Research Article

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Roles of Practitioners in Industry-Government Research Collaborations of South African Clothing, Textiles, Leather, and Footwear Industry: Implications for SDGs and Agenda 2063

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Abstract

This study explores the roles of industry and government in research collaborations from the context of the clothing, textiles, leather, and footwear (CTLF) industry of South Africa. This study further seeks to highlight the implications of the roles of industry and government in SDGs and the African Union Commission Agenda 2063 (hereafter Agenda 2063). Through mixed methods, this study conducted 12 interviews with participants from universities, industry, and government, as well as 22 correctly filled-in questionnaires to address the research questions of this study. The findings highlight that government performs its roles more than the industry when engaging in research collaborations in the South African CTLF industry. The implications of the roles of industry and government to the achievement of SDGs and Agenda 2063 show that the South African CTLF industry contributes to SDGs and Agenda 2063. However, the CTLF industry can contribute even more to SDGs and Agenda 2063 if they take advantage of opportunities presented by research collaborations. This study highlights science, technology and innovation policy gaps that undermine development in the CTLF industry of South Africa and negatively affect the attainment of SDGs and Agenda 2063. This study contributes new knowledge by providing empirical findings on the role of industry and government in research collaborations in the context of the CTLF industry of South Africa.

Keywords: *African Union CommissionAgenda 2063, clothing, footwear industry, government, government-industry collaboration, SDGs, textiles, triple helix*

1. Introduction

Literature indicates that industry is important because it plays a crucial role in developing a country's economy (Abdullahu, Toni & Masrom 2017). Universities are important because they educate citizens and conduct research that assists in developing a country's economy (Bergman 2014). Government creates a healthy environment for industry and universities to contribute to the economy (Abdullahu et al. 2017). These factors highlight roles played by institutional spheres. These institutional spheres are key players in achieving Sustainable Development Goals (SDGs) and Agenda 2063.

Since the adoption of SDGs, many countries' policy strategies have been geared up to achieve SDGs. Agenda 2063 was developed in line with SDGs. Advances have been made globally to ensure

the achievement of SDGs and Agenda 2063. Strategies to monitor SDGs and Agenda 2063 goals are being enhanced (IATT 2018). Research collaborations were identified as a strategy to achieve SDGs (IATT 2018) and Agenda 2063 (African Union 2019). Literature shows that more studies are required at the sector, regional, national, and continental levels to monitor SDGs and Agenda 2063 goals through research collaborations (African Union 2019; IATT 2018; Manzini 2015).

Africa is endeavouring to achieve SDGs and Agenda 2063 by implementing the Science, Technology, Innovation Strategy for Africa (STISA) 2024 (African Union 2019). South African policymakers have endeavoured to align the country's National Development Plan (NDP) vision 2030 to SDGs (StatsSA 2021). This alignment of NDP and SDGs resulted in Industrial Policy Action Plans (IPAPs) and science, technology, and innovation (STI) policies being aligned to SDGs, NDP, and Agenda 2063 (DST 2018; DTI 2014). IPAP outlines governments' industrial policy strategy for priority sectors of the economy. The South African STI white paper outlines the country's policy direction to achieve SGDs, Agenda 2063, and NDP, among others (DST 2018). The above policies highlight strategic policy alignment from SDGs, Agenda 2063, NDP, STI, and IPAP. For these strategically aligned policies to be realised, South Africa must research at sectoral, regional, and national levels to monitor SDGs, Agenda 2063, NDP, and IPAP.

While literature highlights research collaborations in the CTLF industry of South Africa and implications for SDGs and Agenda 2063 (Sihlobo & Mbatha 2022; Mbatha & Mastamet-Mason 2021), literature on the role of practitioners in research collaborations and their implications for SDGs and Agenda 2063 remains limited. This study seeks to contribute to this literature gap by exploring the following research questions:

i) What is the role of industry in research collaboration of the CTLF industry of South Africa?
ii) What is the role of government in research collaborations of the CTLF industry of South Africa?
iii) How do the roles of South African CTLF-industry practitioners affect the achievement of SDGs and Agenda 2063?

This study is important to global policymakers monitoring SDGs and Agenda 2063 because this study may highlight advancements and challenges in the CTLF context. In Africa, this study may assist the understanding of STISA and African Union regarding the gains and challenges of SGDs and Agenda 2063 through research collaborations from the CTLF industry context. This study is valuable to global CTLF-industry practitioners since it will deepen their understanding of research collaborations in South Africa, which is known as a gateway to Africa. Through this study, the South African CTLF industry may deepen its understanding of the sector's role in achieving SDGs and Agenda 2063 through research collaborations. The South African higher education sector will find this study insightful since it discusses research collaborations that the education sector should be spearheading.

This study discusses using the triple helix model of innovation in the CTLF industry of South Africa and research collaborations within this industry. Methods employed in this study are discussed, followed by a presentation of findings. Lastly, this study presents discussions and conclusions of this study. In the next section, this study discusses the triple helix innovation model.

