



Tooling in South Africa

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Executive Summary

The South African tooling industry faces international market pressure induced by increasingly competitive tooling markets in emerging countries in Asia and Eastern Europe. In past decades the South African tooling industry as a whole was not able to progress as fast as its direct competitors in those emerging countries. The slow progression rate was largely caused by a difficult industrial environment and an education system that could not provide highly skilled technical employees needed for international competitiveness. A turnaround is required to ensure the country's manufacturing prospect. The aspired positive development of the South African tooling industry will not be enforced by comparison to other developing tooling countries. Only the comparison with leading international tooling industries, such as Germany, allows for the comprehension of best practice solutions and accelerates the progression.

In recent years, organizational and technological advancements of the South African tooling industry could be noticed. Systematic programs for the tooling industry addressed the issues of tooling specific education and supported capable tool shops in closing the gap to their international competitors. The benchmarkings of 39 South African tool shops between 2011 and 2013, conducted by the Laboratory for Machine Tools and Production Engineering (WZL) in Aachen and the WBA Aachener Werkzeugbau Akademie in cooperation with the National Tooling Initiative Program (NTIP) in South Africa, were part of those advancement programs.

The data and impressions gathered as part of those benchmarkings are the basis for this study. The study describes quantitatively and qualitatively the current state of the South African tooling industry in comparison to international best practice tooling industries, as well as latest developments in tooling.

Currently the overall tooling capabilities in terms of products, processes and resources are well below those of developed tooling countries such as Germany. The majority of tool shops manufacture only locally for the Sub-Saharan markets with a limited and simple tool range, little process know-how as well as a lack in resources that restricts the manufacturing of complex tools. However, there are few tool shops in South Africa that are able to compete internationally. The wide spread of available tooling competences and tooling know-how shows potential for a positive development of the industry in upcoming years. Furthermore the few outstanding tool shops confirm that tooling on an international best practice level is possible in South Africa, regardless of the still noticeable restraints of the industrial environment.



Latest Developments in Tooling

The global demand for series parts continues to increase. At the same time, series parts are available in an increasing amount of derivatives with a decreasing lot size and life-cycle duration per derivative. Growing markets and derivatization lead to an increasing demand for tools.

This demand is addressed by a global tooling industry that features high competitiveness. The tooling industry in emerging markets has been able to improve its quality almost to the standards of traditional markets like Germany or Japan. Yet emerging markets still benefit from factor costs that are substantially lower than those in traditional markets.

With the quality and acquisition price of tools yielding less potential for differentiation other aspects have gained relevance for the tooling industry and their customers. Time-to-market has become a focus for the series production to penetrate the market and achieve efficiency in series production. Efficiency in series production and quality in the series part can also be achieved through innovation in tooling. Innovative tooling concepts can realize shorter production times and lower costs per part as well as new materials or characteristics in the series part.

The productivity of a tool is represented by the tool price and the efficiency that the tool enables in the series production. The value of a tool for the series production is thereby displayed by the total cost of ownership for the customer in series production. Successful tooling companies achieve differentiation against global competition by addressing these aspects with their products, processes and resources.

With its core products, tools or dies, the tooling industry has to ensure a reliable series production according to the spe-

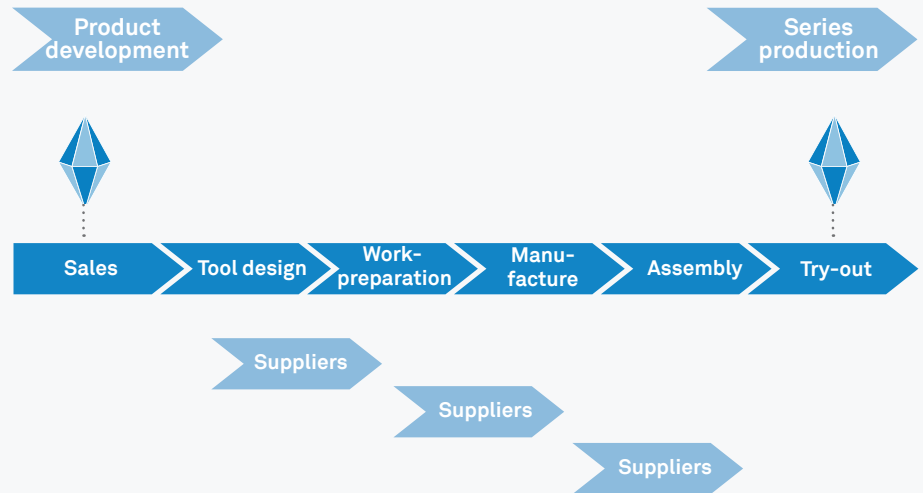
cifications required by the customer. The quality is the critical requirement that has to be addressed by highest precision with regard to geometry and surfaces. The cost for the customer can be managed with tools that are designed according to the specific requirements with regard to lot size and product characteristics.

The time-to-market can be improved through services at the interface with the product development. The tooling process can be accelerated by early collaboration with the development process and guarantee the production feasibility of series parts. These services also yield potential to improve innovation and productivity in tooling. They also have to be linked with other services at the interface with series production. Those include the support during the start-up of tools in series production and their repair and maintenance.

Today the tooling industry can utilize cyber-physical systems to track the tool condition in the series production with sensors and offer tailored services. The gained expertise through collaboration with services can be utilized to address potentials in the series production and offer innovative and more productive tooling solutions for the customer.

