

# Customer Benefit that Is Hard to Imitate

## Toolmaking as a Smart Service for the Plastics Processing Industry

Competitors from low-wage countries have a growing technological competence and force German tool manufacturers to revise their current range of products and services. To prevail in an international competitive environment, they must develop from pure tool manufacturers into “full service” suppliers and knowledge managers throughout the tool lifecycle. This means tapping the available potential of digitization and employing smart services to generate a difficult-to-imitate benefit for their customers in the plastics processing industry.

For some time, toolmaking has been undergoing a fundamental transformation from a work of craftsmanship to an industrial process. This process is enhanced by the trends of globalization, product derivatization and demographic change acting on tool manufacturers as well as their customers.

### Central Challenges Facing the Toolmaking Industry

The business activities of manufacturing companies have been fundamentally al-

tered by the growth of globalization. This transformation has a similar effect on toolmakers: as the link between product development and series production, they are key enablers for the manufacture of industrially produced series goods. However, it is becoming increasingly difficult to achieve differentiation through a higher value core product, namely the tool, since the global market environment for manufacturing companies has changed fundamentally in recent years (Fig. 1). New market entrants with significantly lower factor costs in many cases and the same

standard of technical equipment are increasingly competing with tool manufacturers from high-wage countries [1]. The aim of tool manufacturers, not only in Germany, is therefore to align their entire products and services to the customer's benefit.

The combination of increasing product derivatization and shorter product lifecycles lead to higher demands of tools. Tool costs form a higher proportion of the product unit costs, since the number of units produced per tool is lower [2]. There is thus an additional price pressure

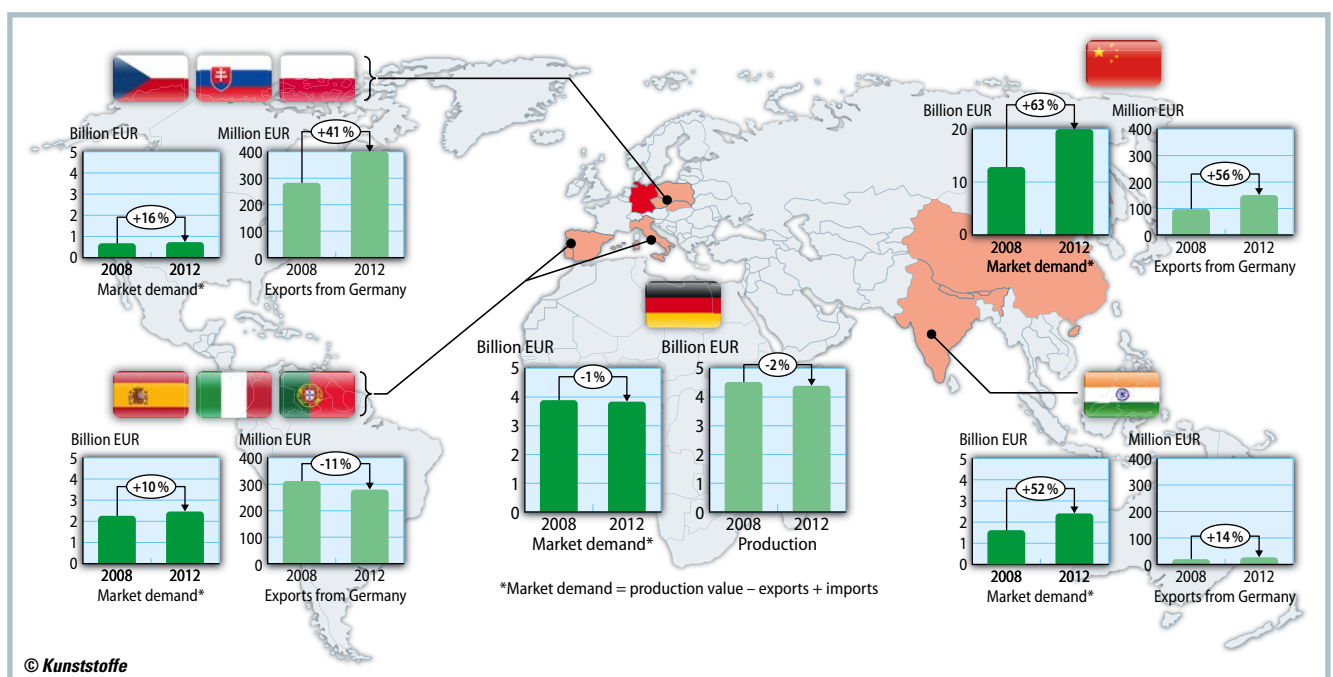
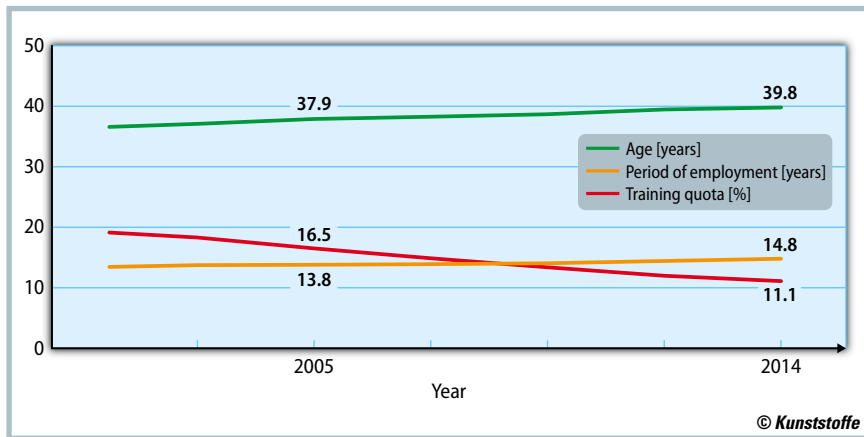


