

Integration through Services in the Tool and Die Making Industry in High Wage Countries

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Abstract--The tool and die making industry is located on the critical path in the production industry between its customers in product development and in mass production. An increasingly competitive global production environment has eliminated the traditional advantage in tool quality of high wage countries. This requires the tool and die making industry in high wage countries to achieve differentiation through quick and reliable processes to enable on-time mass production for their customers. The quickness and the reliability can be increased significantly by offering specific services to integrate the customer at the interface with product development and mass production. Latest study results of the Laboratory for Machine Tools and Production Engineering (WZL) at RWTH Aachen University on value creation networks show that the tool and die making industry in high wage countries has identified the potential of integration through services, but is not able to realize this potential with the customer yet. To bridge the gap between the status quo in the industry and the demand for integration through services, solutions have to be developed. This paper addresses this demand and illustrates three generic tool and die making companies that master the integration through services and achieve differentiation against global competition.

I. INTRODUCTION

Due to its key role in the value chain between product development and series production, the tool making industry is one of these important industries in the production industry. Excellent products can only be manufactured at economical prices with the support of tools. The tool making industry therefore largely contributes to the economic performance of major economies [2, 3, 4, 5]. The tooling industry in the high wage countries Germany, Japan and the USA used to be the most important markets for tools that enable efficient series production. In recent years their dominance in a global context has decreased significantly as the tooling industry in these countries faces margin losses as well as increasing competition from Eastern Europe as well as Central and South Eastern Asia [6, 7]. Value creation networks have been identified as a capable solution to address this need for action in the tooling industry in high wage countries. SCHUH ET AL. have presented digitalization as instrument for the realization of suchlike value creation networks in the tool making industry at the PICMET conference in 2013 [8]. A core aspect of value creation networks is the collaboration with the customer through service integration. While the importance of value creation networks and service integration specifically is now being acknowledged in the scientific community as well as the tool making industry in practice, tool making companies still lack

the competence to successfully engage in collaboration and achieve service integration for a higher value for the customer and differentiation against the global competition [9].

The Laboratory for Machine Tools and Production Engineering (WZL) at RWTH Aachen University has a specific focus on the tool making industry. It is directly linked to the WBA Aachen Tool Making Academy (WBA) as platform for the development of the tool making industry in high wage countries. The tooling companies that are partner of the WBA are illustrated in figure 1. These tool making companies are either independent entities or a separate division of a larger manufacturing enterprise that also features a series production in another division [10].



Figure 1: Partners of the WBA Aachen Tool Making Academy

Based on a study on value creation networks conducted by the WZL with 110 tool making companies, the WZL initiated further research to define how tool making companies have to engage in collaboration with the customer and use service integration as lever for differentiation [9]. Substantial part of this research was the incorporation of the 43 partners of the WBA in workshops and interviews with tool making experts to ensure the practicability of researched solutions. Additionally the databank of the WZL and the affiliated Fraunhofer-Institute of Production Technology (IPT) for tool

making companies was employed to analyze current services in the tool making industry in high wage countries [11].^a

With this conducted research the relevant services for service integration in tool making were identified and three generic types of tool making companies were derived. All of these three types are able to increase the value for the customer and achieve differentiation with the collaboration with the customer by service integration. They represent a blue-print for the tool making industry in high wage countries to improve their competitiveness. The identified services and the derived three generic types of tool making companies are the key results of this paper.

After the introduction the tool making industry in high wage countries will be described. Subsequently the fundamentals of collaboration with the customer in the tool making industry as well as its challenges will be introduced. On that basis the identification of relevant services for the tool making industry and the derivation of the three generic types of tool making companies that successfully address integration through services will be presented.

II. THE TOOL MAKING INDUSTRY IN HIGH WAGE COUNTRIES

The tool making industry enables the series production of the customer with tools. It is located at the interface between the series development of products and the series production. As the existence of tools is inevitable for the series production, the tool making industry is on the critical path towards the consumer of products. The tool making industry in high wage countries has suffered significantly from the global economic crisis in 2009 and 2010. The industry in the key high wage countries for tool making Germany, Japan and the USA has recovered gradually and has recently reached the pre-crisis level of 2008 with regard to turnover [12]. However these tool making companies are still facing margin losses. The reason for that is the increasing competition, especially from Eastern Europe as well as Central and Southern Asia [6]. The quality of tools from low wage countries has increased enormously, but their prices are still comparatively low [7,13,14,15]. The tool making industry in high wage countries has to be able to create differentiation by addressing the five values of tool making [9]:

Costs: Tools account for up to 30% of the total production costs. Due to the use of the tools, planned maintenance and unplanned repairs, additional costs accrue over the lifetime of tools. Up to 60% of the total production costs are determined by the tools for the production of a

product [16]. Innovative tool concepts enable the customers to realize significant cost-saving potential over the life cycle of the product because of the tool's high productivity[9].