While differentiation for the customer is ultimately achieved through the product, the tooling process has to be capable of generating the products. The tooling process has to follow a standardized procedure to continuously meet the highest demands in tooling quality. In the engineering and design phase, products have to be created that feature standardized components for efficient planning, manufacturing and assembly of the products. The repeatability and inherent scale effects of the tooling process lead to lower cost in the tooling process. The complex processes in tooling

Latest Developments



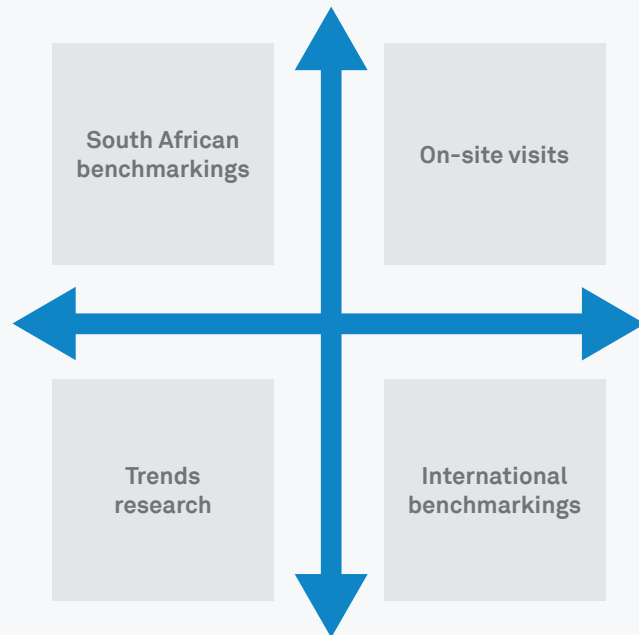
require excellent capabilities in planning of the entire process for all components of a product to achieve a reliable and short time-to-market.

Excellent planning has to encompass the internal process and also external processes of suppliers. The internal processes have to be focused on strategic competences of a tooling company. The internal competences have to be supported by external processes from specialized suppliers. The focus on competences and collaboration with external partners are also key to innovation and productivity in tooling because it allows the specialization and continuous development in strategically selected aspects of tools.

The tooling process is executed by the resources. The core resources in tooling are the employees. The employees feature a high degree of qualification. This qualification is required to be able to master all phases of the tooling process. It has to be enhanced through continuous improvement and knowledge management to realize innovative and more productive tooling solutions.

Employees and their qualified utilization of machines and systems allow continuous adherence to the demands with regard to quality. With a high capacity utilization, efficient machines and automatization the cost in tooling can be controlled efficiently. Software-systems that are stringently organized in CAx-chains ensure the transfer of information and limit the potential for errors along the process.

Design of Study



The study „Tooling in South Africa“ presents an overview of the current state of the South African tooling industry. The tooling industry in this study is represented by companies that focus on tools and dies, jigs and fixtures, measuring equipment as well as models and prototypes. The capabilities of those companies, in this study referred to as tool shops, are the subject of this study.

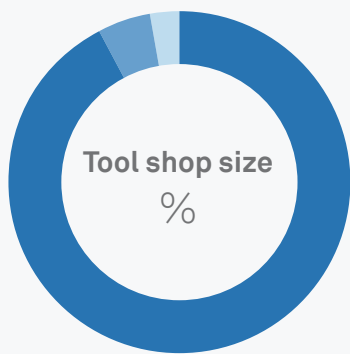
The study indicates the competences of South African tool shops in terms of products and processes as well as employed resources. Furthermore it describes the industrial environment in which South African tool shops operate. The study is based on benchmarkings and on-site visits of South African tool shops. By conducting the data analysis combined with personal impressions a comprehensive understanding of the industry could be formed. The evaluation of the international competitiveness of the South African tooling industry was achieved by comparison with the status quo of leading tooling countries.

International benchmarkings, especially in Germany, are the basis for this comparison. The results of this study are embedded in an continuous trends research that allows for the interpretation of results.

The benchmarking of 39 South African tool shops over the past three years and a long-lasting cooperation with the national tooling industry are the contentual foundation for this study. The benchmarked tool shops portray an overview of the South African tooling industry in terms of market access, company sizes as well as product range. The applied benchmarking questionnaire is structured in seven sections, each with a specific focus. Thoroughly it addresses all organizational, technological and financial aspects of a tool shop.

The entire data was verified during several on-site visits to every benchmarked tool shop. All benchmarked South African tool shops have been visited by a team of German and South African tooling

Design of Study



experts. The on-site visit validates the data provided in the benchmarking questionnaire and ensures the data quality of the database. The impression of the on-site visit together with validated organizational and technological data is the basis for a comprehensive assessment of individual strengths and potentials of a tool shop.

The applied benchmarking procedure is founded in a more than two decade long experience with tool shop benchmarkings around the world. The benchmarking questionnaire applied in South Africa represents the validated standard of the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen and of Fraunhofer-Institute for Production Technology in Aachen (IPT). The database is the largest of its kind for the tooling industry with at present 954 datasets not older than 5 years from more than 10 countries.

Using the database, South African tool shops in this study are not only compared locally but against international tooling regions. The study will focus on and illustrate the gap between the status quo

of the South African industry and international best practice tool shops. The international best practice tool shops are represented by 220 datasets from German tool shops benchmarked in the past three years. Applied research in the tooling industry undermine the statements that are derived from the benchmarking data. As part of a continuous knowledge development through applied research and industry consulting latest trends of the tooling industry were identified. State-of-the-art knowledge regarding organizational and technological trends of the tooling industry support the description of international best practice tool shops. Furthermore research was conducted regarding the industrial environment in South Africa. The industrial environment can generally promote or limit the development of the tooling industry. The description of promotion as well as limitation criteria factors into the description of the outlook for the South African tooling industry.

Market access



Tooling in South Africa

Industrial Environment



[The automotive industry that accounts for more than 12 % of South Africa's manufacturing exports is a key factor of ensuring innovation for the country's tooling industry.]

