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Towards a framework to quantify research-industry (R-I) synergy: A case study of Zimbabwe

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Abstract
This paper shares the research-industry synergy index developed through 212 expert responses from academia and industry in Zimbabwe. The findings were part of results obtained after DPhil studies (2017-2022) under the topic "Towards moral synergy between research and industry in developing countries: a case study of Zimbabwe". The perceptions were captured through Likert Scale responses (LSR) from experts and researchers in both academia and industry. The LSR responses had a scale which ranged from 1=lowest to 10=best. Twenty (20) techno-business parameters were covered under the quantitative component of the case study. This culminated in indices for those in research/academia; those in industry and a third embracing both research and industry sides. The overall R-I synergy level at the time of the study was estimated at 40%, confirming the widely held view that R-I among developing economies like Zimbabwe was limited. The resistance to R-I synergy emanated from; among others; skills shortage, under-funding, limited mentorship, limited exposure to international best practices, poorly equipped laboratories, weak alumni, absence of professional networks depriving idea sharing and training systems that do not match current technology trends. What gets transferred from research to industry is limited. The paper shares aspects that needed serious policy attention for informed intervention by stakeholders. It also argues that developing economies face similar circumstances and urges developed nations to assist in equipping laboratories and needed capacity building.

Keywords: Framework to quantify, synergy, Zimbabwe

Introduction
The World Association of Industrial and Technological Research Organisations (WAITRO) had just concluded its 2022 Global Summit in Cape Town, South Africa with a key message calling for enhanced collaboration among members and between research and industry. This was reportedly in line with UN Sustainable Development Goals (SDGs) 9 and 17. Respectively these SDGs emphasised Industry, Innovation and Infrastructure and the Partnerships for the Goals. Measuring progress in collaborative synergies was key for informed policy interventions. A tool for measuring and monitoring R-I synergy was equally key for policy. Doctoral studies carried out by the author under the supervision of two professorial supervisors between 2017 and 2022, developed a perception-based index in order to generate a quantitative measure for research-industry (R-I) synergy among developing economies using Zimbabwe as a case study.

The research problem
The main research challenge was *resistance* to calls for synergy between research in academia and industry, despite numerous reminders through policy pronouncements (GoZ, 2001; GoZ, 2019; GoZ, 2021) [22, 10-11, 22]; statutes (Research Act, Chapter 10:22) as well as contents of various keynote speeches (Butt Amir (2019) [1]. The second issue pertained to the absence of a dashboard (synergi-gramme) that aids tracking of stakeholders' interventions progress in pursuit of the needed R-I synergy.

Guiding Design Philosophy
The author based the index/model design on core philosophies of simplicity and functionality. This meant developing an index that was not complicated but served in informing stakeholders the existing position.

This was to trigger debate and constructive policy interventions for Zimbabwe and developing countries facing similar situations.

The parameters that were used in building the R-I synergy index or dashboard were derived from:

- The Stage Gate Process (Cooper, 1994) [4] which placed emphasis on teamwork, novelty and customer attention
- Technology Diffusion Theory. Which called for innovations to be transferred from R&D to industry
- Systems Theory (Chen and Stroup, 1993) [2] which emphasized the holistic view and feedback
- Triple Helix, balancing interests of academia, State and industry
- Business Ecosystem, interconnectedness
- 3I Framework: Balancing interests and "Trinity" Framework. Which balanced product research, business incubation and creation of industries.

The study was fully supported by the Zimbabwe Government ministries of Industry and Commerce (Min I & C) and Higher and Tertiary Education, Innovation, Science and Technology Development (Min HTE, I,STD). Table 1 summarises the link between the theories, the study objectives and variables that were used in field data collection.

