

MANUFACTURING AND INNOVATION

Workshop Proceedings Report



science
& technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA



NATIONAL ADVISORY COUNCIL ON INNOVATION

Contents

- Opening and Welcome 1
- Presentations 2
 - The Future of Manufacturing 2
 - Support for the SA Manufacturing Sector 3
 - The Role of Industrial Policy (TALK) 4
- Discussion 7
- Closing Remarks 9



Opening and Welcome

Dr Mlungisi Cele, Head of the NACI Secretariat, welcomed all attendees to the workshop, thanked them for taking the time to attend the session and invited them to participate openly in the dialogue session on manufacturing and innovation. This was a new area of work for NACI and the need for the Council to start looking at the manufacturing sector is driven by:

- The global economic conditions impacting on the South African economy and society, with the manufacturing sector being severely affected. The economy has been struggling to grow and the fall of the currency has had an impact in many areas.
- The country has decided to drive industrialisation and innovation has been identified as a critical factor to help South Africa industrialise and grow to the next level, with improved competitiveness and an improvement in the quality of life for all. And Science and Technology (S&T) is recognised as being important for growth and improving the quality of life of a country's population.

The workshop was an opportunity for NACI to explore how to use innovation to improve the economic performance of the country; and to ensure that the manufacturing sector is assisted in the short-term to medium-term, as it is currently in distress.

Dr Cele introduced the three speakers for the workshop as:

- (i) Ms Zanele Monnakgotla, a NACI Council member, who would provide a high level overview of the NACI perspective and why NACI is interested in the topic to be explored during the workshop.
- (ii) Mr Garth Williams, a Director from Department of Science & Technology (DST), who would provide the government perspective of policy and the view on a range of issues related to manufacturing, but with a focus on innovation and the role of innovation in the economy and in society.
- (iii) Mr Saul Levin, CEO of Trade and Industrial Policy Studies, who would provide a perspective from his role at a non-governmental organisation (NGO).

Presentations

THE FUTURE OF MANUFACTURING

Ms Zanele Monnakgotla, NACI

Ms Zanele Monnakgotla delivered a presentation titled the “Future of Manufacturing”. The presentation provided succinct background information on NACI to enable all attendees to understand NACI’s role and purpose and what it is trying to achieve, including looking at various sectors of the economy and how innovation could be used to improve those sectors. NACI’s role is to advise the South African (SA) government, through the Minister of Science and Technology, about science and technology issues that are pertinent to innovation in the country. NACI Council members are drawn from academia and both the public and private sectors, in order to ensure that all perspectives are considered at Council level in the science, technology and innovation discourse. NACI coordinates matters relating to science, technology and innovation (STI) for the country and advises on coordination within the national system of innovation. The monitoring and evaluation aspect embodied in NACI’s work enables the Council to assist the government to plan better and develop better policies.

The purpose of the discourse therefore was to promote dialogue between NACI and its stakeholders on how innovation could be used to build competitiveness. Tracking of the gross domestic product (GDP) clearly shows the effect on South Africa of the 2008 global recession. The impact on trade from 2008 onwards can be seen in the trend lines for trade and exports of goods and services as a percentage of the GDP. The services sector is playing a dominant role in terms of its contribution to the GDP. The manufacturing sector shows a declining trend over the last ten years between 2004 and 2014, that is, from 15.3% to 13.9%. However, it is important to note that the 1% drop is off a small base, so this is effectively a big drop, which has had a big impact on the South African economy.

When we consider South Africa’s performance in the context of other emerging economies, that is, Brazil, Russia, India, China and South Africa (BRICS); we observe China is out-performing the other four countries in terms of the performance of the manufacturing sector. South Africa’s declining trend is also evident. India is doing well and is showing good growth in its manufacturing sector. When looking at high technology exports as a percentage of manufactured exports, the trend for South Africa is again downwards. China is again seen to be doing very well and India is improving. It is clear that China is out-maneuvring the other four BRICS countries, with South Africa being the lowest performer. The graphs clearly indicate the need for South Africa to improve its manufacturing sector and ensure that manufacturing is a major component of the economy and that it creates jobs.

