

THE ROLE OF COLLABORATION IN THE SOUTH AFRICAN TOOLING INDUSTRY

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ABSTRACT

The efficient design and manufacturing of injection moulds (and other tooling), requires collaboration between multi-disciplinary, geographically separated units and companies, including the company that orders plastic parts, the ones that design and/or produce the moulds and/or mould-components, and those that use injection moulding machines to produce components. Distributed collaborative tooling design and manufacturing, while being a great concept, is still difficult to implement in today's complex environment. This is clear as more functional groups become involved in the total product development process earlier to meet time-to-market and cost objectives.

Although internal design and manufacturing groups may have experience in collaborating with different degrees of success, the global trend is towards greater outsourcing of activities and inclusion of complementary organisations. The requirement for extended collaboration - the process of securely and selectively exchanging, reviewing, and managing the change of product information with other internal participants and external groups such as customers, design partners, suppliers and distributed manufacturing companies - presents huge challenges.

Delivering these capabilities in today's global product development processes requires a different approach to doing business than a few years ago. Companies must be willing to share more information, which "is hard because we are competitors." The toolmaking companies' in South Africa (of which 90% are small and medium size enterprises (SMEs)) concern for success in delivering these capabilities, can also be greatly impacted by the underlying software or information technology infrastructure required for supporting the entire product development process.

This article provides a perspective for SMEs and others that might participate in collaborative tool design and manufacture in South Africa today or in the future.

Keywords: Tooling; design; manufacturing; injection moulds

1. INTRODUCTION

A fast-to-market strategy is among the most important success factors for manufacturing companies. Present and emerging concepts aim at creating a highly integrated concurrent engineering environment in which manufacturing and all other disciplines strongly influence design decisions very early in the product realisation process. Rapid product and process realisation (RPPR) methodologies and tools can help companies integrate design into manufacturing to reduce lead times and costly product and process iterations.

Maintaining and growing a strong, locally based tooling sector is essential to the competitiveness of the South African manufacturing sector. Almost all mass manufactured parts are formed with tools, dies or moulds. The tooling industry can be categorised as companies that are involved in the design, manufacture, testing and validation of specialised tooling that enable the repetitive manufacture and assembly of components from various materials.

The process to design and manufacture a tool, die or mould profitably, involves a huge number of business and technical activities - from the request for a quotation, analysing or preparing specifications, flow simulation or other analysis on a final design, programming of cutter paths for machining, ordering steel and mould components, final machining, surface treatments, tool assembly, try out and rework if necessary, to delivery to the customer, to name but a few - of which many can happen concurrently rather than sequentially. In many instances nowadays, due to shrinking lead times, steel have been ordered and initial roughing starts before the final design is approved by the customer.

Tooling can be quite complex with fixed and moving components with electric power, cooling, hydraulic and electronic control circuits incorporated. Most toolmaking companies today use advanced software for designing and assessing the performance of the components, as well as for creating tool machining paths and programmable tool manufacturing equipment. Few companies today can afford to develop tooling without some form of partnership. There is a varied and growing dependence on external resources and partners for components, sub-assemblies, technology, design skills, know-how, etc. Therefore, it is not surprising that research has shown that the leveraging of partnerships through collaboration can provide competitive advantages for toolmaking companies.

2. COMPOSITION OF THE TOOLING INDUSTRY

2.1 South Africa

The South African Tooling Industry consists of approximately 400 to 450 companies and includes besides dedicated toolmaking companies, also tool designers, standard component and raw materials suppliers, and others associated within the toolmaking value chain. The majority of these companies are SMEs and employs less than 10 employees. In 2001 the South African Automotive Manufacturing Industry imported tooling to the amount of R1.3 billion and exports were listed as R441 million, leaving a trade deficit of R848 million. In 2002 tooling imports in the Automotive Industry

grew to R1.6 billion and exports declined to R363 million, increasing the trade deficit to R1.2 billion.

The main customers for toolmaking companies are the automotive, packaging and white goods industries. There are eight assembling automotive Original Equipment Manufacturers (OEMs) represented in South Africa. The South African tooling industry has not met the expectations of these and other clients, which is illustrated by the fact that South African companies that produce mass manufactured components, spent large amounts on importing plastic injection moulds and press tooling.

