



**AN ANALYSIS OF THE MANAGEMENT
OF RESEARCH AND TECHNOLOGY
ORGANIZATIONS IN NIGERIA.**

BY

LAWRENCE EDET NSA

AUGUST, 2003

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TECHNOLOGY ORGANIZATIONS IN NIGERIA**

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**LAWRENCE EDET NSA
(MATRICULATION NO. 0168)**

**A THESIS SUBMITTED TO ST. CLEMENTS UNIVERSITY,
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REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
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ST. CLEMENTS UNIVERSITY**

AUGUST, 2003

DECLARATION

I hereby declare that this thesis is a product of my own personal research work.

All the materials or data, which have been used in the course of this study, have been duly acknowledged by way of bibliography.

Any error whatsoever which may be contained in this work is entirely mine.

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CERTIFICATION

This is to Certify that this dissertation entitled **“An Analysis of the Management of Research and Technology Organizations in Nigeria”** by **Lawrence Edet Nsa (Matriculation No.0168)** was carried out under my supervision and guidance and has been approved for submission to the St. Clements University for the award of the Degree of Doctor of Philosophy (Ph. D) in Management.

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DEDICATION

I dedicate this research work to my dear Wife, Mrs. Ify L. Nsa, who has been a source of inspiration to me throughout the entire period during which the work was carried out. Her support and encouragement were all that was needed to challenge my wits towards the realization of my objective of completing the programme.

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I wish to thank all those who have contributed in one way or the other to the success of this work but who for one reason or the other have not been individually mentioned here. I wish you all God's blessings.

Finally, I am indeed grateful to the Almighty God for his grace and loving kindness in strengthening my resolve to complete this work.

LAWRENCE EDET NSA

ABSTRACT

This study is an examination of the management of research and technology organizations (RTOs) in Nigeria with particular emphasis on how well this is done to enhance the technological and national growth of the economy.

The term "management" generally defined as getting things done through people is looked at in this work in terms of organizational management, project management, business management, financial management, personnel management, capacity building and support services to industries. An attempt has been made to assess the performance of the Research and Technology Organizations in Nigeria and ascertain the reason(s) for their poor performance and inability to contribute significantly to the technological development of the country and develop best practices that would enhance improved performance for the realization of national development goals.

After extensive literature review on the subject matter, field studies were carried out through surveys and face-to-face interviews. Both quantitative and qualitative data generated were analyzed and the findings discussed exhaustively.

The findings from the research work identified Government as the major financier of RTOs in Nigeria, while industry, NGOs, and the private sector contribute minimally towards their funding. This, therefore, reflects the tremendous influence of government on the management of RTOs. Their autonomy is limited as even the leadership takes directives from supervising bodies and political office holders.

The challenges posed by inadequate funding of RTOs as well as the absence of an appropriate mission makes it imperative for them to restructure. Restructuring here implies, a change in direction of management or a total transformation in ownership, strategy and organization.

These findings led to a number of conclusions: inadequate funding of RTOs militates against their effective performance; absence of market-driven thrust is a major weakness of RTOs activities; RTOs are more effective in organizational management than in business and project management.

It is recommended that Research and Development (R&D) conducted by RTOs should be market-driven; there should be proper collaboration (linkage) between RTOs and the industry to facilitate the commercialization of research results.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Research and Technology activities started in Nigeria prior to the attainment of independence in 1960 especially in the field of agriculture. The colonial masters then, were interested in establishing agricultural extension service centres in order to boost agricultural production. The primary purpose was not to carry out research in indigenous production techniques or processing methods rather it was to extend and apply the findings of researches carried out elsewhere outside the country. The agricultural products thus produced served as industrial raw materials to industries in the United Kingdom. Records have it that the first research station was established in 1899 at Ibadan in Western Region of Nigeria. This research station is what is known today as Moore Plantation, Ibadan. Similar research stations came on stream in various regions of Nigeria such as Samaru in Zaria (Northern Region) and Umudike in Umuahia (Eastern region) in the early 1900.

Furthermore, based on national production of specific industrial crops such as Cocoa, and Palm oil, some regional research centres were established in Nigeria. These included, the West African Institute for Oil Palm in Benin and the West

African Cocoa Research Institute in Ibadan. The sub-regional research stations became full-fledged Research Institutes following the independence of Ghana in 1957. Prior to independence, Ghana was the sub-regional headquarters of the research centres.

The first parliamentary consideration to research activities in Nigeria was in 1964 when the Agricultural Research Institute Act was enacted. Within the same year, an international conference on the Organization of Research and Training in Africa was held (Aluko-Olokun, 1999: 139-48). The outcome of the conference was the resolution for national governments to constitute National Council for Scientific and Industrial Research. Consequently, in 1966 the then Military Government enacted Decree No. 83 establishing the Nigerian Council for Scientific and Industrial Research (NCSIR).

The decree establishing the NCSIR was structurally defective and weak as the Council lacked executive powers and could only offer advisory services. The mandate of the Council did not cover basic sciences, agricultural and medical research (Aluko-Olokun, 1999: 139-48). This structural weakness invariably meant that not much could be achieved. It equally laid the foundation for the progressive poor performance of research institute for over three decades.

Realizing the limitations of the NCSIR, it was replaced by the Nigerian Council of Science and Technology (NCST) in 1970 with more mandates that covered areas such as agricultural sciences, engineering and technology, medical sciences, basic sciences, environmental sciences and social sciences. Between 1971 and 1973 more sectoral research councils such as Agricultural Research Council were established.

The import of Science and Technology (S&T) to national development was not in doubt, but the approach to achieving an S & T-driven economic development was encumbered by the continuous change of the institutional frameworks thus established.

For instance, in 1976, the government advocated for a national S & T policy, which informed the establishment of National Science and Technology Development Agency (NSTDA) a year later. The Agency became the umbrella organization supervising and funding about 22-research institutes so far established. The agency metamorphosed in 1980 to Ministry of Science and Technology with all the Research Institutes under its supervision.

This chequered history of the evolution of Research and Technology Organizations in Nigeria is a testimony of concerted efforts towards using the instruments of Science and Technology to bring about development. As pointed out by eminent scientific scholars such as: given the colonial roots of RTOs, linkages with end users of research results and the larger society were not there. Research therefore was seen as consumption rather than an investment with high potential to turn the economy around. These scholars also observed that RTOs remained isolated and alienated from the productive sector (industries) that are the expected beneficiaries of research findings.

This view was further corroborated by Aluko-Olokun (1999: 139-48) in his comment on a study carried out in 1985 by UNESCO where it was observed, that "S & T policy-making machinery in Nigeria does not seem to have worked out any systematic or comprehensive R & D strategy for advancing industrial technology".

The situation is understandable when viewed from two perspectives; the colonial antecedents to the establishment of RTOs and the nationalist approach. Having briefly examined the first aspect it is desirable to look at the nationalist approach. This approach was anchored on three broad but

specific areas that include, the need to exploit local resources to replace imported raw materials, develop technologies that will assist the nation to develop and utilize its natural resources and to create new processes and products. By this approach, government was the major stakeholder both in terms of ownership of RTOs, its management and funding and also, in determining the direction of research.

Government's overall involvement in the establishment of RTOs alienated them from end-users of research findings such as industries. There were no effective linkages between RTOs and industries. The outcome of this is their inability to commercialize the product of research as researches were carried out without express interest of end-users or clientele in mind. The inability of RTOs to commercialize research findings informed why considerable volumes of research results and innovations were left on the shelf. This equally explains why there was significant gap in the process of innovation, utilization and technology diffusion. Other reported shortfalls in the operational activities of RTOs include lack of clearly defined and measurable targets as well as lack of effective monitoring and performance evaluation. Limited manpower resources due to poor remuneration, low-morale and reward system for productivity were also

reported, which informed human resources flight, as a lot of scientists left the RTOs to join the public or private sector.

The depth of Government involvement further eroded the spirit of business approach to R&D as research was believed not to be an investment with expected returns. This perception of R & D as a consumption rather than an investment killed the spirit of competitiveness among RTOs. Consequently, most RTOs merely exist and look forward to Government subventions. The meagre financial resources from this source are often not judiciously expended as peripheral issues were given greater attention than the core research issues. Often, funds were expended thinly on a wide research area without achieving the desired results. Another critical area desiring elucidation is the inability of RTOs to effectively and sustainably disseminate information on their activities and research findings to the public. The society often times is ignorant of what the research and technology organizations are doing. They are also not aware of any proprietary technology developed. The RTOs, on the other hand, argue that given their level of funding, it is not always possible for them to embark on information dissemination at high level.

1.2 STATEMENT OF THE RESEARCH PROBLEM

For socio-economic development and national growth of any country, a strong technology base is desirable. The natural resources must be developed and utilized both as input to industrial production and as direct products for the social well being of the citizenry. The performance of Research and Technology Organizations in Nigeria established as institutional framework to develop technology and thus bring about industrialization and national prosperity, has fallen short of expectation.

The questions that come readily to mind in respect of the above observation are:

1. Why is it that RTOs have failed to lead the nation towards the path of industrialization and self reliance?
2. What factors are responsible for this,
3. What are their limitations, strengths and weaknesses?
Findings from past studies on RTOs activities in Nigeria reveal that the key impediments to their successful performance is often not technology but management of human and material resources required to develop technology.

The issue in contention is the kind of practices adopted in managing these organizations that encumbered their performance over the years. In fact, the situation has reached a point where government in recent years is finding it difficult to continually fund RTOs. Also, domestic industries are not keen in funding research because of their seeming lack of faith in the managerial capabilities of these organizations. This development, to an extent, explains why RTOs are alienated from the beneficiaries of their research efforts.

The lack of effective linkage between RTOs and manufacturing industries in Nigeria could be indirectly linked to the low performance of these industries in terms of innovativeness, technological capability, competitiveness and overall capacity utilization. In essence local industries are not technologically innovative and have little or no drive for long-term investment in technologies. Consequently they cannot compete in both domestic and export markets. Contrary to the prevailing situation in Nigeria, in developed countries, RTOs assist industries especially small and medium enterprises (SMEs) to develop by providing technical and business extension services, laboratory testing facilities problem solving as well as research and development assistance.

The essence of this study is to assess the performance of RTOs in Nigeria over a decade and a half in order to determine the practices that have hindered them from achieving their set objectives and in meeting the aspirations of the government that established them. The practices identified shall be categorized under ten management process areas, namely: governance, organizational management, business development, financial management, RTO service, project management, personnel management, capability building, networking and operational policies. These practices would be analyzed using relevant performance indicators. The study is therefore expected to come up with best practices for management of such organizations in order to enhance their performance towards the realization of national development goals.

Before discussing the rationale for the study and its scope and limitations, it is pertinent to examine briefly the concept of best practice and benchmarking. In today's' changing world, some RTOs have developed practices that brought them close to their clientele or market and kept them up-to-date with trends in technological development. They equally developed strategies to acquire necessary funding for survival and to become useful stakeholders to their country's technological infrastructure.

In line with the realization of the importance of change in a dynamic scientific environment, RTOs must therefore identify areas in their management structure requiring change and how to go about it. Change is no doubt, desirable for management improvement, even though, it is often resisted. RTOs must be dynamic (i.e. willing to change), competitive, client-driven in their approach and cost conscious with a high degree of probity and accountability.

1.3 RESEARCH OBJECTIVES

The research objectives of the study are both immediate and developmental. The immediate objective attempts to look into specific issues, which are directly addressable within the context of the study. The development objectives on the other hand, attempt to develop models or strategies that could be adopted to re-structure the management systems and improve on the performance of Research and Technology Organizations.