2. Review of Literature

2.1 The triple helix in the CTLF industry of South Africa

The triple helix theory was developed more than two decades ago (Ranga & Etzkowitz 2013; Etzkowitz & Leydesdorff 1995; Etzkowitz 1993). The model has driven university-industry-government research collaborations in developed and developing countries (Nkosi 2015; Ranga 2012). With the triple helix, roles of industry and government are discussed in the context of developed countries and other disciplines, excluding the CTLF industry.

According to the triple helix theory, the industry's role should include collaborating with other

industries, universities, and government to become more innovative (Leydesdorff & Etzkowitz 1996). Ndabeni (2008) states that shifting to a knowledge-based economy can elevate levels of effectiveness and innovation in industry. Industry could reduce costs by shifting to research collaborations (Spinoglio 2015). For research collaborations to be successful, industry has to take part in funding joint research, apply an open innovation strategy, and gain access to results before publications are finalised (Spinoglio 2015). Industry is meant to develop R&D capabilities parallel to universities because industry knowledge affects the success of collaborations (Giuliani & Arza 2008; Etzkowitz, Dzisah, Ranga & Zhou 2007). In South Africa, industry is the largest performer of R&D, and in 2016/2017, R&D expenditure amounted to ZAR 14.781 billion (HSRC 2019). In 2016/2017, industry's percentage of R&D expenditure for manufacturing was second highest at 27.8%. However, CTLF manufacturing had the lowest R&D expenditure (HSRC 2019). Spinoglio (2015) states that open innovation can create significant value through external R&D for industry and that collaborations provide an advantage over their competitors.

According to the triple helix theory on the role of government, government at all levels should encourage citizens to take an active role in promoting "innovation in innovation" (Leydesdorff 2010; Leydesdorff & Etzkowitz 1996). Government takes this active role by providing credibility by establishing policies that allow innovation to overcome challenges (Spinoglio 2015; Martin 2011; Leydesdorff 2010). Government could provide a supportive environment by giving universities independence and removing bureaucracy (Potgieter 2012). Government should provide funds based on market failure to support universities in research when the industry would not be able to perform this role (Etzkowitz 2008). Government funds the largest portion of R&D in South Africa, and in 2016/2017, government-funded ZAR 16.428 billion, which made up 46% of total R&D funding (HSRC 2019). Government could also provide support by providing tax incentives, public venture capital, and incentives (Etzkowitz et al. 2007). Government has research collaborations within the CTLF industry of South Africa. While this is the case, governments' role in research collaborations is underexplored, highlighting the importance of this study (DTI 2014, 2016, 2017).

Studies using the triple helix model in South Africa are limited but growing. Potgieter (2012) highlights that the implementation of research collaborations using the model in the South African context has challenges arising from the institutional sphere that is unable to understand cultural differences. Bergman (2014) discusses the roles of universities, industry, and government in a triple helix context. However, this study fell short of discussion factors that may constitute the role of the institutional sphere that this study could build on. Also, gaps still exist in the role of the institutional spheres to which this study may contribute. In the following section, the limited literature on research collaborations in the CTLF industry of South Africa and identifying gaps that warrant this study were discussed.

2.2 South African CTLF-industry research collaborations

While research collaborations in the CTLF industry have occurred (DTI 2014), literature on collaborations has been non-existent until recently. Mbatha and Mastamet-Mason (2021) assessed the status quo of research collaborations in the CTLF industry of South Africa and found the following. Research collaborations in the CTLF industry of South Africa are at the statist model stage. This statist model is characterised by dominant roles played by government. University-produced innovative products are new organic fabric, water pollution reduction machines for textile firms, identification of possible competitive advantage through technical textiles, and an orthopaedic shoe, among others.

Mbatha and Mastamet-Mason (2021) found that the nature of research collaborations with the CTLF industry of South Africa contributes to SDGs 8 and 9, as well as Agenda 2063 Goal 1. However, very few universities with CTLF-related programmes have research institutions focused on CTLF that are crucial for accelerating research collaborations. Strong boundaries exist between universities, industry and government and result in the role played by universities being below par when

compared with developed countries. The lack of collaboration between CTLF firms, universities with fashion-related programmes, and government contributes to competitive advantage challenges (Mbatha & Mastamet-Mason 2021; Mbatha 2014). As a result, a persistent literature gap remains regarding CTLF-industry research collaborations at regional levels.

Sihlobo and Mbatha (2022) looked at research collaborations from the perspective of research practitioners (academic staff) from all South African universities (traditional, comprehensive, and universities of technology), as well as the collaborations implication for SDGs and Agenda 2063. Their findings are summarised in Figure 1.

