Augmenting the delivery of public research and development projects in developing countries

Abstract

This research took the form of a qualitative study to evaluate the experiences of project management practitioners and identify barriers affecting the application of strategic project management best practices in public research and development projects. Twenty in-depth interviews were conducted in four different public research organisations. Variance estimates were achieved by selecting a sample size of the four public research organisations that are project based, taking into consideration their respective peculiarities with reference to their mandates. The selected case organisations, being government public research organisations, had their projects scattered in every state of the Nigerian federation. The research established that unfamiliarity with best project management practices and strategic project management processes, together with organisational structures and a lack of skilled project management practitioners were found to be the core factors that affected strategic project management application in public research organisations. This research contributes to practice by proposing a framework that could be used to enhance the adoption of strategic project management best practices and execution of research and development projects in public research organisations.

Keywords: Critical success factors; Developing countries; Research and development projects; Nigeria; Organisational effectiveness; Strategic project management.

1. Introduction

Public research organisations occupy prominent positions to enhance the production and proper diffusion of scientific research information (Ighodalo, 2012). When adequately applied, the scientific research information generated from these organisations play a crucial role in creating new knowledge, products, innovative and technological processes, which are prerequisites for stable and sustainable social and economic growth. As observed by Yang and Jung (2016), research organisations have different characteristics depending on national circumstances. Within the context of this study, the term “public research organisation” entails technology research organisations and research institutions that engage in research and development and research training activities with substantial funding support from government and organisations like World Bank, United Nations Industrial Development Organisations (UNIDO) etc. (Ugonna *et al.,* 2015). These organisations are also known to carry out research and development projects that address industrial needs and therefore underscore the relevance of strategic project management during project planning and delivery to achieve an

optimal mix between risks versus return, meet their mandates and still maintain public value from a short-term versus long-term perspective. The character and span of the multi-functional activities of public research organisations give them a critical role, in programmes and policies that aim to advance the knowledge base of research and development and technological innovation and the economic growth of nations.

Arnold *et al.,* (2012) indicated that public research organisations also have a wider role in innovation systems beyond simply providing new technologies to individual businesses. They provide access to skilled personnel, assist businesses with short-term problem solving, support the development of research and innovation capabilities through collaborative work, and provide access to new ideas and concepts (Weck, 2005).

Public research organisations are also unique with peculiar challenges due to the unpredictable nature of research outcomes and their applications, coupled with the fact that only a few lines of research will ultimately have any significant impact (OECD, 2011). This is because the length of time required for the impact and research effort to be felt may be too long to be useful for present-day management and policy decisions. Yet, public research organisations are increasingly expected to enhance their performance and impact rating for the nation and the international research community (Archibugi and Filippetti, 2018; OECD, 2011). Currently, great emphasis is placed on competitiveness and programme funding as a way to steer research and implement priorities, although governments still represent the highest share of funding for public research organisations (Olsson and Cooke, 2013). This trend has raised some concerns to public research organisations with regards to their long-term capabilities to address frontier and fundamental research or to provide independent advice to governments (Nedeva and Boden, 2006). Consequently, as observed by Halaskova *et al.* (2020), there remains a growing policy interest in understanding how public research organisations can improve the efficiency on how resources are used to address a diverse range of societal challenges. This research aimed to ascertain barriers affecting the application of strategic project management and proffered a framework for addressing those barriers and improving the effectiveness of research and development projects implementation in public research organisations in Nigeria. The research answered the following primary question: what are the barriers that affect the application of strategic project management best practices in public research organisations? In answering this question, we adopted actionable research tactic to ascertain best practices for public research and development organisations. Our research uses a reverse-engineering process to extract fundamental constructs of impactful theory elaboration studies and make them explicit and actionable. As shown in the next sections, we have used key research studies as reference points when reversing strategic project management constructs and empirical data to advance the impactful theory elaboration. Consequently, we propose a framework comprising of

strategic project management best practices constructs. Moreover, the paper contributes to linkages among constructs reflecting strategic project management intentions with reference to public research organisations in developing countries. Through the adoption of theory elaboration, we examined how strategic project management constructs have been explicitly and implicitly applied within the context of public research organisations. Fisher and Aguinis (2017) asserted that theory elaboration requires that researchers be familiar with the existing research and that the study should be designed and conducted to explicitly build on what has examined before. Thus, in the next sections we assessed, categorised and integrated the various explanations and applications into distinctive strategic project management themes.

2. Theoretical underpinnings

2.1 Importance of research and development to developing and industrialised economies

As established in the previous section, research and development plays a critical role in maintaining and fast-tracking economic development. The importance of research and development has been widely acknowledged from anecdotal and scholarly sources. For instance, the activities of research and development organisations support the provision of expert advice and analysis, innovative methodological techniques into alternative sources of evidence, opportunities to test novel ideas and opportunities through which their research might potentially influence practice and policy-making. In a report on *Research and Development Financing*, the need and importance of possible mechanisms for increased coordination of research and development on a global level was highlighted (Viergever, 2010). Part of the recommendations of the report proposed a globally coordinated approach to research and development, involving three key elements: coordination in the identification of priorities for action, coordination in the distribution of research among various entities and coordination in the financing of research and development (Viergever, 2010). This showed that the governance of scientific research and technological innovation has become a political and policy concern throughout the world. With the challenges posed by the complexities of the global economy and their implications for human well-being, there is the need to create a dynamic space for research, from the conceptual to the practical and across disciplines, on the myriad places where human rights, fairness and justice intersect with economic globalisation (Barney and Clark, 2007). This necessitated the need to develop a process that will enhance and improve the governance and effective execution of scientific research projects in Nigerian public research organisations.

