacturers interpret their role as reactive problem solvers who individually respond to requests and customer requirements from first call to tool delivery. Approaches for collaborative development or try-out processes with customers are very rare.

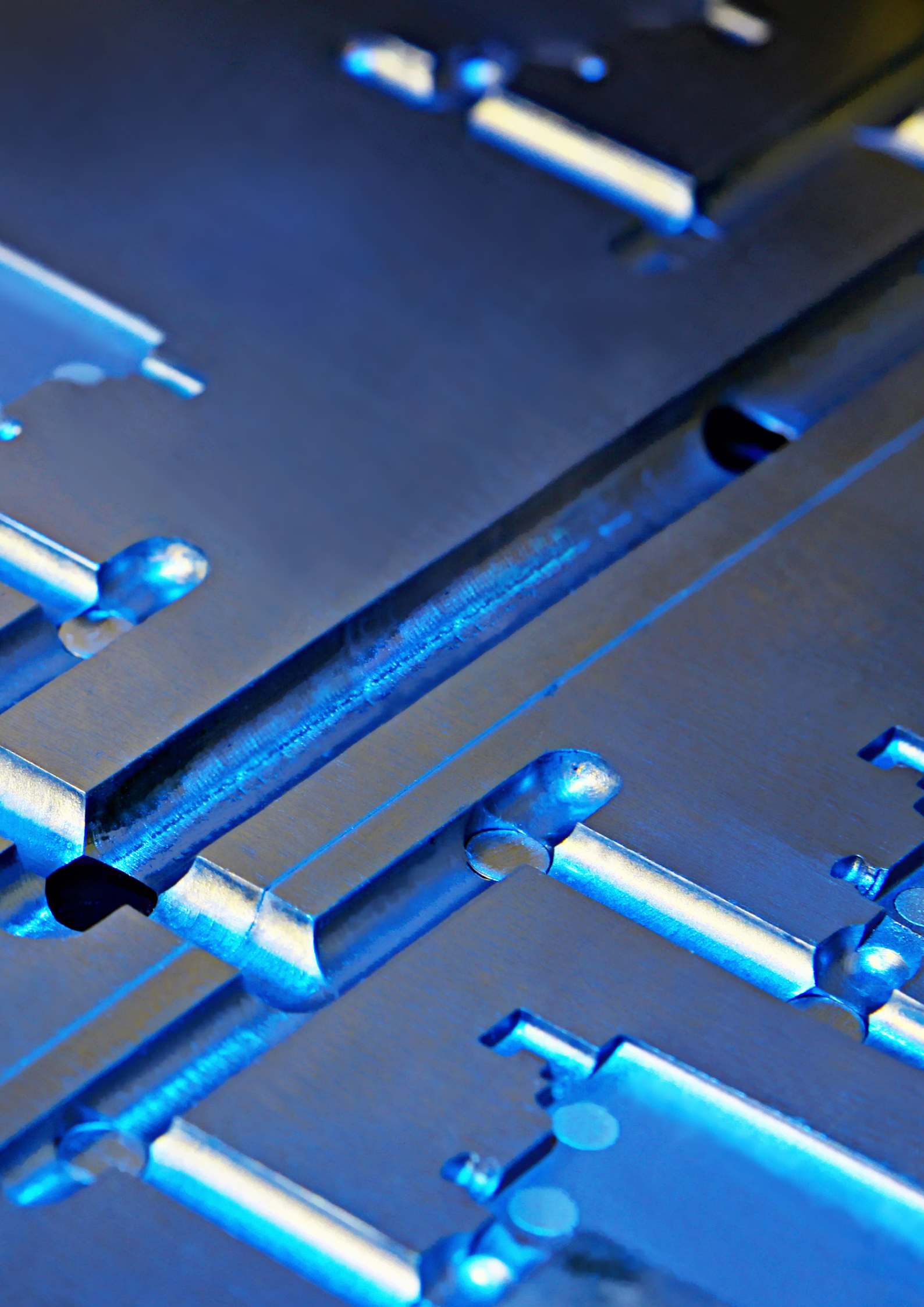
The **customer collaborator** maintains a low level of collaboration intensity with partners, similar to the traditional tool manufacturer. However, the collaboration with customers is characterised by great intensity and is most often interpreted as a core competence. Customer collaborators understand themselves as full-service providers who proactively integrate in the upstream and downstream customer processes, thereby creating added value for their customers.

