Research Contribution to Innovation in Infrastructure Development in Africa: Assessing the Status

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Abstract: After completing the two phases of preliminary research, this paper reports major findings that are directed towards two primary objectives. The first is to assess numerous research findings on the challenges of the African Infrastructure Sector (AIS) that are not currently being employed by various academic and research institutions. The second is to clearly identify the primary factors that contribute to the disconnection between the research findings and the implementation of innovation in the sector. This paper reports that most of the challenges have solutions that have been provided in various documents, while the majority of the challenges that necessitated these research projects continue to negatively affect the AIS. This paper aims to initiate a debate on the need to re-examine the currently existing research findings and convert them to an applied form that is ready for use by practitioners and policy makers. A variety of methods and techniques was used to gather the information contained in the paper, but the primary methods used were reviewing work from researchers across the world regarding the implementation of research findings, reviewing previously published research results on the challenges facing the AIS and semi-structured interviews with senior researchers and policy implementers in randomly selected African countries. The findings of these studies strongly suggest that researchers within these countries continue to present their findings at various forums but that very little of the research is translated for implementation. A number of causes of this situation are identified herein and recommendations for addressing the challenges are given.

Keywords: Africa, Infrastructure sector, Implementation of research results

INTRODUCTION

According to the New Partnership for Africa's Development (NEPAD), the poverty and disorganisation of the African continent stand in stark contrast to the prosperity of the industrialised countries (UNCTAD, 2001). The continued marginalisation of Africa from the globalisation process and the social exclusion of the vast majority of its peoples constitute a serious threat to global stability. At the heart of the African dilemma, argues Todaro (2000), is an inexorable economic decline, a drop in the per capita income, a rapid increase in the population size, the loss of export revenues, the curtailment of foreign investment, the destruction of fragile ecosystems, and the inability of many countries to feed their people or meet other basic human needs. Moyo (2009) argues that African Private Equity investments have a steady record, reportedly yielding approximately 30% over the past ten years, but the overall picture in terms of trends in Africa continues to be a problem. She further argues that,

> with an average per capita income of roughly US\$1 a day, sub-Saharan Africa remains the poorest region in the world. Africa's real per capita income today is lower than in the 1970s, leaving

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many African countries at least as poor as they were forty years ago. With over half of the 700 million Africans living on less than a dollar a day, sub-Saharan Africa has the highest proportion of poor people in the world – some 50% of the world's poor.

The preliminary NEPAD document calls for the reversal of this situation by changing the relationships that underlie it (UNCTAD, 2001). The document argues that Africans are not appealing for the further entrenchment of dependency through aid or marginal concessions. The NEPAD objectives are relevant to all African industries, including infrastructure industries.

The reversal of the situation in Africa requires a number of initiatives across all industries and sectors. One of the reversal initiatives is to address various challenges that affect the African Infrastructure Sector (AIS). There is sufficient evidence to suggest that various experts and researchers across the AIS have proposed a number of solutions to these challenges, but their proposals do not appear to be leading to any significant initiatives to implement them. This paper focuses on the AIS and critically examines the "research results implementation" issues.

This paper is a follow-up to previous papers by Rwelamila (2009a, b), which focused on the Southern Africa Development Community Infrastructure Sector (SADCIS) and the Eastern and Southern Africa Infrastructure Sector (ESAIS). This paper reflects on numerous research findings on the AIS challenges that are being unused at various academic and research institutions, while the majority of the same challenges that necessitated these research projects are causing conflict in the AIS. This paper takes a closer look at the various research themes of the challenges facing the AIS and the solutions proposed towards a productive, practicing AIS. Furthermore, it reports the results of semi-structured interviews with senior AIS researchers and policy implementers in Algeria, Egypt, Ethiopia, Ghana, Sierra Leone, Nigeria, Rwanda, Burundi Kenya, Uganda, South Africa, Botswana, Zambia and Tanzania on which of the published research results have been implemented.

Finally, this paper makes recommendations on "the research results implementation challenge", which needs to be addressed by researchers, practitioners and policy implementers in order to modernise the AIS and provide a base for the NEPAD infrastructure initiatives and consequently contribute to the continued development of the African continent.