Fig. 1. Progressive globalization is having an increasing influence on the toolmaking industry. While market demand and production in Germany are virtually stagnating, market demand and exports from Germany to Eastern and Southern Europe, as well as to China and India are for the most part growing strongly (\*based on the 20 most important trading partners) (source: CDMIA/JEITC, Comtrade, India Tool Association, VDMA, Eurostat)



**Fig. 2.** Demographic change is also leaving its mark in toolmaking. In Germany, the average age of the workforce has been continually increasing for years, while the training quota, as an average for the industry, continues to fall (source: Study "Operational Excellence in Tool and Mold Making," 2010 "Excellence in Production" competition, 2014)

on tool manufacturers and their products. This pressure can be countered by efficient order management that imposes order on the complexity.

Another general challenge for tool manufacturers or manufacturing companies is the progressive demographic transformation. The increasing age of the population in Germany has the consequence for toolmakers that the average age of their workforce is continually growing. At the same time, the quota of trainees, as an average for the industry, has dropped in recent years (Fig. 2). It is likewise often difficult for tool manufacturers to systematize their existing expertise so as to enable them to preserve it in the long term. The key task of tool manufacturers therefore consists in attracting and training capable staff and continually developing their skills [3].

### *Digitization as the Key on the Path to the Knowledge Manager*

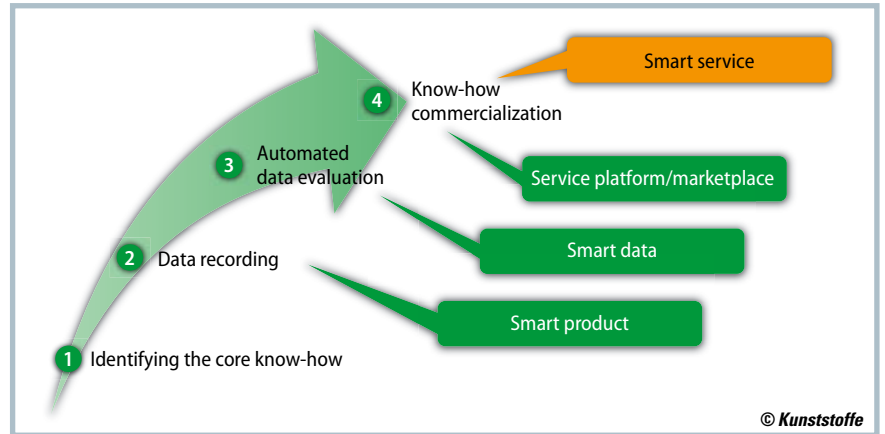
The core task of tool manufacturers consists in providing series manufacturers with efficient tools and resources. However, successful companies have already recognized that, in the face of current challenges, their business relationship with their customers from the plastics industry must extend beyond just producing the tool. Rather, there is increasing importance on customized services linked to the tool, such as service and maintenance packages, manufacture of spare parts or support for production ramp-up. For example, a customer benefit that is

difficult to imitate can differentiate a toolmaker from its competitors who focuses solely on producing tools.

The toolmaking industry has already recognized that it can significantly increase its own competitiveness through collaborative value creation with partners and customers. Integration into the customer's upstream and downstream processes, such as taking on development tasks or performing repairs, provides important clues to allow them to optimize their own tool production. However, the existing potentials of digitalization in the context of Industry4.0 are not being tapped in a way that would allow development into a knowledge manager for customers. Toolmakers can gain significant support in gathering this knowledge through the use of modern information and communication technologies. The focus here is on networking of people, machines and production resources and the product with the aim of making use of the generated data.

### *Smart Services – Services with Added Value for Customers*

The successful development of companies from pure tool manufacturers to "full-service" suppliers and knowledge managers requires the development of smart services. Smart services describe a combination of physical and digital services that provide added value for the customer. RWTH Aachen's Laboratory of Machine Tools and Production Engineering (WZL) identified four fundamental »



**Fig. 3.** In the journey toward smart services, toolmakers pass through four basic development phases (figure: WZL)

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## Service

### References & Digital Version

- You can find the list of references and a PDF file of the article at [www.kunststoffe-international.com/1117754](http://www.kunststoffe-international.com/1117754)

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phases that tool manufacturers pass through in developing so-called “smart services” (Fig. 3).

The first phase consists of identifying the actual core knowledge. For tool manufacturers, the identified core competencies are the starting point for expanding their portfolio of products and services. The aim is, based on existing knowledge, to develop new products and services that are oriented to individual customer benefits and allow the company to differentiate itself from the competition.

This is followed by the phase of data gathering. The basis for this is smart products, i.e. physical products that can communicate with other products and systems through the use of, e.g. sensors or RFID chips. They allow the data affecting the injection molding process, such as pressure profile, temperature distribution or relative movement of the tool, to be recorded.

Following their systematic, continuous recording, the production data is automatically evaluated. By analyzing the recorded data, tool manufacturers acquire a unique knowledge about the behavior of the tool or the entire injection molding process. With this newly acquired information, they can make operational recommendations. By means of learning algorithms, information can be filtered out of the newly recorded data and aggregated into new knowledge (smart data).

The fourth and last development phase is aimed at commercializing the acquired knowledge. Toolmakers must use the potential of the accumulated knowl-