The **partner collaborator** differs from the traditional tool manufacturer by having a high level of collaboration intensity with partners. The collaboration with partners is used to systematically outsource engineering or production scopes that do not correspond to the defined internal core competencies. Hence, partner collaborators interpret the collaboration with partners as a close strategic partnership for improving the individual and joint performance.

The **full collaborator** works intensively with partners as well as customers and thus combines attributes of the partner collaborator and the customer collaborator. Most often collaborative value creation is defined as a core competence. The high collaboration intensity with partners and customers enables the full collaborator to consistently leverage potentials arising from collaborative value creation.

Figure 12: Present classification of survey participants regarding collaboration types





Due to insufficient inter-company coordination capabilities, many manufacturing companies fail to fully leverage the benefits of intensive collaboration

In corporate practice, we observe that many manufacturing companies **struggle to fully leverage the potential of collaborating** with partners and customers. The main reason we identified is **a competency gap regarding the coordination and orchestration of collaborative value creation**, i.e. companies have engaged in collaboration without comprehensively reflecting the implications in their operating model. **Inter-company collaboration necessarily creates interfaces** regarding organisational structures, processes and IT infrastructure, which need to be well designed and foreseen. Where these interfaces are **not managed effectively**, they lead to barriers hindering the coordination of collaborative value creation.

The negative **impact of collaboration barriers** strongly correlates with the collaboration intensity. **Collaboratively producing highly individualised goods** requires a much more **frequent and comprehensive interaction** with partners and customers than it does for producing standardised goods. The tool manufacturing industry represents a prime example in this context, allowing us to further examine the nature and cause of collaboration barriers. The following chapter outlines countermeasures for a more efficient integration **with partners** and customers in order to **dissolve collaboration barriers**.

Inter-company coordination as a challenge

In order to meet future requirements in the tool manufacturing industry, successful companies collaborate intensively and known barriers are overcome. Dissolving these barriers by integrating with partners and customers enables tool manufacturers to leverage the potentials of collaborative value creation.

Barriers for the collaboration with partners

Today, the collaboration with partners strongly depends on individuals, which means high manual collaboration effort on an interpersonal level (see Figure 13). In particular, the lack of common platforms for capacity planning and scheduling or real-time communication of design changes or specific requirements prevents an efficient integration of partners in the operations of tool manufacturers (see Figure 14).

Furthermore, inconsistent data and different data formats lead to errors in collaborative value creation with partners. The reasons for this are manual interfaces, incompatible production planning and

Figure 13: Barriers for the collaboration with partners

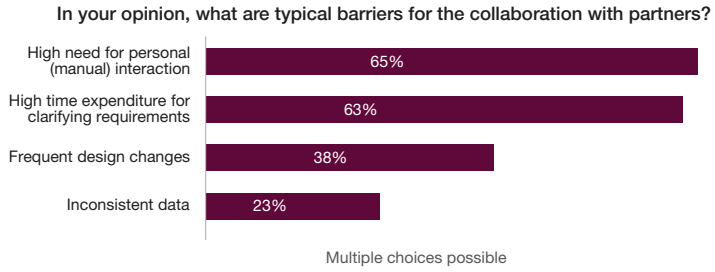
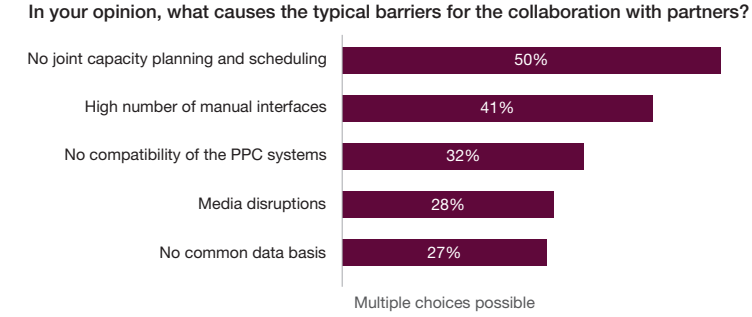


Figure 14: Causes of barriers for the collaboration with partners



controlling (PPC) systems or media disruptions in order processing. Especially in the design phase there is a high risk of working with obsolete data, for example if new design versions or changes by the customer are not transferred. The later such errors are detected, the later relevant components will have to be re-worked or newly produced, leading to increased costs, a significant delay and potentially even a postponement of production start.