South Africa is located at the southern tip of the African continent. It is the 25th largest country in the world with close to 53 million inhabitants. It has the largest and most developed economy in Africa, ranking 25th in the world regarding its normalized gross domestic product (GDP). With roughly \$ 11,700 its GDP per capita still ranks far behind highly developed industrial countries like Germany, having a GDP per capita of roughly € 39,000. Because of a relatively steady growth rate in the last decade, South Africa is acknowledged as one of the five major emerging national economies in the world together with Brazil, Russia, India and China.

Poverty and inequality are still widespread in South Africa. Estimations of the unemployment rate range around one third of the employable population and more than one quarter of South Africans still live with less than \$ 1 per day. Since 2010 the South African economy is rising steadily. In 2013 the economic growth was largely founded in a strong manufacturing sector.

Manufacturing together with mining and agriculture are the main industries in

South Africa. The manufacturing industry contributes roughly 15 % of jobs and of GDP to the economy. The South African automotive industry is one of the most important manufacturing industries for the country. The majority of international automotive OEMs have production plants in South Africa. Examples include BMW, Daimler, Volkswagen, General Motors, Nissan, PSA and Toyota with own production plants. Additionally many component manufacturers have established a production base in South Africa. Because of the strong presence, the internationally driven automotive industry is a key factor for ensuring continuous innovation of the entire manufacturing industry. The tooling industry is diversified in terms of individual competences and product range. The strong automotive industry facilitates tool shops that are internationally competitive.

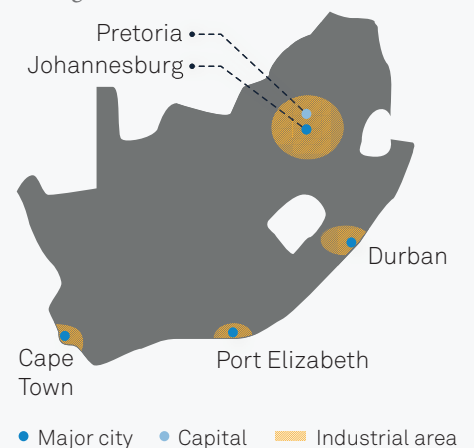
Industrial Environment



[The industrialized areas around the capital, in the cape region in the south of the country as well as along the eastern coastline around the city of Durban account for more than 70 % of the national GDP.]

Manufacturing industry clusters can be found in all regions with a high density of the population. The automotive industry is mostly situated in Gauteng around Pretoria and Johannesburg and in Eastern Cape around Port Elizabeth. Those regions also feature a strong tooling industry with a mix of tool shops focusing on small sheet metal forming tools or injection moulding tools. Manufacturing and tooling can also be found in KwaZulu-Natal around Durban and Pietermaritzburg and Western Cape around Cape Town. In those areas, the focus of the industry lies predominantly on injection moulding. In terms of industries, the remaining areas of South

Africa are characterized mainly by mining and agriculture.



[Disregarding mineral ores, metals and fuels, South Africa exports almost 30 % of goods and services to Sub-Saharan countries.]

Apart from the mining industry, there is no industrial sector with strong international ties to Europe. The South African tooling industry mainly manufactures for the domestic market and bordering countries of the Sub-Saharan continent. The focus of the majority of tool shops lies on

injection moulding for the consumables and appliances industry. Only very few tool shops with ties to the international automotive industry have started recently to build up business connections with international and European partners.

Industrial Environment



[The still developing education system restrains industrial companies from becoming internationally competitive.]

South Africa has a developed transportation system with excellent accessibility to the entire Sub-Saharan region. The quality of internet and telecommunication is on a high level. The electricity supply is unreliable and blackouts occur frequently, complicating an efficient manufacturing process with high-technology machinery. The level of qualification and overall level of education of employees is low. Especially tool making know-how is scarce. The World Economic Forum ranks an inadequately educated workforce as the most problematic factor for doing business in South Africa. The government has started to react by funding purposeful programs to systematically improve the level of technical education. Labor costs are low but since the efficiency of the workforce is also low the overall value of employee-intensive production time is limited. Multiple work shifts per day are not common in the South African industrial sector and difficult to implement due to the characteristics of the South African labor law.

The influence of unions is strong, which led to frequent strikes and significantly increasing labor costs over the last few years. The availability of tool steels and other tool components is restricted. Processed materials mostly have to be imported from overseas. Financial resources are difficult to obtain especially for small companies in the tooling industry, since local banks operate very restrictive with regards to loans for small and medium enterprises. The value of the South African currency (Rand) is decreasing compared to Euro and US-Dollar. The development complicates the sourcing of international goods, like tool steel for South African companies, on the other hand the ability to export goods is strengthened by a weak currency.



Product



[The overall tool complexity and innovative capacity of South African tool shops is low.]

This chapter examines the dimension of the product competence of the South African tooling industry. For the evaluation of the product competence, three different key criteria are considered. The first criteria, which describes the product competence, is the physical complexity of a product itself. The second criteria comprises the product range and the core competences.

The third criteria covers the amount and the type of services offered by South African tool shops.

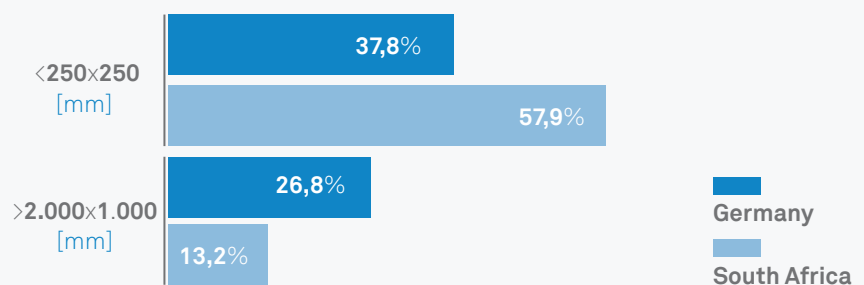
The majority of locally manufactured tools do not exceed the size of 250x250 mm. Those tools are almost exclusively manufactured for the local market with a high percentage of single cavity injection moulds. They mostly do not feature high requirements in terms of precision and accuracy. It is noticeable that the leading and excellent South African tool shops are working exclusively for local sites of the international automotive industry. Those

tool shops are able to meet high and internationally comparable standards of the automotive industry in terms of precision and accuracy.