IMPLEMENTATION OF RESEARCH RESULTS: THEORY AND PRACTICE

The gap between research findings and practice within the AIS has been and continues to be a concern for those knowledgeable about the region and those who believe that infrastructure development should be a deliberate, managed process in order to optimise the contribution of the sector in meeting the AIS's demand. Infrastructure demand is closely tied to regional social economic development objectives, industry wide performance and competitiveness, and improved value to clients and society.

When taking a closer look around the world and across infrastructure sectors, the situation in Africa is not pleasing when you look for good practice

approaches regarding "research results implementation" benchmarks. There are a few success stories in almost every sector, but the health industry across the world appears to have approached the negative effect of a gap between research findings and practice with a different attitude. A significant number of research projects and workshops have been taking place, and there are positive signs of the formulation of appropriate initiatives towards closing the gap (for examples, see Haines and Donald, 1998; Haynes and Haines, 1998; and Garner et al., 2004). Literature from the health industry is used extensively in this document to address the underlying issues between theory and practice.

A reflection on various developments from the health industry research (for example, Lipman and Jones, 1999; Pless, 1982; and Garner et al., 1998; and Bero et al., 1998) provides an appropriate lens to reflect on developments in the greater AIS. There are strong indications that suggest that getting research results into the right hands so that they can be used to improve the infrastructure sector is not an easy task. As in the two preliminary studies, which focused on the Southern Africa Development Community (SADC) and Eastern and Southern Africa (ESA) countries (Rwelamila, 2009a; b), language, which appears to be one of the stumbling blocks in many industries and sectors, is even more of a problem in the infrastructure sector. The technical language used by research specialists is typically not the same as that used by the general public. Furthermore, while academics are eager to share their findings, they are not trained to deal with the public. In addition, there the tenure system provides little incentive for academics to share their findings (Lipman and Jones, 1999; Pless, 1982). The motivation encourages the production of research results but not the dissemination of it.

IMPLEMENTING RESEARCH FINDINGS: WHO IS RESPONSIBLE?

In an examination of the health industry, Pless (1982) argues that research has an air of mystery for many practitioners, which is generated, often unnecessarily, by the unfamiliar terminology and an abundance of statistical symbols and notations. This observation is also true for the infrastructure industry and undoubtedly is also applicable to many other industries. This is why many practitioners within infrastructure development companies and other infrastructure experts find it difficult to interpret the conclusions and decide whether, when and how the findings should be applied. This same uncertainty and confusion surrounds studies regarding infrastructure sector development policies; the conclusions are not always easily understood, and the practical implications are frequently unclear. Therefore, many potentially useful findings are never used for the benefit of stakeholders or the general public.

The assumption is that interested practitioners take the time to seek out, read and digest the findings reported in journals and conference proceedings as best they can. Pless (1982) argues that most investigators realise that they should not rely upon a reader's eagerness to learn or a passive diffusion of knowledge to ensure that their results are acted upon quickly and appropriately. He further contends that "...not all results should be put into practice quickly, since, in many instances, the passage of time helps sort the wheat from the chaff". However, Pless (1982) strongly suggests that researchers must learn how to increase the efficiency of the implementation of their results, results that have typically required

considerable expense, time and energy to produce. Clearly, not all researchers have an equal cause for concern. Many researches conduct their research (Lipman and Jones, 1999; Pless, 1982) at a basic level of enquiry that is usually only of interest to other researchers. These researchers can safely assume that any published findings of genuine merit will become part of the general store of knowledge. However, Pless (1982) contends that much of the research is intended to modify current practices. If the results of such research are sufficiently conclusive then there should be a measurable response after their publication. There are strong indications that suggest that the processes of dissemination and adoption of new findings is slow and generally inefficient.

IMPLEMENTING RESEARCH RESULTS: THE EVIDENCE

Interview Logistics

Fifty-six (56) semi-structured interviews were conducted with randomly selected senior infrastructure sector researchers and policy implementers in the countries listed in Table 1, which also indicates the distribution of the field of all of the subjects.