Potential approaches for the integration with partners

For a large part of the tool manufacturers in Germany, providing platforms for an integrated inter-company PPC represents an effective measure for integrating with partners (see Figure 15). Furthermore, the implementation of inter-company communication platforms and systems for controlling and steering a production network are potential approaches for an efficient integration.

Barriers for the collaboration with customers

In corporate practice, product design changes often happen late and despite design freezes. This fact represents one of the biggest challenges for the tool manufacturing industry in terms of customer integration (see Figure 16). Designs need to be adapted, versions maintained and the customer frequently consulted. In most cases, data needs to be manually corrected due to a lack of automated interfaces (see Figure 17), real-time data transmission is almost non-existent. Consequently, the finalisation of a design is postponed, which leads to a delay in all downstream areas.

Figure 15: Approaches to integrate with partners

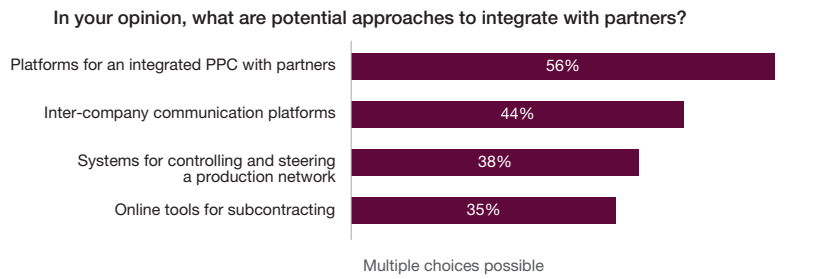


Figure 16: Barriers for the collaboration with customers

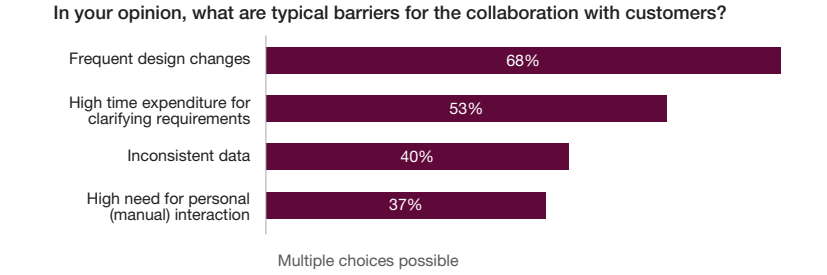
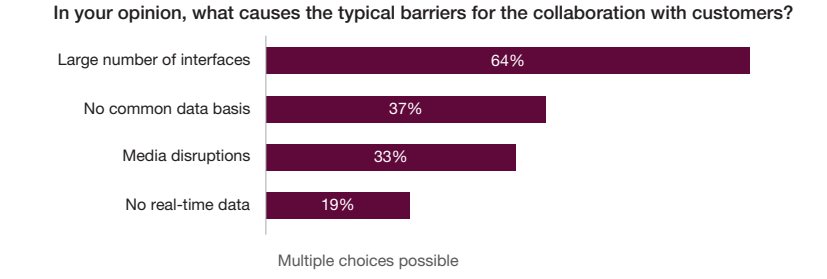


Figure 17: Causes of barriers for the collaboration with customers



> *90% of all errors occur at interfaces – reducing the number of interfaces with our customers is hence a top priority*
>
> **Jürgen Wlochowicz**, Head of Tool Manufacturing, KIRCHHOFF Automotive Deutschland GmbH