Table 1: Connecting Theories, Objectives and Variables used under the study

Theory	Selected Dimensions (with a bearing on R-I synergy)	Study objective(s) covered	Variable(s) derived for questions under the expert survey
Stage Gate	▪ Market first before R&D ▪ Novelty and Prior art (literature/patents review) ▪ Teamwork ▪ Excellent communication ▪ Excellent compensation for employees	R-I synergy factors and the Commercialization variables	**KII** ▪ Extent of R-I synergy ▪ Issues causing resistance to R-I synergy ▪ Suitability of R&D facilities to support synergy ▪ Suitability of teaching and mentorship facilities for synergy ▪ Government role in synergy ▪ Attributes that support synergy (teamwork, passion, facility sharing) **Researcher/ Expert survey** ▪ Questions 1 to 5 on demographics, research output **LSR questions** ▪ Questions 6.1 to 6.10 ▪ Questions 7.1 to 7.10 ▪ Questions 8.1 to 8.10 ▪ Questions 9 and 10 on policy recommendations and resource needs
Triple Helix	▪ Functions ▪ Level of interactions ▪ Enabling role ▪ Existence of shared interest in R-I synergy	Extent of R-I synergy Factors Policy dimensions	
Diffusion	▪ Infrastructure and manpower for innovations ▪ Technology transfer ▪ Income and benefits flow	R&D intentions and transfer Commercialisation Inventory of innovations ready for commercialization	
Systems	▪ Holistic view and management ▪ Extent and importance of feedback ▪ Inter-face options	Nature, level of R-I Engagement Feedback levels leading to strengthened synergy	
Business Ecosystems	▪ Interconnectedness ▪ Extent of innovations and transfer from R to I or within R/I ▪ Level of productivity gains ▪ Sustainability signals	Connections Flow of benefits (mutual) Sustainability	
3i-Framework	▪ Interests ▪ Ideas ▪ Institutional	Contested interests and synergy	
"Trinity" Analytical Framework	▪ Institute ▪ Incubators ▪ Industrial base	Synergy among the three Synergistic benefits	
Policy mix for commercializing university technologies	▪ Direct funding support and synergy with technology transfer demos, science parks ▪ Importance of high innovation capacity ▪ How the three key stakeholders (scientists, Technology Transfer Offices-TTOs, private investors) relate ▪ The quest for harmonizing different barriers, varying motivations and dissimilar roles played by each	Policy analysis Significance of high innovation capacity in synergy The quest for balancing stakeholders' interests (scientists, TTOs, private sector) Harmonising barriers, motivations and dissimilar roles	

***Source*:** Author analysis; also shared by Kwaramba P K *et al* (November, 2022) [19].

The twenty parameters selected for the R-I Synergy Index

Twenty (20) parameters that were used in developing of Likert Scale Responses (LSR). These parameters were used under both research and industry circumstances.

The parameters used, within the working context of both R & D or I & C, were

- R-I synergy level.
- Extent of lobbying for R-I synergy.
- Extent of R-I synergy support from statutes and policies
- Level of inclusivity in search of new ideas.

- Extent to which the customer was given priority attention.
- Level of skills and empowerment towards R-I synergy
- Joint R-I review.
- Extent of rewarding novelty.
- Level of exposure to international best practices in R-I synergy
- Bankable business plans that spoke to both R and I
- Extent of encouragement to read latest literature and related process/product patents
- Extent of teamwork within and across R and I
- Extent of quarterly engagements between R and I

The parameters used based on personal expert opinion (same question for R&D or I&C) were

- Level of influence of time and distance
- Extent of breaking down projects into manageable stages
- Extent of R-I synergy inclusion in keynote speeches, strategic plans and policies
- Extent of culture, skill and competence in support of R-I synergy
- Role of mentors and senior management in supporting R-I synergy
- Extent to which personality differences hinder R-synergy
- Extent to which the absence of valuation of intellectual property (IP) and R&D outputs hinder R-I synergy

Each of the parameters had a 1-10 Likert scale rating, with 1=lowest whilst 10=highest. A colour code was also incorporated as follows: 1-4 Red [Classical, Traditional]; 5-7 Amber [Changing towards Ideal] and 8-10 Green [Current Global Best Practice/Ideal]. Over 212 respondents fed into the development of the R-I synergy dashboard. Tables 2 and 3 as well as Figure 1 give resultant indices.

Empirical Measurement

Empirical findings are shared under table 2 below.

