MerSETA Plastics Chamber Research 2016

A STUDY OF INNOVATION CULTURE AND CAPABILITY IN THE SOUTH AFRICAN PLASTICS INDUSTRY

Final Report

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EXECUTIVE SUMMARY

Today, almost all manufacturing organisations are faced with a dynamic environment characterized by rapid technological change, shortening product life cycles, and globalization. It is apparent that organisations, especially technology-driven ones, operating in this kind of a market environment need to be more creative and innovative to survive, to compete, to grow, and to lead. Innovation through creativity is essential for the success and competitive advantage of organisations as well as for strong economies in the 21st century. (Gumusluoglu and Ilsev, 2009. Citing: Mumford and Gustafson, 1988).

It is against this backdrop and with particular reference to the sad plastics industry reality of a high failure rate among small to medium-sized entry-level or start-up companies but also increasingly among more long-established companies that this research project, a qualitative study, was conducted. It follows but is not directly linked to a three-phased research initiative on the part of the merSETA's Plastics Chamber that occurred between 2011 and 2014.

The overall stated purpose of the research on the part of the merSETA Plastics Chamber was to explore the skills and knowledge related or linked to innovative practices in order to grow the Plastics industry sector in South Africa; in the context of a futures-orientation linked to advanced manufacturing technology and practices.

The report is structured as follows:

Section 1 presents a brief review of literature on innovation which clarifies core innovation concepts as they relate to the research purpose and objectives and as such providing the basis for the conceptual and methodological frames, which will also be explained. Section 2 presents a brief overview of current salient aspects of the plastics industry, as contextual backdrop for presentation of findings, which is the focus of Section 3. Section 4 contains respondent recommendations for company and sector strengthening. Finally, Section 5 presents an overall discussion, recommendations and conclusion.

CONCEPTS AND METHODS

The key concepts are derived from a comprehensive review of literature conducted (Garisch, 2016), which informed both the investigative and analytical frameworks.

In view of the research remit for an in-depth exploration of the skills and knowledge needs linked to innovative practices in order to grow the plastics industry sector in South Africa, a qualitative research approach was decided on as best fit, with semi-structured interviews or

"conversations with purpose" as data collection method. (Please refer to the main report for sample description)

KEY FINDINGS

Perspectives on "surviving" and "thriving" in the market

- *Doing business in the highly competitive environment that is the plastics market has become an extremely tough assignment – just to break even and survive, first and foremost.*
- *Differentiating oneself from competitors as the basis for gaining competitive advantage is an "entirely different matter" – particularly given the fact that (in theory at least) the playing fields are level in terms of access to the same technology and raw materials; by-and-large all subscribing to the same quality and performance standards governing production processes and organisational systems (by virtue of ISO-compliance and so forth)*

Reflections on scope for (radical) innovation in the sector

- *South Africa is by-and-large a follower of global technological innovation trends*
- *A company can only be accorded innovator (product) status if it can lay claim to ownership of trademarks and propriety-designed products*
- *Propriety product innovation reportedly only comprises around 30% of innovation in the industry*

Respondent views on key industry contextual factors impacting on company sustainability and competitiveness

Labour force – challenges around demand and supply

- *In an overall sense, a lack of pool of sufficiently knowledgeable and skilful people for the industry at large to draw on represents the single-most critical stumbling-block to growing a competitive industry – and no time for (wholescale) on-job upskilling*
- *Skills gap widening as old-school skills exit the system but no young generation of suitably-equipped artisans to replace them as artisanal vocation and work has lost its appeal*
- *The physical demands of the job as well as lack of long-term financial security are some of the factors noted for young people not wanting to consider tool-making as a career option*

SABS's current inability to perform its oversight role

- *As a result of SABS 'collapse', the pillars or building blocks to support an industry-wide innovation culture not in place – with reference to the monitoring of (quality) production.*
- *In principle SABS role performance questioned as effectively amounting to no more than issuing of required documentation/ certification regardless of quality-related aspects at plant level*
- *Lack of inspectors to enforce adherence to standards*

Raw materials – cost and supply issues

- *Sasol's status as monopoly supplier and its 'anti-industry friendly' behaviour*
- *Access to clear material (recyclers) and engineering polymers a challenge*
- *New raw materials a challenge*

Industry-wide R&D culture in support of product innovation lacking

- *A "short-sighted" culture of focused immediate problem-solving challenges at the expense of a more systematic, research and development-based approach (in line with European practice) is decried for eroding sustainable and competitive product innovation*

A disconnect between institutional research bodies and industry hampering innovation

- *Higher Education and Research Institutes are reportedly looking for industry partners as joint-collaborators on product/ material development (partly motivated as compensatory measure in light of funding cuts) but industry is unwilling to invest in white collar research due to its focus on achieving practical results in the shortest possible time, as governed by a time-is-money bottom line – in direct contrast to the culture in Europe scenario where such collaborative knowledge generation networks are the lifeblood of an innovative plastics industry,*

Insufficient support to industry form government and industry bodies

- *Government endorsement of new product takes too long – if at all*
- *Lack of incentives to export*
- *The dti's initiation programme is lauded as one of the most successful initiatives and drivers in respect of industry strengthening. Its sudden termination is widely bemoaned as having a devastating effect on industry well-being*
- *Small businesses not looked after by government – it is too hands-off regarding SMEs and they are being "killed off" by regulatory restrictions and red tape*

- *Because of the cost and time investment required for ensuring BEE compliance – though supported in principle and largely adhered to; SMEs are experiencing its current nature and focus as having a significantly detrimental impact on business performance and growth; and, by extension, sectorial strength.*

Plastics SA

- *The Federation is lauded for strong Generic Training provision, its Aptitude Assessment service, company-strengthening Energy Survey initiative, and Informational Events. Aspects highlighted as inhibiting the effectiveness and impact of its interventions – in respects of SMEs in particular – are the relatively high fees and its technical training interventions at this time being predominantly injection-moulding focused*

Innovation status in the plastics sector

Product innovation

- *For most part, product development or innovation comprises providing a competitively-priced solution to a customer request or specifications for either enhancement of (modification or tweaking) or whole-scale change to an existing product (or component thereof) – and, to a very limited extent ("roughly 30%") new (propriety) product development;*
- *This translates into an innovation issue of "for-profit" design and manufacturing (benefitting both supplier and customer) compliant with industry quality and performance standards.*

Service innovation

- *Inextricably linked to product quality and competitive pricing, quality and scope of service provision is viewed as a critical source of differentiation – that is, with regard to both quality and consistency (on time-in-full with close-to-zero reject rate, every time) and scope (rendering a "complete service" or turnkey solution).*

Process innovation

- *Process-related (incremental) innovations focused on improving operational efficiencies as well as overall organisational efficiency comprise the bulk of industry-wide innovation-in-action culture – on the basis that such innovations are the drivers of quality and competitively-priced product and service offerings as the basis on which increased market position/ share and profits.*

Organisational / managerial innovation

- *Strong established organisational innovation culture across all categories of companies. Indeed, a strong sense of urgency is palpably evident this regard as captured, for example, in strategically-driven pursuits spanning the adoption of lean manufacturing and entrepreneurial principles, flattening of organisational structures, introduction of HRD-related measures for ensuring a "happy", empowered and productive workforce, and so forth. Broadly, organisational changes so described relate to improvement of efficiencies.*
- *Whilst many such changes could be considered as "merely" ISO-driven – that is, company context-specific "innovations" within the prescribed ISO framework or guidelines; others do indeed represent the outcomes of internal, strategically-driven initiatives.*

Examples of successful innovation outcomes

"Pioneering in-house development of an online manufacturing management system (MMS)"

One of our innovations is that we came up with an innovative idea to measure the business' results – an online system we call our MMS system which was innovated by the senior management team. No one knows about the system except us. It has been patented.

It's a quality checking, the inputs is obviously done via networking, the machine measures your OEs, it measures you OPPs, it measures every single thing. I come in the morning, I run a report and I am up to date with my factory.

So the guy on the factory floor, he's got a light that comes up, it signals him, telling him about his quality checking is now due and he'll go now and do his quality check. Those inputs are pulled into the system so now we know we can run a report – who actually did the quality check last and then in the event of traceability, we can pick up on it. So this is an integrated system, totally integrated system that works off a server. It measures an output of equipment of the machines, it tells you how many bottles you supposed to be making a minute, it tells an output of what should of went out and into the warehouse and it's integrated with our JD system, it can tell you about the supply chain, how much actually was manufactured and everything of that. So this is a closed ERP[1] system, we would think it is. It ties up with the ERP system. It's a fantastic system. So this is one of the big, big innovations for us.

[1] Enterprise resource planning (**ERP**) is a category of business-management software—typically a suite of integrated applications—that an organization can use to collect, store, manage and interpret data from many business activities, including: product planning, purchase. manufacturing or service delivery.

It's been implemented now for the past five to six years. It's been in development stages all the way. It's still under development right now. We're still looking for more other things to put on in terms of innovation.

When this factory was, our employees were, they no knowledge of computers, they had major problem in terms of understanding of computers and whatever. So what we've done was we obviously put our employees onto computer training. We started to train them ourselves to get them to understand basic understanding of computers.

"Resolving the made-for-order—made-for-stock dilemma (settling for middle ground)"

> *I think the whole working capital story… withholding of stock-piling venture or whatever is being overdone, because there is a somewhere in-between that. Reckless production is sometimes a product of accounting processes – so if you have production recoveries allowable in your accounting process, you drive a certain behaviour in your company, which is crazy.* [Sales Executive]

By this respondent's account (and reported general consensus), an exact model for ensuring successful inventory management cannot be prescribed. A useful approach suggested, based on newly-adopted initiative by the respondent's company, is to track and profile two 'volatility'-related aspects:

a) customer ability to understand their own demand (which is reported to range "between 40% and 60%")

   So we apply best behaviour assessment – we record what he tells us and then we go and test it to his actual behaviour. And you can see, some guys are consistently 'overs' or 'unders' or serial whatever's. And then we would in our own planning, adjust that accordingly. [ibid.]

b) company's production ability/output, with particular reference to reliability of processes

   …And then we obviously track our production output. We have a demonstrated capacity and a demonstrated ability, and we would like to hold x amount of weeks of supply. That is kind of how we manage that. [ibid.]

"Industry-leading system for raw material feed"

Because we making product of recycled material and because of the unstable nature of the input, we have created our own system that monitors and feeds the various grades of recycled chips. So as they come we evaluate them, we have got a little test-extruder that extrudes it and we watch it. We have got an entire room that is full of hoppers and there is a control-chap that sits there.

So, we are streets ahead in terms of our raw material feed into the factory – the rest of the industry feeds raw material into buckets and that's about it.

"Complete in-house capability and efficiency – the best of the best"

We have built in-house capabilities, capacity to do our own plant development, our own manufacturing asset development. We have got our own engineering shop which is very fit for purpose. We have got a computer aided design capability, so we have got obviously the electronic capability, but we also have the skills that can put drawings together fairly quickly. And we building engineering capacity, we have the laser cutting machine.

We don't buy anything out, from ovens to moulds. So the problem with that is, I can't go anywhere to find a machine that works for us. We are the best, so for me to go and shop around to try and find a machine to buy does not work for us. So everything is worked out on paper, trial and error, built in-house.

I have developed a few machines and then a few years later I see one of those in another factory, you know. Even moulds or whatever, you will never see us copy another mould, from nobody. We build machines to build the machines, so yes. We don't copy anything... like our ovens – I was all over the world there is no other oven in the world like ours. Nothing, never! Not in Europe, not in America, not in Australia, it is the only ones there.

The only thing that is the same is that they rock and roll, but even that function, ours are totally different - taking it out of the oven to putting it on a turn table… everything is different.

It is all about efficiencies.

"World pioneers of 100 percent recycled…"

Our [product – brand name withheld] is made from 100% recycled material – we're the only [product] manufacturer in the world that has that claim and has it certified. We pioneered the process with SGS, an international certification body – it is extremely difficult to make product out of 100% recycled material. Most other brands do that make products out of recycled material will put in a percentage of virgin to get a stable base. Also, we are 80% post-consumer based, which again is the highest level in the world.

So in terms of innovation, we are ahead of the rest of the world.

"Digital printing on the tube – a world second"

We brought in a tube line a couple of years ago which has. That is only the second one in the world. So we would be second in the world to offer this. We received the Gold Pack Award for Innovation because of that.

"The most advanced multi-colour [four-barrelled] injection moulding machine in the world – as outcome of 'quantum-leap' innovative modification of a standard or base [two-barrelled] machine"

We do dramatic innovation… Take the standard multi-colour injection moulding machine that everybody is using around the world – a 1400-ton clamp machine. It has a massive rotating platen, a four carotene mould… four injection units; either this way or that way. Now we just couldn't afford it. So we hunted around the world bought until we could find somebody who could custom build us a 7,000-ton machine. But it only had two barrels. And how did we get around it? We just built two tools – so we've got a platen here, a platen there and the tools split in the middle and the centre part rotates... because opposing forces cancel one another out. So we should clear this side and move the clear from that side to this side. So ours has also got an injection unit this way and an injection unit that way. So now we have a 700 ton machine doing what a 1400 ton machine does. Now that's heavy innovation, it's a quantum leap… it was a bold decision – so much so that our licensors [when told about our plan for modification] took one look at this and went: "Good luck with that but we're not interested"… the Germans kept telling us – "You will not shoot this thing, you will not get your lighting values out of it". But we got it right! … there it is, running – the most advanced multi-colour injection machine in the world, doing its thing right here in Uitenhage!

Innovation-promoting organisational characteristics and requirements

Strategic visioning and "innovation integration" capability

- *The institutionalising of a distinct innovation strategy separate from but aligned to or integrated with core business strategy is not common practice. For most part, innovative intent is enmeshed with established (mainstream) business principles and practices espousing quality, efficiency/ cost-effectiveness and speed that govern product,*

Technology development capability

- *Fit-for-purpose acquisition based on proper market analysis / intelligence and a business case informed by an organisation-specific requirements assessment or audit, emerged as the agreed on (general consensus) golden rule for guiding technology capability development in support of increased productivity, efficiency and profitability or return on investment.*
- *Whist instances of highly-advanced technology acquisition are in evidence, in general a cautious "we know what is available but for now we wait and see" approach appears to govern the adoption of advanced manufacturing technology.*

Human resources capability

- *Strategic need: "to get the right people in the right places"*
- *Established practice: "If you can't employ the right person in the right position, then you train them into that position"*

Organisational structure and culture

- *The core theme to emerge with regard to the organisational **structure**-competitiveness perceived linkage is that the structure and makeup of a company – regardless of size – should allow for quick and transparent decision-making in responding to business opportunities and resultant product development/innovation process,*
- *Respondents endorse the critical role of organisational **culture** and its values base play in their respective organisations with reference to the positive impact on employee behaviour and, by extension, effective and efficient organisational functioning. Values and principles emphasised in particular are commitment, responsibility, teamwork and interpersonal sensitivities/ respect and caring were highlighted in particular*.

Innovation system

Innovation process

- *The nature or level of creativity governing (new) idea generation and conceptualisation at the innovation initiation phase of product innovation process (radical) could be viewed as the essential element differentiating competitors, given the level playing fields in respect of production / manufacturing capability (quality and efficiency) due to all producers (theoretically) having access to the same technology.*
- *Response-speed in relation to customer request for an initial product design is recognised as a key differentiating or competitive advantage-promoting factor in securing a business opportunity; with an actual sample/prototype trumping a drawing and with (complete) in-house design and technological capabilities as necessary conditions.*
- *"Many people/ companies reportedly get it (very) wrong when quoting on future business, which can lead to the downfall of smaller companies in particular".*

Funding channels for stimulating innovation

- *A much-bemoaned industry (manufacturing generally) trend of clients generally not offering – if not refusing – to compensate suppliers for product development costs incurred. Only two companies reported dedicated budgetary provision being in place in support of innovation-focused research and development as well as inter-divisional collaboration.*

Sales and marketing capability

- *A significant number of long-established SMEs (some who have in the meantime grown into large enterprises) to a significant degree underplay the notion of marketing (by virtue*

of being sales-driven), essentially because of being sustained through reliance on direct trust- and loyalty-based customer/ end-user relationships grown over many years (historical client base)

- *Electronic or internet platforms-based product marketing, though coming at a cost and requiring particular expertise, is advocated by many respondents, the younger generation in particular, as non-negotiable for succeeding in business in the electronically-connected world of today.*
- *Lacking in electronic marketing capability – whether as a result of expertise or financial resource limitations – is fingered as a key contributing factor to the high failure rate among small start-up companies*

Implications for knowledge and skills provision to the sector

Knowledge and skills requirements in relation to occupational groupings

- *The most commonly-highlighted competence shortcoming at operator level does not relate to technical knowledge and skill per se but rather fault-finding and trouble-shooting*
- *A critical scarcity of "good" toolmakers*
- *Scarcity of "quality" maintenance artisans – millwrights / fitters and turners, electricians and plumbers – possessing the appropriate industry-specific technical aptitude, capability and experience is similarly decried; given the rapidly-diminishing pool of "old guard" artisans.*
- *The need for industry-ready pattern makers and laminators emerged as the most immediately sought after functionaries in specialised production environments*
- *Finding suitably-qualified supervisors reportedly is a wide-spread problem, as is the lack of "really strong and competent" engineering professionals entering industry in any significant numbers with reference to senior management positions*

Specific knowledge, skills, aptitude and attitudinal deficits

- *Foundational grounding in language, science and mathematics*
- *Strong critical thinking / problem-solving capacity lacking across all occupational groupings*
- *Cross-over knowledge and skills required with regard to maintenance artisans – with particular reference to SME context*

Ability/ aptitude and attitudinal constraints

- *Aptitude (problem-solving) and attitude (willingness to learn) are viewed as key determinants of successful on-job learning, work performance and progression*

- *Prevalence of a culture of entitlement and excessively unrealistic expectations in relation to career advancement and material gain*
- *With reference to a reported tendency of negative attitudes to work/job, once secured; the need for instilling a "work-and-values" culture among job entrants was highlighted*

Respondent recommendations for strengthening the sector

For companies and the sector to become more competitive (internationally) essentially requires:

- *Instilling of passion and mind-set for design and innovation*
- *Putting in place the necessary systems for promoting innovation*
- *Support from government, which is not sufficiently forthcoming at this time*

"Industry big picture"–derived integrated strategy for driving broad-based collaborative approach to common problems and opportunities

- *The putting place of a neutral structure / body ('broker') for bringing together all stakeholders to make the sector healthy and competitive – on the basis of an integrated strategy to promote a collaborative approach to common problems as well as opportunities*

Value-chain based Cluster Model for industry strengthening

Provision by industry

- *Plastics SA should team up with merSETA and the government and do basic plastics training, 50 people at a time – who have first been assessed with regard to aptitude and willingness to learn. This initiative could either be fully-funded by government or on completion of their training, after assessed as competent and industry-ready, such trainees could be pooled, from where theybe hired out to industry (R10,000?)*
- *As key industry player, SASOL should revive its training provision role and infrastructure for training provision to the industry at large*

Overall discussion, recommendations and conclusion

Overall discussion

In terms of the overall research focus, the investigative intent was to uncover what the empirical evidence – established culture and practice – ultimately says about the essence of innovation (capability) as a force of change and fortune the plastics industry environment. In

the answer to this central question lie the seeds required for strengthening and growing a "distressed" plastics industry sector.

It became clear, repeatedly and emphatically so, that all the latest and best technology in the world cannot in and of itself ensure differentiation or competitive advantage and market position achievement as outcome (though it may certainly aid in this) as everyone can obtain (theoretically at least) such means. Differentiation is achieved through the "clever" use of such means, which is dependent on the 'quality' and veracity of (an organisation's capacity for) creativity displayed in respect conceptualisation and design and attendant implementation efficiency in relation to product, service or process innovation or "creating" – on a for-profit basis and market (segment) demand-aligned basis. In a strict radical innovation sense, product innovation assumes an engineered product, in relation to which plastic may or may not be used as preferred material (if the case, then a grounding in materials science naturally is a prerequisite).