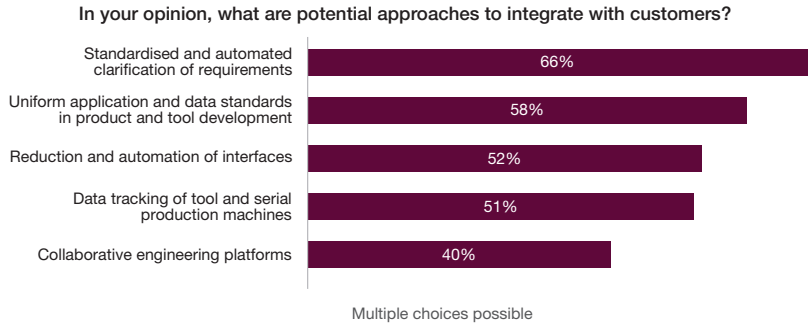
After the initial tool try-out, test runs are conducted on the serial production equipment of the customer. The tool manufacturer is under tremendous time pressure, as every downtime in serial production leads to high costs. Therefore, tool manufacturers aim to manage the number of testing loops and potential re-work as efficiently as possible, which is often hindered by the lack of clearly defined interfaces between tool and serial production plant. There is usually no digital interface to the tool to help the tool manufacturer collect and analyse performance and status data in order to clearly determine the cause of error. As a result, the cause of error cannot be directly attributed to either the tool or the production plant, neither during testing nor the following serial production.

Potential approaches for the integration with customers

With respect to the development processes, a standardised and automated requirement clarification is a key lever for integrating processes with customers (see Figure 18). In addition, uniform programme and data standards for developing products and tools as well as the reduction and automation of interfaces are indispensable.

During tool testing and serial production, a systematic tracking of performance and status data of tools and serial production plants can mitigate the interface issues. Furthermore, the acquired performance data can be used to collaboratively optimise serial production and integrated product and tool development processes.

Figure 18: Approaches to integrate with customers



Digital Transformation enables manufacturing companies to efficiently integrate with customers and partners, thereby forming a digital value network

Mobile devices, social media, real-time interaction – **digital technologies** have long become **part of our private and social lives**. Within the context of increasing digitalisation in recent years, **company communication and information technologies**, among others, have become **increasingly important** and already have an evident influence on the performance in all industries.

Many companies have recognised the benefits of a targeted application of these technologies and the implicit potentials for productivity boosts. They have started to focus employees and investments of their value-adding structures on the application of digital technologies to **increase turnover and profitability** *(Footnote 1)*. However, **Digital Transformation in the manufacturing industry has progressed slower** compared to other industries. This is especially true for the area of capital goods, which includes the products of the tool manufacturing industry.

