

# Efforts in Measuring Research-Industry (R-I) Synergy within Emerging Economies –Empirical Views for Africa, Zimbabwe as a Case Study

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DOI: <https://dx.doi.org/10.47772/IJRISS.2024.8080120>

Received: 11 July 2024; Revised: 27 July 2024; Accepted: 31 July 2024; Published: 04 September 2024

## ABSTRACT

This paper contextualizes the measurement of research-industry (R-I) synergy within the framework of Africa's development aspirations namely: SADC Industrialization Strategy and Roadmap (2015-63); the AU Agenda 2063 as well as the UN Sustainable Development Goals. It buttresses the role of research and subsequent commercialization of output in economic development. The Zimbabwe mixed methods study and findings offer crucial lessons for Africa's success. R-I synergy measurement and supportive theories such as Stage Gate®, Triple Helix, Technology Diffusion, Systems Thinking and Policy Mix for Commercialising University Technologies are also covered by the paper further concretising the connection. The empirical evidence from Zimbabwe was obtained through a survey of 212 experts in both academia and in industry. Twenty Likert Scale Response (LSR) responses were analysed for both Research and Industry categories leading to indices for academia, industry and both. Using this Zimbabwe case, the R-I synergy was realized to be low 40%. Other African countries are reported to have even lower indices, measured at 20% and below. Empirical findings are also triangulated with key informant interview (KII) findings which supported the low index and reasons why it was low. What needs policy and statutory improvements relative to the quest for R-I synergy indices to go beyond 80% is also postulated. It is important to consider both resource limitations, personnel capacity and individual attributes in addressing low synergy. These broader improvements are exposed for wider deliberation by stakeholders across Africa.

**Key words:** measuring research-industry synergy, commercialization, development, policy improvements

## INTRODUCTION

Whilst the call for synergy between research and industry has been loud (Chetsanga 2021; Simbi, 2022; Dube, 2022; Maurice Bolo, 2020) across the continent, many emerging economies seem to have challenges in measuring and monitoring research-industry synergy (R-I synergy) so that there is effective policy intervention. R-I synergy has a bearing on the extent to which innovations impact economies and the society at large. Despite calls at annual international research symposia, through various policy releases, through statutes establishing technical universities and through content of keynote speeches at graduation ceremonies R-I synergy has remained low (Kwaramba, 2022). This paper borrows from findings on 2018-2021 doctoral studies with Zimbabwe as a case study as well as other publications to explore why R-I synergy has been repetitively resisted by emerging economies. It shares various indices that can be used to measure and quantify monitor synergy as various interventions are instituted.





## LITERATURE REVIEW

### Continental Development Context:

The author postulates, as under Kwaramba (2022) that various continental strategies for regional and/or national development stand to benefit from quantification of R-I synergy. Hence the R-I synergy context was evaluated at varying levels namely: national (Zimbabwe), sub-regional (SADC), continental (AU) and global (UN SDGs).

Table 1 shares these contexts.

Table 1: Mainstreaming R-I synergy from country to global levels

	<p><b>Zimbabwe National Development Strategy (NDS)1: 2021-2025:</b> Selected thematic areas for development are: Food and Nutrition Security; Value Chain Development and Structural Transformation; Digital Economy &amp; Infrastructure and Utilities; Human Capital Development; Environmental Protection; Housing Delivery. Success hinges on linking innovations and business.</p>
	<p><b>Industrialisation Strategy &amp; Roadmap (2015-2063):</b> Key development areas are: Diversification of Economies away from single commodities and/or heavy reliance on raw materials; Enhanced Productivity and Competitiveness; Shifting from factor-driven stage towards innovation-driven stage, exploitation of advanced technologies; Industrial development, market integration and supportive infrastructure/services. The regional success also hinges on linking innovations and business.</p>
	<p><b>Agenda 2063:</b> Core development elements entail: Integrated High Speed Train Network connecting African Capitals and Commercial Centres; African Commodities Strategy (Value-addition, Local content development); Intra-Africa trade boost (actual trade, policy support connectivity systems); African Passport and Free Movement of People; Peace: ending wars, civil conflicts, gender-based violence, preventing genocides; Clean, affordable electricity, strengthened power pools (in support of transformation processes); Enhanced intra-regional flights' connectivity between African capital cities; connectivity and efficiencies; Cyber Security; African Space Strategy; Virtual &amp; e-university for Africa; Pan-African e-network; Annual African Economic Forum, for reviewing progress. Research, innovations and harnessing of new solutions trigger success connecting with business.</p>
 <p>United Nations</p>	<p>17 Sustainable Development Goals-SDGs</p>

Source: Government of Zimbabwe (NDS1); SADC (2015-2063); AU Agenda 2063; UN SDGs

**Theories and Variables Extracted when building the R-I Synergy Index:**

Table 2 gives theories that guided analysis; the variables used in the indexing and links with varying policy calls in emphasizing the importance of R-I synergy.

