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Examining the Effectiveness of the South African Apparel Industry's Systems of Innovation

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Abstract

The debate on national innovation systems in Africa continues as Africa seeks to lead its development. This paper examines South Africa's apparel industry's 2007 to 2017 industrial policy action plans (IPAPs). The triple helix theory is used to guide a content analysis. The content analysis shows that the sectoral systems of innovation (SSI) of the South African apparel industry have met coherence policy issues since 2007. This paper also identified underlying policy inconsistencies in the SSI of the South African apparel industry. This paper recommends and suggests that the policy relating to the apparel industry be revised following the identified SSI policy inconsistencies to strengthen the performance of the apparel industry SSI. This paper validates Manzini's (2015) call for a closer look at SSI and identifies one of the approaches to assess policy coherence or inconsistencies in the apparel industry and other industries.

Keywords: Clothing industry, economic policy, innovation, science, technology, triple helix model of innovation

1. Introduction

The South African government has introduced the concept of national innovation systems (NSI) to promote any sector in the country that will improve the socio-economic development of the country. The NSI is "a means by which a country seeks to create, acquire, disseminate, and put into practice new knowledge that will help the country and its people achieve their individual and collective goals" (Department of Arts, Culture, Science and Technology, 1996). In this paper, sectoral systems of innovation (SSI) are defined as a means by which a sector seeks to create, acquire, disseminate, and practice new knowledge that helps a sector improve its competitive advantage and socio-economic contribution to a country. Since the apparel, textile, leather, and footwear industry (hereafter referred to as the apparel industry) is one of the identified sectors of the South African government (Department of Trade and Industry, 2007; 2010), this paper analyses policy coherence or inconsistencies in SSI.

Manzini (2015: 03) emphasises the need to study innovation systems in sectors to enable policymakers to develop evidence-based policy interventions and achieve policy coherence. This

paper, therefore, addresses Manzini's proposal to study SSI, specifically in the relationship between the apparel industry, related research, and innovation partners. The policy inconsistencies in this paper were identified because of Manzini's (2015) recommendation to question SSI. The objective is to assess how the partnership has succeeded in creating, acquiring, and transforming new knowledge into a competitive advantage and socio-economic development through all institutional sectors involved (university, industry, and government), thus strengthening policy coherence. The South African White Paper on Science and Technological Innovation (Department of Science and Technology, 2018: ix) defines and explains policy coherence as follows:

"Achieving policy coherence involves the systematic promotion of mutually reinforcing policy actions between government departments to create synergies to achieve agreed objectives and to avoid or minimise negative impacts on other policy areas. Policy coordination involves the alignment of programmes and activities among different actors to achieve policy goals".

In the context of this paper, achieving policy coherence is viewed as a stage where strategic alignment is achieved among universities, industry, government, and other stakeholders in research and development activities. When relationships are aligned, national resources across institutional domains are optimised to implement SSI and national goals.

This paper analyses critically the Industrial Policy Action Plans (IPAPs) of the South African apparel industry from 2007 to 2017 to determine whether SSI is policy coherent or inconsistent. In terms of this paper, 'policy coherence' is the alignment of policies and strategic objectives between universities and research institutions (which create and disseminate new knowledge), industry (that disseminates and implements new knowledge), and government (that regulates policies) so that a sector can improve its competitive advantage and socio-economic contribution. On the other hand, 'policy inconsistency' is defined as a condition in which there is little or no alignment between the policies and strategic goals of the stakeholders, resulting in stagnation of the sector's competitive advantage and declining socio-economic contributions to the country.