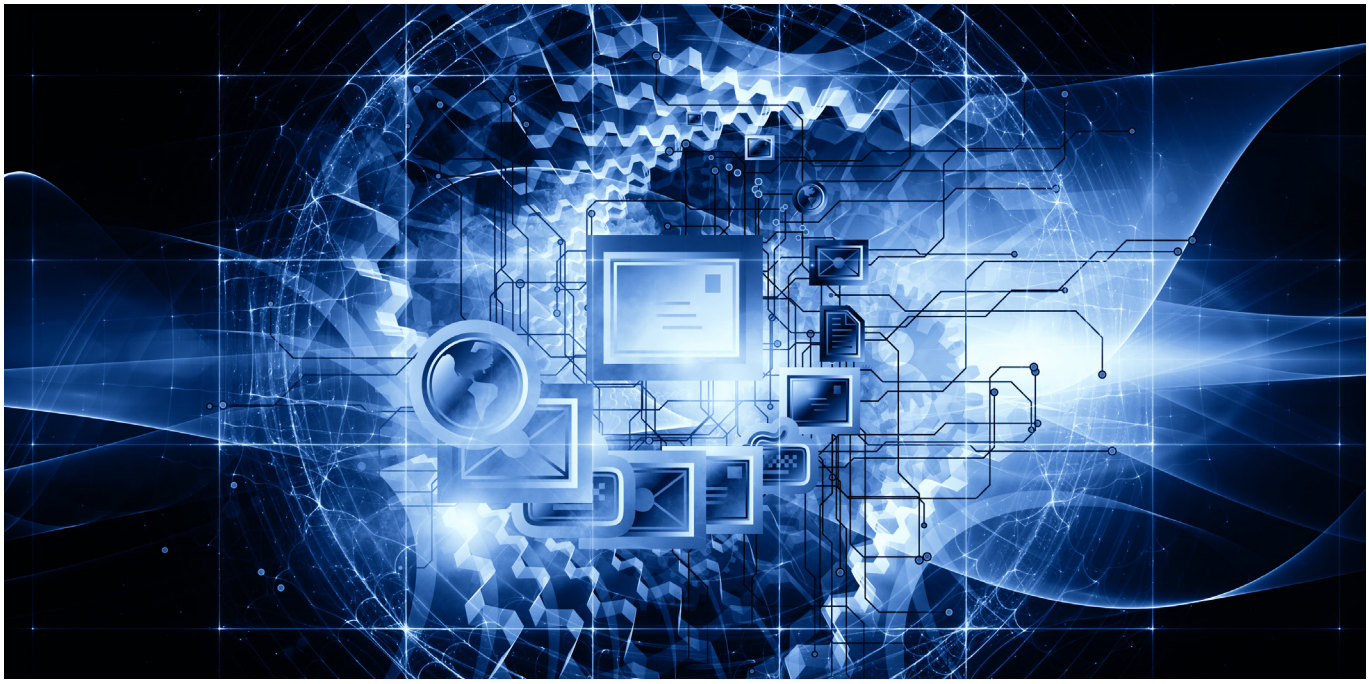
Digital Transformation offers an enormous potential to the **manufacturing industry** to secure its **global productivity and competitive edge** *(Footnote 2)*. In particular, this applies to the **coordination of inter-company value creation** and related topics discussed in this study. Other opportunities for additional effects of a comprehensive Digital Transformation approach include **boosting innovativeness** with the support of development partners (crowdsourcing) or **increasing operational flexibility** through a closer collaboration with partners in serial production.

Examining the **tool manufacturing industry as an example**, this study illustrates how manufacturing companies can **address specific business challenges by embracing Digital Transformation**. In this chapter, we have identified digital technologies that provide solutions to the characteristic challenges of coordinating collaborative value creation.

[1] For further information on Digital Transformation, please consult the Capgemini Consulting study "The Digital Advantage: How Digital Leaders Outperform Their Peers in Every Industry".

[2] For further information on how manufacturing companies can use Digital Transformation, please consult the Capgemini Consulting study "Are Manufacturing Companies Ready to Go Digital?".

Digital value networks as a success factor



The need for Digital Transformation

The tool manufacturing industry has acknowledged the potential benefits of collaborating with partners and customers and has therefore continuously established collaborative value adding structures. This trend will further intensify in the future, when full collaborators will emerge as the most prominent type of collaboration (see Figure 19).

This development puts high demands on the coordination of collaborative value creation. However, historically developed structures hinder coordination, which leads to a discrepancy between the increasing intensity of collaboration and the actual level of integration. This discrepancy is reflected in the barriers for the coordination of a value network described in the previous chapter. Hence, the dissolution of collaboration barriers by consistently integrating with partners and customers needs to accompany the increasing collaboration intensity.

Figure 19: Future classification of survey participants regarding collaboration types

As the results of the previous chapter indicate, Digital Transformation offers effective levers for integrating partners and customers into a value network. However, identifying the right kind of investment areas, selecting promising technologies and engaging as well as further developing the affected employees are prerequisites for a successful Digital Transformation.

