



# Responding to Shifting Demand for Skills

How do we get firms and post-school education and training organisations to work together?

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How do we get firms and post-school education  
and training organisations to work together?

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## ABBREVIATIONS AND ACRONYMS

AIDC	Automotive Industry Development Centre
ASCCI	Auto Supply Chain Competitiveness Initiative
DHET	Department of Higher Education and Training
DST	Department of Science and Technology
dti	Department of Trade and Industry
GDP	gross domestic product
HCDP	Human Capital Development Programme
ICTs	information and communications technologies
IDZ	industrial development zone
merSETA	Manufacturing, Engineering and Related Services Sector and Training Authority
NASSP	National Astrophysics and Space Sciences Programme
NATED	National Technical Education
NCV	National Certificate (Vocational)
NQF	National Qualifications Framework
NRF	National Research Foundation
NSFAS	National Student Financial Aid Scheme
NUMSA	National Union of Mineworkers of South Africa
OEM	original equipment manufacturer
PSET	post-school education and training
SARCHIs	South African Research Chairs
SASA	South African Sugar Association
SETA	Sector Education and Training Authority
SKA	Square Kilometre Array
SMRI	Sugar Milling Research Institute
SSI	sectoral system of innovation
STC	Shukela Training Centre
TVET	technical vocational education and training
UCT	University of Cape Town
VLBI	Very Large Baseline Interferometer





# INTRODUCTION

Firms in South Africa are challenged to upgrade their technology and to innovate so that they can become more productive and competitive in a global and national economy. At the same time, they are challenged to create more jobs for sustainable and inclusive growth in the context of high unemployment and growing inequality. This means that the nature of the education, training and skills required is changing rapidly, challenging post-school education and training (PSET) organisations to be more flexible, adaptable and responsive.

In light of this, and to contribute to improving alignment between dynamic skills demand and supply, the White Paper for Post-School Education and Training (2013) sets out a vision for an integrated and responsive PSET system. The sector education and training authorities (SETAs), colleges and universities will be expected to play a strategic role, engaging and consulting with stakeholders, to more effectively link education and work in line with their distinct missions. To support this, a key strategic priority articulated is to create an institutional mechanism for skills planning. The White Paper proposes that effective skills planning should inform supply-side planning in PSET organisations, particularly the development of new qualifications and programmes, funding priorities, sectoral or regional plans, and so on.

In the PSET domain, however, concern is expressed that the role of universities and colleges should not and cannot be reduced to the narrow instrumental function of preparing skills for the labour market.

And questions are posed criticising the assumptions of the human-capital approach that typically underpins skills planning globally and in South Africa. In particular, the assumption that increased education and training and skills will *lead* to economic growth – or that employability will lead to increased employment – is challenged. Evidence of global economic trends and rising unemployment is cited to support calls for a more critical engagement with the relationship between education, skills and economic growth. Nonetheless, and despite these critiques, it is indisputable that work is intrinsic to human well-being, and that a core role for universities and technical vocational education and training (TVET) colleges is to prepare young people for active participation in work and the economy. To achieve *that role* in the interests of inclusive national development, more effective strategic planning and interaction with firms and intermediary organisations (such as industry associations or SETAs) is crucial.

We cannot, however, assume that universities or colleges or firms will *automatically* respond to a call to produce the number and kind of qualifications and skills that may be required at different levels for specific occupations in key sectors in order to meet firms' current and dynamic future skills needs. Universities and colleges may have their own contrasting priorities and strategic missions, may lack the expertise to respond effectively to firm demand, or may lack the mechanisms that support external linkages with industry and firm partners. Similarly, we cannot assume that firms have either the commitment or the expertise and capacity to engage with education and training organisations.

A central challenge for the implementation of the goals of the White Paper thus lies within the capabilities of key organisations:

*How do we ensure that, in the South African context, PSET organisations have the will, matching expertise and capabilities to meet industry demand?*

We propose that firms and skills planners need to have an enhanced understanding of the capabilities of PSET organisations so as to inform and influence their core education and training activities. And, in turn, universities, TVET colleges, and other public and private providers need to have an enhanced understanding of how they can respond to the changing technological capabilities and skills needs of firms in relation particularly to professional, occupational and skills-oriented programmes, and to their role in producing graduates for the workplace and the national economy.

To achieve this, we adopt an innovation systems approach, grounded in evolutionary economics, which is a conceptual framework that has not yet been used systematically or widely in South Africa to inform skills planning. For an innovation systems approach, at the heart of explanations of economic growth and development is a focus on the *alignment* between knowledge, skills and capabilities for learning in firms, and those in the education and training subsystems, that is, on capabilities for knowledge, technology and innovation. It is a dynamic approach, tracing change over time and highlighting how previous historical trajectories and conditions shape what is possible in the present. It offers a systems approach that maps the main actors in key systems and subsystems, the linkages and networks between them, and flows of knowledge and resources for learning and innovation. Such an approach enables us to identify weaknesses that may lie *within the system*, including misalignment between networks, missing organisations, and critical blockages of flows of knowledge and resources.

Alternately, weaknesses may lie *within organisations*, related to their interactive capabilities. By ‘interactive

capabilities’ we mean the capacity of a university or college or firm or government agency to learn and develop effective strategies or mechanisms in response to new goals or economic and social shifts. So, we may have a large group of highly qualified graduates who have the competences (in the sense of basic attributes) required by firms. However, it is only through interaction and learning that these may become technological capabilities for firms or academic capabilities for education and training organisations. This, in turn, enables us to identify how education and training systems can act to constrain or facilitate economic growth and highlights spaces for intervention.

## About this report

This report represents work in progress, that is, a first attempt to synthesise and highlight trends emerging from our research, primarily to inform initial discussion and debate.

We have conducted three in-depth case studies that provide a systemic analysis of capability-building in a sectoral system of innovation that is regionally bounded: astronomy and the Square Kilometre Array (SKA); automotive component manufacturers in the Eastern Cape; and sugar-cane growers and millers in KwaZulu-Natal.

Main sector of economy	Sectoral system of innovation	Geographical spread	Un/structured approach to skills development
Primary sector	Agro-processing: Sugar	KwaZulu-Natal	Industry-led schemes and ad hoc
Secondary sector	Automotive: Component manufacturers	Eastern Cape	Government and industry-led schemes and ad hoc
High technology	SKA	National/ Western Cape	Foresight and planned skills development

The first three sections provide a short synopsis of each case. The fourth section begins to explore how we can ensure that PSET organisations have the will, expertise and interactive capabilities to address firm demand. (Detailed reports on the case studies and conceptual framework can be accessed on the project website: [www.lmip.org.za](http://www.lmip.org.za)).

# CASE 1

## THE SKA AS A SUCCESS STORY OF SKILLS AND TECHNOLOGICAL CAPABILITY-BUILDING

This case provides an instance of a structured and focused public-sector intervention to develop high-level skills needed for global competitiveness, aligned with strong university-based dynamic interactive capabilities.

In recent years, astronomy has emerged as a growing niche within South Africa's national innovation system. Geographic advantage has been successfully leveraged by long-term public support, including policy measures to protect geographical areas suitable for astronomy, and sufficient funding to establish competitive, world-class astronomy facilities. However, it became clear to strategic movers from the early stages of the Square Kilometre Array (SKA) bid that this geographic advantage would have to be complemented by hugely increased capabilities in terms of astronomy and engineering in order to tilt the odds of success sufficiently in South Africa's favour, and to justify the large investments that would have to be made. Thus, backed by high levels of public, political and financial support, highly co-ordinated skills development efforts were rolled out that required intensive interaction between actors on the skills demand and skills supply sides of the sectoral system of innovation. The allocation of the SKA project to South Africa has accelerated this growth trajectory, which will continue as the instrument scales up over the next decade.