2. Literature Review

2.1 Overview of the triple helix model of innovation in the context of the apparel industry

The origins of the triple helix model can be traced back to Sabato and Mackenzi (1982) and Lowe (1982), who discussed these elements (Ranga & Etzkowitz, 2013). The triple helix model of innovation describes how knowledge is created, acquired, disseminated, and put into practice through collaboration among various stakeholders in an open innovation environment. The model was developed in the 1990s at a workshop in Amsterdam organised by Leydesdorff and Etzkowitz (1996) (Etzkowitz, 1993; Etzkowitz and Leydesdorff, 1995). Over the years, the triple helix model of innovation has evolved into various forms (statistical model, laissez-faire model, integrated model, and quadruple model), demonstrating its effectiveness and continuous evolution as the environment for innovation changes (Carayannis & Campbell, 2009; Singer & Peterka 2012; Etzkowitz, 2008; Patel, Jagger, & Nemoto; 2015). The triple helix model of innovation is relevant to the analysis of NSI and SSI in both developed and developing countries (Nkosi, 2015; Ranga, 2012; Spinoglio, 2015; Giuliani & Arza, 2008; Leydesdorff, 2010; Etzkowitz & Zhou, 2018; Mbatha & Mastamet-Mason, 2021; Sihlobo & Mbatha, 2022).

2.2 Institutions involved in the sectoral system of innovation

The Organisation for Economic Cooperation and Development (OECD, 1997: 12) advises:

"Each country has its own institutional profile, which depends on corporate governance, the organisation of the higher education sector, and the scope and orientation of government-funded research. There are marked differences in the relative roles and weights of different institutions in

national innovation systems, which partly explains the concentration at the country level [...]

Technological innovation occurs within a particular industry structure and national context; a better understanding of that context or system will lead to better government technology and innovation policy”.

The NSI sets expectations for government, universities, and industry. With respect to government, OECD (1997) states that government policies should emphasise the role of joint research and development activities and technical cooperation among institutional sectors. In addition, these policies should enable joint activities, such as joint patenting, joint publication, and personal mobility within institutional spheres. The policies should also include the implementation of intellectual property rules, labour market policies, and exchange programmes that facilitate linkages between research and development. Existing literature supports the role of government in developing policies that promote research linkages to reach SSI (Leydesdorff, 2010; Leydesdorff & Etzkowitz, 1996; Leydesdorff, 2010; Martin, 2011; Spinoglio, 2015; Potgieter, 2012). However, in the context of South Africa, the Human Sciences Research Council's (2019) Centre for Science, Technology, and Innovation Indicators (HSRC-CeSTII) show that the government provided 46% of total research and development (R&D) funding in 2016/2017. In the context of the apparel industry's R&D linkages, Mbatha and Mastamet-Mason (2021) explain that NSI actors are active and research linkages are at a statist stage. Mbatha (2022) indicates that the government provides research funding, but few apparel companies take advantage of this opportunity. Few institutions offering programmes in apparel and textiles are aware of these funds. The underutilisation of these funds may indicate policy inconsistencies in the SSI in relation to the South African apparel industry, or those relevant policies are isolated from implementers.

The OECD (1997: 41) notes that it is the industry's responsibility to find partners for research and development linkages, identify relevant new knowledge, and adapt the knowledge to industry-specific needs to improve competitive advantage. The existing literature confirms this (Etzkowitz et al., 2007; Giuliani & Arza, 2008; Spinoglio, 2015). In the context of the South African apparel industry, the HSRC-CeSTII indicated that the industry provided the second-highest level of funding for research and development linkages in 2016/2017 (HSRC-CeSTII, 2019). In the context of the apparel industry's research and development linkages, Mbatha (2022) reports that the apparel industry is underperforming in research and development linkages, thereby highlighting possibilities of policy inconsistencies that the SSI in the South African apparel industry may be experiencing.

Universities are significant knowledge producers (OECD, 1997). However, South African universities generally engage in research and development activities to increase their funding to survive financially rather than to generate knowledge. Universities are under constant pressure to research as government funding reduces if research goals are not met (Spinoglio, 2015; Erdil, 2015). In most developed countries, knowledge generated through research leads universities to adopt and contribute to the economic development of their respective countries (Etzkowitz et al., 2007; Giuliani & Arza, 2008; Erdil, 2015; Carayannis & Campbell, 2012). In contrast to contributions in developed countries, South African fashion design and textile programmes are only moderately involved in research and development relationships (Mbatha, 2022; Sihlobo & Mbatha, 2022). Inadequate inclusion of research linkages highlights the need to review SSI for policy coherence or inconsistencies.