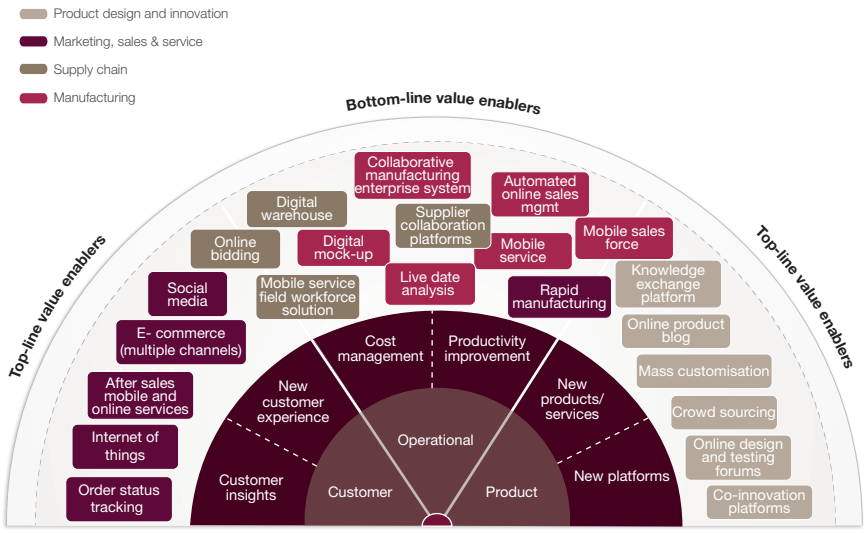
Capgemini Consulting has developed the "digital innovation radar" for the manufacturing industry to generate a more systematic view of the broad range of investments (see Figure 20). The radar differentiates between digital technologies that help to improve operational efficiency (bottom-line value enablers) and those that aim at increasing revenues (top-line value enablers). Six different benefit potentials of digital technologies are defined in line with this classification, which are predominantly used in the four generic value steps of the manufacturing industry, namely product design and innovation, manufacturing, supply chain, and marketing, sales and service.

For the tool manufacturing industry, the digital innovation radar represents a framework for identifying digital technologies that enable the efficient integration of customers and partners into a collaborative value network.

Integration of a value network by Digital Transformation

Developing a tool manufacturing company into a full collaborator has to be accompanied by a digitally enabled integration with partners and customers, thereby forming a digital value network.

Figure 20: Digital innovation radar



The systematic business-benefit driven selection and introduction of digital technologies forms the basis for the transformation. For this purpose, the technologies are assigned to three successive maturity levels (see Figure 21). These levels can serve as a guideline for tool manufacturers in their gradual development into a full collaborator by leveraging the benefits of Digital Transformation. Please note that the maturity levels do not directly correspond to the collaboration types; a stringent distinction between partners and customers is not always necessary for defining a digital roadmap. Selecting the adequate maturity level and corresponding technologies fundamentally depends on the targeted intensity of collaboration.

Maturity Level 1

The digital technologies of the first maturity level are characterised by a low level of complexity and a comparatively easy implementation. They can largely be introduced and used without an active participation of partners or customers. Integrating with the IT systems of the partners or customers is usually not necessary.

Order status tracking: The fundamental significance of supplying tools on time for the start of a customer's serial production implies that the customer will demand continuous information on the order status. Providing a web-based order status tracking system helps in automating and streamlining these

information processes and simultaneously increases transparency with respect to the status of delivery and the resulting delivery date.

Online design and testing forum: The introduction of an online design and testing forum helps to create a uniform digital interface between the development departments of tool manufacturers, partners and customers. Specifically, this supports an automated clarification of requirements and offers access to a common database, which helps to avoid media disruptions and the use of different document versions in the collaboration between the organisations. Furthermore, an online design and testing forum offers the possibility to systematically provide the results of tool testing as well as the performance data of the tools currently in operation.

Online bidding: Internet-based tenders can be used to conduct situational outsourcing as efficiently as possible. Online bidding reduces the complexity and timeframe of the tendering process and significantly increases process transparency for all participating parties. This can considerably reduce the sub-contracting costs.

Maturity Level 2

Introducing and using the technologies of the second maturity level is more complex compared to the technologies described above. The related benefits are higher with respect to increasing the level of integration in a value network. Effectiveness, though, can only be achieved by actively involving partners and customers. An automated transfer of information and data is mandatory.