Table 2: Connecting Theories, Objectives and Variables used in the R-I Synergy Index

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	<ul style="list-style-type: none"> <li>Market first before R&amp;D</li> <li>Novelty and Prior art (literature/patents review)</li> <li>Teamwork</li> <li>Excellent communication</li> <li>Excellent compensation for employees</li> </ul>	<ul style="list-style-type: none"> <li>R-I synergy factors</li> <li>Research commercialization variables</li> </ul>	<p><b>KII:</b></p> <ul style="list-style-type: none"> <li>Extent of R-I synergy</li> <li>Issues causing resistance to R-I synergy</li> </ul>

Triple Helix	<ul style="list-style-type: none"> <li>• Functions</li> <li>• Level of interactions</li> <li>• Enabling role</li> <li>• Existence of shared interest in R-I synergy</li> </ul>	<ul style="list-style-type: none"> <li>• Extent of R-I synergy</li> <li>• Factors</li> <li>• Policy dimensions</li> </ul>	<ul style="list-style-type: none"> <li>• Suitability of R&amp;D facilities to support synergy</li> <li>• Suitability of teaching and mentorship facilities for synergy</li> </ul>
Technology Diffusion	<ul style="list-style-type: none"> <li>• Infrastructure and manpower for innovations</li> <li>• Technology transfer</li> <li>• Income and benefits flow</li> </ul>	<ul style="list-style-type: none"> <li>• R&amp;D intentions and transfer</li> <li>• Commercialisation</li> <li>• Inventory of innovations ready for commercialization</li> </ul>	<ul style="list-style-type: none"> <li>• Government role in synergy</li> <li>• Attributes that support synergy (teamwork, passion, facility sharing)</li> </ul> <p><b>Researcher/ Expert survey:</b></p> <ul style="list-style-type: none"> <li>• demographics, research output</li> </ul>
Systems	<ul style="list-style-type: none"> <li>• Holistic view and management</li> <li>• Extent and importance of feedback</li> <li>• Inter-face options</li> <li>• Interconnectedness</li> </ul>	<ul style="list-style-type: none"> <li>• Nature, level of R-I Engagement</li> <li>• Feedback levels leading to strengthened synergy</li> <li>• Connections</li> <li>• Flow of benefits (mutual)</li> <li>• Sustainability</li> </ul>	<p>LSR questions on</p> <ul style="list-style-type: none"> <li>• policy</li> <li>• recommendations</li> <li>• resource needs</li> </ul>
Policy mix for commercialising university technologies	<ul style="list-style-type: none"> <li>• Direct funding support and synergy with technology transfer demos, science parks</li> <li>• Importance of high innovation capacity</li> <li>• How the three key stakeholders (scientists, Technology Transfer Offices-TTOs, private investors) relate</li> <li>• The quest for harmonising different barriers, varying motivations and dissimilar roles played by each</li> </ul>	<ul style="list-style-type: none"> <li>• Policy analysis</li> <li>• Significance of high innovation capacity in synergy</li> <li>• The quest for balancing stakeholders' interests (scientists, TTOs, private sector)</li> <li>• Harmonising barriers, motivations and dissimilar roles</li> </ul>	

Source: Kwaramba P K *et al* (November, 2022)

**R&D Resource Limitations:**

The findings of Government commissioned performance review of the Scientific and Industrial Research and Development Centre (SIRDC), the main source of innovations targeting industry is given by table 3.