A. Immediate Objectives

The immediate objective of the study is to investigate, understand and describe the context of an organization's practices and benchmarking, which defines processes, practices and performance indicators for measuring which

practices are most successful in meeting RTOs goals. It includes but not limited to the following:

1. To identify good practices in force within RTOs and those that need to be discarded.
2. To identify organizational processes and practices which are critical to developing closer and effective interactions between RTOs and their clients.
3. To identify linkage(s) if any, between RTOs and industries in Nigeria.
4. To develop performance indicators for the measurement of the R & D effectiveness of RTOs.

B. Development Objectives

The development objectives, which are futuristic, shall address the following areas:

1. To provide knowledge required as a basis for the development of a conceptual framework for future modeling of RTOs structures and operations.

2. To develop methodology and information for project design to diagnose RTOs need for new practices and implementation plan for transformation.
3. To develop networking method for the exchange of business principles and best practices for RTOs daily operations as a means of strengthening management capabilities
4. To recommend strategies that could be used to assist RTOs to institute change in their organizations practices.

1.4 **JUSTIFICATION OF THE STUDY**

RTOs are often being criticized in Nigeria for not living up to their expectations having failed to contribute to the technological and economic development of the country. Although, studies have been carried out on their operational activities, revealing problems and constraints, not much work has been done in the area of R&D management as a possible factor responsible for their failure to deliver.

The need to study the R&D management of RTOs cannot be overemphasized. Consequently, this will lead to the identification of the problem of R&D inefficiency in understanding industry's needs and translating those

problems to an R & D mission. It will also, lead to having the right kind of trained personnel to undertake efficient R & D management and finally transfer R & D results to the production system within a specific time period.

This study is expected to reveal the current situation in the management of RTOs in terms of organizational management, project management, business management, and support services to industries, financial management, personnel management and capacity building. It is envisaged from the outcome of the study that as industry and the society appreciate the significant role of RTOs as catalysts towards industrial and economic development of the country through good management and better performance, they would be encouraged to finance research activities. It would also change their perception of local R & D once they realize that funds so invested would certainly yield the much-desired dividend in the future.

The study will identify current management practices of RTOs that are considered to meet international standards and those that need to be improved upon in order to enhance performance. The findings and recommendations will immensely assist RTOs wishing to improve their performance, as it will provide considerable source of

knowledge that can be used as a guide. Apart from the RTOs that will benefit directly from the study, the findings will also be useful to the government and industry.

For the government, it will provide a guide towards formulating measures to promote research and development in the country. As the current major financier of R & D in the country, it will make use of such findings to assess the effectiveness of R & D activities and overall performance of RTOs in the country. The resultant output would guide government in formulating policies to strengthen RTOs and enable them contribute to the socio-economic development in the country.

As a source of knowledge, the study will serve as a repository of information on best management practices for RTOs in the country and contribute to available relevant literature in R&D management. It will equally expose other areas for future research, which are required for the continuous improvement of R&D activities in the country. The overall expectation from this study is the transformation of RTOs in Nigeria for better performance.

1.5 STATEMENT OF HYPOTHESIS

For the purpose of this research work, the following hypotheses have been formulated for subsequent testing. The result of the testing will assist the researcher to have a framework for interpreting the research findings in a tentative and meaningful manner.

HYPOTHESIS ONE

Null (Ho): Inadequate funding of RTOs does not militate against their effective performance.

Alternative (Hi): Inadequate funding of RTOs militates against their effective performance

HYPOTHESIS TWO

Null (Ho) : RTOs are not effective in organisational management when compared to business and project management.

Alternative (Hi): RTOs are effective in organizational management when compared to business and project management.

HYPOTHESIS THREE:

Null (H₀): Absence of market driven R&D thrust is not a major weakness of RTOs activities.

Alternative (H₁): Absence of market driven R&D thrust is a major weakness of RTOs activities.

The above hypotheses will be tested in the course of the study. The test of the hypotheses will be presented in the main text of the thesis. The chi-square (χ^2) statistical deduction will be used to test the hypotheses.

1.6. SCOPE AND LIMITATIONS OF THE STUDY

Research and Technology Organizations in the context of this study include government-owned or public research institutions and technology business incubators. Private research and development organizations and universities are excluded.

Research and Technology Organizations (RTOs) in Nigeria exist in different contexts and were established for various purposes. One of the prime objectives of this study is to establish a common understanding of the basic structure and functions of an RTO. In order to achieve this, a systematic methodology that categorized the management operations of

an RTO into major process areas was adopted. Also, sub-processes, which provide basis for assessing daily operational practices used by RTOs to achieve their set objectives, were studied.

Ten major management process areas were chosen for the study. They include the following:

- Organizational Management – Management processes adopted by RTOs
- Project Management – Strategy used to manage Projects
- Business Development – Awareness creation RTOs products/research findings
- RTO Service - Services offered to clientele and beneficiaries
- Financial Management – Accountability and transparency
- Personnel Management - Recruitment of the right caliber of personnel and establishing effective motivational system
- Capability Building - Identifying capability building opportunities

- Networking
 - Establishing linkages with firms and other organizations

- Operational policies
 - Should be linked to government policy thrust.

Of the 35 Research and Technology Organizations in Nigeria, 25 were studied. (See Table 4.1 and Appendices 2 and 3 on pages 263 & 264).

REFERENCE

Aluko-Olokun, I. The Way Forward For Strengthening R&D Capacity-Building in Tertiary Institutions and Research Institutes. In, Research Capacity Building for Sustainable Development in Nigeria, Ed. Adeniyi, P. O., Unilag Consult, Lagos Nigeria. (1999).

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

To review the numerous literatures on the management of RTOs it is pertinent to consider the evolution of Research and Development (R & D) systems generally as being informed by societal demand for Science and Technology (S & T). Consequently, the social function of S&T is reviewed alongside the structure of management of RTOs, R&D management performance, impact orientation and restructuring. Furthermore issues relating to best practices for RTOs management are discussed in terms of concepts application, benefits and imperatives, including success stories.

In the introductory chapter, the development of R & D activities in Nigeria was discussed in terms of its historical perspective. This account gave an overview of the evolution of R & D system in the country and the structural deficiencies associated with it.

It could be recalled that the economy of Nigeria was built through concerted efforts in developing its agricultural and

forestry resources as well as solid mineral resources and energy. As time progressed, it was recognized that the future of the country depends to a considerable extent on developing and applying knowledge to the productive sector of the economy.

Technology has to be developed before the country's extensive resources could be tapped economically. This explains why the focus is on R & D institutions that will help to develop the natural resources, especially agricultural resources.

The Nigerian society and indeed policy makers are conscious of the significant role Science and Technology can play in the overall development and growth of the nation. Hence it is desirable to examine the social relevance of S & T in the context of national development.

2.2 SOCIAL FUNCTIONS OF SCIENCE AND TECHNOLOGY

Technology development has been strongly linked to the nature of a society. The level of awareness and appreciation of the importance of technology have influenced considerably, the development of most societies and countries of the world.

The perceptions of the influence of society on technology development give credence to the social function of science and technology in relation to the emergence of industrialized economy. The social function of science in relation to production has significantly influenced the industrialization process of most countries, both developed and developing ones.

In fact, the current trend in the development of manufacturing production and engineering could be linked to the form in which scientific institutions developed, mainly in advanced countries.

Scientific institutions in these countries were strongly linked to production through a network of engineering institutions and machinery manufacturers. This equally determined the types of research that the scientific institutions carried out. The society therefore, has significant influence over the development of science and technology including the choice and direction of research. The way the society and economy are organized affects scientific activities. A society that is uninformed of the benefits of science and technology to national growth and development cannot encourage the evolution of science and technology.

It is therefore, not the problem of building scientific and technological institutions; rather the society must have need for such institutions. If this need is not established, there is every possibility that new research institutions will perform the same way as the existing ones and therefore, may not have any bearing to development of production.

This implies that the society is expected to bring pressure on local research institutes so as to utilize the instrument of science and technology to bring about development. Cooper (1978: 3-4) observed that the lack of pressures on science from the local economy implies that the main determinants of research orientation are the individual decisions of research workers who unfortunately take their lead from international orientations of research. He further stated that the "scientific communities in less developed countries are output of advanced country's science with very limited links with the economic and social realities which surround them"

The absence of effective linkage between science and technology and social realities in less developed countries explains vividly the current structure of S & T development process. In essence, the evolution of S & T in these countries lacks two vital ingredients required for sustainable growth; these are production and societal awareness or pressures.

This scenario is typical of the Nigerian S&T development process.

Science and Technology activities in Nigeria are neither production-oriented nor society-determined. The social functions of S & T are therefore missing which invariably affect the direction and development process of science and technology.

It is obvious that production and societal needs are critical factors among others that shape the development of a scientific culture and institutional frameworks required for technological development. Without the culture and institutional framework, formulation of scientific policies will not be attained quite easily.

Globally and in most countries, irrespective of their level of development, governments have been deeply involved in the establishment of institutional frameworks for promotion of domestic capability. The institutional frameworks are Research and Technology Development Organizations. In Nigeria, where firms' level of research and development (R&D) is still at nascent stage, these institutions are often looked upon to play an important role in building up technological competence of the domestic industries. They

are equally believed to contribute to the National Innovation System (Nelson, 1993).

Recent developments worldwide have shown that greater responsibilities lie in the ability of these institutions to contribute to technological development of nations. As the world economy is currently undergoing reforms and changes, institutional approach to management of technology is equally changing. Research and Technology Organizations must therefore cope with the impact of the changing world, especially as it relates to globalization and its consequences of open economies, highly competitive markets, and trans-national flows of expertise, technologies and services.

Pradosh and Mrinalini (1999) observed that the performance and relevance of the research institutes in less developed countries have been under strong criticism for their activities not being geared fully towards addressing societal needs especially in industries. The concept of change in a dynamic world cannot be overemphasized. The realization that change is essential and desirable for the efficient and successful management of technology development institutions in Nigeria is imperative for national development (Abdullahi and Ajoku, 2001). Research and Technology Development organizations need to change their traditional management

approach in the discharge of their responsibilities to the society in order to be competitive, cost effective and client-driven. These are determinants for improvement and successful performance of RTOs depends on its success rate in the initiation and implementation of its programmes and projects with measurable impact. To this end, there is a need from time to time to evaluate their performance in order to determine if the institute is properly focused in the discharge of its responsibilities. This will help to keep track of its goals. It is pertinent also to note that the goals of the RTOs often shape the nature of their programmes and projects. The management of these programmes and projects is the critical function that determines their successful performance

2.3 STRUCTURE OF RTOs MANAGEMENT SYSTEM

The structure of research and technology organization's management system is reviewed from the following perspectives:

- * Organizational Structure - culture, environment mandates, missions, objectives and strategy.
- * Research Orientation - policy issues, planning process.

- * Funding Structure - programmes and projects
- * Linkage of research with production and;
- * Commercialization of research findings.

Management is the cornerstone of organizational effectiveness and is concerned with arrangements for carrying out organizational processes and the execution of work.

Peter Drucker, a renowned management expert, once observed that, "it is management that enables the organization to contribute a needed result to society and the economy and the individual".

Management is a complex and discursive subject and as such, it is not intended in this work, to go into details of the concept of management. Nevertheless, it should be appreciated that management relates to all activities an organization undertakes at different levels. This implies that management is a process common to all the functions carried out within an organization.