The SKA requires a host of competences and capabilities for interaction to meet its core mandate. The SKA organisation itself can even be defined by these capabilities – being able to connect skills, knowledge, technologies, networks, institutions, intermediaries, and funding in order to deliver the

world's largest science project in a developing country. The context in which this takes place is inherently dynamic, along two major axes. Firstly, the SKA is operating in the context of very rapid growth in radio astronomy in South Africa, which is largely made up of the organisational growth of the MeerKAT and SKA itself. Secondly, the technologies underpinning the SKA are rapidly changing, but, in some areas, are not yet developed. This requires advanced capabilities in technology forecasting.

### **A densely connected local network linked into global networks**

Astronomy represents a case of a sector that requires high skills levels, high technology levels, and advanced interactive capabilities. It includes applied research, basic research, and 'blue sky' research. The contours of the sectoral system of innovation that achieve this include actors based within universities, science facilities (such as large national telescopes), research institutes, firms (largely engineering firms), local and international intermediaries (both public and private), and policy support at the national level (see Figure 1). The SKA innovation network is densely connected globally, with the main actors all connected to one another, surrounded by a large penumbra of peripheral actors spread around the world. Multiple networks, all global in scale and intensive in their levels of engagement, are connected through the axis of the global SKA project, which, in turn, overlaps with other networks in the broader astronomy innovation system. The organisation is driving skills development and interaction in African partner countries through the African Very Large Baseline Interferometer (VLBI) network, and by acting as a

network node for many African universities. This structure partly explains the richness of interaction, and also its ability to facilitate the rapid growth and international success of recent years.

## **Skills needs in the astronomy sector and the SKA**

Firms and science facilities in the astronomy sector have a range of skills needs. Among firms, routine skills needs include demand for a wide range of engineering specialists and technicians. Among science facilities, both astronomy skills and engineering skills are required. Given the very rapid rate of growth in the sector, the ability of firms and science facilities to adapt to non-routine changes in the environment is critical. The ability of the astronomy sector as a whole to anticipate these changes and make strategic decisions was one of the factors that enabled the successful allocation of the majority of the SKA to South Africa. Only five years ago, the skills pool available for astronomy was much smaller than it is currently, and Afro-pessimism prevented some actors from looking ahead to the upcoming growth prospects. However, strategic action and conscious efforts to facilitate interaction have largely overcome these challenges, even within the constrained South African skills landscape. Niche areas of skills have been strategically developed over time to meet the needs of the sector. Dedicated research into skills requirement projections, matched with a high level of funding from government actors channelled into the higher education system, has rapidly grown the competences available to employers and greatly increased South Africa's capabilities and competitiveness in the international arena over the last decade.

## **Strong network alignment as an advantage in the SKA skills development system**

The astronomy sectoral system of innovation benefits from strong network alignment among its key actors. There are several forums, both formal and informal, in which the main employers in the sector engage with the main skills development organisations in order to align curricula, research,

and funding. These include forums based within universities, such as the National Astrophysics and Space Sciences Programme (NASSP), as well as those based within science facilities, such as the SKA's Human Capital Development Programme (HCDP).

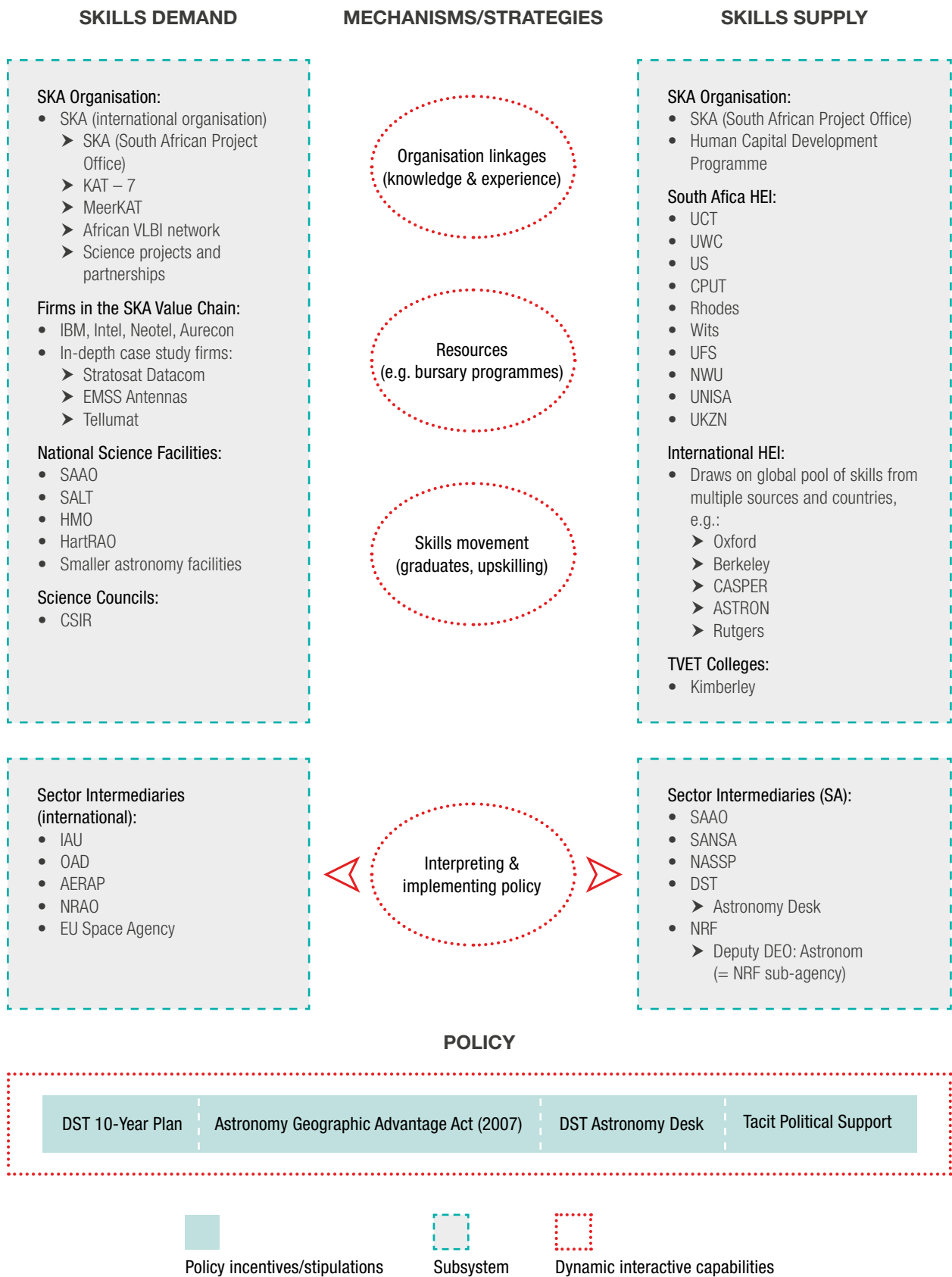
Among public-sector intermediaries, the Department of Science and Technology (DST), the National Research Foundation (NRF) and the Department of Higher Education and Training (DHET) have each conducted evidence-based research and developed strategic approaches to the planning and funding of skills development in the sector. This has included dedicated funding for South African Research Chairs (SARChs) and for the SKA's HCDP. More importantly, perhaps, strong informal linkages exist between individuals and organisations, generating widespread awareness of skills demand and skills supply issues among all the major actors.