The importance of research and development as one of the main contributors to sustainable growth in highly industrialised and developing economies is undisputed among economists and especially in the context of the modern knowledge-based economies (Acquaah and Agyapong, 2016; NEPAD 2014; George *et al*., 2014). This means that government support for research and development activities is widely accepted, in contrast to public support in the area of investment, production or commercial protection (Garcia-Quevedo, 2004; Giebe *et al.*, 2006; Heijs, 2003; Stresse *et al.,* 2016). Furthermore, according to Greenstone (2011), from the historical point of view, the importance of research and development has been evident for at least a century as future economic progress is driven by the invention and application of new technologies. Research and development is the category that develops and drives these new technologies (Greenstone, 2011). Although private sector firms carry out research and development projects, they are mainly focused on "applied" research projects, where the pay-off to their bottom line is likely to only benefit them. Their role is not to undertake broad research and development at the national level but more focused on several benefits like gaining access to external knowledge sources, and utilising resources provided by other collaborators. In contrast, government's sponsor the "basic" research projects that seek wide ranging scientific understanding that can affect entire industries, rather than individual firms (Greenstone, 2011).

This research focused on government-sponsored research and development projects because the impacts transcend all spheres of human endeavour – social, economic, political, educational, scientific and technological – clearly serving as determinants of the pace of growth and development of the entire society (Odia and Omofonmwan, 2013). Research and development also plays an important role in innovation, which, in recent years, has taken centre stage as one of the main drivers of economic growth and poverty alleviation. Policy makers, in turn, can help spread the benefits of innovation through policies that encourage growth in the areas of science, technology and innovation (UNESCO 2010). However, Nigerian policy makers/implementers, and organisation administrators have unfortunately not yet become fully attuned to this global trend that research and development revolutionises crude production, poor yield, insufficiency, poverty, dissatisfaction, stagnation, under-development etc. into high proficiency/productivity, poverty eradication, fulfilment and development, as observed in certain other parts of the world (Odia and Omofonmwan, 2013). Rather, the Nigerian experience is that the government adopted the framework of establishing organisations and institutions (research institutions and universities) but failed to adapt the true tenets upon which such institutes evolved in their source of origin. These tenets include establishment, proper management led by sound/seasoned administrators appointed in an

unbiased manner, proper project funding, desired research outcomes, appreciation, and acceptance/utilisation of the end products by its own people (Odia and Omofonmwan, 2013).

According to Dodsworth and Cheeseman (2018), collaborative research projects with development organisations and policy makers have been on the rise. While the research and development experiences and backgrounds of developing and industrialised economies may be quite different, their industrial technology development models nevertheless present important grounds for exploring alternative strategies that may assist developing countries to acquire firmer research and development capabilities. In view of the current global competitiveness, the need for public research organisations to intensify scientific research has been identified as being of great importance for competitiveness in modern economies (Zoogah *et al.,* 2015; Acquaah and Agyapong, 2016; Coccia and Rolfo, 2009). Nigerian public research organisations must therefore intensify and improve their scientific research; this will result in innovations, which will in turn, drive the economic growth of the country. Despite the unique environment in public research organisations, one could suggest that research and development projects would benefit immensely from the application of strategic project management techniques. In a rapidly changing environment with diverse issues impacting on projects, strategic project management can also support the achievement of projects as well as organisational goals (Brown, 2007). This will also improve the research and development impact, which will give rise to growth in science and technology and in turn lead to industrialisation. This in turn can generate job opportunities, increase income, increase the production of goods and services, create wealth and improve the quality of life in Nigeria (Siyanbola *et al.*, 2011). Within the context of this study, strategic project management can be defined as a process of managing complex projects by combining business strategy and project management techniques in order to implement the business strategy and to deliver organisational breakthrough.

2.2 Unification of strategic project management in research and development organisations

The surreal socioeconomic factors resulting from recent global events like COVID-19 has impressed the need for R&D organisations to consider immediate and longer-term changes. These changes range from adjustments in their project portfolios to organisational modifications to basic work processes and expectations. Thus, strategic project management has become a key activity in most modern organisations requiring new and improved methods of management and technical skills, hence the need for its application as a strategic tool. The

success and survival of organisations is partly determined by the outcomes of its projects, and this has also led to the application of project management as a tactical tool to execute projects (Riis and Pedersen, 2003; Wang *et al.,* 2010; Wessels, 2007). The role played by strategic project management has increased significantly in recent years, with both private and public organisations in Nigeria adopting strategic project management as a way to implement strategic objectives and manage operations (Siyanbola *et al.*, 2011). However, the effectiveness with which projects are planned and managed is known to have a major impact on the business's competitiveness and its environment. With the increasing complexities of technologies, in addition to shorter project life cycles, organisations are forced to rely on research and development as a key strategy (Anbari *et al.,* 2008; Mikkola, 2001). Strategic project management has been identified as a means of avoiding the pitfalls inherent in the management of projects (especially Research and Development projects) in public research organisations in Nigeria; these difficulties are in most cases the reasons for the failure or abandonment of a project (Nwachukwu *et al*., 2010).