Table 3: Observed R&D Short-Comings based on 2020 Government Commissioned Review

<b>a) Assessment Aspect: Human Capital for R&amp;D, Commercialization</b>		<b>Findings</b>			
<b>Assessment Parameter</b>	<b>Very inadequate</b>	<b>Inadequate</b>	<b>Moderate</b>		
Personnel Head Count (number)	√				
Staff & Board Remuneration Level	√				
Culture of Performance	√				
Human Capital Strategy	√				
Training and Development		√			
Motivation and Retention		√			
Competence Levels					√
Suitability for R&D					√
Defined Career Pathway					√
<b>b) Assessment Aspect: Financial Resources for R&amp;D, Commercialization</b>		<b>Findings</b>			
<b>Assessment Parameter</b>	<b>Very inadequate</b>	<b>Inadequate</b>	<b>Moderate</b>		
Adequacy for Government Grant for Salaries, Capital Equipment and Operations	√				
Donors/Partners Funding Levels	√				
Own income Generation Levels		√			
Operations Funding for Industrial Support (R&D, training, advisory services)		√			
Funding through inter-parastatals relationship		√			
<b>c) Assessment Aspect: Technical Systems and Operations for R&amp;D, Commercialization</b>		<b>Findings</b>			
<b>Assessment parameter</b>	<b>Very inadequate</b>	<b>Inadequate</b>	<b>Moderate</b>		
Equipment and tools for R&D, Industrial support	√				
Funding Levels to Acquire Equipment and Tools	√				
Processes		√			
Staffing		√			
Marketing and Publicity		√			
Stakeholder Engagement		√			
Monitoring and Evaluation		√			

Impact Evaluation, Feedback to the Government		√	
Supporting ICT tools			√
Collaboration			√
Statutory Compliance			√
Physical/ Superstructures for R&D			√

Source: Adapted from Ministry of Finance and Economic Development (2019), Zimbabwe

The resource limitations also compromised R-I synergy.

### Africa-wide Synergy Rating of Industry-Research Linkages

Apart the detailed Zimbabwe Study covering R-I synergy, Maurice Bolo (2020) carried out similar analysis covering countries: Ghana, Kenya, RSA, Botswana, Uganda and Malawi. Table 4 gives the findings.

Table 4: Africa-wide Synergy Rating of Industry-Research Linkages

Parameter	Rating/Index (%)
Partnerships and linkages with private sector	20
Supportive policies and regulatory systems	15
Funding for collaboration	13
Supportive skills, capacities, communication, coordination	10
Supportive research and innovation infrastructure	10
Trust, confidence, interest in collaboration	8
Supportive research and data quality	5
Average for the seven parameters	12
<b>Source:</b> Maurice Bolo (2020)	
1 <sup>st</sup> World (Japan; USA; UK; South Korea; Scandinavian Countries)	Over 80%

## METHODOLOGY

The study used mixed methods approach and the instruments used for data collection are given as appendices 1 and 2. The quantitative component targeted researchers and/or technical officers in research organizations and industries within Harare in: crop seeds; stock feeds; ICT; foundry; chemicals manufacturing; fertilizer; agrochemicals; finance and banking; food and beverages and lobbying organizations. 212 responses were analysed, 97 from industry and 115 from academia. Twenty (20) variables used were considered under the study. The qualitative component targeted key informants in the same sectors using questions administered through the expert questionnaire. A Likert Scale (McLeod, 2019; Cunningham & Link, 2014) was used in the R-I synergy dashboard. The Likert Scale Response (LSR) rating of 1-10 was used and interpreted as 1 being the Lowest/poorest whilst 10 was the Highest/best. A colour coding system (adapted from the <https://www.hubplanner.com>how-to-apply-red-amber-green>; Kwaramba, 2022) was also incorporated into the indexing as follows: 1-4 Red [**Classical, Traditional**]; 5-7 Amber [**Changing towards Ideal**] and 8-10 Green [**Current Global Best Practice/Ideal**]. Table 3 gives the resultant indices.

## FINDINGS

### Respondents:

The type and situation of the respondents were:

1. 27% female and 73% male
2. dominant highest qualification was a Master’s degree in both R&D and I&C with respective proportions of 59% and 46%.
3. Master’s degree and Doctorate (PhD) degree holders constituted 66.4% for the R&D side and 51.1% for I&C.
4. average age were 42 years
5. average post-first-degree years were 16 years
6. average years of innovative work were 12 years
7. average years of mentorship were 10 years.
8. most responses were drawn from the applied sciences and engineering fields, followed by commerce and natural sciences.