Table 1. Categories and Number Interviewed

Countries Surveyed	Category and Number Interviewed		
	Academics and researchers	Researchers	Policy implementers
Kenya	2	1	1
Uganda	1	1	2
Botswana	2	1	1
South Africa	1	1	2
Tanzania	2	1	1
Zambia	2	1	1
Algeria	1	1	2
Egypt	2	1	1
Ethiopia	1	1	2
Ghana	2	1	1
Sierra Leone	1	1	2
Nigeria	2	1	1
Burundi	1	1	2
Rwanda	2	1	1

The research findings covered in the interviews were taken from randomly selected papers and reports written by expert researchers from 14 randomly selected African countries. A summary of the recommendation themes of these documents is provided in Table 2.

After the recommendation themes (A & A1; B & B1; C & C1; D & D1; and E, E1 & E2) were identified through content analysis techniques (Leedy and Ormrod, 2005), an informal verification process was carried out by communicating with the interviewees (Table 1) in order to establish if the recommendation themes were relevant to the respective country. Themes that are relevant are identified with a letter "R". The interviewees were also requested to indicate if they were familiar with the research report/paper on the respective recommendation theme; these are identified by the letter "K". The themes that were not relevant and those with which they were not familiar with are indicated by the letters "Ro" and "Ko", respectively.

Table 2. Research Recommendation Themes per Country

Countries Surveyed	Research Recommendations Themes and Authors				
	Msita (1998) and DPW (1999) Rwelamila and Lobelo (2000) Lema (2000)	Lema and Price (1998) Mlinga and Lema (2000) Talukhaba (1988) Talukhaba (1999)	Rwelamila et al. (1999) Kamala and Hindle (2000) Rwelamila et al. (2000)	Rwelamila (1996)	Wall and Wells (2000) Carradine and Logie (2000) Ssegawa (2000)
	(A): Uncoordinated infrastructure professionals (A1): Insolvencies among infrastructure firms	(B): Poorly constructed work and low productivity (B1): Developing informal contractors	(C): Bad practice procurement approaches (C1): Majority of IPMs are accidental	(D): Poor project management	(E): Improving infrastructure materials supply (E1): SMME development (E2): Poor SMME financial management
Kenya; Uganda; Botswana; South Africa; Tanzania; Zambia; Algeria; Egypt; Ethiopia; Ghana; Sierra Leone; Nigeria; Burundi; and Rwanda.	R&K	R&K	R&K	R&K	R&K

Relevant (R) & Familiar (K); Not relevant (Ro) & Not familiar (Ko)

Table 3. Interview Results – Implementation Scores

Countries Surveyed	Recommendation Themes and Implementation Scores					
	A & A1 T = 200P	B & B1 T = 200P	C & C1 T = 200P	D T = 100P	E, E1 & E2 T = 300P	Total %
Kenya	50P & 05P	45P & 05P	20P & 05P	35P	45P, 45P & 10P	**27%**
Uganda	25P & 05P	40P & 05P	20P & 05P	35P	40P, 40P & 10P	**23%**
Botswana	30P & 05P	50P & 05P	20P & 05P	40P	50P, 50P & 20P	**28%**
South Africa	60P & 20P	60P & 30P	50P & 40P	50P	70P, 50P & 20P	**45%**
Tanzania	60P & 10P	40P & 05P	50P & 05P	35P	45P, 45P & 10P	**31%**
Zambia	60P & 10P	40P & 05P	30P & 05P	35P	45P, 40P & 10P	**28%**
Algeria	50P & 15P	50P & 25P	45P & 30P	40P	60P, 40P &15P	**38%**
Egypt	55P & 20P	55P & 25P	45P & 40P	45P	60P, 45P & 14P	**41%**
Ethiopia	25P & 05P	40P & 05P	15P & 05P	35P	40P, 40P & 15P	**23%**
Ghana	65P & 05P	40P & 05P	45P & 05P	30P	45P, 50P & 15P	**31%**
Sierra Leone	20P & 05P	25P & 05P	10P & 05P	20P	30P, 25P & 05P	**13%**
Nigeria	60P & 05P	35P & 05P	40P & 05P	35P	40P, 45P & 20P	**29%**
Burundi	20P & 05P	25P & 05P	15P & 05P	25P	35P, 25P & 05P	**17%**
Rwanda	30P & 05P	40P & 05P	25P & 05P	30P	35P, 35P & 15P	**23%**