Injection moulding is also prevalent among the leading and excellent South African tool shops. There is no tooling industry for large sheet metal press tools. Tool standardization is a constant research topic in the tooling industry.

Low complexity injection moulding tools have a high potential for the standardization of modules and components. Tool standardization requires a high tool design competence. Most South African tool shops with repetitive and low complex tools are still not able to address the potential of standardization.

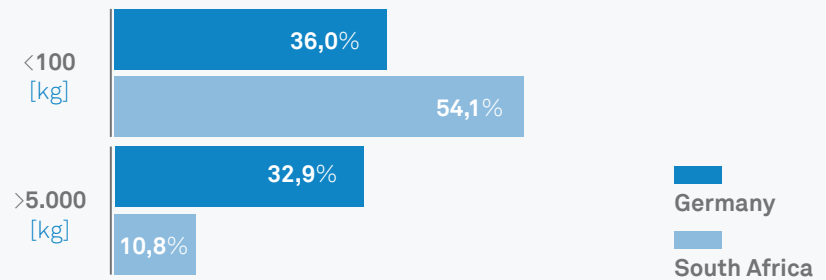
Complexity - Size



Product



Complexity - Weight



[In South Africa, 31 % of all orders include additional services. In Germany additional services are included in 58 % of all orders.]

The majority of tool shops in South Africa offer a wide range of different products. This is especially true for less developed tool shops. They are not able to form marketable competences and in turn are often forced to take on any work, regardless of its specification. Concentration on certain competences requires reliable partners to react flexibly to customer requests. However, collaboration among specialized tool shops and its suppliers is not common in South Africa. Only the leading and excellent tool shops begin to form competence-based supplier networks. Successful tool shops mostly offer their tools in combination with additional services. This allows them to form unique selling points and enables an integration into the value creation process of the customer.

Offering additional services to tool shop clients besides selling tools, is one key success factor of international best practice tool shop. In Germany additional services are included in 58% of all orders, while in South Africa only 31% of all orders include

additional services. Customers expect more than just the delivery of a reliable tool at the agreed date. Customers want to buy an efficient production with a high output rate and a high reliability. Each production stop costs money and should be corrected as soon as possible. Therefore the tooling industry has the possibility for versatile integration into the value creation process of the customers.

Customer integration begins upstream by actively supporting the product development process and thereby influencing the product and tool design. Some of the best practice tool shops dispatch their designers to the product design department of the customer to guarantee the producibility of the developed product from the tool shop's perspective. Also consulting contracts between tool shop and product development are often negotiated in Germany. Both types of upstream integration enable the subsequent tool shop to manufacture a requirements-oriented tool for the customer.

Product



Downstream orientated tool shops may offer tool maintenance and service support. Integrating into the value creation process of the customer can start even earlier in the process. Offering try-out cycles to test the tool in terms of function and efficiency is one option of integration before delivery. International best practice tool shops go even further and offer their customers a measurement of their presses with an intelligent and self-adjusting tool to compare the results of the try-out cycles with the series production. Ramp up monitoring as well as repair and maintenance work are common services offered by German tool shops. Also small series

productions with the use of try-out presses are offered in many cases by German tool shops. There are successful examples for customer integration and the provision of additional services in South Africa as well. For example one South African tool shop has developed an online platform for their customers, where the customer is able to see the progress of the ordered tool. Hereby, the customer is always informed about the current state of the tool, which increases the transparency of the manufacturing process and creates confidence in on time deliveries.

[In South Africa more than 50 % of tool shops do not offer a focused range of tools instead of concentrating on their core competences.]

The majority of South African tool shops manufacture injection moulds or simple stamping tools for the local market. The requirements in terms of accuracy and precision are significantly lower compared to the German industry average.

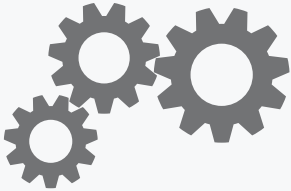
Instead of focusing on a specialized product range and forming marketable competences, South African tool shops are mostly forced to take on any manufacturing work. However focusing on core competences and special tools is risky for most of the tool shops in South Africa, because a focused range of tools requires a focused group of customers which can not be

found in South Africa very often. Nevertheless, there are leading and excellent exceptions of tool shops setting limits to their product portfolio by serving only certain industries.

Although South African tool shops offer a wide range of products, it is conspicuous that South African tool shops are more dependent on single clients than the average of German tool shops. Figures show that the number of main clients of South African tool shops is significantly lower than it is in Germany.



Process



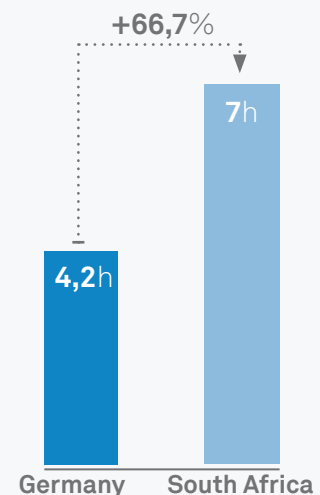
[The speed of the execution of processes is low especially due to missing data consistency and missing supportive systems.]

