

## Challenges in skills development in foundry industry in Gauteng

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**Abstract:** Although a wide variety of casting processes entail the work in foundries, lack of sufficient engineering skills, education and training has become a major issue in recent years. This paper highlights the challenges faced by the foundry industry in South Africa. Majority of the metal castings in South Africa are done in Ekurhuleni in Gauteng. Difficulties in finding trained foundry men and pending retirements of experienced staff are the major challenges they face. In this paper we acknowledge the need for active interaction between the academia and foundry industry to further enhance suitable skills in the casting technology in small and medium enterprises. We propose a new model for skills development in the foundries in Gauteng. This model will have some measurable outcomes.

**Key words:** skills development, a model for skills development, foundries in Gauteng

### Introduction

Metal casting is a process in which molten metal is poured into a mold to produce products for the automotive, valve, pipes and fittings, construction, art, agriculture, and mining industries. A wide variety of casting processes and metals (most commonly, iron, aluminium, steel, and copper-base alloys) are used.

The most common metal casting processes in South Africa are green sand casting (using a sand mold), investment casting (using a ceramic mold) and die-casting (using a metal mold). The reason one process is chosen over another for the production of a cast metal part is based on factors such as the number of parts required, the complexity of the part design, the type of metal being cast, cost and cosmetic requirements. Majority of the foundries use sand casting technologies. Foundries purchase new, virgin sand to make casting molds.

South Africa has about 200 different foundries ranging from small to large. More than half of all the foundries are located in Gauteng (Phele, Roberts and Steuart, 2004) and 65 per cent of all the foundries are located in Ekurhuleni due to the historical demand in mining and metals sector. South Africa averages a production rate of about 400 000 t/y of metal castings. International competitiveness is becoming the ultimate challenge of the new millennium. It requires high quality products manufactured with state-of-the-art technologies at low cost. This in turn is based on improved engineering skills, training and education, relevant applied research and an active interaction between academia and industry.

According to ASGISA (ASGISA, 2006) the South African government plans to half unemployment and poverty by 2014. Some of the constraints that were identified in the above report are shortage of suitably skilled labor, regulatory environment not conducive to small and medium businesses. Some less advanced sectors such as chemicals and metals beneficiation have been identified for development in the above report.

Some Acts and levies that currently regulate skills development in South Africa namely Skills Development Act (No. 97 of 1998) (Skills Development Act, 1998) and Skills Development Levy (No. 9 of 1998) focus more on development of skills in education. National Skills Funds initiatives with SMEs target skills development for miners and chemical engineering industries but not specifically the foundry sector.

### Objectives

Education and the replacement of skills continue to be a major issue for most South African foundries which find themselves with a large age amongst their workforce, pending retirements of experienced staff and difficulties in finding trained and educated foundry men. The lack of investment in formal apprenticeships for at

least 18 years has led to the significant shortages of trained workers coming through the ranks. In this paper we propose a model for skills development in the foundries in Gauteng.

The above main objective has the following sub-objectives:

- To identify the challenges faced in developing skills in the foundries in Gauteng
- To identify skills development goals
- To determine the role of UJ-MCTS (University of Johannesburg – Metal Casting Technology Station) in providing skills to the SMEs
- To focus on skills attained and technology used at the SEDA-Limpopo incubator
- To investigate the role of ICTs for skills development of SMEs
- To develop a model for skills development based on the above.

## Research Design and Methodology

A qualitative approach will be used. Focus groups are usually conducted with groups based on a topic chosen by the researcher and consists of 6-8 participants interviewed by the moderator (Flick, 2006), but some have used fifteen (Goss and Leinbach, 1996). Based on focus groups or the group discussions the researcher can explore what different participants reflected on each other's ideas and document how facts and stories operate (Kitzinger, 1994).

Focus groups will be conducted with the tenants in one of the foundries to get a brief overview of the challenges they faced, skills attained, skills needed and the need for further training. During the focus group sessions we could conduct the interviews in an unstructured and natural way and study the people in a natural setting.

Every participant will sign off a certificate of consent to participate in such a research. While using visual methods (Rose, 2007) one may require some contextual knowledge of the imagery the researcher is interested in and an expressive content of the image is necessary. Photos related to casting training conducted by MCTS-UJ during the years 2012/2013 for SMEs around Gauteng and for the training at SEDA incubator in Limpopo will be collected as visual material.