### Empirical Measurement:

Table 5: Full-Empirical Dashboard Findings: Zimbabwe

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
<b>Expert views within context of Organizations, Companies (I&amp;C) relative to Universities, R&amp;D centres (R&amp;D)</b>			
1. Level of R-I Synergy rated highly in Zimbabwe	3	3	10
2. Extent of R-I Synergy support by Statutes/Ordinances/Policy/Strategic Plans	5	4	10
3. Extent of lobbying by professional bodies in R and I	4	4	10
4. Extent of exposure to international best practices in R&I synergy	5	4	10
5. Degree of inclusivity in search of ideas	5	4	10
6. Customers 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	4	4	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	4	3	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
<b>Expert personal views</b>			
14. Extent to which R-I synergy is positively influenced by organizational culture, staff skills and competence levels	4	4	10
15. Mentors, senior management, management role in support of R-I synergy	2	2	10
16. Personality differences are effectively mitigated in support of R-I synergy	4	3	10
17. Fair valuation of R&D services and IP is key in R-I synergy	4	3	10
18. After agreeing on confidentiality issues, the organization's access by time and distance are key for R-I synergy	5	5	10
19. Extent of inclusion of R-I synergy in strategic plans, policies, keynote speeches	3	3	10
20. Development projects across R & I are broken down into manageable stages with decision points in between	4	3	10
<b>Overall [All 20 Parameters]</b>	<b>4.2</b>	<b>3.7</b>	<b>10</b>
<b>Combined R&amp;I</b>	<b>4.0</b>		<b>10</b>

Source: Expert Survey Findings, 2022; Kwaramba (November 2022)

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 the 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). These parameters

were on: Level of R-I synergy; Statutes, policies, strategic plans supporting R-I synergy; Inclusivity in search for new ideas; Breaking down projects into stages for effective roll-out; Management had sole right to make decisions; Encouragement of teams to read latest literature and patents; R&I joint review meetings and Professional bodies lobbying for R-I synergy. For these differential policy attention is key and needed. Twelve (12) of the 20 parameters showed no significant difference at 5% (N=212). Policy interventions will be similar.

Africa-wide R-I synergy ratings are given by table 4. The ratings are even lower (in the Red colour code) for the covered countries, averaging 12%. What is very important to note is that all cases are in the Red Category, far away from the ideal. Issues in need of urgent address (gaps) were: policies and statutory improvements; funding; mentorship; capacity limitations at organizational level and subdued interest in R-I synergy. Contrasting R-I rating in the 1<sup>st</sup> World, which generally is over 80% (Green colour code). Research is imbedded in industrial operations and processes are continuously improved in line with global market trends.

### **Key Informants' Positions:**

Observing confidentiality principles of not disclosing names and positions of key informants, views are documented without respective sources. The key informant position and/or messages during the study, without names, were:

### **Academia/R&D Centres:**

After administering open-ended questions (appendix 1) condensed main views from academia were extracted as:

1. “vested interests and personality differences at top level” often hindered R-I synergy
2. “Zimbabweans were averse to technology across all levels; you ask for R&D funding, unfreezing of researcher positions and retention of critical skills to be prioritized and they don’t listen to you”.
3. “the Zimbabwe seed industry was set up and still relies on R&D but there are limited flows into R&D from very same private sector”.
4. “university linking offices were not strong enough to drive the R&D agenda into industry”
5. “research fellows strengthened delivery of university mandates – strengthened teaching and produced novel products” and “revival and strengthening of the research fellowship position in universities was key for R-I synergy in Zimbabwe”.
6. “harnessing of diaspora skills and regular organization of online sessions in technology advances was lacking”
7. “authorities take time to approve agreements for cooperation whilst industry wants timely decisions”. these delays in the signing of memoranda of agreement as well as secrecy and non-disclosure agreement (S/NDA) also delay or stop collaboration

### **Industry/Commerce:**

Condensed views from industry were extracted as:

1. Zimbabwe must wake-up; “Zimbabwe missed the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> industrial revolution and cannot afford to miss the 4<sup>th</sup> industrial revolution”. The 4<sup>th</sup> industrial revolution is dominated by technology and R&D from universities and research centres will be key.
2. “there are infrastructure challenges both at I&C as well as R&D levels as laboratories are not well equipped and not manned by skilled personnel”. This negatively affected R-I synergy
3. “Zimbabwe Iron and Steel Company -ZISCO had no R&D Unit and new ideas were generated outside Zimbabwe. “We just implemented what was imported. When operating environment worsened, we responded by shutting down until today”.
4. “the strategy must be right if R-I synergy is to be realized”. “have been in courts fighting theft of intellectual property, ranging from designs through brands and trademarks in the electronics sub-sector” on global markets.
5. “research facilities must be equipped with modern technology for relevance to current industry



needs/challenges”

6. “we now have a Standing Committee on R&D under Confederation of Zimbabwe Industries-CZI” to support calls for R-I synergy in Zimbabwe. “Dawn of a new era”
7. “very few corporate leaders have research experience and interest and this limits R-I synergy”.
8. “there should be a thorough needs assessment of R&D at industry level”
9. “many Corporate Executives want quick earnings, have no time to invest in R&D whose returns are realized after a long time”.

