merSETA Plastics Chamber Research 2018/19

RESEARCH 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?"

RESEARCHERS:

Vanessa Davidson & Carel Garisch

PRESENTATION OF RESEARCH FINDINGS

merSETA Inter-Chamber Consultative Conference
Holiday Inn Garden Court, ORT Precinct, Johannesburg

16 &17 May 2019

PRESENTER:

Vanessa Davidson

Research Focus, Design & Methodology

I. Research Focus

In light of the shortage of technicians and the lack of preparedness of graduate engineers entering the workplace, the study focused on education and training provision for the plastics sector at University and University of Technology level (NQF levels 6–10) in order to understand:

- *What diploma, degree and post graduate courses are in place?*
- *Do meet the specialised skills required by the plastics industry and,*
- *If there a shortfall or lack of education provision, what needs to be done to address the problem?*

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.

II. Research Design & Methodology

In view of the research topic a **mixed methods approach** utilising both quantitative and qualitative methods was decided on. **Data collection** involved *three distinct phases*:

Research Focus, Design & Methodology *(–cntd.)*

- ***Quantitative data***

  1) Analysis of the merSETA Workplace Skills Plan and Annual Training Report data for the last 5 years
  2) Desktop research into education and training offerings at NQF levels 6-10 - aligned tothe plastics sector.

- ***Qualitative data***

  3) Semi-structured (face-to-face) interviews were conducted across four categories of respondents:

     (i) Engineering Department / School Heads and Learning Programme Convenors at HE institutions

     (ii) HR and Plant/Production Managers representative of the various sub-sectors of the industry;

     (iii) Newly-employed Graduates in the plastics industry; and

     (iv) Representatives of Industry Associations

  All interviews were recorded and transcribed verbatim and a thematic approach adopted in regard to **data analysis** The coding process consisted of two cycles of manual coding (pre-set and emergent codes or categories).

Research Focus, Design & Methodology *(–cntd.)*

The study **sample** was made up as follows:

- The targeting of ***Companies*** was informed by an initial informal interview with the editor of an industry magazine, based on a recommendation from Plastics SA. In the end, 7 out of a targeted 10 companies participated in the research and a total of 18 interviews were conducted. The shortfall of 3 companies was compensated for by drawing on 2016 research data (Garisch, 2016).

  Provincial distribution: Gauteng: 4, Western Cape: 3, Kwazulu-Natal: 2 Eastern Cape: 1.

- The selection of ***Industry Associations*** was based on a recommended initial list provided by Plastics SA. 3 out of the targeted 5 associations participated in the research and a total of 3 interviews were conducted.
- From desktop research into provision by ***HE institutions***, 6 institutions were selected based on their direct offering of plastics-related learning programmes or affiliated degrees. All targeted institutions participate, comprising 5 universities and 1 university of technology, which translated into 8respondents being interviewed.(1representative submitted written inputs via email as the scheduled interview had to be cancelled at the last moment.)

SPECIFIC Findings (Respondent Views)

I. Respondent views on the STATUS of INDUSTRY STRENGTH

- ***Industry not globally competitive***
  - *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*

SPECIFIC Findings *(–cntd.)*

- ***Ignorance about the (plastics) polymer industry***
  - *Lack of **knowledge of the industry** has implications for growth*
- ***Impact of the demise of erstwhile 'strong technician training programmes'***
  - *The loss of the **National Diploma** in Polymer Technology has created a skills gap*

II. Respondent views on EMPLOYMENT OF ENGINEERS AND TECHNICIANS

- ***Current employment status, trends & issues***
  - ***Engineers**' current employment status is limited*
  - *Declining work opportunities for graduate **Polymer Scientists***
  - *Difficulty recruiting suitably qualified and experienced personnel across **all categories***