Planning and implementing of strategic project management requires changes in the processes, methods and tools used to attain organizational objectives. While the scope of planning and implementation may differ based on perspective, in general, planning and implementation of R&D tasks requires the introduction of an R&D strategy based on the organisational environment, availability of resources, organisational goals and the allocation of resources and various alternatives for a series of processes. Key to achieving this is the determination of relevant processes, methods, and tools to implement and criteria to monitor. According to the traditional project management approach, projects are successful if they meet the time, budget, and quality or performance goals, yet research has shown that most projects are late, over-budgeted, and do not deliver their expected objectives (Kardes *et al.,* 2013; Suikki *et al.,* 2006; Stefanivic and Shenhar, 2007). This research was therefore motivated by the need to examine the rate of project failure in public research organisations in Nigeria. It also aimed to aid senior project practitioners to focus on project management best practices that will improve capacity utilisation and promote new research ideas. Research can then be carried out which will lead to innovation and the commercialisation of research results in Nigeria. The application of strategic project management tools and techniques in public research organisations is gradually becoming an important issue in developing economies, especially in a country such as Nigeria where projects of different sizes and structures are undertaken. Although research and development projects are known to be different from other types of projects due to their long-term nature, their dependency on the actions of others and the difficulty of project definition (Technology One, 2011), their ultimate benefits to the

economy informed the need for the implementation of strategic project management concepts. In addition, rapid changes in environmental policy, with new breakthroughs, problems and risk issues, affect the relevance of research and development projects. This also emphasises the need for the application of strategic project management and for public research organisations to have robust supporting frameworks for the management of their projects.

According to Brown (2007), strategic project management is a project management tool used to manage and measure project outcomes and ensure optimal value for an organisation. Furthermore, projects undertaken by an organisation must meet a set of criteria determined by the organisation's leadership to ensure alignment with the organisation's strategic vision. The application of strategic project management in public research organisations would therefore assist with the implementation and maintenance of research and development projects. It would also address the holistic method of applying the soft skill-set of the project management body of knowledge (leadership, team management, and complexity and ambiguity management) (Jung and Wang, 2006; Quadri, 2010). This will develop the capacity, competence and tacit knowledge necessary to ensure successful prioritisation, management, implementation and procedural closeout of research and development projects in public research organisations (Ovbagbedia and Ochieng, 2015; Zuofa *et al.,* 2015). One of the goals of strategy is to determine why some organisations are more successful than others, and to understand the mechanisms that can help organisations achieve and sustain a competitive advantage (Grant, 2010; Rumelt *et al*., 1994; Vapola *et al.,* 2010).

Competitive advantage is the ability of an organisation to create more value than its rivals, and therefore achieve a superior return on investment (Barney and Hesterley, 2006). Sustained competitive advantage requires capabilities that provide enduring benefits and are not easily copied by competitors or rendered obsolete (Barney and Clark, 2007; Kwak and Anbari, 2009). Strategic projects, which are considered to represent the core of corporate growth, change and wealth creation (Asrilhant *et al*., 2005) can be observed in research and development projects carried out by public research organisations. The application of strategic project management crystallises the concept of project differentiation and integration management. It is the fusion of the W5-H3 embodiments of a typical development project (what, when, where, who, why, how, how much and how well) and their application, relevance and dynamism to the whole lifecycle of developing projects – initiation, planning, execution, monitoring and closing (Abbassi *et al.* 2014; Acur and Umit, 2003; Quadri, 2010). This process would help in the establishment of an easy process of project evaluation, and the identification of the root causes of project failures in public research organisations. Therefore, strategic project

management as a project management tool is used to select and manage projects that will address the mission, vision and strategic objectives, leveraging on the tacit knowledge of creation and innovation enthusiasm in the organisations (Ovbagbedia and Ochieng, 2015; Ochieng *et al.,* 2013; Zuofa *et al.,* 2015). This comprehensive but streamlined unique approach with emphasis on research and development projects simplifies the justification for reengineering the management and execution of research and development projects in such a way as to incorporate the strategic project management techniques and minimise the incidence of project failures in public research organisations.

2.3 Exigency of strategic project management in research and development projects

To provide the superlative value to public R&D organisations, their portfolios must contain a balance of project categories and risk levels and the number of projects must be controlled to guarantee that all projects can be resourced effectively while still sufficiently facilitating an adequate flow of innovation. A common message from project management is the assertion that adopting certain strategies or establishing best practices will improve project outcomes. As found from the reviewed literature (Mikulskienė 2014; Callahan and Brooks, 2004; Green 2005; Grundy and Brown, 2002), strategic project management is used by researchers and practitioners of project and programme management to refer to alignment of organisational strategy with the project management techniques for effective implementation and management of project-based organisations. Strategic project management has been found to help organisations to invest their limited resources in the best way possible so as to achieve success and also meet the expectations of all the stakeholders (Stefanovic and Shenhar, 2007; Reid *et al.,* 2001). Governments and organisations usually embark on different projects with the aim of creating new services, or improving the functional efficiency of the existing ones. All these projects require appropriate skills and techniques that go beyond technical expertise to also encompass effective skills to manage limited budgets, and monitor shrinking schedules and unpredicted outcomes, while at the same time dealing with people and organisational issues (Abbasi and Al-Mharmah, 2000; Chipulu *et al.,* 2015).

The application of strategic project management practices in public research organisations has been identified as an efficient approach that would help in upgrading management capabilities and enable public organisations to efficiently complete projects and attain developmental objectives (Arnaboldi *et al*., 2004; Bachmann *at al.* 2016). Studies have confirmed that the application of modern methods and techniques has a great effect on public institutions (Olateju *et al*., 2011). Arnaboldi *et al*. (2004) observed that the application of project

management strategy in public organisations was as a result of pressure on governments to abandon bureaucratic organisation in favour of leaner structures. White and Fortune (2002) examined the current project management practices in the public sector in the UK by collecting data from 236 project managers in some public institutions. The study investigated the effectiveness of project management methods, tools, and techniques that had been used in successful projects. The study revealed that 41 per cent of the reported projects were judged to be completely successful based on time, budget and specification, although the respondents reported that there were some drawbacks experienced in the execution of the projects. Similarly, Abbasi and Al-Mharmah (2000) investigated the strategic project management tools and techniques used by the public sector in Jordan by surveying fifty industrial public firms. The research identified that the use of strategic project management tools and techniques among the public sector companies was considerably low.