The declining performance of the manufacturing sector as well as investment in the sector broadly, suggests that South Africa needs to consider the potential of sub-sectors. Additive manufacturing (AM) is considered to be a big opportunity for the country and although South Africa has started to work on this, there is much to be done and room for improvement. 3D and 4D printing has provided major opportunities globally: the global forecast for 2016 is US\$2.6bn and by 2020, the figure is estimated to be a US\$21bn industry. There is therefore a huge growth opportunity and many countries are aligning with these opportunities and investing – including China and other emerging economies. The AM breakthrough technologies provide an opportunity for South Africa to jumpstart its in-decline economy. AM could work in South Africa’s favour, as it is a mineral-rich country and the minerals could be used in beneficiation scenarios; SMMEs could easily become involved as 3D printing costs are lower than the costs of a production plant; lower cost 3D printers are being developed, the 3D printing sector holds huge potential for job creation, which would stem the growing high unemployment figures.

Although an advanced manufacturing strategy has been in place in South Africa since 2002, the strategy has not worked well and changes need to be made. Work is being done on prototypes and value-added technology at the CSIR and at the Vaal University of Technology. In SA, the main uses at the moment are in aerospace, medical fields and dental prosthetics. 3D has already proven that it offers many opportunities, as the results of investments made by China have shown.

SUPPORT FOR THE SA MANUFACTURING SECTOR

Mr Garth Williams

Director: Advanced Manufacturing, DST

Mr Garth Williams delivered a presentation titled Support for the SA Manufacturing Sector. The presentation included the following issues:

The DST is working closely with the Council for Scientific and Industrial Research (CSIR) on advanced manufacturing. The CSIR is one of the main science councils of the DST. Manufacturing matters because it provides excellent multiplier effects in terms of supply chains; but this means that supply chains must be in place. Manufacturing offers higher wages than some other sectors, including services. Consider that when the United Kingdom (UK) was battered by the global financial crisis, Germany coped with the crisis far better, because of the strength of its manufacturing base. Also consider that while agriculture can create jobs, manufacturing creates more sophisticated jobs and therefore the multiplier effect is much higher.

An international study was done by McKinsey on why manufacturing matters. A similar study was done in South Africa by Deloitte, and the country's figures compared to global figures – with disappointing results. The world is moving towards advanced manufacturing, but being competitive in manufacturing is dependent on talent-driven innovation and advanced technology. The study conducted by Deloitte shows that talent-driven innovation is ranked number 1 in importance for competitiveness. Advanced manufacturing is distinguished from standard manufacturing in terms of it being knowledge and technology-intensive manufacturing. The rise and fall of the services sector and the decline of the manufacturing sector has also been reported on by the Financial Mail and the graphs are clear on this. The decline of the manufacturing sector has been exacerbated by the growth of the services sector. A contributing factor was low cost producers during the pre-1994 years, but the country no longer enjoys this advantage. Competitiveness is an issue and conventional manufacturers are reluctant to invest in the required technology. If we look at the major inputs, it is no wonder we are where we are: compare the wages in South Africa to those of our peers, Malaysia, etc. The statistics shows that SA suffers from: high wages; low productivity; high transport cost. The work done by McKinsey was localised and it was seen that: local manufacturing is not competitive; the number one cost is labour and materials. It is therefore no wonder that manufacturers operate in survival mode.

Shoring indicates where manufacturers will be investing next and it can be seen that industrialised nations want to re-invest in manufacturing. This will be determined by the availability of resources in proximity to innovation and demand. Drivers are diverse, as there are different kinds of manufacturing, e.g. labour intensive manufacturing will go where labour costs are low. But there may be some sectors in which we could be more competitive than we think. The new game changers report makes for interesting reading. The cover story indicates that China is becoming more research and development (R&D) intensive; has a multi-decade approach to improving its competitiveness; will lose 85 million jobs over the next decade; will move manufacturing off-shore to low cost producers such as Vietnam.