## **Post-school education and training organisations addressing skills needs**

Skills needs in the sector are primarily addressed by South Africa's research universities, with a smaller role played by universities of technology. Within research universities, departments of physics, mathematics, computer science, and engineering are the most relevant. Only the University of Cape Town (UCT) hosts a department of astronomy, which has been a key actor. Various modes of interaction between astronomy employers and universities have proved significant, in ranking order:

1. The availability of high-level niche competences and capabilities among academics with strong academic reputations, in fields of astronomy, engineering, mathematics, and information and communication technologies (ICTs,) is a necessary (but not sufficient) condition for interaction.
2. Interactive capabilities vested in individual academics, particularly premised on tacit competences for interaction that facilitate the maintenance of informal networks with SKA, science facilities, other international academics

**Figure 1: Capability-building processes in the astronomy sectoral system of innovation**



and firms, have played a central and catalytic role in all main interactions.

3. Interactive capabilities vested at the departmental level and faculty level that support interaction have at times provided space and support for interaction (particularly in engineering) (for example, participation in the HCDP and the NASSP forum).
4. Interactive capabilities at the institutional level play only an indirect role, primarily in terms of influencing the overall performance of the academics and the university (for example, a university contracts or technology transfer office provides support or a bursary office that manages and supports postgraduate students).

Despite the clear need for vocational skills within the expanding astronomy sector, efforts by the SKA to engage with public TVET colleges have so far proved to be only partly effective. One TVET college, as a result of its geographical location, has been the test bed for this engagement. It seems that limited competences and interactive capabilities, and opaque college leadership, have constrained the efficacy of the interaction and the production of outputs, with an apparently low return on investment.

### **Challenges to skills development in the SKA**

Of course, challenges remain. Astronomy is a highly globalised activity, and astronomy actors in South Africa also draw on international sources to meet their skills needs. Gaining entry for international employees is a major constraint – the process is slow, expensive, and unpredictable, which acts as

a bottleneck on skills supply. Another challenge is that the TVET system has insufficient competences and capabilities to meet the SKA's requirements.

At universities, undergraduate curricula in science and technology reportedly change slowly, making it difficult to adapt to rapid and radical change. None of these problems have, however, been critical, and all of them are actively identified for mitigation by various actors in the sector.

### **The SKA project: a success story**

Overall, the SKA provides a success story, showing how a South African organisation can meet demanding mandates and achieve excellence on the international stage. This has required alignment of a set of conditions, actors and networks, namely:

- Ample public funding;
- A long series of high-stakes calculated strategic risks that turned out to have very large net returns;
- Strong policy support at the top political levels;
- Well-organised and strategically oriented interactive capabilities required to manage the complex skills, knowledge and technology to deliver on the SKA mandate;
- Long-term, well-funded, well-informed, well-organised skills planning that has been responsive to the skills demands of the SKA; and
- Academics, departments and universities with the competences and dynamic interactive capabilities required to interact in complex networks with the SKA, firms, science facilities and government, nationally and globally, for their mutual benefit.

## CASE 2

# MEETING ROUTINE SKILLS NEEDS IN THE TIER 1 AUTOMOTIVE COMPONENT SECTOR IN THE EASTERN CAPE

This case was selected as a sectoral system of innovation in which intermediate and high-level skills are critical to future growth of jobs and competitiveness, and in which there has been a structured industrial policy intervention on the part of the state (although not focused on skills specifically).

The automotive sector is of huge economic, political and symbolic importance to South Africa. It is a significant part of South African industry and of the economy as a whole. In 2012, it contributed 7% of gross domestic product (GDP). This underplays the true significance of a sector that contributes more broadly through its multiplier effect to the development and health of a range of related manufacturing sectors. The sector is a major employer, with over 100 000 directly employed in manufacturing and another 200 000 in supporting and related services. Moreover, it is a vital part of South Africa's export strategy, with over 50% of its output being exported. It has therefore been a significant recipient of state subsidies through the Industrial Policy Action Plans over the past two decades. The sector is also of political significance. The importance of the car as a symbol of modernity and the national pride linked to having a vibrant automotive industry should not be discounted, particularly as South Africa is home to two of the most powerful brands in the sector: BMW and Mercedes.

Our case study focused on the Eastern Cape province, and on the sectoral system of innovation around 'Tier 1 firms': the main component suppliers to the global automotive manufacturers.<sup>1</sup> The Industrial Policy Action Plan III identified as a pressing need the importance of supporting the component sector to strengthen its position globally and the technological upgrading of local component

firms has been identified as a priority. There have been valuable efforts to interact to build capabilities within the sector, with the key organisations involved identified in **Figure 2**.

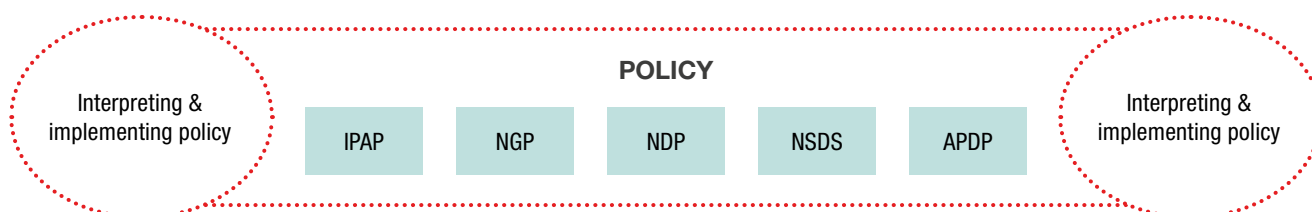
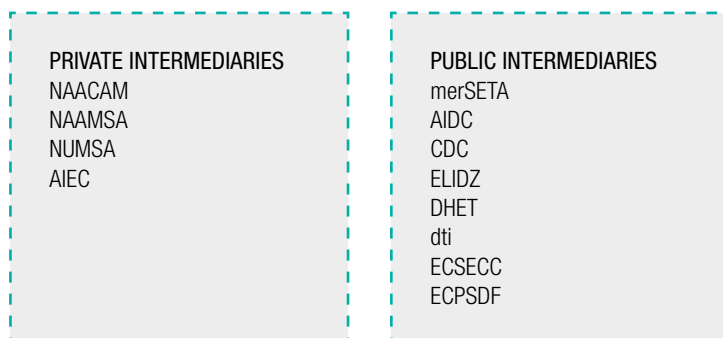
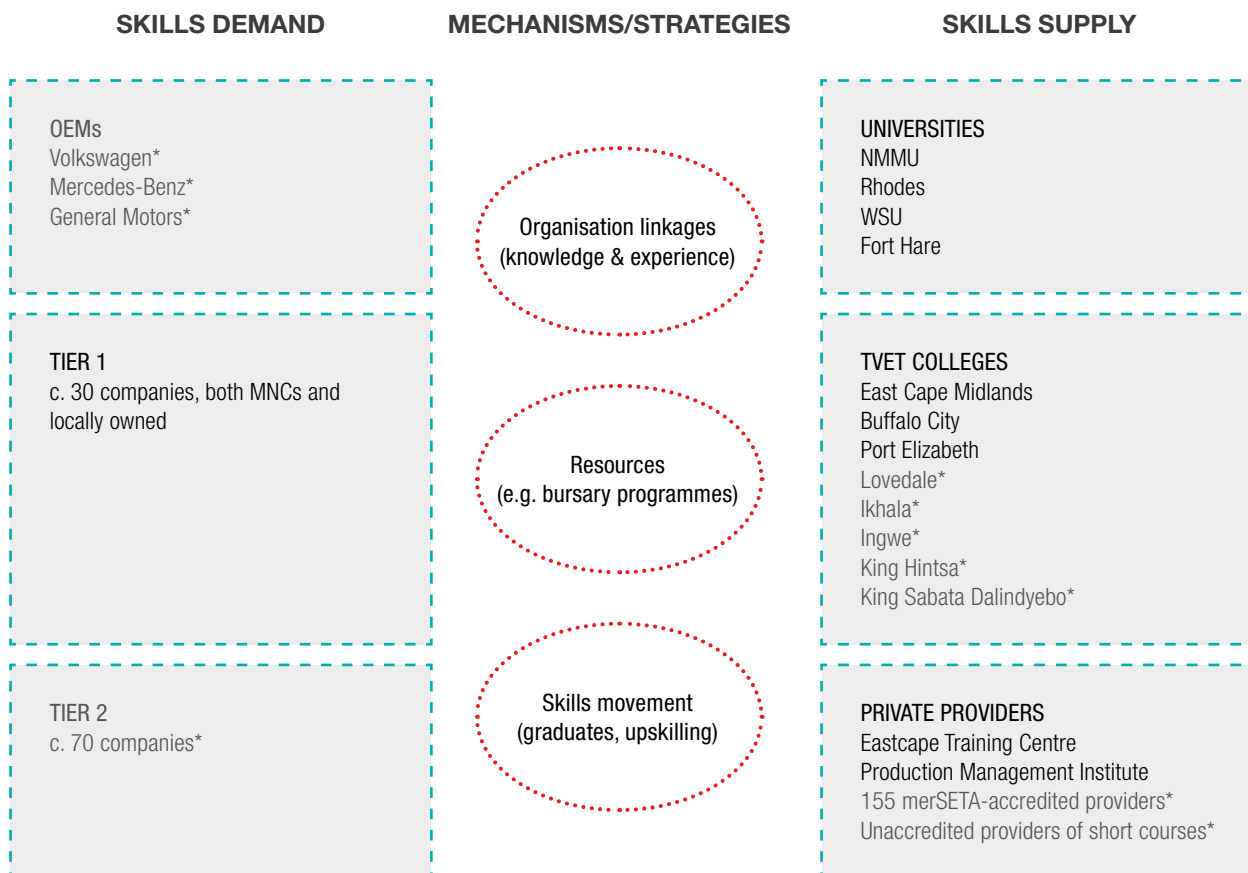
The sector is, however, strongly disciplined by global production chains. All the large original equipment manufacturers, and many of the component firms in the study, are multinational corporations, and the decision to stay and invest in their South African operations is subject to frequent reappraisal. In this light, policies such as the Motor Industry Development Programme (1995–2012) have been successful in that they have kept the South African sector alive. There are a few examples of South African plants becoming sources of learning for other sites in their multinational corporation's (MNC's) operations, and these can be built upon and extended.