The overall responsibility of management is the attainment of the given objectives of the organization (Mullins 1996). These are end results the organization intends to achieve. Within

the framework of the objectives are policy guidelines for the operations and activities of the organization.

Naylor (1999) defined management as the process of achieving organizational objectives, within a changing environment, by balancing efficiency, effectiveness and equity, obtaining the most from limited resources, and working with and through other people.

Although there are various definitions of management, the above definition presents five key elements, which are pertinent to the objective of this study.

- Achieving organizational objectives. Objective is a target to be accomplished and organizations are more successful if they aim for outcomes that are both challenging and achievable.
- Within a changing environment; changing world outside an organization imposes new demands and problems. A key part of management function is to maintain an awareness of such changes and prepare responses to them.

- Balancing efficiency, effectiveness and equity. Efficiency is a measure of how well resources are transformed into outputs while effectiveness is the assessment of how far a stated objective is achieved.
- Equity is fairness to all. It is equally the distribution of outputs among recipients.

The 3Es (Efficiency, Effectiveness and Equity) form a changing choice for organizations.

- With and through other people; management is primarily a social process, often defined as “getting things done through people”.

In the course of the study, the RTOs will be assessed from the above five key elements of management. Specific organizational behaviours are examined to bring home the importance of organizational management to the overall performance and success of an RTO. Consequently, issues such as organizational effectiveness, culture, climate and change are briefly discussed. Before considering the above stated issues, it is worthy to look at ownership and features.

Ownership

Ownership of an organization presupposes that the owner will determine the goals and mode of conduct of businesses or activities. RTOs in Nigeria are public sector owned, that is, they are owned by governments. The public sector is a broad term covering a range of organizations in both manufacturing and service sectors. Public sectors share common problems such as the extent of state control over management decisions, levels of government spending and conflict of goals. The following features capture the nature of public sector organizations:

- Concerned with providing a service for the well being of the community rather than just of a commercial nature;
- The scale, variety and complexity of their operations,
- The difficulties in measuring standards of performance or services provided compared with profitability;
- The demand for uniformity of treatment and public accountability for their operations;

- Tendency towards more rigid personnel policies such as specific limitations on levels of authority and responsibility, etc.

These features often combine to result in increased bureaucracy in public sector organizations.

Weber (1964) viewed organizational development as constituting the development of bureaucracy enshrined in the belief of authority within organizations, the methods and principles of control and basis of decision – making and planning. It is believed that public sector organizations are often influenced by the ownership structure controlled by government and therefore influences the manner of conduct of business. Mandate or rules are laid down by government, which must be strictly obeyed. This situation creates rigidity among the organizations and does not give room for change.

Dunkerly (2001) noted that bureaucratic intransigence and red tape often appear as unnecessary problems and yet they frequently occur and are rarely overcome in an organization. Over time, bureaucratic structures result in bureaucratic dis-functioning, which arise from attempts by management to increase control in the organization. This might occur from

the need to assert power by management or to achieve greater efficiency.

Bureacracy slows down progress and hinders rapid response to changing environment of an organization.

Organizational Culture and Climate

Organizational culture is viewed as the product of goals, structure, ownership and size as well as company history, technology, its products marketing and environment (Salaman, 2001). It refers to those factors which enable us distinguish one organization from another and are the product of its history, management, operating environment, technology goals, etc Mullins (1996) described organizational structure in broad terms as “the collation of traditions, values, policies, believes and attitudes that constitute in pervasive context for everything an organization think and do”. Simply put, organizational culture is the way an organization conducts its activities. The culture and structure of an organization develops over time and in response to a complex set of factors.

Strong cultures are associated with those organizations where the guiding values of top management are clear and consistent and are widely shared by the employees. Such

cultures are typified by a set of strong values passed down by senior management.

The processes of creating positive organizational culture entail setting guidelines, which promote strong shared values, possibly with emphasis on enthusiasm, diligence, loyalty and service to customers.

Advocates of good organizational culture have come to relate it with success and performance of organizations. The main arguments surrounding organizational culture are that a particular culture can be created to enhance performance.

In essence, the general message of the organizational culture is that its values, beliefs, ethos, way of doing things influence its performance and that these elements could be actively manipulated by management (Hailey, 1999). This could be achieved through changing managerial style or the use of its communication mechanisms. The aim was for example that through a cultural change personnel would come to believe in the value of being close to the customer, management would believe in profitability through people and as such, both groups would display high level of "effective commitment to their employing organizations (Penley and Goulds, 1988).

In addition to organizational culture and arrangements for the execution of its processes management has a responsibility for creating a climate in which people are motivated to work willingly and effectively.

Succinctly put, organizational climate can be "said to relate to the prevailing atmosphere surrounding the organization to the level of morale, and to the strength of feelings or belonging, care and goodwill among members (Mullins, 1996).

Organizational Effectiveness and Performance

Concern for organizational effectiveness is a necessary requirement for organizational survival and relevance. To assess the effectiveness, or success of an organization is not an easy task, as it entails analyzing both the definitive structure and the one caused by human intervention (Mullins, 1996). The criteria for measuring success may differ from one type of organization to another. Success may be short-lived but one thing is central, that is, "the importance of achieving productive result through the effective management of people and their commitment to and involvement with the organization" (Mullins, 1996).

Organizational effectiveness leads to higher performance. Performance management is seen as an area of human resource management that can make the greatest impact on organizational performance. It is viewed as a key integrative mechanism, linking individuals' goals and responsibilities to the objectives of the business. It is equally viewed as a means of enhancing organizational control over employees, constructing a consistent statement of managerial expectations.

Performance management is usually conceptualized as consisting of three elements, viz, objective setting, formal performance evaluation and linkage between evaluation outcomes and development, including rewards in order to re-enforce desired behaviour (Storey and Sisson, 1993).

The findings from a field study further support the linkage between effective management and human resource management. Thamhain (2001) in a study on technology oriented R & D environment observed that effective management of innovative R & D teams involves a complex set of variables related to the task, people, and organizational environment. He reported that successful organizations, and their managers pay attention to the human side of management. Fostering a work-environment conducive to

innovative work, where people find the assignments challenging as well as leading to recognition and professional growth is desirable for organizational successful performance. Woodall and Winstanley (2000) also noted that it is universally recognized that organizational management is a vital ingredient in securing improved business performance. Performance of RTOs will be discussed more under R & D management.

Organizational Change

An organization can only perform effectively through interactions with the broader external environment in which it exist (Mullins, 1996). Factors such as uncertain economic conditions, fierce world competition, government patronage or intervention and developments in the field of technology create an increasingly volatile environment. To survive, an organization must be dynamic and responsive to change. An organization must at all times be prepared to face the demands of changing environment as the main pressure of change is from external forces. The organization therefore must give attention to its future development and success. The internal stakeholders have a role to play. The successful implementation of new work methods and practices is dependent upon the willing and effective cooperation of all staff.

For many organizations, the “old” ways of doing business simply cannot continue if they are to survive in today’s demanding society. Research and technology organizations over the years thrived and achieved fame by focusing efforts on their core competency – basically doing one thing and doing it very well. Here, emphasis is on structure, procedures and loyalty to the organization; hierarchical management structure in which responsibilities are assigned to specific areas of the organizational activities. The question that needs to be asked by RTOs is “to what extent should emphasis be placed on long –term survival or growth and development?”

Organizational Structure and Restructuring

The structure of an organization also influences the management direction and its focus.

Conventionally, the following levels of management structure have been identified in contemporary management literatures:

- The Board of Directors
- Top/Senior Management
- Middle – Level Management and
- Operational Management

In an organization, the board and top management are considered to be quite strategic to overall organizational management. These groups have the responsibility of giving direction and focus to the organization and therefore, are involved in the strategic management process. The onus rests on them to shape the objectives, strategies, policies and programmes of the organization. Also, they must have the competence to evaluate and control the organizational activities to ensure efficiency, productivity and satisfaction of clients' expectations and other stakeholders.

The Board

The Board of an organization should comprise people that can make positive contributions towards the achievement of organizational objectives (Ohaba, 2001). Appointments to Boards of RTOs have been based on some considerations, which might not be in their interest.

Ohaba (2001) reported that Board members were appointed in some organizations based on societal status, political patronage and other considerations regardless of limitations of knowledge of the specific functioning of the organization.

A well-constituted Board is expected to assess from time to time, the current performance in line with the organizational

goals, objectives, strategies and policies. Evaluation of performance is imperative in order to ensure that the organization is properly focused and its relevance to societal needs assured.

Top/Senior Management

The top management coordinates the daily organizational activities. It constitutes the core management team that will help to actualize the organizational objectives and develop appropriate strategies and policies. Teamwork is therefore desirable for organizational effectiveness. Drucker (1974) noted that " one-man top management is a major reason why businesses fail to grow".

In most RTOs the Chief Executive Officer (CEO) and Directors or Heads of Department constitute the top management structure.

An effective top management team is inevitable as an ineffective team, especially, one that its members operate through autonomous, sometimes mutually hostile side organizations can destroy innovation (Beer and Eisenstat 2000). These are described as "Silent Killers" which CEOs must be weary of and guard against. They constitute the dysfunctional organizational behaviour, deeply rooted,

largely unrecognized and seldom confronted. They severely limit organizational effectiveness.

The current downturn in RTOs' fortunes in the country provides a unique opportunity to examine its management practices and processes, because the hubris of good time breeds inefficiency.

It has been reported that in most RTOs' CEOs often find it difficult to make changes in the organizational structure and overall management practices (Perel, 2002). Perel observed that if a new CEO fails to make changes within the first six months on the job, it would be extremely difficult to do so. The reason is that within this period, everyone from top management to office assistants expects and is eager for change. It is also during this period that resistance to change is lowest because of apprehension about the unknown CEO. The CEO is not bound to past practices and as such can raise controversial issues, initiate new directions and realign people and organization at will. At this stage, he stands in a position to receive Board's support.

Reshaping an RTO requires the management team to define, accept and vigorously preserve the organizational culture within which breakthrough innovation can flourish (Perel,

2002). Organizational culture plays a major role in determining the extent to which collaborative and trust based groups processes can operate effectively within an organization (Adams and Adams, 1998). Effective and efficient management of RTOs with measurable impact can be achieved if CEOs, Boards of Directors and top Management significantly changes the way they perceive and commit to breakthrough innovation. Each group has a stake, CEOs and Boards are to provide courageous leadership, while top management are to support the CEOs in such a way as to engender courage.

CEOs must therefore, make innovation happen and should surround themselves with people capable of thinking better and smarter than themselves (Ackerman, 2000).

In the light of emerging realities in the field of management of RTOs, the need for organizational restructuring has been recognized. Salaman and Storey (2001) observed that organizational structuring and restructuring are fundamental to the idea of a strategic approach to managing human resources. A proliferation of new organizational forms has signaled a revolution in the management of organizations. There are numerous indications that very significant departures have been from the classical bureaucratic form.

New organizational structures have been the clearest manifest sign of radical change in human resource and business strategies. The underlying ideas and principles of the new organization include the emphasis on responsiveness, speed and flexibility; the primacy of knowledge, intellectual capital and hence learning.

Research Orientation

The various RTOs established by the Federal Government of Nigeria have enabling Decrees and or legislations to give legitimacy to their activities. It would therefore appear that each RTO has evolved its own policy, goals, objectives and strategies strictly tailored to the enabling Decree (Oke, 1999).