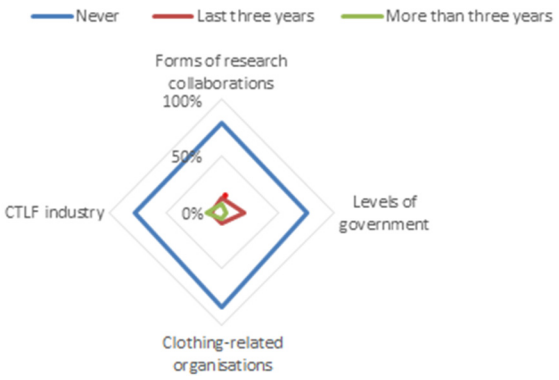

Figure 1: Summary of Sihlobo and Mbatha (2022)

Figure 1 shows that very few academic staff from South African universities engage in research collaborations, and the majority indicated that they have never been involved in research collaborations. Sihlobo and Mbatha (2022) found that academic staff contributions from South African universities have been low compared to developed countries.

Based on the literature presented on South African CTLF-industry research collaborations, the study found that research collaborations are in the early stages despite the government's efforts that began more than a decade ago (DTI 2007). Fewer universities seem to be responsible for the presented state of research collaborations in the CTLF industry of South Africa. While Mbatha and Mastamet-Mason (2021) praise the government for driving research collaborations in the CTLF industry of South Africa, Sihlobo and Mbatha (2022) show that academic staff in South African universities seems to be slow in adapting to the modern role of universities. The recently developed CTLF industry master plan also puts less emphasis on research collaborations as a strategy for achieving its master plan (Barnes & Hartogh 2018). The STISA implementation report states that research collaborations among all stakeholders, including university research centres of excellence, enhance innovation and entrepreneurial success (African Union 2019).

3. Research Methodology

This study is a cross-sectional mixed-methods research design whereby quantitative and qualitative research techniques were employed (Creswell 2014). For the quantitative part of this study, CTLF-industry firms have sampled both probability and non-probability sampling. Random sampling was employed to sample firms from the CTLF industry through probability sampling. As a result of the low response rate, this study then employed non-probability sampling techniques (snowball) to increase the response rate and visited CTLF industry association events to collect data. Then snowball sampling technique was then employed to access respondents who were difficult to reach (Woodley & Lockard 2016). Teddlie and Yu (2007) confirm that both probability and non-probability sampling

techniques can be used on a sample when concurrent mixed methods sampling is used.

Table 1 indicates that in the CTLF industry, the majority (36.36%+36.36% = 72.72%) of CTLF-industry firms come from the three main provinces where CTLF-industry firms occur in South Africa. The majority of CTLF-industry firms' respondents came from mainly compliant CTLF-industry firms and CTLF-industry metropolitan regions. In the South African CTLF industry, firms are defined as compliant when they satisfy government-legislated regulations governing employment, health and safety, and payment of minimum wages (Department of Labour, 2013). Table 1 shows that majority of respondents came from manufacturing CTLF-industry firms. Table 1 indicates that the majority of respondents come from CTLF-industry firms that employ 401 to 500 employees.

Ten statements were used for this study from a nominal four-item scale that indicates how frequently CTLF-industry firms play certain roles when participating in research collaborations. Scales consisted of the following categories 'not involved in R&D linkages', 'never performed this role', 'occasionally performed this role', 'often performed this role', as well as 'never', 'occasionally', and 'often'. Quantitative paper-based questionnaires and online questionnaires were distributed to CTLF-industry firms.

Table 1: Demographic frequencies of CTLF-industry firms of South Africa (n = 22)

Demographic frequencies of respondents		
VARIABLES	**RESPONDENTS**	**PERCENTAGES**
Provinces of CTLF-industry firms		
Gauteng	2	9.09%
Western Cape	8	36.36%
KwaZulu-Natal	8	36.36%
Other	4	18.18%
	22	**100**
Regions of CTLF firms		
Metropolitan	16	72.73%
Non-metropolitan	2	9.09%
Both	4	18.18%
	22	**100**
Compliancy status of CTLF firms		
Compliant	20	95.45%
Non-compliant	2	4.55%
	22	**100**
Type of CTLF firms		
Full manufacturing	17	77.27%
Cut-trim-make Manufacturing	3	13.64%
SMMEs clothing firms	1	4.55%
Combination of firms	1	4.55%
	22	**100**
Employment size of CTLF firms		
1 – 50 employees	3	13.64%
50 – 100 employees	4	18.18%
101 – 150 employees	2	9.09%
151 – 300 employees	3	13.64%
301 – 400 employees	2	9.09%
401 – 500 employees	8	36.36%
	22	**100**
Distribution of nationality of CTLF firms		
National clothing firms	21	95.45%
Multinational clothing firms	1	4.55%
	22	**100**

Data collected was captured in Excel and converted into STATA/SE v14.0 for data analysis. The data achieved by a descriptive analysis were conducted for quantitative data analysis. reliability of data was tested using Cronbach's alpha, achieving 0.80. Reliability is acceptable when the value of alpha is equal to 0.70 or above (Taber 2018). Quantitative data was also put through validity measures explained by Clark-Carter (2010), including face, construct, content, and criteria-related validity.

For the qualitative part of this study, non-probability sampling (heterogeneous sampling) was employed to select respondents suitable for this study to address its research questions. Heterogeneous sampling is a suitable technique when a sample is drawn from multiple stakeholders (Etikan, Musa & Alkassim 2016). Through heterogeneous sampling, this study sampled 12 respondents as shown in Table 2 (Potts & Walwyn 2020).