### **Routine skills needs of Tier 1 firms in the automotive sector**

Tier 1 firms typically take skills development seriously. Currently, there are relatively limited needs for high-level skills produced by PSET organisations. Much product innovation takes place elsewhere, particularly in Germany. Nearly three-quarters of employees are classed as lower-skilled, and there is a relatively low turnover of artisanal and professional engineers. Rather, their skills profile leads firms to focus on upgrading. Much of this will be done in-house, and what these firms want most from external providers to meet their routine skills needs, are short courses. This is something public providers are generally poorly placed to deliver.



**Figure 2: Capability-building processes in the automotive sectoral system of innovation in the Eastern Cape**



Note: The organisations marked with an asterisk are not a core part of this study, but are actors in the sectoral system of innovation (SSI).



Firms do acknowledge valuable relationships with public providers, such as participation in an innovative Formula Student project which produces a racing car to compete internationally, collaboration on course design, and the payment of generous stipends to learners. Nonetheless, firms treat such relationships largely in an ad hoc way.

### **Bringing the sector together: the roles of public and private sectoral intermediaries**

The automotive sector is characterised by a rich set of public and private intermediaries that reflect both the sector's own internal organisation and the priority placed on it by national and provincial governments. This has resulted in a complex network of relationships and activities, with significant additional resourcing for skills development. Much of this is directed at short courses and internal skilling of existing staff.

The planned Auto Supply Chain Competitiveness Initiative (ASCCI) may be a step-change in the way that private intermediaries address sectoral skills needs. ASCCI is a partnership between the manufacturers and component firms' industry bodies, the Department of Trade and Industry (dti), the Manufacturing, Engineering and Related Services Sector and Training Authority (merSETA), the National Union of Mineworkers of South Africa (NUMSA), and individual firms. It will have a major focus on skills development to enhance component supplier capabilities. It is anticipated that the initiative will include engineer, artisan and operator skills programmes as well as team-leader training. At present, there appears to be little sense of the importance of including PSET organisations from the outset.

There is a real sense of a provincial skills system, even if it is not fully functioning and shows a strong bias towards the coastal industrial corridor. This is in contrast to several other provinces. There are a range of metropolitan and provincial structures; relatively strong involvement from provincial government and its agencies, most notably the Automotive Industry Development Centre (AIDC); and proactivity

from the two large industrial development zone (IDZ) initiatives, Coega and East London. Through and beyond these, representatives from industry, government and providers meet regularly and have some sense of a shared understanding of and commitment to the automotive sectoral system of innovation.

Currently, the provincially-funded AIDC plays the central role in skills alignment. Much of its work is focused on the skills and innovation needs of specific component manufacturers. The AIDC supports high-profile partnerships involving public PSET organisations and initial education and training programmes. This is also a significant activity for merSETA, often in partnership with the AIDC. Both are key actors that integrate skills development in the sector, and, crucially, pull together industry and providers in vital ways. The province's two IDZs are also potentially significant players in upskilling, but there is currently little articulation between provincial authorities and IDZs and the public PSET organisations.

### **Post-school education and training organisations' capabilities for upgrading in Tier 1 firms**

Much of the skills development required for upgrading and to raise the competitiveness of South African component manufacturers is therefore likely to be concentrated on short inputs. Making sure that public providers are capable participants in these initiatives is vital.

In spite of major policy initiatives in the PSET system in recent years, unresolved tensions remain that constrain institutional and systemic capabilities. Both general and sector-specific institutional competencies are relatively fragile across the public PSET organisations in the province. All the public TVET colleges and most of the public universities have experienced mergers and most are effectively only a decade old. Several are in administration or have acting leadership. Nonetheless, all have older traditions that they could potentially draw upon. This is particularly so in Port Elizabeth, where there is 90 years of history of automotive manufacturing and technical education. Engagement with the

automotive sector is highly concentrated in four urban-based education and training organisations.

Whilst interventions such as recapitalisation and the extension of the National Student Financial Aid Scheme (NSFAS) to public TVET colleges have enhanced competencies, other issues remain problematic. These include the scale and pace of the envisaged growth of the TVET sector and its likely impacts on often fragile colleges; the continued turbulence around public TVET college governance; and the unintended consequences of key decisions regarding programmes and qualifications. There are concerns among firms, for example, that the core programmes of the former technikons and technical colleges, BTech and NATED, have not been successfully replaced, linked to concerns about inconsistencies in the DHET's approach to encouraging work-based education. The public TVET colleges are rather weakly linked to the Tier 1 firms.

Private providers appear to be operating successfully in response to some skills needs, primarily in necessary but not mission-critical areas such as health and safety. There is little sense that they are contributing significantly to the innovative or competitive capabilities of the sector.

All the public providers share concerns about their human resources, both in terms of understaffing and under-qualification and the lack of clear policy on teaching qualifications. There are issues too about changing organisational cultures. Public higher education leaders stress that any drive towards employability and responsiveness needs to be seen as simply one aspect of a broader set of higher education missions.

Career and placement services are developing across most of the public PSET organisations, but it appears that the notion of placement is being used too loosely and broadly, leading to some overloading of placement services. Work-based education was a major theme of both provider and firm interviews. Private providers are particularly strong in their practice of work-based education.

Among public providers, however, there was much frustration about the constraints on what managers saw as a key element of responsive provision.

TVET college staff believe that neither the National Certificate (Vocational) (NCV) nor NATED allows for a good practice of work-based education. At the universities of technology, there are worries that the move away from the BTech will undermine strong traditions of work-based education.