Interview Results: Synthesis and Analysis

In order to establish the levels of research finding implementation, the recommendation themes identified in Table 2 were put before the respondents (see Table 1) to indicate if implementation had taken place and, if so, the extent of the implementation. A percentage was used to indicate the "implementation of research results recommendations"; 0P (points) corresponded to no implementation and no plan evidence towards implementation, while a score of 100P (points) indicates that full implementation had taken place. Each research result recommendation was treated independently of the others and is marked on a 100-point scale. The maximum point value each country can get from a total of 10 research results recommendations if full implementation of recommendations had taken place was 1,000. The interview results with the total measurement scores for the implementation research results recommendation are shown in Table 3.

The interview results confirm the issues discussed, that there is a significant gap between knowledge production and knowledge consumption. The percentage score for implementation of research results in all 14 countries is less than 30%. The overall average is 28%, suggesting that approximately 72% of the produced research results remain unimplemented in the countries surveyed. In order to obtain a clear picture of the situation and understand the underlying issues behind these disappointing scores, the countries are categorised into three strata for discussion: Strata I – very poor and poor; Strata II – beginning to improve and improving; and Strata III – positive improvement.

Strata I:

This category consists of two countries – Sierra Leone (13%) and Burundi (17%).

The Sierra Leonean research recommendation scores are the lowest of all of the countries surveyed (13%). A closer look at theme A (score of 20P) shows that infrastructure experts are poorly coordinated because the traditional infrastructure professions, architects and engineers, are poorly regulated. There are lessons that can be learned from Tanzania (60P), South Africa (60P) and Zambia (60P). Insolvencies among infrastructure firms appear to be a common occurrence. As in the other 13 countries that were surveyed, there is no formal development programme in Sierra Leone for informal contractors. The post-war environment has complicated the whole situation to such an extent that local contractors are left to fight for their survival. Project procurement in Sierra Leone, as in most African countries, is still dictated by the traditional procurement approach. This has led to a situation where alternative procurement systems are embraced with traditional procurement tools (hence the score of 10P for theme C). The procurement system environment has directly contributed to the slow emergence of infrastructure project management (IPM) as a distinct profession in Sierra Leone. This is also true in most of the countries that were surveyed, with the exception of South Africa.

As in most African countries surveyed, the majority of IPMs are still accidental project managers, enthusiastic civil engineers and architects with a very small IPM knowledge base that assume the role of an IPM. As in most African countries, the fact that the majority of IPMs are accidental was confirmed by theme C1 score (05P) and the process of project management is consequently very poor (theme D, score of 30P). The quality and efficiency of the logistics of infrastructure materials in Sierra Leone is still archaic and requires a well-organised strategy (theme E, score of 30P). The need to reconstruct war torn areas has put indirect pressure on the development of local contractors; this has brought a slight change to the plight of citizen contractors but a lot still needs to be done (theme E1, score of 25P). For instance, the financial management ethos of SMMEs is almost non-existent (theme E2, score of 05P).

The Sierra Leone building environment and specifically the infrastructure sector continue to face an enormous challenge in improving a 13% positive research implementation position. There are strong indications to suggest that Sierra Leone appears to have the worst research implementation environment among the countries surveyed. In addition to the disorganised building environment, the post-war environment appears to have made the situation

worse. A well-conceptualised project appears to be the only option for improvement.

The situation in Burundi is closely related to that in Sierra Leone and similar interventions are recommended.

Strata II:

The majority of countries surveyed fall into this category. These include Kenya (27%), Uganda (23%), Botswana (28%), Tanzania (31%), Zambia (28%), Ethiopia (23%), Ghana (31%), Nigeria (29%), and Rwanda (23%). Each of these countries appears to be working towards establishing communication between researchers, practitioners and policy makers. Ethiopia, Uganda, Kenya and Rwanda have begun to create an environment that is conducive for communication between researchers, practitioners, and policy makers; Tanzania, Botswana, Zambia, Ghana and Nigeria have made significantly more progress, however. The establishment of the National Construction Council in Tanzania and similar organisations in Zambia, Ghana and Nigeria has raised awareness of the need to bridge the gap between research and implementation. Tanzania and Ghana have a research deficit below 70%, and the rest of the countries have a deficit greater than 70%.