Many policies covering different sectors of the Nigerian economy have been put in place to guide the process of development. Science and technology policy which is aimed at directing and coordinating R & D towards meeting the needs of the society especially in the field of agriculture, industry, health, etc, has had chequered history of evolution in the country (Emovon, 1999).

Without solid S & T policy, industrial policy will be nothing but the promotion of commerce. Industrial policy requires increased productivity predicated on intensive research into

local raw materials as input to manufacturing and the acquisition of engineering design, fabrication skills as well as adaptation of modern technologies and machinery (Emovon, 1999).

Policy formulation has been recognized as a veritable component of organizational decision-making process. Irrespective of the level of its formulation, policy remains a pre-determined general guide established to provide direction in taking decisions (Ohaba, 2001).

A good policy framework must have vision and mission. It should be able to give the direction that research management should follow.

Apart from the vision and mission, a research philosophy or orientation is desirable. In addition, policies must have objectives, which will give insight into the anticipated achievement in their implementation.

Policies should be dynamic and should be reviewed, retooled and modified as newer opportunities and challenges manifest. Ohaba (2001) identified the need for policy towards S & T and R & D matters in Nigeria and the importance of a feasible

strategy to enforce research-to-commercialization or creation of wealth philosophy in the management of RTOs.

Research policy is lacking among RTOs in Nigeria (Ajoku, 2002). Because research policy is lacking, there are evidence that research planning is not seriously carried out, hence research priorities and targets are not set. Furthermore, little or no attention has been paid to the economic as opposed to the technical aspects of research projects. The conduct of research is hardly carried out in a systematic or comprehensive manner. All these factors combined to affect research orientation in the country.

Funding Structure

It has been recognized that in “today’s environment of shrinking fiscal resources and global interactions, more effective R & D management methods need to be established”. Some countries such as Canada through their Research Councils have responded to this growing need by applying a variety of strategic management tools to increase RTOs’ effectiveness.

The rapid decline in funding of RTOs in both developing and developed countries is affecting research orientation. Traditionally, these institutions were set up to assist in

industrial development and were fully supported with government funding. Many years of stagnation and unproductiveness has resulted to the increasing reduction in government funding. There is no doubt that RTOs that received more than half of their money directly from industry or in a manner that its use is controlled by industry become industry focused (WATRO, 1999). They conduct work that is respected and valued by industry and industry will support their continued existence. On the other hand, those that receive more than half of their money from government without any mechanism whereby industry directs or influences the work conducted are not valued by industry. This scenario explains why RTOs in developing countries cannot relate their activities with industries. Even when RTOs conduct research that could be relevant to industry, their findings are not considered to be of importance since the research had no industry support.

In Nigeria, government basically fund most of the research activities both at the university level and RTOs. Industry or private sector establishments have played a very limited role.

McDougal (1996) reported a similar situation prevalent in the province of Alberta in Canada. He associated this with the structure of the Canadian economy, which is significantly

influenced by high degree of foreign ownership of the industries, particularly, in capital-intensive natural resource development. Most of the research in this area that was funded by industry was done outside Canada.

Likewise in Nigeria, the multinational companies have not encouraged local R & D through funding support as their researches are carried out by their parent company outside the country.

Another dimension to the issue of funding of RTOs is the narrow structure created by their owners. Government policy and legislation establishing the RTOs, never encouraged them to source for fund outside government budgetary allocation. Current realities on the limitations of the government have made them to look for alternative source of funding. Some are presently running consultancy units, even though they are not well skilled in this area, as the funds are not rolling in as expected. R & D is often considered a weak voice, if indeed it has a voice at all. In most organizations corporate strategy is driven by financial performance and not technology.

In R & D organizations, budgets dictate behaviour more than innovation (Perel, 2002). R & D budgets are under constant pressure. As fiscal pressures are growing the new driving

force in research is accountability and value for funds expended. This requires priority setting and development of strategies to achieve priorities and indicators to assess and measure results.

Linkage of Research with Production and Commercialization of Findings

The historical process of development showed that research laboratory became the source of technological innovation only after scientists became interested in the inventions, which craftsmen and machine makers had developed. It is after this stage that entrepreneurs drew science into closer relationships with production as they began to invest in scientific research as a potential source of profit. This was the situation then, in developed countries until recently when research became the main source of innovation and improvement over inventions.

Cooper (1978) observed that the way scientific institutions were linked to production through a network of engineering institutions and machinery manufacturers, and the types of research they carry out are contingent upon the process of historic development of the industrialized market economies.

For research to be linked to production, the foundation must be laid through the societal demand for it. The society

therefore is a critical factor in determining the level of contribution of research to a productive economy. Scientific institutions in less developed countries do not have the same social role like those in developed countries. This implies that they are bound to serve different social purposes.

The inability of scientific institutions to contribute to development has been associated with underdevelopment (Cooper, 1978). However, it is believed in some quarters, that underdevelopment is a historically unique form of economic organization which cannot be related to development in the advanced countries.

Development in these countries is seen as the product of interaction between pre-capitalist economic forms and industrial capitalism. This situation is lacking in less developed countries, which invariably made scientific activities including research to be seen as a consumption rather than an investment. Based on this precept, it is argued that the dynamics of underdeveloped economy is responsible for the prevailing situation where local scientific institutions are alienated from production. As long as this situation prevails, these institutions will remain unproductive and not market-driven in the choice, implementation and management of their research programmes and projects.

This historical review of the inability of research to be linked with production has given an insight to the current problem of RTOs in Nigeria. It is obvious that the foundation was not laid from the on-set for research to be linked with production or to be market-driven.

RTOs exist in different contexts and are established for a wide variety of purposes (WAITRO 1999). These institutions are designed to play a significant role in closing the gap created by near absence of private sector of firms' level R & D. In other words, they are expected to contribute significantly to the up building of technological competence of domestic industries. Despite the high hopes and expectations placed on RTOs, their performances as well as relevance in recent times have been under strong criticisms (Pradosh and Mrinalini 1996). This is based on the fact that their R & D activities are not being geared towards meeting the needs of the industries and society at large.

Various studies on management of R & D have indicated the absence of close interaction between RTOs and industries, which is a major weakness in their activities. This weak link between industry and RTOs is well recognized (Araoz, 1994, Bell, 1993, and Rush, 1995).

The lack of closer linkage with industries has also been associated with the problem of organizational efficiency in understanding industry's need translating such needs to an R & D problem and having the right kind of trained personnel for undertaking R & D management and transferring R & D results to the production system (Pradosh and Mrinalini 1996).

Instituting the linkage has been found to be a difficult task since mutual benefit from such partnership is uncertain, intangible and not easy to assess. Pradosh in support of this view, observed that it is much more difficult in the condition of a typical developing country where R & D is not an integral part of the industrial culture and technology competitiveness is not the rule of the business (Pradosh and Mrinalini, 1996)

Furthermore, the problem of diverse business boundary and managerial environment is an important factor for consideration.

Bell (1993) in his study noted the prevalence in the work culture of RTOs, a kind of elitism as they are contended with government patronage. As far as accountability for their performance is concerned, they enjoy autonomy. Hence they are accountable only along the line of organizational hierarchy

and not to the users of their R & D results, supposedly industry.

It is important at this juncture to draw attention to the objective of pooled resources, infrastructure and skilled manpower for immediate use of industries, which informed the establishment of RTOs in less developed countries.

Unfortunately, the environment never encouraged the growth of RTOs, which negates the objective. In developed countries, RTOs grew incrementally on the basis of the objective conditions provided by growing technological competitiveness among industries (Bell, 1993). While imitating developed countries, less developed countries established RTOs based on the same organizational structure without similar objective.

Consequently, these institutes over the years preferred to define their R & D problems on their own without any formal or informal interaction with potential users (Pradosh and Mrinalini 1996). In fact, in some cases, half hearted efforts were made in transferring technologies developed in their laboratories to end-users. In Nigeria, the limited demand for R & D products is as a result of the structure of production in the country. The industrial Structure could be divided into a

sector dominated by foreign capital and are few by local capital.

The "Local sector" is often small and made up of production units many of which cannot rise above the craft stage.

The local sector undertakes no R & D and this had been attributed to the fact that it consists of small and medium size production units.

In view of this, there is a wide belief that R & D can only be carried out by large enterprises of the multinational type, possibly, due to factor of scale. However, in developed countries, this view is no longer tenable. Recent developments in industrial economies show that SMEs are R & D driven. There are reports showing that SMEs are not always surpassed by large firms in terms of percentage sales as a result of research.

The absence of effective linkage of research with production also explains to a significant extent, the inability of RTOs to commercialize their viable research results. Nnadi (2000) commenting on the need for establishment of mechanisms for effective transfer of research and development output from RTOs to domestic industries suggested that appropriate

linkages should be forged between researchers and industrial or commercial establishment in order to exploit valuable research results.

He further observed that the lack of interest by domestic industries in the research output of RTOs was associated with the strong preference for foreign technologies. This, he believed, explained why domestic industries are not keen to establish in-house R & D locally or patronize local RTOs. This situation informed why the local industries lack technological innovation culture and do not show interest in engaging quality scientific and engineering personnel.

The lack of confidence in the quality and competence of local "high level manpower", especially among foreign-based multinational companies affected the linkage between RTOs and domestic industries (Nnadi, 2000).

On the part of indigenously owned industries, the level of appreciation and response to the issue of collaboration with RTOs was associated with the level of education of local entrepreneurs as educated or professional elite entrepreneurs are more receptive than the lower class entrepreneurs (Nnadi, 2000).

Reviewing the commercialization of R & D outputs in Africa, Oragwu 2000) reported that a RTO established in Nigeria for instance, achieved relative degree of commercialization of their research output in the field of agriculture than in industry. This, he attributed to the involvement of end-users in the formulation of researches.

He suggested that for RTOs to achieve sustainable marketing and commercialization of research output, they must ensure the following:

- high quality research capacity
- high standard technological management ability and;
- well designed and purposeful professional marketing and technical information skills.

Furthering the discourse on the “local sector” factor, the Raw Materials Research and Development Council (RMRDC) in a nationwide survey in 1989 of the industrial sector, reported that the scope and intensity of local R & D were limited and inconsistent with the importance and contribution to Nigeria’s industrial output. In fact, the industrial sector contributes relatively little to the development of indigenous R & D

capacity and relies almost entirely on imported technologies (RMRDC, 1989).

It was also reported from the survey that poor record of commercialization of local R & D results which is traceable partly to the absence of routine interaction between researchers and industrial beneficiaries of research. From the preceding issues discussed, it is obvious that RTOs were established based on societal or political desire to address its technological needs. The society therefore, must have cultural and industrial characteristics in order to influence and shape the direction of RTO activities. These issues affect how an RTO is structured, how it operates and the marketing of its services (WAITRO, 1999). The outlet for RTO services is constituted by the clients, beneficiaries and funders. Also, RTOs were established through the actions of an ownership or mandating authority, often, Government, in the case of public RTOs. The management processes are therefore examined from two main perspectives, the internal and external processes.

The internal process embody issues such as governance, organizational management, project management, business development and RTO services. These process areas constitute the core of RTOs activities and serve as indices for

performance assessment. Other internal processes include financial management, personnel management and capability building. The external process entails RTOs external environment and its links with external agencies. The process areas include networking and government policies and programmes. These factors could be used to analyze the strength, weaknesses, opportunities and threats (SWOT) of RTOs.