Nevertheless, there is a large set of interactions between providers and employers. There are numerous examples of learnerships, apprenticeships and training contracts at the public and private colleges. Private providers inherently have a high level of industry engagement, as programmes are typically employer-commissioned. The strongest employer-provider interactions come through the industry advisory boards at the comprehensive universities that incorporated former technikons. There are some excellent examples of partnerships between public TVET colleges and industry, many facilitated by intermediary organisations such as the AIDC and merSETA. Both universities of technology deliver short courses for small, medium and micro-sized enterprises (SMMEs). Both work placements and graduate placements are common, even if they cannot meet the demand.

A set of sectorally-specific interactive capabilities has been developed. Sectorally-funded chairs (with Volkswagen, General Motors and merSETA) are important examples of the expanded capability of the PSET system to engage with the automotive sector. There is evidence of capabilities regarding strengthening innovation, quality systems and human resources management in a range of firms, including components manufacturers. The AIDC and merSETA are at the heart of these interactions, but a number of other actors are also involved. The capacity of public providers to work with the automotive sector is evident in international partnerships; income generation from short courses and training contracts; and infrastructural, materials and staff development with much of this supported by intermediary organisations.

## **Scope for improving responsiveness to skills needs**

Effectiveness and maintaining future competitiveness are constrained by the global logic of the automotive sector. These constraints are particularly serious for component firms in the Eastern Cape. To date, the capabilities of the provincial PSET system to interact within the sector are directed primarily at technological capability-building for automotive manufacturers. Indeed, there is a sense that the PSET system is relatively capable in producing whole qualifications and graduates at National Qualifications Framework (NQF) levels 4–6, but these are not the core skills needs being expressed by component

firms, which want far more in the way of short courses to develop sector-specific skills.

There is scope for public PSET organisations to do more to support dynamic growth in the sector. The research highlights and identifies multiple spaces for intervention so that local PSET organisations can develop dynamic interactive capabilities in order to provide the skilled graduates and the skills upgrading programmes required to match not only routine needs, but also facilitate the capabilities of the Eastern Cape component suppliers to participate in global production chains and innovation networks more effectively.

## CASE 3

# A SELF-SUFFICIENT SKILLS DEVELOPMENT SYSTEM IN THE SUGAR-CANE GROWING AND MILLING SECTOR IN KWAZULU-NATAL

The final study represents the case of a relatively self-sufficient private skills development system that has developed over time, but that could benefit from stronger alignment with the public post-school sector.

The sugar sector is one of the oldest and most important agro-processing sectors in South Africa. Sugar-cane ranks as the second-largest field crop and, as a capital- and labour-intensive sector, it contributes significantly to social and economic development in the largest sugar-producing regions in the country, KwaZulu-Natal and Mpumalanga. Since sugar-cane growing and milling are highly interrelated to the extent that they are mutually dependent, we analysed sugar-cane growing and milling in KwaZulu-Natal as a sectoral system of innovation.

Over time, the industry has created a self-sufficient system for meeting 'sugar-specific' skills needs, especially at the intermediate skills level for milling operations. 'Sugar-specific' skills form part of the specialised resources necessary for technological development in the sector. Public PSET organisations – specifically universities, universities of technology and agricultural colleges in KwaZulu-Natal – have been included in the system since the very beginning, to varying degrees. Over the years, the system has been shaped by changing skills needs, the willingness and capacity of PSET organisations to respond to these changing skills needs, and changes in the political sphere.

When the public PSET system was found to be unresponsive to skills needs in the 1960s and 1970s, the main firms, farmers and private sectoral

intermediaries decided to develop their own training centres for producing 'sugar-specific' intermediate skills. The self-sufficient skills development system has been developed and modified over time, and has been deemed appropriate for providing the *routine* skills necessary for technological development.

A strength of the sugar sector is that research has always been highly valued, especially for developing new cane varieties and improved ways to grow and mill sugar. The extent to which new knowledge is used does, however, depend on effective knowledge transfer and diffusion as well as training for developing the necessary skills for adapting and using the new knowledge gained, and the willingness of firms/farmers to use new knowledge. Knowledge transfer and diffusion are key mandates of the main sectoral intermediaries, but have become challenging in recent years.

### **Diversification and new entrants driving new skills demands**

Currently, major drivers of changing skills needs include the development of new products and by-products, loss of skills due to an ageing population and competition from other industries, and new entrants to sugar-cane growing (including land reform farmers and co-operatives).

Sugar-cane growing and milling in South Africa is in a crisis as it struggles to strengthen its position in terms of access to world markets, and protect its share in the domestic market. The sector has also experienced labour unrest recently, with employees at sugar mills demanding higher wages. Despite its

comparative production efficiencies, the South African sugar millers find it difficult to export profitably to the world market, as the global sugar price is severely affected by subsidy-induced overproduction in some major sugar-producing countries. Access to the major markets for raw and refined sugar is further restricted by high tariffs and preferential trade arrangements in the form of tariff rate quotas. The sector has called for increased regulation in terms of import tariffs to protect its position in the domestic market and improve cost-effectiveness. While the sector has always focused on incremental innovation, less emphasis has been placed on producing new products and processes, and on new ways of organising sugar-cane growing and milling activities.

One area in which the sugar sector can profit from new downstream products is renewable energy from the by-products of sugar-cane production. The co-generation of electricity in sugar-cane milling from burning bagasse enables sugar mills to produce electricity in excess of their own requirements. Legislation allowing the sugar sector to profit from the energy produced has not, however, been introduced as yet. Furthermore, the milling process has the potential to produce fuel-grade ethanol. Hence, the expected creation of a market for bioethanol in South Africa presents an important opportunity for the sugar sector to diversify and grow revenue. The absence of an enabling legislative environment in respect of renewable energy represents a misalignment that is a constraint on the sector. The sector would also need to develop the necessary skills for profiting from renewable-energy production.

At the same time, there has been a rapid increase in new farmers mainly due to land reform policy, and in the number of co-operatives. The sector thus faces the challenge of dealing with an overwhelming number of new farmers with little or no knowledge of how to manage a sugar-cane farm, let alone use new technologies. Technological development, especially for farmers, is challenging. New farmers present a demand for skills that the sector is not equipped to provide internally, that is, soft skills and business management, to promote inclusive development.

These new challenges to diversify in order to enhance competitiveness result in changing (non-routine) skills needs that firms, farmers and private sectoral intermediary organisations are not equipped to address, so that the key actors are in need of new collaborative arrangements with PSET organisations (either public or private).