In Nigeria, the implementation of modern project management tools, methods and techniques is still not well established in public organisations (Ugonna *et al*., 2015; Zuofa *et al.*, 2015). This has resulted in the failure of public institutions and their contractors to perform their duties concerning the budget, specifications and deadlines of the projects awarded (Olateju *et al.,* 2011). Similarly, Idoro and Patunola-Ajayi (2009) identified social and political systems, cultural blocks and lack of financial support as barriers to successful project planning and execution in Nigerian public sector. It is noteworthy to state that recently public research organisations have started the application of strategic project management in the planning and execution of their projects but this is yet to be fully implemented. Some of the organisations have come up with strategic and action plan for their projects, thus the problem is not with the planning but the implementation of those plans to enhance project success. This necessitated the need for this study on the implementation of strategic project management in public research organisations.

Research carried out by Asrilhant *et al.,* (2006) on techniques to support strategic project management in UK oil and gas organisations identified that there were two processes involved in the application of strategic project management in the organisation. These are evaluation and control, and while evaluation involves framing, planning and valuing a strategic project, which may end with its approval or not, control involves management review and redesign of a strategic project through to its completion (Asrilhant *et al*., 2006). Furthermore, Asrilhant *et al*., (2007) also identified that the key concepts of the strategic project management process known as the ‘critical elements’ are the context, content and output elements. These help the organisation to focus attention on the success of the project. Notwithstanding, a gap was also identified between the critical elements, and the project managers were found to not pay

attention to the management of strategic projects (Asrilhant *et al*., 2007). It is therefore not surprising that Stefanovic and Shenhar (2007) reported that since the establishment of modern project management as a formal discipline, it has focused on the execution of processes in the most efficient way, and while strategic project management is the most recommended tool, its implementation is yet to be adopted fully.

The non-application of strategic project management by some organisations can be seen in a study carried out by Stanleigh (2006) and a report entitled "*From Crisis to Control: New Standards for Project Management"*. The report showed that a small fraction of projects undertaken by organisations (roughly 2.5 per cent) are 100 per cent successful (Stanleigh, 2006). It emphasised the need for organisations to ensure that only those projects that are aligned with the corporate strategic vision are executed, thus the need for the implementation of strategic project management. For a successful implementation of strategic project management in an organisation, Stanleigh (2006) suggested four key strategies that could assist organisations in regaining control over their projects and ensuring a strategic fit (Brown, 2007; Ochieng *et al.* 2016): ensure that all projects are strategically aligned, create a project management-focused culture, implement strategic project management best practices and create a strategic project measurement system.

Shenhar *et al*., (2002) also suggested a new framework for strategic project management. This framework is made up of four elements, which are: product definition and competitive advantage, business perspective, project scope and strategic focus. In view of the unique nature of public research organisations, an insight into the political and cultural context of the organisation needs to be considered when applying the strategic framework. Therefore, a combination of Stanleigh's strategy and Shenhar *et al*., strategy framework, linked to the critical elements (context, content and output) of strategic project management along the project life cycle as illustrated in *Figure 1*, could be employed by the research organisations for effective implementation of strategic project management in the management of research and development projects.

Figure 1: Project framework from strategy intention

According to the 2016 PMI Guide to the Project Management Body of Knowledge, the context and content elements in *Figure 1* are the most influential elements that affect the achievement of a strategic project's outputs. The context element includes the structural, cultural, economic, social, political, competitive and sectorial environment in which organisations are located

(Pettigrew, 1997; Raesfeld *et al.,* 2012), while the content element is for conducting process research to link the analysis of the process to the project outcome (Pettigrew, 1997). These form the essence of the strategic project management process (Asrilhant *et al*., 2007; Sakar *et al.,* 1998), and as such could be used in the execution of research and development projects in public research organisations in Nigeria. Notwithstanding all the strategies, research and outcomes regarding the implementation of strategic project management, most organisations, according to Brown (2007), have not taken the time to adopt the high-level view of their projects to ensure that the resources consumed (i.e., time, money and people) are adding value to the organisation. The application of strategic project management in public research organisations, which has come to stay, has gone through the planning stage in most organisations in Nigeria but is not yet fully implemented, as can be observed from the reviewed literature; this highlights the need for a conceptual framework for the strategic management of projects. The subsequent section presents the method employed to develop the strategic project management framework.

3. Method

The decision for the research design to be adopted was based on the nature of the problem or issue being addressed by the researchers, their experiences, and the area of study. The choice of research design, which connects the research methodology, was also guided by the worldview assumptions of the researchers in carrying out the study. The research question examined project management practices, tools, the factors affecting the application of business strategy, and how the effective implementation of strategic project management could improve the rate of project success in public research organisations. A variety of project management personnel were selected for interviews across the board. This was to explore the views of experienced project management personnel at the managerial level and also the views of lower level project management personnel, who are mostly responsible for the routine project activities. Thus, the researchers were able to retrieve in-depth data based on the experiences from the array of participants. All participants were staff from the selected research organisations in Nigeria were considered to have good knowledge of managing research projects. Bryman (2012) suggests that the minimum number of interviews should be between twenty and thirty if the research is to be published. This number is also important because the data provides useful insights into the different management methods from different perspectives and world views, but at the same time is not so large that it limits undertaking deep and detailed interview analysis. Hence, twenty interviews were conducted in the four different public research organisations in Nigeria. These four organisations were parastatals under the Federal Ministry of Science and Technology. As indicated previously,

the Federal Ministry of Science and Technology is the statutory organ of the Nigerian government with the responsibility to direct activities in the science and technology sector.