2.4 RESEARCH AND DEVELOPMENT (R&D) MANAGEMENT

Before reviewing the R & D management process of RTOs, it is pertinent to briefly examine the historical development of R & D management. The essence of this historical review is to bring out in the proper perspective the evolutionary process of management of R & D and to place in the right context the stage at which less developed countries such as Nigeria have reached in the evolutionary ladder of R & D management.

Furthermore, other issues considered as RTOs activities such as governance, business development, organizational approach to R & D, capacity building, networking and marketing, as well as management information system shall equally be examined alongside the concept of best practices.

In discussing these critical areas, the limitations to research management shall be identified.

Historical Development

Globally, the management of public sector research as well as the RTOs has changed considerably in the past 30 years, which helped to drive development especially in developed countries. Within this period, the emphasis of research was no longer placed on individual researchers and their institutes, but rather on programmes and initiatives.

In a study carried out by Evaluation Associates in the United Kingdom (UK) on the development of the management of public sector research; they identified and defined three broad generations of research management to include;

- The Initiative Approach
- The Systematic Approach
- The Strategic Approach

These approaches constitute, the first, second and third generations of research management.

First Generation – Initiative Approach

The initiative approach to research management was built on the reputation and priorities of individual scientists.

Decision-making was often carried out through researchers peer networks. This implies that individual scientists were assigned significant role in decision-making. Some of the constraints of this approach include, absence of strategic frameworks, absence of monitoring and evaluation, lack of manpower planning and management of research funding, priorities were the exclusive preserve of scientists or researchers. Despite these constraints, appraisal and review were given considerable attention. It must be born in mind that traditionally, research management has been the domain of scientists and technologists (WAITRO, 1999). Unfortunately, the application of new management tools and techniques including measures for quality and productivity enhancement has not been central to the management of RTOs.

Second Generation – The Systematic Approach

The systematic approach is a second generation of research management. It is a transition phase between the first and third generation research management. This approach was formed by the creation of Research Councils, increased investment in research by government, stronger pressures for audit and accountability. This approach equally saw the birth of centre of excellence where emphasis on accountability and strategic initiatives, on which the operational activities of

RTOs were based. While the system remained managed by scientists, the pressure to account for expenditure and defend decisions, however, led to the development of a substantial administrative structure (Boddington, 1998). Also, emphasis was placed on strategic priorities, while funding of research became a matter of negotiation between researchers and governments, funders. Boddington in his study identified six prime characteristics of the systematic approach.

- a stronger emphasis on rigorous appraisal;
- detailed documentation and administration to ensure accountability;
- regular reviews and monitoring;
- hands on management of major projects and programmes;
- an increased emphasis on organizing scientific activity into programmes and institutes;
- strong manpower planning and extensive evaluation (from the mid – 1980s).

In addition, this approach promotes equity of decision-making, research quality and accountability among RTOs. Evaluation, which was a later inclusion, often takes place after research completion. Its impact on research management is

generally through lessons learnt, recommendations and feedback to researchers and managers.

Third Generation –The Strategic Approach

In the 1990s when the pressure on RTOs to perform increased in addition to continued pressure on research budgets, stronger emphasis was placed on “the concept of relevance and contribution of research to wealth creation”. (Evaluation Associate 2002: 1-2). RTOs were also requested to come up with strategies to reduce costs of administering research. This period heralded the “strategic approach” to management of research, which is termed as the third generation of research management.

The idea to restructure RTOs evolved as well as the creation of arms length government agencies and privatization of services and laboratories.

This emerging dimension to R & D management was more prominent in developed countries where there was a radical shift in funding research through the adoption of strategies that encourages scientists, Government and industry to go into agreement.

Consequently, management of research was being transformed away from domination by administration and peer review towards evaluative management based on verifiable objectives and output and outcome indicators (Boddington, 1998). In this context, research findings were seen as an “intervention” by government, and other funders with the intention of achieving a specific result.

It was this period that ushered in the business approach to research management. (WAITRO, 1999) in their land mark study on best practices to strengthen the capability of RTOs noted the recent emphasis on application of business principles in research management. This implies that research is managed as a “business and subject to the disciplines of business planning and performance measurement.’ (WAITRO 1999). The business approach to research management is well documented (Mc Dougall, 1996; Pieris 1996; Pradosh Mrinalini 1999, Bozeman and Rogers 2002).

The strategic approach emphasizes three basic concepts; partnership management, strategic management and evaluation management. Partnership management involves different stakeholders in defining research priorities and how to utilize the outcome. Consequently, “Scientific research was seen as a partnership between researchers, government and

industry and commerce" (Bozeman and Rogers, 2002.) Kumar and Kumar (1997) reported that public research organizations and laboratories in Canada established strong partnerships with government and the private sector, thereby strengthening the links in the Canadian innovation system.

The Centre for Promotion of Technology Management (CPTM) in South Africa in recognition of the evolving role of public and private sectors in economic management advocated for public – private sector technology management smart partnerships. In this regard, "the management is required to support and promote a culture of excellence in scientific and technological development and provide a regulatory and fiscal environment that promotes innovation, while the corporate sector takes the lead in ethical business practices that leads to wealth creation through the application of technology" (CPMT, 1997 unpublished paper)

Whichever perspective it is viewed, researchers under strategic approach were made to appreciate that the needs of industry and government are their legitimate concern, while the strength and diversity of the science base is a legitimate concern for both government and industry (Boddington, 1998).

This implies that in future, partnership management will lead to greater understanding by all the parties of each other's needs.

The strategic approach is equally evaluative as it approaches research management from evaluative methods such as foresight, benchmarking, appraisal and evaluation. Foresight encourages a consensus building process, which matches possible features in the science base with the desirable features for commerce, industry and government.

Benchmarking supports a comparative evaluation process used to identify best practice and performance, and to set benchmarks for expected performance.

Appraisal entails the assessment of specific proposals for policies, research projects, programmes and initiatives.

Evaluation supports rigorous, independent analysis of ongoing or completed activities including collecting performance data on achievement of objectives and impacts of research.

The three concepts of partnership management, strategic management and evaluative management are interwoven to justify performance.

From the historic account of the evolution of research management, it is obvious that in developed countries, research management has moved beyond the second generation to the third generation, while in most less developed countries, they are still battling with the first generation. Only few have transmitted to the second generation while still battling with the oddities of the first generation.

Management Processes

In discussing the management processes of RTOs in Nigeria, prominence is given to the issue of governance, services and business development, organization and approach to research, capacity building, networking and management information system.

Every identifiable functional aspects of RTOs management system such as governance, organizational management projects management, capacity building, networking, etc; must be structured in such a way as to enhance the ability of RTOs to meet the technological needs of their clients and the

society (WAITRO, 1999). Hence, the review of literature on the above aspects of this study of management processes is very central to accomplishment.

Governance

Recent studies have identified the lack of corporate courage as a factor hindering managing innovation in private and public sector research organizations. Perel (2002) observed that lack of courage by Chief Executives and Boards of Directors to embrace change or take a long-term view of their business is a major impediment to sustaining innovation today.

Courage is often confused with hard work and confident decision-making. Battlefield courage, no doubt is different from the courage needed to commit an organizations resources to a long-term effort where risks may be limited to loss of face if the investment fails (Perel, 2002). Where failure leads to a physical harm, courage means going beyond deterministic goal setting and the exercise of conventional management authority. This requires shedding the complacency of traditional, comforting ways of thinking and doing things. It also requires decisions and actions that actually accomplish something that few others are willing to try for fear of the consequence of failure.

In order to efficiently and effectively manage RTOs, the Chief Executives and Boards must have the courage to commit the human and material resources of the organization towards achieving the corporate goal. In this regard, the appointment of the chief executive must take into consideration managerial competence and also meritocracy. The organization must have mission and vision, which should be engraved in the minds of staff of the organization.

Organizations exist to achieve the objectives for which they were established. While pursuing their objectives they need not lose their mission and vision. Therefore, the attainment of such objectives, mission and vision should be the primary concern of management.

An approach to explain management success is through "strategic management leadership". It refers to excitement, passion and enthusiasm as a driving force, which energizes teams, unleashes talents and enhances management performance.

In management, high in spirit is the existence of constructive management cultures which encourage members to pursue goals enthusiastically, gain enjoyment from their work, be supportive of other members, be sensitive to the satisfaction

of their group and meet their higher other needs (Thamhain, 2001).

Members of management teams that are high in spirit are highly involved in management, demonstrate management commitment, feel gratified and fulfilled in management tasks and exhibit management satisfaction. Research organizations need a substantial degree of organizational and managerial flexibility in order to process gained experiences and new information and to meet the changing research objectives that evolve in the course of economic development.

Organizational processes and managerial practices play a strong role in determining R & D effectiveness and in making the delivery system more oriented towards client or market. While organizational processes are permanent and not prone to frequent changes, managerial practices are subject to changes as and when necessary by virtue of the organizational goals. An organization seeking for relevance within its operational environment must be interdependent as it changes the internal organizational diversity.

Governance requires among other issues, change and change requires courage. Instilling a climate that recognizes the critical need for innovation and encourages and rewards

innovative behaviour require a change in the mindset of many CEOs (Perel, 2002). R & D managers can and do play a significant contributory role with better framing of their research agenda in business terms. However, the ultimate responsibility for sustained managerial courage rests with the CEO and the Board of Directors. A courageous leader, backed by a courageous Board, will inspire a courageous organization (Perel, 2002). CEOs that are desirous to achieve performance success must personally create and sustain a corporate culture that encourages creativity and entrepreneurial behaviour which are the active ingredients for a market driven R & D.

Organization and Approach to Research

In order to promote, encourage, monitor and prioritize research activity, RTOs must develop an institutional research strategy. The strategy will entail the establishment of a Research Strategy Review Process. The strategic management of research activity is the operational responsibility of senior management team. Though the statutory responsibility for the promotion of research rests with the Board and the top management, the task of devising research policy and overseeing its implementation, rests with top management. RTOs must therefore, be conscious of the need to regularly review, evaluate and update their research strategy and activities.

Bozeman and Rogers (2002) in their study on strategic management of government-sponsored R & D, observed the need for regular review and evaluation of R & D strategy. They noted that R & D portfolio management is a dynamic decision process whereby a business list of active new product and R & D projects is constantly updated and revised. Through this process, new projects are evaluated, selected and prioritized, existing projects may be accelerated, killed or de-prioritized, and resources are allocated and reallocated to the active projects. Systematic and strategic R & D programme management is difficult to achieve in public sector research organization (Bozeman and Rogers, 2002).

The review process should be part of the strategic plan and conducted in a comprehensive way to include;

- the formation of a Research Staff forum which will be a quarterly or an annual event and should provide feedback to the review process.
- preparation of an annual and detailed audit and assessment reports on all research activities and inform management of the current strength and emerging areas.

- External researchers and experts could be engaged to provide input particularly in the assessment and prioritization process of research.
- The use of outcomes of the audit and assessment report to help the institute to identify priority areas for support from internal sources of funds.

This strategy will invariably ensure that the RTOs research strategy is focused and dynamic in approach. It is a process that fully takes account of internal and external factors and influences with the prime aim of ensuring that RTOs continue to develop quality research capabilities in areas of strategic importance and relevance.

A factor constraining strategic management of government R & D is that agencies are subject to external controls quite different from those emanating from the private sector environment. Agencies are subject to annual federal budget cycles, which is a severe limitation in R & D planning. RTOs that are under the supervision of a parent ministry must be attuned to the priorities of officials in the ministry hierarchy.

Government R & D has been reported to have multiple stakeholders, some of whom may have conflicting objectives

and preference functions. Evaluating government R & D is generally more difficult because of multiple objectives.