Table 2: Empirical Dashboard Findings

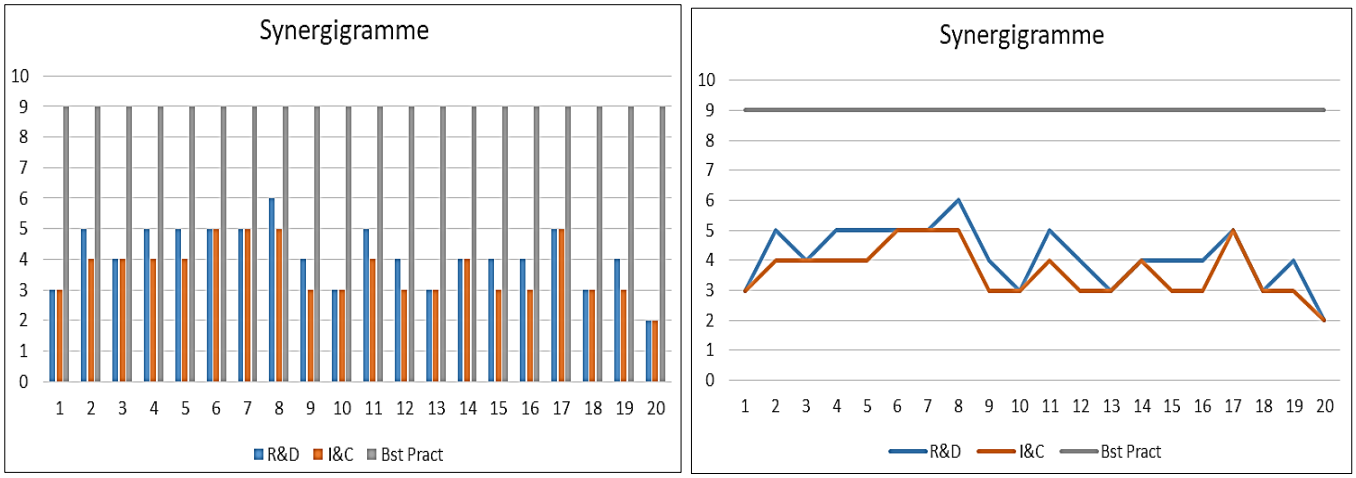
Defined Likert Scale Ratings (SLRs)	1-4 Red	5-7 Orange	8-10 Green
	R&D	I&C	IDEAL
Expert views within the context of Universities, R&D centres (R&D) relative to Organisations, Companies (I&C)			
▪ R&D LSR Ratings (N=114)	4.2		10
▪ I&C LSR Ratings (N=98)		3.7	10
▪ All LSR Ratings (N=212)	4.0		10

***Source*:** 2021 Expert Survey Findings

Table 3: Full-Empirical Dashboard Findings

Defined Likert Scale Ratings	1-4 Red [Classical, Traditional]	5-7 Orange [Changing towards Ideal]	8-10 Green [Current Global Best Practice]
Parameter	**R&D Likert Scale Rating**	**I&C Likert Scale rating**	**IDEAL**
Expert views within context of Organizations, Companies (I&C) relative to Universities, R&D centres (R&D)			
1. Level of R-I Synergy deemed and rated highly in Zimbabwe	3	3	10
2. Extent of R-I Synergy support by	5	4	10
Statutes/Ordinances/Policy/Strategic Plans			
3. Extent of lobbying by professional bodies in R and I	4	4	10
4. Extent of exposure to international best practices- R&I synergy-	5	4	10
5. Degree of inclusivity in search of ideas	5	4	10
6. Customer view given top priority by both R and I	5	5	10
7. Bankable business plans by both R and I in place, supporting synergy	5	5	10
8. Extent of encouragement to read the latest product literature and/or product patent information	6	5	10
9. Skilled, capacitated, empowered personnel in place for R&I synergy	4	3	10
10. Joint R-I review of lecture material, case studies and student practical sessions	3	3	10
11. Generators of novel ideas in both R and I being rewarded effectively	5	4	10
12. Extent of teamwork (within, across) R and I	4	3	10
13. Regular (quarterly) R - I engagement sessions in support of synergy	3	3	10
Expert personal views			
Extent to which R-I synergy is positively influenced by organizational culture, staff skills and competence levels	4	4	10
Mentors, senior management, management role in support of R-I synergy	2	2	10
Personality differences are effectively mitigated in support of R-I synergy	4	3	10
Fair valuation of R&D services and IP is key in R-I synergy	4	3	10
After agreeing on confidentiality issues, the organization's access by time and distance are key for R-I synergy	5	5	10
Extent of inclusion of R-I synergy in strategic plans, policies, keynote speeches	3	3	10
Development projects across R & I are broken down into manageable stages with decision points in between	4	3	10
Overall [All]	4.2	3.7	10

Source: Expert Survey Findings



***Source*:** Analysis of Survey data

Fig 1: Bar-graph and Line-graph Versions

I&C rated synergy level to be slightly lower than how R&D/academia rated the same. The overall R&D category rating of the extent of R-I synergy was 42% whilst that of I & C was 37%. The overall LSR rating for Research - Industry synergy was 40%. All the three ratings were in the Red category. This shows the level of resistance to calls by policy makers for "silos" to be broken. It also shares that task ahead for those mandated to bring research and industry together through statutes or incentives or even a combination.