As a theoretical construct, organisational innovation capability is the synergistic or holistic outcome of the integration of various key organisational capabilities or elements and expressed in terms of competitive advantage-enabling innovation performance, as measured (in the strict sense) in relation to propriety products and patents delivered. But such products in and of themselves cannot guarantee market position – a necessary condition for which is consistency of supply or service (requisite quality assumed); on time-in full, every time. As such, competitive advantage is assured through the dynamic interplay or integration of the creativity of the innovation stream and quality, efficiency, flexibility and speed as attributes of the business mainstream.

Of the sampled companies clearly on the top of their game, whether convertor or compounder or recycler; what they all have in common is the successful execution of the above recipe for success. In essence, this boils down to the institutionalisation of innovation capability and culture on an organisation-wide basis, as expressed in the dynamic and finely-balanced integration of entrepreneurial flair (natural inquisitiveness, never-say-die attitude and creative problem-solving) as driver of innovative conceptualisation and design with sound business or corporate principles and practices – an 'ambidextrous' organisational orientation to doing business involving a happy marriage of new-/ innovation-stream and mainstream dimensions.

Overall recommendations

Overall recommendations for sectorial strengthening are aligned to the above "essentialist" or dynamic capabilities-focused analysis and interpretation of empirical data concerning the characteristics of highly innovative and strongly competitive companies. It will assume the format of Theory of Change for addressing the sectorial need for strengthening.

Problem statement:

- For the majority of manufacturing companies embedded in the plastics industry – across all size and process-methodology categories – surviving, never mind thriving, at this time constitutes an ongoing struggle against considerable challenges.
- Some of these are of their own making (whether strategic or resource related) whilst others stem from factors in the broader environment over which they have no control but have to respond to in adaptive (innovative) ways to remain sustainable, first and foremost, and competitive.
- In all, the plastics sector at this time finds itself in a state of distress (as is the case with other industry sectors); as evidenced in particular by the high failure rate of small, and to a certain degree medium-sized companies – not just start-up companies but also long-established "third or fourth generation" enterprises.

Remedial Objective:

To instil or strengthen innovation culture and capability in struggling companies in the South African plastics industry sector in order to be (become) more sustainable and competitive in increasingly tough local, regional and global markets.

Theory (assumptions) of Change:

IF struggling or 'not-sufficiently' competitive companies (SMEs):	***IF, at sector level:***
Assess ("soul search") – supported by industry change management experts – their current strategic orientation to and capacity strengths and weaknesses (including R&D) with regard to being able to "innovatively" play in the market *and* Implement the identified organisational changes required for bolstering organisation-wide innovation capability *and* Remain committed to the path set through such re-focusing and reinvention *and* Receive the required external support and assistance from government and other relevant sectorial stakeholders	All value chain constituencies as well as all other relevant industry stakeholders come together in the spirit of collaboration and support – under widely-supported leadership – for a strategic review or 'diagnosis' of sectorial health and well-being, with a particular focus on SME support requirements *and* The debated and agreed-on vision or "prescription" for sectorial strengthening is translated into an integrated Sectorial Strategy and Plan; *and* Stakeholder role and responsibility allocation is clearly stipulated and agreed on and resource provision adequately quantified *and* A framework for monitoring and evaluation of strategy implementation is developed and enacted

	and Knowledge-rich networking and collaboration is enacted, with a strong focus on research
THEN Previously-vulnerable or underperforming companies will have the internal capacity to respond creatively (innovatively!) and efficiently to both opportunities and challenges on their path	***THEN*** Sectorial challenges and opportunities can be responded to and addressed in nuanced (innovative!), effective and sustainable ways
AND THEN Convertors, compounders and recyclers will boast innovation capabilities allowing them to successfully compete and flourish in the market (local, national and international contexts), which translates into a robust and thriving plastics industry sector	

Conclusion

The overall purpose of this investigation was to establish how innovation is situated and plays out – its nature and dynamics as embedded at company level – in the plastics industry and the implications for support, human resources in particular, so as to develop or strengthen overall sectorial innovation capability.

At the end of a long process of discovery and analysis the researcher has reached the same overall conclusion as embedded in a respondent statement in the previous section concerning sectorial strengthening and, which indeed also appears to be a view held by the CEO of Plastics SA: that the only way to remedy the currently distressed plastics industry (by and large) is through “more” and “better” innovation on an industry-wide, company-by-company basis. “Better” in this case relates to product innovation of the discontinuous or radical kind – assuming that systemic constraints would be resolved (for most part, at least).

In this view, innovation culture or capability clearly translates into a human resource issue; in particular, the mind-set or perspective and attitudinal change required to embrace the creativity-driven innovation challenge together with organisational change invariably required – instead of remaining on a pre-set, efficiency-focused and safe business pathway not always leading to differentiation.

INTRODUCTION

Today, almost all manufacturing organisations are faced with a dynamic environment characterized by rapid technological change, shortening product life cycles, and globalization. It is apparent that organisations, especially technology-driven ones, operating in this kind of a market environment need to be more creative and innovative to survive, to compete, to grow, and to lead. Innovation through creativity is essential for the success and competitive advantage of organisations as well as for strong economies in the 21st century. (Gumusluoglu and Ilsev, 2009. Citing: Mumford and Gustafson, 1988).

Throughout the 1980s and 1990s, managers and organisations faced operational challenges affecting their very existence. High quality, value-added imports were challenging the traditional dominance of Western industries in areas such as automotive, electrical and semiconductors. Initially hesitant to recognise and react to the significant changes occurring in their marketplaces, these organisations eventually responded spending much of the 1990s rationalising to core businesses, delayering, outsourcing and reengineering for productivity. During this period, competitive advantage rested variously on mainstream variables like efficiency, quality, customer responsiveness and speed.

In the new millennium, control over the above variables represents the minimum threshold to "play the game". While each factor remains important, it is unlikely of itself or as part of a group to provide a sustainable competitive advantage. Constantly decreasing product life cycles and short cycle times mean market leadership can be lost within a short period. Current achievements are therefore not to be relied on to carry organisations into the complex, competitive future. Accordingly, organisations of today are required to innovate, not just occasionally but often, quickly and with a solid success rate. The winners will be the innovators with bold thinking and strategic management abilities, oriented to change. (Lawson and Samson, 2001; Poškienė, 2006).

Thus, innovation represents today's competitive advantage, supported by strong mainstream capabilities in quality, efficiency, speed and flexibility. This view of the world points to a need for managers to coordinate daily mainstream operations, while also cultivating innovation and change within their companies.

It is against this backdrop and with particular reference to the sad plastics industry reality of a high failure rate among small to medium-sized entry-level or start-up companies but also increasingly among more long-established companies that this research project, a qualitative study, was conducted. It follows but is not directly linked to a three-phased research initiative on the part of the merSETA's Plastics Chamber that occurred between 2011 and 2014.

The overall stated purpose of the research on the part of the merSETA Plastics Chamber was to explore the skills and knowledge related or linked to innovative practices in order to grow the Plastics industry sector in South Africa; in the context of a futures-orientation linked to advanced manufacturing principles and technology. Towards this end, the two broad areas of investigation were framed as follows:

- What particular capacities or capabilities and attributes are required and what other broader contextual conditions must be satisfied in order for South African plastics industry-embedded manufacturing or service-orientated organisations to be sustainable and compete successfully in the market place, both locally and globally?;
- What are the implications for appropriate knowledge and skills provision to the plastics industry-specific occupational and professional groupings in relation to sectoral growth and strengthening (increased sustainability and competitiveness)?

The report is structured as follows:

Section 1 presents a brief review of literature on innovation which clarifies core innovation concepts as they relate to the research purpose and objectives and as such providing the basis for the conceptual and methodological frames, which will also be explained.

As Section 2 presents a brief overview of current salient aspects of the plastics industry, as contextual backdrop for presentation of findings, which is the focus of Section 3. It comprises the following sub-sections:

Section 4 contains respondent recommendations for company and sector strengthening. Finally, Section 5 presents an overall discussion, recommendations and conclusion.

It is hoped that the findings emerging from this study and their implications for remedial intervention will indeed contribute to the overall goal of plastics industry sector strengthening into the future, company by company.

SECTION 1:
CONCEPTS AND METHODS

1.1 Conceptual framework

The key concepts presented here is derived from a comprehensive review of literature (Garisch, 2016) which informed both the investigative and analytical frameworks. Chief among them are innovation-as-process, innovation capability, innovation performance, and competitive advantage.

1.1.1 Innovation in a manufacturing context

Innovation has been conceptualized in many different ways. In 1934 Schumpeter captured the essence of innovations by defining it as being at the heart of the entrepreneurial role, "creating of a linkage between new ideas and markets – new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business".

A selection of definitions from the literature convey successive formulations of innovation:

- *The generation (development) or adoption (use) of new ideas or behaviours… innovation results in the implementation of a product, service, technology, or practice new to the adopting organisation.* (Damanpour, 2012: 426)
- *Innovations constitute an indispensable component of the corporate strategies for several reasons, such as: to apply more productive manufacturing processes, to perform better in the market, to seek positive reputation in customers' perception and as a result to gain sustainable competitive advantage.* (Gunday, 2011: 2)
- *Innovation is a course which, from decision to decision, will lead you to the right market with the right product at the right time.* (Akrich, 2002: 193)
- *The implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. (OECD, 2005).*
- *Innovation is a process that links together regional knowledge, assets and networks to transform ideas, insights and inventions into new processes, products and services that capture global market share*". (Council for Competitiveness, 2005)

1.1.2 Nature of innovation

Radical innovation relate to those innovations that are ground-breaking, disruptive, creating discontinuity, and changing the status quo. It involves two dimensions: a technical dimension which indicates a significant leap in technological development and a social dimension which indicates the potential for entirely new features and improvement. *Incremental* innovations, on the other hand, refine and improve the existing conditions, are adaptive and rely on current knowledge and areas of expertise,

Exploratory innovations require a more radical departure from the established norms and routines and help firms enter a new product-market domain. Firms engaged in radical innovation tend to focus on exploration, flexibility-enhancing, and adaptive activities. *Exploitative* innovations, on the other hand, help firms improve their existing product-market positions. Firms engaged in incremental innovation tend to focus on exploitative, efficient, and aligning activities.

1.1.3 Types of innovation

A *product innovation* involves the introduction of a good or service that is new or significantly improved regarding its characteristics or intended uses; including significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. The term product covers both goods and services. Product innovation is a difficult process driven by advancing technologies, changing customer needs, shortening product life cycles, and increasing global competition. For success, it must involve strong interaction within the firm and further between the firm and its customers and suppliers.

A *process innovation*, on the other hand, concerns the implementation of a new or significantly-improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products.

A *marketing innovation* involves the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are targeted at addressing customer needs better, opening up new markets, or newly positioning a firm's product on the market with the intention of increasing sales. These innovations are strongly related to *pricing* strategies, *product package* design properties, and product *placement* and *promotion* activities – along the lines of "four Ps" of marketing.

Finally, *organisational innovation* relates to the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations. Organisational innovations increase firm performance by reducing administrative and transaction costs, improving workplace satisfaction and thus labour productivity, gaining access to non-tradable assets such as non-codified external knowledge or reducing costs of supplies. As organisational innovation-related aspects are essentially "management" in kind, *managerial innovation* is often used as substitute for organisational innovation as organisational innovations are strongly related with all the administrative efforts of renewing the organisational routines, procedures, mechanisms, systems etc. to promote teamwork, information sharing, coordination, collaboration, learning, and innovativeness. In these regards, a critical aspect addressed by De Leede and Looise (2005) is that of innovation-supporting human resource management (HRM) – the importance of linking human resource management (HRM) with business management and, in particular, the linkage between organisation strategy and HRM.

1.1.4 Innovation-as-process

Innovation in organisations has been conceived both as a discrete outcome and as a process. Studies of innovation as outcome mainly explore external and internal organisational conditions under which an organisation innovates. By contrast, Baregheh et al. (2009)[2] put forward the following definition in terms of which innovation is conceived as:

> *… the multi-stage process whereby organisations transform ideas into new/ improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.*

Flynn and Chatman (2004) similarly define innovations as the combination of the two processes of: a) *creativity*, or the *generation of new ideas*; and, b) *implementation*, or the actual introduction of the change and eventual commercialisation. They emphasise that these two phases may overlap substantially and should not be conceived as distinct occurrences or sequential stages in the innovation process.

Dubrin (1984) defines the ***creativity*** as:

> *…the ability to process information in such a way that the result is original and meaningful; it is the combined influence and effort of people with creative potential working in an environment that encourages creativity*.

[2] Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management decision*, *47*(8), 1323-1339.

1.1.5 (Organisational) innovation capability and competitive advantage

The literature points that innovation as source of competitive advantage, is commonly misconceived as essentially or only being about firms possessing or developing technological capabilities. Zawislak et al (2012: 14), amongst many other researchers, are quick to point out the fallacy of such a restrictive view of organisational innovation capability by drawing attention to the contrary: Why not are all firms that invest on their technological capability innovative?; or, Why do other firms that do not invest so much in that display strong innovative performance? Organisational innovation capability quite clearly is something far more complex or multifaceted than simply being technologically capable. After all, to exist or survive and to thrive, every firm must have some specific capabilities in order to identify market gaps to be filled with new offerings of value. However, there is no agreement on what are the capabilities that ensure survival and superior performance, nor a consensus on the ultimate definition of innovation capability.

Chang et al. (2002: 442-444) conceive innovation capability in relation to the comprehensive set of characteristics of an organisation that facilitate innovations by enabling firms to recognize, seek out, learn, organize, apply and commercialize innovative new ideas, processes, products and services.

Empirical evidence obtained by these authors suggest that a firm's ability to search (openness capability), plan (strategic integration capability), tolerate (autonomy capability) and commercialize (experimentation capability) were significantly and positively correlated with the radical innovation performance. Towards this end, an autonomous organisational climate and a culture that supports and tolerates radical innovation is, by implication, a necessary condition.

Zawislak et al. conceive innovation capability as the synergistic outcome of both the technological learning process by the firm translated into technology development and operations capabilities as well as the managerial and transactional routines represented by the management and transaction capabilities. The integration or interplay of these four capabilities effectively promotes innovation, which creates competitive advantages.

In similar vein, the construct of innovation capability is proposed by Lawson and Samson (2001) as a higher-order integration capability – the ability (or not) of a firm to integrate key capabilities and resources to successfully stimulate innovation. Accordingly, they contend that successful innovation contains core elements and processes, regardless of the industry or firm. Furthermore, viewing innovation as "representing today's competitive advantage" and characterising innovation as "a force of instability, often requiring long-term vision and commitment to yield results", innovation is conceived as the dynamic interplay of: the

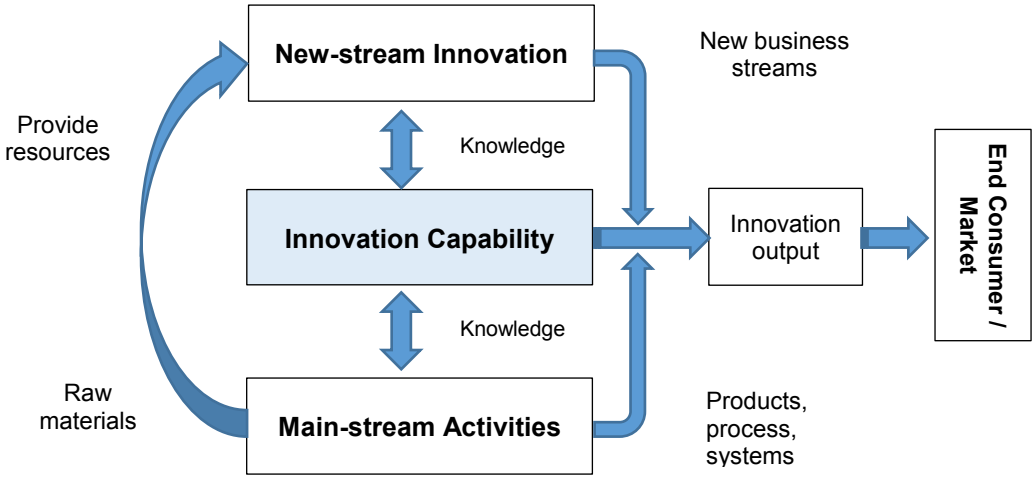
"uncertain and dynamic environment of the innovation new-stream – comprising "all the resources possessed by the organisation that are devoted to identifying and creating new value for customers" and which "leverages knowledge to develop the new products, processes and systems (that will underlie future success); and strong mainstream capabilities in quality, efficiency, speed and flexibility

Research and development, incremental mainstream investment programs and organisational systems all contribute to the innovation newstream. The newstream is powered by the innovation capability which "enables it to act like a funnel seeking, locating and developing potential innovations that can be transferred into the mainstream". It is emphasised that innovation capability itself should *not be viewed as a separately identifiable construct* – it is composed of practices and processes for stimulating, measuring and reinforcing innovation and therefore represents a key mechanism for self-renewal within the organisation and its products as it brings together the efficiency of the mainstream with the creativity of the newstream.

However, the mainstream of the business remains critical as it represents the firm's *interface* with customers and the market. It is not enough for a company to be highly innovative. There must be controls and management practices in place that allow it to *manage* the *tensions* of growth and innovation versus control. For this reason, a balance between mainstream and newstream *resources* is required for optimal performance outcomes.

The above is captured in the following diagram.

Figure 1: An integrated model of innovation capability.



(Source: Lawson and Samson, 2001: 383)

As in time the ability of the mainstream to fulfil customer demands will decline as competition intensifies and the product line ages. Constantly decreasing product life cycles and short cycle

times mean market leadership can be lost within a short period. The mainstream will therefore invest in the innovation new-stream to create the new products, markets, technologies and businesses of the future because, ultimately, it is the need to produce real products, on time and on budget that ultimately drive the success of a business.

IN ALL:

The stronger the innovation capability possessed by a firm, the more effective will be their innovation performance, which in turn is positively linked to enhanced firm or economic performance. NESTA has estimated that 63 percent of productivity growth in the UK in the period 2000-2008 stemmed either directly or indirectly from innovation (NESTA, 2014). Previous research has shown that innovative businesses grow twice as quickly as non-innovative ones (Mason et al, 2009) and are more profitable and valued at a premium by the share market relative to their less innovative counterparts. (Gunday et al, 2011).

That said, recent research at the level of the firm has shown that there is not a straightforward relationship between innovation and growth because the latter is episodic and depends on capturing the value of innovation as well as creating new products and processes (Coad et al, 2014). A combination of factors is commonly associated with business growth and competitiveness, including innovative products and processes, engagement in R&D, export performance, human capital and the supply chain.

1.2 Design and methodology

1.2.1 Design

In view of the research remit for an in-depth exploration of the skills and knowledge needs linked to innovative practices in order to grow the plastics industry sector in South Africa, a qualitative research approach was decided on as best fit, with semi-structured interviews or "conversations with purpose" as data collection method.

As a first phase, an extensive literature review was conducted (Garisch, 2016) for conceptualizing both investigative and analytical frameworks. This was followed by instrument design around the key themes and questions arrived at – as captured in the interview guide which is attached as Appendix 1.