The management of R & D in public sector oftentimes has no clear notion of the desired output. Whereas, the private sector R & D evaluation is generally straight forward with the function of R & D being measured in terms of company's internal return on investment, the benefit of public sector sponsored R & D tend to be more diffused with respect to both type and impact (Bozeman and Rogers, 2002).

Bozeman and Rogers further more in their report suggested a balanced approach to R & D management in the public sector. They opined that government managers should consider the extent to which their projects produce both traditional output such as articles and patents, as well as provide contributions to scientific, technical and human capital, the growth of which makes discrete output possible. They concluded by observing that government R & D management unlike the private sector usually seeks public domain knowledge and technology products and thus, the analytical convenience of internal rate of return is not available to government managers. Also, most government funded R & D does not have commercial products and processes whereas the proof of success in industrial R & D is usually a product or commercial process.

Business Development and Networking

The issue of market drivenness of RTOs deserves elaboration, as it is currently a critical success factor in determining their performance. Network and performance have been described as synonymous, since through network, a firm internalizes the market within itself (Alchian and Demsetz, 1972).

Technology as it relates to knowledge, skills, procedures or processes and products is linked to both market and non-market settings. The recognition given to market setting as an important factor in the utilization of technology is quite elaborate (Ahrens, 2002). A technology that is developed without market for it or end-use need is no technology.

In the development of national innovation system, the marketability of technology or R & D products must be given adequate consideration, if measurable impact is to be made.

R&D investments are usually associated with substantial risks and information asymmetries may impede the effective functioning of markets (Ahrens, 2002). Consequently, market forces alone will under-provide technological innovation. A selective approach to support and induce indigenous technological efforts in adapting new technologies to local

conditions is desirable. This will equally strengthen the market-orientedness of technological development.

It is pertinent to stress here, the role of risk in the management of R & D as it differentiates public and private sector. Public sector R & D hardly permits the serious vetting process and flexibility reminiscent of private sector R & D. While private sector calculates risk in connection with product development and ultimately sales revenue, public sector projects are seldomly evaluated in this way (Bozman and Rogers, 2002).

Furthermore, Bozman and Rogers observed that the proof of success in industrial R & D is usually a product or commercial process. However, most government funded R & D do not have commercial products and processes to show. Indeed, the most often cited rationale for declining public sponsorship of R & D is that there is no market for the information produced from such research.

To think business-like in the management of R & D in the public sector consideration must be given to the expenditure on any particular development product vis-à-vis the anticipated benefits on revenue to be generated when the product is introduced to the market. Emphasis therefore, is placed on the technical risks, that is, if the product is a

marketable one and the market risks that is, if the product can be introduced to a suitable market niche in order to generate revenue.

Nevertheless, making R & D market driven in RTOs, presents some obvious organizational problems. Unlike private sector R & D public sector R & D present some problems associated with the synchronization of the business plan of the potential client industry and the R & D priorities of the RTOs as they are structurally and organizationally independent (Pradosh and Mrinalini, 1996).

To make R & D market driven, it implies that RTOs must have a suitable organizational structure that will create the necessary linkages with the client industry sector. This implies, establishing effective organizational linkage between RTOs and industries, which must take into consideration the difficulties involved, as their business orientation is different. To succeed in establishing an effective linkage, the RTOs must embark on organizational re-engineering as well as being business like.

In a competitive environment, which is the current trend in global economy, RTOs are expected to be market-oriented and competitive too. The principle of competition requires that

governments establish a market-oriented regulatory and legal framework to enhance competition among organizations of the innovation system. It is believed that through this process, inefficient organizations will be replaced by more efficient ones via a market-based selection process or continuous evaluation of organizations (Basant and Chandra, 2002). For this to happen, there must be in existence, sufficiently flexible network structures comprising government agencies, RTOs and private enterprises. Also, the existence of industrial or technology clusters enhances the opportunities for the creation of string business networks including scientific and technological collaborations (Kumar and Kumar 1997). Formal and internal networks, linking scientists and engineers in industry with those in RTOs constitute important channels for distribution of knowledge and business approach to R & D. Furthermore, in time of scarce public resources the principle of lean RTOs is applied, which seeks to avoid bureaucratic rigidities especially time-consuming administrative procedures that hinder fast achievement, utilization and commercial exploitation of research results (Ahrens, 2002).

RTOs are self-organizing entities that should not be evaluated according to formally correct administrative procedures but according to their research performance. The principle of

continuous evaluation holds that no organization should survive if it does not succeed in the market or lacks scientific technological reputation (Ahrens, 2002).

To achieve market drivenness in RTOs, public R & D efforts should be embedded in innovation production networks that link research institutions, industry and government. Marketing strategy for R & D entails marketing high-level competence in an industry market; such strategies must be very personal and based on long term relationship (network). Karlsen (1998) noted that R & D market is very personal, irrational and often times the customer's needs is very unclear. The barricades of acceptance of R & D have been found to be high among SMEs (Karlsen, 1998).

Pradosh and Mrinalini (1999) suggested that market orientedness of an RTO should be understood in terms of its organizational capability of internalizing the market by gaining privileged access to all kinds of assets and resources possibly through networking. This, they designated as the first principle of organizing an RTO in a market oriented way. Therefore, the importance of networking and good personal communication cannot be underestimated.

Capability Building and Project Management

Apart from market network, another critical issue is knowledge management. It has been recognized that there are limitations of individual human beings in accessing and processing information and converting such to knowledge and innovation. This development suggests that an organization must have an arrangement for processing acquired information to knowledge. Hence it must ensure that knowledge created within the organization, that is, those possessed by personnel or acquired through its network are utilized and transformed into innovation. This is called " the second principle of a value creating organization" (Pradosh and Mrinalini 1999). The concept of technology includes technical knowledge as well as institutional arrangements and skills, which are necessary to efficiently transform inputs into, output (Pack and Westphal, (1986). Many managers of Research and Technology Organizations are concerned about building up scientific and technical capability as well as producing discrete impacts (that is, product or process development) from particular projects.

This approach leads to different assumptions about programme management and to a different extent, R & D approach. If an RTO seeks to develop an R & D portfolio based on capability building, then the production function

will be improvements in scientific and technical human capital. This could be used to measure the performance of the RTO and its contribution to intellectual capital and overall development to the national innovation system.

Intellectual capital, which comprise intangible assets, including employee knowledge, patents and research is rapidly entering mainstream use as an effective tool to increase organizational competitiveness (Bogan and English, 2002). Also, scientific and technical human capital has been identified to be integral components of the Intellectual capital. Bogan and Rogers (2002) described scientific and technical human capital to include the formal educational endowments usually encompassed in traditional human capital concepts, but also, the skills, know-how's "facit knowledge" and experimental knowledge in individual scientists. Scientific and technical human capital, they further observed, is the sum total of scientific, technical, and social knowledge and skills embodied in a particular individual. In other words, it is the unique set of resources that the individual brings to his or her work and to collaborative efforts. This implies also, that in the knowledge of how to manage a project, a team of junior researchers or project officers is part of scientific and technical human capital. Furthermore, knowledge of the expertise of

other scientists and their willingness to share it is part of scientific and technical human capital.

Organizations therefore, develop systems that support best practices knowledge culture by focusing on primary activities such as education or training, communications, rewards and recognition and employee development (Bogan and English, 2002). Scientists and engineers should receive training in order to develop management skills that are needed for project development, management and technology commercialization efforts. RTOs could collaborate among themselves and with industry in developing a series of targeted courses for scientists and engineers on various aspects of technology transfer including entrepreneurship (Kumar and Kumar, 1997).

Management Information System

In many developing countries, the operational data required for effective planning in research organizations is very weak or in some cases, not available. Research activities were not adequately documented and information of breakthroughs and other achievements were equally not properly kept for easy reference. Independent assessment of activities in RTOs showed that they lack information on the activities of each other. Abdullahi and Ajoku (1998) reported that scientists in

Research Institutions and Universities in Africa do not know what each other is doing and therefore reaffirm the need for prompt and more reliable information on research activities.

Information storage on operational activities of RTOs is very poor and often limited to the filing system with the attendant difficulties of data accessibility and retrieval.

Information resource management is desirable for effective management of an organization as information or data like labour, capital and raw materials need to be managed efficiently and effectively.

Data is one of the most valuable resources of any organization. Without data and ability to process it, an organization would not be able to manage its activities very well. A lot of RTOs generate scientific and technical information, which are not usually kept properly and processed further for use in planning and decision-making. The use of data to produce an output in the form of information helps people to take decisions and plan well. When information is used by an organization in taking decisions, it is called management information. To effectively keep track of management information generated in an

organization, a data base system is needed. This system is called management information system.

New trends in corporate management have identified that for years; huge corporate databases are the lifeblood for today's large profit and non-profit organizations (Abdullahi and Ajoku, 1998). These databases provide necessary information required for effective and efficient control of operations by managers and executives.

2.5 RTOs PERFORMANCE AND IMPACT ORIENTATION

Performance of RTOs has been a growing issue of local and international concern. The need for them to contribute significantly to the economic development of nations, especially developing countries is assuming considerable dimensions. This in turn, has induced pressures on RTOs to perform or become irrelevant to the overall development process.

The current emphasis on managing change has presented further challenges in ensuring the adoption of new processes, and better techniques that will enhance organizational performance and encourage competitiveness.

Consequently, RTOs must cope with the impact of globalization and its consequences of open economies, highly competitive market and trans-national flows of expertise, technologies and services (WAITRO, 1999).

The pace of change is so rapid that no single organization can ever claim to have overall effective operating practices and good ideas. To be in the forefront of science and technology developments, an RTO must look inward as well as outward for constant improvement and new ideas.

Although the expectation of government and perhaps, the public are deep rooted in applied research, which should bring about industrial development and economic growth, most RTOs are engrossed in pursuit of basic research. Their work was often measured in terms of the number and quality of their publications, which could not be related to contributions to industrial development or greater linkage with the productive sector of the economy. There is no doubt that this situation is responsible for the declining interest of government funders and possibly the reduced budgetary support to RTOs. Given the above scenario, it is obvious that irrespective of government policies, industries cannot attain their full potentials in less developed countries if there are no improvements in their ability to access, absorb, adapt and

exploit new technologies and business techniques. For this to happen, RTOs must improve in their management practices and efficiency of their services. To this end, performance standards must be set, its realization monitored and evaluated.

RTOs have the compelling need to establish performance-reporting standards in order to meet the varied and changing information requirements of public and private funders and other users of performance information such as clients, management and staff. The standard of reporting though not the same as standard of performance, are intended to contribute to both better accountability and organizational performance. (Cutt and Murray, 2000). They provide a framework for the next logical stage, which would be the development of criteria of success.

Measuring the performance of an organization had been associated in the past with financial success or profitability from product development (Baguley, 1994). The money measures used in the past of which some are currently being used include, return on investment, liquidity, payback period, discounted cash flow, indirect costs and others. In a non-profit making organization such as RTOs, these money measures might not be used to determine their performance.

In fact, these financial measures are increasingly seen as inward looking and more concerned with resource utilization rather than satisfying customers or client need (Baguley, 1994).

Accountability conventions treat R & D as an expense and not an investment (Boer, 1999). Even, a more fundamental issue is that past financial performance is not a reliable guide to future performance. For industrial R & D financial thinking about R&D has evolved well beyond basic discounted cash flow models (Boer, 2002).