Key informant views supported low R-I synergy and reasons why the index was low. The reasons were both personal/professional gaps and resource limitations. Therefore, this postulates that it will not be enough just to look into resources in isolation from capacity limitations. Resources might be poured without realizing desired outcomes.

## ZIMBABWEAN POLICIES AND STATUTES

The extent to which policies, statutes, contents of strategic plans as well as keynote speeches support R-I synergy is summarised under this section of the paper.

### Policies

For Zimbabwe, the intention to fiscally support R&D so that it feeds into industry exists. However yearly allocations for R&D of around 0.3% of GDP (actual disbursements have often been reduced to less than 0.01% of GDP) negate the pursuit of R-I synergy. Treasury caters for researcher remuneration, laboratory equipment and operations for state entities. However, the support levels have been perennially inadequate.

Brain drain has also been common with the 2018 critical skills audit showing an average 62% deficit (sciences, engineering, technology, medicine had over 90% deficits). This adversely affects R&D output. Subsequently low R&D output becomes a handicap for R-I synergy. This was also compounded by prolonged freeze of recruitment in a bid to cut costs by the Government. Prolonged vacancies curtailed output from research, and limiting synergy with industry.

There should also be unbiased platforms where academia-industry collaborations are tracked with best practices being promoted and gaps being addressed. Joint funding for joint R-I projects is rare. The Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development has appointed industrialists on state university councils. Currently 85% of members of such councils are from industry and commerce in a bid to foster R-I synergy. Various public entities have revolving funds where funds collected for services are used internally to fund operations. The resources mobilized are limited and rarely incentivize the generators directly.

The setting up of Innovation Hubs at universities is a noble idea and is in line with international best practices. The low R&D output earlier shared stands to threaten the Hubs Idea.

### Statutes:

The Constitution of Zimbabwe 2013, Chapter 4, Part 2, 61 (1) provides for (a) “freedom to seek, receive, communicate ideas”; (b) “freedom of ... scientific research and creativity” and (c) “academic freedom”. This provides breathing space for R-I synergy within Zimbabwe but exploitation of these provisions remains weak.

The Patents, Industrial Designs, Trade Mark, Copyrights Acts are in place for Zimbabweans to benefit from through the safeguarding to their IP but these statutory provisions are not being exploited due to weak R&D capacity and limited awareness by wider public.

The Research Act [Chapter 10:22] and the Centre for Education, Innovation, Research and Development [Chapter 25:34] and the SIRDC Constitution (registered under Research Act) provide for “promotion, direction, supervision and coordination of research” and “to provide engineering and technological solutions to industry and the community to generate income”. These are declarations in support of national development

through technology. However, they omit the nuts and bolts that compel Boards, Management and Staff to take R-I synergy seriously. IP rights belong to the Research Council of Zimbabwe (RCZ) and no incentive is explicitly extendable to researchers. There is no provision for neutral mediation in case of disputes between research (university, center) and industry. The R&D output and industry needs are less frequently shared and rarely matched. The Zimbabwe Open University (ZOU) and University of Zimbabwe (UZ) Acts “provide for research” but the link with industry and commerce is silent. It should be appreciated that the Government of Zimbabwe has noted these gaps and has taken steps to improve the affected statutes. The Research Act [Chapter 10:22] is under review to enhance R-I synergy and to enforce the 1% of GDP for it to be channeled for R&D funding (Mukono, 2021; Munyeza, 2019).

The Chinhoyi University of Technology (CUT), Zimbabwe National Defense University (ZNDU) and Harare Institute of Technology (HIT) Acts have additions that include “development, practice of design and technology”; “create opportunities for income generation”; “making university a self-sustaining entity”; “incubation, transfer and commercialization of technology” and “continual relevance to industry” among others. These Acts seem to be moving towards R-I synergy. Relative to the USA statutes earlier shared more needs to be done for academia-industry synergy to be strengthened (Chetsanga, 2021; Simbi, 2022).

The University Research Committees/Boards are provided for under various ordinances but are not well-resourced financially. The statutes are silent on capacity to conduct research and development, that is, the need for state-of-the-art laboratories, needed equipment/ consumables and servicing expenses which are often in foreign currency. There is no statute facilitating facility and skills sharing – so that there is relevant output to transfer to industry and commerce.