A closer look at theme A reveals that infrastructure experts are now well coordinated across these countries because the traditional infrastructure professions, architects, engineers, and quantity surveyors, are statutorily regulated. The only professions that are not currently regulated by law are infrastructure construction project management and infrastructure construction management. South Africa also has an advantage in this aspect.

The majority of IPMs within these countries are still accidental project managers – again enthusiastic civil engineers, architects, infrastructure construction managers (or construction managers) and quantity surveyors, that fill the gap with a below minimum IPM knowledge base. The fact that the majority of IPMs are accidental is confirmed by the theme C1 scores; the processes of managing projects are consequently very poor (see theme D scores).

Strata III:

Only two countries fall into this category – South Africa (45%) and Egypt (41%).

The South African research finding implementation scores are the highest of the 14 countries surveyed. This was expected based on a comparison of the economic development levels of the countries. The theme A score (coordination of infrastructure professionals, score of 60P) is high relative to the other countries and is a reflection on the status of organisation of infrastructure experts. All infrastructure professionals in South Africa are required to register by statutes, and this has brought a formal framework for regulating professionals to ensure good practices. Egypt scored lower than South Africa (55P) because not all infrastructure professionals are required to register.

The principal aim of regulating these professions is to protect the public. It is important to note that South Africa is the only country in Africa that has a statutory registration requirement for IPM and infrastructure construction managers (ICM) as

distinct professions. Although insolvencies among infrastructure firms (theme A1, score of 20P for both countries) are fairly common, the situation in South Africa and Egypt are slightly better than the other 12 countries surveyed. Strict financial systems and advances in corporate governance systems have significantly contributed to the situation. Compared to the other countries surveyed, the general quality of construction work could be described as "good". This promising situation is confirmed by a theme B score of 60P. There is no formal development programme in South Africa for informal contractors, but like Botswana, the informal contractors appear to take advantage of the results of some initiatives, which are primarily intended for formal emerging contractors (theme B1 scores). However, it should be noted that the state of informal contractors support is still below the required levels. Project procurement approaches in South Africa and Egypt are still dictated by the traditional procurement approach, and this is also true of countries in Strata I and Strata II.

It is important to note that, although Egypt is categorised with South Africa, the South African situation is better than the rest of the countries surveyed, though they also still have a long way to go to reach the required levels. Although the majority of IPMs practicing in South Africa are predominantly accidental ones, as in most of the other countries, the emergence of the statutory registration body, the South African Council for Project and Construction Management Professions (SACPCMP), has provided an element of standards and provides future possibilities for enhancing IPM knowledge as one of the requirements (reflected in the theme C1 score of 40P).

The gap between research findings and implementation is still quite large. A deficit of approximately 55% in South Africa and 59% in Egypt is alarming for both countries, which boast a good number of world-class infrastructure construction companies and a well-established base of infrastructure experts.

Summary of interview results

The interview results from the randomly selected senior infrastructure sector researchers and policy implementers in the 14 countries confirmed the author's hypotheses proposed in the first and second phases of this study (Rwelamila, 2009a, b) that there is a gap between research findings and practice in the AIS. Research implementation gaps shown in Table 3 should be a concern to all AIS stakeholders – especially public policy implementers, constructors and other infrastructure experts.

The Sierra Leonean implementation score, which is the lowest of all of the countries surveyed (13%), has a lot of room for improvement. Closing the 87% gap requires a team effort from all of Sierra Leone's infrastructure sector stakeholders – academics, researchers, policy makers and implementers to reflect on the Sierra Leonean infrastructure sector challenge solutions that have been suggested but not implemented.

The Burundi implementation score (17%), which is very close to that of Sierra Leone, should be a cause for concern and serve as a challenge to all of the stakeholders in the Burundi infrastructure sector. The 83% gap indicates that all policy makers, researchers and practitioners need to find ways of addressing the gap.