Time-to-Market: Product life cycles shorten continuously in most industries. In times of high global competitive pressure, the success or failure of a product is often decided by the time passed until the market launch. Therefore the speed of order processing and the lead time in tool making has direct impact on the product success [9].

Quality: Besides the tool itself and the interaction of the tool and the machine, the products are dependent on the precision and surfaces of tools. These factors determine the customers' perceived quality and thus its satisfaction. In addition to technological developments, various organizational measures, caused by the high complexity of tool manufacturing, are necessary to achieve high customer satisfaction through quality [9].

Innovation: New types of processes and tool concepts enable a more economical series production. Because of its expertise tool making companies can actively participate in the customers' product development and thereby contribute to innovations with regard to the product or the series production processes [9].

Productivity: The productivity of a tool in use significantly determines its life cycle costs. Therefore a high level of tool availability is a crucial factor in the tool's overall cost calculation, which affects the tool making processes [9].

III. COLLABORATION WITH THE CUSTOMER IN THE TOOL MAKING INDUSTRY

The upstream collaboration with the customer in series development and the downstream collaboration with the customer in the series production is of great importance for successful value creation in the tool making industry. Fully realizing the potentials of collaboration with customers requires a comprehensive upstream and downstream collaboration [17]. Figure 2 shows the interface between tool making companies and their customers.

As the level of quality of the competition has been increasing, efficient value creation itself is required to improve the values of a tool making company and enhance its position against the global competition. Tools are made in single or small batches and tool making companies require flexibility in resources as every order featured different requirements and processes. Therefore the value creation in the tool making industry was for a long time predominantly focused on the internal manufacturing of a tool making company [6]. A tool making company could provide all processes and technologies that were required to make an entire tool. Results of the annual competition "Excellence in Production" underscore this with the a value creation depth of 70% and above in the tool making industry [11]. In recent years the concept of industrialization in the tool making industry was addressed extensively to support tool making

^a The databank of WZL and IPT consists of detailed data of approximately 1000 tool making companies. The databank is continuously updated through benchmarking activities of WZL and IPT as well as the annual competition "Excellence in Production" (EiP). The EiP awards the most successful tool making company in Germany every year. The EiP has annually approximately 300 tool making companies participating in the competition (for additional information see <http://www.excellence-in-production.de>).

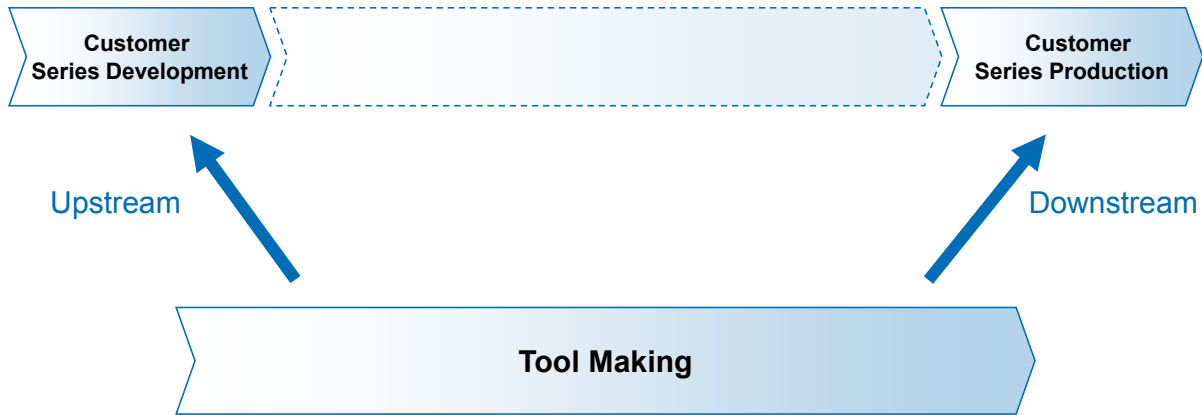


Figure 2: Tool making and its upstream and downstream interface to the customer

companies in the increase of process efficiency and differentiation [18]. The concept is addressing the internal value creation of a tool making company and has allowed a significant efficiency increase. According to KLOTZBACH the enabler for industrialization in the tooling industry is the focus on core competences [19].