Table 2: Description of interviewees from the sample

Description of sectors*	Interviewees
Governement directors	3
University fashion design heads of departments	3
CTLF industry-related research institution	1
CTLF industry-related technology station	1
CTLF industry consultants	2
CTLF industry association	1
Director of firms in the CTLF industry	1

*All respondents are connected to the research collaborations in the CTLF industry of South Africa

The saturation point was reached with the above respondents. Qualitative data collection instruments had 12 to 15 lines of inquiry depending on whether respondents come from universities, industry, or government. This study has ethical clearance from Tshwane University of Technology (FREC 2018/03/05). Qualitative data was thematically analysed based on adapted Braun and Clarke's (2006) thematic analysis framework. Furthermore, this study followed Connelly's (2016) advice to achieve trustworthiness that includes credibility, dependability, conformability, and transferability.

Qualitative and quantitative data were separately analysed. During the presentation of findings, quantitative data were used to supplement qualitative findings. This supplementation of qualitative data is because quantitative data could not yield a higher response rate and thus limited possible rigorous statistical analysis. The findings of this study are presented.

4. Limitations

The number of quantitative participants (n = 22) from the CTLF industry was low, preventing this study from employing more robust statistical analysis methods to strengthen the robustness of the findings. While this is the case, these participants came from the main regions of the CTLF industry of South Africa. The number of qualitative participants (n = 12) presented in Table 1 provides this study with a strong foundation to support the robustness claimed in this study. Very senior managers from universities, industry, government, and associations were qualitative participants in this study. The qualitative data was used as the main source of this study while the qualitative data was employed as supportive data to illustrate the findings from qualitative data sets.This study excluded traditional universities that typically engage in research more than comprehensive universities and universities of technology.Future studies should explore reasons why research and development collaborations interest is low in the CTLF industry and universities with clothing-related programmes.

5. Results

Guided by Potts and Walwyn (2020), the findings of this study are presented in two sections to address these research questions: i) What is the role of industry in the research collaboration of the CTLF industry of South Africa? ii) What is the role of government in research collaborations of the CTLF industry of South Africa? iii) How do the roles of South African CTLF-industry practitioners affect the achievement of SDGs and Agenda 2063? The presentation of the findings on the role of government in research collaborations of the CTLF industry will also discuss how these roles affect the achievement of SDGs and Agenda 2063. A similar pattern will be followed when discussing the findings on the role of the CTLF industry of South Africa in research collaborations. In the next section, this study presents the findings on the role of government and its implications for the SGDs and Agenda 2063.

5.1 Findings on the role of government in research collaborations and its implications for SGDs and Agenda 2063

While the quantitative findings are presented in Figure 2, they are used to support the qualitative findings which is the foundation of this study. Figure 2 presents frequencies on the role of government in research collaborations in the CTLF industry of South Africa.

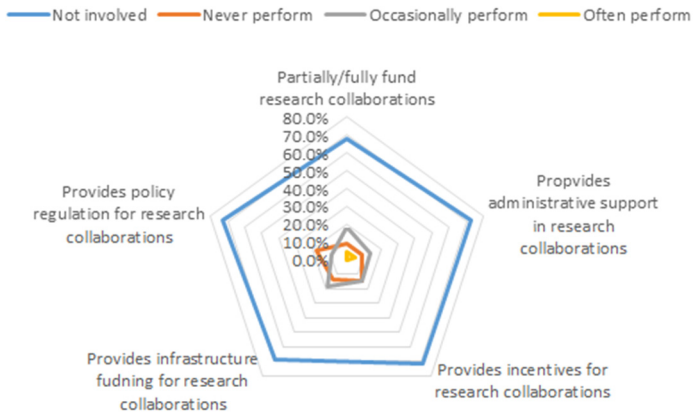

Figure 2: Frequency of role of government in research collaborations in CTLF industry of South Africa (n = 22)

These frequencies will be discussed in detail when qualitative findings are presented. Funding research collaborations, policymaking for research collaborations, receiving progress reports on research collaborations, funding research infrastructure, and providing research collaboration incentives are used as themes to report on the findings on the government's role in research collaborations.

5.1.1 Funds research collaborations

The findings show that government plays a role in funding research collaborations within the CTLF industry of South Africa. Participant Government Science Council indicates that students involved in research collaborations are funded through one of the government's agencies, stating, "[P]re-dominantly our funding stream comes from government [...] National Research Foundation (NRF)

predominantly funds most of the students we have on our side". Participant University 4 shows that government also funds university-driven research collaborations by stating that "he is busy with a project that is funded by THRIP, an organisation in DTI [...] the project is still in its early stages. We started at the beginning of this year". These findings show that government does play a role in providing funding for research collaborations.