Other players in the South African apparel industry innovation system include the Council for Scientific and Industrial Research (CSIR), a government-funded research institution (Sihlobo & Mbatha, 2022). Other government-funded institutions include the Cape Clothing and Textile Cluster (CCTC), the KwaZulu-Natal Clothing and Textile Cluster (KZNCTC), the National Footwear and Leather Cluster (NFLC), and the Exotic Leather Cluster (ELC). Finally, the South African apparel industry has technology institutions involved in research and development collaboration (Sihlobo, 2022). These institutions are instrumental in improving research and development linkages (Sihlobo & Mbatha, 2022; Mbatha & Mastamet-Mason, 2021) that have improved competitive advantage in the

apparel industry (Mbatha, 2018; Mbatha 2021). While these institutions exist and play an important role, it is unclear whether SSI has coherent or inconsistent policies, highlighting a gap to which this paper can contribute.

2.3 Challenges of competitive advantage in the South African apparel industry

The South African apparel industry has always played an important role in job creation (Mbatha, 2021; Nasttrass & Seekings, 2021), with employees being predominantly women (Vlok, 2006; Mbatha & Mastamet-Mason, 2015). Prior to 1994, the apparel industry had a monopoly in the domestic market as it was heavily protected from outside competition. A high level of protection in the past contributed to poor quality production processes, resulting in the production of low-value-added goods and a failure to focus on international competitiveness (Vlok, 2006). After 1994, South Africa was integrated into the global trading system, which led to competition from international imports. Since 2005, the opened markets forced the apparel industry to develop value-added apparel. These products included custom-made apparel and other formal wear, eventually becoming popular in the domestic and export markets.

The era of trade liberalisation in South Africa saw a significant decline in jobs in the industry (Mbatha & Mastamet-Mason, 2015; Morris & Barnes, 2014). For example, in 2013, 60,000 jobs were lost in the apparel industry, down from 120,000 previously (Barnes & Hartogh, 2018). The loss of jobs is attributed to the high cost of production in South Africa, contributing to the cost of products that cannot compete with imported goods (Morris & Barnes, 2014). The loss of competitive advantage in the South African apparel industry highlights the poor coordination of SSI in this industry.

Despite the challenges faced, the apparel industry has been one of the government's preferred industries since 1996. The apparel industry largely requires low to medium-skilled labour, the majority of whom are women in less-developed regions of South Africa (Department of Trade and Industry, 2007; 2010; 2014; 2016; 2017). The South African government recognises the clothing industry as a labour-intensive sector (Department of Trade and Industry, 2007; 2010). The apparel sector requires less sophisticated technological advancements, making it one of the strategic industries that can be easily rebuilt (Department of Trade and Industry, 2007; 2010; 2014; 2016; Barnes & Hartogh, 2018: 7). Due to the challenges of competitive advantage that have persisted in the industry for more than two decades (1996 to 2018), the sector has yet to achieve its socio-economic goals (Mbatha & Mastamet-Mason, 2015; Barnes & Hartogh, 2018; Morris & Barnes, 2014).

Among the key challenges affecting the sector's competitive advantage are low innovation readiness, lack of highly skilled human capital, outdated technologies, fragmented value chains, and ageing infrastructure (Mbatha & Mastamet-Mason, 2015; Barnes & Hartogh, 2018; Morris & Barnes, 2014; Mbatha & Mastamet-Mason, 2018). Studies have proposed solutions for competitive advantage in the South African apparel industry (Mbatha, 2014; 2018; Mbatha & Mastamet-Mason, 2015; 2018; Morris & Barnes, 2014). However, progress has been slow and results are hardly satisfactory. This paper suggests that relevant policymakers pay special attention to the development of SSI for the South African apparel industry and ensure that all institutional sectors are involved. Collaboration with all stakeholders will ensure that policy is coherent and inconsistencies are identified and addressed promptly.