Tests for significance in difference

Eight (8) of the 20 parameters were significant in difference between R and I at 5% (N=212). The parameters were: Level of R-I synergy (Question 6.1); Statutes, policies, strategic plans supporting R-I synergy (Question 6.3); Inclusivity in search for new ideas (Question 7.1); Breaking down projects into stages for effective roll-out (Question 7.2); Management had sole right to make decisions (Question 7.3); Encouragement of teams to read latest literature and patents (Question 7.6); R&I joint review meetings (Question 7.7) and Professional bodies lobbying for R-I synergy (Question g7.8). Twelve (12) of the 20 parameters showed no significant difference at 5% (N=212).

Implications

Moving away from R-I synergy levels of 40% [Red] towards 80-100% [Green] requires a paradigm in both research and industry. The study findings showed that both sides have work to do in order to shift away from the classical way of relating to one another. The unfortunate circumstance was that both converged in the Red zone, calling for urgent action/reaction if development efforts are to bear fruits. Issues requiring attention under both research and industry included: researcher/expert incentives, policy and statutory reviews, exposure to international best practice cases and even capacity building in inter-facing skills for personnel involved in facilitating linkages. Culture change towards teamwork and passion for success (together) in linking research and industry were deemed key. Stakeholders were also urged to start very early to inculcate culture and practice of collaboration so that when they assume leadership positions, they will have synergy within themselves. Co-curricular (membership of clubs linking research and industry or advancing thematic fields of study) and extra-curricular engagements (sports) were deemed key. They foster teamwork and a winning mentality – ingredients needed for sound R-I synergy. Harnessing diaspora expertise and experience as well as membership to professional networks were essential. These quickly connect one to international best practice cases. The needed foreign currency for such engagements must be availed if interventions are bear fruits for developing economies like Zimbabwe. The WAITRO Global Summit 2022 urged capacity building and funding for the transformation of researched product into start-up companies and enhanced research commercialization. Over 40 Africa member countries agreed on the need and action for enhanced research commercialization.

Context of economic development

Once R-I synergy is moved from the currents levels of 40% towards desired 80-100%, developing economies like Zimbabwe will witness the fruits of transferring innovations into industry. These will be in the form of: serious high-value job creation; enhance income generation and financial independence from fiscus; ability to pay for utilities, incentives for more R&D; enhanced injection of novelties in industry; enhanced competitiveness; relief to tax payers (they will contribute in tax payments); ability to reinvest in R&D infrastructure, to attend tech expos for new ideas and wider economic development through application of new ICT-based ideas.

Conclusion and Recommendations

The resistance to R-I synergy resulted from, among other issues; critical skills shortage average 63% for Zimbabwe according the 2018 national survey, gross under-funding, gaps in R-I synergy mentorship, limited exposure to international best practices, poorly equipped research laboratories, very weak alumni connections, absence of professional networks among scientists depriving idea sharing as well as training systems that do not match current technology trends. What gets transferred from research to industry resultantly is limited. The experts hear the message calling for R-I synergy but are not enabled. The paper shares aspects that needed serious policy attention for informed intervention by stakeholders, drawing from the dashboard findings. It also argues that developing economies face similar circumstances as shared by the synergi-gramme. It implores and urges developed nations and/or those with resources to assist in equipping laboratories and needed

capacity building. Developing nations are urged to lead in their countries in improving R-I synergy for the benefit of sound economic development.