Global Industry 4.0 indicates the strategy results of leading, developing and catch-up countries. The innovation chasm indicates that promising technologies don't make it to market because of the valley of death. The areas where DST is investing are indicated on the graph. The DST focus is to achieve various outcomes by leveraging-off the available opportunities. By adding a champion, the DST injects a catalyst, in order to achieve the goals that have been set, e.g. in manufacturing and related sectors. Some work is being done in terms of AM and there is some emerging research in areas that impact manufacturing, biospace, aerospace, etc.

Roadmaps are also in place. The sector clustering graphs indicate the spread of clusters that offer walk-in service, e.g. agro-processing, manufacturing. The impact over the last few years of programmes to bolster the economy, create jobs and help firms become more competitive is also seen.

THE ROLE OF INDUSTRIAL POLICY (TALK)

Mr Saul Levin

CEO: Trade and Industrial Policy Studies

Mr Saul Levin spoke on the topic, Trade & Industrial Policies and Strategy. Issues raised in the talk included the following:

If we don't have manufacturing, the economy cannot grow. Advanced industrial nations have worked this out – hence the re-industrialisation and on-shoring that is happening in the world. The United States (US) is starting to attract industry again and has realised the benefits provided by a strong and robust manufacturing sector. The UK is also starting to focus on industry. The economic development of countries is through growth of the manufacturing base. It is an important lead sector in any economy, as it creates opportunities for the services sector and upstream inputs. There is a reaction in terms of linkages in the economy. To ensure a robust and growing manufacturing sector, the role of innovation in manufacturing has to grow. Without innovation, any organisation or country will be stuck at the bottom of the barrel and chasing the lowest common denominator. Without innovation, there will be no growth and no job creation, even if there was some initially at start-up.

Innovation starts to add value and move the organisation up the value chain, creating better paying jobs and an improved economy. Consider the example of a hair cut from a hairdresser, which provides an easily comparable job role and cost: in Cuba, the cost is 2 \$?? for a poor cut and 10 pesos for a good cut; in the US, the cost is \$50; in Nigeria, the cost is \$4; in South Africa, the cost is \$?? – which is too high; in Malawi, the cost is \$2. The productivity of a hairdresser is not significantly different in Nigeria and South Africa. But why does the person in an advanced industrial economy earn so much more? The issue relates partly to the rest of the economy and what happens in the dynamic sectors and the manufacturing sector of the economy. So innovation in manufacturing is important.

Many studies have been done on the need to invest in order to move up the value chain and at firms investing in production capabilities. Without investment, there will be no growth in the economy and the rate of investment in SA is low: Latin American countries are twice as high as SA; South Korea is three times higher than South Africa. Investment is also required by the private sector, as it translates into new factories, innovation and ideas – therefore it is critical for growing a dynamic economy. Government is a player in investment in technology, but some institutions need to become more engaged with what really needs to happen in the economy. There are gaps and the country needs to be more effective, especially with unlocking the potential of tertiary institutions to work better and more meaningfully with industry and in respect of taking innovation programmes to scale. The country needs to look at how to get linkages between modes 1 and 2 research and at how to focus on research that will help industry to grow. There needs to be diffusion of technology and an understanding that you don't always need to invent brand new inventions. Greater understanding is needed of the role that technology can play in enhancing productivity. When you have a dynamic economy there are spill-over effects, for example, investment in underground mining sensors could spill-over into the home security industry.

Consider that the technology used in the Apple phone was developed by the US government for various defence programmes and a good entrepreneur saw the possibilities that the new technology provided and created the iPhone. So the initial innovation was done by the US government and the spill-over created a leading global company. This shows that it is important to get the spill-over right. We have to think about how to move up the value chain and we will only start winning when we are investing in working and becoming more productive. But we still have 25% to 30% unemployment. We must invest, including in the productive sectors, but have to address unemployment, as no-one can expect the economy to improve with that level of unemployment.