3. Methodology

The study used a qualitative-analytical research method with a particular focus on the relevant content of the study (Chiwandire & Vincent, 2019). Content analysis refers to the gathering of information from documents and artefacts, which may be text in various formats, images, illustrations, drawings, audios, or videos that are soft or hard copies (Bowen, 2009: 27). Researchers use content analysis to examine repeatable patterns in documents, emphasising the "systematic way of reviewing or evaluating documents that ensure the reliability/validity/trustworthiness of the

information collected". Bowens (2009: 28) states that document analysis "requires an examination and interpretation of data to make meaning, gain understanding, and develop empirical knowledge". Among the key documents examined in this study was the Industrial Policy Action Plan 2007-2017, which is available in electronic format. The IPAP has existed for more than a decade, contains relevant information, and is referenced in various studies (Zarenda, 2013; Mbatha, 2018; Mbatha & Mastamet-Mason, 2018). Other documents consulted include peer-reviewed articles and papers that address NSI, SSI, the triple helix model of innovation, and the challenges of competitive advantage. These documents contain relevant information for referencing or discussion in this paper.

The content checklist of relevant concepts from all documents (IPAP, NSI, SSI, and the triple helix model) was developed to guide data collection. The guiding questions used were mapped to the following key themes that emerged from the content analysis of the documents:

- Development of an apparel Centre of Excellence
- Science, technology, and innovation in apparel SSI
- Emergence of clusters in the South African apparel industry.

The identified themes were used to present the findings and discussions of this paper in the next section. Then, the existing literature was used to support or refute the study findings.

4. Results and Discussions

4.1 Decline of the clothing centre of excellence

The findings show that the SSI of the South African apparel industry included science, technology, and innovation from the outset (Department of Trade and Industry, 2007: 23). The CSIR and the Department of Science and Technology (Department of Trade and Industry, 2007) expressed this through the 2007 IPAP Key Action Plan, that highlighted plans to create a centre of excellence for textile technology. In 2010, the Centre of Excellence was renamed the Textile Engineering Centre of Excellence, and the centre is responsible for implementing the Skills Enhancement Strategy for South Africa's apparel industry (Department of Trade and Industry, 2010). While the Department of Higher Education and Training (DHET) collaborated with the Department of Trade and Industry on the skills strategy, only the Sector Education and Training Authorities (SETAs) in the apparel industry played a role in its implementation. In line with the Skills Enhancement Strategy, the Sector Education and Training Authorities sent a delegate to the Czech Republic in 2010 to receive training in textile technology. The participants sent for this training did not have the basic textile skills required. Some participants commented that the training was too technical and did not benefit them as planned. Some participants reported that they could not apply the textile technology knowledge they gained during the training in their daily work, either in the classroom or in the factories where they are employed. The apparel industry missed the opportunity to identify appropriately relevant people in the industry or academic staff from textile-related training programmes for the training. Relevant qualification translates into appropriate action that translates the knowledge gained into quality production or teaching materials disseminated to students in their programmes. The South African apparel industry missed the opportunity to develop a competitive advantage through textile technology opportunity (development of advanced skills) (Porter, 1998). This missed highlights the policy inconsistencies between the university, industry, and government when implementing IPAP goals. Further, the missed opportunity highlights a disconnect between policies and implementation strategies relevant to the sector.

The results show that South African universities with apparel-related programmes in the apparel industry only emerged from the 2014 IPAP. Research and development linkage activities existed between apparel-related university programmes and the Textile Engineering Centre of Excellence (Department of Trade and Industry, 2014: 69). Although the inclusion of programme linkages shows a positive development in terms of policy coherence, only a few universities have

participated, and most apparel and textile researchers were left out. Although there is an improvement in SSI policy coherence, inadequate research partnerships result in not addressing the industry challenges regarding the policies. Extensive engagement in research is critical for South Africa's apparel industry's growth and development.