Study results show that for the future development of the tool making industry the potential of intense collaboration with customers and suppliers in value creation networks is of great relevance [9]. It allows tool making companies to focus on their core competences collaborate with customers and suppliers to be able to offer a comprehensive spectrum of tools and services. Integration with regard to the customer describes a relationship between its customers and a tool making industry. The service integration in the tool making

industry addresses the relationship between a tool making companies and its customers. By offering services to the upstream and the downstream customer a tool making company can achieve an integration into the processes of its customers. It thereby delivers increased value and improves its customer retention. In the single and small batch production of the tool making industry service integration plays an even more significant role as all tools are made to order and are very complex from the design up to their utilization in the series production of the customer [20].

Suppliers of tool making companies are utilized to contribute their specific core competences to a tool. Suppliers therefore have to be synchronized regarding their core competences and the required capacities to efficiently support a tool making company in its value creation [9].

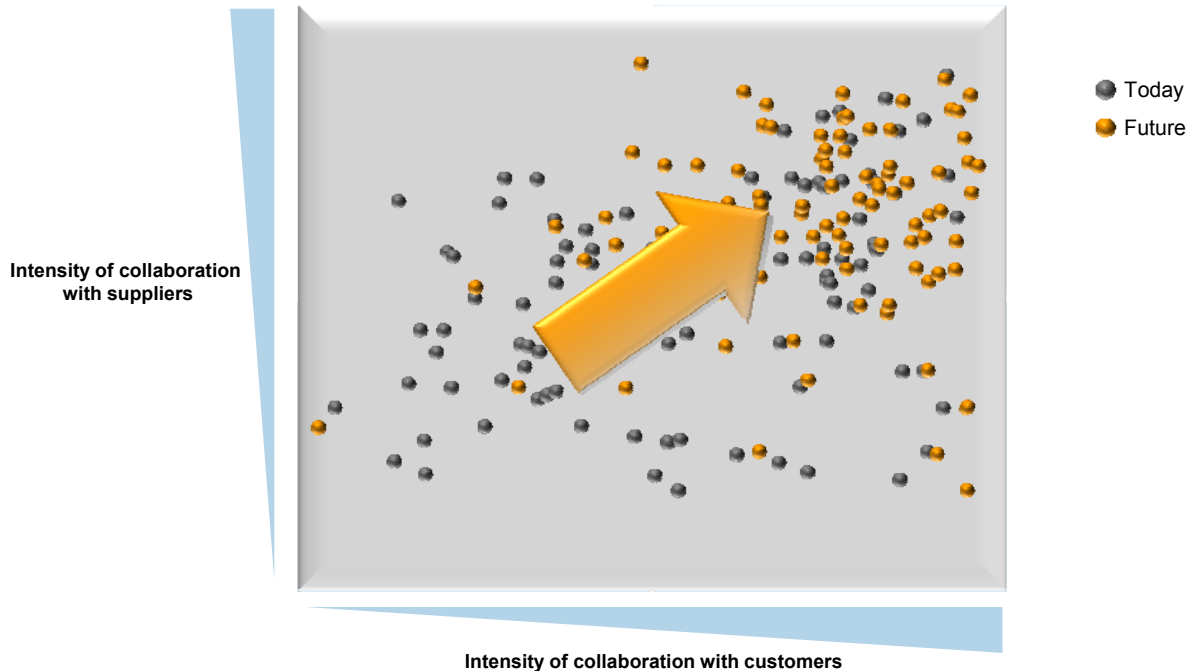


Figure 3: Collaboration in the tool making industry with suppliers and customers

While at the moment the majority of tool making companies in Germany features a relatively low intensity of collaboration with customers and suppliers, in the future the intensity of collaboration will increase significantly. This is illustrated in figure 3 and represents a result of a of the WZL of the RWTH Aachen University in Germany with 110 tool making companies. The companies judged the intensity of their collaboration with customers and suppliers on a discontinuous scale. Additionally all companies were interviewed to determine their exact comparative intensity of collaboration. The collaboration with suppliers and customers enables tool making companies to improve their efficiency with regard to all five values of the tool making industry [9]. Collaboration can therewith be interpreted as enabler for differentiation of tool making companies in high wage countries against their global competition as they address indicators for a competitive advantage according to BARNEY [21]. The indicators addressed are specifically the increased value for the customer as well as the limited imitability and substitutability. As successful collaboration requires industrialized processes, tool making companies from low wage countries with limited capability in their value creation lack the competences and resources to be able to exploit the potentials of collaboration in the tool making industry [9]. Collaboration therefore yields the potential for increased competitiveness of tool making companies from high wage countries.

IV. RELEVANT SERVICES FOR THE TOOL MAKING INDUSTRY

To realize the potential of collaboration with the customer through services integration the relevant services for the tool making industry have to be identified. Therefore the participating partners were questioned in interviews and workshops on services that can be employed to increase value for the customer and achieve differentiation. Furthermore 164 datasets of tool making companies of the last three years were thoroughly analyzed. As a result 7 services were identified which are relevant for service integration in the tool making industry. These services are illustrated in figure 4.