There is silence on neutral mediators in technology transfer matters. The fair mediation role remains weak or non-existent. Incentives for researchers are not legislated and IPR are in the hands of the centre (RCZ, DR&SS, and SIRDC) or university or company. The act is silent on the welfare of the researcher so that he/she is retained to complete projects and ultimately create vital IP.

Of late Technology Transfer Offices, Innovation Hubs and Pro-Vice Chancellor posts have been part of universities in an attempt to enhance collaboration. Personnel manning these offices need exposure to international best practices so that they R-I synergy needs effectively.

The R-I synergy, emanating from research/academia is not covered by the Private Business Corporation and Companies Act, key statutes establishing industry. Such efforts remain restricted to moral suasion.

The Industrial Development Corporation Zimbabwe (IDCZ) Act [Chapter 14:10] provides for “establishment and conduct of industrial undertaking”, “facilitate, promote, guide and assist in the financing of new industries” and “finance expansion, . . . , modernization of existing industries”. The intentions are noble but the limitations are on the details of how to implement the provisions. The funding, skilled personnel and the will to put provisions into practice remain limiting. The inclusion of R&D unit(s) or serious collaboration with academia within Zimbabwe or diaspora should have been added to the statute. Progress reports and sharing of best practices should also have been added.

## **ECONOMIC DEVELOPMENT CONTEXT**

Gaps in policies, resource support levels, strategic plans and statutes subsequently deprive the economy by stifling job creation and limiting income generation. The burden on Treasury to pay for utilities and competitive salaries/incentives for more R&D remains among state entities. Unlike international best practices, injection of novel products and services into industry remains restricted. Industry competitiveness remains suppressed and the ability to reinvest in R&D infrastructure remains a challenge. Attendance of technology expos for new ideas remains zero. Collectively industry and wider economic development remains suppressed.

## **CONCLUSION-FROM ZIMBABWE/AFRICA INTO THE GLOBAL VILLAGE**

Whilst empirical R-I Synergy Indexing for the rest of African countries is necessary for a full continental

picture, these findings point towards low R-I synergy (the Red category). These empirical pointers threaten developmental aspirations under various initiatives such as SADC Industrialisation Strategy (2015-2063) and the AU Agenda 2063. The same applies to the UN's 17 Sustainable Development Goals (SDGs). Stakeholders need to take note and devise strategies and tactics to improve the scenario. What gets generated as research output should be soundly transferred and/or exploited for the benefit of economies and ultimately society at large. Country and continental gaps in policies, strategic plans and statutes as well as in resourcing for retention, infrastructure and exposure need attention for better. Personal attributes at expert level also need attention.

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KWARAMBA Philemon Kurima PhD

**Appendix 1: Key Informant Interview (KII) Questions:**

**Zimbabwe Open University (ZOU) Higher Degrees Department; DPhil Research Project**

Researcher: P K Kwaramba (0772 237 012) [pkkwara90@yahoo.co.uk](mailto:pkkwara90@yahoo.co.uk)

Supervisor: Prof J Kurasha (0772 135 035); Prof L Dube ([dubelig@gmail.com](mailto:dubelig@gmail.com))

I, Philemon K Kwaramba, am a DPhil Student at the Zimbabwe Open University (ZOU). You are invited to participate in the research project titled “**Towards moral synergy between Research and Industry in developing countries – the case study of Zimbabwe**”. The aim of this study is to investigate why there is resistance to synergy between research and industry using Zimbabwean case and recommend policies that benefit development aspirations of our nation. Other economies have prospered through between research and industry. Comparative identification of hindrances and suggestions on the best way forward would sharpen policies and strategies within Zimbabwe and beyond. Your participation in this study is voluntary. You are free to withdraw at any time and any stage with no negative consequences. There will be no monetary reward for participation in the study. Confidentiality and anonymity of records will be maintained by ZOU Higher Degrees Department. If you have any questions or concerns, contact me or the supervisor using above contact details. These Likert scale based questions should take between 10 and 20 minutes to answer and I hope you will spare time to complete this questionnaire.