Knowledge exchange platform: Along with great potentials, the systematic exchange of knowledge in a value network also carries fundamental risks for the participants. Hence, a systematic and transparent knowledge management is required, for which an intercompany knowledge exchange platform represents a digital solution. A tool manufacturer can thereby ensure a systematic and secure exchange of knowledge with its partners and customers.

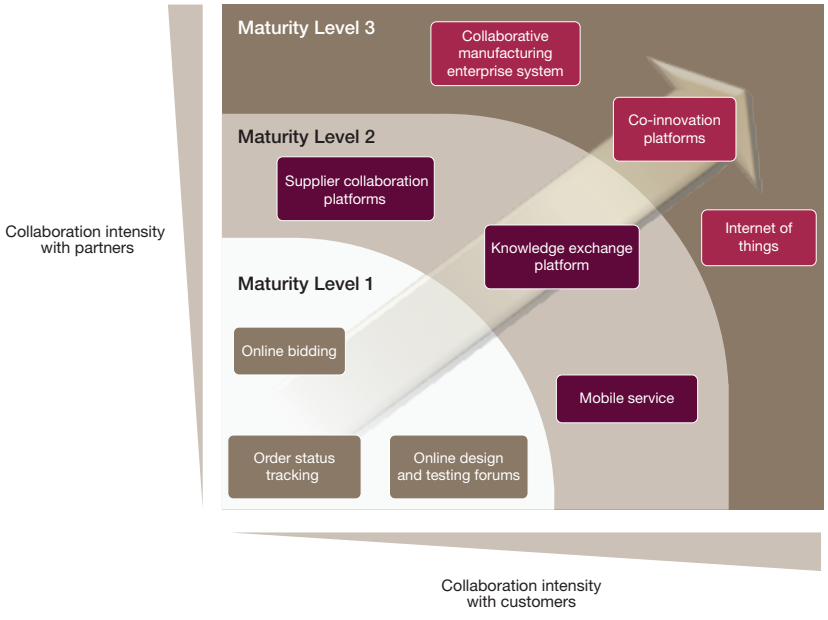
Supplier collaboration platform: Web-based supplier collaboration platforms are used for co-ordinating the situational or systematic outsourcing to partners. They are characterised by a low level of complexity and support the exchange of information to increase transparency along supply chains. This enables a continuous reconciliation of delivery dates, queries into demand and inventory, and the central provision of actual delivery scopes.

Mobile service: When employees of a tool manufacturer visit the customer onsite, the interaction processes can be significantly improved through modern information and communication technologies. The use of connected devices enables access to the data and communication infrastructure of the tool manufacturer. Access to all relevant data through mobile interfaces – anywhere and anytime – thus becomes a reality, which means services can be provided much more effectively.

Maturity Level 3

The digital technologies associated with the third level of maturity enable the full integration of partners and customers in a digital value network. An effective use of these technologies requires the active participation of all partners and customers and a comprehensive inter-company connectivity between the respective IT systems. Accordingly, the introduction and usage of these technologies is more complex.

Figure 21: Maturity levels of digital technologies (extract)



“It is no longer possible to coordinate an international tool manufacturing network without the help of digital tools, be it in terms of communication, planning and controlling, or technological and organisational collaboration”

Dr. Christian Hinsel,
Head of Tool Manufacturing,
Hirschvogel Automotive Group

Collaborative manufacturing enterprise system: These systems offer powerful technological support for the coordination of intensive collaboration processes with partners. Basically, the idea is to expand the logic of an ERP system to the inter-company level. In that respect, a collaborative manufacturing enterprise system represents an inter-company management system for the planning and controlling of collaborative value creation. For an effective use of the system, all partners provide comprehensive planning, design or inventory data and create an automated interface to their internal ERP systems. Requiring only limited coordination efforts, collaborative value creation can thereby be planned and controlled in a transparent and efficient manner.

Co-innovation platforms: The collaborative development of complex, comprehensive solution concepts is a key challenge in a value network. A co-innovation platform offers the technological support for these collaborative development processes. These systems have a direct interface to the internal CAD systems and provide a web-based communication and data exchange platform. A uniform data access helps in effectively preventing media disruptions and version conflicts as well as controlling the change processes in a transparent manner. The collaborative processes are supported by virtual workrooms integrated in the CAD software, allowing inter-company teams to work on joint projects. A co-innovation platform thereby enables the implementation of an integrated process and product development with partners and customers.