The tools, dies and moulds produced for the South African market in the past, often catered for much lower production runs compared to their counterparts in Europe and the Americas. That situation forced South African tool rooms to supply lower quality, lower priced tooling solutions. Consequently, these tool rooms were only able to recover minimum profits and hence did not have the funds to invest in proper operational systems, training of personnel and new equipment. The lack of formal training programmes for the industry, coupled with a severe skills shortage, aggravated the situation even further. The toolmaking industry is characterised by its dysfunctional structure with fragmented pockets of excellence, which also have been deteriorating over the last 10 years.

Most tool rooms only operate one shift per day, five days a week. Equipment is generally under-utilised or used inefficiently. However, the manufacturing costs are relatively high due to a lack of modern capital equipment and less than optimum capacity usage. Even though the South African average toolmaker wage is low, the value added return is very low when compared to international counterparts. Raw materials and standard mould base components are mainly bought from South African representatives of international tool steel and other manufacturers for relatively high prices.

2.2 International

Taiwan, Korea and Portugal, are countries with well-developed toolmaking/tooling export capacity. Many of the countries with emerging capacity are competing in the same market as South Africa, notably Australia, China, India, Malaysia and Indonesia. International companies are partnering in consortiums to gain market access and the major strengths of the international competitors are the low prices, the high quality and the advanced tooling know-how. Government funding in Portugal allowed the establishment of a tooling technology centre offering specialised training, research and development, tool testing and validation; thereby encouraging cooperative tool delivery networks and consolidated tendering on export projects. The country has since become one of the largest contract tooling sources in the world, exporting tooling to the USA, and other countries including South Africa.

What has happened in these countries more than a decade ago, was that the need for industry and government cooperation and collaboration was realised to ensure that their tool, die and mould manufacturing competence and capacity flourished, in view of acceptance of the fact that toolmaking forms the backbone for any manufacturing country. These governments have taken a definite stance in

mobilising their tool making industries through various mechanisms and assistance. Mechanisms aimed at greater industry wide cooperation in marketing and technology practices were introduced which include investment in technologies (hard and soft) for toolmaking companies. Various assistance programs have been instituted for example to finance working capital or equipment by loans, improving toolmaking companies' competitive ability by implementing formal quality management systems or implementation of manufacturing software. Several governments have supported the establishment of manufacturing advisory centres focussing on benchmarking best global business and technical practises to transfer to companies in their respective countries. Establishment of training facilities with up do date equipment and support for basic and advanced training and skills development was and is still part of these mechanisms. The support of applicable R&D programmes in conjunction with universities or dedicated research centres to stimulate innovation in the longer term has also derived benefits for particular countries.

The most significant customers for toolmaking companies are the automotive OEMs who see technical and cost advantages in sourcing tools and dies locally which include:

- lower logistical costs (shipping, travel, communication, etc.),
- better communication which is especially important for complex tools and dies,
- shorter lead and response time due to improved communications,
- more familiarity by the local companies with domestic requirements (design, tryout, die standards, etc.),
- a better ability to implement engineering changes as well.

3. A CHANGING MARKET

OEMs are experiencing challenges to improve their competitiveness in an increasingly aggressive international market. The demand for automotive tooling is heavily dependant upon new product introduction. OEMs are also strategically moving from design, manufacturing and assembly specialists to positioning themselves as customer-focused market makers (Vehicle Brand Owners (VBOs)). Many OEMs have already outsourced considerable research and development, design and manufacturing work. Compression of product life cycles due to competitive pressures has required their suppliers and their toolmaking companies to adapt by shortening their lead times also in supplying tooling to OEMs.

Responsibility for development and engineering will be shifted even more onto First Tier and lower tiered suppliers, who are required to build new capacities. The automotive supply industry will consolidate and reduce in numbers to cope with the outsourcing agenda. In addition to an aggressive middle market consolidation, several kinds of partnerships and dynamic networks of companies will have to be constructed to answer to the needs of OEM's. These networks will be compounded on core competencies as required.