### **A core network meeting routine skills needs**

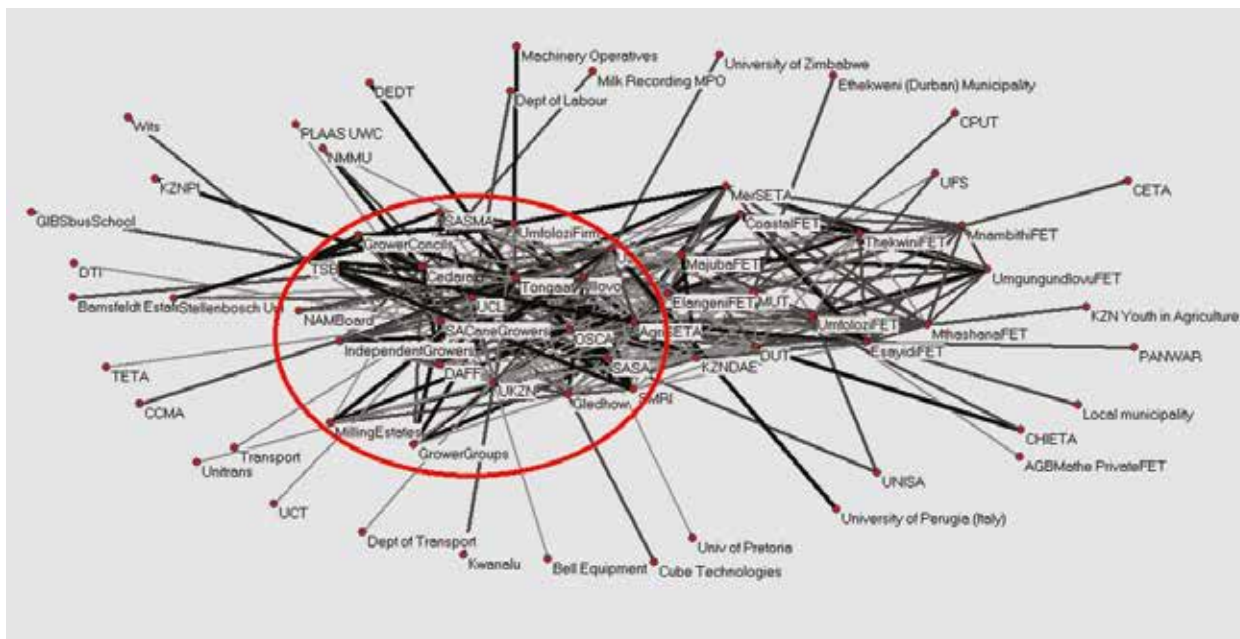
An analysis of interaction between PSET organisations, firms and farmers is depicted in **Figure 3**. The diagram reflects the collaborative arrangements related to skills development, highlighting a dense core network of organisations (within the red circle) that work with one another. This core network mainly includes the private and public sectoral intermediary organisations, the private-sector sugar-cane growers, milling companies, and the agricultural colleges. Private training providers provide tailor-made programmes to fit firms' training needs.

Universities and universities of technology located in the province are included to a lesser extent, mainly to recruit students for the Engineers-in-Training and bursary programmes of the milling companies and sectoral intermediary organisations. Universities outside of the province are brought in for specific purposes, mainly to provide training in leadership and management skills at the milling companies, in the face of an ageing population of supervisors.

TVET colleges tend to operate on the periphery, playing a very small role in the milling companies' skills development networks, and benefiting by placing students at firms or farms to gain work experience. The diagram thus highlights a relatively self-sufficient system of skills development that is not strongly aligned with the main PSET organisations.

In response to the recent changes in skills needs, the shape of the skills development networks is in flux. Notably, *collaborative* linkages between the private sector and universities and agricultural colleges are being revived. PSET organisations, too, are increasingly seeking collaborative linkages with

**Figure 3: Network map illustrating the skills development networks in the sugar-cane growing and milling SSI**



Source: Project data

Note: The thickness of the lines corresponds with the scale of interaction such that the thicker the line, the greater the scale of interaction.

firms/farmers and sectoral intermediary organisations in response to a policy push to become more responsive and relevant and improve the employability of their students. The space is created to enhance interactive capabilities to play complementary roles in skills development in the sugar sectoral system.

### The need to develop the interactive capabilities of PSET organisations

In general, the older, more well-resourced universities and agricultural colleges have:

- Better qualified academic staff;
- A well-developed culture of working with firms and farmers in the sugar sector;
- Well-established and effective organisational structures (e.g. well-functioning co-operative learning office, work-integrated learning strategy);
- A diversified funding base (and therefore less reliance on government funding); and
- A reputation for producing ‘good’ graduates in the relevant fields, and/or relevant research.

Forming collaborative linkages with industry in the local context can also be of benefit to PSET organisations for building their capabilities. The PSET organisations with relatively high interactive capabilities also tended to rely on established formal and informal linkages of individual academics or academic departments. When individual academics or academic departments had well-established linkages with industry, these linkages were more important than formal institution-wide policy for working with the sugar industry. But, this was only the case for the well-established, well-resourced PSET organisations with a culture of working with firms/farmers in the sugar sector that stemmed from their reputation for producing ‘good’ graduates. Formalised policy and structures were, however, found to be important for co-ordinating and systematising interaction with industry to harness the benefits for improving teaching and learning.

Public TVET colleges are deemed to produce graduates with low-level and poor-quality education and training due to relatively low levels of capabilities to respond to firms and farmers’



intermediate skills needs. The major constraints to the contribution of TVET colleges include:

- Funding limitations;
- Reliance on the DHET for funding and the curriculum for national programmes;
- Rapidly changing policy;
- Insufficient numbers of staff (thus high workload) and underqualified teaching staff; and
- Reputation for producing poor-quality programmes and, hence, difficulty in developing linkages with firms.

Rather than focus on the needs of industry in their local contexts, most of the TVET colleges struggled to keep up with changes in policy and changing student preferences. The TVET colleges thus act as a 'weak link', hindering alignment in the sectoral system, highlighting one area for intervention.

SETAs are currently being set up as brokers between industry, government and PSET organisations, and as strategic partners for TVET colleges. There is an urgent need to build the capabilities of the TVET colleges and improve the relevance of the colleges' programmes to respond to the skills needs of a core industry in the regional context.

The agricultural colleges, in contrast, are undergoing major restructuring to reposition in response to the need for transformation in the agricultural sector, especially the focus on inclusive development. The agricultural colleges, currently under the Department of Agriculture, Forestry and Fisheries, are expected to take a provincial focus to better engage in local economic and social development by providing in-service training for agricultural extension officers, engaging in technology development and training partnerships, and providing tailor-made training in order to respond more directly to the needs of the local context. The agricultural colleges are also revising their curricula to align more closely with the needs identified by public- and private-sector stakeholders in the agricultural sector. Owen Sitole College of Agriculture, for example, has formed linkages with Tongaat-Hulett's social development division and the Shukela Training Centre to offer sugar-specific

training to its students. Since the college is situated in the region with the largest number of sugar-cane farmers, especially small-scale farmers, it aims to use its strategic partnerships with the sugar industry to develop the college as a 'Centre of Excellence for Sugar'.

## **Complementary roles of public and private sectoral intermediaries**

Public and private sectoral intermediary organisations play pivotal complementary roles in supporting and co-ordinating skills development and planning in the sugar-cane growing and milling SSI. The private intermediaries tend to focus more on responding to industry- and firm-specific issues, whereas the public intermediaries tend to focus more on 'public good' objectives important for the upgrading of firms and farmers in the sector.

Specialised sugar-specific education and training programmes at all levels (basic to high skills levels), were provided by private training centres run by the private intermediary organisations and also supported by the public intermediary organisations. For example, the milling companies typically send their factory staff to the Shukela Training Centre (STC), referred to as the preferred provider of engineering and agricultural (intermediate-level skills) training in the sugar sector. The STC is a private training provider accredited by AgriSETA and is a wholly owned subsidiary of the South African Sugar Association. It is thus run by industry to serve industry needs. Another example is the training offered by the Sugar Milling Research Institute (SMRI), a private sectoral intermediary organisation funded by the sugar industry. All 'Engineers-in-Training' students attend a 10-week intensive Sugar Technology course offered by the SMRI. The 'Engineers-in-Training' students are bursary holders enrolled in engineering programmes at universities and universities of technology.

In general, the intermediary organisations contribute to aligning skills supply and demand through:

- Articulating the skills needs of firms and farmers;
- Supporting and co-ordinating skills development and planning in the SSI, including facilitating

engagement between firms, farmers, government, intermediary organisations and PSET organisations;

- Providing funding for education and training;
- Promoting complementarity of efforts in the system;
- Providing education and training not provided elsewhere (the private intermediaries);
- Standard-setting and assisting with ensuring compliance with policy; and
- Managing innovation, including promoting and facilitating collective learning, and knowledge transfer and diffusion, research and development.

Key private sectoral intermediary organisations like the South African Sugar Association (SASA) and the SA Cane Growers' Association have the necessary expertise, mandate, social capital, and thus processes in place to conduct education and training. However, they report difficulty in accessing government funds to equip themselves to provide education and training for co-operatives of emerging farmers, for example.