In other countries, people became productively engaged in agriculture and the agricultural sector shows innovation, e.g. seeds and implements, and there is improved productivity. South Africa doesn't show this; instead, there is a push out of rural areas to cities, as people look for work; successful commercial farmers are becoming global players and mechanising, which means jobs are not being created, as these are not tiny operations that employ a few people – they are job-shedding operations. There is an opportunity to create jobs with small commercial farms, but not with a survivalist approach.

While investment in technology and the manufacturing sector does create jobs, prospects for people and improved income, we need to guard against creating manufacturing for the lowest common denominator; we don't need manufacturing of baseballs at 50c instead of something higher up the value chain at \$7 per hour. So we need to consider the important impact on wages and the economy. Government has developed an Industrial Policy Action Plan (IPAP) and the DST is working on this while the plan features strongly in government's plans. We need to understand that we cannot use an approach that sees all businesses as being one type of animal, as the result is then a policy framework that focuses on the lowest common denominator. And this simply does not make sense for innovation. The TIPS studies consider four categories of companies: large exporting companies, who are major players in the country; small, highly innovative firms that generate new ideas and who have a small but important niche role to play; ordinary firms that are not investing in innovation, but which comprise the bulk of the economy; micro enterprises and informal enterprises. An effective strategy requires that the nature of these four categories of firms is understood and that the policies that are developed talk to the nature of the firms – otherwise you will just have policies that do not work. We need to understand that each category of firm has different blockages to innovation and we need to understand what stops them from taking advantage of innovation, in order that innovation programmes can be targeted correctly.

An example of the large exporting companies would be the mining value chain or the motor sector, which are large procurers, but where there has been a shift over the last 15 – 20 years, as they have become global players: local procurement has dropped and global procurement increased, with a turnaround in the 60%-40% ratios. A lot of money is being spent, but not on R&D. The key issue is to unlock and support growth of the mining sector; part of this is supporting the capital technology sector, as mining companies say they need equipment and improved equipment. And here we have the classic chicken and egg situation. But the bottom-line is that someone must invest. Also consider the significant exit of skills from South Africa to Sweden, Germany, Australia, etc. and institutions and skills have declined significantly. This situation must be turned around if mines are to spend locally. However, whilst the Rand is at its lowest point in twenty years, local procurement becomes more attractive; but South Africa must be able to offer world class technology. There is capacity, but investment is required. Also remember that in the motor industry; all innovation is done under licence from original equipment manufacturers (OEMs) overseas, which means there is no spill-over effect.

The small, high-tech players play a disproportionate role in supporting innovation. Although there are only some 20 000 employees in the sector, they play an important role, as many innovations die in the valley of death and it is critical that they take new ideas and products forward. The main constraint in this segment is the lack of skills – PhDs are needed, but not in this scenario, and the skills shortage becomes a constraint to innovation, which needs high, intense technology skills. Lack of financing is a significant problem as well. Consider that in Silicon Valley, the typical venture capital markets played a significant role in picking 20 possibilities and only expecting one firm to survive – but that one success would be a gigantic success. South Africa does not have the market to play this game. We need to understand that we are outside of certain markets and that we don't offer the particular conditions for this type of approach to work. So we need to look at development finance and the role of the organisations in context.

Within the category, the rest of the companies, we see that film, music, pharmaceuticals and some others are internationally dominant, or if there is a local player, the player goes global. The result is intellectual property (IP) protection. With others, formal protection of IP is neither a constraint nor an enabler. The question is: How do we use the IP system to support these companies, without the system catering to only one part of the economy? In the small business category, organisations are often cut out of the networks that offer access to technology, as organisations don't have links with the rest of the economy. The question in terms of this category is therefore: How do we get

technology to these companies, as investors in the second category? Remember that the role of the State is to diffuse technology to this category. Consider the example of the township micro enterprise that is repairing motor vehicles, but his customers will soon be replacing the old model Toyota Corollas and the like with newer motor vehicle models that include computerisation aspects. If the micro enterprise does not have the technology required to service the new model vehicles, he will soon be out of business. These types of micro enterprises are not investing, but they need to invest in order to grow. Diffusing the technology that is already out there could have a big impact on some firms, which means that a better understanding of this type of outreach approach is required.