Performance measurement in public research organizations is difficult to carry out, as there are no established performance standards. Unlike the private research organizations where new processes or products with measurable profit indices could be used to measure performance, public sector research organizations do not have such indices.

However, there are indications of the use of certain variables such as productivity, which could include the number of referred publications, citations in the literature, persons trained and qualitative narratives that evaluate the scientific excellence, relevance, dissemination of project results to assess the performance of RTOs.

In addition to the use of the above discrete outputs, percentage earnings from industry support services to overall operational expenditure are used to determine the performance. Furthermore, the numbers of contract-based research earnings are equally used.

Performance of RTOs could be associated with the environment in which they operate. The organization, which learns from interaction with its environment is of course an organization that is continually adapting and improving its performance (Baguley, 1994).

Baguley (1994) further noted that the performance of an organization is not only compared to the best which it has achieved elsewhere. The "best performance" therefore serves as a "bench mark" against which an organization's performance improvement is measured.

The concept of best performance necessitates discussion on "best practices." Since it is these practices, which are considered "best" that determine the overall performance measurement, it is pertinent to examine briefly the concept of best practices. The application of benchmarking in order to identify best management practices for RTOs would provide

them with the knowledge needed to help improve their performance.

Best practices benchmarking can be described as the process of seeking out and studying the best internal and external practices that produce superior performance. The performance can be measured through various financial and non-financial performance indicators. Benchmarking uses multiple evaluation criteria as a way of measuring the capacity of an RTO to compete in its domain. The criteria include long-term vision, mission, strategy, customer orientation, staff satisfaction, training policies, research abilities, etc. Other measurements include client satisfaction, market share, staff loyalty, financial ratios, productivity and overall performance. These measurements are used to compare with those of other organizations in the sector in order to discover the best practices adopted by the leading RTOs in the sector. Having reviewed the importance of identifying and promoting best practices in an organization, it is pertinent to note the limitations of best practices benchmarking.

In applying benchmarking tools, it is necessary to be sensitive and objective. The problem of evaluating an RTO for instance, in Africa and a European or North American RTO in

the same field within the same set of parameters, present issues for consideration. Since the settings are not the same, it is difficult for RTOs in less developed countries with obvious limitations to emulate those in developed countries in all aspects of their operations.

The thinking that best practices is the best strategy for better management of organizations has been criticized. Cutt and Murray, (2000) reported that the belief among management experts and researchers that certain practices work better than others, thereby producing more successful outcomes is no longer tenable. They observed that years of research have failed to prove conclusively that these “best practices” actually produce the result claimed for them over long periods of time and across different organizations.

This implies that best practices exist within certain context such as personal, historical, cultural, economic, political or technological. (Cutt and Murray, 2000). They therefore, concluded that the one universal “best practices” is a commitment to developing information system that reveals when improvements are effective for that particular situation. In summary, there is a relationship between the society, technology development and the economy. The society should have a considerable amount of influence on the

development of science and technology, including the choice and direction of research.

However, there seem to be no societal demand on the local research institutes for the utilization of the instruments of science and technology to enhance development in less developed countries.

Furthermore, the research institutes on the other hand, do not as a matter of deliberate policy, relate to the society to determine the direction of research.

The inability of research and technology organizations to properly articulate their policies and programmes in order to effectively discharge their responsibilities to the society is due to poor management of their human and material resources, the improvement of which is critical to their overall success.

Therefore the management systems of RTOs must be reviewed from time to time with a view to ensuring that they are properly focused and achieve their stated objectives. Particular attention must be paid to areas such as organizational structure encompassing culture, environment, mandates, mission, objectives and strategy; research orientation which involves policy issues and planning

process; funding structure; linking of research with production. Research efforts should be geared towards solving problems of production for the benefit of all members of the society.

Another area within the management system, which must be looked at, is the commercialization of research findings, which should bring the products of research to the national and international market place to better the economy and enhance the growth in the nation's gross domestic product (GDP).

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In pursuant of this study, preliminary steps were taken to explore a wide variety of sources of information and data, which formed the background for the review of literature on the subject matter of research interest.

To this end, efforts were made to scan available literatures on management of research and technology organizations. It is through the literature review that considerable numbers of inquiries were made to determine the target respondents, which formed a critical input to the study.

The list of target respondents consisted of role model R & D institutions, first generation technology business incubators and emerging ones in Nigeria.

This chapter therefore, aims at briefly examining the various strategies and techniques of realizing the goals and objectives of the study. It is hoped that through the methods that were adopted the progress made as well as limitations to effective

contribution to the growth of Nigerian economy by Research and Technology Organizations will be elucidated.

Concerted effort is made to give vivid explanation to the various processes adopted in sourcing for data, information or research materials. In addition, various sources of data and techniques used in extracting information are equally highlighted.

The findings and interpretations are analyzed using standard and simple statistical methods in addition to descriptive methods of data analysis.

Citation analysis was carried out based on the practice of including lists of references to previous work at the end of the report.

3.2 RESEARCH DESIGN

Research design is desirable for the prime purpose of data collection that will assist in addressing pertinent research questions and test the hypothesis earlier stated on the introductory chapter.

In essence, research design is “the structuring of investigation aimed at identifying variables and their relationship.”

It serves as a useful guide to generation of data from the study. Through research design primary data are generated. The types of research design used are survey and ex-post facto design. The decision to use these designs stems from the fact that the survey focused on sample population of RTO. Also, it was as a result of the fact that information exist already on the management performance of RTOs over the years. This implies that part of the study was retrospective and existing data were utilized.

The survey methods considered quite pertinent and used for the study are the questionnaires and face-to-face interviews. The use of questionnaires, is an excellent method of collecting quantitative data. Consequently, they were designed in such a way as to ensure accurate capture of data and high response rate.

Interviews were conducted using semi-structured interview schedule and where desirable, separate interview schedules were prepared for different types of respondents.

In all cases, interviews focused on qualitative aspects of technology management. Attempts were made to extract as much information as possible on what worked and did not

work for the organization and the challenges currently being faced.

3.3 CHARACTERISTICS OF THE STUDY POPULATION

In designing the questionnaire cognizance was taken of the nature of the population studied, as it is institution specific.

The characteristics of the population were determined in order to exclude non-relevant respondents who are equally an integral part of the overall population.

For this study, the classes of respondents included R & D Managers in RTOs, Chief Executive Officers, (CEOs) and centre managers of Technology Business Incubators in Nigeria. There are 35 RTOs, which constitute the population. The project fieldwork was therefore, conducted in twenty-five (25) RTOs spread in 36 states of the Federation of Nigeria. The RTOs are located both in urban and sub-urban centres. The lists of the RTOs are presented in Appendix 1, 2 and 3.

The choice of these core RTOs for the study is based on their field of coverage, which include agriculture, industrial, science, and technology and enterprise development. The size of the sample is 100, which is considered as a fair representation of the characteristic of the representation of

RTOs in Nigeria. The unit of study or what constitutes the population from which the sample was drawn are the senior management staff of RTOs, both technical and non-technical staff.

It is pertinent to remark that the reasons for sampling the RTOs is to reduce within manageable level the expense and time consuming nature of studying all the RTOs in Nigeria.

It is important to note that all the RTOs are government-owned.

3.4 PRIMARY AND SECONDARY DATA COLLECTION

Primary Source of Data

In the preceding section, attempt was made to briefly present an insight to the design methodology emphasizing on the use of survey techniques for data gathering.

The primary data were obtained through the use of questionnaires and in-depth interviews. The questionnaires were designed to contain limited number of sample questions carefully chosen to address the problems under study. It therefore, contained a mix of open-ended and close questions.

The essence of the open-ended questions was to create some level of freedom of expression of views and opinions without hindrance or reservation, thereby guaranteeing unbiased or restricted supply of information or data. On the other hand, the close-ended questions are designed to guide the respondents in order to supply only the relevant answers and information for the study.

The questionnaire therefore sought brief profile data on each RTO including their management capabilities. This allowed for the opportunity to place in proper context the RTOs management capabilities and strategies and to compare differences between institutions. Other questions sought quantitative and qualitative data on the impact of management. The questionnaires were in some cases personally administered and collected. In addition, resource persons were engaged to assist in administering and retrieving the questionnaires. Of the 100 questionnaires distributed, 56 were retrieved given a 56% retrieval rate, which is considered fair considering the negative attitude to responding to questionnaires in this part of the world. Sample questionnaire is presented as Appendix 1.

Apart from the questionnaires, the use of interviews was adopted to assist in gathering valid and reliable data relevant

to the research questions and objectives. Semi-structured interviews were used to explore and explain themes, which emerged from the use of questionnaires. Also, they formed the basis to validate findings from the use of questionnaires.

In using the semi structured interviews, a list of themes and questions was drawn for RTOs to address the following:-

- Respondents (RTOs) were asked to describe how they undertake a wide variety of research management functions from project conception, acceptance, implementation, management through to commercialization.
- Respondents were asked to assess how their institutions performed in various aspects of research management and which factors they considered as the most significant challenges to effective management in their environment.
- They were also, asked to give details of the units or department(s) or individuals responsible for commercialization and linkages with industry.

- Respondents were also asked to indicate how much knowledge of funding opportunities outside government budget, which are available for R&D.

Furthermore, open and probing questions such as listed hereunder were asked as the case may be to encourage respondents provide extensive and developmental answers.

- Given the reasons adduced “that non-performance of RTOs in Nigeria is associated in part with research output not being relevant to the needs of potential clients,” what factors are predisposed to this?.
- Please comment on the observation “that lack of better management capabilities or skills among senior management staff including R & D managers is responsible for the poor performance of RTOs”
- What in your opinion do RTOs that need to do to improve on their performance and contribute to the national system of innovation?
- What are the constraints outside RTOs that prevent them from achieving their full potential?

The process of using the semi-structured interviews therefore offered immense opportunity for social interaction with the respondents and also explanations to the questions, asked.

Secondary Source of Data

In recognition of the importance of re-analysing data that have been collected already for some other relevant purposes, secondary source of data was explored. There is no doubt that secondary data can provide a useful source from which to answer the research questions. So a combination of primary and secondary source, of data was considered desirable in achieving the goals of the study. The secondary data accessed included raw data and published summaries.

The choice of secondary data to access was guided by the research questions, objectives and the literatures reviewed.

Also, the study benefited extensively from accessing data via the Internet. Data on the Internet was located using search tools, which made it possible to locate data using key words associated with the research questions or objectives.

Project records and documents in the RTOs studied were examined in order to extract useful data and information. Project records often give account of the nature, frequency

and effects of activities embarked on during project implementation. The researcher was mindful of the problems of projects records or secondary data in general, which is associated with lack of comprehensiveness, in some instances.

3.5 VALIDITY AND RELIABILITY OF RESEARCH STUDY

Mindful of the credibility of research findings, considerable attention was given to the reliability and validity of research design. Therefore, in planning for the study, issues such as subject error and subject bias were considered to be factors that could affect the study.

To address the issues of subject error efforts were made to ensure that the questionnaire completed will not generate much different results at different times.

For the subject bias, the researcher was aware that in some organizations, information dissemination is highly restricted as a result of fear or threat of unemployment, insecurity and as such anonymity of respondents to questionnaires was maintained. Validity, which is concerned with whether the findings are really about what they appear to be, was noted. Consequently attention was paid to relationship between variables to ascertain if they are causal relationship or not before inferences were made.

Ambiguity about causal relationship was excluded as much as possible.