Content analysis has been defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Berelson, 1952, Krippendorff, 1980, Stemler, 2001, Weber, 1990). Qualitative content analysis of the articles related to Ekurhuleni foundry would give an overview of the challenges faced by the foundries and skills development goals. Content analysis techniques will also be used to analyze group interview data.

## Data Analysis and Results

A few articles related to skills development in Ekurhuleni foundries were used for content analysis. The unit of observation is these articles in Table 1 and the unit of analysis is sentence unit that indicate the category 'skills development in foundries in South Africa'. The Ekurhuleni municipality related articles are selected based on the fact that the majority of Gauteng foundries are in the region.

Some of the search criteria used for final sampling for various searches in Google (Google, 2013): skills shortage, challenges in skills development in Gauteng foundry, foundry industry in Ekurhuleni, technology in casting, and technological capability in Ekurhuleni. There were no articles specific to skills development specific to Gauteng foundry industry except a few related articles based on MCTS's role. In Table 1 we provide the references used for content analysis.

Table 2 provides the skills development goals and achievements based on the articles in Table 1. In Article 2 and article 5 (Table 1) authors agree there are challenges to casting industry namely: financial constraints, economic risks, lack of qualified personnel and lack of familiarity with new casting. Article 4 mentions a concern in the level of education and associated skills levels.

In Article 3, Information Technologist, metallurgical engineers including material processors and developers are listed as 'scarce skills' in South Africa, based on the Department of Labor information. Article 6 mentions the accuracy and repeatability of 3D printing process. The articles (see Table 1) could not provide a clear picture of skills needed or skills attained in small foundries in Gauteng. Moreover many Gauteng foundries could not be reached for more focus group sessions.

**Table 1:** References used for content analysis

	<b>Article title available online and web link below – All articles accessed on 3 Feb 2013</b>
<b>Article 1</b>	Ekurhuleni:towards a local industrial policy for driving pro-poor growth and a people-centred economy. Link: <a href="http://siteresources.worldbank.org/INTLED/Resources/339650-1144099718914/ProP oorEkurhuleni.pdf">http://siteresources.worldbank.org/INTLED/Resources/339650-1144099718914/ProP oorEkurhuleni.pdf</a>
<b>Article 2</b>	Industrial strategy and Local economic development: Manufacturing policy and Technology capability in Ekurhuleni. Link : <a href="http://www.tips.org.za/files/Industrial_Strategy_Phele_Roberts.pdf">http://www.tips.org.za/files/Industrial_Strategy_Phele_Roberts.pdf</a>
<b>Article 3</b>	Skills shortage in South Africa. Link: <a href="http://papers.ssrn.com/sol3/papers.cfm?abstract_id=992111">http://papers.ssrn.com/sol3/papers.cfm?abstract_id=992111</a>
<b>Article 4</b>	Ekurhuleni Metropolitan Municipality – University of the Witwatersrand joint programme of research on industrial development in Ekurhuleni Link: <a href="http://www.wits.ac.za/files/res7a70c7de72b647a2833306dccb809079.pdf">http://www.wits.ac.za/files/res7a70c7de72b647a2833306dccb809079.pdf</a>
<b>Article 5</b>	Smart Industries. Link: <a href="http://www.tips.org.za/files/Smart_industries_the_importance_of_technology_and_R_D_for_industry_performance.pdf">http://www.tips.org.za/files/Smart_industries_the_importance_of_technology_and_R_D_for_industry_performance.pdf</a>
<b>Article 6</b>	An Introduction to Rapid Casting: Development and Investigation of Process Chains for Sand Casting of Functional Prototypes. Link: <a href="http://scholar.sun.ac.za/handle/10019.1/70557">http://scholar.sun.ac.za/handle/10019.1/70557</a>

**Table 2:** Category 1: Skills development goals and achievements: focus foundries

<b>According to the article</b>	<b>Improves quality</b>	<b>More focus on use of up-to-date technology</b>	<b>More focus on productivity</b>	<b>To facilitate and grow SMEs</b>	<b>Build skills development network</b>
<b>Article 1</b>				√	√
<b>Article 2</b>	√				
<b>Article 3</b>		√	√		
<b>Article 4</b>		√			
<b>Article 5</b>	√				
<b>Article 6</b>		√			

Some of the unique responses of the tenants during the focus groups sessions facilitated by Mr. Kulani Mageza, the Station Engineer at UJ-MCTS are in Table 3.