The project team leader, Ms Kirtida Bhana of Plastic SA, issued a formal invitation to companies to participate in the study, which was followed up by the managers of the three provincial Plastics SA head offices covering Eastern and Western Cape (combined), Gauteng, and Kwazulu-Natal. The latter approach was decided on due to the short window of opportunity available for soliciting participation – that is, instead of the researcher undertaking

this task in a 'cold-calling' manner. Even so, soliciting of participation proved more difficult than expected. Whilst some companies were from the outset willing if not keen to participate, others initially proved more reticent for reasons of initial suspicion about the "research agenda" or assuming discussion might be to invasive in focus with regard to technical aspects ("trade secret"). Once such initial concerns were appropriately addressed, resistance generally waned. However, some companies either did not respond to invitations at all or pulled out close to the time of scheduled interviews on a pretext of one kind or another. At the time the researcher did wonder to what extent the dynamics observed in these regards were representative of broader sector dynamics in relation to collaboration, information sharing, collegiality and so forth.

1.2.2 Data collection and analysis

Given the focus of this project, the ideal scenario envisaged in respect of respondent selection was to request companies, with particular reference to medium and large companies, to nominate as many a possible representatives who could engage associated with company innovation processes in one way or another to participate in interviews. Due to the constricts of time, small group interviews were decided on in cases where but invariably these numbers were in many cases not due to production and other immediate demands on the days of interviews being conducted.).

A semi-structured interview schedule, as noted, was used to guide data collection but also to give respondents the freedom to express themselves. Accordingly, the interviews were conducted in a conversational manner to allow respondents to feel comfortable and to elaborate on issues allowing for additional issues to be raised and explored. All participants were informed of the ethical considerations as well as given an opportunity to ask questions around the project, before commencement. For accuracy purposes, interviews were recorded and transcribed verbatim.

Though the interviews were designed to last between forty-five to sixty minutes; however the majority of interviews ended up lasting between and sixty and ninety minutes, with a few interviews approaching the two-hours mark. In cases where time 'overruns' occurred, it was because of the fact (trend) once respondents got into 'deep' reflection mode, the natural inclination was to pursue the conversation till 'all of possible relevance was said' – that is, when immediate time constraints did not dictate otherwise

Qualitative data analysis is the process of moving from data (primary or secondary) to evidence-based interpretations; and eventually to findings. The challenge of qualitative data analysis is enormous – to make meaning of usually large volumes of data and then to communicate the essence of what the data reveal in a clear and unambiguous manner. The

validity and reliability of the findings from the abstract processes of analysis is heavily dependent on the skills and experience of the analyst.

The data analysis process starts off by labelling segments of text (in the transcripts of interviews) that relate to the key areas (key research questions), which generally become the coding categories. A coding category can be broken down into a smaller number of segments – the "codes", also referred to as deductive codes – to reflect a more refined and detailed representation of the meaning of the text. However, a coding category may also emerge from the data itself; that is, a category not defined as a Key Area prior to the analysis. The associated codes are known as inductive codes. Coding categories (linked to particular key research questions) are then grouped together into a higher-level category or theme. Altogether, these coding levels will become the basis for reporting – in relation to a particular theme, the coding categories represent the 'findings' and the associated codes the 'evidence'.

The coding process consisted of two cycles of manual coding of transcripts and involved both pre-set and emergent codes.

1.2.3 Sample description

In the end, 40 companies participated in the research, translating into 79 company representatives-as-respondents. Their provincial spread of participating companies (associated with Plastic SA office presence) is as follows:

Table 1: Geographical and spatial distribution of companies

Provincial distribution	Spatial distribution			Total
	Urban	*Peri-urban*	*Rural*	
Eastern Cape	4	1		**5**
Gauteng	13		1	**14**
KwaZulu-Natal	10			**10**
Western Cape	11			**11**
Total	**38**	**1**	**1**	**40**

Individual company representatives spanned the following job title/ designation categories:

Table 2: Company representative distribution in terms of job titles

Respondent job title/ designation	Number
CEO	4
Managing director	8
Owner/ founding director	4
Director	3

Change management consultant	1
Commercial director	1
Managing member	5
General Manager	3
Sales executive/ director/ manager	3
Design executive	1
Technical director	4
Senior manager	2
Factory / production / operations manager	8
Financial manager	3
Quality manager	7
Marketing manager	1
Works manager	1
Product director / manager	2
Project manager	1
Senior researcher	2
Laboratory manager	1
Site services manager	1
HR manager	5
Logistic manager	1
Training manager	1
Training administrator	1
Skills development facilitator	1
Senior technologist	1
Laboratory technician	1
Senior technician	1
SHEQ supervisor	1
Total	**97**

Company distribution in terms of size (number of employees) size sees an even distribution across all three categories:[3]

Table 3: Company distribution in relation to size (employees)

Spatial distribution			**Total**
Small	*Medium*	*Large*	
12	13	15	**40**

Injection moulding and 'derivatives' (injection blow, stretch, etc. moulding) represents the core manufacturing process most prevalent among sampled companies, followed by extrusion (11 – film-sheeting, bagging and piping), recycling (3), rotational moulding (2) and compounding

[3] Department of Labour classification criteria used, that is: micro/small – 1 to 49 employees, medium – 50 to 149 employees, and large – above150 employees.

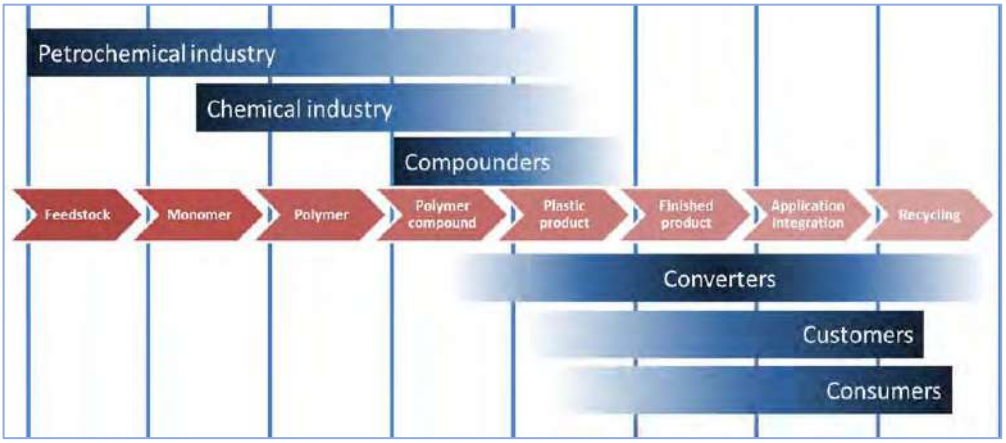
(1). Other methodologies included secondary manufacturing/ fabrication (2), (independent) testing (2) and materials research and development (1).

The overwhelming majority of companies (34) have been in existence for more than 10 years whilst six companies are fairly recent market entrants having been established in the last five years.

PART TWO

Contextual overview: The South African plastics industry[4]

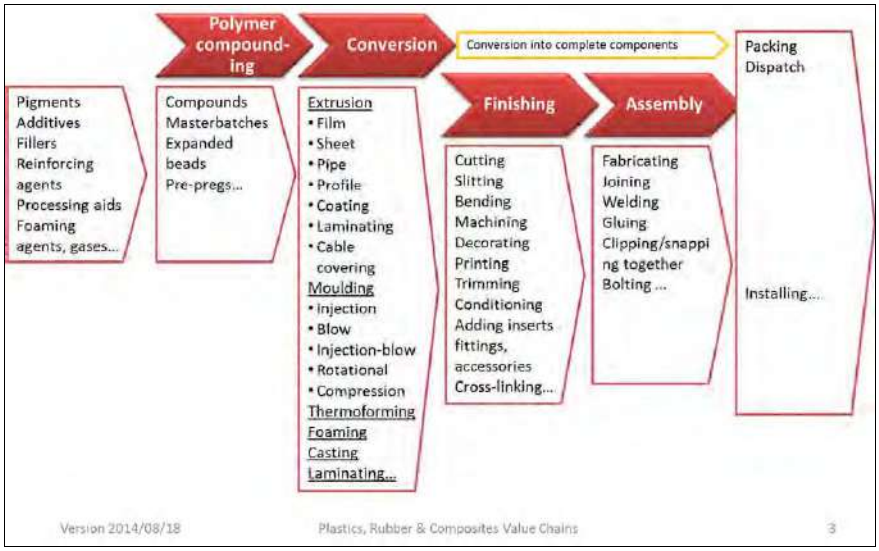
Figure 2: Plastics, rubber and composites value chains



Process value chain

The diagram below reflects a typical ***process value chain*** (manufacturing methods/ processes) in the plastics industry. The values add activities are mainly in the areas of finishing and assembly. The conversion process is mainly a high volume, low margin process. The diagram depicts the various materials, processes and activities taking place in each node.

Figure 3: Generalised plastics value chain



Source: Vorwerk and Farquahson, 2014

[4] Unless otherwise indicated, information in this sub-section is extracted from Vorwerk & Farquahson, 2013.

Some plastic products are in themselves a final product, but the vast majority are inputs into other industries where they form components for the manufacture and assembly of other products.

Size of the local industry

South Africa's plastics industry is the largest of its kind in Africa and converts 1.49 million tons of both locally produced and imported polymers. It is dominated by the packaging industry which accounts for 53% of the local market followed by building and construction at 13% and agriculture at 8.9%. The upstream sector is focused on the production of various polymers. The main feedstock for the polymer production is natural gas and coal by Sasol Ltd – the country's foremost polymer producer. Fluctuations in the price of gas and coal have a direct effect on the cost of production of downstream products.

In global terms, the South African plastics industry is significantly small – less than 0,5% – and because of this, local companies operating in the plastics sector have no influence on the global prices and they cannot pass on the fluctuations of input costs to the end user.

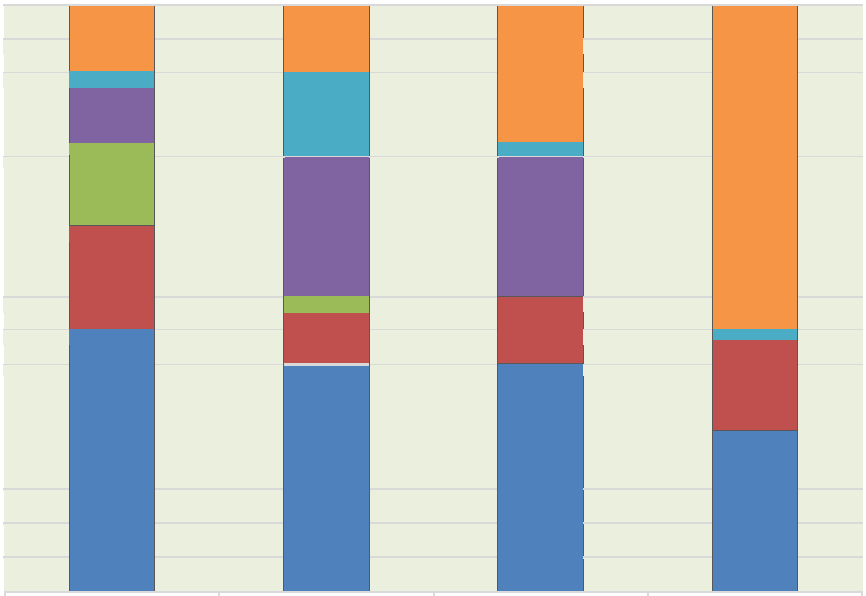
Plastics Converting Industry

It is estimated that there are about 1 800 plastics converters operating in South Africa. These vary from small, micro organisations, medium, large, up to very large international corporates. Some of the raw material suppliers are of the opinion that the era of large corporate businesses has come to an end and that the future of the plastics industry will be based on smaller entrepreneurial businesses.

Despite expectations of some growth in the usage of plastics products and plastics packaging in the next five years, trends suggest that the sector is not using its full potential as a manufacturing sector in Southern Africa.

Market Sectors

The plastics converting industry manufactures components for a wide variety of market sectors. The segments are based on polymer consumption, i.e. tonnages. It is not representative of the value of the plastic components. One ton of plastics in the engineering market sector is worth much more as one ton in the flexible packaging market. Both offer, however, essential properties for its application area. Only products manufactured in South Africa are included. Imported finished products are not included.



	South Africa 2015	Europe 2013	Australia 2008	USA 2014
Other	14,5	21,7	25,0	46,0
Automotive & Transport	4,2	8,5	5,0	4,0
Electrical & Electronics	6,3	5,6	7,0	
Agriculture	8,9	4,3		
Building & Construction	13,0	20,3	26,0	16,0
Packaging	53,1	39,6	37,0	34,0

Source: Plastics SA, May 2016

The top four markets for plastics in South Africa are packaging, building & construction, agriculture and electrical & electronics. If compared internationally, the South African packaging sector is much more dominant than in Europe, Australia or in the USA.

In Europe, packaging makes up 39.6 percent of their domestic consumption, building & construction 20.3 percent automotive 8.5 percent and electrical and electronics 5.6 percent

Packaging is also the largest market sector (37 percent) in Australia2, with building & construction second at 26 percent, electrical & electronics 7 percent, and automotive 5 percent.

The American Chemistry Council also reported packaging as their largest sector at 34 percent, building & construction second with 16 percent and automotive and transport third with 4 percent.

The previous market sector study was conducted in 2011 and some sectors shifted. The current data collection method was thorough and back-up data has been obtained for a minimum of 75 percent of the domestic virgin polymer production of 2015.

Table 4: Market sectors for local polymer converted in 2015, 2012 and 2000 – based on tonnages

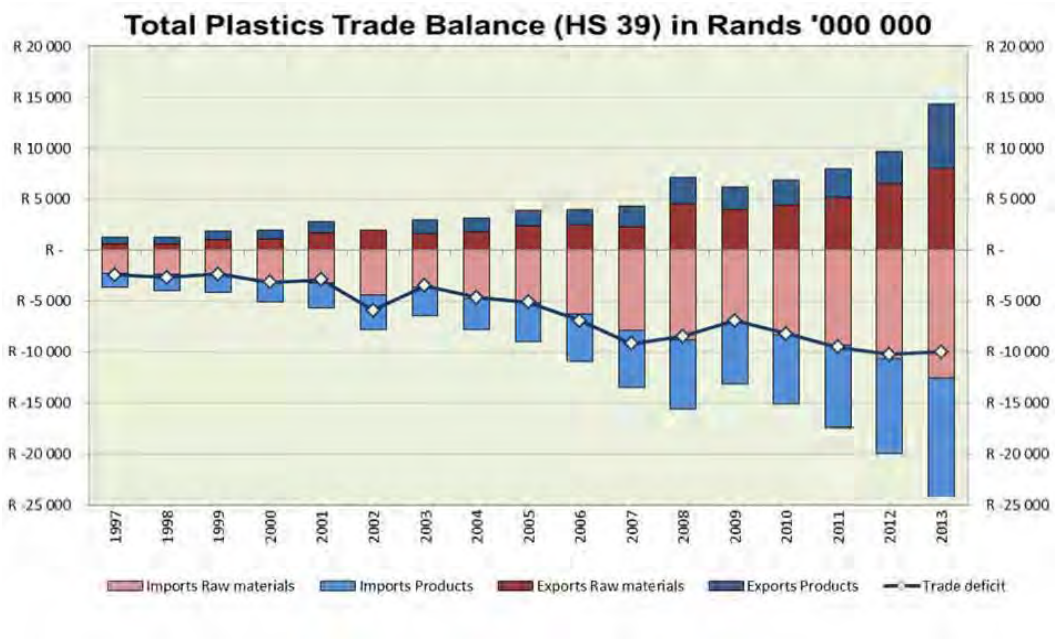
	Representation in 2015 %	Tonnages in 2015	Change in ranking since 2011	Representation in 2011 %	Tonnages in 2011	Representation in 2000 %
Rigid Packaging	29,7%	443 212	↔	28,7%	372 947	25%
Flexible Packaging	23,3%	348 128	↔	25,8%	335 649	27%
Building & Construction	13,0%	194 438	↔	15,3%	199 053	7%
Agriculture	8,9%	133 379		4,0%	52 011	4%
Electrical & Electronics	6,3%	93 641	↓	5,8%	75 114	6%
Automotive & Transport	4,2%	62 572	↓	5,5%	71 054	4%
Housewares	3,9%	58 258		2,8%	36 522	2%
Mining & Engineering	3,6%	53 076	↓↓	4,8%	62 521	4%
Furniture	2,7%	40 121	↔	2,5%	32 096	2%
Other	2,0%	29 821		1,2%	15 322	11%
Medical	1,0%	15 279	↓	1,8%	22 810	4%
Clothing & Footwear	0,8%	12 084	↔	1,1%	14 561	2%
Sport & Leisure	0,5%	6 976	↔	0,8%	10 341	2%
Total	100,0%	1 490 985		100,0%	1 300 000	100%

Source: Plastics SA, May 2016

Trade

The total trade deficit for plastics in 2013 amounts to just over R10 billion. This is money that could have added value to the local industry. If added, it would have added 0.3 % to the GDP. Serious programmes are needed to reduce this deficit and a successful beneficiation programme could achieve exactly that.

The trade deficit for polymers alone was 75 482 tons which was 36% less than in 2012. This deficit amounted to R4 456 million which was 8.7% more than the previous year. This illustrates the reduced value of the Rand from 2012 to 2013. The exchange rate is a vital part of the performance of the local industry. Most of the additives (auxiliary chemicals) required are imported. The raw materials used to manufacture engineering and medical components are imported as well. The industry should embrace the poor currency and export finish and beneficiated products, but the higher import costs of some critical raw materials and the volatility of the exchange rate hamper export development.



Growth in the Plastics Sector

An overall growth in polymer production of 28.7% was experienced in the last 10 years, despite the international economic down turn in the last decade.

Growth forecasts for the plastics and rubber industry are very variable and depend largely on the performance of the sectors which use their products. As such, the market growth for plastics is a factor of the overall growth in the economy.

The Plastics Industry appears to have grown quite consistently over the last five years, despite the impact of the global financial meltdown in 2008. The industry consumption of virgin raw material has grown by 2.2% and the use of recycled raw material has grown by 2.7% in 2013.

Raw materials

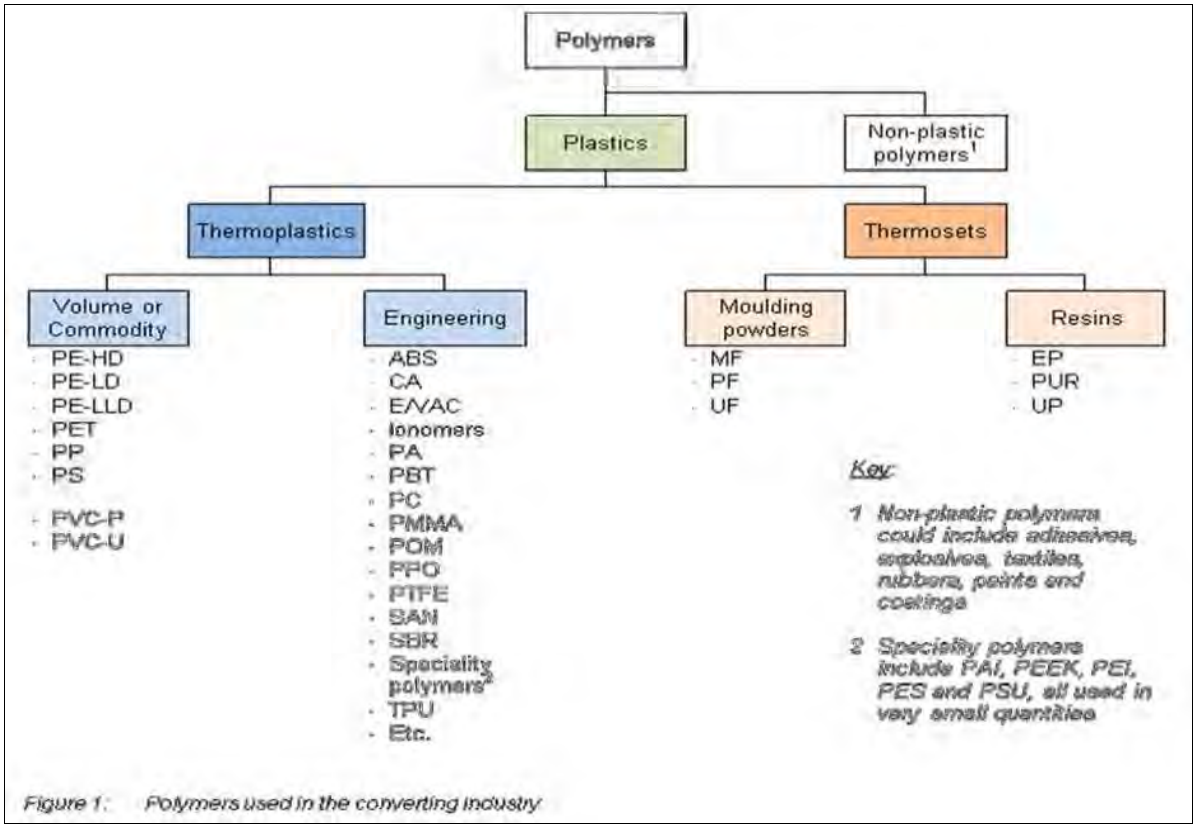
Raw materials used in the plastics industry include polymers in its pure format and modified polymers used as compounds, blends and alloys. Additives would also form part of the raw materials and can be used in its pure state or as master batch. This section is focussing on the polymers only.