The tooling competence of a country is not only characterized by the ability of tool manufacturing, but also by the ability of mastering processes. Process competence consists of three criteria. The first criteria is the speed of the tool manufacturing process itself and the speed of processes in the indirect departments. The second criteria is the level of reliability of the due date. The third criteria describes supplier handling and the real net output ratio. Speed and responsiveness are attributes of leading tool shops. The speed of the production process is reflected in short lead times. Lead times can not be assessed individually, as they always depend on the product complexity and the type of tool. When comparing lead times of products with a similar complexity, German tool shops are able to perform similar tasks at a higher speed. This is mainly due to systematics in the production process. German tool shops put a lot of effort in the upstream processes of the manufacturing. The use of 3D design software and simulation programs provide a sound preparation of the production process. On the shop floor the high point of an industrialized tool shop is a synchronized production with a visible and structured material flow through the production. The indirect departments of best practice tool shops put a lot effort in planning and work preparation. The pursuit of highly efficient production is achieved by avoiding waste like waiting, overproduction or inefficient movements. To increase process maturity and reduce lead times not only a proper

planning system is needed, but also a planning systematic needs to be developed.

Studies have shown that customers appreciate short lead times, a high due date reliability and the responsiveness of tool shops higher than the price of the tool. The time it takes for a tool shop to submit an offer is directly linked to customer satisfaction and moreover the likelihood of getting an order is contingent on the speed of the quotation process. The time of the quotation process is comparable between South African and German tool shops. Still the actual time consumed for preparing an offer is significantly longer in South Africa compared to Germany. This may be caused by a missing systemic support of the quotation process in South Africa.

Speed & Maturity - time consumed to prepare an offer



Process



[40 % of the delivered products reach the customers with delay. Due date reliability is a major potential of South African tool shops.]

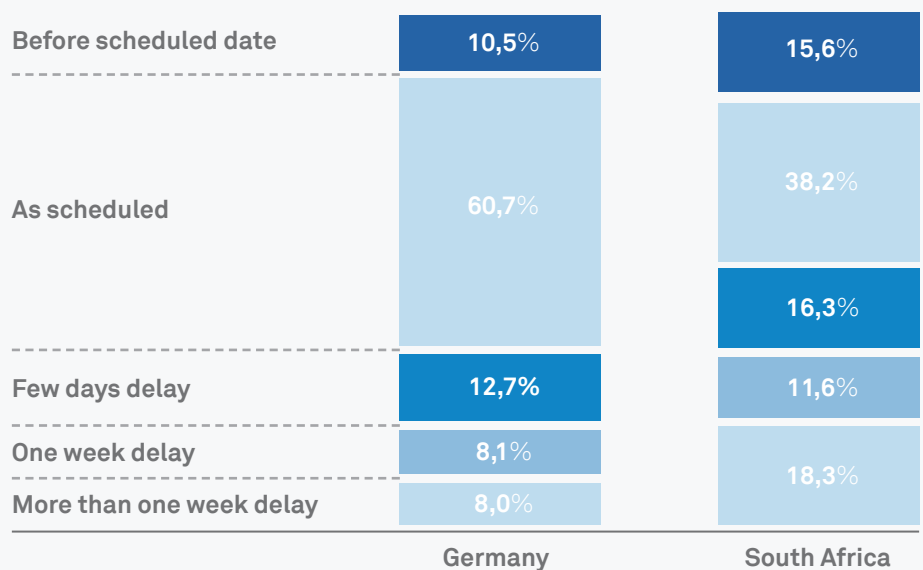
The tooling industry is the enabler of the series production. A sophisticated series production plans the start of production based on the predicted delivery date of the tool. A reliable delivery of the tool is essential for the adherence of the production plan. Hence, an on time delivery is also one of the most important attributes that make up for customer satisfaction. Although the lead time in South Africa is comparable to Germany, the due date reliability is a major potential of the South African tooling industry. Nearly twenty percent of tools in South Africa are delivered with more than one week delay. Process reliability is also determined by the ability to identify and develop tool shop

suppliers. In order to ensure an efficient tool making process, tool shop suppliers need to deliver the ordered quality at the right time.

To ensure timely delivery of the tool, while running the tool shop at a high capacity, a production process planning systematic is essential. Most South African tool shops neither have a planning systematic nor a planning system to organize the processes on the shop floor.

Only a few leading and excellent tool shops have a proper planning systematic and adequate system support. This applies not only for the production planning, but also for the design and quotation process.

Reliability - Due date reliability



Process

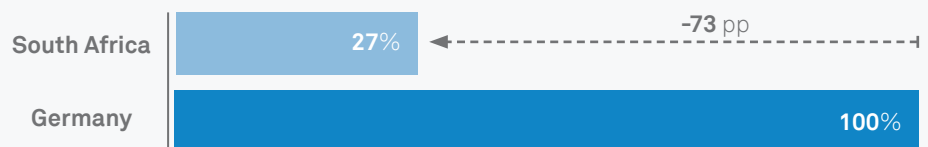


[The real net output ratio is high. The South African tooling industry is struggling with supplier handling.]

Traditionally, the tooling industry is craftsmanship oriented with a high level of real net output ratio. During the industrialization of the tooling industry, the real net output ratio has decreased due to the integration of suppliers. South Africa's tooling industry deals with a lack of trust in their suppliers. According to the idea of craftsmanship, many manufactures still rely on their own competencies. Therefore, only a few tool shops feature a supplier management, subsequently potential suppliers are not categorized. Further supplier development is not pursued, whereby strategic partnerships cannot be developed. It is contradictory that focusing on core

competences is aimed on. The real net output ratio of German tool shops has steadily decreased. Focusing on core competences could be increased in cooperation with strategic partnerships. Nevertheless, some South African tool shops have already started to source design work externally. Especially leading South African tool shops work close together with external partners. Even whole process steps are sourced from strategic partners. To increase the average process maturity of South African tool shops a rethinking of process design and value creation in terms of value creation networks needs to be done.

Speed & Maturity - Value creation per day (normalized)





Resources



[On average, the CNC rate of the machine park is more than 15 pp lower than in the German tooling industry. Manual machining still is regularly used in every tool shop in South Africa.]