**Table 3:** Unique responses of tenants on skills development by SEDA - Limpopo incubator tenants

Role	Skills attained	Did University/Industry assist?	Any other technology used for marketing or for casting?	How can MCTS-UJ assist in improving casting skills?	Did you get any training to do casting or to use any other technology?
Learner	Casting skills, melting, polishing, designing and manufacturing	yes	yes	Provide more training	yes
Learner	Polishing, melting, casting engraving, carving shapes out of metal, soldering	Yes, skills on casting with pewter, use of silicon moulds, recycling methods	Wax trees for casting	Provide training on CAD	Yes, how to use rubber moulds with investment powder and wax trees
SME	Jewellery manufacturing, melting, rolling and cutting of metal	UJ	No	More training needed on different ways of casting	Yes
Managing jewellery business	Casting the metal and some metal mixture	Yes, UJ	Marketing through chat rooms/ WhatsApp / Facebook	More practical exercises on casting	Yes
SME specialising in handmade products	How to market the products and the business	Yes, Johan Wessels / Jewellery casting of Silver/ Vukani-Ubuntu Jewellery project- casting of brass copper and silver	No	Follow up training needed	Nil
Manufacture own unique jewellery pieces	Learned to make ring, bracelet, necklace, earrings, learned how to cast trophies using pewter	We were taught to make rubber molds and how to pour pewter into the prepared rubber mold	No, strictly practical skills	Bursary needed to study metal technology courses in all levels	Only training in casting

He conducted the session with 13 people at the SEDA Limpopo Jewelry incubator on 28<sup>th</sup> March 2013. Initially he sent invitation and a brief to the SEDA incubator a few days before he went to conduct the session. A predetermined location was arranged to conduct the session at the incubator premises to further enhance this research.

Most of the tenants were learners although some were SMEs. The tenants were allowed to discuss and write down personal comments on the skills that they attained at the incubator, challenges they faced and their role in the incubator.

During the focus group session they also wrote their thoughts on how MCTS-UJ can assist them in improving casting skills, whether institutions/ industry assisted in developing skills in casting and whether they used any other technology, for example, cell phone, computer, pamphlets for marketing etc.

Tenants obtained designing, melting, cutting, soldering forging and casting skills at the incubator. All agreed either University or Industry personnel assisted with casting skills and majority agreed UJ provided the required training. They were already using social networking sites for marketing their products and suggested getting more assistance in using computer programs to make anything they like.

**Visual data:** A group of nine SMEs from around Gauteng were trained at the ground floor Foundry lab at UJ As evident in Figure 1 and Figure 2 institution is an important role player in providing casting skills to SMEs.



**Figure 1:** Training provided by MCTS to the Rand Refinery SMMEs



**Figure 2:** Casting made of pewter by Rand Refinery SMMEs



**Figure 3:** Pewter used during training for Rand Refinery SMEs

Rand Refinery SMEs were trained on casting, melting and rubber mold technology from AMT (Advanced Materials Technology). Ms. Palesa Riba, previous Station Engineer, MCTS-UJ trained them for two weeks from the 19<sup>th</sup> till the 30<sup>th</sup> of March 2012.



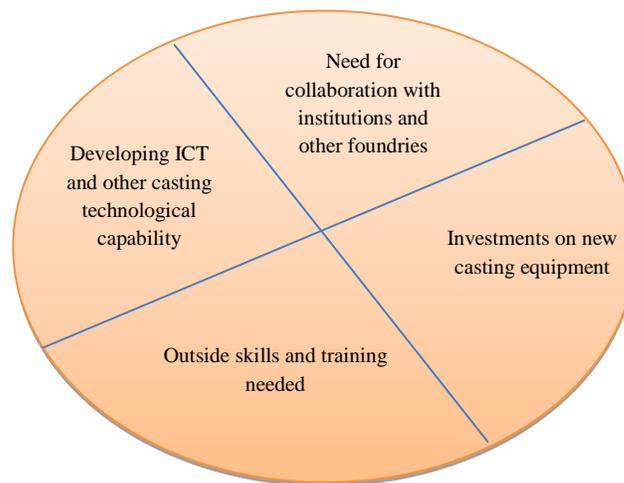
**Figure 4:** Training provided by Mr. Kulani Mageza, UJ-MCTS to the SEDA Limpopo Jewelry group



**Figure 5:** Casting Training provided by UJ-MCTS to the SEDA Limpopo jewelry tenants

## Findings and discussions

In this section we propose a model for skills development in the foundries in Gauteng. Figure 6 provides a clear picture of what can develop the skills in foundry men in Gauteng. Based on the multiple challenges faced by the foundries we have identified 4 areas through which we can develop the skills.