Research organisations under this ministry facilitate the development and deployment of the nation's science and technology apparatus to enhance the pace of socio-economic development through appropriate technological inputs into productive activities. The four organisations were purposefully selected because they planned and guided R&D projects in different aspects of science and technology with particular emphasis on areas where the country had clearly defined comparative advantages in human as well as material resources. Projects undertaken in these organisations range from healthcare, education, transport and service performance to provide value in terms of public benefits. The profiles of the interviewees, their years of experience and interview dates have been highlighted in Table 1.

Table 1: Profile of interviewees and date of interview

As illustrated in Table 1, participants were drawn from different hierarchical positions, and from different organisations. This helped the researchers to gain a broad and deep understanding of strategic project management implementation from different perspectives. There was a common interview protocol consisting of twelve questions together with a one-page consent form, signed by the interview participants. The initial questions focused on the interviewee's personal history and career background in the studied organisations and their project activities. The subsequent questions enabled the participants provide their own rich unfiltered narratives on project management practices, tools, the factors affecting the application of SPM and how the effective implementation of SPM could improve the rate of project success in PROs. For all interviews, the emphasis was on the interviewee's own interpretations however, there were a few interventions with additional open-ended and guiding follow-up questions to constantly stimulate the dialogue, keep focus and gather details. All the interviews were face to face with the average duration of each one being about one hour and forty-five minutes.

In this research, variance estimates were achieved by selecting a sample size of the four public research organisations that are project based, taking into consideration their respective peculiarities with reference to their mandates. The selected research organisations, being government public research organisations, had their projects scattered in every state of the federation. For this study, the case study was focused on public research organisations. First the researchers identified the specific case by selecting four out of eight public research

organisations in Nigeria under the Federal Ministry of Science and Technology (FMST) that are project based and involved in research that contribute to the national economy.

Case studies enabled the researcher's to understand specific issues, problems or concerns of strategic project management application; to gather an in-depth and rich understanding of the application of strategic project management in the execution of research and development projects; and enabled the selection of an appropriate data analysis method which involved the selection of multiple cases that were analysed and compared. Yin (2009, *p.14)* defined the case study method as an empirical inquiry that "investigates a contemporary phenomenon in-depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"; where the case study inquiry "relies on multiple sources of evidence, with data needing to converge in a triangulating fashion". For example, the goal of the case study method is not to produce summary statistics about a set of observations but rather to explore and describe in-depth the meaning of a certain phenomenon in its environment (Eisenhardt, 1989). It is worth emphasising that, for this research, the four case studies (*A, B, C and D*) were used to explore and describe in-depth how research and development projects were carried out in public research organisations in Nigeria. This was particularly important as the nature of research and development projects was different to other types of projects like construction, IT and engineering projects, and thus each project had distinct characteristics based on the type of research and the environment. Consequently, it was considered appropriate to use a case study approach in determining the application of strategic project management by public research organisations. Furthermore, rather than adopting a purely one-dimensional approach to the research design, a pluralistic research design, advocating the use of multiple research methods within a single study, was adopted so as to benefit from the complementary strengths of the different research methods. Moreover, this research approach was chosen to generate answers to the questions: "How?" "Why?" and "What?" For this study, the following question needed to be answered:

- What are the barriers that affect the application of strategic project management best practices in public research organisations?

Although the use of case study has many advantages, there are also challenges associated with its use. These include the challenge of identifying the case, as the case selected may be broad or narrow in scope, and as such the researcher must decide which bounded system to study (Creswell, 2013).

Data analysis was carried out using NVivo, a computer assisted qualitative data analysis software. The software removed the physical task of making codes and copying them

(Creswell, 2009; Bryman, 2012) which led to a more objective review of the generated data. Validity and reliability were achieved by first assessing the knowledge already existing on strategic project management in public research organisations and other public organisations. However, the verification was carried out after the data was analysed and interpreted. This involved the organisation of a seminar to present the findings to project management personnel for an objective critique of the study. It also involved the preparation of publishable briefs on aspects of the study and the publication of the research results in journals in order to fill knowledge gaps and disseminate the results to the academic and research communities. Rigour was achieved by focusing on verification and validation; these included the responsiveness of the researcher during the survey, methodological coherence, sampling, and data analysis. The philosophical position of this research was based on the two main philosophical positions of social research. At the ontological level, the research adopted a realist position because the strategic project management process employed by different public research organisations for the execution of research and development projects in Nigeria had a structure that was independent of the individuals and could vary considerably. In addition, the research considered conducting the investigation in a practical rather than an abstract way. At the epistemological level, the research adopted the interpretivist position because the nature of the research problem was focused on the development of strategic project management framework to be used as a guide to minimise barriers and enhance strategic project management practices in the execution of research and development projects in Nigeria. According to Ritchie and Lewis (2003), the interpretive approach is valuable for identifying problems, and in this research it enabled the researchers to recognise the differing viewpoints of various people in the organisations. The next section details a symposium of findings drawn from the interview transcripts that formed the basis of the proposed framework. Conclusions drawn from previous sections, the associated practical implications and the way forward are presented in the final section.

4. Framework development

This section provides a description of the proposed strategic project management framework for project management practitioners to use in the management of research and development projects. The purpose of developing a strategic project management framework is discussed and also the key factors to be considered in proposing the framework. In order to assess its practicality, suitability and effectiveness, the subsequent part of this section focuses on data verification and validation. The verification and validation exercise is important because it provides ways in which to measure the quality of knowledge in a knowledge base, and to indicate where work needs to be done to rectify anomalous knowledge (Preece, 2001). Although there are a number of frameworks used for strategic analysis and strategy

development, there have been very few frameworks created for deployment that are widely accepted by project management practitioners (Saunders and Mann, 2007; Taplin 2006). Research has also shown that there has been no development of a generally accepted framework for implementing strategy at either corporate or operational level (Jiang *et al.,* 2008; Minarro-Viseras *et al.,* 2005; Noble, 1999; Okumus, 2003; Saunders and Mann, 2006). This has revealed a gap within the project management discipline for the development of an acceptable framework for use in strategic analysis and project development.