More than 30 different materials are used by the converting industry to manufacture a whole range of products, from single use packaging items to engineering components designed to last thirty or more years. Most of the commodity polymers are produced in South Africa.

Figure 4 indicates the various plastics used in the converting industry. Most of the volume or commodity polymers are produced in South Africa except for PS. Most of the local production of plastics raw material is utilized or converted in South Africa into products. The following

volume or commodity polymers are produced in South Africa where downstream beneficiation could take place:

Figure 4: Polymers used in the converting industry



Polymer Beneficiation (Downstream)

South Africa faces an enormous challenge of diversifying away from resource extraction towards value added manufacturing that will create jobs. This position seeks to ensure more value is added to domestic polymer products before export, so as to generate greater economic value and the creating of employment.

Polypropylene, PVC and composite beneficiation has been identified by government as key pillars of South Africa's industrialization push.

The plastics sector is in many ways representative of the diversified manufacturing industry in which growth is necessary as part of broader-based economic development. The manufacture of plastic products is not ultra-labour intensive, but it is labour absorbing. It is not ultra-capital-intensive but requires investment in the appropriate, relatively sophisticated, machinery and moulds if world-class products are to be made with the design and characteristics consumers expect. As such, it requires bringing together a set of production

capabilities, along with ensuring the basic conditions are in place such as competitively priced inputs, access to finance and the ability to source appropriate machinery and moulds.

Research and comparisons worldwide indicate that the plastics sector is one of the engines of growth under industrialization.

Key Opportunities

- automotive sector
- food packaging
- medical products
- construction – pipes, flooring, building sheets, window and door frames
- electrical and electronic cables, appliances and casing components
- recycling
- composites

(This is not meant to be a comprehensive list)

The integration of plastics products with the initiatives of other sectors and cross cutting areas are critical and could result in specific beneficiation programmes.

Some of the advantages of the South African plastics industry are:

- Sufficient and cost competitive propylene feedstock
- Owner driven small and medium businesses with entrepreneurial spirits
- Globally competitive polymer production technology and facilities
- Industry location relative to the Southern African markets
- Well-developed downstream converter sector with widespread end-product applications
- Large automotive sector

Cross-cutting constraints to beneficiation

- Infrastructure – shortages of critical infrastructure such as rail, water, ports and electricity supply have a material impact on sustaining current beneficiation initiatives and a major threat to future prospects of growth in the chemical value addition
- Research and development
- Skills sought for expediting local beneficiation
- Access to international markets for beneficiated products

Key barriers to growth in the plastics sector

- Customised incentive programmes for the industry needed
- Cost of input material
- Preferential procurement not assisting plastics industry
- Compliance cost – creates uneven playing field with international competitors
- Specifications used as protectionism – (e.g. local plastics no specified in APDP)
- Trade agreements – not supporting local manufacturers
- Cost of labour
- Productivity – unable to compete internationally
- Cost of electricity and reliability of electricity supply
- Skills shortage – technologists/technical management
- Innovation
- Limited research and development
- Strong rand undermines competitiveness
- Limited level of export readiness
- Strong competition from imports and economic crises
- The slow pace of technological upgrading
- Shortage of infrastructure and logistics costs
- No or limited machine manufacturers in South Africa
- Tooling sector weak in South Africa and mainly maintenance orientated
- Relatively small local and regional market
- Long distance from attractive export markets
- Inland location of production facilities in the case of exports
- Develop special economic zones for manufacturing beneficiation that are, for example, duty-free, VAT-free and have tailor-made infrastructure

Plastics Sector Imperatives

- Grow the plastics sector
- Diversify the plastics sector
- Promote labour absorbing downstream investments
- Promote exports of plastics products
- Zero plastics to landfill – 2030
- Develop career paths and provide skills to meet the needs of the plastics industry and its people

PART THREE

FINDINGS

Introduction

In presenting the findings emerging from analysis of experiences and perspectives conveyed by respondents in relation to the key investigative focus areas as directed by the stated research objectives, the following structure has been decided:

In the first sub-section, respondent perspectives on playing the market are presented, with particular emphasis on requirements for 'surviving and thriving'. Then follows reflections on the scope for innovation, of the radical or discontinuous kind in particular. The third sub-section presents an overview of the status of innovation in the sector with reference to predominant types and representative practices in relation to each. The fourth subsection is the most substantial of all as it comprises a critical discussion established culture and practice in respect of innovation capability-promoting organisational characteristics and requirements, which hold implications for "good practice" in a generalizable way. In sub-section five respondent views are presented on factors that support or inhibit their companies' capacity to be competitive. In sub-section six, findings are presented with regard to knowledge and requirements for sectorial strengthening. The final sub-section comprise respondent suggestions for ways of strengthening the sector are considered.

3.1 Perspectives on surviving and thriving in the market

Though emphasising divergent aspects, all respondents are united in their assessment – if not issuing of warning to prospective market entrants – how tough it is to make it in the South African plastics industry (in the current economic climate in particular) given the reality that even when reasonably successful "your profit margins remain thin" and how competitive or cut-throat (staying ahead of competition) doing business has become; as illustrated by the following statements.

> *You can be as good as you want to, one mistake is fatal. It will take you years to win that person's trust again. It is not so easy.* [Managing Member: Company 28 – large]
>
> *The dynamics of the plastics industry is that you can't stand still for one second, literally one second, because your competitor does a little trick and now he can cycle*

quicker than you; and straight away he has got a 10 percent [competitive/ market share] advantage. [Sales Director: Company 39 – large]

They [a generic reference] are making plastic bags, thousands and thousands of these plastic bags a day. Somebody can get a machine identical, put the same thing in, and make exactly the same product tomorrow – on a faster machine, slightly lighter weight, so he is considered slightly cheaper… [Director: Company 10 – large]

When you are dominating [a particular market segment] like we are… that might sound like a cosy place to be. But the down side is that you've got to keep it there because everybody wants to take your lunch. So you cannot rest on your laurels, just sit back and go on as before, you've got to constantly find ways to stay there. [Operations manager: Company 8] … We might have a year of competitive advantage at the most…but then they will catch up. So if we don't continue to improve, we'll just fall behind again. [Mould Services Manager: Company 8 – large]

So playing this market … it is highly competitive – it's got a relatively easy barrier to entry if you can put your money in it. However, to differentiate yourself from the other players is an entirely different matter. [Director: Company 17 – medium-sized]

What the above views clearly convey is that doing business in the highly competitive environment that is the plastics market has become an extremely tough assignment – just to break even and survive, first and foremost. Differentiating oneself from competitors as the basis for gaining competitive advantage is, as expressed in the last statement, "an entirely different matter" – particularly given the fact that (in theory at least) the playing fields are level in terms of access to the same technology and raw materials; by-and-large all subscribing to the same quality standards governing production processes and organisational systems (by virtue of ISO-compliance and so forth); and indeed being burdened by global economy-related and industry-specific contextual factors that at this time inhibit competitive performance. As a factory manager at a large company (respondent 70, company 32) reflected: "Anyone can buy a machine and a mould or tool and run a product… everyone has access to the same technology and can do the same thing – so the basics is the same for everyone. So why would a customer use you? I think the difference comes in how do you do it…."

However, respondent views show significant variation on what particular attributes of their companies are responsible for them gaining a competitive edge and thriving; ranging to just applying sound fundamental business principles and practices; efficiency in all areas of business functioning.

Innovation very important… it gives you the edge in the market. If you lose that initiative and that innovation you are going to lose your edge. Because obviously whatever you do is just going to be copycat. So innovation is very important in every field in our business, whether it is marketing, whether it is in the technology field, whether it is on transport, or whatever product. If you don't do it, you can close your doors. [Respondent 63: Commercial Director, Company 30]

3.2 Reflections on scope for (radical) innovation in the sector

Many a respondent at the very start of interviews insisted on first addressing the scope for 'true' (product) innovation in the South African plastics industry/ market context – as an obvious starting point or setting of the scene, as it were, for more in-depth discussion on the core innovation-related aspects as focus of the study.

With reference to the South African plastics industry's status in the innovation stakes, so to speak, the emphatic assessment by a respondent, who had been an industry insider since its cradle days, is that *South Africa is by-and-large a follower of global technological innovation trends*… "We have made some products that have been world-leading but we have not technically been a world leader and we never will be – we import the best machine technology that's available and we try and implement and use it as best we can but we don't go out and invent technology – we're not inventors." (Respondent 21: Director, Company 10 – large).

Raising the question as to what should be considered "true" product innovation in the plastics context, another industry veteran strongly advocates that a *company can only be accorded innovator (product) status if it can lay claim to ownership of trademarks and propriety-designed products*… "Putting a product in the trade market that's got a brand, that's got equity. Then, and only then, can they harness the concept of innovation – how do they engineer it, how do they injection mould that product as an *engineering exercise of innovation*? (Respondent 6: CEO, Company 3). But in addition to laying down a marker for claiming innovator status, this pronouncement is also intended as an denouncement of sorts with regard to the "many injection moulders out there who are mere job shoppers… locked into feeding their 'master' (injection-moulding machines) and then shipping off their product to the real innovators" – that is, established companies which (merely) "use plastic as their medium of choice and injection-moulding machines as their machines of choice to get to the end goal of placing a product in the market".

Finally, a commercial director at a 'market-leading' rotational-moulding company (Respondent 63, Company 28) is of the view that "the reality of the fact is that *there is not much room for innovation for approximately seventy percent of our market* – it is a

standard or core product and you need to feed that market". In this context, it is essentially in relation to "your upper LSM group where you really can show innovation…. through creating star products that will carry you through; that is, until they are obviously duplicated and then you need to start again". (Respondent 63: Commercial Director, Company 28 – rotational moulding)

Serving the purpose of 'orienting' the researcher at the commencement of the investigative journey, these assessments painted a picture of a South African plastics industry/market culture characterised by and large by limited 'true' technological and product innovation – that is, of the radical or discontinuous kind as opposed to mainly process-focused efficiency/productivity-enhancing incremental innovation. Implicit questions arising from such a status assessment included: Is this due to lack of innovation capability generally across the sector? Are the majority of converters really just jobbers and copycats or trend followers? What does this say about an innovative culture and entrepreneurial spirit?

3.3 Respondent views on key industry contextual factors impacting on company sustainability and competitiveness

In Section Two, Industry Overview, various factors and issues that impact on company sustainability and performance were highlighted, as identified by previous research. Respondents were nevertheless asked to reflect on these aspects. A few salient themes are presented here, some of which confirm previously identified constraining factors whilst others emphasise different aspects.

Having to adapt to the pressure technology changes and instant access to information – and the rapid pace of innovation

A matter of quality and speed…

> *At the moment …especially with the globalisation issue that you see …the world is becoming just one market place… one small market place. And things like speed, being able to meet targets, and quality…it's all about that. [Respondent 1: Production Manager, Company1]*

Harnessing change…

> *Because of the social media and information tech kind of stuff, but everything [with particular reference to is now sort of freely available to us, so we can actually innovate far, far quicker – you can actually come up with an idea and actually bring it to concept at such a rapid speed now. So adapting to technology changes that happen so quickly… if you're not actually continuously readapting or reinventing yourself all the*

time and harnessing change, you can quite easily fall off the radar. [Respondent 6: CEO, Company 3]

The imperative for recapitalisation (machinery)

In 30 years that I myself have been a moulder [with reference to injection-moulding]*, the last three years saw the biggest change-over in machinery - it's all about energy saving, computer… the automation with getting drive motors. Like, certain motors only use energy when needed, it actually...if you've got a two minute cycle and you're action is only 30 seconds, it will only use power 30 seconds.*

With the new equipment… if factories in South Africa don't recapitalise in the next two years, it's going to be too late. [Respondent 23: Operations Manager, Company 11]

The more it changes the more it stays the same – (extrusion) technology oversell (in relation to the South African context)?

Whilst acknowledging the rapid pace of technological change of technological advancement, another respondent [26: MD, company 12 – medium-sized, extrusion], is of the view that in spite of all the significant innovations and changes in machinery – becoming much faster, improved loading systems and the like; the basic principles of extrusion remain unchanged … "so we are not really affected by all this drastic and rapid change" [implication: it is not all it is made out to be?]. In this context, the respondent is of the view that "in South Africa, I think we've been oversold on the 'co-ex [-trusion] concept… or dream', if you want to call it – I still think that in a lot of applications in relation to our market we can still get away with the mono line".

Duty-free, cheap and high-volume imports threatening the industry – SMEs in particular

The imports from China has killed a lot of South African businesses, especially the textile industry was hit the hardest with the Chinese imports, you know. And the next sector to feel that is the plastic industry. [Respondent 23: Operations Manager, Company 11]

There's no import duties on wheelie bins at the moment. I mean, China is getting that stuff in, dumping it here by the container loads and at lot cheaper price than the locally manufactured ones. The dti is not protecting us. [Respondent 35: Director, Company 17]

In this regard, the vast majority of respondents are looking at government to protect the industry by legislative means, with particular reference to ensuring the survival of SMEs.

Convertors not supported by regional / local customers – highlighting the need for local and regional collaboration and support initiatives

- *Convertors in certain geographical areas shouldering the burden of low volume local demand due to lack of support from local industry (contractors sending work elsewhere)*

One respondent reported on an apparent Eastern Cape-specific problem faced by convertors is low demand for products as a result of local industry players contracting work out to contractors in Gauteng, Western Cape and KZN provinces.

> *We've got lots of industries here in the Eastern Cape … if we were fully supported and they weren't so hell bent on always buying from out of town, we would be a lot more successful. Now, the big question is, what are we doing wrong, but I haven't got that answer… So, there's not enough local support that actually says, hey man, let's rally up the troops here, and let's make this area a winner area. No, no we won't, we'll just send the work out to Durban or wherever. (Respondent 26: MD, Company 12)*

SABS current inability to perform its oversight role – the need for and emergence of private testing and certification entities

- As a result of SABS 'collapse', the pillars or building blocks to support an industry-wide innovation culture not in place – with reference to the monitoring of (quality) production.

  It is a critical institution for monitoring and enforcing quality standards – and ours has collapsed. So industry has the responsibility of almost policing itself.

  I think we have a major crisis here. As an industry you have to do the basics right of production and monitoring and then you have to optimize as you get better. And then you can start innovating. You know, like the way a country like Germany operates…. (Respondent 48: Marketing Specialist, Company 20)

- *In principle SABS role performance questioned as effectively amounting to no more than issuing of required documentation/ certification regardless of quality-related aspects at plant level*

  Unfortunately SABS was a lot of window dressing… they did not care what you did at your plant as long as you had or could show you had the right documents. (Respondent 73: Works Manager, Company 35)

- *Lack of inspectors to enforce adherence to standards*

Inspectors are non-existent. There are about four that I know of, four guys in South Africa who are qualified as inspectors. This is a big issue. Plastics SA has a course but it is too basic and it is a non-NQF course.

Raw materials – challenges and opportunities

The high costs incurred by companies in sourcing raw materials are unanimously cited by all respondents as the primary factor (next to the fluctuation in exchange rate) impeding economic performance of companies, as reflected by the following selection of respondent statements:

- *Sasol's status as monopoly supplier and its 'anti-industry friendly' behaviour*

Its practice of parity pricing or the price fluctuation on the international basis comes in for particular criticism, if not outrage.

Effectively we can probably get the product at nearly half the price because of our manufacturing base being a lot lower in rands. But we don't… we pay very close to international prices. As a matter of fact, we currently bring material in at a cheaper rate as what the guys can make in South Africa. [Respondent 56: MD, Company 25]

Our biggest cost driver is raw material, and unfortunately we are 70% reliant on SASOL for our brand of material – they have the monopoly. And they do parity pricing. [Respondent 65: MD, Company 30]

- *Access to clear material (recyclers) and engineering polymers a challenge*

The major challenge is raw material supply on the recycle side. Having good consistent supply and as I said, the clear is a major problem in the country, getting hold of clear material. [Respondent 71: COO, Company 33]

90% of all engineering polymers used in this country are imported. Nobody manufactures it locally at the moment. So glass fibre nylons and glass fibre poly-props are all imported. [Respondent 59: Director, Company 27]

- *Conversion of biodegradable raw materials a challenge*

As regards the changing nature of raw materials, one respondent is of the view that in relation to (in-house) recycling and the ways in which sorting and recycling are currently done, "we are not quite ready for biodegradable and all that"… "We can't do that properly yet, we're learning that". [Respondent 5: GM, Company 2]

Labour force – challenges around demand and supply

- *In an overall sense, a lack of pool of sufficiently knowledgeable and skilful people for the industry at large to draw on represents the single-most critical stumbling-block to growing a competitive industry – and no time for (wholescale) on-job upskilling*

  I believe the knowledge and skill in terms of plastic technology – mould-making and plastics skills – is one of our biggest problems in the country. [Respondent 24: Change management consultant to industry and former owner of successful companies.]

  From an industry perspective, our biggest challenge is we don't have the people, the skill. All of our processes would work a hell of a lot better if we simply had the skill… Trying to convert without correctly-talented people… it's scary. [Respondent 78: Sales Executive, Company 39]

  We have a massive problem getting people of a high enough calibre, trained sufficiently to be able to understand and run these new (advanced) machines. Their technical aptitude and capability have to be at a far higher level. [Respondent 21: Director, Company 10]

- *Skills gap widening as old-school skills exit the system but no young generation of suitably-equipped artisans to replace them as artisanal vocation and work has lost its appeal*

  It is difficult to find the younger guys with the right sets of skills. [Respondent 57: Technical and Product Manager, Company 26]

  The toolmaker that we have is over 60… you will not find the same quality toolmaker today. But he wants to retire in three years' time. So, you are looking for the guy of 30 years who you want to take along on the process of the next 15 years or so, but he isn't there. There is such a huge gap that we can't fill. [Respondent 46: Financial Manager, Company 19]

  Unfortunately skills like his are dying [with reference to a 'brilliant' millwright-as-maintenance technician] – and there's nothing to fill that void and that's the biggest threat that our industry and many other industries face. [Respondent 8: Financial Manager and soon-to-become CEO, Company 4]

  There isn't this youth coming in and taking over the plastics industry, it is not there! [Respondent 73: Works Manager, Company 35]

- The physical demands of the job as well as lack of long-term financial security are some of the factors noted for young people not wanting to consider tool-making as a career option; as in the words of one respondent:

  "Tool making occupation just is a hard job….there is just this big block of ice cold steel you are working on... there is no soul in that piece of steel. It can't be fun… but at least your [tooling] machine is running… a little bit of life there.