**Figure 6:** A model for skills development

As evident in Articles 3 and 4 there is a need to focus on investments on new technologies for casting. There will be financial constraints for the use of cutting edge technologies to be introduced, but these technologies are essential to develop skills. A Dell netbook was provided by UJ-MCTS to the SEDA Limpopo incubator group for the year 2012. This netbook will facilitate effective communication between the SMEs and the trainers at MCTS, UJ. They are hoping to use email, live chat and probably SKYPE in future to exchange ideas. This will also reduce transport costs tremendously.

MCTS is also looking at providing other Information and Communication Technology (ICT) such as Facebook page to network with all the SMEs. There was no evidence of use of any ICTs by the Rand-Refinery SMEs in Gauteng. As evident in the focus groups with SEDA-Limpopo jewelry tenants used WhatsApp (WhatsApp, 2013) and Facebook (Facebook, 2013) for marketing their products. They were keen to get more training on computer programs used for casting and designing. Figure 1,2,3,4 and 5 will say a thousand words about the skills attained by collaboration with educational and other technical institutions. This is essential for the growth of SMEs. Collaboration can further enhance casting and other technical skills and any assistance for training.

## Conclusions

This paper focuses on challenges in skills development in foundries in Gauteng. We use focus groups and other visual material to further enhance the study and develop a model for skills development in the foundries in Gauteng.

The proposed model provides the four areas one need to focus on namely: developing ICTs and other casting technological capabilities, need for outside skills and training, need for collaboration with institutions and other foundries, and the need for investments on new casting equipment.

Foundries experienced many challenges namely: lack of qualified personnel to train and they lacked familiarity with new casting technologies. Further collaboration with institutions could provide more training and support as evident from the focus groups with the incubators.

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## References

ASGISA report. (2006). Available on line: <http://www.info.gov.za/speeches/briefings/asgibackground.pdf> accessed on 25Jan'13 Accessed on 3 February 2013

Phele, T.,Roberts, S.,Steuart, I. (2004). Industrial Strategy and Local Economic Development: Manufacturing Policy and Technology Capabilities in Ekurhuleni. Available online [http://www.tips.org.za/files/Industrial\\_Strategy\\_Phele\\_Roberts.pdf](http://www.tips.org.za/files/Industrial_Strategy_Phele_Roberts.pdf) Accessed on 3 February 2013

Skills development act. (1998). [http://www.nqf.org.za/download\\_files/nqf-support/Skills%20Development%20Act%20\(No.%2097%20of%201998\).pdf](http://www.nqf.org.za/download_files/nqf-support/Skills%20Development%20Act%20(No.%2097%20of%201998).pdf)

Rose, G. (2007). “*Visual methodologies: An introduction to the interpretation of Visual Materials*”. London. Sage London.

Berelson,B. (1952). “*Content analysis in communication research*”. Illinois: Free Press.

Flick U. 2006 Introduction to qualitative research, SAGE publication. 3<sup>rd</sup> Edition. Available online: [http://www.tim.ethz.ch/education/courses/courses\\_fs\\_2011/course\\_docsem\\_fs\\_2011/Literature/19\\_Flick\\_Ch15](http://www.tim.ethz.ch/education/courses/courses_fs_2011/course_docsem_fs_2011/Literature/19_Flick_Ch15) Accessed on 3 February 2013

Goss J.D., Leinbach T.R. (1996). ‘Focus groups as alternative research practice’, *Area* 28 (2): 115-23.

Kitzinger J. (1994). ‘The methodology of focus groups: the importance of interaction between research participants’, *Sociology of Health* 16 (1): 103-21. Available online: <http://onlinelibrary.wiley.com/doi/10.1111/1467-9566.ep11347023/pdf> Accessed on 3 February 2013

Google (2013). Available online: [www.google.co.za/](http://www.google.co.za/) Accessed on 3 February 2013

Krippendorff, K. (1980). *Content Analysis: An Introduction to Its Methodology*. Newbury Park, CA: Sage.

Stemler, S. (2001). *An overview of content analysis. Practical Assessment, Research & Evaluation*, 7(17). Available online: <http://PAREonline.net/getvn.asp?v=7&n=17> Accessed on 3 February 2013

Weber, R. P. (1990). *Basic Content Analysis*, 2nd ed. Newbury Park, CA.

WhatsApp. (2013). Available online: <http://www.whatsapp.com/> Accessed on 3 February 2013

FaceBook. (2013). Available online: <https://www.facebook.com/> Accessed on 3 February 2013