SPECIFIC Findings *(–cntd.)*

III. Respondent views on KNOWLEDGE, SKILL & ATTRIBUTE SHORTFALL (graduates)

- ***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***

SPECIFIC Findings *(–cntd.)*

IV. (HE-level) EDUCATION & TRAINING of Engineers & Technicians

- ***Views of HIGHER EDUCATION Respondents***

  - ***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 and knowledge mix) = a process engineer with a post-graduate qualification (either Honours degree or Post-Graduate Diploma) in (plastics) polymer science'.*

SPECIFIC Findings *(–cntd.)*

- ***Views of INDUSTRY Respondents***
  - ***Link** between **science** and the **mechanical** side **missing***
  - *"Expensive" degree if graduate has no relevant **plastics industry exposure***
  - *Graduates lack of awareness of the **business environment***
  - *Unrealistic **attitudes** and **expectations***
  - ***"Ideal" qualification / knowledge blend** for graduates in the plastics conversion industry:*
    - *Combination of **mechanical engineering** and **polymer science** due to the plastics converting industry having a strong engineering function dominated by machinery.*
    - ***"Turnkey" (polymer) scientists,** i.e. fully work-ready (plastics) polymer scientists familiar with machinery and equipment*

SPECIFIC Findings *(–cntd.)*

V. Status of Industry–Higher Education COLLABORATION

- ***Views of INDUSTRY Respondents***
  - ***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 HIGHER EDUCATION respondents***
  - ***Industrial Advisory Boards*** *(department-based) as primary formal structure for engagement with industry*
  - *Close* ***historical relationships*** *by virtue of having been "born off' industry*
  - *Ad hoc* ***troubleshooting service*** *as basis for engagement*
  - ***Strong advocacy*** *amongst stakeholders regarding collaboration BUT* ***no substantive action*** *accompanies engagement*
  - *Partnerships develop and are sustained on basis of* ***trust relationships*** *between key individuals*

OVERALL Findings

I. (Graduate) engineers and technicians in the plastics industry

- ***OVERALL Finding 1*: Uptake of graduate engineers and polymer scientists in Industry**

  Graduate engineers and post-graduate polymer/materials scientists *are by-and-large* ***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*: Areas of knowledge & competence shortcomings of graduates**

  Apart from sub sector-specific shortcomings with regard to ***practical knowledge and expertise*** *(on-course practical exposure to current industry machinery), areas of knowledge and skill/competence and attribute shortfall among job entry-level graduate engineers (and polymer scientists) are* ***high level analysis and advanced problem solving; contextual process/project management, and interpersonal and communication skills****, which undermine teamwork capability. Interestingly, shortcomings with regard to disciplinary knowledge were not highlighted.*

OVERALL Findings *(– cntd.)*

II. HE-level education and training provision & research support

- ***Overall Finding 3: Current scope and relevance of current qualifications***

  With the exception of Stellenbosch University, ***undergraduate qualifications/ programmes 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*** *(studies and research projects). However, a mechanical engineering dimension (conversion process-focus) is not addressed.*

- ***Overall Finding 4: An 'ideal' plastics industry (conversion) engineering qualification***

  Industry respondents: *A combination of polymer science and mechanical engineering disciplinary knowledge fields together with grounding in conversion sub sector-specific process knowledge .*

  HE respondents: A *qualification comprising a polymer/ materials science–process (chemical) engineering disciplinary blend focused on providing students with a solid grounding in knowledge of 'plastics-specific' science and processing.*

OVERALL Findings *(–cntd.)*

- ***Overall Finding 5*: Funding shortfall as critical cross-cutting theme impacting on education and training provision, uptake and research output**

  *Increasing 'critical' shortfalls in funding for universities in recent years severely inhibit the capacity of academic departments and research institutes to deliver on all aspects of provision. Such a **drying up of funding** is widely bemoaned and in particular regard to:*

  - *bursary funding for both undergraduate and post-graduate students has become increasingly difficult in recent years – that is, not just for covering tuition fees but also living and travel expenses*
  - *Research funding in respect of post-graduate student enrolment and research projects (no institutional funding for research, including staff and equipment)*
  - *Funding for internships for graduates*
  - *Industry demand/ support for short course provision has declined dramatically in recent years*