From the surveyed CTLF-industry firms, only 12.3% have applied for research collaboration funding using THRIP. De Beer (2011) highlights that THRIP was instrumental in developing research collaborations in their industry. Unfortunately, the CTLF industry of South Africa cannot say the same. The THRIP funding cannot be accessed if one of the institutional spheres is not involved (DTI 2016). Figure 3 shows that Sihlobo and Mbatha (2022) found that 79% of academic staff from South African universities are not involved in research collaborations. Lack of academic institutional involvement may explain why the rate of THRIP application has been low.

These findings show that research collaborations in the CTLF industry of South Africa are missing an opportunity to increase their contribution to SDGs 8 and 9, as well as Agenda 2063 Goals 1 and 7.

Qualitative findings highlight that government plays the role of funding industry-based research collaborations through other policy funding instruments. Participant Government 2 narrates that the "government provided funding for a footwear industry association, and it was approved and was about ZAR 17 million". Participant Consulting Firm 1 highlights how they go about accessing government funding for research collaborations:

[P]ut in a proposal to fund a research project to understand what those implications are, which would be funded by DTI administered by the IDC. That's through DTI's competitor's programme, Clothing and Textiles Competitiveness Programme (CTCP) and specifically through Competition Improvement Programme (CIP).

These funding streams are accessed through IPAP. The findings show that government has multiple instruments to ensure that research collaborations are funded.

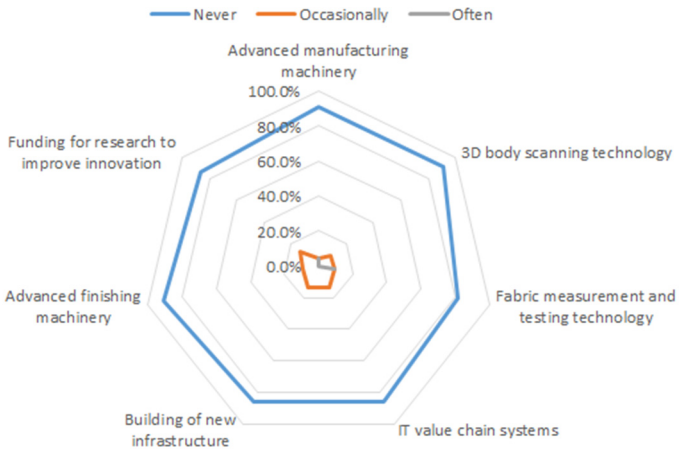

Figure 3: Frequency of THRIP funding applications (n = 22)

Quantitative findings presented in Figure 4 show that IPAP funding applications for research collaborations in the CTLF industry of South Africa are few. Figure 4 shows that of the surveyed South African CTLF-industry firms, 85.7% have never applied for this funding, and 14.3% have applied. While IPAP highlights that research collaborations exist (DTI 2014), this empirical evidence shows that such collaborations are fewer than desired.

These findings show that research collaborations in the CTLF industry of South Africa can contribute more to SDGs 8 and 9, as well as Agenda 2063 Goals 1 and 7.

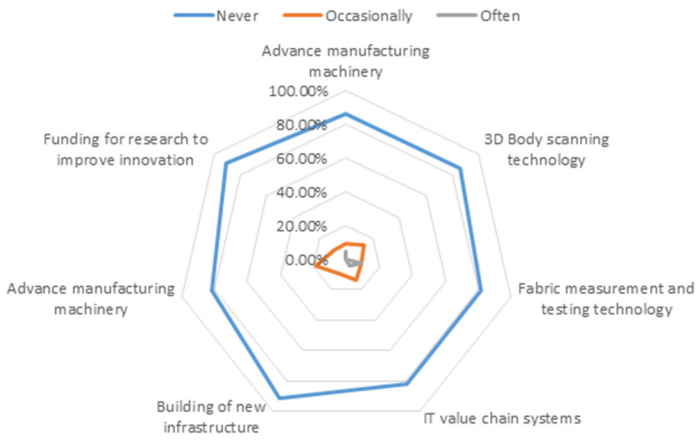

Figure 4: Frequency of IPAP research collaboration funding applications (n = 22)

Figure 4 provides empirical evidence that government performs the role of funding research collaborations in the CTLF industry of South Africa. Figure 2 highlights that of the surveyed CTLF-industry firms, 68.2% have not been involved in government-funded research collaborations.

These findings show that the role of providing research collaboration funding played by the government contributes to SDGs 8 and 9, as well as Agenda 2063 Goals 1 and 7.

5.1.2 Policymaker for research collaborations

The findings show that government plays the role of being a policymaker in research collaborations. Participant Consulting Firm 1 states that "the reality is that government are policymakers, they are policy regulators". Participant Government 1 supports that government is a policy regulator, stating, "We are responsible for policies for those particular sectors". Guimon (2013) corroborates that in research collaborations, the government establishes policies. Figure 2 indicates that of the surveyed CTLF-industry firms, 72.7% have not been involved in research collaborations. While qualitative findings show that government does play the role of policymaker, quantitative findings (Figures 2, 3, and 4) show that the surveyed CTLF-industry firms are not using the policies for research collaborations. It is worth noting that, of the surveyed CTLF-industry firms, the majority come from the main regions of the CTLF industry in South Africa, as shown in Figure 2.