References

1. Butt Amir. Science of Entrepreneurship Keynote Address at the 12th bi-annual Zimbabwe International Research Symposium (ZIRS), Harare International Conference Centre (HICC) organized by the Research Council of Zimbabwe (RCZ), Harare, Zimbabwe; c2019.
2. Chen Herbert. The Supporting Systems of Science Parks: Case Introduction of Tus Park UNESCO World Technopolis Association (WTA) International Training Workshop, Conference Hall, INNOPOLIS Foundation, Republic of Korea; c2014.
3. Chetsanga CJ. Africa: Industrializing for Economic Prosperity: My Life and Work in Science and Technology Themba Books; c2021. ISBN:9798433807693
4. Cooper RG. The Next Stage for Stage Gate ® - Pragmatic Marketing in Research and Technology Management published by Industrial Research Institute, Washington, DC, USA; c2014.
5. Confederation of Zimbabwe Industries (CZI)/CEO Africa Roundtable. Strategy for Economic Transformation and Development through Industrialization for Zimbabwe: Research Report prepared by Crown Agents United States of America (USA) with funding under United States Agency for International Development (USAID); c2018.
6. DAMVAD Analytics. Economic Impact of Research Collaborations with the Norwegian University of Science and Technology-NTNU Copy right 2017, DAMVAD Analytics A/S Heneage 39 DK-1058 Copenhagen; c2017. https://www.damvad.com
7. Government of Zimbabwe. National Development Strategy (NDS) 1 – Towards a Prosperous and Empowered Upper Middle-Income Society by the Year 2030 Government Printers, Harare, Zimbabwe; c2021.
8. Government of Zimbabwe. Centre for Education, Innovation, Research and Development Act Chapter. 2021;25:34. No.3/2021
9. Government of Zimbabwe. Agriculture and Food Systems Transformation Strategy- 5-Year Agriculture Gross Value Projections Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement; c2020 Aug.
10. Government of Zimbabwe-GoZ. Zimbabwe National Industrial Development Policy (ZNIDP) 2019:2023 Ministry of Industry and Commerce, Mukwati Building, Harare, Zimbabwe; c2019.
11. Government of Zimbabwe –GoZ. Performance Review of the SIRDC: Analysis, Assessment and Recommendations for a Turnaround Strategy conducted by Tetralink Taylor and Associates East Africa with funding from the African Development Bank (ADB) validated at an all-stakeholder workshop held on the 20th of September 2019, Crowne Plaza Monomutapa Hotel, Harare, Zimbabwe; 2019 Sept.
12. Gweme F. Enhancing the Commercialisation of R&D Results using the Stage Gate Process Model: Implications for R&D Institutions in Zimbabwe A Dissertation submitted in partial fulfilment of the requirements of the Eastern and Southern Africa Management Institute-ESAMI-Executive Masters in Business Administration –EMBA-Degree; c2011.
13. International Association of Science and Technology Parks. Annual World; IASP; c2008.
14. Conference on Science and Technology Parks and the Members' Annual General Meeting, Johannesburg, South Africa; c2008.
15. IASP Africa Division. Science and Technology Parks (STPs) and Business Incubators (BICs) in Africa Survey Report Project and Knowledge Management Department, IASP; May 2011. http://www.iasp.ws
16. IASP. IASP Strategigramme; c2018. www.iasp.ws /AOIs
17. Klimuk V, Tarasova A, Yulia K, *et al*. Synergistic interaction of education, science and industry Leadership Education Personal Interdisciplinary J2; c2020. p. 53-58. https://doi.org/10.1365/s42681-020-00009-y
18. Kijkasiwat P, Cave J, Hewa Wellalage N, Locke S. Synergistic model to boost business performance: a New Zealand Case Study Journal of Small Business Enterprise Development. 2022;29(2):241-260. © 2021 Emerald Publishing Limited https://doi.org/10.1108/JSBED-O3-2020-0063
19. Kwaramba PK, Kurasha J, Dube L, Munzara A. The Quest for a Framework to Measure and Monitor Research-Industry (R-I) Synergy – Empirical Evidence from Zimbabwe IOSR Journal of Humanities and Social Sciences (IOSR-JHSS). November, November 2022;27(11):56-60. e-ISSN: 2279-0837 p-ISSN: 2279-0845 www.iosrjournals.org
20. Martin Jacques. When China Rules the World: The End of the Western World and the Rise of the New Global Order Penguin Publisher; c2009.
21. Michael Remington J. The Bayh-Dole Act at Twenty-Five Years: Looking Back, Taking Stock, Acting for the Future Journal of the Association of University Technology Managers Summer Issue. 2005;17(1):15-31
22. Government of Zimbabwe-GoZ. The Research Act Chapter 10:22 22/2001 Government Printers, Harare; c2001.
23. Ministry of Finance and Economic Development. Turnaround Reform Strategy and Action Plan for the Scientific and Industrial Research and Development Centre-SIRDC- Final Report Tetralink Taylor and Associates East Africa in JV with Pazel Conroy Consulting Ltd with financial support from the African Development Bank, Nairobi, Kenya; c2020 Jan.
24. Ministry of Higher and Tertiary Education, Science and Technology Development. Strategic Plan 2019-2023- Education 5.0 Heritage-Innovation-Industrialisation The Modernisation and Industrialisation of Zimbabwe through Education, Science and Technology, Harare, Zimbabwe; c2019a.
25. Ministry of Higher and Tertiary Education, Science and Technology Development. Government of Zimbabwe's Priority Programmes 2019-2030 on Innovation, Science and Technology Development The Modernisation and Industrialisation of Zimbabwe through Education, Science and Technology, Harare, Zimbabwe; c2019b.
26. Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development –MinHTE,