Currently, the main private sectoral intermediaries, labour market organisations and firms are included in the 'sugar committee' of AgriSETA. It may be of benefit to a sector and the PSET organisations in a province or region, to include engagement of the PSET organisations in such a forum.

## **The need for new collaborative arrangements to meet non-routine skills needs**

In general, the sugar-cane growers and millers have, over time, developed a self-sufficient system for meeting their routine skills needs. Public universities, universities of technology and agricultural colleges provide more general education and training, while sugar-specific education and training is mainly provided by the training programmes offered by the private sectoral intermediaries, and practical training is provided by firms/farmers. Professional associations, like the Engineering Council of South Africa, also contribute to ensuring that high-quality qualifications are produced in relevant fields.

A gap exists for meeting non-routine skills needs, particularly management and leadership skills for factory supervisors at the milling companies, and business management and soft skills required by the overwhelming number of new farmers in the sector (land reform farmers and co-operatives). There is also a need for skills to produce renewable energy from by-products. The sector has identified the need for new collaborative arrangements with PSET organisations (public or private) and funding support from government bodies in order to develop education and training programmes to meet these non-routine skills needs. Public TVET colleges, in particular, could contribute to addressing the skills needs of land reform farmers and co-operatives but would need to improve their capabilities to respond.



# HOW DO FIRMS AND POST-SCHOOL EDUCATION AND TRAINING ORGANISATIONS WORK TOGETHER?

We began by posing a critical issue for skills development in South Africa: if our skills planning processes identify a demand for specific qualifications, professions, occupations or scarce skills, how do we ensure that our PSET organisations have the will, the expertise and the interactive capability to address this demand? In this section, we emphasise two key dimensions: first, the value of understanding economic dynamics, actors and their interaction in networks at the *macro-level*, and second, the significance of building dynamic interactive capabilities of PSET organisations across the system at the *meso-level*.

## Understanding economic dynamics, actors and interaction in networks at sectoral and regional levels

Our case studies highlight that the starting point has to be a macro-level analysis of economic dynamics. Meaningful skills planning requires a **contextualised analysis of routine skills needs**, but more significantly for inclusive economic and social development, an analysis of the **dynamic shifting skills needs** required for competitiveness and inclusion. The SKA has succeeded in creating and participating in global innovation networks that facilitate technological capability-building at the national level. The automotive sector in the Eastern Cape is challenged to maintain and grow local participation in global production chains. The sugar sector is challenged to diversify markets and to promote inclusion of new (land reform) farmers.

All of these economic challenges require new kinds of skills development involving new collaborative arrangements.

For **firms, government and other intermediaries**, such a systemic, dynamic and contextualised analysis of sectors in specific spatial regions can lead to more fine-grained analysis and skills planning processes.

For **PSET organisations**, we argue, the message is that a better understanding of routine *and changing* occupations and skills needs of firms in key sectors can assist strategic planning of niche fields and focal disciplines and enhance responsiveness. PSET organisations provide foundational, occupational and professional-oriented programmes and do not 'train' for specific sectors. However, stronger alignment with critical sectors nationally, regionally and locally can aid firms' technological capability-building, which is crucial for social and economic development. The connections, flows of knowledge and degree of specialisation between foundational, occupational, sectoral and firm specific curricula and programmes can be enhanced.

This, however, depends on the identification and mapping of the **key actors** involved in skills development **networks** in the region and nationally that do (and could) contribute to meeting skills needs.

For **firms, government and private intermediary organisations**, understanding interaction in skills development networks can provide a better-informed sense of the changing PSET landscape,

and of the potential providers of relevant and useful qualifications and programmes.

For **PSET organisations**, the cases highlight the significant role that can be played by public and private intermediary actors in linking more proactively with specific sectors, professions or occupations. This, we see, can take the form of funding learning programmes, or brokering relationships, or facilitating flows of knowledge and information between universities, colleges and groups of firms in a sector. Colleges or universities can enhance their reach and impact with firms by working with intermediary organisations.

To achieve this, the research mapped the actors operating in networks and went beyond the mapping to understand the ***nature of alignment and the strengths of individual relationships***. In the sugar case study for example, network analysis revealed that there is a core network of actors centred on the firms, industry associations and private providers, which includes agricultural colleges and universities to a limited extent, but largely ignores TVET colleges.

The research also provided an analysis of existing gaps, missing linkages and blockages, which is invaluable in the design of strategic policy interventions. It points to the need to find ways to address specific gaps or blockages. So, to take the sugar case a bit further, one option would be to propose that private colleges are functioning adequately and should be left to their own devices. However, these private providers are not as effective in addressing *new* skills needs of emerging farmers, or *changing* skills needs as downstream products such as biofuels are developed. Another option is thus to fund the private providers to expand their expertise to function more effectively as the preferred providers of sugar-specific education and training. As government policy commitment is to strengthen the role of public PSET organisations in skills development, a third possible intervention might be to build co-operative partnerships between public agricultural and TVET colleges and the private providers that have been functioning successfully, for capability-building in the sugar sector.

Similarly, for firms, a better understanding of network mis/alignment and gaps, can inform processes of technological upgrading and innovation in a sector. In the automotive case, we found that, unlike the OEM multinationals, local component manufacturers have only recently begun to organise skills development programmes as a sector in order to support growth priorities set in national industrial and provincial economic development policies.

### **Focus on capability-building of post-school education and training organisations**

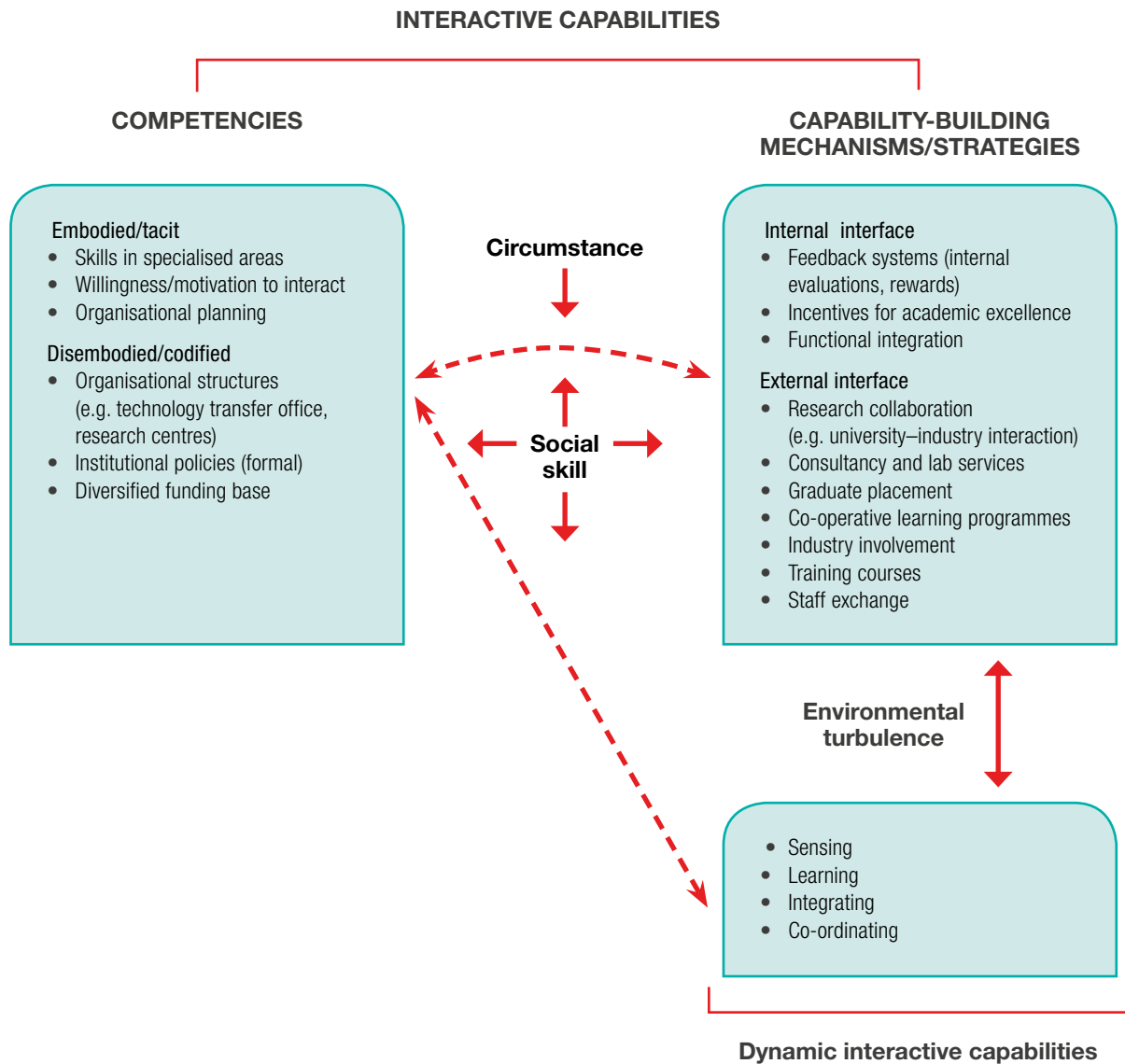
At the heart of our case studies is a focus on the meso-level, that is, on the interactive capabilities of the PSET organisations in each sectoral system of innovation. When it came to understanding the will, expertise and interactive capabilities of PSET actors, the descriptive analysis in each case was underpinned by a conceptual framework. We have hinted at the framework in the report thus far, but, here, we set out the key concepts in the diagram below, and demonstrate the kinds of insight possible. Note that this diagram is generic, and we would need to adapt it for higher education and TVET organisations, as each has distinct roles and characteristics.