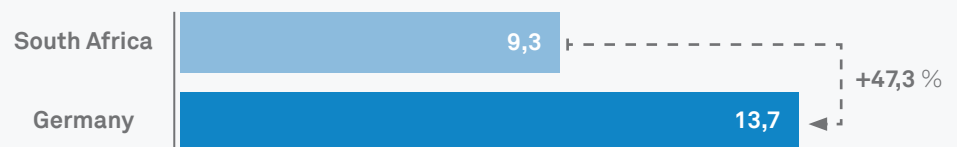
Resource competence describes the ability of a tool shop to align machines, employees and finances to the demands of the product and process range. Therefore resource competence is not only the description of the availability of assets but also the ability to use and develop the available assets for the advancement of the tool shop.

The evaluation of machinery of a tool shop addresses mainly the overall technological capability of available machines. It is apparent that technical equipment in the majority of South African tool shops has a significantly lower standard than the German tool shop average. However, the average age of the machinery is often comparable to the German tool shop average. As an example, the average age of milling machines of the entire South African datasets is 10.3 years compared with an average of 6.3 years of the German comparison group. The amount of different manufacturing technologies per tool shop is lower on average in South Africa compared to Germany. For the majority of tool shops,

low complexity and a lack of technology know-how is the reason for few employed manufacturing technologies. Still even with only few available manufacturing technologies most tool shops are not able to form outstanding competences in the handling of those.

The automation of the manufacturing process is a possibility to enhance the overall efficiency of the tool shop. The analysis and evaluation of the level of automation covers a range of features that address either the part-automation of the machine itself or solutions for interlinking machines. Examples are robot cells with palletizing systems or handling and loading systems for multi machine usage but also machine feature like automated tool changer or rotary tables. Automation still is research topic in the tooling industry. Only few tool shops in Germany employ stringent automation solutions. However, the over-all level of automation still is much lower in South Africa. The CNC rate of the machine park is more than 15 pp

Machines - Number of manufacturing methods



Resources

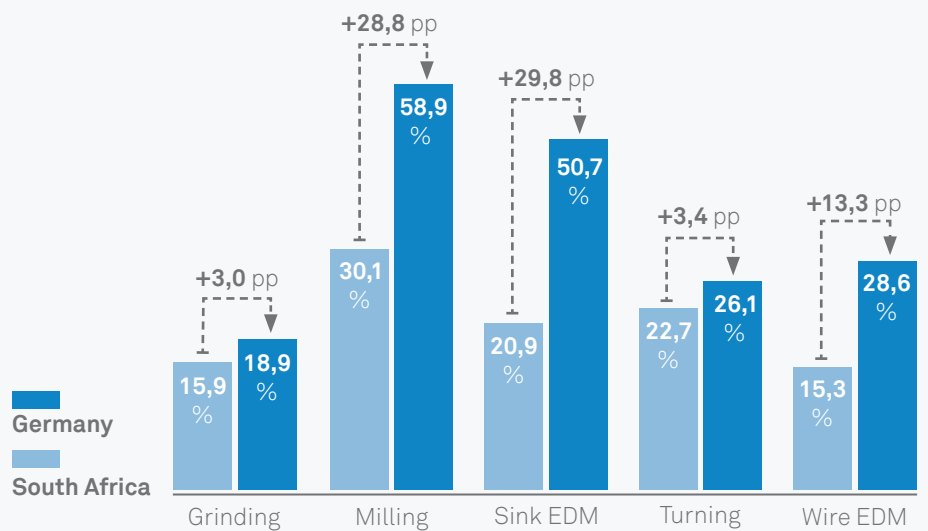


lower in South Africa than it is in Germany. Nevertheless the differences in factor costs often do not justify investing in automation solutions since additional personnel is often a cheaper solution.

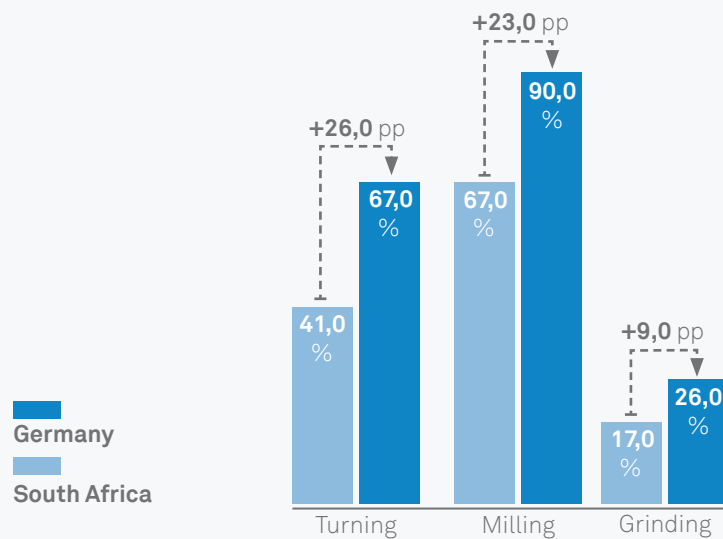
Data consistency has not yet been addressed in South Africa. Especially the potential of an automated CAD/CAM interface is still untapped in the majority of South African

tool shops. Furthermore, simulation and 3D programming are still exceptions to the most sophisticated tool shops working for the automotive industry. Overall the IT support in the tool shop and on the shop floor is a challenge that the South African tooling industry has to approach in the upcoming years.