  When you're 20 years old the pay is great but when you get to 30 the pay is absolutely shocking. That is why they leave that industry and go into production. And that is why tools are so expensive." [Respondent 64: Managing Member, Company 29 – small]

Industry-wide R&D culture in support of product innovation lacking

- *A "short-sighted" culture of focused immediate problem-solving challenges at the expense of a more systematic, research and development-based approach (in line with European practice) is decried for eroding sustainable and competitive product innovation*

One respondent keenly familiar with the extent and nature of international industry practices concerning research and development decries the impulsive nature, as it were, of problem-solving or solution-seeking as characteristic of industry (manufacturing sector in general), amongst smaller companies in particular. Whilst credited for allowing decision-making efficiency – as opposed to the more lengthy, red tape-based system and processes governing formal, systematic R&D practices and results implementation associated with more bureaucratic environments, whether in higher education or industry contexts – of concern is the reported short-sighted and ultimately unsuccessful in the long run.

> *I think one of our best features which is "Maak 'n plan" ['make a plan'] where we don't have the red tape of the Europeans, is also one of our worst, because we tend to do things too quickly and we tend to not put enough effort and research into it. So, the Europeans tend to take a very long time to develop something, but when it's developed, they've considered everything. [Respondent 57: Technical and Product Development Manager, Company 26]*

A disconnect between institutional research bodies and industry hampering innovation

Higher Education and Research Institutes are reportedly looking for industry partners as joint-collaborators on product/ material development (partly motivated as compensatory measure in light of funding cuts) but industry is unwilling to invest in white collar research due to its focus on achieving practical results in the shortest possible time, as governed by a time-is-

money bottom line – in direct contrast to the culture in Europe scenario where such collaborative knowledge generation networks are the lifeblood of an innovative plastics industry,

Insufficient support to industry form government and industry bodies

- *Government endorsement of new product takes too long – if at all*

  Some years back we worked with Stellenbosch University on a product [product name withheld]. It cost us about R1 million just to get all the specifications qualified. After two years we were still not approved because unfortunately the parastatals that had to assist us didn't. So we were forced to take it overseas. We were in 26 countries overseas before we were successful... but we never had to wait for longer than a month or two for approval [or not]. [Respondent 23: Operations Manager, Company 11 (Small)]

- *Lack of incentives to export*

  They've allowed the Chinese to bring their products in… their products are flooding the market; but they don't give us incentives to get ours out. We're probably sitting with an 80/20 ratio. And for the sector that is a helluva disadvantage... they're not looking after our industry. [Respondent 38: Founding Director, Company 17]

- *Small businesses not looked after by government – it is too hands-off regarding SMEs and they are being "killed off" by regulatory restrictions and red tape*

  I think what they tried to do, is they have tried to be hands-off about it. They have redrafted something on BEE legislation, with the thinking that the big brothers are going to manage and grow the supply chain to have a certain transformation. And there is logic in there, I understand that, but they have become too hands-off. So they have made it industry's responsibility to train and to ensure that there is growth of smaller suppliers and entrepreneurs. Industry is just struggling to do what it has to do and remain profitable. [Respondent 22: Group HR Manager, Company 10]

  A lot of small to medium companies go under because of all the red-tape and restrictions. [Respondent 61: MD, Company 28]

- *The dti initiation programme is lauded as one of the most successful initiatives and drivers in respect of industry strengthening. Its sudden termination is widely bemoaned as having a devastating effect on industry well-being*

"The Good"

We started in a 18 sq. metre little shop. Originally we had to contract out a lot of work. Then in 2000 when we had to get this building… we struggled; there was no money. But fortunately there was an initiation programme for manufacturing via the dti which has helped tremendously, the capitalization programmes. Subsequently, after about ten years, we reapplied for the second part of that programme. Without those programmes we wouldn't be where we are today.

So definitely, I can't see a small company starting if there's no programme in place, it is nearly impossible. Except if you come from wealth, but like us who came from no money, you cannot start a company if there isn't a DTI initiative programme, then you are wasting your time. [Respondent 23: Operations Manager, Company 11]

"The Bad"

The development programme, or I call it the rebate structure… equipment coming in, they have stopped it. We put in a R70 million investment into the organisation, we should have got about R20 million back – nothing! We won't get it back. So if you are not strong enough to absorb all that...so the way the government does that, it is very detrimental to how our businesses operate. Not the way they're running it, it's the way they just all of a sudden shut a programme down. [Respondent 56: MD, Company 25]

- *merSETA effectiveness in supporting industry is experienced to be undermined by the complexity of its administrative system as well as officials lacking technical background*

"The most difficult administration to understand."

We don't understand their language, we don't understand what they're telling us, they have made it so complicated, but the voucher system worked better. It is at the point where if a small company starts now, why would he apply for funding? He is so busy setting up his business that if he doesn't understand how the Merseta is working and he hasn't got a HR department that he...you know, that needs to be changed or they must give a training centre in the plastic sector using the PSA and say here's a class for two days or three days, this is how we are working, this is what you must do.

"Officials lack technical background."

At that time we applied for a second apprentice in the tool room, they came walking around our tool rooms saying, 'Have you got such and such a machine'? They don't know what it is all about… they are not toolmakers themselves, they're not tradesmen themselves. In the end our application was declined but no proper reason was given.

Plastics SA

- *The Federation is lauded for strong Generic Training provision, its Aptitude Assessment service, company-strengthening Energy Survey initiative, and Informational Events. Aspects highlighted as inhibiting the effectiveness and impact of its interventions – in respects of SMEs in particular – are the relatively high fees and its technical training interventions at this time being predominantly injection-moulding focused*

3.4 Innovation status

In view of the above perspectives on innovation, the focus now shifts to the extent to which the above perspectives on innovation are reflected in established innovation culture practice – as indicative

3.4.1 Product innovation

The overall or 'representative' picture emerging from respondent descriptions of established culture and practice in respect of product development or innovation is two-fold in nature:

Existing customer product enhancement/ modification

By far the most prevalent innovation-related activity comprises providing competitively-priced solutions to a customer request for product enhancement of (modification or tweaking) or whole-scale change to an existing product (or component thereof) – with implications for raw materials selection (development). Essentially, this translates into providing "for-profit" design and manufacturing solutions to (benefitting both supplier and customer) according to quality standards and – that is, providing solutions to customer. Ongoing engagement with customers in this regard is a key characteristic.

> Customer requests range between highly prescriptive, often involvding actual drawings to vague concepts for translating into by the supplier's design team.

The following respondent statements convey the context associated with of (existing) client product enhancement:

> *So and what I am finding is, innovation [generally] is about not changing a product [existing] or producing something new, but about tweaking it to give it more appeal or making it different to the competitor's product.* [Respondent 65: MD, Company 30]
>
> *They come with their specs [for a product or product component] and then our design team will advise a customer if something is going to work or not; or*

suggest changes. But it's all, it's all their product, it is all the customer product, even if we design the tool, we design it according to the customer specifications. So we are more of a service type of company – we don't go out there and look what the market or the world want from you…what's the stuff that's selling or what's the stuff not selling. So we don't design our own products… [Respondent 1: Production Manager, Company 1]

The most extreme degree of dictating of terms by the customer reportedly in respect of the "poor suppliers" to the automotive industry sector:

I really feel sorry for those guys because they are dominated by the automotive industry – they are actually told to produce what, how, when, from what raw materials and so on. They effectively dictate what profit you make. It is just impossible… But that is not just in this country; it is the case worldwide. [Respondent 49: Laboratory Manager, Company G]

New product development / innovation

Innovation in support of the development and putting in the market of propriety products, as noted, comprises a relatively small percentage of industry practice.

Our propriety products probably make up 40% of our range, the other 60% is customer-owned products. Some products you just end up with – a customer goes bankrupt and you buy the mould from him, and so on. So there's various reasons for our products but overall it has just been natural progression. [Respondent 35: Director, Company 17]

Finding

- *For most part, product development or innovation comprises providing a competitively-priced solution to a customer request or specifications for either enhancement of (modification or tweaking) or whole-scale change to an existing product (or component thereof) – and, to a very limited extent ("roughly 30%") new (propriety) product development;*
- *This translates into an innovation issue of "for-profit" design and manufacturing (benefitting both supplier and customer) compliant with industry quality and performance standards.*

3.4.2 Service innovation

A strong industry trend that came to the fore, involving both large and small–medium companies, is that of providing turnkey solutions in respect of all of the "complete range" customer's needs – either offered to customers or requested by them.

For us as a company supplier pricing it is not our number one factor – we believe in the service and quality of product first, but we are aware of the price. We have to have good stock holding, quality product and I believe that service is key to everything. When we say we will have the project materials ready for 2 week delivery, if you give a date you need to stick to it. So we pride ourselves on that. [Respondent 50: Managing Member, Company 22 – Small]

The nature and extent of such service delivery is succinctly explained as follows:

What customers do want is that you must be able to give them more or less a turnkey solution. So, if they for instance they want a specific type product and you are one of their preferred converters, then they would like you to go and do the design work, for that packaging product that they require for their end-product. And you must do the design, you must advise them on where to have moulds manufactured – they don't mind paying for the mould, it's theirs. So they must know that you have got or that you can tap into the kind of facilities that can design and manufacture the mould and you can convert the product and then you as converter can maintain those moulds.

So you need to make sure that you can offer them a turnkey solution. But to do that you have to be on top of your game as you have to do some really clever costings, clever management, clever warehousing, and clever storage. [Respondent 56: MD, Company 25 – Large]

Finding:

Inextricably linked to product quality pricing, quality and scope of service provision is viewed as a critical source of differentiation – that is, with regard to both quality and consistency (on time-in-full with close-to-zero reject rate, every time) and scope (rendering a "complete service" or turnkey solution).

3.4.3 Process innovation

Process-related (incremental) innovations focused on improving operational efficiencies or productivity as well as overall organisational efficiency by respondent accounts comprises the bulk of industry-wide innovation activity.

It's about our operational (manufacturing) efficiencies which allows us to successfully service our customers – our end-user and, of more direct importance, the retail trade, which is our 'actual' customer. There is no use in coming to the trade with a fantastic product that is going to sell at a good price, but when they order a hundred cases you

only deliver 40 because you are not doing it properly. [Respondent 20: General Manager, Company 20 – extrusion]

"On-time delivery & low reject rate":

I have been very lucky as a sales person, in that because our [Company 10] reject rate is so low. Our on-time and in-full is by far the best in SA. At the moment we probably sitting at 98%, because we had a few hiccups, but normally we sitting about on 99% on time and in-full. Our opposition, I think the highest one according to the people that measure it, is sitting at about 81%. So, we are by far the most efficient in that way – supplying the customer on time. [Respondent 21: Director, Company 9 – injection/ blow moulding]

Generally, process innovations reported span the following areas:

- Modifications on the machines to improve output, control or energy efficiency – and with particular reference to innovative adaptations for South African conditions; climate-wise but also to compensate for knowledge and skills shortcomings on the part of operators.
- Continuous improvement programs/projects (CIP) related to overall plant improvement/ in-house capabilities development or context in a quest to ensure facilities and technologies are aligned to "world class manufacturing standards"
- Innovative ways of sourcing source machine components so as to be able to bypass agents
- Through research devise different ways ("codes and designs") and exploring different material properties for solving the problem of "getting the static from the robot onto the label so it sticks to the mould".
- Product cost reduction (reducing cycle time) and product improvement-supporting ***"materials innovation",*** involving either researching and changing to better grade materials or, alternatively, in-house material formulation experimentation (which involves "part science, part black arts"). In respect of the latter, PVC provides the most scope as "the SAN spec is purely about being a [product] performance standard, merely telling you PVC must be the main component – it doesn't tell you it must have so much stabilizer and so much of this or that raw material".

  New material innovation generally is reportedly more confined to engineering polymers, a large proportion of which goes to the automotive sector and are driven by compounders.

3.4.4 Organisational / managerial innovation

Organisational innovation, as previously noted, is focused on the implementation of a new organisational methods in the firm's business practices, workplace organisation or external relations. Organisational innovations have a tendency to increase firm performance by reducing administrative and transaction costs, improving workplace satisfaction and thus labour productivity, gaining access to non-tradable assets such as non-codified external knowledge or reducing costs of supplies. Thus, organisational innovations are strongly related with all the administrative efforts of renewing the organisational routines, procedures, mechanisms, systems etc. to promote teamwork, information sharing, coordination, collaboration, learning, and innovativeness. Attention was also drawn to the fact that, as organisational innovation is essentially concerned with management-related aspects, the term "managerial innovation" is invariably used as substitute for organisational innovation, with particular reference to "the crucial role of managerial innovations in developing strategies for growth, facilitating organisational change and renewal".

Respondent descriptions concerning organisational changes or developments that have occurred in support of advancing overall company competitive performance both explicitly and implicitly point to a strong established organisational innovation culture across all categories of companies. Indeed, a strong sense of urgency is palpably evident this regard as captured, for example, in strategically-driven pursuits spanning the adoption of lean manufacturing and entrepreneurial principles, flattening of organisational structures, introduction of HRD-related measures for ensuring a "happy", empowered and productive workforce, and so forth. Broadly, organisational changes so described relate to improvement of efficiencies.

Whilst many such changes could be considered as "merely" ISO-driven – that is, company context-specific "innovations" within the prescribed ISO framework or guidelines; others do indeed represent the outcomes of internal, strategically-driven initiatives.

(These and other aspects will be returned to for further consideration in a later sub-section.)

3.5 Examples of successful innovation outcomes

"Pioneering in-house development of an online manufacturing management system (MMS)" (Company 31 – blow-moulding)

One of our innovations is that we came up with an innovative idea to measure the business' results – an online system we call our MMS system which was innovated by the senior management team. No one knows about the system except us. It has been patented.

It's a quality checking, the inputs is obviously done via networking, the machine measures your OEs, it measures you OPPs, it measures every single thing. I come in the morning, I run a report and I am up to date with my factory.

So the guy on the factory floor, he's got a light that comes up, it signals him, telling him about his quality checking is now due and he'll go now and do his quality check. Those inputs are pulled into the system so now we know we can run a report – who actually did the quality check last and then in the event of traceability, we can pick up on it. So this is an integrated system, totally integrated system that works off a server. It measures an output of equipment of the machines, it tells you how many bottles you supposed to be making a minute, it tells an output of what should of went out and into the warehouse and it's integrated with our JD system, it can tell you about the supply chain, how much actually was manufactured and everything of that. So this is a closed ERP[5] system, we would think it is. It ties up with the ERP system. It's a fantastic system. So this is one of the big, big innovations for us.

It's been implemented now for the past five to six years. It's been in development stages all the way. It's still under development right now. We're still looking for more other things to put on in terms of innovation.

When this factory was, our employees were, they no knowledge of computers, they had major problem in terms of understanding of computers and whatever. So what we've done was we obviously put our employees onto computer training. We started to train them ourselves to get them to understand basic understanding of computers.

"Resolving the made-for-order—made-for-stock dilemma (settling for middle ground)"

[Company 39]

> *I think the whole working capital story… withholding of stock-piling venture or whatever is being overdone, because there is a somewhere in-between that. Reckless production is sometimes a product of accounting processes – so if you have production recoveries allowable in your accounting process, you drive a certain behaviour in your company, which is crazy.* [Sales Executive]

By this respondent's account (and reported general consensus), an exact model for ensuring successful inventory management cannot be prescribed. A useful approach suggested, based on newly-adopted initiative by the respondent's company, is to track and profile two 'volatility'-related aspects:

c) customer ability to understand their own demand (which is reported to range "between 40% and 60%")

> *So we apply best behaviour assessment – we record what he tells us and then we go and test it to his actual behaviour. And you can see, some guys are consistently 'overs' or 'unders' or serial whatever's. And then we would in our own planning, adjust that accordingly.* [ibid.]

d) company's production ability/output, with particular reference to reliability of processes

[5] Enterprise resource planning (**ERP**) is a category of business-management software—typically a suite of integrated applications—that an organization can use to collect, store, manage and interpret data from many business activities, including: product planning, purchase. manufacturing or service delivery.

> *…And then we obviously track our production output. We have a demonstrated capacity and a demonstrated ability, and we would like to hold x amount of weeks of supply. That is kind of how we manage that.* [ibid.]

"Industry-leading system for raw material feed"

[Company 9 – extrusion]

> *Because we making product of recycled material and because of the unstable nature of the input, we have created our own system that monitors and feeds the various grades of recycled chips. So as they come we evaluate them, we have got a little test-extruder that extrudes it and we watch it. We have got an entire room that is full of hoppers and there is a control-chap that sits there.*
>
> *So, we are streets ahead in terms of our raw material feed into the factory – the rest of the industry feeds raw material into buckets and that's about it.*

"Complete in-house capability and efficiency – the best of the best"

[Company 28 – rotational moulding]

> *We have built in-house capabilities, capacity to do our own plant development, our own manufacturing asset development. We have got our own engineering shop which is very fit for purpose. We have got a computer aided design capability, so we have got obviously the electronic capability, but we also have the skills that can put drawings together fairly quickly. And we building engineering capacity, we have the laser cutting machine.*
>
> *We don't buy anything out, from ovens to moulds. So the problem with that is, I can't go anywhere to find a machine that works for us. We are the best, so for me to go and shop around to try and find a machine to buy does not work for us. So everything is worked out on paper, trial and error, built in-house.*
>
> *I have developed a few machines and then a few years later I see one of those in another factory, you know. Even moulds or whatever, you will never see us copy another mould, from nobody. We build machines to build the machines, so yes. We don't copy anything… like our ovens – I was all over the world there is no other oven in the world like ours. Nothing, never! Not in Europe, not in America, not in Australia, it is the only ones there.*
>
> *The only thing that is the same is that they rock and roll, but even that function, ours are totally different - taking it out of the oven to putting it on a turn table… everything is different.*
>
> *It is all about efficiencies.*

"World pioneers of 100 percent recycled…" (Company 9: extrusion – refuse bags)

> *Our [product – brand name withheld] is made from 100% recycled material – we're the only [product] manufacturer in the world that has that claim and has it certified. We pioneered the process with SGS, an international certification body – it is extremely difficult to make product out of 100% recycled*

material. Most other brands do that make products out of recycled material will put in a percentage of virgin to get a stable base. Also, we are 80% post-consumer based, which again is the highest level in the world.

So in terms of innovation, we are ahead of the rest of the world.

"Digital printing on the tube – a world second" (Company 10 – custom moulding)

We brought in a tube line a couple of years ago which has. That is only the second one in the world. So we would be second in the world to offer this. We received the Gold Pack Award for Innovation because of that.

"The most advanced multi-colour [four-barrelled] injection moulding machine in the world – as outcome of 'quantum-leap' innovative modification of a standard or base [two-barrelled] machine"

(Company 14 – injection moulding-based supplier to automotive industry)

We do dramatic innovation… Take the standard multi-colour injection moulding machine that everybody is using around the world – a 1400-ton clamp machine. It has a massive rotating platen, a four carotene mould… four injection units; either this way or that way. Now we just couldn't afford it. So we hunted around the world bought until we could find somebody who could custom build us a 7,000-ton machine. But it only had two barrels. And how did we get around it? We just built two tools – so we've got a platen here, a platen there and the tools split in the middle and the centre part rotates... because opposing forces cancel one another out. So we should clear this side and move the clear from that side to this side. So ours has also got an injection unit this way and an injection unit that way. So now we have a 700 ton machine doing what a 1400 ton machine does. Now that's heavy innovation, it's a quantum leap… it was a bold decision – so much so that our licensors [when told about our plan for modification] took one look at this and went: "Good luck with that but we're not interested"… the Germans kept telling us – "You will not shoot this thing, you will not get your lighting values out of it". But we got it right! … there it is, running – the most advanced multi-colour injection machine in the world, doing its thing right here in Uitenhage!

"Ironically, our biggest innovation is the MacDonald's effect."