4. COLLABORATION - A SURVIVING STRATEGIC CHOICE FOR SOUTH AFRICAN SMEs IN THE TOOLMAKING INDUSTRY

4.1 Background

Collaboration begins by realising and being aware of the "new" rules for competitive success. After acceptance of the fact, it builds on by redesigning a shared vision and strategy, culture, structure, tools, measurement and reward systems and technologies which support, and enable, collaboration-based business to occur. Collaboration must be understood as the act of bringing information and skills together that exist across a group or team of participants and also sharing it quicker to improve the end result.

SMEs are mostly independently owned and financially controlled by the owner(s). Business competition, however, comes from organisations that are local, national and global. Size in terms of number of employees or number of locations, is no longer an issue to become a global competitor. Large companies can afford carrying "extra" resources in down times compared to SMEs who need to react on a short term focus and be flexible when acquiring resources. Most SMEs also need to achieve return on investments in a relatively short period of time. The resources that are needed to address technology and technology issues are often confusing. Time is of the essence for SMEs and to become familiar with the ever-changing information technology, for example, means that resources have to be diverted to this activity. The key drivers of SMEs are their ability to differentiate between competitors, their independence and their flexibility, which must be harnessed to address the opportunities that exist for the future.

To compete globally, the South African toolmaking industry will have to combine its capacity to be able to address the volume of work associated with large projects in shorter time scales. Such project delivery entities or mechanisms will allow toolmakers to partner or network for effective, efficient and competitive service delivery in response to clients' multi-tooling needs. Some benefits that can stem from such collaborative toolmaking networks include the following:

- increased speed and shortening of the tool mould design and manufacturing process,
- increased team productivity in terms of cost and quality and reduced waste of various kinds in design and manufacturing errors,
- improved communication with colleagues, collaborators, suppliers, customers, etc.,
- increased and higher loading of work on toolmaking companies based on their core competencies and specialities.

Single points of entry for customers need to be created to be in line with the trend that global automotive buyers do not want to deal with multiple toolmaking companies, but with one individual company when placing an order of say 70 different tools or moulds to be produced. The tasks of such a network coordinator in the network can vary but can typically include the acquisition of tooling projects, the project management, the product design, the specialised tool design, the contracting of component suppliers and assembly workshops and other activities as required by the customer.

Such networks promote the development of niche specialties of suppliers, and a more focused and smaller capital investment may be required. In the past capacity may have been created at most companies individually and utilisation of expensive machinery were then not optimal. Through collaboration, fragmented capacity, as well as access to islands of expertise can become available. The feast or famine cycles that toolmaking companies were always characterised by, can be reduced and countered.

The appearance of videoconferencing, whiteboards, and Netmeeting as well as software solutions to manage the flow of electronic product facilitates the sharing of product data across company functions, customers and suppliers and aids global manufacturing. These developments in information technologies have given rise to a supply chain that is highly integrated. For a so called virtual enterprise to be successful in achieving these goals, it is necessary that partners adopt the necessary technology for efficient communication and data exchange required. These solutions allow companies to share common business processes and a common knowledge of the product throughout all stages of its lifecycle, from concept to retirement.

Most CAD/CAM vendors have introduced web based functionality in their products. It is common for OEMs to use the Internet or private networks to share and access product data with their suppliers and/or customers. The companies share designs over the Internet with different access permissions depending on their specific roles to modify or view a design. With the growth of global collaboration, more SMEs will need to exchange design and manufacturing information with other entities in their supply chains.

Some pre-requisites for SMEs that want to participate in collaborative toolmaking include the following;

- Companies need to clearly define their core competences and stay on the cutting edge to remain competitive. It is important to tap into resources such as an association and other technology transfer mechanisms that disseminate appropriate information on new techniques and processes into the industry.
- Efficient project management must be practised by the coordinator as well as all partnered companies to successfully run such networks.
- SMEs need to apply the principles of lean manufacturing to identify and eliminate waste in their activities and move to a more planned and synchronous flow type operation.
- They further need to know what the true and real financial costs of their operations are in order to provide realistic cost proposals as continuous improvement will have to become part of everyday life.
- It may be a requirement to upgrade and formalise their business systems for example to implement a formal quality management system as required by their customers.