These findings show that the role of policymaker played by government contributes to SDGs 1, 5, 8, 9, 12, and 17, as well as Agenda 2063 Goals 1, 3, and 7. However, the failure of surveyed CTLF-industry firms to use the research collaboration policies reduces the contribution that the CTLF industry could make to SDGs and Agenda 2063.

5.1.3 Receive progress reports on research collaborations

Qualitative findings show that government plays the role of receiving progress reports in research collaborations. Participant Government 2 indicates government's receipt of progress reports:

[T]hey should report and remember it is a partnership with the university there will be BTech students, MTech, and I think there will be one DTech student so, at end of the day, they will be expected to produce academic reports studys and journals.

Participant Government 1 adds that "No, we monitor that [...] we can't just give someone a project to run for us which we are funding, and then we don't monitor". Figures 2, 3, and 4 show that the surveyed CTLF-industry firms are not involved in research collaborations in the CTLF industry of South Africa. This highlights that government receives progress reports from a few CTLF-industry firms that are involved in research collaborations. These progress reports may also allow government to track its contribution to SDGs and Agenda 2063.

5.1.4 Funds research infrastructure

This study found government-funded research infrastructure that relates to pilot testing, computer-aided design, and 3D body scanning technology within the CTLF industry's research collaborations. Participant Government 3 indicates that 'So, we build a plant whereby everyone will bring their technology and try to fit it wherever it should be fitted. So, it is a demonstration or a testing plant'. Participant Government Science Council states that:

Through a scheme that we run, funded by DTI, we set up in Umtata called a Fashion Design Innovation Centre. This centre has two technologies: the first one is a computer-aided design (CAD)... And another platform we have set up in Umtata is what we call your cut, make and trim (CMT).

The findings highlight that government performs the role of funding research infrastructure. However, Figure 2 indicates that of surveyed CTLF-industry firms, 68.2% have not been involved in research collaborations in the CTLF industry of South Africa. These findings highlight that majority of surveyed CTLF-industry firms may not be contributing to SGDs and Agenda 2063 by not partaking in research collaborations.

These findings show that providing research collaboration infrastructure funding by the government may contribute to SDGs 1, 5, 8, 9, 12, and 17, as well as Agenda 2063 Goals 1, 3, and 7.

5.1.5 Provide research collaboration incentives

The triangulated findings show that government does play the role of providing incentives for research collaborations. However, the CTLF industry in South Africa is yet to take advantage of such incentives. The South African government uses THRIP and IPAP to provide research collaboration incentives. About the THRIP incentive, Participant University 4 states that he is busy with a project funded by THRIP an organisation in DTI. Participant Consulting Firm 1 states about IPAP government-funded incentive:

So, we've put in a proposal to fund a research project to understand what those implications are, which would be funded by DTI administered by IDC. That's through DTI's competitor's programme Clothing and Textiles Competitiveness Programme (CTCP) and specifically through Competition Improvement Programme (CIP).

Figure 2 indicates that of the surveyed CTLF-industry firms, 71.4% have not been involved in research collaborations. As a result, they have not witnessed government providing an incentive. Participant University 4 explains:

There is funding available from the government, but I don't know from an industry point of view why they are still not buying into the process. I have spoken to people who oversee the project, and there are very few applicants for funding. Yet, it is available.

Government incentives require research collaborations among institutional spheres. Due to existing boundaries (Mbatha & Mastamet-Mason 2021), institutional spheres in the CTLF industry of South Africa have not taken advantage of these incentives.

These findings suggest that the CTLF industry of South Africa could contribute more to SDGs and Agenda 2063 if they would increase their involvement in research collaborations.

5.2 Findings on the role of the CLTF industry of South Africa and its implications for the SGDs and Agenda 2063

Figure 5 presents frequencies on the role of CTLF-industry firms in research collaborations in the CTLF industry of South Africa. These frequencies will be discussed in detail in the next section.

Figure 5: Frequencies on the role of CTLF-industry firms in research collaborations in the CTLF industry of South Africa (n = 22)

Figure 5 shows that the surveyed CTLF-industry firms stated that they are not involved in research collaborations. Of the CTLF industry firms, 11.6% have never performed the stated roles. This brings the frequency of surveyed CTLF-industry firms that do not engage in research collaborations to 69.2%. As presented in Figure 2, it is worth noting that the majority of surveyed firms come from the main regions of the CTLF industry in South Africa.

The following section discusses the qualitative findings and weaves in the quantitative findings presented in Figure 4. Qualitative presentations will be based on themes derived from qualitative data analysis and surveyed literature.

5.2.1 Funding of research collaborations

The findings show that CTLF-industry firms fully fund research collaborations in the CTFT industry. Participant University 3 states that "[T]hey bring in a project and we will do product development for them and what they do is they fund all costs related to the projects'. Quantitative findings presented in Figure 4 corroborate this by showing that 4.5% of the surveyed CTLF-industry firms often fund research collaborations in the CTLF industry of South Africa.