Countries falling in Strata II have an average implementation score of 27% and therefore an average deficit of 73%. Although the implementation scores are better than that of Burundi and Sierra Leone, this is a significant deficit that requires an appropriate solution. Current developments in prioritising infrastructure development within these countries, especially in Tanzania (31%), Ghana (31%) and Rwanda (23%), are encouraging and should be supported by both the public and private sectors.

Although South Africa and Egypt appear to have better research implementation than the other 12 countries, as indicated by scores of 45% and 41%, respectively, these scores are not proportional to their economic development levels and resources or their ability to address challenges facing both infrastructure sectors. The corresponding gaps of 55% and 59%, respectively, should serve to stimulate debate among the academics, researchers and policy makers and implementers within these countries.

If these results are interpolated for the whole African infrastructure sector, the message to all stakeholders is that, despite the considerable resources that are spent on research, relatively little attention is being paid to ensuring that research findings are implemented. There is a need to find appropriate interventions that can be used to promote behavioural change among the infrastructure sector practitioners and to promote the implementation of research findings. The W107 could become a mediator for these interventions.

CONCLUSIONS AND RECOMMENDATIONS

The results of this third and final study and the theory and practical issues reported above strongly suggest that there is a large gap between the infrastructure sector knowledge generated through research and its application in individual sectors, expert organisational, and policy innovation.

The 72% average deficit for the fourteen countries surveyed is alarming and a huge challenge. Therefore, the question that should be asked by AIS stakeholders is "How can the AIS community solve this challenge?" First, the research community must acknowledge that the problem exists. Various studies in the medical industry have identified a number of barriers that are relevant to the infrastructure sector, including inadequate interactions between researchers and practitioners, a lack of knowledge of advances in various spheres of infrastructure project management and infrastructure construction management, and a resistance to change. One cannot fault these perceptions. The core of the problem is deficiencies in the infrastructure researchers' knowledge of how to inform and alter the behaviour of both practitioners and clients.

The best efforts of basic researchers and those in infrastructure management and infrastructure project management research are of little use to the clients, the users of the environment products built and other infrastructure experts if the results are not conveyed to those who can use them in an efficient manner. Busy infrastructure industry practitioners cannot be expected to search through journals, conference proceedings and other research reports or to interpret the results correctly when the reports are laced with statistics. It is the responsibility of the researcher to convey the information in a more applicable form and to follow up any proposed infrastructure industry development findings

to determine if the findings have reached their targets and the intended changes in behaviour have been made. If not, the researchers must identify the reasons for the failure and look for a way to rectify it.

This is a new challenge for most academics, researchers policy practitioners (such as CIDB, NCI, etc.) and may require the combined efforts of several infrastructure experts from different areas. However, it is an essential undertaking and one that must be approached with dedication and innovation if research efforts are to be effectively used in the difficult years ahead. This initiative may be best served by starting with W107.

The Way Forward

Based on lessons learned from a World Health Organisation (WHO) (2008) technical paper, the following steps would enhance the use of research by policy-makers in the AIS:

1. Documenting and communicating the outcome of research to interested stakeholders.
2. Improving the ability of researchers to communicate their findings and the abilities of policy-makers to make use research results.
3. Create a culture and environment where the work of researchers is recognised and appreciated and evidence is demanded by the policy-makers.

In order to implement the above, the following actions are essential based on WHO 2008:

1. Develop national strategies for infrastructure research that are based on a systems approach, where there is clear relationship between the input and outcome and impact of research activities on the development of the AIS.
2. Inculcate a research culture among all those connected with the AIS in order to ensure that the value of research and researchers is recognised and that a supportive research environment is created at all levels.
3. Form partnerships with industry, development partners and civil society and sectors other than the AIS.
4. Ensuring policy relevance is a critical variable when setting national infrastructure sector research priorities or funding research with public funds.
5. Develop the capacities and abilities of national policy-makers to use research findings by organising seminars or talks at the national public policy-making level and in environment schools, departments, and colleges.
6. Introduce a cadre of intermediaries in the AIS-based ministries or departments who understand research and the intricacies of policy planning.
7. Ensure that research funded by public funds has a plan and budget in place for the dissemination and communication of the results to the policy-makers and people of that country or region.

8. Plan regional consultations where policy-makers and researchers can share their difficulties and discuss ways to improve the use of research.

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