#### **Competencies to interact**

We investigated, first, the competencies of each individual PSET organisation relative to the specific education and training subsystem of which it is a part. These could be tacit and embodied in individuals. So, for example, the SKA case illustrated well the facilitative role played by academic leaders who saw the value in interacting with the core SKA intermediary organisation, firms, government agencies and other scientists in global innovation networks, and brought about changes in their departments and universities. ***A change in thinking, to convince more actors of the significance of interaction and networking with a range of actors for national development goals, may be required across the PSET systems.***

Tacit competencies also relate to expertise in key areas, illustrated by the reluctance of sugar

**Figure 4: Capability-building processes in post-school education and training organisations – a generic framework**



millers to work with some local TVET colleges. The negative experience of the SKA with TVET colleges also related to the poor competencies of the college, both tacit in the form of leadership and in the absence of codified competences, such as a structure or unit that could support and facilitate interaction. *Issues of quality programmes, curriculum, pedagogy and disciplinary fields are core and a fundamental focus for PSET organisations and education intermediaries.*

**Interactive capabilities**

Colleges or universities may have the requisite competencies, but they also need the capability-

building mechanisms and strategies that promote interactive capabilities. They may have (or lack) internal and external interface mechanisms that support interaction within sectoral networks. One external interface mechanism that is historically and currently very effective is the system of co-operative learning pioneered in the technikons and developed in the universities of technology. *The potential for such mechanisms to be replicated and extended to universities and colleges is high.*

In the automotive case, one university had a strong external interface mechanism through a research centre that collaborates actively with the automotive

sector, and internal support structures to promote industry involvement and interaction. This interaction was, however, largely limited to the specific centre involved. In the SKA case, in contrast, there was a higher degree of functional integration, in that the university as a whole was behind the engagement, new teaching and research programmes were established, staff exchanges facilitated academic capability-building, and more students were recruited and knowledge niches grown. Where interactive capabilities are weak, it may be that *they can be created and nurtured through a public-private partnership, with involvement of the private sector and employers themselves.*

The TVET colleges largely lacked such internal and external interface mechanisms to support capability-building, but individual colleges varied. In the sugar case, for example, one college had a testing centre that led to collaboration with private providers and agreements with firms to place students. Some colleges have advisory bodies on which local industry and universities serve. *Such structures and interface mechanisms can be extended to more departments in more colleges, and interaction can be deepened.*

### **Dynamic interactive capability**

A final critical dimension is what we have called dynamic interactive capability. This relates not only to the capacity to meet *routine* needs, but to be continually sensing changes in the environment, adapting to the demand for new skills and co-ordinating change across the university or college. The private colleges provided good instances of such capabilities. A negative example was provided by an interviewee, who exclaimed that although she drove past sugar fields every day on her way to work, she had not identified sugar firms as potential partners. The PSET organisations in the automotive sector network displayed lower levels of dynamic interactive capabilities, evident

in their ad hoc and very reactive roles in the sectoral system of innovation. *Developing dynamic interactive capabilities of individual lecturers, academics and organisations will mean that universities or colleges can respond appropriately to changing skills demand, developing the capabilities to offer new programmes informed by analysis of economic demand, of the needs and capabilities of other actors in key networks and of their own existing organisational capabilities.*

### **The next steps**

In this synthesis report, we have highlighted only at a very generalised level how an innovation systems approach can inform the ways in which firms and post-school education and training (PSET) organisations can be supported to interact more effectively to address skills demand.

Going forward, we are initiating a process of engagement with key government, intermediary and PSET actors. The aim is to think through the policy implications and the kinds of interventions that could facilitate dynamic interactive capabilities for each set of actors:

- A first step in this process will be a policy roundtable aimed at stimulating dialogue with as wide a range of stakeholders as possible.
- As a second step, we plan a series of papers that will interrogate the case study evidence on competences and interactive capabilities in relation to the specific roles of universities, TVET colleges, private providers, public and private intermediaries, and firms.
- A third step we propose is a set of workshops with SETAs, universities, TVET colleges and the DHET to determine whether and how the research approach can be packaged to inform skills planning.

# ENDNOTES

1. It was not possible to study the entire automotive value chain. OEMs have strong skills development structures and processes, and there are known shortages of artisans in the retail services sub-sector. We do not offer a comprehensive study of the full potential for growth along the entire automotive value chain.



**For those interested in learning more about the LMIP and the case study research, detailed reports on the case studies and conceptual framework can be downloaded from the project website ([www.lmip.org.za](http://www.lmip.org.za)).**

**Working papers on the conceptual framework:**

- Bongiwe Mncwango (2013) Skills, competencies and capabilities in the Innovation System: reconfiguring the post-school sector
- Glenda Kruss and Il-haam Petersen (2014) Understanding interactive capabilities for skills development in sectoral systems of innovation: a tentative framework

**Case study reports:**

- Il-haam Petersen and Glenda Kruss (2014) Understanding interactive capabilities for skills development in sectoral systems of innovation: a case study of the sugarcane growing and milling sector in KwaZulu-Natal
- Michael Gastrow, Glenda Kruss and Il-haam Petersen (2014) Understanding interactive capabilities for skills development in sectoral systems of innovation: a case study of astronomy and the Square Kilometre Array telescope
- Simon McGrath, Glenda Kruss and Il-haam Petersen (2014) Understanding interactive capabilities for skills development in sectoral systems of innovation: a case study of the Tier 1 automotive component sector in the Eastern Cape



LABOUR MARKET  
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### Responding to Shifting Demand for Skills

#### About the LMIP

The Labour Market Intelligence Partnership (LMIP) is a collaboration between the Department of Higher Education and Training, and a Human Sciences Research Council-led national research consortium. It aims to provide research to support the development of a credible institutional mechanism for skills planning in South Africa. For further information and resources on skills planning and the South African post-school sector and labour market, visit <http://www.lmip.org.za>

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