This study found that there are CTLF-industry firms that do not have the means to fund research collaborations in the CTFT industry of South Africa. This study highlights that the CTLF industry also makes use of CTLF industry entities to fund research collaborations in the CTFT industry of South Africa. Participant Industry 1 states that "As an industrial association we don't have resources or finances, I must say, to commission research as an association". Quantitative findings presented in Figure 4 support that the CTLF industry uses CTLF-industry entities to fund research by indicating that while 13.6% are involved in research collaborations, they never fund these collaborations. Mbatha (2014) explains that competitive-advantage challenges erode capital that could be spent on funding research collaborations in the CTLF industry of South Africa.

This study indicates that firms in the CTLF industry of South Africa have less co-funding of

research collaborations. Participant Industry 2 highlights this:

I wouldn't say they are a co-funded operation. I haven't had anything like that where we've researched in that way, and I think it is an opportunity. And the more I talk to you, I think the more my mind is becoming a bit more creative.

Figure 4 corroborates these findings by highlighting that of the surveyed CTLF-industry firms, 59.1% are not involved in funding research collaborations. Triangulated findings show fewer findings for research collaborations are offered by South African CTLF-industry firms.

This low rate of funding research collaborations shows that the CTLF industry has a long way to go to ensure that Africa funds its developmental activities as suggested by SDGs 8 and 17, as well as Agenda 2063 Goal 7.

5.2.2 Science, technology, and innovation providers

The findings show that STIs that may exist within respective CTLF-industry firms are not tapped into by other institutional spheres within research collaborations. Participant University 1 indicated that "industry has got research, they do their research in the house to see how business can grow". Figure 4 corroborates these findings by showing that of the surveyed CTLF-industry firms, 68.2% do not make firms' employees available as supervisors since they are not involved in research collaborations. Figure 4 further shows that of surveyed CTLF-industry firms, 72.7% do not make the firm's infrastructure available for research collaborations. These findings corroborate Mbatha and Mastamet-Mason (2021) who found that South African CTLF-industry firms have strong boundaries that may explain the high percentage of firms not involved in research collaborations.

This study's findings further show that involvement in a cluster allows CTLF-industry firms to outsource their research roles to CTLF-industry consulting firms. Participant Industry 2 shows that CTLF-industry firms that belong to clusters have research benefits when compared to those that do not, saying, "So a cluster is a cluster of companies, but we use a benchmarking and manufacturing analysts company to administer that for us. So they are very research orientated". The presentation of findings in Figure 4 points out that CTLF-industry firms are not involved in research collaborations. This lack of involvement in research collaborations may be explained by the ability of CTLF-industry firms to outsource their research activities to CTLF-industry consulting firms. Outsourcing may explain the low rate of university participation in research collaborations, among others, as found by Sihlobo and Mbatha (2022) and this study.

Limited research collaborations with universities and government in the CTLF industry suggest the CTLF industry underperforms to achieve SDGs 8, 9, and 17, as well as Agenda 2063 Goal 1.

5.2.3 Receive first-hand access to findings

The findings show that CTLF-industry firms receive first-hand access to findings when involved in research collaborations. Figure 4 shows that of the surveyed CTLF-industry firms, 4.5% receive first-hand access to findings when involved in research collaborations. The findings show that CTLF-industry firms play the role of respondents in master's research projects. Participant Industry 2 shows that:

Case studies were two. There was a case study on lean implementation and the other one was on the effect of lean implementation on our people. It looked at how lean affects people.

This finding shows that research collaborations in the CTLF industry of South Africa contribute to SDGs 3, 4, 8, 9, and 12, while also contributing to Agenda 2063 Goals 1 and 6.

Findings show CTLF-industry firms are given first-hand access to technical textiles research collaborations. Participant University 4 indicated that "We had a lot of interviews, but it didn't go very well because you know companies had to convert their companies to technical textiles […] And currently, that the is a big gap in our market". Porter (1990) argues that industries that do research in sophisticated disciplines and use such findings may gain a competitive advantage. The reluctance of

CTLF-industry firms of South Africa may be seen as a missed opportunity to gain a competitive advantage in the technical textiles sector.

These findings indicate that research collaborations in the CTLF industry of South Africa missed an opportunity to contribute to SDGs 8 and 9, as well as Agenda 2063 Goal 1.

The findings indicate that CTLF-industry firms were given first-hand access to intellectual property to produce a new innovative fabric. Participant Government Science Council narrated:

The research was to take mechanically modified flex, give a hundred kilograms of that material to a mills firm and share with them the processing parameter that we used for them to produce different types of blended yarns and that trial was a success.

The findings show that the CTLF industry of South Africa may have gained a competitive advantage through this new innovative fabric as per Porter's (1990) previously stated argument on how to gain a competitive advantage.

The findings show that research collaborations in the CTLF industry of South Africa contribute to SDGs 6, 8, and 9, as well as Agenda 2063 Goal 1.

