

Research Project Title:

What is the shortfall or lack of plastics technicians and plastics engineers in South Africa and what can be done to address the problem?

Authors: Vanessa Davidson and Carel Garisch

Final Report: Summary

Background

Commissioned by the Plastics Chamber of the merSETA the project focused on the education and training of Technicians and Engineers in the plastics industry. The study, which employed a combined quantitative—qualitative approach, aimed to identify gaps in provision and to make recommendations to the merSETA on future interventions to support the plastics sector.

With three focal points (industry, higher education and associations) to the study, the research sought firstly to understand the general industry dynamics and issues as they impact the education and provision of Technicians and Engineers. This contextual understanding is a vital component in unpacking dynamics that are not always 'obvious' and seek to understand the 'nuances' affecting training provision. The study sought to understand the current employment status and trends, job titles and function differentiation, appointment and promotion criteria of personnel from an industry perspective and to identify what the current knowledge and skills shortfalls are.

The views of Higher Education institutions and the current and planned course offerings were examined in light of the industry position, specifically with respect to the preparation of 'work-ready' graduates from Universities and Universities of Technology. The study also focused on the current status of industry and academic collaboration and concludes with recommendations from all respondents on how to strengthen the supply of Engineers and Technicians in the plastics industry.

Specific Findings

Industry overview	
Not globally competitive	<ul style="list-style-type: none">• Industry lacking innovation culture• Prohibitive costs of imported materials and machinery a barrier to uptake by small companies• Inefficiencies costing the industry• Industry lags rest of world in terms of R&D investment and innovation-promoting outputs• The implementation of LEAN manufacturing principles inhibit specialisation and innovation• "Bad" structural dynamics and business approaches undermine company effectiveness and competitiveness
Ignorance about the industry	<ul style="list-style-type: none">• Lack of knowledge of the industry has negative implication for growth
Impact of the demise of erstwhile 'strong technician training programmes'	<ul style="list-style-type: none">• The loss of the National Diploma in Polymer Technology has created a 'critical' skills gap
Current employment status and trends	<ul style="list-style-type: none">• Engineers' current employment status is limited• Declining work opportunities for graduate Polymer Scientists• Difficulty recruiting suitably qualified and experienced personnel across all categories

Job title and function differentiation in relation to company size	<ul style="list-style-type: none"> • Generally, but not exclusively, the scope of work increases as company size decreases
Appointment and Promotion Criteria	<ul style="list-style-type: none"> • Industry experience is considered more important than qualifications for production staff. • Internal promotion is preferred to external appointments and for senior and technical positions, an employment agency is used.
OFO Codes	<ul style="list-style-type: none"> • The OFO codes are considered too rigid and too limiting in descriptors to adequately fit industry job titles.
Knowledge, skill and attribute shortfall	<ul style="list-style-type: none"> • Problem-solving (abstract) skills significantly lacking among engineering graduates • Management skills • Interpersonal and communication skills which undermines collaboration and team work capability • Administrative skills • 'Right' attitudes
Training provision shortcomings	<ul style="list-style-type: none"> • Industry-wide and industry-specific training is desperately needed • The pervasive, entrenched and reactive culture of 'we'll make plan' undermines a systematic and industry needs-driven knowledge and skill development intervention in the long term • Too few plastics industry-focused degrees and diploma offerings to cater for industry needs. • Systemic short-comings are decried with regard to artisan training and development for the plastics industry, with a particular lack of formal training opportunities in respect of: blow moulding, colour matching, supplier training.
Education and training of engineers and technicians (HE level)	
Current developments	<ul style="list-style-type: none"> • New BEngTech in Materials Engineering in Polymer Technology for TUT (2020 phase-in). • Stellenbosch University is the only university that officially offers a Polymer Science undergraduate stream. • Adoption of UK Apprenticeship 'Degree' Model by WITS. • TVET-HE articulation – no formal collaborative framework in place in regard to TVET colleges, so students who enter HE studies do so on the basis of meeting specific course entry requirements.
Views of HE Respondents	<ul style="list-style-type: none"> • Core purpose and focus of higher level [HE] education and training is about principled learning and imparting high level analytical skills • Value-adding "generic attributes" of graduates (Masters and Doctoral graduates in particular) are mis-understood and therefore not sufficiently appreciated by industry • Ideal plastics industry engineer (qualification mix) – a process engineer with a post-graduate qualification (either Honours degree or Post-Graduate Diploma) in (plastics) polymer science'. • Honours or Post-Graduate Diploma programmes (part-time) in Polymer/ Materials Science and Materials Engineering viewed as the 'ideal' option or vehicle for up-training of industry (technicians/ technologists). • Lack of/ significant shortfalls in funding is the single-most critical factor impeding teaching and research outputs
Views of Industry Respondents	<ul style="list-style-type: none"> • Link between science and the mechanical side missing • "Expensive degree" if graduate has no relevant plastics industry exposure • Graduate conceptual thinking compensates • Graduate lack of awareness of the business environment. • Unrealistic attitudes and expectations • "Ideal" qualification / knowledge blend for graduates in the plastics conversion industry
Status of industry-Higher Education collaboration	
Views of Industry Respondents	<ul style="list-style-type: none"> • Little / lack of collaboration on the part of Higher Education • Formal channels for engaging with Higher Education institutions lacking • Intellectual property rights issues regarding collaborative research outputs • Industry-specific training and research institutes are largely lacking in South Africa