(Company 39: multi-national – packaging and other)

And by that we mean the ability to absolutely replicate a branded product. So our customer base sits with the biggest consumer companies in the world, and they have a very strong desire when you pick up [brand name] in Outer Mongolia; Brazil; Australia, it must be exactly the same. So that is probably ironically, how you replicate this 100%. The colour must be absolutely the same; the tactile response to it must be the same. That is where we sit in the market as a big part of what we are doing. It has to be exactly the same.

3.6 Critical analysis of key organisational elements promoting innovation capability – with generalizable implications for good practice

Introduction

Zawislak et al (2012: 14) draw attention to questions such as: Why not are all firms that invest on their technological capability innovative? or Why do other firms that do not invest so much in that display strong innovative performance?

Drawing on dynamic capabilities theory in exploring organisational innovation capability, Lawson and Samson (2001) characterise the firm as a "collection of resources and capabilities rather than a set of product market positions" (p. 379). In this context, the concept of innovation capability is used to describe the ability of high-performing innovators to achieve effective performance, that is, the *capability to innovate that creates the potential for firm-wide behaviours leading to systematic innovation activities or processes* within the firm. *Innovation capability* is thereby proposed as a *higher-order integration capability or meta-capability*. Organisations possessing this innovation capability have the ability to *integrate key capabilities and resources of the firm to successfully stimulate innovation* – integrating the seeking, locating and developing potential innovations for enabling the creation of the required new products, markets, technologies and businesses of the future with strong mainstream capabilities in quality, efficiency, speed and flexibility because it is the need to produce real products, on time and on budget that ultimately drive the success of a business. In short, as integration mechanism, innovation capability brings together the *efficiency* of the mainstream with the *creativity* of the "new"- or innovation stream.

Against this backdrop, the analytical focus now shifts to what respondents consider to be essential organisational attributes – as manifested in established organisational structure, culture, systems and processes/ practices – which collectively on and integrated basis contribute to the organisation's capacity for product, service and process innovation in the quest for differentiation / competitive advantage and market position. The key elements for guiding this analysis of established culture and practices are derived from the literature.

3.6.1 Strategic visioning and "innovation integration" capability

With particular reference to radical or discontinuous product innovation, it is emphasised in the literature the most innovative companies, for whom innovation is more than benchmarking or seeking to succeed simply by matching others, adopt an offensive strategy, vision and a target which, if achieved, will create products that outperform and provide a distinct market position. This requires their employees to have clarity of purpose and commit to the challenge

to find totally new ways of doing things in order to achieve the goal of being "better than the rest" if not "best of the best". Successful innovation in these terms therefore requires a clear articulation of a common vision and the firm expression of the strategic direction as a condition for institutionalising innovation – without a strategy for innovation, interest and attention become too dispersed. Furthermore, the link between vision, strategy and innovation is important as strategy determines the configuration of resources, products, processes and systems.

In view of the above overall emphasis on the need for firms to articulate and institutionalise a clear and "binding" competitive advantage-promoting innovation vision and culture, respondent reflections on their companies' or organisations' strategic orientation towards innovation reveal that:

Finding

The institutionalising of a distinct innovation strategy separate from but aligned to or integrated with core business strategy is not common practice. For most part, innovative intent is enmeshed with established (mainstream) business principles and practices espousing quality, efficiency/ cost-effectiveness and speed that govern product,

Indeed, some respondents feel that quality and technical standards-compliance (ISO and SABS certification; or alternatives) – also encompassing strategic formulations (vision, mission, values and strategic objectives statements) – in and of itself sufficiently governs all aspects of business functioning and efficiency to allow surviving and thriving in industry.

The following respondent statements reflect strategic perspectives on the nature of doing:

- *Our strategy is simply to run our machines at a decent price, give good quality production, just basically good service, and good relationship… invoice it out, collect the money and make some sort of profit or break even.*
- *Just follow basic business or management principles, of which the most important one is that if you can't make money you close – it begins and ends with cash flow; it is everything.*
- *Strategy drives everything*… what markets you are going to target or focus on; what products you are going to produce; what technology you going to invest in, all of that. If you don't have a clear strategy, you are going to end up buying the wrong technology, the wrong equipment… you know, all those kinds of things.

The only explicit references to innovation strategy were to be found in value statements of some of the large companies (accessed through desktop research or in annual reports received on occasion of research visits).

However, whilst formalisation of orientation to innovation in the form of a dedicated strategy (and attendant dedicated funding channel) – separate from but aligned to mainstream business strategy aligned may by and large not comprise institutional characteristics not awareness of the need for and role played by innovation as a driver of current and future business focus, strategy and culture At the same time respondents were quick to claim adherence to an innovation culture in the day to day conducting of business.

> *In order to secure any business, one needs to innovate. We approach it in two ways, very simplistic-wise. The first way is that, market relevance or customer-facing – by the remit that could be almost anything imaginable under the sun that makes sense to the consumer or end-use market. And the second way we would be looking at innovation as profit improvement.* [Respondent 78: Sales Executive, Company 39]

> *Innovation very important… it gives you the edge in the market. If you lose that initiative and that innovation you are going to lose your edge. Because obviously whatever you do that is going to be just copycat. So innovation is very important in every field, in our business, whether it is marketing, whether it is in the technology field, whether it is on transport, or whatever product. If you don't do it, you can close your doors.* [Respondent 63: Commercial Director, Company 30]

> *Some companies might have a separate innovation division and innovation could be seen as something only sitting in product design and processing. But [the company] innovation isn't only in our product design; it's in technology improvements, in how we process this and how we move our materials around the site. There's innovation at everything, it's across the business. We are constantly looking to innovate and innovation doesn't have to come at a massive price tag all the time. Sometimes it does, sometimes it doesn't.* [Respondent 19: Operations Manager, Company 8 – Large]

However, what is alluded to in the majority of instances (as considered in earlier sub-sections) comprise incremental innovation aligned to customer-driven demand for product enhancement projects; not propriety product design and development from scratch. This reality could possibly partly explain why “offensive” innovation strategizing and resource provisioning in the quest for leveraging competitive advantage and increased market share proves to be the exception rather than being an industry-wide phenomenon?

3.6.2 Technology development capability

Based on a company’s strategic orientation in terms of playing the market and associated core business focus and aligned ongoing market scouting for new growth opportunities, the company’s technological capability naturally plays a determining role in its capacity to respond

successfully to such opportunities and associated innovation requirements (as one of several capabilities). Zawislak et al (2012) define this capability or capacity as comprising:

> *The ability that any firm has to interpret the current state of the art, absorb and eventually transform a given technology to create or change its operations capacity and any other capability aiming at reaching higher levels of technical-economic efficiency.*

It is furthermore emphasised in the literature that innovative (radical) firms are able to link their core technology strategies with their innovation and business strategies. This alignment generates a powerful mechanism for competitive advantage.

In an overall (strategic) way *respondents articulated appreciation for the organisational-empowerment contribution of a dynamic technological capability*, as highlighted by Zawislak et al (2012) in so far as leading to technical change that allows for a successful innovation process; as attested to by the following statement:

> *So the decision was taken to invest in new technology, and that decision added a fundamental change to the whole company... a whole rebirth. It has made a huge difference in terms of the increased productivity and profitability – I mean, at the moment we have got more work than we can actually cope with.*
>
> *BUT also very importantly, it has also opened up our doors for innovation – because now you have got the technology, now what is the best way of using it? So the decision to invest in the technology actually then, you know, created the whole opening up of a fountain of ideas of what to do.* [Respondent 71: Chief Operating Officer, Company 33 – "green" bags manufacturer]

Market intelligence gathering

Attendance of trade fairs or shows was widely confirmed as the foremost avenue for *market intelligence gathering* in respect of the latest global trends and developments concerning new machinery and raw materials, the K-show in Germany in particular. That is, in contrast to local intelligence sources, in the main comprising the ongoing visits from sales representatives of these global suppliers, international trend spotting "agents" as part of company collegial networks (CEOs and MDs invariably also perform a scouting role), and internet-based desktop research.

An "open-minded approach" is advocated as necessary for maximising learning about new trends and developments – "for getting our new ideas". A case in point involves a visit to Propak (the South African trade show) where design executive from a large rigid packaging (Company 8) manufacturing (as told by one member of the management focus group – to

acclaim from the other members) “picked up a great innovation idea from something that was totally not even related to our machines”; that is, with reference to a particular printing machine’s safety method which was creatively adapted and successfully implemented in production.

In respect of the K Show and with reference to the same company noted above, a group of newly-qualified/ appointed engineers, as an established practice, accompany the officially-designated company representatives for the sole purpose of exposure to “all things different”, as a way of stimulating and incentivising them.

However, by general respondent consensus it is recommended that K Show attendance is approached in a “planned way… because if you go there without a plan, you're going to be lost – you won't come back with any useful information” (Operations Manager, Company 8 – with reference to its sheer size and danger of information load). “Best practice” advocated in this regard is to meet up with existing suppliers, for them to provide pointers as to where to look and enquire to ensure company-specific interests or agendas are best served. In respect of raw materials in particular the importance of visiting the parent companies was highlighted because “they’ve got a whole range of light stabilizers which the sales rep never told me about” (Technical and Product Manager, Company 26 –piping manufacturer).

Technology investment patterns

With regard to technology investment patterns, by majority respondent account the focus is first and foremost is (predictably so, it could be said) on production equipment/ machinery-related or hardware changes or improvements for increasing productivity (faster or shorter cycles) and efficiencies (saving energy, lowering scrap rate, etc.). International benchmarking and “improvement beyond” mark the particular strategic orientations of market leading and indeed world class companies represented.

The need for tempering a “natural inclination” of wanting obtain only the latest and best equipment (smallest, fastest) is widely emphasised – focusing instead on particular production-related requirements; the following statement illustrating a case in point:

> *We've been going the European route with all our equipment and moulds. You pay a lot more for it but you know as a rule in your scrap rates, cycle terms, up times, you’ll get better efficiency and quality in product. But recently we bought a robot which was made in Taiwan; more expensive than a Chinese robot but a fraction of the price of a European one. It's essentially worked very well… it’s horses for courses; we didn't need a four of five second robot, we needed a 15 second one.* [Respondent 70: Factory Manager, Company 32]

Investment in respect of information technology-driven functions also came in for specific mentioning, with particular reference to design capability-strengthening (modelling software) and production performance monitoring software. The benefits to be derived in respect of investment of the latter – though off-the shelf availability at an affordable price reportedly comprises a major obstacle for SMEs) – are lauded as follows:

> *We decided to invest in OEE – overall equipment efficiency software. Now we're looking at how much scrap we're producing, availability of machinery versus what they're supposed to run at, and we're taking the measure of that to see where we are at as far as squeezing every possible efficiency out of the company… rather than going to buy the next biggest toy out there.* [Respondent 26: MD, Company 12 – injection moulding]

Finding:

Fit-for-purpose acquisition based on proper market analysis / intelligence and a business case informed by an organisation-specific requirements assessment or audit, emerged as the agreed on (general consensus) golden rule for guiding technology capability development in support of increased productivity, efficiency and profitability or return on investment.

Advanced manufacturing technology

Technological developments in support of increased speed and control as driver of change.

> *I always say we are 10 years behind Europe. In Europe they do not sell a machine like we sell here, the manual… hydraulic machine. It is obsolete in Europe – you are not allowed to use a plastic welding machine if it does not have memory capacity to record all that stuff. But it is changing in our industry. I recently sold one to a contractor with a small company – he resisted at first but in the end did not have a choice because his end user had specified that all welds needed to be done by a machine with data logging capabilities.* [Respondent 50: Managing Member, Company 22 – supplier of machinery and fittings to industry]
>
> *Technology changes so quickly that adaptiveness, that if you're not actually continuously harnessing change – readapting or reinventing yourself all the time – you can quite easily fall off the radar* [with particular reference, in this instance, to incorporation of information technology capability]. *We can now innovate far, far quicker than in a lifetime previously – you can come up with an idea and bring it to concept at such a rapid speed now.*

Trends coming to the fore as regards the embracing or uptake or advanced manufacturing principles and technology could best be summarised as investment in the 'latest' technology with particular focus on replacing older generation machines and tools with either semi-automated or fully-automated ones in a quest for increasing efficiency and quality of production – with computerised system control as leverage (and conversely, less control in the hands of operators). The most widely-talked about technology relates to in-mould labelling whilst 3-D Printing utilisation appears to be on limited scale only. (The researcher was shown rather impressive-looking samples printed in the tool room at one injection/ blow-moulding company.)

Finding:

Whist instances of highly-advanced technology acquisition are in evidence, in general a cautious "we know what is available but for now we wait and see" approach appears to govern the adoption of advanced manufacturing technology.

3.6.3 Human resources capability

Having considered approaches to and practices for bringing about organisation-wide technical change in support of innovation capacity – setting the "technical scene" as a pre-condition for allowing new products to be "creatively thought up" (that is, technological capability, in terms of Zawislak et al, 2014); the focus now shifts to the interlinked human dimension as innovation capability-supporting resource.

Strategic need – "to get the right people in the right places"

> *In plastics, if you don't have the skills… the right people in the right places, you don't have a company. You can have the best machines and all those sorts of things but if you don't have the right people driving it all you've got nothing… you're not going anywhere.* [Respondent 50: Managing Member, Company 22]

Having the "right people" in the "right places" by all counts comprises a company's most critical asset – a non-negotiable fundamental which, in essence, means the difference between differentiation and profitability, or failing. This basic truth was also held up as of special relevance to small and medium-sized companies.

In short (and assuming the "right" technology is in place), by respondent accounts this comes down to having technical staff and production managers who understand the processes and make sure the processes run efficiently ("and then you will be able to differentiate yourself and the profits will come"). In respect of production management expertise, a representative at a large quantified the ideal makeup as comprising "75% technical, 25% management".

Whilst achieving such a balance is acknowledged as “presenting its own challenges”, it nevertheless is credited as being one of the company’s critical success factors.

In addition to the fit-for-purpose technical expertise as essential requirement, role-versatility also emerged as a widely endorsed requirement for ensuring success in the industry – in association with lean and versatile manufacturing in particular.

The need to have staff that are “happy and stimulated” also emerged as an essential requirement for ensuring the achievement of efficiencies/productivity and product quality; consistently so.

Established practice: “If you can’t employ the right person in the right position, then you train them into that position”

In-house job-specific education and training – or “training into the organisation” – in respect of work readiness and continuous development by and large the key driver in ensuring human resource capability – predictably so in view of the all-round bemoaned lack of a pool of operational, vocational/technical, professional and management personnel appropriately-skilled or prepared in relation to plastics industry-specific labour force demands. In short, in the words of an operations manager at a medium-sized injection moulding company: “We don't get the raw material we need in terms of people and capabilities – the only way we are going to fix it is if we do it ourselves” (Respondent 22: Company 11).

In practice, the “fixing” task alluded to essentially translates into the task of getting newly appointed employees *work-ready* with regard to acquiring the appropriate level of understanding and competence in respect of company-specific equipment and processes as well as appreciation of organisational culture in order to be in a position to contribute to company fortunes in a value-adding way – a process that in many reported cases can span years. Towards this end, gaps in foundational (theoretical) knowledge and skills have to be addressed as a starting point in respect of operators/artisanal staff (school-leavers) who are trained from scratch; as well as in the case of newly-qualified artisans who invariably display core deficits concerning basic knowledge and skills as well as lacking in practical work experience. The latter aspect also extends to newly-qualified professional engineering categories of personnel. Availability of plastics industry-familiar management personnel is reportedly “non-existent”, as consequence of which new management appointees (from other sectors) first have to be grown into job-readiness.

A strong trend reportedly gaining traction as a widely-adopted practice in support of securing the appropriate “raw material” in respect of prospective operational and technical staff is the instituting of matric with mathematics and science as *selection* criterion; compared to a previous “off the street” selection culture – together, that is, with assessment or *screening* of

candidates with regard to personal attributes pertaining to aptitude, attitude (e.g. natural interest or inquisitiveness and being a team player) and motivation (drive). The following statement is representative of widely-held sentiments:

> *I'd rather have somebody who has the ability to learn and the willingness to learn but lacks the formal knowledge and skill than someone who has a formal qualification but lacks these personal qualities.* [Respondent 73: HR Manager, Company 27 (compounding)]

In contrast to exposure of established staff to *continuous development* interventions or measures (aligned to changing knowledge and skills requirements due to new technologies being introduced), *cross-training* focused on both entry-level as well as long-serving staff emerged as a widely-practiced industry trend in relation to both SMEs and large companies and– but for different reasons. In the case of the former, with regard to small companies in particular, the agenda is to ensure backup capacity as across all function areas as each of these is invariably one-person-dependent; or, in the words of the CEO of a small extrusion (film-sheeting) company: “My ultimate dream is to have every one of the people on our floor capable of doing any of the jobs... it makes a huge difference by having that sort of back up because we’re small” (Respondent 7, Company 4). In respect of large companies, the focus appears to be essentially two-fold: a) cross-training of new technical staff to ascertain which technical areas attract or unlock their “true interests and drive”; and b) to ensure more extensive maintenance capacity rather than having to be reliant on a team of single trade-competent functionaries.

(Note: Aspects considered above as well as implications arising will be taken up again in Section 3.7, “Implications for education and training”.)

3.6.4 Organisational structure and culture

In the literature the following organisational attributes have been linked to radical innovation in particular.

Unless the overall formal business ***structure*** and its resulting processes are conducive to a favourable environment, other components of the innovation system are unlikely to succeed. With reference to high performing firms Ashkenas (1998) and Maira & Thomas (1998) found that “the more permeable and organic the structure, the greater the potential for innovative ideas and behaviour to flourish” – that is, innovation capacity and performance are enhanced by the breaking down of barriers separating functions, product groups and businesses.

The following two statements (by respondents from large companies) provide company-context substantiation:

We are a large company but decisions are made very quickly because there's a lot of transparency… and because there's quick decision-making we don't miss out on opportunities because of that – we get opportunities very quickly. [Operations Manager, Company 8 – Large]

We are totally flat. We don't have levels of corporate stuff to go through. Decisions are made very quickly and then we push them through straight-away – we are very fleet-footed in this regard and we perceive it as a competitive advantage. [General Manager, Company 9 – Large]

A key distinguishing feature or characteristic of innovative companies which, according to Lawson and Samson (2001), *allows them to successfully and consistently produce new products and services in a quality-focused, efficient and responsive manner is the presence of company-wide innovation capability*…"pervading all aspects or dimensions of an organisation's existence, from the core value system to the practices and behaviours that are manifested on a daily basis". This aspect was endorsed by a representative of high-level innovating company as comprising a critical characteristic in support of competitive performance/ advantage:

Some companies might have a separate innovation division and innovation could be seen as something only sitting in product design and processing. But at ["Company 8"] innovation isn't only in our product design; it's in technology improvements, in how we process this and how we move our materials around the site. There's innovation at everything, it's across the business. We are constantly looking to innovate. [Respondent 19: Mould Services Manager, Company 8 – Large]

An organisational ***culture*** equipped to support risk-taking, freedom and self-management – encouraging radical innovation to take place through an autonomous culture, which fosters individuality, as well as creativity and tolerance of failure; and a creative climate, with autonomy and resources. Whilst many studies have identified the willingness to take risks as a preferred behaviour for innovative firms (Saleh & Wang, 1993), innovative firms do not take unnecessary risks. They tolerate ambiguity, but seek to reduce it to manageable levels through effective information management and tight control over project milestones.

Poškienė (2006) explored the "complex associations" between creativity, organisational culture and innovation and in this regard organisational culture is defined in terms of the "complex set of ideologies, traditions, commitments, and values that are shared throughout the organisation and that influence how the organisation conducts its whole performance becoming a potential source of innovation, advance and advantage. Accordingly, culture is the force that shapes the arrangement of an organisation with values providing the principles

applied in organisational situations, changes, and challenges. For example, an organisation based on democratic managerial principles had been found to have the effect of "uniting its members to strive for creative decisions, innovations, quality, and excellence" (ibid: 47).