Internet of things: The term “Internet of things” (also referred to as “Industry 4.0”) refers to the connection of physical objects via the Internet, thus enabling an automated interaction of machines. This technology allows tool manufacturers to intensify their interaction with the serial production of customers. The connectivity of the tools in use enables an automated compilation, transfer and analysis of performance data. This offers the possibility of a more targeted process optimisation and a proactive maintenance of the tools. Thus, the Internet of things provides the technological foundation for maximising customer benefits through related services.

The application of the digital technologies described above needs to be carefully aligned. Intelligently connecting the individual systems not only allows leveraging synergy potentials but may also considerably increases the performance of the technologies. For example, linking the technologies collaborative manufacturing enterprise system, supplier collaboration platform and online bidding enables the automation of planning and controlling of production processes in a digital value network. Another example would be to create an interface between a knowledge exchange platform and a co-innovation platform in order to effectively leverage the existing knowledge in a digital value network.

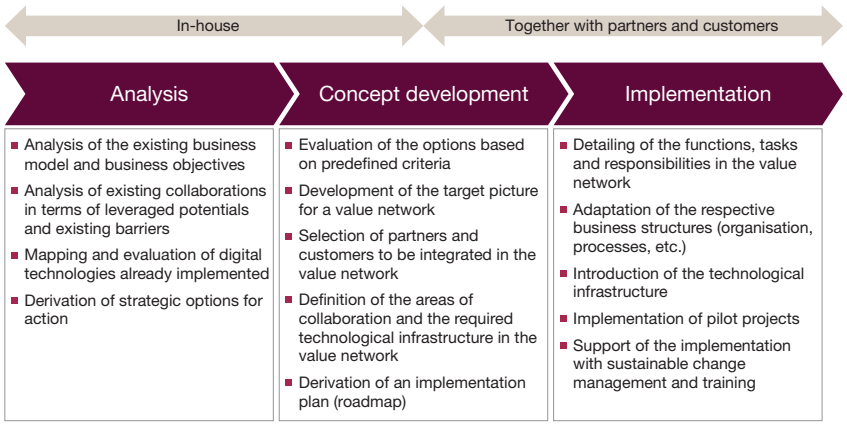
Recommendations and outlook

The study clearly underlines the need for change in the tool manufacturing industry: the full collaborator will become the dominant collaboration type. This means that the demands for effective coordination will increase along with an ever-greater intensity of collaboration with partners and customers.

In order to fully leverage the potential of Digital Transformation, we recommend to follow a three-step approach. Through using this approach, tool manufacturers will be able to address the challenge of Digital Transformation and generate true added value.

The first step is to analyse the current situation of the company. The initial focus is on the business model and the business objectives. In addition, existing collaborations are analysed for their digital potential and existing barriers. In parallel, digital technologies already implemented should be analysed and evaluated.

Figure 22: Transformation approach



In the next stage – concept development – the options are systematically evaluated using predefined criteria such as revenue potential, required organisational changes and IT costs. Based on the results, a target image is developed that provides the framework for selecting future partners and target customers. Together with these partners and customers, potential areas of collaboration are identified and the necessary technological infrastructure is defined. This serves as input for developing the digital roadmap. Based on the results, potential options for establishing a digital value network are derived.

The implementation and resulting transformation itself are the subject of the third step. Building on detailed functions, tasks and responsibilities in the value network, the existing operational structures (organisation, processes, etc.) are adjusted. Furthermore, the defined technological infrastructure is introduced and piloted before going live across the entire network. The investment in change management should be driven by the level of impact of the change. After all, this process is not merely about implementing new technologies but requires the further development and commitment of the affected employees.

Collaboration in value networks and their efficient coordination by leveraging digital technologies will be a key success factor in the tool manufacturing industry. An early and targeted development of the related competencies will enable tool manufacturers to generate a sustainable competitive advantage.

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WZL RWTH AACHEN

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