Views of HE Respondents	<ul style="list-style-type: none"> • Industrial Advisory Boards as primary formal structure for engagement with industry • Close historical relationships by virtue of having been “born of” industry • Ad hoc troubleshooting service as the basis for engagement • Strong advocacy amongst stakeholders regarding collaboration BUT no substantive action accompanies engagement • Partnerships developed and sustained on the basis of trust relationships between key individuals
Suggestions to strengthen industry, the supply of engineers and technicians in particular	
Industry Respondents	<ul style="list-style-type: none"> • Industry-wide and specific training desperately needed • Adopt the German Model • Reinstate a plastics technology diploma • Combine initial Higher Education and Internship-based training • Workplace exposure for students instead of full internship • Higher Education curriculum development and alignment in consultation with industry and informed by research • Establishing a highly-visible, multi-sectoral and multi-level skills planning and development pipeline involving all stakeholders and role players • Higher Education institutions to acquire machinery • Through Plastics Chamber–HE collaboration develop a broad spectrum and pool of skills catering for the multiple skills needed by all the plastics industry sub-sectors • Plastics SA Training – PSA the ‘obvious’ training partner to industry • Provincial specialist training centres required • Industry as a whole should support TVET colleges more proactively on an interactive partnership basis • As the major raw materials supplier, SASOL should be funding internships. • Advocacy for careers in plastics industry • Plastics Chamber—Higher Education collaboration • Optimising monitoring and development research focus • Collaborative research around key plastics engineering problems/challenges • Optimising the use of university department’s equipment and post graduate student resources to solve industry research and development challenges is seen as an opportunity • Providing a forum, on a regular basis, where universities and students can inform industry about their research focus areas and potential benefits to be derived by industry is viewed as beneficial • ‘Good’ practices promoting company well-being
Industry Association Respondents	<ul style="list-style-type: none"> • The relationship between industry and higher education is not a simple one and in some instances it is viewed as ‘adversarial’. • Manufacturing exposure • Importance of standards and testing as a key focus area for consideration – to implement and uphold standards in the industry. • Applied research
HE Respondents	<ul style="list-style-type: none"> • Two-stream model for post-graduate provision – a Masters and Doctoral stream but also allowing for exit at Honours Level • Three-tiered approach to education and training for plastics industry-focused graduates • Level 1: Focus on producing Technicians and Technologists (BTech) • Level 2: Honour’s level focus targeting ‘people knowing chemistry or chemical engineering, but who don’t know plastics’. • Level 3: Focused at Masters and PhD levels where students conceptualise projects and test for workability in the laboratory, after which they are employed by industry to develop these projects and processes (up-scale) for eventual commercialisation. • Internships – as representing “the only” vehicle for facilitating industry-readiness of (post- graduates) ‘at no cost to company’ (however, lack of interest from companies is bemoaned) • Establish plastics industry RESEARCH CHAIR – as most effective and cost-effective model for stimulating / driving effective and cost-effective innovation research in the plastics (polymer) industry

Overall Findings

(Graduate) engineers and technicians in the plastics industry

Overall Finding 1:

Graduate engineers and post-graduate polymer/materials scientists are not perceived by industry to be essential for plant function and performance. But there is an appreciation of the analytical capabilities of engineers and an awareness of the engineer-technician differentiation with respect to job functions and where they can add value.