OVERALL Findings *(–cntd.)*

III. HE–Industry partnerships and collaboration – shortcomings

- ***OVERALL Finding 6:***

  In general there is a 'disconnect' between industry and HE which results in misunderstanding of their respective offerings and collaborative opportunities. Various strategies and interventions have been tried but they lack sustainability, leaving informal networking as the chief 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 – with approaches to HE being essentially limited to request for materials characterisation and development, and/or product testing and analysis-based trouble shooting.

Suggestions to strengthen industry – the supply of engineers & technicians in particular

I. Views of INDUSTRY ENTERPRISES:

- *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*

Suggestions to strengthen industry – the supply of engineers & technicians in particular *(–cntd.)*

- *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*

Suggestions to strengthen industry – the supply of engineers & technicians in particular *(–cntd.)*

- *Collaborative research around key plastics engineering problems/challenges*
- *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*

II. Views of INDUSTRY ASSOCIATION respondents:

- *The relationship between industry and higher education is not a simple one and in some instances it is viewed as 'adversarial'.*
- *Manufacturing exposure for students*
- *Importance of standards and testing as a key focus area for consideration – to implement and uphold standards in the industry.*
- *Useful applied research by HE institutions*

Suggestions to strengthen industry – the supply of engineers & technicians in particular *(–cntd.)*

III. Views of HIGHER EDUCATION respondents

- *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 Recommendations

I. Stimulating the uptake of engineers in the plastics industry

- ***Overall Recommendation 1:***

  The current low uptake of qualified engineers and technicians could be mitigated through advocacy by industry bodies, with particular reference to advocacy/ awareness-raising:

  - *In SCHOOLS concerning career opportunities in the plastics industry and corresponding education and training opportunities at relevant HE institutions*
  - *In INDUSTRY about the potential value-add to company performance by qualified personnel (graduates and post-graduates) in relation to key attributes and competences like principled, disciplinary knowledge, socio-economic understanding of the impact of engineering, high level analytical capability and the capacity for critical and innovative thinking.*

OVERALL Recommendations (–cntd.)

II. Enhancing the scope and relevance of HE provision with regard to the education and training (re conversion sub-sectors in particular); as well as research support to industry

- ***OVERALL Recommendation 2:***

  - *The Plastics Chamber and Plastics SA should assume strong leadership and facilitating roles to effect changes to current provision as suggested by industry and HE constituencies in pursuit of aligning the current HE qualifications and programmes to ensure the supply of dedicated plastics industry engineers, scientists and technicians.*
  - *Of particular focus should be the amending the current 'stock and trade' qualifications comprising a polymer/ materials science—process/ materials engineering disciplinary mix to also include a mechanical engineering dimension whilst also reducing the scope of the polymer science component to an exclusive 'plastics knowledge' focus in consultation with ECSA.*
  - *Such an undertaking should take the form of a joint venture between the relevant HE institutions and industry stakeholders, with funding, as may be required, provided by industry.*

OVERALL Recommendations (–cntd.)

- ***Overall recommendation 3:***

  Industry bodies are implored, as a critical priority, to find creative and substantial ways to alleviate the increasing funding crisis burdening HE institutions in partnership with industry with particular reference to:

  - *bursary support for post-graduate students to address the decline in uptake of higher-level studies and corresponding opportunities for specialisation*
  - *research funding (dedicated staff and equipment)*
  - *equipping practical training facilities to enhance world-of work readiness of graduates*
  - *funding of internships for graduates*
  - *stimulating uptake by industry of short course offerings*

Overall Recommendations *(–cntd.)*

III. Strengthening Industry-HE relations and collaboration

- ***Overall Recommendation 4:***

  Against the background of the disconnect that currently characterises Industry–HE relations and collaboration, by and large, and unsuccessful attempts in the past to bridge this divide in any sustainable or lasting ways; Industry Associations, the Plastics Chamber and Plastics SA should devise effective ways to promote engagement and trust relationships-building between HE and industry to collaborate around mutual areas of concern, needs and aspirations – with the ultimate goal of high-level human capital development interventions that will nurture an innovative and competitive plastics industry.