At higher levels within IPAP, links are made between innovation and industrial clusters and cluster organisations, which means that spatial economic zones (SEZs) start to become important. An example is the cluster emerging on the East Rand with defence technology, as Denel has turned its business around. There is much support offered within IPAP in terms of the working of these types of clusters. IPAP also looks at investment in employees and process improvements that are critical, e.g. new technology for firms and helping firms to upgrade equipment, but not necessarily global improvement. Government could become a major procurer of solar heaters in order to create demand and stimulate that industry. IPAP is also looking at encouraging innovation through taxation, e.g. tax rebates.

We need to consider the industrial policy for South Africa and the importance of having innovation as a key driver. We must consider how to use industrial policy to grow sectors, based on rising investments in order to encourage investment in innovation and adapting innovations to local conditions. A core issue is how to create greater employment, because generally, when you become more innovative, you shed jobs. But this could lead to jobs being created in other areas, e.g. computer controlled drip irrigation may displace workers on farms, but with increased productivity there could be more jobs in packing and distribution, for example. So, with job shedding, one needs to look at alternative activities for employees, so that innovation does not always result in job displacement and allow SA to still grow and create jobs on the back of innovation.

Discussion

All participants were invited to consider the relationship between innovation and manufacturing and raise issues, comment and offer suggestions regarding the key questions that NACI needs to consider in the future. Questions and comments (Q/C) were then taken from the floor as follows:

ISSUES RAISED

- 1) That in all discussions about manufacturing, the word 'design' is never used – yet active economies are designing products that are top class using effective design. A problem in South Africa is thinking that manufacturing starts after design – which is a hang-over of our importing approach.
- 2) We are putting too much emphasis on PhDs. While it is important to say we need it philosophically, we must consider: do we need PhDs for a vibrant manufacturing sector? What we really need to make manufacturing work is systems; production engineers, etc.
- 3) To replicate what happens internationally, where organisations go through the cycle of verifying that a product can be made with a given system, in order to prevent complete re-design of the manufacturing process. While there may be signs that this approach is starting to be considered in South Africa, the question must be asked: How much are we attending to this?
- 4) There is agreement that we don't need any more PhDs, as they can't find employment. One of the worst things the government did was to take away the technology institutes and turn them into universities. The second point is to ask TIPS to share a little more information about how jobs can be increased, despite innovation. We have heard the example provided about agriculture, but in the absence of high tech agricultural input, are there other ways to improve job opportunities?
- 5) A major challenge with innovation is making the prototype after the design is complete. Financing is not available. On completion of design, payments have to be made, so how can SMMEs move from the design phase to the prototype and manufacturing phases? Can the DST assist with this problem?
- 6) The panel was asked to provide an explanation of the statement regarding private sector reluctance regarding investment in new technology and knowledge.
- 7) With regard to the adoption of new technologies by the private sector: what needs to be adopted? Consider that new technologies from overseas would present a challenge, as these were developed for the unique conditions prevailing overseas.
- 8) Lack of skills is a huge challenge in South Africa and it was mentioned in all the presentations today. But what is being done about the totally dysfunctional skills development system in this country? And when will something be done about it, in order to ensure that it supports the skills and unemployment problems?

THE RESPONSES

R: Regarding the queries relating to design and digitisation: my perspective is that design is neglected; however, we need to guard against becoming overly design-centric. Nevertheless, it does have a place, e.g. in additive manufacturing and there is a programme for this, but additive design requires a different skill set to traditional design. We are introducing this at programmatic level. But initiative is required at the highest level and must involve real co-funding of public-private partnerships. Consider that in the US the project was set up upon the recommendation of the Presidential Advisory Council, which reported into the White House.