The framework for this study was developed using the key variables identified in the project management practices as shown in Table 2-these variables were retrieved from the qualitative analysis. As highlighted in Table 2, these have been regarded as the components of strategic project management and have been grouped under the following categories: organisational structure, management involvement and strategic project leadership style, appointment of project team and team competence, project alignment with organisational strategy, project prioritisation and selection, project management principles and a solid strategic project management process. From the qualitative findings of this research, for effective implementation of strategic project management in public research organisations in Nigeria, the evaluation and prioritisation of an organisation's research and development projects are required, together with an understanding of its overall corporate strategy. Lack of knowledge of project management principles and strategic project management concepts were observed, suggesting the need to train project management practitioners in order to achieve the effective execution of research and development projects. Participants further suggested that a lack of understanding of the practical application of the strategic project management concepts in the execution of research and development projects was a problem. To address this, there was a need to propose a framework that would:

- Assist project management practitioners in public research organisations in Nigeria to minimise barriers that affect the execution of research and development projects;
- Ensure that projects selected for execution align with the organisational strategy.

Table 2: Framework variables

A basic framework necessary for the implementation of strategic project management concepts in an organisation needs to combine strategic and project management principles with tactical project alignment (Brown, 2007), to adopt project portfolio management (Garfein, 2007) and to develop strategic project leadership (Green, 2005; Shenhar, 2012). This is to enable the organisation to successfully select and implement their projects. For a framework

that can assist project management practitioners in public research organisations in Nigeria, the following components were considered and used to develop the strategic project management framework: strategic project leadership, appointment of project teams at the beginning of the project, project team competences, strategic alignment of projects, strategic project portfolio management and maximisation of research and development strategy in the organisation. It is worth mentioning that these components were retrieved from the interview analysis. The conventional tools of project management provide a universal formal part of the profession (Shenhar, 2012), but have been found to be insufficient in dealing with social, economic and environmental issues, or in addressing dynamic business requirements. Considering that research and development projects are risky by nature (OKLC, 2008), and are unpredictable, inconsistent and involve a great deal of uncertainty and complexity (Shenhar, 2012), a more strategic approach was required that, if correctly implemented, would ensure effective execution of the projects. Figure 2 highlights the key components of the systematic framework in the execution of research and development projects in public research organisations in Nigeria.

Figure 2: Components of the framework

The proposed framework considers the key components of strategic project management at the operational level for effective implementation. The components would help to enhance the strategic project management process and promote the successful execution of research and development projects in public research organisations in Nigeria. For a research organisation to perform well there is the need for an optimal and flexible organisational structure that will enable it to respond to changes and attain a competitive advantage. Based on the qualitative findings, the researchers were able to develop a detailed integrated strategic project management framework that is simple and easy to implement (*see Figure 2*). The integration of project management techniques and strategic project management aimed to provide a comprehensive approach to the application of strategic project management in the execution of research and development projects.

4.1 Theme 1: Project-based organisational structure and management involvement

During the discussion, although the majority of the participants (*Project personnel 1, 3,4,6,7,8,9,11 and 12)* favoured the establishment of a strategic project management office, the project directors specifically argued that the establishment of a strategic project management office was not required in a project-based organisational structure. Their justification was that its inclusion would distort the organisational structure, suggesting that a

division within a planning department could carry out the functions of a strategic project management organisation. As established from the discussion there was a misconception among public research organisations in Nigeria regarding strategic project management techniques and their application. This could explain why, for those organisations that have initiated strategic project management for the effective execution of research and development projects, its implementation has remained a challenge. On the subject of management involvement in the execution of research and development projects, the majority of participants (*Project personnel 2, 5,10,12,13,14 and 15*) affirmed that management involvement was an important factor in strategic project management. Although the widely held response was to either strongly agree or agree, participant 1 strongly disagreed with one of the variables, that of employee motivation being a factor within management involvement, stating that it was not required. During the discussion, two participants (*Project personnel 1 and 10*) suggested that management involvement would contribute to the effective execution of research and development projects. From the results participants (*Project personnel 17,18,19 and 20*) acknowledged that management involvement was an important factor.

4.2 Theme 2: Strategic project leadership and appointment of project team

From the verification results the participants' preferences for and reliance upon dynamic, motivational, team building, inspirational, visionary and business-focused leadership styles in public research organisations were evident. Although a large majority of the participants (*Project personnel 1,6,7,8,9,10,11,12 and 15*) favoured dynamic, motivational, team building and inspirational leadership styles, interestingly, during the discussion some participants (*Project personnel 2,3,19 and 20*) did not agree with the visionary and business-focused leadership styles. It would seem that the four styles were favoured by participants because these allowed them to gain a greater level of commitment and motivation from their project leader. The public research organisations have been found to operate within a functional structure that has a long-standing reputation for being adversarial, as demonstrated by weak relationships between employees. This has led to numerous problems including poor project performance. However, participants' suggestions were that those factors that may influence the type of leadership style could depend upon relationships between project teams, the type of research and development project, the project duration, and the knowledge of both the leader and the team.

There was a consensus during the meeting that, in order to appoint a project team, the selection and composition of the teams should be based on leadership skills, an ability to innovate, and the ability to work in a team. From the verification findings, all the participants

(*Project personnel 1-20*) acknowledged that the appointment of project team was an important factor in strategic project management. This was reflected in the participants' response in the verification questionnaire, where 'the selection of project team with leadership skills', 'ability to work in teams' had the highest scores in the verification exercise followed by 'innovative project team'. Reflecting on their experiences, the participants' view was that team selection in public research organisations was based on leadership skills and the ability to work in teams. The establishment of a cross-functional steering team received the lowest score, with some participants suggesting that the ability to establish a cross-functional steering team was not an important factor to consider during the selection and appointment of project teams. Although some of the participants (*Project personnel 8,13,14,15 and 17*) failed to rate 'building cohesion and stability in team working' in their questionnaires, during the discussion they expressed the need for teams to build a cohesive and stable team. This means that, although some of the variables were scored lower than others, the general view was that all the variables were important.