There can be some barriers to collaboration namely cultural (where companies are reluctant to share information since the level of trust to share does not exist yet), technology (companies have difficulties sharing information because of disparate systems and the associated cost to implement) and organisational (companies have

to adjust their work culture and style to be more cooperative). With careful planning, most of these barriers can be minimised and overcome.

4.2 A pioneering initiative

A National Tooling Initiative (NTI) was established in March 2002 to formulate and implement a solution strategy that will ensure the competitiveness, sustainability and growth of the South African toolmaking industry. A Stakeholders Forum steers the initiative and has identified fundamentals that have to be addressed in order to revive and grow the declining local tooling industry. The forum agreed that the initiative would be piloted through focussing on the tooling requirements of the automotive industry.

One of several objectives of the initiative is the establishment of the Toolmaking Association of South Africa (TASA), which was officially inaugurated in May 2004. Five regional chapters have been established and it is the intention of the association to work towards the improvement of the toolmaking industry, and provide key links in the manufacturing supply chain, liaising with government and other role players to reduce the need for OEMs to import tools, dies and moulds.

5. COLLABORATION IN THE SOUTH AFRICAN TOOLMAKING INDUSTRY – A SLOW GROWING REALITY

A key element of the NTI is to address the competitive delivery of tooling solutions for the needs of the automotive industry through enabling and developing collaboration networks. These networks will have to cater for various tooling technologies such as plastic moulding, press tooling and die casting, in accordance with the OEM market demands and requirements.

Ngena MouldNet (NMN) is a plastic injection mould design company based in Gauteng and the company has a long working relationship with nine individual tool rooms. This group of companies have the intention of addressing the need in the South African automotive plastics industry for a local reliable supplier of quality medium and large injection moulds. A particular range of technological competencies and gaps have been identified within the group as a whole, which needs to be developed further by the collaborative group. The cluster members are linked via an IT network so that communication and inputs from quotation preparation, the design and engineering analysis, manufacture, assembly, testing, producing first samples, tool debugging, second samples, tool sign off, be handled electronically, as well as a substantial part of project management, to co-ordinate and manage the various partnered toolrooms.

Mould designs are undertaken centrally at NMN by internal tool designers, with input from the nine tool component manufacturers, and others as required. Once a mould design is complete, it is broken down into feasible and efficient work packages and shipped to the relevant tool rooms. Control of this process takes place via the collaborative product development system. Feedback is dealt with through the system to ensure efficient and speedy handling of queries, or any modifications required. All information required for the tool rooms to complete their tasks is issued

in terms of drawings and specifications under configuration control. Combined output is increased by using accurate scheduling and capability management, while working with the existing available individual supplier capacities. This process strives to enable all suppliers to perform at increased levels, by allowing sub contractors to focus on their core business, and the coordinators to focus on the collective output of the network.

NMN will train a number of mould designers over a period of four years. After the initial tool designers have completed their training, they will be allocated to other potential clusters. Their main focus will be to provide the clusters with designs through CAD/CAM data that will maximise the utilisation of the individual partnered tool room's material removal and manufacturing capacity.

6. CONCLUSION

Many SMEs do not have the resources to identify, assess or access??, adapt and incorporate new technologies and business strategies such as strategic alliances.

The successful further development of the established network will provide a reference for other SMEs to identify their role in collaboration agreements. Demonstration and case studies to measure and illustrate the specific benefits of collaborative tooling design and manufacturing networks, will provide a way of encouraging the diffusion of new technology and will highlight sources of support needed to create and sustain such mechanisms.

By creating additional manpower capacity through skills development relating to the tooling design aspects, and enabling the integration of existing fragmented capability and capacity through the application of standardised modern computer aided engineering technology, the total capacity for local tooling design and manufacturing can be enhanced and developed to address the needs of the automotive OEMs.

Successful validation of the model for the automotive industry would offer opportunities for replication in other industry sectors based in South Africa.

7. REFERENCES

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