The results further reveal that SSI policy coherence became stronger in the 2016 and 2017 IPAP as more institutional sectors were involved in research and development linkages. The Centre of Textile Engineering Centre of Excellence was not mentioned in IPAP (2016; 2017), highlighting missing linkages in instrumental research collaborations and partnerships. There is no clear indication of who will be responsible for the strategic goals and existing research and development linkages in the future, especially in postgraduate studies. The exclusion of the Textile Engineering Centre of Excellence from IPAP (2016; 2017) SSI highlights policy inconsistencies that will be identified by investigating the SSI.

4.2 *Strengthening the triple helix model in South Africa's apparel industry*

The results show that in 2007, joint research and development activities for the apparel industry of South Africa included the government (namely the Department of Trade and Industry, Department of Higher Education and Training, and Sector Education and Training Authorities) and research institutions (namely Centre for Scientific Industrial Research). However, the findings do not reveal any direct involvement of South African universities offering fashion design or related programmes, which are part of the Textile Engineering Centre of Excellence (knowledge-producing institutional sphere according to OECD) (1997). The 2007 IPAP does not mention the South African apparel industry as an actor in the Textile Engineering Centre of Excellence. According to the IPAPs reviewed, the South African apparel industry is not involved in the Textile Engineering Centre of Excellence. The exclusion of two important institutional sectors (universities and the apparel industry) highlights the policy inconsistencies in the apparel of South Africa's SSI. In addition, the exclusion highlights weaknesses in strategic planning and the identification of relevant role players in the research partnerships.

The absence of universities in the 2007 to 2010 IPAP contributed directly or indirectly to the persistent lack of competitive advantage (Mbatha, 2014; Morris & Barnes, 2014; Mbatha & Mastamet-Mason, 2015; 2018; Barnes & Hartogh, 2018). While the number of students and graduates in South African universities with clothing and textile-related qualifications increased between 2011 and 2013 (Mbatha, 2018), the sector continues to face challenges related to competitive advantage despite the strategic focus of the Textile Engineering Centre of Excellence on skills development. Such challenges may be attributed to the lack of participation of South African universities and the South African apparel industry in implementing SSI through the 2007 to 2010 IPAP policy.

The triple helix model of innovation in the apparel industry is at a statist stage, where relevant partnership role players working in isolation make the situation worse (Mbatha & Mastamet-Mason, 2021). A core objective of the 2017 IPAP was to "emphasise R&D and transition to a knowledge-based economy" (Department of Trade and Industry, 2017: 6). The 2017 IPAP outlined several strategies that solidify the role of universities in SSI in the South African apparel industry, as they are partners in research and development in four of eleven key action plans in the 2017 IPAP through 2018. These research and development linkages are primarily in the leather and footwear sectors. Universities such as the University of Pretoria (UP), Durban University of Technology (DUT), Cape Peninsula University of Technology (CPUT), and Vaal University of Technology (VUT) are preferred partners for research and development in the 2017 IPAP key action plans (Department of Trade and Industry, 2017). Although there is a demonstrated SSI policy coherence in South Africa's apparel industry, research priorities should not be limited to only the four universities listed. Excellence research partnerships should be realised by leveraging and harnessing experts in various South African universities rather than by limiting the scope. Expanding research partnerships outside the traditionally preferred universities will enhance the role of universities in the SSI apparel industry in

South Africa. Despite the listed preferred universities in IPAP (2018), the 2017 IPAP still does not include the Textile Engineering Centre of Excellence and 3D body scanning projects. The exclusion of the Textile Engineering Centre of Excellence and 3D body scanning projects further highlights the SSI policy inconsistencies in South Africa's apparel industry.

4.3 *Science, technology, and innovation in the sectoral systems of innovation*

The apparel industry 2007 IPAP focuses on building science, technology, and innovation infrastructure. The apparel industry 2010 IPAP used science, technology, and innovation to achieve the following objectives (Department of Trade and Industry, 2010):

- Development of the South African apparel sizing database using 3D body scanning technology
- Development of computer-aided design using 3D scanner data
- Development of processing capabilities for new natural fibres such as flax, wild silk, cashmere, and kenaf
- Development of non-woven products and fibre-reinforced composites through new technologies
- Developing technologies for apparel design.