Sincerely

Investigator’s Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Respondent’s Consent: \_\_\_\_\_ Date: \_\_\_\_\_

Kindly tick what applies to you (√)

<b>R&amp;D</b> (Research organization, university, polytechnic, other academic categories)		Industry/Commerce (I&C)	
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**Research Questions: For obtaining comparative views among opinion leaders – Research (R&D)\_vs Industry and Commerce (I&C) at Key Informant Interviews-KII level:**

1. What is the extent of collaboration between R&D (from research centres, universities, polytechnics among others) and industry& commerce in Zimbabwe? [Is there dialogue? Is there synergy? Through which agents? How visible?]
2. In your own opinion what issues repetitively hinder synergy between academia and industry in Zimbabwe? [Statutes/ordinances, Policies, Bureaucracy, Business Culture, Lack of exposure, Distance between R&D and I&C, absence of a champion, absence in strategic plans, instability of Governing bodies, inappropriate valuation of R&D and related IP issues, Weak networks..]
3. Are research facilities not fit to support the quest for moral synergy due to competence issues, lack of modern-day research instruments or access rules/restrictions?
4. Is there a mis-match between teaching/mentorship matters in academia and what industry needs/expects?
5. In your opinion do we have researchers or research managers with passion towards synergy between R&D and industry?
6. Are innovative ideas screened holistically before being presented for executive consideration?
7. Do we have exceptions –cases where R&D and I&C have fruitful synergies in Zimbabwe?



8. Does Government have a role in creating the needed synergies or other unifiers are needed?
9. How should R&D be packaged so that it attracts serious industrial attention (directly, through media, at technology expos)?
10. What should be done to create/enhance synergy between R&D and industry for Zimbabwe?

**Appendix 2: Research Scientist/Officer/Expert Level Questions:**

**Zimbabwe Open University (ZOU) Higher Degrees Department/DPhil Research Project**

Researcher: P K Kwaramba (0772 237 012) [pkkwara90@yahoo.co.uk](mailto:pkkwara90@yahoo.co.uk)

Supervisor: Prof J Kurasha (0772 135 035); Prof L Dube ([dubelig@gmail.com](mailto:dubelig@gmail.com))

I, Philemon K Kwaramba, am a DPhil Student at the Zimbabwe Open University (ZOU). You are invited to participate in the research project titled “**Towards moral synergy between Research and Industry in developing countries – the case study of Zimbabwe**”. The aim of this study is to investigate why there is resistance to synergy between research and industry using Zimbabwean case and recommend policies that benefit development aspirations of our nation. Other economies have prospered through between research and industry. Comparative identification of hindrances and suggestions on the best way forward would sharpen policies and strategies within Zimbabwe and beyond. Your participation in this study is voluntary. You are free to withdraw at any time and any stage with no negative consequences. There will be no monetary reward for participation for participating in this study. Confidentiality and anonymity of records will be maintained by ZOU Higher Degrees Department. If you have any questions or concerns, contact me or the supervisor using above contact details. It should take between 10-20 minutes and I hope you will spare time to complete this questionnaire.

Sincerely

Investigator’s Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Respondent’s Signature/Mark: \_\_\_\_\_ Date: \_\_\_\_\_

Dear Respondent, Kindly tick what applies to you (√)

<b>R&amp;D</b> (Research organization, university, polytechnic, other academic categories)		<b>Industry/Commerce (I&amp;C)</b>	
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**Research Questions (For comparative Analysis-R&D vs I&C at researcher level):**

**Kindly answer the three (3) sets of Likert Scale based questions covering your own opinion, history and the future (in line with international best practice on linkage between R&D and industry).**

1. Respondent Demography: Age \_\_\_\_\_ Years \_\_\_\_\_ Gender (M/F) \_\_\_\_\_
2. Highest Academic Qualifications: \_\_\_\_\_  
 Field of study: \_\_\_\_\_ [Commerce, Natural Sciences, Applied Sciences, Engineering, Medical field, other (specify)]  
 Professional membership (if applicable) \_\_\_\_\_
3. Working area: Research, Academia (R&D) or Industry and Commerce (I& C) \_\_\_\_\_
4. Working Years (post-1<sup>st</sup> degree/diploma qualification) \_\_\_\_\_

5. Years in R&D (where applicable) \_\_\_\_\_

Years of mentorship (where applicable) \_\_\_\_\_

R&D produced (optional):

Output indication/Number of Product(s) /Processes \_\_\_\_\_

Number or list of Publication(s) \_\_\_\_\_

**6. Opinion on Moral Synergy between R&D and I&C (Likert Scale Rating of):**

6.1 In your opinion the level of synergy between R&D and I&C in Zimbabwe is VERY high

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.2 Existing skills, competence levels and enterprise culture in Zimbabwe do not give space to synergy between R&D and I&C

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.3 Statutory instruments such as the Research Act chapter 10:22, Companies Act and Acts establishing Universities as well as the respective ordinances fully support synergy between R&D and I&C in Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.4 Mentors and senior management in both R&D and I&C should play an active role in promoting synergy between research and industry for Zimbabwe to prosper

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.5 Personality differences among management and researchers (mentors and senior management) in both R&D and I&C are key reasons why there is no synergy?