Machines - Level of Automation



Machines - CNC Rate



Resources

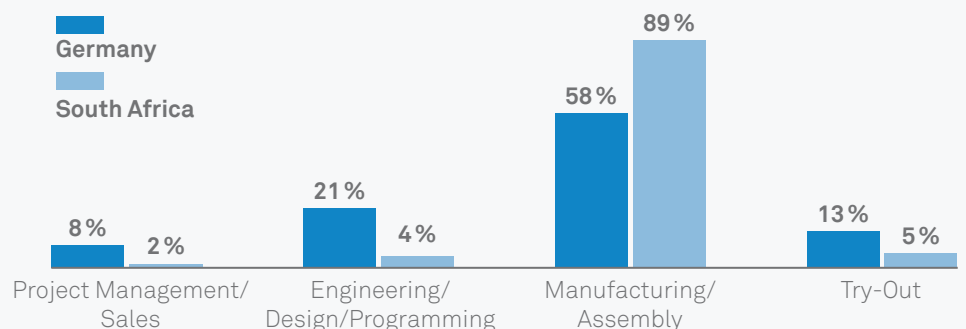


[Labor productivity calculated as value add per employee is almost 300 % higher in Germany compared to South Africa.]

Employees and their qualification guarantee the possibility for future development and innovation of a tool shop. The South African education system does not provide a technical education comparable to German standards. The qualification of basics as well as tooling specific know-how depends largely on the environment that apprentices learn in. In recent years, government funded programs have begun to professionalize the technical education of tool makers. Still the amount of unskilled employees is high. Machine operator usually work without a specific certification and since formal technical degrees were initiated only recently also many tool makers work without a degree. The still developing education system and missing supportive aids on the shop floor are the main reasons for the large difference of the labor productivity between Germany and South Africa. The labor productivity is currently almost 300 % higher in Germany compared to South Africa.

The distribution of employees along the order process indicates a tool shop's abilities in terms of engineering and design, planning as well as customer integration. The trend of the tooling industry in Germany is strengthening the interfaces to the customer at the beginning of the order process in design and engineering and at the finalization during try-out. That trend is also noticeable in the employee distribution. Due to simpler tools or pre-engineered and pre-designed tools from international tool shops, engineering and design is not yet a core competence in the South African tooling industry. Manufacturing and assembly are still the most valued departments of the order process.

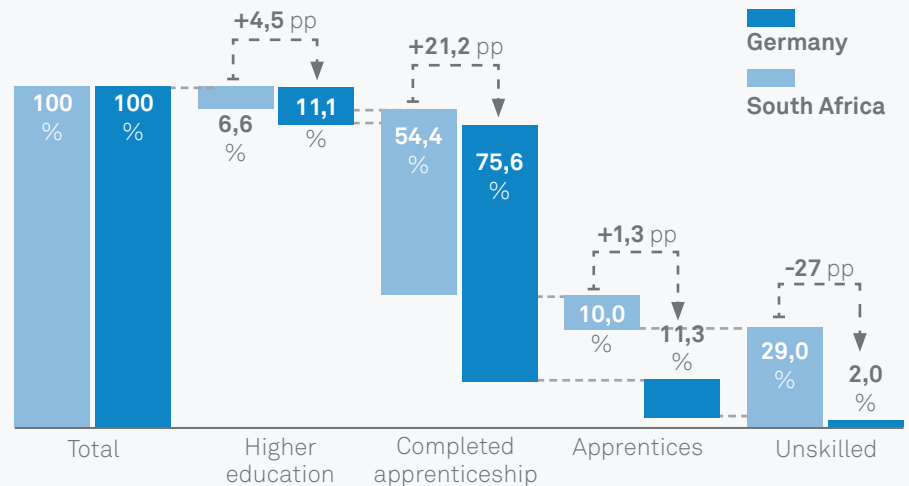
Employees - Employees distribution alongside process chain



Resources



Employees - Qualification



[South African tool shops have a drastically different cost structure than German tool shops: Personnel costs are on average more than 50% lower and the share of material cost relative to the total tool cost 16 pp higher.]

Capital resources are the basis for a sustainable business development, especially in the tooling industry that is characterized by volatile incoming orders. The South African banking sector is hesitant regarding loans for smaller tool shops. As a result, those tool shops have particular difficulties investing in new resources. Furthermore, the benchmarking shows that the debt-equity ratio of South African tool shops is significantly worse compared to the German average. The working capital is a criteria that shows how well tool

shops use the available funds. The benchmarking revealed that South African tool shops have a high share of available equity tied up in inventory. The reasons for that are twofold: For one the inventory contains the raw materials and tool components that are imported from overseas at internationally fixed prices. With regards to equity and revenue of a South African tool shop, those international prices have a greater impact on a South African tool shop than on a German tool shop. The second reason is a lack of process

Resources

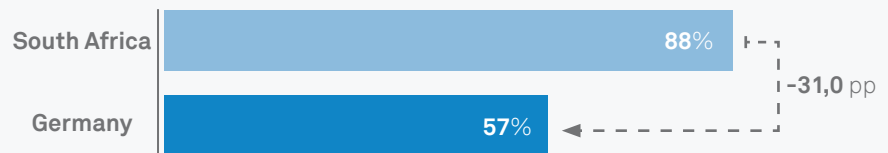


know-how in keeping lead times and semi-finished parts to a minimum. South African tool shops have disadvantages compared to the German tooling industry with regards to available resources. This was to some extent or another noticeable at every analyzed tool shop and affected machine, employee as well as financial resources. The effects lead to an overall different cost structure of South African tool shops: Compared to Germany personnel costs are less important but the share of material cost relative to the total tool cost is significantly higher.

Only few tool shops have technical equipment comparable to German leading or excellent tool shops. Automation is not yet a topic for the South African tooling

industry however the lack of automation can be partly compensated with the availability of inexpensive employees South African tool shops are confronted with the issue of finding qualified employees. The education system especially for technical qualifications still is evolving and largely dependent on the individual tool shops that takes on an apprentice. The availability of capital funds is restricted. South African banks are hesitant towards lending tool shops money for the necessary investment in machines and employees. Furthermore, many tool shops do not have the means or knowledge to use the available funds as efficiently as possible.