In these regards, respondent across all company categories – medium and large in particular – indeed extoled, based on lived experience:

As such, the above echo findings by Lawson and Samson (2001) who established that "one of the best ways of developing an open innovative culture is to respect and invest in people – management recognise that these employees may have different visions for the future and seek to incorporate these views into their innovation direction".

As regards the latter, a significant trend reported is that of large companies emulating small company culture. The statement below is by a director of a highly innovative large injection-moulding company (Company 10) that has for years been successfully operating, if not industry-leading, in its niche market:

> *So that would be I think our biggest attribute – low waste, very high skills and then this culture of TLC… [Company 10] became a family [with reference to the early days following its formation] and with that came a very caring mentality, being supportive of each other, and teamwork. I think that has probably been our biggest success – we have no equipment that others don't have, we have no magic wand that makes us better than anybody else. It has allowed us to play in the niche market with great success.* [Respondent 21: Director, Company 10 – Large]

Whilst the above-quoted case represents a caring organisational culture as "organic" outcome, other large companies are reportedly pursuing the instilling of such a cultural orientation as a strategic objective for economic gain, in the sense of people who are cared for/ looked after will boost productivity and quality.

Given the central role of ***leadership*** in driving company culture and overall company performance, corresponding essential personal attributes requirements highlighted as essential include: a "love for plastics", passion for the job, drive, entrepreneurial flair and "can-do" attitude, a sense of urgency, toughness/ resilience, and ethical conduct.

> *It's about passion, it's about something that is in your head…it's not just about the money. This is your life so you have to be passionate about what you're doing otherwise you won't stay motivated and focused.* [Respondent 42: Technical Director, Company 42 – Medium-sized]

Finding

The core theme to emerge with regard to the organisational structure-competitiveness perceived linkage is that the structure and makeup of a company – regardless of size – should allow for quick and transparent decision-making in responding to business opportunities and resultant product development/innovation process.

Finding

Respondents endorse the critical role of organisational culture and its values base play in their respective organisations with reference to the positive impact on employee behaviour and, by extension, effective and efficient organisational functioning. Values and principles emphasised in particular are commitment, responsibility, teamwork and interpersonal sensitivities/ respect and caring were highlighted in particular.

3.6.5 Innovation system

[As a given, all relevant business management systems and compliances must be in place for supporting the monitoring and control of quality and efficiencies.]

Innovation process

Respondent accounts paint a picture of a by and large uniform adherence across medium and large companies to the key phases of the overall innovation process; that is, market intelligence as first step to identifying business opportunities in respect of product development (conversely, existing customer would approach supplier with requirements for a new product or modification to existing product); followed by ideas generation or conceptualisation and design; evaluation and approval of design; tooling (if relevant); running and approval of samples; manufacturing, distribution and/or marketing.

Market searching / intelligence-gathering in support of business opportunities

Successful innovation requires the ability to harvest ideas and competencies from a wide array of sources, which are deemed even more important to radical innovation. It is suggested that this type of externally-sourced knowledge determines the likelihood of the creation of a breakthrough innovation. “Organisational intelligence” is primarily about learning from customers and learning about competitors as understanding both competitors and markets is critical for effective innovation (management). It has been defined as: “The capability to process, interpret, encode, manipulate and access information in a purposeful, goal-directed manner, so it can increase its adaptive potential in the environment in which it operates” (Glynn, 1996: 1088).

The picking up of market trends and associated business opportunities with regard to the nature of both customer needs/wants and volume demand as well as products and pricing of

competitors by most respondent counts represents the logical and necessary first step in new product development (radical innovation) or the improvement/ enhancement of an existing product (incremental innovation). What such a scouting in essence seeks to deliver are *ideas* to inform competitive advantage-promoting new product development and/ or value-adding to existing market segment-specific products aligned to either brand improvement (aesthetics or shape-related) or a cost-cutting agenda (lighter, cheaper, etc.) – that is, over and above market intelligence concerning technological capability development, including new materials becoming available on the market.

Managing directors/ members (or other senior management representatives) and sales or marketing people by respondent accounts appear to comprise the key organisational "agents" tasked with picking up on market trends (demand) and associated potential business opportunities with regard to both customer demand as well as information on products and pricing of competitors – the former by virtue of their (international) "market intelligence rich" industry networks and the latter in respect of their on-the-ground connectedness. As the technical and product manager at a large piping company explains:

> *I would say about 90% of our projects are initiated by our sales people because the voice of the customer comes back to you through them – and they have their eyes on the competitors' products and pricing. For example, they tell me a client says, "No, you know what, this p-trap of yours is not a nice design, our plumbers like the other one better – the one from your competitor. Or sometimes they'll come to you and say, "You know what, these are the prices of our competitors and this is our price. We are way higher than them and we've got to do something about it." And that's the type of stuff that you start acting on.*

As considered in an earlier section, the stimulus for product development or enhancement in the majority of cases of sampled companies comes from current or prospective client needs for either new product development or modification or enhancement of an existing product (or part thereof). Expression of needs/wants in this regard range from "vague ideas or concepts" to extensively specified criteria or parameters (sometimes accompanied by detailed drawings).

Once an opportunity or ***idea*** has come to the fore in relation to product development (or service or process improvement, for that matter; the next stage involves ***conceptualisation*** of the "best solution" concerning shape, weight, strength etc. – either in relation to criteria specified by client or in anticipation of value attachment by prospective when product is put on the market. Such conceptualisation, by all respondent accounts, involves an intensely

creative process of ideas generation and decision-making, culminating in a design being presented.

What emerges by and large as a shared practice across medium and large companies is that this initial ideas generation or conceptualisation of exercise by and large involves a collective "round table" or team effort representative of all relevant divisions or function areas and with consideration of variables like technological and operational capabilities, raw materials availability; human resource capacity, funding availability; and so forth.

The flavour of this creative decision-making or problem/ solution-seeking, which combines individual and inter-divisional strengths, is captured by the following respondent accounts:

> *We get the team together, sit around the table – the top staff in this are the sales guys and the design team – about 15 guys around a table and with about 100 years of experience all in all and we brainstorm… How are we going to do it? How is it going to work on the floor? So you get a lot of different ideas and you put that all together and you come up with a solution… But it's not head in the clouds stuff, we're pretty hands-on about it.* [Respondent 31: General Manager, Company 15 – medium-sized]

> *We try to innovate our ideas and insight on how to make the end user's product, you know, compatible for what we want at the end of the day, at that stage important. A lot of communication and a lot of problem solving will happen between us as a design team, the quality team, the logistics team, the production team to make sure that everything integrates with each other, in sync with each other to get that specific thing.* [Respondent 1: Production Manager, Company 1 – Medium]

Idea/ design evaluation and approval (or not) then follows as next step. In respect of new product development, an in-depth analysis of the design is conducted and approval for manufacturing/commercialisation or not approved in terms of commercial viability or "opportunity at the right price"; as governed by a host of criteria, first and foremost of which pertain to whether it lends itself to optimally-efficient manufacturing processes (including tooling) in alignment with maximising return on investment, compliance with industry standards governing product performance (strength, durability, environmental impact, etc.).

In the case of customer-initiated or driven design and attendant quoting, pricing and quality considerations appear to be the dominant criteria for customers granting approval. In this regard, a critical aspect highlighted by one respondent concerns the reality that "many people/ companies reportedly get it (very) wrong when ***quoting*** on future business, which can lead to the downfall of smaller companies in particular".

The nature or level of ***creativity*** governing (new) idea generation and conceptualisation at the innovation initiation phase of product innovation process (radical) could be viewed as the essential element differentiating competitors, given the level playing fields in respect of production / manufacturing capability (quality and efficiency) due to all producers (theoretically) having access to the same technology.

[It should be borne in mind, as emphasised in the literature, that creativity is not viewed as a sufficient condition for innovation as the latter depends on the successful implementation of creative ideas – involving a range of other organisational capabilities or competences, which on an integrated has overall organisational innovation capability as higher-level outcome].

Sample products or proofs are then run, with tooling (design and making) occurring either occurring in-house or on an out-sourced basis. Both the rotation moulding companies and the majority of injection moulding-based (and "related") companies in the sample have in-house tooling capabilities.

Once samples are approved, full-scale production can commence.

Response-speed in relation to customer request for an initial product design is recognised as a key differentiating or competitive advantage-promoting factor in securing a business opportunity; with an actual sample/prototype trumping a drawing and with (complete) in-house design and technological capabilities as necessary conditions.

> *From when we started out over thirty years ago – and that is still how it is today – the whole idea was to react faster than anybody else when a client wanted something. And that is where we still have an edge on everybody else. Once you have come up with the ideas you have to take something to show the client within a couple of days if not the next day for his approval – I'm not talking about fancy drawings and stuff – they want to see a sample of the real thing… get the mould out immediately even if it means causing your moulder a near-heart attack. If you promise to take something in a few days and you don't the client is going to tell other people and they will get there before you. That's the bottom line. It's as simple as that.* [Respondent 38: Founding CEO, Company 17 – rotational moulding]

Accepting the above "golden rule" as an industry best practice standard, does this, by extension, require complete in-house design and technological capabilities as necessary conditions? By account of respondents representing actively innovative, industry-leading companies, the answer is overwhelmingly affirmative; as attested to by the MD (Respondent 61), also at a rotational moulding company (second of two in the sample):

We have built in-house capabilities, capacity to do our own plant development, our own manufacturing asset development. We have got our own engineering shop which is very fit for purpose, with a laser cutting machine and so forth. We have got a computer-aided-design capability, so we have got obviously the electronic capability. But very importantly, we also have the skills that can put drawings together fairly quickly.

However, dissenting voices represented by representatives of other equally high innovators who outsource design and/or tooling due to lacking in-house capabilities or who have capability but outsource due to demand (volume) do not consider themselves disadvantaged to the extent that response speed is compromised – that is, on condition that such outsourcing is tightly controlled. The utilization of a dedicated technology partner is said to completely negate lag-time in these respects.

Upon approval of samples by the relevant stakeholders, manufacturing commences followed by distribution and/or marketing.

New ideas/ creativity generation (management)

The critical importance of new ideas, as the crux in regard to sparking innovation, is clearly underscored by the above considerations the above – or, as emphasised by Zaltman et al (1990: 3-4) their "manifestations as practices and products are the core of change".

By extension, need to actively encourage creativity right at all levels. Significant stratification is in evidence in respect of the extent to which creativity or the process of generating ideas is institutionalised. This spans random idea generation by individuals to deliberate structural arrangements as well as incentive or reward schemes.

With regard to institutional arrangements for ideas generation – characteristic of medium and large organisations; the following description can be viewed as representative of established practices in more advanced working environments (in this case at a 'high-end' supplier to the automotive industry):

We involve everybody in innovation. In addition to our weekly project meetings and two-weekly new project meetings, we have a bright ideas programme, we let our people throw ideas around. We also have open door policy – the production guys, anyone can walk in and have discussions with us. And that pretty much is where it's at – it's about developing or allowing people to do their own thing. [Respondent 28: Managing Director, Company 14]

In respect of *incentive schemes*, one company, for example, introduced an incentive programme whereby staff across all categories can earn up to 10% additional on their

wages/salaries by achieving certain targets in relation to improvements brought about concerning raw material cost, efficiencies, waste/reject, and so forth. Interestingly, (1989) found that *individual rewards* tend to *increase idea generation and radical innovations*, while *group rewards* tend to *increase innovation implementation and incremental innovations*. Furthermore, Mezias & Glynn (1993) found that without explicit support to the contrary, managers are likely to adopt a less risky course of action and focus on developing incremental variations of existing products; that is, at the cost of stimulating radical innovation required to create new markets and alter the basis of competition.

Funding channels for stimulating innovation

> *Something we've discussed of late is the amount of time and money we spend on development and not really being able to get a return on it. Because no company will give you an order number for development, it just doesn't happen, so you have to have faith and believe that you'll get your order to make it viable.* [Respondent 31: General Manager, Company 15 – Medium]

The above statement is representative of a much-bemoaned industry (manufacturing generally) trend of clients generally not offering – if not refusing – to compensate suppliers for product development costs incurred. As emphasised in the literature, dedicated innovation-stream funding channels are essential for enhancing innovation capacity. Only two companies reported dedicated budgetary provision being in place in support of innovation-focused research and development as well as inter-divisional collaboration.

3.6.6 Sales and marketing capability

> *The world economy has moved from a pull economy to a push economy. In other words in the old days, you use to make stuff and you used to stand in queue to buy it you know, now there is surplus capacity so you pushing a product into the market and, essentially, the importance of sales and marketing has really increased. It is putting the right product in the right place, putting it in at the right time, looking at the right distribution channels, having the right sales people. It is really, really important to get to know your customers, building long-term relationships with them. And our company has done that very well.* [Respondent 33: Sales Manager, Company 15]

Whilst the key sentiments in the above assessment are generally endorsed by respondents, divergent positions emerged in respect of the actual need for marketing and the most effective or "best" way for conducting sales and marketing.

A significant number of long-established SMEs (some who have in the meantime grown into large enterprises) to a significant degree underplay the notion of marketing (by virtue of being

sales-driven), essentially because of being sustained through reliance on direct trust- and loyalty-based customer/ end-user relationships grown over many years (historical client base) – that is, over and above securing new business opportunities by way of competitive tendering. Another reason for subscribing to such an "it's completely about relationships" ideology is linked to the reported phenomenon of being "dragged along by buyers" – in the niche market context at least. A sales director of a long-established, highly successful company (Company 10 – Large) explains as follows:

> *Because this industry is so small you follow people around… so this guy was a buyer at Johnson and Johnson; he leaves J&J and he goes off to Ricket, where he leaves and he goes to Tiger Brand. I can name you 10 buyers who I have known for 30 years and they are at their fourth and fifth companies. And they just drag you along with them.*

With particular reference to small founder-director run companies, one respondent links the lack in marketing as established practice to the reality that "generally, highly-skilled technical people cannot market… they have really incredible plans in theory but to make those things work – those two things need to link with each other" (Financial Manager, Company 19). The latter aspect was indeed also highlighted by the MD at a large industry-leading "typically lean-entrepreneurial company"; with specific reference to "balancing the corporate side and the entrepreneurial ethos on which the company was originally founded" – that is, guarding against the former curtailing the latter to the detriment of innovative performance.

On the other hand, reaching out to prospective new clients as well as ongoing engagement with existing clients through electronic or internet platforms-based product marketing, though coming at a cost and requiring particular expertise, is advocated by many respondents, the younger generation in particular, as non-negotiable for succeeding in business in the electronically-connected world of today. One respondent from a dynamic small company explains:

> *In this modern era you need to be savvy in your marketing and you've got to be on the edge. You have to have an up to date Facebook page and a good website and the Google AdWords. Our website cost us a lot of money and we spend a lot of money on Google-add words in a month. But it is worth it at the end of the day, if you look at it, it is a working salesman – a 24-hour salesman reaching a broad audience. You have to be in people's faces all the time because after some time they will make a mental note, even if jut on an unconscious level, that connects them with your name and products.* [Respondent 50: Managing Member, Company 22 - Small]

Indeed, lacking electronic marketing capability – whether as a result of expertise or financial resource limitations – is fingered as a key contributing factor to the high failure rate among small start-up companies as this mode of marketing represents the only avenue available to such companies for promoting their products in the market place.

3.7 Implications for knowledge and skills development

- *So how do I differentiate? I differentiate by making sure my machines are better. BUT, the machines mean nothing without competent staff… so your focus is really also on the people.* [Respondent 5: General Manager, Company 2 (small)]
- *We have here a wonderful asset, you have access to wonderful markets, and certain of the plastics we do would be infinitely exportable but we don't have people. Provide the right skill and, trust me, we would produce quality products that will blow your socks off. It is literally that simplistic. At the end of the day there is no fundamental shortcoming other than appropriately-skilled people.* [Respondent 78: Sales Executive, Company 39 (large)]

Having considered themes arising from respondent descriptions of established innovation culture and practices in respect of sampled companies, the focus now shifts to knowledge and skill requirements to strengthen innovation and competitive capability at both company and sector levels – that is, in relation to occupational group-specific knowledge and skill requirements/ deficits as well as specific knowledge fields.

The main source of data in this regard comprises respondent reflections, supplemented by aspects implicitly-derived from relevant themes considered in previous sub-sections.

3.7.1 Knowledge and skills requirements in relation to occupational groupings

The occupational groupings emphasised as representing challenges in respect of a readily available pool of expertise essentially cover the full range of supplier staff categories.

The most commonly-highlighted competence shortcoming at operator level does not relate to technical knowledge and skill per se but rather fault-finding and trouble-shooting, a deficit which, as reported, takes on added significance given that ever-more complex machines being introduced and considering the reality of them working in an environment characterised in terms of “lots of moving parts”. As this competence shortcoming is reported to also be prevalent among long-experienced operational staff “no matter how skilled they are”, it is not deemed to be linked to deficits in technical knowledge and skill but rather associated with innate aptitude; which, by implication, touches on the need for

A critical scarcity of "good" toolmakers is overwhelmingly bemoaned as one of the key force-related factors inhibiting company competitiveness; and is indeed linked to the high degree of outsourcing of mould-making among sampled companies across all size groupings. In the case of small and medium companies, such outsourcing in many instances is a compensatory measure due to resource constraints given the capital investment required for establishing, maintaining and updating a highly functional tool room.

> *The mould is at the heart of your business – the crux of your success because it impact on the amount of waste generated etc. But mould-making [as an occupation] is very challenging: you have to understand the machinery part, the engineering side; you must understand the science behind the material side and you must understand the mould – how to run it. And the crux of it all is an understanding of the combination and logic behind all three these components.* [Respondent 24: Change management consultant to industry and former owner of successful companies.]

Scarcity of "quality" maintenance artisans – millwrights / fitters and turners, electricians and plumbers – possessing the appropriate industry-specific technical aptitude, capability and experience is similarly decried; given the rapidly-diminishing pool of "old guard" artisans. Whilst inadequate initial skilling, including workplace integrated learning, is identified as a key contributing factor… "they are being cranked out but can't even wire a plug, never mind fault-find!" (Respondent 70: Factory Manager, Company 32 – large), concern is also expressed that a vocational career in manufacturing has lost appeal among youth – "a mind-set thing of not wanting to get your hands dirty getting a machine to work; preferring rather to be stuck behind a computer or doing an intellectual activity that has an engineering base" (Respondent 22: Group HR Manager, Company 10 – large). One direct consequence of lack in availability of this vocational grouping is that existing toolmakers are of necessity drawn into fulfilling a maintenance role at the cost of performing their core function.

Overall, though, insufficient availability of knowledgeable and skilled *machine setters and tuners* emerged as the most pressing occupation-specific demand and supply disconnect. In-house training and development of a machine setter by account of one respondent takes around three years whilst in the case of a tuner this period could extend up to five years "before you get any real return" (Respondent 65: MD, Company 30 – medium-sized).

As regards more specialized technical knowledge and skills requirements in relation to more workplace environments utilising more sophisticated or advanced manufacturing or production processes, for example, high-end suppliers to the automotive sector or secondary processes-focused chemical piping fabrication (glass-reinforced plastics); *the need for industry-ready pattern makers and laminators emerged as the most immediately sought after*

functionaries in specialised production environments (the latter involving "more of a combination than welding is" – HR Manager, Company 27, small).

Lack of access to a readily-available pool of plastics industry machinery-familiar *electronic or automation technicians* is said to leave smaller companies vulnerable, who as a result of resource constraints of necessity have to out-contract for such expertise; as one respondent explains:

> *We've got these fancy machines sitting here that cost a lot of money… but when they go down. We had one down last month through a simple software error which we had created for ourselves and it took us two weeks to sort out the problem. It gave me lot of grey hairs, I can tell you that… it was touch and go [with reference to stopping production altogether]. You see, we have to outsource the software side but you don't have the skill sets floating around. So we're continually having to hunt for the right person who understands your machine [in a moment of crisis]. It really is a big concern going into the future.* (MD, Company 12, small).