Quantitative data analysis from Figure 4 highlights that of surveyed CTLF-industry firms, 27.3% occasionally receive first-hand access to findings when involved in research collaborations. Figure 4 further shows that of the surveyed CTLF-industry firms, 9.1% never receive first-hand access to findings in research collaborations. Lastly, Figure 4 indicates that of the surveyed CTLF-industry firms, 59.1% are not involved in research collaborations in the CTLF industry of South Africa.

These quantitative findings indicate that the CTLF industry of South Africa continues to miss opportunities to improve its competitive advantage, innovation rate, and contribution to SDGs and Agenda 2063.

5.2.4 Guide progress report in research collaborations

Quantitative findings presented in Figure 4 indicated that of the surveyed CTLF-industry firms, 9.1% do guide progress reports on research collaborations. The qualitative data findings provided no data to support that CTLF-industry firms perform the role of providing a progress report on research collaborations in the CTLF industry of South Africa. The findings were consistent with quantitative data findings in Figure 4 that indicate that 59.1% of CTLF-industry firms are not involved in research collaborations. These findings highlight that strong boundaries may exist in research collaborations in the CTLF industry of South Africa as found by Mbatha and Mastamet-Mason (2021). These findings show that strong collaboration boundaries negatively contribute to SDGs and Agenda 2063.

5.2.5 Availing of infrastructure for research

Quantitative findings presented in Figure 4 indicated that of the surveyed CTLF-industry firms, 9.1% do avail infrastructure for research collaborations. Qualitative data findings provided no data to support that CTLF-industry firms avail infrastructure for research collaborations. The findings were consistent with quantitative data in Figure 4, indicating that 59.1% of CTLF-industry firms do not avail CTLF-industry firms' infrastructure for research collaborations. Again this shows that strong boundaries exist in research collaborations. These strong boundaries in CTLF industry research collaborations reduce the contributions made by the South African CTLF industry to SDGs and Agenda 2063.

6. Discussions

Bogoro (2015) highlights that governments in African countries battle to perform their roles. This study found that the South African government performs above other African countries in its role in research collaborations. This finding is consistent with South African literature on the triple helix that indicates that the South African government has developed research collaboration policies and

drives research collaborations (Mbatha & Mastamet-Mason 2021; Pillay 2015; Sithole, M, Ritacco & Batidzarai 2015; De Beer 2011). Based on these findings, global policymakers and entities established to oversee the achievement of SDGs and Agenda 2063 will understand that the South African government has put policy instruments in place to ensure the achievement of SDGs and Agenda 2063. It is worth noting by government practitioners that while policy instruments are in place, research collaborations are still not flourishing, thus reducing the impact of these policies on SDGs and Agenda 2063.

The findings of this study show that it is CTLF-industry firms that are less interested in research collaborations resulting in fewer roles being fulfilled. This low interest in research collaborations may be due to several factors. Firstly, this may be due to the THRIP funding requirement that the industry should contribute 50% of research collaboration funding and that there must be a university partner involved (DTI 2016). Mbatha (2014) found that the CTLF industry has less R&D funding due to competitive challenges they face and the country's compliance rules that require CTLF-industry firms to pay workers legislated wages. Lastly, Sihlobo and Mbatha (2022) show that universities have little interest in collaborating. Therefore, the CTLF industry will not qualify to apply for research collaborations since the government requires a university partner. Based on these challenges, the South African CTLF industry is unable to maximise opportunities to develop a competitive advantage, as Porter (1990) argues. More studies are required to understand why there is little interest in research collaborations from the CTLF industry and universities. In the next section, I discuss the findings regarding the role of government in research collaborations.

7. Conclusions

This study had the following research questions: i) What is the role of industry in research collaboration of the CTLF industry of South Africa? ii) What is the role of government in research collaborations of the CTLF industry of South Africa? iii) How do the roles of South African CTLF industry practitioners affect the achievement of SDGs and Agenda 2063? In pursuit of the latter, this study found the following and drew these conclusions.

This study found that CTLF industry firms play few roles related to research collaborations in the CTLF industry. This lack of roles is largely due to limited financial resources to keep these CTLF industry firms operational. While the government was found to be performing their roles in research collaborations, the financial challenges experienced by CTLF-industry firms prevent such government efforts from being supported by CTLf industry firms for a more positive impact on the industry, SDGs, and Agenda 2063.

This study found that the roles of industry and government impacted SDGs 1, 3, 4, 5, 6, 8, 9, 12, and 17, as well as Agenda 2063 Goals 1, 3, 6, and 7. Due to few financial resources to spend on research and development by industry, research collaborations in the CTLF industry contribute less than they should to SDGs and Agenda 2063.

Practitioners, policymakers, and entities designed to oversee the achievement of these goals should use this study to improve strategies to unlock research collaboration opportunities to increase the chances of development in Africa from the South African context. National, regional and African structures with a mandate to unlocking trade can use this study when developing strategies to unlock trade challenges on the African continent. This study contributes new insights into the discussions about the progress on SDGs and Agenda 2063 from within a CTLF industry and South African context.

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