Three services can be utilized for upstream service integration in tool making companies. These services are focused on the interface between the design of products in product development and the subsequent design of tools in a tool making company to enable the series production of the designed product. Tool making companies have extensive competence with regard to the forming process for series products and therewith also with regard to the feasibility of designs. Tool making companies can help realize innovation with regard to characteristics of the product and the efficiency of the series production. All innovations in the series product demand a feasible design to be transferred into practice. A product design can only be final if it is possible to manufacture this exact design with the tool in the series production. However frequently certain surfaces and geometries cannot be realized and cause the necessity of redesign in product development. The tool making company is able to make this process more cost- and time-efficient with selected services. **Product design optimization** is the target-oriented adaption of product design to make it feasible for tool making and the series production of the product (57% of the orders in the analyzed tool making companies were offered with this service). The other upstream services result represent a deeper farther integration into the series development. With **consultancy of product development** a tool making company directly supports the design process of products. Any product design or changes to it can directly be analyzed and a tool making company can ensure that only those designs are detailed the are feasible for tool making and series production (48%). This service allows the customer the save costs and time. Also the tool making company increases its customer retention and the efficiency of its tool making processes. A tool making company offering **product development and design** integrates a traditional process of the customers into its own value creation (35%).

Downstream service integration addresses the interface to the series production and has the potential to accelerate the launch of the series production of new products to. An accelerated launch leads to an earlier market penetration of

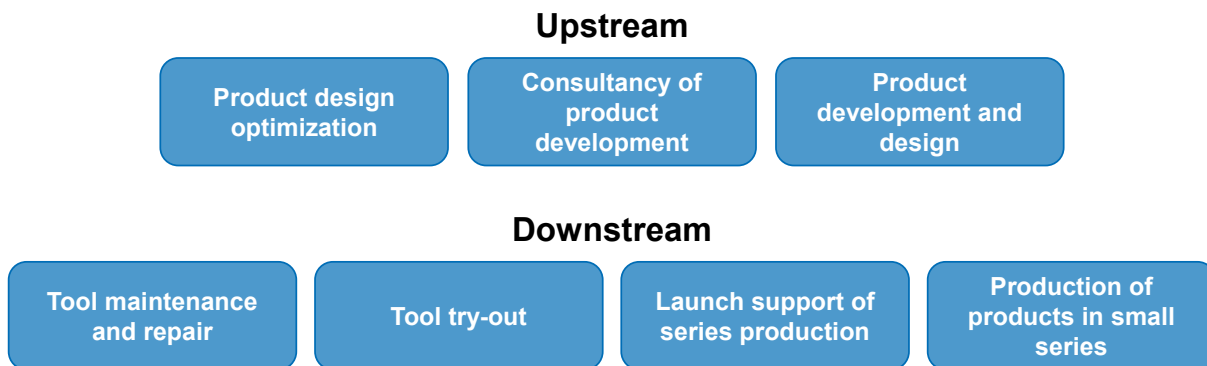


Figure 3: Relevant services for service integration in the tool making industry

new products for the customer and saves time and costs for the customers as well as for tool making companies themselves. The service **tool maintenance and repair** represents an integration into the ongoing series production (56% of the orders in the analyzed tool making companies were offered with this service). Thereby a tool making company allows its customers in the series production to minimize downtime. The **tool try-out** represents the qualification process of a tool until the production of series products that meet the demands of the customer is possible (70%). With the offer of this service tool making companies allow their customers to immediately start the launch of series production after the delivery of a tool. The **launch support of series production** allows a deeper downstream integration (49%). Thereby a tool making company assists with the set-up of the tool on the machine in series production and ensures a smooth launch of the series production. Additionally tool making companies can offer to execute production for the customer with **production of products in small series** (35%). This allows the customer to save potential investments in machines for series production or guarantee an ongoing series production in case of downtime on their own machines.