Overall Finding 2:

Apart from a shortfall in practical knowledge of graduate engineers and technicians, industry reported graduates fall short with respect to soft skills. However, the undergraduate curricula do include development of these soft skills, suggesting a curriculum 'uptake' issue and not a curriculum 'shortfall' by Higher Education institutions. Why this is so can be researched further, but could include learning aptitude, motivation, selection of candidates, process related issues, lack of awareness of the plastic conversion industry as well as weak human capital development intervention.

HE education and training provision for the plastics industry

Overall Finding 3:

With the exception of Stellenbosch University, undergraduate courses are limited to a BEng or BScEng degree in chemical engineering as the generic entry level programmes but they do not have any significant level of exposure to plastics materials science and processing. Specialisation in polymers/materials science and materials engineering only happens at post graduate level largely through research-based masters and doctoral studies, but the mechanical engineering-linked conversion process is not addressed.

Overall Finding 4:

For industry, a graduate-level qualification combining polymer science and mechanical engineering with a grounding in conversion process knowledge is perceived as the 'ideal' for the education of engineers. Higher Education, by contrast, favour a polymer/materials science (chemical) engineering blend with a grounding in 'plastics specific' science and processing.

Overall Finding 5:

Both industry and Higher Education flagged an increasing shortfall in funding which results in declining post graduate enrolment and research activities. Full bursaries are increasingly difficult to find. Higher Education must self-finance research projects and the purchase of equipment for practical training. Funding for internships is not available. Industry demand for short courses has diminished with a corresponding decline in offerings.

HE–Industry partnerships and collaboration – shortcomings

Overall Finding 6:

In general there is a 'disconnect' between industry and HE which leads to misunderstanding of their respective offerings and collaborative opportunities. Various strategies and interventions have been tried but they lacked sustainability leaving informal networking as the mode of engagement. The lack of collaboration is seen as having a negative impact even though both industry and HE appreciate their mutual interdependencies. They cannot seem to establish a long-term sustainable collaborative

framework to address relevant research, materials science development, industrialisation of research output, testing facilities and the support needed for standardisation of processes and products.

Overall Finding 7:

A general lack of a trust-based 'working relationship' between industry and HE inhibits the collaborative commercialisation of innovative research. Industry appear, by and large, to be the reluctant partner. Industry appear to prefer approaching HE with research requests for materials characterisation and development, and/or product testing and analysis-based trouble shooting.

Overall Recommendations

Overall Recommendation 1:

The current low uptake of qualified engineers and technicians could be mitigated through industry body advocacy. This would mitigate the lack of awareness of the potential value add of qualified personnel with principled disciplinary knowledge, a socio-economic understanding of the impact of engineering, high level analytical capability and the capacity for critical and innovative thinking.

Overall Recommendation 2:

Amend the current 'stock and trade' qualification comprising a polymer/material science and process/materials engineering mix, to include mechanical engineering. In a joint venture between HE and industry, and funded by industry; reduce the scope of the polymer science component to an exclusive 'plastics knowledge' focus in consultation with ECSA.

Overall Recommendation 3:

Enhance work readiness of graduates by HE and industry collaboratively improving practical training facilities at HE institutions, with funding from industry. In addition, early industry awareness and activation of undergraduate learners about opportunities in the plastics industry.

Overall Recommendation 4:

Industry bodies, Plastics Chamber and Plastics SA should devise effective ways of promoting engagement between HE and industry to collaborate around mutual areas of concern, needs and aspiration with the ultimate goal a high level human capital development intervention that will nurture an innovative and competitive plastics industry.

Overall Recommendation 5:

In light of 'insufficiently plastics-focused' HE provision, it is suggested that the Plastics Chamber and Plastics SA assume strong leadership in regard to:

- a) effecting changes to the current qualifications in pursuit of the 'ideal disciplinary mix' for dedicated plastics scientists, engineers and technicians;*
- b) find creative and substantial ways of alleviating the funding crisis burdening HE institutions;*
- c) encourage better short course uptake by industry to build trust; and*
- d) stimulate multi-dimensional industry funding and investment to support the above*