ISTD. Zimbabwe's Innovation Hubs Phase 1 Government of Zimbabwe, Harare; c2018a.
27. Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development. Funding Models for Research and Development to operationalize Zimbabwe's Innovation Hubs Government of Zimbabwe, Harare; c2018b.
28. Ministry of Higher and Tertiary Education, Science and Technology Development. University Industries Incubation Tour A report by the high-power delegation comprising the Minister, 10 Vice Chancellors, Zimbabwe Manpower Development Fund (ZIMDEF) Chief Executive Officer (CEO), Advocates in Government and Senior Government Officers, Government of Zimbabwe, Harare, Zimbabwe; c2017 Apr-May.
29. Ministry of Higher and Tertiary Education, Science and Technology Development-MinHTE, STD. Transformation of Higher Education for Industrialisation and Modernisation a Report on the Proceedings of the workshop held on Friday, 19th of May 2017, Council Room, University of Zimbabwe, Harare; c2017 May.
30. Muranda Z. Academia-Industry Interface: the Weak Link in Human Capital and New Industry Development Marketing Matters in the ZimMarketer December 2021 Edition published by the Marketers Association of Zimbabwe © MAZ; c2021.
31. Rao Bharat and Mulloth Bala. The Role of Universities in Encouraging Growth of Technology-Based New Ventures International Journal of Innovation and Technology Management. 2017 Aug, 14(4). https://doi.org/10.1142/S0219877017500146
32. Ravindra Nath. Creating Enabling Environment for MSMEs-Indian Ecosystem in Research Council of Zimbabwe (RCZ) 2017: The 11th Zimbabwe International Research Symposium Book of Papers Presented ISBN 978-0-7974-7845-6 ISSN: 2412-2386 edited by Nhachi CFB (2017) Harare, Zimbabwe; c2017.
33. Paul Krutko. Collaborating to solve the big challenges in ISAP2020 Virtual, The Human factor: people, communities and the innovation ecosystem, www.iasp.ws Malaga, Spain; c2021.
34. Sabola Byson. Intellectual Property and Wealth Creation Presentation at the Inaugural Zimbabwe National Career Guidance Conference held on the 4th of July 2019, SIRDC Campus, Harare, Zimbabwe; c2019.
35. Saruchera F. Determinants of Commercialisation of Technological Innovations in Developing Economies: A study of Zimbabwe's Research Institutes. A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy, University of KwaZulu-Natal; School of Management, Information Technology-IT and Governance; College of Law and Management Studies; South Africa.
36. Scientific and Industrial Research and Development Centre-SIRDC. Strategic Plan 2021-2025 – Moving towards an empowered and prosperous Upper-Middle Income economy anchored on National Development Strategy 1 SIRDC, Harare, Zimbabwe; 2021 Mar.
37. SIRDC Supplement to the Nation published by the Sunday Mail, 2019 Nov 10. www.sirdc.ac.zw
38. SIRDC. Strategic Plan 2019-2021 © SIRDC Harare, Zimbabwe; c2019 Jun. www.sirdc.ac.zw
39. Constitution of the Scientific and Industrial Research and Development Centre (SIRDC) registered in terms of Part V, Section 24 of Research Act Chapter 10:22/2001 on 1st of February 1997.
40. The USA Technology Transfer and Commercialisation Act; c2000. https://www.govinfo.gov
41. University of Zimbabwe. University of Zimbabwe 2019-2025 Strategic Plan: Educating to Change Lives University of Zimbabwe Office of the Vice Chancellor, Harare, Zimbabwe; c2019. p. 43.
42. WAITRO Strategic Plan 2030: Work Programme 2021-2022 www.waitro.org
43. WAITRO. Annual Summit 2022 Cape town South Africa; c2022.
44. Zimbabwe Statistical Agency (ZIMSTAT). Monthly Summary of Zimbabwe External Trade Statistics for the period January 2019 to Mid-June 2021 Harare, Zimbabwe; 2021 Aug. www.zimstat.co.zw
45. www.iasp.ws International Association of Science, Technology Parks
46. www.undp.org/SDG9 (Sustainable Development Goal number 9)