With these 7 services for service integration tool making companies can directly address the values of tool making. Costs for the tool making company as well as their customer can be saved. Innovations in new products or processes in series production can be enabled and supported. The time-to-market can be shortened through upstream and downstream integration as the tool making company can use service to smoothen the interface to the customer and accelerate certain processes that are traditionally executed by the customer.

Quality and productivity can also be improved for the customer with feasible product design and the support of a tool making company in the series production of its customer.#

V. CONCEPTS FOR SERVICE INTEGRATION

Based on these services three generic types of tool making companies that successfully address service integration were derived. These types are characterized by the intensity of their collaboration. Using the result of the study on value creation networks as basis the three different types are indicated in figure 5. With regard to collaboration with customers in the following the Traditional Tool Room, the Customer Integrator and the Full Collaborator will be addressed. The Traditional Tool Room features the lowest intensity of collaboration. The Customer Integrator and the Full Collaborator both feature a high intensity of collaboration with customers. However, through synergies with the collaboration with suppliers the full collaborator is able to achieve service integration towards the customer on a higher level.

The **Traditional Tool Room** is characterized by a low collaboration intensity with partners and customers. Regarding the collaboration with customers, the Traditional Tool Room interprets its role as reactive problem solvers who individually responds to requests and customer requirements from first call to tool delivery. The Traditional Tool Room reflects the traditional understanding of tool making as one-time design and manufacturing of tools in one batches. It executes specific services to achieve limited upstream and downstream service integration. The Traditional Tool Room