4.3 Theme 3: Alignment of projects with organisation's strategy and project selection and prioritisation

The alignment of a project strategy with the organisation's overall strategy was rated as the highest important variable during the verification discussion. During the discussions, participants (*Project personnel 4,5,6,9,10,13,18 and 19*) further highlighted its importance in helping organisations enhance their performance in the strategic management of research and development projects. From the verification result, it can be seen that all the participants (*Project personnel 1-20*) acknowledged the need to align projects with an organisation's strategy. Some of the project directors present at the meeting recognised that their organisation's performance stood to gain by ensuring that projects were aligned with the organisation's strategy. Referring to their experience, the participants suggested that this part of the framework had been found to be effective in practice. In reality, the participants (*Project personnel 1-20*) emphasised that research and development project performance depends on the effective alignment of projects with the organisational strategy. With respect to the selection and prioritisation of projects, the participants agreed that the prioritisation of strategic projects and the selection of projects to address the organisational strategic goals were key in the strategic management of Research and Development projects. In order to achieve an effective project performance, it is essential to select and prioritise strategic projects in order to create new products that will address the economic need of the country. In general, the participants agreed that the project selection and prioritisation was an important dimension to the strategic management of research and development projects. Referring to their experience, the participants recommended that this element within a strategic project

management framework was an effective variable in practice.

4.4 Theme 4: Maximising R and D in the organisation and project management principles

During the discussion, participants (*Project personnel 3,4,5,6,7 and 8*) argued that the maximisation of research and development depends on resources (people) and the research and development process employed in the organisation. Among the variables discussed as important factors in the development of a strategic project management framework, the participants agreed that the need to 'provide proven process and techniques' was a key element. Most of the participants suggested that project management principles depended on the four variables identified within this particular category. During the discussion, participants also emphasized that risk management and quality management were also significant factors that would contribute to successful implementation of project management principles in a strategic project management framework. Although some participants did not fully endorse some of the variables contributing to the project management principles, the general response was that all the variables were required to some degree. In general this showed that a project management principle was an important factor in a strategic project management framework.

4.5 Theme 5: Strategic project management process

In addressing the strategic project management process, almost all the participants (*Project personnel 1-20*) agreed that the strategic project management process is essential to achieving strategic management of research and development projects. It was not surprising to see that, when the participants reflected on their personal experiences of project execution, they associated some of the variables with effective research and development project performance. The factors emerging from this category indicate that the framework needs to address both project implementation and the monitoring and control of projects. From the results, it was found that these variables were rated highly, indicating their importance to the strategic management of projects. Participants agreed with the strategic project management framework variables identified in this study. In addition, during the discussions the researchers observed that the participants agreed with all the factors identified as necessary for the development of a strategic project management framework. The participants (*Project personnel 15,16,17,18,19 and 20*) also acknowledged that an enhanced project performance could be achieved if the six categories at the operational level were combined and managed effectively. Furthermore, there was also a consensus that the initial focus should be on the nine variables discussed in this section.

4.6 Validation and verification of framework outcomes

There were twenty participants (*Project personnel 1-20*) who participated in the validation exercise. Participants acknowledged that the framework highlighted several key factors of strategic project management that are required in order to enhance the execution of research and development projects in selected public research organisations in Nigeria (*see Figure 3*). However, 4 participants (*Project personnel 1, 2, 4, and 18*) were of the view that, although the framework presented a useful means of enhancing the execution of research and development projects, a practical example was required to enable project management practitioners to compare those projects executed using the framework against those completed under the old project system, and also to highlight areas of improvement, if any. This, they suggested, would also provide a better understanding of the framework, but emphasised that training would be needed prior to its full implementation. Interestingly, during the discussions, participants acknowledged that there is an increased need to extend this to other research organisations, aside from the Federal Ministries of Science and Technology in Nigeria, to enable them collaborate. In their opinion, the framework provided a generic application and established a basis for the execution of research and development projects (*see Figure 3*). Reflecting on their personal experiences, the majority of participants (*Project personnel 1,2,3,4,6,7,9,10,12,13,16 and 17*) agreed that the proposed framework, which could be generally applied, would help to streamline research and development activities through improved management and control and thus ensure greater research and development project success. With the increasing need for their organisations to perform better, participants affirmed that the strategic project management framework provides a background for further research on the strategic management of research and development projects. The results revealed by the verification and validation exercise suggest that there is the need for researchers in public research organisations to advance beyond the mere conventional management of projects to a more enhanced and strategic management style, as this will enable public research organisations to achieve a sustainable competitive advantage.

Figure 3: The proposed strategic project management framework

The proposed framework is presented in Figure 3 and is based on qualitative findings. The growing trend in enhancing innovation, is giving rise to a need for the effective and successful execution of research and development projects. The proposed framework in this study has implications for project management practitioners working in public research organisations and is committed to enhancing the delivery of research and development projects. It is not suggested that the use of a strategic project management framework by project management practitioners in public research organisations will result in an instant understanding and awareness of what is required of them. However, the proposed strategic project management framework would provide the project management practitioners with a wealth of experience in a condensed and simplified format, which may be used as a guide toward the successful execution of research and development projects. In turn, this could improve the performance of the project management practitioners themselves, which would further guarantee project success. As affirmed by the participants during validation process, it is expected that, in applying the strategic project management framework, its value could be of immense benefit to the public research organisations in Nigeria. It could achieve a more focused research and development objective that would yield improved results and enhanced competences and capabilities. Furthermore, it could ensure effective project management and allow project management practitioners in public research organisations to consistently reach high performance levels. The proposed framework was intended to provide project management practitioners in public research organisations with an understanding of the process of managing and executing research and development projects effectively. As illustrated in the verification and validation results, the participants expressed willingness and a capacity to incorporate the strategic project management framework into their organisations. Finally, the strategic project management framework is expected to provide project management practitioners in public research organisations with a clear and simple set of guidelines to improve the probability of project success. In the next section, recommendations and further research work are presented.