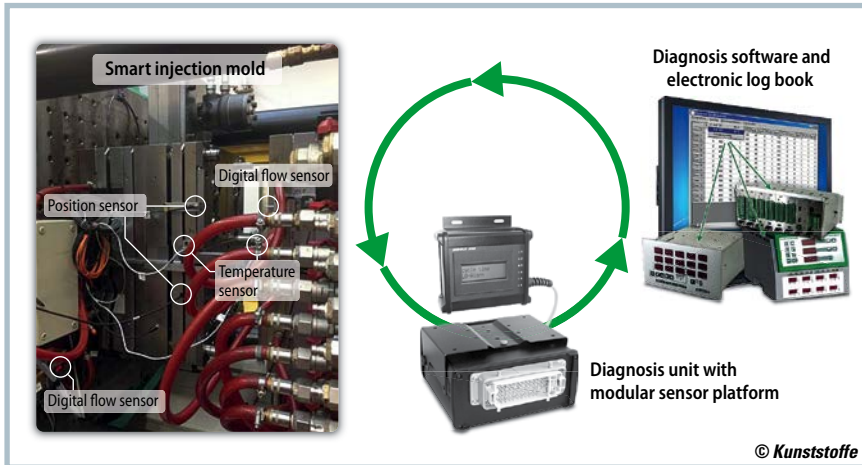
edge and conceive a customized added value in the form of a service. Service platforms in the form of marketplaces are one way of configuring smart services in a modular way and marketing them.

### Successful Examples of Smart Services in Toolmaking

In practice, toolmakers have already developed smart services for the plastics processing industry. One example are portable measurement equipment, with sensors mounted on the customer's injection mold. It allows toolmakers to conduct on-the-spot analyses of the tool and production process.

The process-relevant data, such as cycle time or relative movement of the tool during the production process, can be read off to allow targeted reworking of the tool. This results in advantages for both parties: tool manufacturers have concrete starting points for reworking the injection mold, and can charge this, together with the analysis, as a service rendered. The plastics processing series manufacturer benefits from preventive adaptations, since process deviations are identified at an early stage and expensive production downtime can be avoided.

The reading off of data relevant to the tool and process during the production process can even be automated by equipping the injection molds with sensors for measuring different parameters. The sensors in turn are connected to an external diagnosis unit via a modular sensor platform. As a result, the data record-



**Fig. 4.** Test rig of a smart injection mold with diagnosis unit. By logically linking the sensors integrated in the tool, different scenarios for monitoring the tool state can be realized (figure: WZL)

ed during the production process can be automatically transmitted to the evaluation unit and evaluated.

Real-time transfer of the data enables toolmakers to observe process parameters in the sense of continuous monitoring and to register any deviations. Tool manufacturers are thus capable of predicting future failure of the tool and performing preventive maintenance and repairs in order to avoid costly downtime.

As part of the “smart tools – smart injection molding tools for expanded product service systems” research project, sponsored by the German Federal Ministry of Economics and Technology (BMWi), the Laboratory of Machine Tools and Pro-

duction Engineering (WZL) at RWTH Aachen University, together with a consortium of industrial partners, developed a smart injection mold (**Fig. 4**). Various sensors are installed in the tool to record the relevant data. By logically linking the temperature sensors, flow sensors, force transducers or cycle counters integrated in the tool, several scenarios for state monitoring of the tool can be realized [4].

A step toward automatic production optimization is provided by tool concepts in which the tool actively intervenes in the production process as a smart mechatronic system. The tool communicates actively with the production system and automatically regulates the defined process

parameters. The real-time process data can be used to modify settings in the injection mold and in the production plant, or to adapt process parameters. As a result, the defect quota in the process can be reduced and the required product quality can be achieved during the production process.

The added value for the customer is the productivity increase that is gained as a result of the automatic adaptation of the process parameters performed by the tool. Increased customer benefit also results from the feedback of the knowledge gained during the utilization phase of the tool. The recorded data can be used by toolmakers to develop tools according to requirements and thereby tap cost potential for the series process [5].

### Summary

Digitization in the context of Industry 4.0 is opening up a great deal of potential for toolmakers to expand their business model. The development of smart services forms the basis for tool manufacturers to become more intensively involved in the value creation processes of their plastics processing customers. This opens up additional value creation possibilities. Smart services thus support tool manufacturers in their development from pure tool manufacturers to complete system suppliers and knowledge managers for their customers. ■