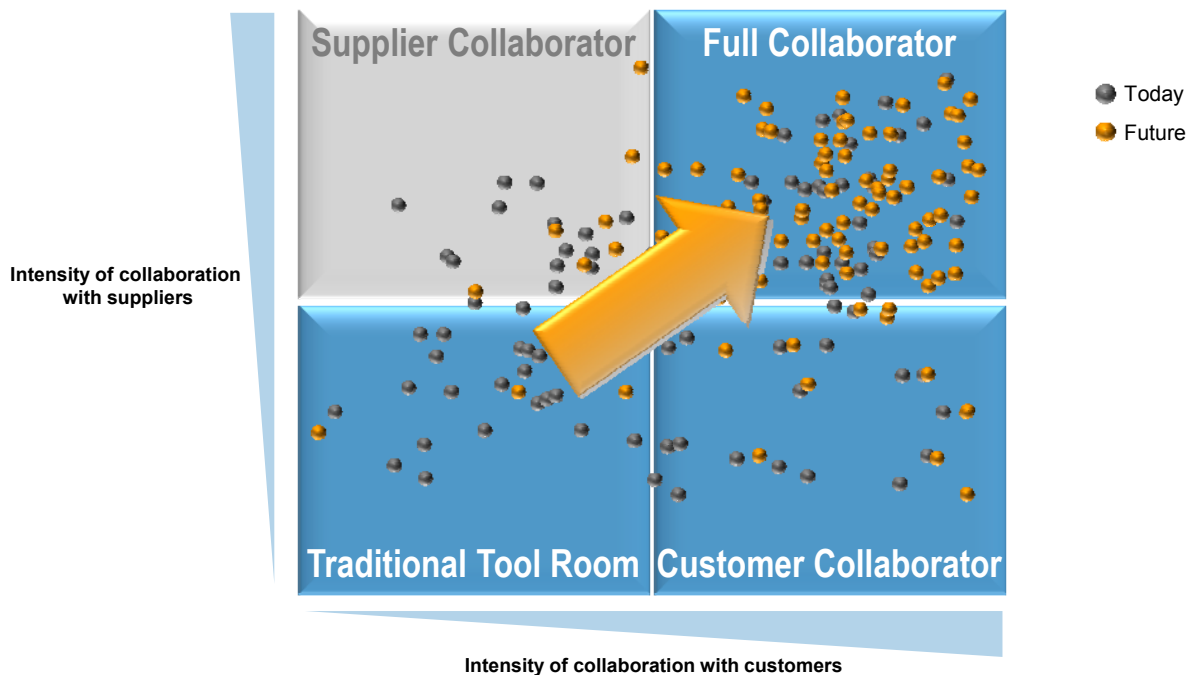


Figure 2: Collaboration types in the tool making industry

offers the service **product design optimization**. However this service is interpreted primarily as measure to improve the order processing within the Traditional Tool Room. Tool making can only be competitive, if the processes are efficient. This requires optimized design of the series products at a relatively early stage. **Tool try-out** as well as **tool maintenance and repair** are used for downstream service integration. These services today are a requirement for most customers. Tool making companies can only be competitive if they are able to offer a tool that is ready for the launch of series production. The offer of services and therewith service integration is only being addressed upon specific order of the customer. The Traditional Tool Room can be used as an example for successful limited service integration. The services offered are directly employed to support the capability of the internal processes of a Traditional Tool Room. However going forward the Traditional Tool Room will be the least frequent type. In the future tool making companies will generally put more focus on the collaboration with customers and thereby also service integration.

For the **Customer Collaborator** the collaboration with customers is characterized by high intensity and is most often interpreted as a core competence. Customer collaborators understand themselves as full-service providers who integrate into the upstream and downstream customer processes, thereby creating added value for their customers. In contrast to the Traditional Tool Room the Customer Collaborator interprets all services as added value for the customer. With regard to the upstream interface to the customer the Customer Collaborator offer services for the support of the design of parts to ensure their manufacturing feasibility already in the design phase of series products. In addition to the service offered by the Traditional Tool Room the Customer Collaborator also uses **consultancy of product development** for upstream service integration. For core tools of the Customer Collaborator the entire **product development and design** can be offered. With regard to the downstream service integration **launch support of series production** as well as **production of products in small series**. For the launch support the Customer Collaborator has capacities to work with the customer on-site. In case of any downtimes in the series production try-out machines of the Customer Collaborator are utilized for production. The Customer Collaborator thereby offers full service to its customers once an order is placed.

The **Full Collaborator** is characterized by the highest degree of service integration of the three types. The substantial increase in comparison to the Customer Collaborator is caused by the link between specific order of the customer and activities addressing upward and downward integration of the customer. The Traditional Tool Room and the Customer Collaborator address service integration on specific orders of the customer. The Full Collaborator is in continuous contact with its customers regardless of specific orders from the customer. It is part of value creation networks of customers and suppliers that is constantly exchanging

information on specific orders. Furthermore within this value creation network the strong partnership with customers and suppliers is used to make developments and improvements together regardless of specific ongoing orders. The Full Collaborator interprets the relationship with the customer as a sustainable partnership that enhances the capability of the tool making company as well as the capability of the customer. In the future the Full Collaborator will be the most common type of tool making company in high wage countries.

VI. CONCLUSION

The tool making industry in high wage countries is characterized by an environment of high competitive pressure. For the tool making industry the efficient internal value creation with industrialized processes used to be the focus for successful differentiation. Due to a growing number of competitors from low wage countries in Eastern Europe and Southeastern Asia with rapidly developing companies industrial processes do not suffice any longer to address the values successfully. Value creation networks for the tooling industry yield the potential to successfully address these value in the future. Collaboration with the customer is a core aspect of a value creation network of a tool making company. The integration through services towards the customer allows companies to improve the capabilities of a tool making company with regard to the values of tool making.

In this paper 7 relevant services for service integration in the tool making industry were identified. Based on the identification of seven relevant services three generic types of tool making companies were defined that allow tool making companies to design their collaboration with the customer accordingly and realize the potential of service integration. With the results of this paper tool making companies are able to adapt their service offerings and subsequently improve their service integration for increased competitiveness.

The result of this paper also yield demand for further research on value creation in the tool and die making industry. Thereby the collaboration with suppliers should be analyzed as there is a strong link between the collaboration with customers as well as the collaboration with suppliers. This is illustrated by the type Full Collaborator which achieves the most intensive service integration through synergies from continuous exchange between the Full Collaborator, its customers and its suppliers.

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