Conclusions

Current Situation

- *Conflation of Artisan, Technician and Engineer by industry*
- *Differing views from HE and Industry*
- *Generic education provision only*
- *Specialisation at post graduate level only*
- *Historical HE polar position: Engineering and Science*
- *ATR data limited (dichotomous findings)*

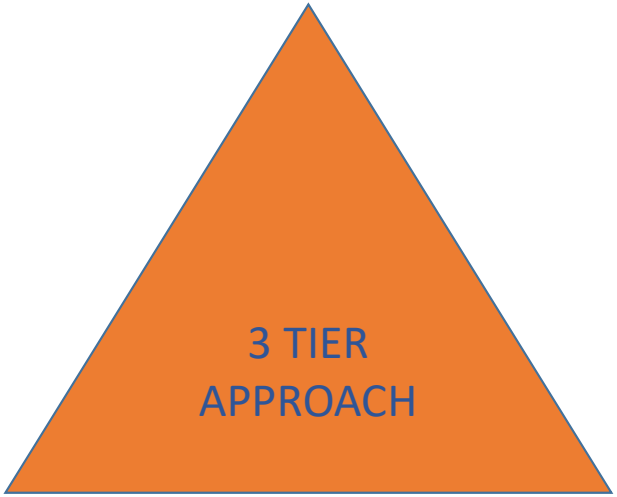
Solution

- *Combine Science and Engineering*
- *Process "know how" addressed*
- *Engage on electives*
- *Machinery*

3 tier qualification approach…

Qualification Alignment

3. Masters and PhD studies leading to industry commercialisation and strong research support grounded in industry needs.



1. Develop a Plastics National Technical Diploma

2. Develop an "ideal" graduate qualification

*Industry: Polymer Science and Mechanical Engineering with "conversion" sub-sector **specific process** knowledge in consultation with ECSA.*

*HE: Materials Science-Process (chemical) Engineering blend with knowledge of plastic specific science and **processing**.*

An Honours Exit option will support industry.

Long-term sustainable collaborative framework to support:

- *Relevant research and possibly a Research Chair at HE*
- *Materials Science development*
- *Industrialisation of research outputs*
- *Testing facilities*
- *Support for standardisation of processes and products*
- *Supporting innovation (Garisch, 2016)*
- *HE and industry Forum*

THREE STUDY RECOMMENDATIONS: STIMULATE, ENHANCE AND STRENGTHEN

Formal joint venture between industry and HE

- *Skills Planning and Development Pipeline and Skills Pool*
- *Human Capital development plan that nurtures innovation and competitiveness*

HIGH VISIBILITY

MULTI-SECTORAL

MULTI-LEVEL

- *Plastics Chamber, Plastics SA and Industry Associations critical*
- *All stakeholders and roleplayers*

MOVE BEYOND INFORMAL INDIVIDUAL TRUST RELATIONSHIPS

MOVE BEYOND THE DISCONNECT AND RELUCTANT PARTNERSHIPS

HOW?

COMMITMENT

- *Higher Education*
- *Industry*
- *Industry Associations*
- *Plastics Chamber*

A CREDIBLE FUNDED LONG-TERM INTERVENTION GLOBALLY-RECOGNISED

FUNDING

- *Bursaries*
- *Post graduate research*
- *Practical Training*
- *Interns (SASOL?)*
- *Equipment and Machinery*
- *Short course development and uptake*

Thank you

VANESSA DAVIDSON

Cobban Consulting

072 836 3998

vanessa@cobbanconsulting.co.za