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.6 The gaps in valuation of R&D and related IP by academia hinder synergy between R&D and I&C in Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.7 Distance between R&D Centres and Industrial Sites hinder moral synergy between the two

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.8 Low/no coverage of calls for synergy between R&D and I&C in keynote speeches, strategic plans, industrial development policies and documents rolling out innovation hubs hinder collaboration

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.9 Professional bodies like Zimbabwe Institution of Engineers (ZIE), Engineering Council of Zimbabwe (ECZ), Zimbabwe Academy of Sciences (ZAS) industrial bodies like Confederation of Zimbabwe Industries (CZI), Zimbabwe National Chamber of Commerce (ZNCC), Zimbabwe Association of SMEs should act as unifiers towards moral synergy]; between R&D and I&C in Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

6.10 The usefulness of R&D as promoted by the technology transfer offices(TTOs), visibility of TTOs and retention of R&D teams are key for R&D – Industry synergies

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

**7. History to present day (Likert Scale Rating):**

7.1 In its search for new ideas that grow or sustain operations/business, your organization has been inclusive (by skill, experience, position, age, gender)

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.2 Key development projects are broken down into stages with decision points between them

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.3 The Managing Director or Chief Executive Officer or Vice Chancellor or Executive Director and the top management have sole right to make decisions across stages and on behalf of professional staff

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.4 The organization carries out market analysis to support the idea(s) with the voice of the customer being given space before proceeding or dismissing it (them)

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.5 Your organization crafts a business plan to guide the evolution and up-take of the new ideas or projects

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.6 Organization persuades/instructs the development team(s) to read latest literature and patents information to enhance understanding and creativity /innovation

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.7 Considering rapid technological and business changes across the globe R&D, Universities, Industry and Commerce are jointly reviewing learning/teaching/lecturing material

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.8 Professional bodies such Zimbabwe Institution of Engineers (ZIE), various Councils Governing medical service, the Research Council of Zimbabwe (RCZ) Standards Association of Zimbabwe (SAZ) and industrial lobby groups such as CZI and ZNCC are lobbying for synergy between R&D and I&C

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.9 Teamwork across R&D and I&C is common and brings the best in terms of development for Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

7.10 Technology transfer offices/ industrial liaison officers are key at universities and organizations in facilitating synergy between R&D and I&C within Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

**8. Futuristic thinking and views for Zimbabwe (based on your expert opinion and feelings) - (Likert Scale Rating):**

8.1 In its search for new ideas that grow or sustain operations/business, your organization should be inclusive (by skill, position, age, gender)

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.2 The Managing Director or Chief Executive Officer and the top management should not have sole right to make decisions across stages and on behalf of professional staff

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.3 The organization should carry out market analysis to support the idea(s) with the voice of the customer before proceeding or dismissing it (them)

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.4 Your organization must craft a bankable business plan to guide the evolution and up-take of the new ideas or projects

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.5 Generators of new ideas from industry or research centres or universities should be given incentives and recognised through elevations/ monetary rewards or time-off

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.6 There should be teamwork across R&D and I&C to bring the best in terms of development for Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.7 Professional bodies such Zimbabwe Institution of Engineers (ZIE), various Councils Governing medical service, the Research Council of Zimbabwe (RCZ) Standards Association of Zimbabwe (SAZ) and industrial lobby groups such as CZI and ZNCC should lobby for synergy between R&D and I&C

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.8 Technology transfer offices (TTOs) must be capacitated in speedy valuation of R&D/IP issues as well as drafting of non-disclosure agreements for meaningful synergy between R&D and Industry to bring the best in terms of development for Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.9 Statutory instruments to be modification in support of synergy between R&D and I&C for sound development in Zimbabwe

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

8.10 Quarterly sessions between R&D and Industry are needed to create and/or strengthen synergy between the two sides

1	2	3	4	5	6	7	8	9	10
Do not agree at all		Weakly agree		Agree		Strongly agree		Perfectly agree	

9. What should be done towards strengthening moral synergy between R&D and I&C in Zimbabwe

10. What kind of resources (\$, manpower, equipment, policy support) are needed for moral synergy between R&D and I&C (quantify to the best of your ability)?

**END**