Finances - Debt equity ratio



Conclusion & Outlook

The South African tooling industry faces international market pressure induced by increasingly competitive tooling markets in emerging countries in Asia and Eastern Europe. The proficiency level of those tooling markets is increasing faster than in South Africa, resulting in major challenges for the South African tooling industry. To take the challenge to compete against the tooling industry in emerging countries, it is necessary to compare the South African tooling industry with international best practice tool shops from Germany. The South African tooling industry can only get better, if they learn from the best.

By continually benchmarking the South African tooling industry since 2011 by the Laboratory for Machine Tools and Production Engineering (WZL) in Aachen and the WBA Aachener Werkzeugbau Akademie in cooperation with the National Tooling Initiative Program (NTIP) in South Africa many potentials could be identified.

As this study has shown, the South African tooling industry needs to develop its proficiency level to compete with emerging countries in the long run. There are a few tool shops in South Africa working on a high international competitive level. They are comparable to German tool shops and work for the automotive industry like BMW, Daimler, VW and Toyota as a general rule. This is an example that tool shops despite the limited industrial environment can be internationally competitive in South Africa. Still the majority can not compete with Germany and mostly not even with tool shops from Asia or South America. Major potentials can be identified in the fields of products, processes and resources. As these three dimensions can not be evaluated independently, the overall industrial environment of the South African tooling industry has also been a part of the benchmarking projects.

Industrial Environment

The education system especially for technical qualifications still is evolving to meet the needs of the industry. The South African manufacturing industry has little business connections outside the Sub-Saharan continent. The automotive industry has a key role in the South African tooling industry.

Products

The overall tool complexity and the innovative capacity of tools manufactured in South Africa is low compared to the German average. Furthermore the product range in terms of services is very limited. Upstream or downstream customer integration is an exception, although a few successful approaches can be identified.

Processes

The process maturity in general and the due date reliability in particular are major potentials for the South African tooling industry. The process speed is low and the real net output ratio is very high. There is neither a planning systematic nor a planning system in place at most tool shops. Best practice tool shops put a lot of effort in work preparation and process planning to speed up lead times and increase the efficiency.

Resources

Resources in terms of machinery and other technical equipment are not comparable to international best practices. Financial resources are limited, which restrains the growths and enhancements of tool shops.

To ensure further development, the tooling industry in South Africa needs to be strengthened continuously by addressing each of the four mentioned fields. A well developed industrial environment is the basis for the development of the tooling industry. Apprentices need to be supported

Conclusion & Outlook

in the education and need to have the chance to get a permanent employment in a tool shop. Organizations such as the NTIP are examples of how the education of young people can and must be supported. Tool shops with a wide product range need to concentrate on their core competencies and need to develop their skills even further. A great potential in terms of product variety is the offer of services. Consulting the mass production in the product design stage or dispatching a designer to the product development will generate two benefits. The first benefit is the creation of additional value. The second benefit is a tool optimized product design. Offering repair and maintenance work is an easy way to integrate in the customers value creation process. Due date reliability is one of the most important features that make up for customer satisfaction.

A sound work preparation and a simple but effective process planning reduces the lead times and upgrades the due date reliability. Putting more effort in the indirect departments and the upstream

process steps saves a lot of time on the shop floor. Investments in new machinery is only necessary if the output of the machinery is still too low while running at its physical capacity. Scheduled maintenance of the machinery will increase the reliability which again increases the working time and the output. The work of the WZL and the WBA in cooperation with the NTIP contributes to a successful development. As the past has shown, the benchmarkings of tool shops in yearly intervals and executing targeted intervention projects are powerful instruments to develop tool shops even further.

Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University



The Laboratory for Machine Tools and Production Engineering (WZL) is a leading research and innovation facility, comprising four chairs and covering all relevant topics of production technology at the RWTH Aachen University in Germany. In eight different work areas, research activities not only relate to fundamental theories and findings but also to the application of findings in an industrial context. The department business development of the chair of production engineering at the WZL focuses on applied research and industrial consulting projects on the tooling industry as the key enabler of the series production. For more than 10 years the WZL conducts the tooling specific competition “Excellence in Production”, awarding the best tool shop of the German-speaking region every year.

WBA Aachener Werkzeugbau Akademie



The WBA Aachener Werkzeugbau Akademie is the leading partner of the tooling industry in the German-speaking region. Because of its close ties to the RWTH Aachen University and the Fraunhofer Institutes in Aachen, the WBA can draw on focused know-how regarding current industry topics. Many bilateral consulting projects enable close partnerships with leading companies of the tooling industry. The extended benchmarking database to which the WBA has access is the core foundation of tooling specific knowledge. With its five business areas Applied Research & Development, Specific Industry Solutions, Client-oriented Consulting, Professional Development and the Demonstration Tool Shop the WBA addresses the entire tooling industry with specific services.

National Tooling Initiative Programme (NTIP)



The National Tooling Initiative Programme (NTIP) is a partnership between the South African tooling industry and the South African government. Its aim is the rehabilitation and growth of the tooling industry, which has been identified by the government as a key industry for the South African manufacturing competitiveness and therefore as stimulus for sustainable economic growth and job creation. The revolving benchmarking and enhancement projects of the NTIP in cooperation with WZL and WBA are means to close the gap of the South African tooling industry to international competitiveness.

Fraunhofer Institute for Production Technology IPT



The Fraunhofer Institute for Production Technology IPT, located in Aachen, combines knowledge and experience in all fields of production technology. In the areas of process technology, production machines, mechatronics, production metrology and quality as well technology management, the IPT offers partners and customers tailor made solutions and immediately actionable results for modern production. Together with WZL and WBA the IPT conducts benchmarking projects in the tooling industry focusing on the technological capabilities of tool shops.

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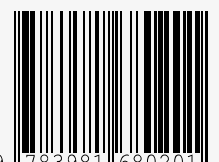
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