The science, technology, and innovation initiatives led by the Department of Science and Innovation, CSIR and the Industrial Development Corporation (IDC) excluded a very important stakeholder: the apparel industry. The exclusion of the apparel industry highlights the inconsistency of the SSI policy.

Some universities have 3D body scanning technology. Some of these universities have partnered with industry and government for research and development (Department of Trade and Industry, 2014). However, the 2010 IPAP does not identify these universities as sponsors of science, technology, and innovation initiatives. It is worth noting that the 3D body scanning project was also not included in the 2017 IPAP as a second key initiative, which the SSI has not followed up with South Africa's apparel industry. The exclusion of the 3D body scanning projects highlights SSI policy inconsistencies.

In 2014, the apparel industry and universities with relevant programmes were introduced as partners in linking research and development (Department of Trade and Industry, 2014). The inclusion of the relevant programmes highlights an improvement in SSI policy coherence. The involvement of universities aimed to create South African apparel and footwear sizing systems by completing the consolidation of 3D body scanning technology data by 2015. Despite the availability of 3D scanners in some universities for more than a decade, South Africa's apparel industry still relies heavily on adopted sizing systems from Western countries (Ola-Afolayan et al., 2021). Through technical committees, the South African Bureau of Standards continues to revise its sizing systems in line with international standards (Ola-Afolayan, et al., 2021). The sizing systems' ongoing revisions to conform with Western standards highlight the inconsistencies in policy SSI, as there is a disconnect between industry and university research activities (Mbatha, 2021). The lack of reports on outcomes of the implementation of the above science, technology and innovation initiatives reported in the 2016 and 2017 IPAP highlights SSI policy inconsistencies.

4.4 *Results according to "the emergence of clusters in sectoral systems of innovation of innovation"*

Porter (1998: 78) defines clusters as companies and institutions linked by the production value chain of products and services in a compact geographic location. The formation of clusters is the result of immense pressure from competitive advantage. In the context of the apparel industry, the pressure on competitive advantage stems from challenges (Mbatha & Mastamet-Mason, 2015; Mbatha, 2021), including Asian countries importing apparel products into South Africa and the failure to take

advantage of opportunities arising from international trade partnerships. In response to the competitive pressures that the South African apparel industry has faced for more than two decades, the Department of Trade and Industry developed competitiveness programmes to support the South African apparel industry (Department of Trade and Industry, 2007). In 2009, the programmes led to the launch of the Clothing and Textiles Competitive Programme (CTCP), which paved the way for South African clothing industry clusters (Department of Trade and Industry, 2014; 2017a). The Department of Trade and Industry states that "The CTCP acts as a confidence-building catalyst in the apparel sectors, where more and more technologies are being introduced to accelerate global competitiveness" (Department of Trade and Industry, 2017a: 90).

Under the CTCP, the South African apparel industry developed clusters that include the National Leather and Footwear Cluster, the National Fashion Cluster, the National Cotton Cluster, and the National Exotic Leather Cluster (Sihlobo & Mbatha, 2022). The clusters improve SSI policy coherence.

According to the Department of Trade and Industry (2014: 69), "the clusters provide formal platforms for cross-sectoral knowledge exchange as they include members from across the textile-apparel-retail value chain and the leather-shoe-retail value chain". Through the work of the National Exotic Leather Cluster (the oldest cluster), South Africa is building a studio in New York for the rapid development of exotic leather goods (Department of Trade and Industry, 2017a: 96). The footwear industry's production growth of two million pairs could also be supported by the leather and footwear clusters (Department of Trade and Industry, 2017b: 16). This example of a cluster improving development rapidity highlights the SSI coherence in South Africa's apparel industry.

However, KwaZulu-Natal's apparel and textile clusters and the Western Cape's Apparel And Textile Clusters are not mentioned in the 2007 to 2017 IPAP. These clusters were established in 2005 with funding from the Department of Trade and Industry, among others (Cape Clothing and Textiles Clusters, 2017; KwaZulu-Natal Clothing and Textiles Clusters, 2017). These clusters operate in regions at the heart of South Africa's apparel, textile, leather, and footwear industries. A cluster's board members include a representative from the university (Western Cape Clothing and Textiles Clusters). While the clusters' geographic location suggests a well-thought-out SSI policy coherence, their absence from the 2007 to 2017 IPAP highlights policy inconsistency.