Finding suitably-qualified supervisors reportedly is a wide-spread problem, as is the lack of "really strong and competent" engineering professionals entering industry in any significant numbers with reference to senior management positions; and, in particular, populating the operations manager–general manager–MD supply chain, as it were. Unmet demand is also expressed in respect of industry-familiar or experienced process engineers/ managers.

3.7.2 Specific knowledge, skills, aptitude and attitudinal deficits

Foundational grounding in language, science and mathematics

Foundational grounding deficits in respect of *general competency in mathematics and science* and *language proficiency* are fingered all round as bedevilling operational efficiencies in various ways. As remedial measure, companies are increasingly resorting to senior certificate with mathematics and sciences as job entrance criteria at operator level. Even this being the case, actual competence levels reportedly still fall far short of the mark.

The following respondent statements convey the essence of how these knowledge and competence deficits play out in the workplace:

> *Some of the guys can't read job cards – they can't read the numbers and therefore do not understand the instruction. So you have to repeatedly explain to them and check on them* [Respondent 35: Director, Company 17 (rotational-moulding) – with specific reference to raw materials mix to be used]

You can't teach those people (entry-level prospective machine operators and setters) because they don't even have the basic maths and science training… there are less than half a million learners in matric doing proper maths and something like only fifty percent of them get more than forty percent. By these standards you need to pass with between eighty and ninety percent to have any chance of running or operating the advanced machines we have. This is our biggest problem now; it's a pandemic! [Respondent 22: Group HR Manager, Company 10].

Conceptual thinking / theoretical understanding

Lack of *conceptual thinking ability* represents another generic competence shortcoming repeatedly emphasised by respondents, resulting in operational staff "not being able to gain the required theoretical or conceptual understanding as to why they have to do certain things in a certain way" (Respondent 66: Quality Manager, Company 30). This holds particular significance in the context of increasingly complex production technology and processes characterising workplace environments.

Collectively, the above range of shortcomings are reported to severely inhibit in-house training efficacy. Two additional complicating factors noted in this regard by a respondent are: a) reluctance or resistance on the part of affected staff members to enrol for ABET or other language proficiency development interventions as they perceive these as representing an agenda for exposing their shortcomings or ignorance ("make them look stupid") and, for the same reason, b) refusal to submit to written tasks or assessments; with the result that these have to be conducted orally.

Arising implicitly from the above is the need training delivery "innovation", as compensatory measure. "Best practice" reported at one company in this regard comprises the following:

So with training, mostly all we can do is practical stuff, not theoretical training… and then you have to show examples by means of pictures or other visuals instead of being able to use course notes and illustrations. [MD: Company 30, medium-sized (injection/blow-moulding)]

… *you actually have got to change your whole training approach and plan to accommodate the people who are illiterate or not as literate as the next guy.* [ibid – Training Administrator]

On account of other respondent reports, some companies resort to increasing automation of machinery and processes as a pragmatic approach to coming to terms with this particular human resource capability issue – so as to remove control from operators, if not the need for these functionaries altogether.

Strong critical thinking / problem-solving capacity lacking across all occupational groupings

As noted previously, a reported industry-wide deficit in fault-finding and/or problem-solving capability among the new generation of manufacturing-sector job entrants – first and foremost in respect of artisans, but also extending to technicians and engineers. As regards the former category and with particular reference to maintenance artisans, the urgency associated with in-the-moment trouble shooting and repairing capability in cases of breakdowns is bluntly stated as follows:

> *The tool must be changed… he must find the fault; and it must be fixed now – immediately, so that it doesn't affect production.* [Respondent 45: Director, Company 19, medium-sized (extrusion/piping)]

And then of course they also have to contend with problem-solving challenges as they emerge in the course of preventative or scheduled maintenance tasks performance.

At professional engineering level (technician, technologist, engineer) the focus shifts away from hands-on to more systems level problem-solving, with particular reference to process and performance data-driven continuous improvement projects, which indeed call for problem-solving or logical processes specifically of the innovative kind.

However, whilst extensive respondent engagement and respondent agreement on the centrality to manufacturing/ operational and indeed organisational efficiency – in pursuit of differentiation/ competitive advantage attainment – of a grounded organisation-wide "innovative" problem-solving or solution-seeking and related decision-making capability and culture; there is at the same time agreement on a problematic surrounding the essential nature or character of problem-solving a knowledge-skill-aptitude phenomenon, so to speak; whether is teachable or not.

Cross-over knowledge and skills required with regard to maintenance artisans – with particular reference to SME context

3.7.3 Ability/ aptitude and attitude

Aptitude (problem-solving) and attitude (willingness to learn) are viewed as key determinants of successful on-job learning, work performance and progression

> *I'd rather have somebody has the ability to learn and the willingness to learn but lacks the formal knowledge and skill than someone who has a formal qualification but lacks these personal qualities.* [Respondent 73: HR Manager, Company 27 (compounding)]

Two dramatic career progression instances stemming from such positive attitudinal inclinations reported at a compounding company involve a) a "youngster" who started as

painter and within eight years progressed to quality and process manager and “given the opportunity, he would obtain a degree, no question about it because he is so determined”; and, b) a receptionist who progressed to the rank of logistics and procurement clerk, “now handling a R20m a month procurement account plus all of our suppliers” (ibid).

Whilst the PSA is lauded for the assessment service rendered in this regard, a “prohibitive” pricing structure is said to prevent uptake by smaller companies, who stand to benefit most from such a offerings.

Prevalence of a culture of entitlement and excessively unrealistic expectations in relation to career advancement and material gain

Recommendation:

With reference to a reported tendency of negative attitudes to work/job, once secured; the need for instilling a “work-and-values” culture among job entrants was highlighted

In contradistinction to the above stands the bemoaning of a high prevalence negative personal attributes on display once a job has been secured. These range from labour “becoming more defiant if not militant” with regard to declaring themselves untouchable when lax attitudes are pointed out (like “playing on their phones at 02h00 whilst the machines are running”) by virtue of claimed political party or labour union backing; complacency standing in the way of appropriately-skilled and knowledgeable taking initiative when the situation so demands – in respect of problem-solving or trouble-shooting in particular; and unrealistic expectations by newly qualified appointees as regards career advancement, with particular reference to material gain and promotion to managerial level.

In the context of the above, many an ‘exasperated’ respondent made pleas for a stronger emphasis on work and workplace-related values training to be incorporated workplace readiness preparation of prospective employees in manufacturing environments.

3.8 Respondent recommendations for strengthening the sector

It was decided to only present respondent recommendations of an over-arching nature as the findings in the sub-section on industry-related factors inhibiting innovation performance hold self-evident implications for remedial action.

For companies and the sector to become more competitive (internationally) essentially requires:

- *Instilling of passion and mind-set for design and innovation*
- *Putting in place the necessary systems for promoting innovation*

- *Support from government, which is not sufficiently forthcoming at this time*

The putting place of a neutral structure / body ('broker') for bringing together all stakeholders to make the sector healthy and competitive – on the basis of a "big picture"-based integrated strategy to promote a collaborative approach to common problems as well as opportunities

- *Strategy formulation should be informed by a "big picture" emerging from a round table (all relevant stakeholders) debate as to what exactly are the key issues that must be addressed in an integrated way – "not just a case of more training" – and what would be the most effective way of taking it forward*
- *The strategy must outline goals, allocate agreed-on roles and responsibilities to specific role players/ stakeholders; as well as make provision for specific costs for implementation*
- *The Department of Trade and Industry (dti) should approach Parliament to task the Department of Science and Technology (DST) to put money into research*
- *The dti should make funding assistance available to take the research to industry – in respect of which the Plastics SA CEO must play a central role*
- *The dti should beseech the Industrial Development Corporation (IDC) to commit to an industry recapitalization programme so as to make cheap loans available; with merSETA playing a coordinating role*

Value-chain based Cluster Model for industry strengthening

- *The basic principle is to try and get the whole supply chain together in one place and the also even competing companies in the industry – the latter feed of each other / drive each other from an innovation point of view. They share ideas, they learn from each other they share people so that is what makes everything a lot more efficient and it drives the industry forward. People must not be scared of competition, because competition is what drives growth. If there is no competition the industry will stagnate – it's good to have competition, healthy competition obviously.*
- *There has to be an integrated strategy so you want to start from, especially in plastics, because plastics are a recyclable product. So you need to have an integrated system so it ties in with the whole recycling process so you want to get the finished product that goes out in the market place once it's been used you want to get it back into the cycle – starting with your waste sources through your waste collectors, through your recyclers, through your convertors, and then all the way back to your consumers and the feeding*

back into the whole process. And you want to keep it local; you want to keep it as a local cluster

- *There needs to be a certain infrastructure in place, so infrastructure from the waste management point of view. Because as I said with recycling you need the economies of scale, so you can't have every company doing its own thing because then it is just not efficient.*
- *So it needs to be more an overall thing, you need to have an overall waste collection that gets fed into your recycling industries that then feeds your different convertors.*

Plastics SA should team up with merSETA and the government and do basic plastics training, 50 people at a time – who have first been assessed with regard to aptitude and willingness to learn. This initiative could either be fully-funded by government or on completion of their training, after assessed as competent and industry-ready, such trainees could be pooled, from where theybe hired out to industry (R10,000?)

As key industry player, SASOL should revive its training provision role and infrastructure for training provision to the industry at large

PART FOUR

Overall discussion, recommendations and conclusion

4.1 Overall discussion

In terms of the overall research focus, the investigative intent was to uncover what the empirical evidence – established culture and practice – ultimately says about the essence of innovation (capability) as a force of change and fortune the plastics industry environment. In the answer to this central question lie the seeds required for strengthening and growing a "distressed" plastics industry sector.

It became clear, repeatedly and emphatically so, that all the latest and best technology in the world cannot in and of itself ensure differentiation or competitive advantage and market position achievement as outcome (though it may certainly aid in this) as everyone can obtain (theoretically at least) such means. Differentiation is achieved through the "clever" use of such means, which is dependent on the 'quality' and veracity of (an organisation's capacity for) creativity displayed in respect conceptualisation and design and attendant implementation efficiency in relation to product, service or process innovation or "creating" – on a for-profit basis and market (segment) demand-aligned basis. In a strict radical innovation sense, product innovation assumes an engineered product, in relation to which plastic may or may not be used as preferred material (if the case, then a grounding in materials science naturally is a prerequisite).

As a theoretical construct, organisational innovation capability is the synergistic or holistic outcome of the integration of various key organisational capabilities or elements and expressed in terms of competitive advantage-enabling innovation performance, as measured (in the strict sense) in relation to propriety products and patents delivered. But such products in and of themselves cannot guarantee market position – a necessary condition for which is consistency of supply or service (requisite quality assumed); on time-in full, every time. As such, competitive advantage is assured through the dynamic interplay or integration of the creativity of the innovation stream and quality, efficiency, flexibility and speed as attributes of the business mainstream.

Of the sampled companies clearly on the top of their game, whether convertor or compounder or recycler; what they all have in common is the successful execution of the above recipe for success. In essence, this boils down to the institutionalisation of innovation capability and culture on an organisation-wide basis, as expressed in the dynamic and finely-balanced integration of entrepreneurial flair (natural inquisitiveness, never-say-die attitude and creative

problem-solving) as driver of innovative conceptualisation and design with sound business or corporate principles and practices – an 'ambidextrous' organisational orientation to doing business involving a happy marriage of new-/ innovation-stream and mainstream dimensions.

4.2 Overall recommendations

Overall recommendations for sectorial strengthening are aligned to the above "essentialist" or dynamic capabilities-focused analysis and interpretation of empirical data concerning the characteristics of highly innovative and strongly competitive companies. It will assume the format of Theory of Change for addressing the sectorial need for strengthening.

Problem statement:

- For the majority of manufacturing companies embedded in the plastics industry – across all size and process-methodology categories – surviving, never mind thriving, at this time constitutes an ongoing struggle against considerable challenges.
- Some of these are of their own making (whether strategic or resource related) whilst others stem from factors in the broader environment over which they have no control but have to respond to in adaptive (innovative) ways to remain sustainable, first and foremost, and competitive.
- In all, the plastics sector at this time finds itself in a state of distress (as is the case with other industry sectors); as evidenced in particular by the high failure rate of small, and to a certain degree medium-sized companies – not just start-up companies but also long-established "third or fourth generation" enterprises.

Remedial Objective:

To instil or strengthen innovation culture and capability in struggling companies in the South African plastics industry sector in order to be (become) more sustainable and competitive in increasingly tough local, regional and global markets.

Theory (assumptions) of Change:

IF struggling or 'not-sufficiently' competitive companies (SMEs):	***IF, at sector level:***
Assess ("soul search") – supported by industry change management experts – their current strategic orientation to and capacity strengths and weaknesses (including R&D)	All value chain constituencies as well as all other relevant industry stakeholders come together in the spirit of collaboration and support – under widely-supported leadership – for a strategic review or 'diagnosis' of sectorial

with regard to being able to "innovatively" play in the market *and* Implement the identified organisational changes required for bolstering organisation-wide innovation capability *and* Remain committed to the path set through such re-focusing and reinvention *and* Receive the required external support and assistance from government and other relevant sectorial stakeholders	health and well-being, with a particular focus on SME support requirements *and* The debated and agreed-on vision or "prescription" for sectorial strengthening is translated into an integrated Sectorial Strategy and Plan; *and* Stakeholder role and responsibility allocation is clearly stipulated and agreed on and resource provision adequately quantified *and* A framework for monitoring and evaluation of strategy implementation is developed and enacted *and* Knowledge-rich networking and collaboration is enacted, with a strong focus on research
THEN Previously-vulnerable or underperforming companies will have the internal capacity to respond creatively (innovatively!) and efficiently to both opportunities and challenges on their path	***THEN*** Sectorial challenges and opportunities can be responded to and addressed in nuanced (innovative!), effective and sustainable ways
AND THEN Convertors, compounders and recyclers will boast innovation capabilities allowing them to successfully compete and flourish in the market (local, national and international contexts), which translates into a robust and thriving plastics industry sector	

5.3 Conclusion

The overall purpose of this investigation was to establish how innovation is situated and plays out – its nature and dynamics as embedded at company level – in the plastics industry and the implications for support, human resources in particular, so as to develop or strengthen overall sectorial innovation capability.

At the end of a long process of discovery and analysis the researcher has reached the same overall conclusion as embedded in a respondent statement in the previous section concerning sectorial strengthening and, which indeed also appears to be a view held by the CEO of Plastics SA: that the only way to remedy the currently distressed plastics industry (by and large) is through “more” and “better” innovation on an industry-wide, company-by-company basis. “Better” in this case relates to product innovation of the discontinuous or radical kind – assuming that systemic constraints would be resolved (for most part, at least).

In this view, innovation culture or capability clearly translates into a human resource issue; in particular, the mind-set or perspective and attitudinal change required to embrace the creativity-driven innovation challenge together with organisational change invariably required – instead of remaining on a pre-set, efficiency-focused and safe business pathway not always leading to differentiation.

The researcher has encountered too many striking instances of successful institutionalisation of innovation – across large and small enterprises, whether convertor, compounder or recycler – not to conclude that there is sufficient reason to believe that the South African plastics industry sector can be strong and flourishing; and also considering that global best-of-the-best practices can be found on our own doorstep (if only they could be shared?). The core requirement for releasing the innate creative force embedded in the sector is for visionary leadership and an integrated sectorial strategy to be put in place to guide the collaborative effort needed for resolving the issues currently undermining sectorial health.

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Appendix 1: Research Questions (Interview Guide)

merSETA–Plastics Chamber Research 2016:

Manufacturing, Innovation & Competitive Advantage

Interview Guide

Research Purpose

The overall purpose of the research project is to explore *company-level innovative systems and practices* and associated the skills and knowledge requirements – in the context of a futures-orientated advanced manufacturing and sustainable development environments – as a basis for growing the Plastics industry sector in South Africa.

Interview Focus

The following innovation-related aspects and issues will be explored:

- market trends and demands and the need for innovation; with particular reference to advanced manufacturing and sustainable development contexts
- brief company overview (structural-functional aspects) and extent and nature of established or embedded innovative practices and outcomes at your company
- key elements or competences that influence organisational innovation capability → innovation performance → overall company performance and competitive edge
- human resource management–innovation management alignment
- suggestions towards an integrated innovation (capability) model for informing 'best practices' – at both company level and sector level

Note:

Participants from companies at which (high level) innovation is not (yet) a core dimension of organisational culture should not in any way feel that their contributions may not be of value.

1. Context: manufacturing and the need to innovate

"The literature says":

The emergence of the knowledge economy, intense global competition and considerable technological advances – with particular reference to the demands associated with advanced manufacturing (and materials) and sustainable manufacturing – has *seen innovation become*

increasingly central to competitiveness as it is the mechanism by which organisations produce the new products, processes and systems required for adapting to changing markets, technologies and modes of competition.

Escalating levels of commitment to innovation are required simply to stay in the same place, much less improve competitive position.

"Firms do not compete on new products, but rather on a deeper factor — the capacity to create new products and processes and respond to changing market circumstances".

1) *With reference to the above, what in your view are some of the key market-related drivers of change in the plastics and related industries sector in South Africa – currently and into the future?*

2) *By extension (if not already noted), what do you consider to be the most pressing and challenging implications that individual companies as well as the sector have to contend with and to survive and thrive in such an environment?*

2. Your company and innovation

2.1 (Brief) Company Profile

- History (how long in operation) and nature of company (size, growth, etc.)
- Core business focus (past-present-future perspective to indicate changes, if any) – in relation to Plastics Value Chain
- Business Model | Organisational structure, systems and processes
- Human resource (management) related aspects – staff categories, expertise development and gaps, etc.
- Production and management systems and processes

2.2 Innovation focus and practices

3) *To what extent is your company innovation-orientated?*

4) *If so, what types of innovation?*

5) *With reference to product and process innovations (as relevant), please describe your company's established innovation practices – how does the innovation process 'typically' work in your company, "from beginning to end" (initiation through to adoption)?*

6) *What aspects of the innovation process work well / are successful and in what respects are difficulties experienced (which frustrate successful outcomes)?*

2.3 Innovation Capability & Innovative Performance

7) *What would you regard as core elements and processes – key competences and resources – that are essential for developing effective/successful organisational innovation capability and innovative performance?*

8) *From an innovation management perspective, what are the specific human resource requirements 'to make it all work'?*

9) *What significant innovative outcomes or changes (including 'management innovations') have been produced to date which can be credited for strengthening your company's competitive edge and, ultimately, increasing its market share?*

10) *What are the main internal and external factors (contextual conditions) which support / inhibit the effectiveness of your company's innovative capability and performance (including overall management) in support of overall company performance?*

11) *How would you rate the effectiveness or success, at this time, of your company's innovation capability and performance and relatedly, overall company performance?*

12) *In your view, does company size (necessarily) play a determining role concerning innovation capacity?*

3. Strengthening the sector

13) *What appear to be the main factors or contextual conditions that are currently inhibiting sectoral growth?*

14) *What in your view are 'obvious' opportunities or avenues for promoting sectoral growth?*

15) *What possible support measures could be considered to realistically mediate these constraints in both short and long term and also bearing in mind the particular needs of small companies?*

4. Suggestions towards a generally-applicable innovation model for best practice promotion

Finally, as a way of consolidating our reflections and discussions concerning various innovation-related dimensions at company-level as well as sector growth-related aspects and issues – and with reference to international established practices:

16) *What are your suggestions for an Integrated Innovation Model that could inform best practices on a sector-wide basis?*