5. Discussion

The research focused on the application of strategic project management for the execution of research and development projects in public research organisations in Nigeria. As established in this research, the concept of strategic project management is new to public research organisations in Nigeria, and its impact on research and development projects was relatively unknown. However, most of the participants from those organisations where strategic project management had been introduced agreed that the introduction of strategic project management had positively influenced the execution of research and development projects and, if implemented, was expected to enhance project success.

It was identified that, for an effective application of strategic project management in the execution of research and development projects, there is the need for public research organisations in Nigeria to adopt the proposed strategic project management framework to ensure strategic selection, prioritisation and alignment of projects with the organisational strategy. With the quest for an increase in research and development performance gains importance, the need for research organisations to successfully execute research projects will undoubtedly increase. However, the framework proposed in this research may not be able to eliminate all the barriers that affect the application of strategic project management in the execution of research and development projects. Nevertheless, despite the fact that public research organisations are government-owned organisations and may therefore operate outmoded procedures, should the strategic project management framework be employed by senior project management practitioners, it would serve as a standard structure superior to the traditional approaches used in the execution of research and development projects. It was further established that in Nigeria there is no standard structures for governing the activities of public research organisations, and this has created a fundamental barrier to the effective execution of research and development projects in research organisations. The proposed framework, therefore, is a standard project management framework that can be used to bridge this gap.

From the findings, it emerged that the organisational culture and a lack of knowledge about project management principles and concepts were the core areas upon which all the factors that affected strategic project management application in public research organisations hinged. As shown in this study, the motivation of employees emerged as one factor that affected public research project management practitioners' attitudes towards the effective execution of research and development projects in Nigeria. Although initial findings from the participants indicated that strategic project management was practised in public research organisations in Nigeria, the subsequent results indicated that what was actually practised was traditional project management methodology. The resistance to change practices, and inability to manage changes that occurred during project execution, were common barriers that affect the effective application of strategic project management in research and development projects. Meanwhile, it was established that the involvement of top management of public research organisations in Nigeria was found to contribute to the overall actualisation of the research organisation's execution and management of research and development projects. In general, therefore, it appears that the success of research and development projects in Nigerian public research organisations depends on the effective implementation of strategic project management, and the proposed framework presents a standard approach that will enhance project performance.

According to those who participated in the focus group session if the framework is successfully implemented, the success of future research and development projects will not only improve, but also there will be an increase in research output, leading to the marketing of innovations that can impact positively on the industrial sector of the country. The research achievements with regards to contribution to knowledge have been summarised in the following points: gaps in practice have been identified with regards to the theory of strategic project management and the practical application of the process; regarding research innovation, the research contributed to knowledge by providing an integrated strategic project management framework for an enhanced execution and management of research and development projects.

6. Conclusion

As presented in this study, the success of public research organisations depends on the effective execution of research and development projects. Thus, the following recommendations were deemed necessary for project management practitioners working in public research organisations: public research organisations should ensure that strategic project management concepts are integrated into their project proposals and operational manuals and are enforced as a matter of policy; for research and development projects, the top management of research organisations should adopt the strategic project management process to guarantee a streamlined project execution. This can be achieved by appointing a project team with the right skills to manage and execute those projects; prior to the inception of any project, research organisations should establish a clear project budget and set aside sufficient funds, when available, to ensure that projects are conducted through to completion and that no new projects are commenced without adequate funds being available; a repository of policies is required to enhance the commercialisation of research and development projects. The supervising ministry of public research organisations should encourage the adoption of a standard and consistent structure for the effective monitoring of research and development project activities, and maintain constant compliance with such.

This research was primarily limited by the scant literature in the area of study. The application of strategic project management in research organisations is a relatively new area and there was not much information available; the generalisability of the findings.In terms of contributions, this study offers several contributions to theory elaboration and practice. Theoretically, the study uses a reverse-engineering process to extract fundamental constructs of impactful theory elaboration studies and make them explicit and actionable. Moreover, the study contributes to linkages among constructs reflecting strategic project management

intentions with reference to public research organisations in developing countries. Through the adoption of theory elaboration mode, an exploration of how strategic project management constructs have been explicitly and implicitly applied within the context of public research organisations is attained. this research has achieved its aim to propose a strategic project management framework for project management practitioners in public research organisations and, although the strategic project management framework was for public research organisations in Nigeria, the authors propose that public R&D organisations in similar developing countries can adopt the framework in the paper. . There are also some other areas in the application of strategic project management that were not covered in-depth due to the scope of this research work. It is recommended that further research be undertaken in the following areas: follow-up research is required to validate the potential of using the framework for managing research and development projects in different research organisations, a matter that could not be incorporated here due to the scope of this research. This would provide not only data about the validity of the strategic project management framework in generic terms, but would also generate additional data on the impact of strategic project management initiatives on projects, data which could be used to further refine the proposed strategic project management framework. Although there has been significant research on strategic management of projects, the focus has been more on construction, information technology and engineering projects with little or no attention to Research and Development projects. This highlights the need for further research on the use of strategic project management to address different areas of research and development projects in research organisations.

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