R: In Germany, 4.0 is now emerging, so our broader manufacturing sector may not be ready for certain innovations. Also, the issue of cyber security comes into play.

R: There is grant funding for prototype development and a DST intervention programme into specific firms and sectors. There may be a specific programme that can be accessed and this can be investigated; but this is not a unique problem – it is ubiquitous to start-up. Some consideration has been given to the adoption of a small US programme that has been run for 30 years, with good success: it uses public funds to take small ideas with a small budget to scale and then more budget is provided later. But this is still in the early stages and there is only much discussion behind closed doors to report.

R: Evidence of the reluctance of the private sector to invest in technology and knowledge was provided in the work done by the Manufacturing Circle and then in the Deloitte study that replicated this work locally. The ranking was 7th i.t.o. priorities. Visits to firms also reveal that some are very innovative and some not at all. The steel crisis at the moment is a classic case of under-investment for decades, which has led to lack of competitiveness.

R: Regarding PhDs – it's not about whether we need them or not, it's what industry needs. Does industry need them? For example, are we doing the right ground work now for shale in the future, if that industry is to be developed? If not, we will be buying the required technology from the US, which has the technology that is needed. Another example is the cosmetics industry: do we need people to do the basic blending or to get the higher notes in blending? The starting point is to understand the needs and to develop the country's strategies around those needs. We need to ask: Do we need modes 1 or 2 research, and how do you connect the two? We must acknowledge that some people may do interesting research, but others do research that is required by industry – and we need to look at the benefits of both carefully.

R: In terms of technology and jobs in agriculture: there are opportunities in the agricultural sector and we need to look at how we put in place measures to support the growth of that industry, e.g. in the cold chain ?, veterinary scientists. With the latter, we may have a few hundred, but may need a few thousand. Also consider that if we don't have the facilities to vet the process, we can't access the markets. For example, a trade mission to Russia may have produced good contacts, but goods cannot be exported to them, as there is no agreement and no protocols. With the agriculture sectors, we have to add noughts and take quantum leaps to ensure transformation. Another example is Ethiopia and Kenya, which saw the export flower market opportunities and invested – but if you don't have the airport facilities, you can't export flowers. We can't have white elephants that deliver huge abattoirs with huge investment, but which then have three sheep a day going through the facility. That is just meaningless and wasteful investment.

R: There has been a tendency to say that rural people can be subsistence farmers – but this doesn't work. Even the Spar in Umtata buys its potatoes from another area through a system that ensures competition in getting food to market. So the country needs to re-think how it can unlock potential. And it needs to understand what people want to do with their lives and not dictate this: some may want to be subsistence, peasant farmers, but some people who have been retrenched from the gold mines would prefer to be a wage labourer, rather than grow a patch of cabbages for own consumption.

R: Understanding of needs is key and more work needs to be done by the country in this regard. We need to understand why we need investment in technology. We need to understand why we need investment in workers as well, in order to raise productivity and for people to take advantage of double and triple salary improvements. In the steel and mining industry, upper sector workers earn three times as much as the others because of the minimum R12 000 negotiated by the unions. But there must be a productivity benefit as well, through better workers and technology.

Closing Remarks

Dr Mlungisi Cele advised in closing that the workshop was the start of the conversation between all stakeholders and the conversation would continue. Issues that require further conversations have been noted. Some practical problems and solutions are needed and government workers need to assist all businesses, including by directing them where to go to obtain the assistance they need.

Dr Cele thanked all the workshop organisers for their efforts and the NACI Council members and the DST DDGs for attending the session. He also thanked all attendees for taking the time to participate in the discussion.

The session closed at 13h06.

Physical Address
Suite L2, Enterprise Building
Mark Shuttleworth Street
The Innovation Hub
Pretoria
0087

Postal address
The NACI Secretariat
Private Bag X894
Pretoria
0001

Tel: 012 844 0925

www.naci.org.za