Although the geographic location of the Cape Clothing and Textiles Cluster and the KwaZulu-Natal Clothing and Textiles Cluster is considered strategic, the two clusters work only with their member companies and not with the South African apparel industry. While the clusters' lack of cooperation with the South African apparel industry may explain their absence from the 2007 to 2017 IPAP, it also highlights and confirms the inconsistencies in the policy of SSI.

5. Conclusions

The review of the apparel 2007 to 2017 IPAP was conducted through the lens of SSI as recommended by Manzini (2015). Manzini (2015) argued that studying SSI would reveal gaps that NSI studies may not identify because of their survey nature. This paper supports Manzini's argument, as the SSI of the South African apparel industry did indeed identify policy inconsistencies that NSI studies did not previously identify.

As contextualised in this paper, SSI is a means by which the clothing and textile sector seeks to create, acquire, disseminate, and implement new knowledge to competitive advantage for making a socio-economic contribution to South Africa. The South African government provides policies, grants, and incentives to SSI to improve SSI policy coherence.

The apparel 2007 to 2017 IPAP review of SSI highlights some positive developments in South Africa's apparel industry. The development of the Centre of Excellence for Apparel and Textiles and the clusters represented a promotion of policy coherence in the SSI of South Africa's apparel industry. This paper also noted an improvement in the triple helix model for innovation implemented in SSI in the South African apparel industry with the introduction of clusters and other institutional sectors as

stakeholders in SSI.

While the SSI policy coherence was evident, there were also policy inconsistencies in SSI in the South African apparel industry. As the linkages improved in SSI between 2007 and 2017, the review shows that project linkages dropped were underpinned by science, technology, innovation, research and development, including the Textile Engineering Centre of Excellence and 3D body scanning technology. The strategic importance of apparel and textile clusters was not recognised as they were not included in SSI between 2007 and 2017. The limited role of universities with apparel programmes limits the production of relevant new knowledge crucial to improving SSI policy coherence. The weaker apparel industry SSI leads to competitive advantage challenges in the favourable challenge environment (skills, innovation, and relevant new knowledge). The competitive advantage challenges will persist through 2030 and beyond if the identified policy inconsistencies are not addressed. The weaker SSI is due to the South African apparel-industry-associated university, industry, and government institutions not yet included in the SSI.

The SSI of the South African apparel industry is not yet consistent with the definition of SSI described in this paper's introductory section. Due to the policy inconsistencies identified in this paper, the South African apparel industry is unable to "create, acquire, disseminate, and put into practise new knowledge that helps the country and its people achieve their individual and collective goals", which may prove very difficult.

By 2017, the SSI of the South African apparel industry had not adequately implemented the 2007 IPAP initiatives assigned. If the relevant SSI initiatives outlined in 2007 IPAP are not progressively pursued in 2017, challenges in the South African apparel industry will persist. Dialogue among stakeholders in SSI is necessary to address existing policy inconsistencies while improving policy coherence.

This paper recommends the following to improve the SSI of South Africa's apparel industry. Future apparel industry IPAPs should consider all institutional sectors (university, industry, government, research institutions, and sector consultancies) when developing key action plans to achieve SSI. All initiatives related to the SSI of the South African apparel industry should be highlighted when developing strategies. More efforts should be made to ensure policy coherence between the goals of the apparel IPAPs and the goals in the institutional spheres. Finally, with government support, IPAPs should pay more attention to the apparel industry's dissemination and application of new knowledge.

The involvement of universities as relevant research and development partners by the apparel industry will promote policy coherence in SSI in the South African apparel industry. All stakeholders should endeavour to deepen SSI linkages to reduce policy inconsistencies and improve policy consistencies identified in this paper.

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