For secondary data used, a critical assessment of the validity and reliability was made which involved an assessment of the methods used to collect the data where the information is available. In addition, the process by which the data were selected and collected or recorded was evaluated.

3.6 DATA ANALYSIS

Data collected can be presented in qualitative or quantitative form, thereby making interpretation of findings much easier.

Data analysis therefore, implies that quantitative and qualitative information derived from the study are broken down in an understandable format. Trends and pattern of associations and relationships among variables contained in the data were established.

It is only in this form that the information can be interpreted or inferences drawn as well as conclusions made. It is against this background that data analysis is considered quite critical to the study. The basic method employed for the analysis of the data collected for the study is descriptive analysis.

Quantitative descriptive analysis was used to summarize the enormous information or data generated in the study to enable appropriate analytical methods be used to analyze the relationship between variables.

In this regard, statistical instruments were used to analyze data. Statistical tools such as pie chart, bar chart, tables and percentage distributions were used as well as Chi-square test.

3.7 LIMITATIONS OF THE STUDY

Irrespective of the efforts made in carrying out the study based on the above research methodology, there are limitations to the procedures adopted. Some of these have been mentioned in the preceding sections. The sampling from a population and design of the study schedule, presents some unforeseen imperfections, which might be attributed to extraneous circumstances beyond the control of the researcher. Nevertheless, concerted efforts were made to ensure that limitations were reduced to the barest minimum.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.1 RESPONSES TO QUESTIONNAIRES

The survey carried out on research and Technology Organizations (RTOs) in Nigeria encompassed a detailed look at the practice of management of RTOs covering organizational, project, business management and services as well as corporate governance.

In this chapter, attempt was made to analyze the findings from the responses to the questionnaires used in the survey as well as the in-depth interviews. Preliminary models developed for the management practices and findings assisted in discussing their current practices and what is tenable elsewhere in the world. By this act, a partial best practices analysis is carried out. Also, stakeholders' analysis is undertaken through the interviews conducted. Key questions were addressed to randomly selected senior management staff of RTOs and their responses formed the basis for stakeholder's analysis in order to determine their strengths weaknesses and disposition to change.

Apart from the assessment of management practices of RTOs, the respondents were asked to assess their institution's performance in various aspects of research management and identify the factors that they regard as the most significant challenges or obstacles to effective research management.

In order to determine the response rate and the margin of error of the sampling, steps were taken to calculate the response rate. Using the formula stated below, the response rate was thus (1) determined:

$$\text{Response Rate} = \frac{\text{Total No. of Responses} \times 100}{\text{Total No. of Sample} - \text{ineligible/}}$$

Given No. of Sampled

RTOs = 25

Responses Received = 18

Ineligible/ = 6

Invalid 1

Response Rate = $\frac{18 \times 100}{25-6}$

= 94.7% \approx 95%

Margin of Error = 5%

To validate the sample size, the following calculations were carried out. The assumed sample size is 25 RTOs, while the response rate is 95%.

$$\begin{aligned} \text{Actual sample size (N)} &= \frac{n \times 100}{re \%} \\ n = \text{min. sample size} &= 25 \\ re = \text{estimated response rate} &= 95\% \\ \text{Actual sample} &= \frac{25 \times 100}{95} \\ \text{Size (N}^a) &= 26 \end{aligned}$$

Responses received from 18 out of 25 RTOs surveyed in Nigeria were further analyzed.

The sample size of 25 is within the confidence level of actual sample size of 26. Based on the sample size of 25 relative to population of 35 RTOs in Nigeria, a sampling fraction of 71% was calculated. Therefore, the marginal error in sampling will be $71 \pm 5\%$.

The RTOs under the Federal Ministry of Health did not respond to the questionnaire while the Federal Ministry of Industry had no RTO under its supervision.

The major RTOs in the country identified are listed in Table 4.1

TABLE 4.1 LIST OF MAJOR RESEARCH AND TECHNOLOGY ORGANISATIONS IN NIGERIA

S/N	Name of Institution	Location	Functions
	A. <u>Science and Technology</u>		
1.	Federal Institute of Industrial Research Oshodi (FIIRO), Lagos.	Lagos	Research and development into food processing, agro allied, textiles pulp and paper, design and fabrication of prototypes micro-electronics and information services
2.	National Office for Technology Acquisition and Promotion (NOTAP), Abuja	Abuja	Vetting registration and monitoring technology transfer agreements, documentation innovations and inventions and promotion of intellectual property rights.
3.	National Research Institute for Chemical Technology (NARICT) Zaria	Zaria	Research into industrial chemicals, polymers and plastics, hides and skins including leather and leather products
4.	Nigerian Building and Road Research Institute, Abuja	Abuja	Research into engineering materials and the use of local materials and methods in road and building construction.
5.	Project Development Institute (PRODA), Enugu	Enugu	Research into engineering design and fabrication, ceramic products, electrical and electronics products; energy, including coal

6.	Raw Materials Research and Development Council (RMRDC), Abuja	Abuja	Support and expedite industrial development and self reliance through the maximum utilisation of local raw materials as inputs for the industries.
7.	Nigerian Institute for Trypanosomiasis Research (NITR), Kaduna	Kaduna	Research into tsetse and simulum flies and diagnostic methods on the control of onchoereciasis and trypanosomiasis.
8.	National Agency for Science, and Engineering Infrastructure (NASENI), Abuja	Abuja	Research into engineering infrastructure development
9.	Nigerian Stored Products Research Institute (NSPRS), Ilorin	Ilorin	Research into stored and preservation systems for agricultural produce.
10.	Scientific Equipment Development Institute	Enugu & Minna	Equipment development, glass wares fabrication.
11.	Technology Business Incubators.	Aba, Nnewi, Lagos & Kano.	Incubating small business in order to commercialize research results, inventions and process innovations.
12.	Regional Program for Technology Management	Lagos	Human resource development in Technology management
13.	National Centre for Technology Management	Ile-Ife	Training of Technology Managers.
	B. <u>Agricultural Sciences</u>		
14.	Agricultural Extension and liaison Services (AERLS).	Zaria	Overall planning and coordination of all agricultural extension; specialist support activities in crops, livestock,

			fisheries, forestry irrigation, agric engineering and food technology, collation and dissemination of agric. innovations to states extension services.
15.	Cocoa Research Institute of Nigeria (CRIN) Onigambari	Ibadan	Research in cocoa, kola cashew, coffee and tea.
16.	Forestry Research Institute of Nigeria (FRIN)	Ibadan	Research into natural forests, plantations, wood products and wild life.
17.	Institute for Agricultural Research (IAR)	Zaria	Research into (a) genetic improvement of sorghum, groundnut, cowpea, cotton and sunflower, (b) farming systems research and extension covering Northwestern Nigeria.
18.	National Animal Production Research Institute (NAPRI)	Zaria	Research into cattle, goats' sheep and poultry as well as into animal feeds and exotic breeds.
19.	Institute for Agricultural Research and Training (IAR &T)	Ibadan	Research into maize, kenaf, jute and soil sciences.
20.	Lake Chad Research Institute (LCRI)	Maidu- guri	Variety improvement of wheat and barley. Improvement of farming systems and all agricultural crops.
21.	National Institute for Freshwater Fisheries Research (NIFFR)	New Bussa	Research into fresh water fisheries and other aquatic resources in rivers, natural and man-made lakes.

22.	National Root Crops Research Institute (NRCRI)	Umudike	(a) Research into yams, cassava, cocoyam, Irish Potatoes and ginger. (b) farming systems research and extension covering the South-Eastern Agricultural zone.
23.	National Veterinary Research Institute (NVRI)	VOM, Jos	Research into livestock diseases and their control including the production of vaccines and sera.
24.	Nigeria Institute for Oceanography and Marine Research (NIOMR),	Lagos	Research into the geographical phenomena of the Nigerian ocean bed and the contiguous landmass, research on marine and brackish water fisheries and oceanography.
25.	Nigerian Institute for Oil Palm Research (NIFOR)	Benin	Research into oil palm coconut, raffia palm and ornamental palms and dates
26.	Rubber Research Institute of Nigeria (RRIN)	Benin	Research into natural rubber and its by products.
27.	National Horticultural Research Institute (NIHORT)	Ibadan	Research into fruits vegetables, their processing and preservation and development of indigenous ornamentals.
28	National Cereals Research Institute (NCRI)	Bida	Research into rice, soyabeans, beniseed and sugar cane.

Source: Momah S. (1997)

The analysis and distribution pattern of the RTOs that responded to the questionnaire is represented in Table 4.2 and Figure 4.1 respectively.

S/N	Category of Institutions	No. of Institutions	No. of Respondents	Percentage (%) Respondents
1.	Agric RTOs	5	31	55.4
2.	Science & Technology RTOs	12	21	37.5
3.	Environment RTOs	1	4	7.1
	Total	18	56	100

Table 4.2 Category of RTOs responding to questionnaire

Their distribution is shown in figure 4.1, which is considered a fair spread covering agricultural research institutes, science and technology research organizations and environmentally related research institutions.

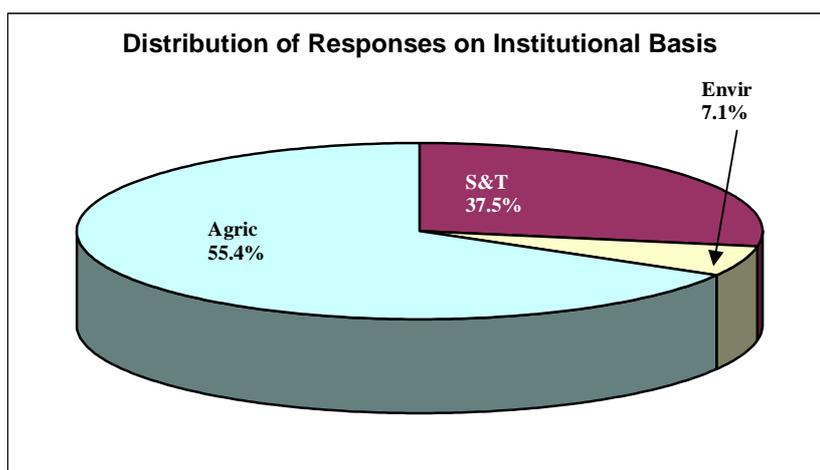


Figure 4.1: Distribution of responses on institutional basis

Of the five institutes with mandates in agricultural research that responded, a total of 31 questionnaires were completed, which is a percentage response of 55.4%.

For Science and Technology (S & T) related organizations, 12 institutions responded with a total of 21 questionnaires retrieved, which gives a percentage response of 37.5%. Further analysis of the respondents with S & T mandates, shows that 8 were from core science based research and management development, 4 Industrial research and 9 technology business incubators.

Generally, more questionnaires were retrieved from the agricultural research institutions, despite the fewer number of institutions that responded.

The converse is the case with the science and technology institutions, as more institutions responded with very few questionnaires returned. Some institutions returned one questionnaire, while others returned more than one. The low response from the research institute(s) in the environmental sector is a reflection of the number of such institution(s) within the sector.

4.2 MANAGEMENT PRACTICES OF RTOs

What is the nature of management practices of RTOs in Nigeria when viewed from the perspective of governance, financial management, services, business development organizational management, project management, capacity building, personnel management, networking, policy and programmes.

GOVERNANCE

Ownership Structure

Respondents were asked to give details of the ownership structure and legal status of their organization. Two classes of ownership were identified, government and private sector (Figure 4.2), Government has the major owner and determines the legal structure of RTOs through its agencies (Figure 4.3).

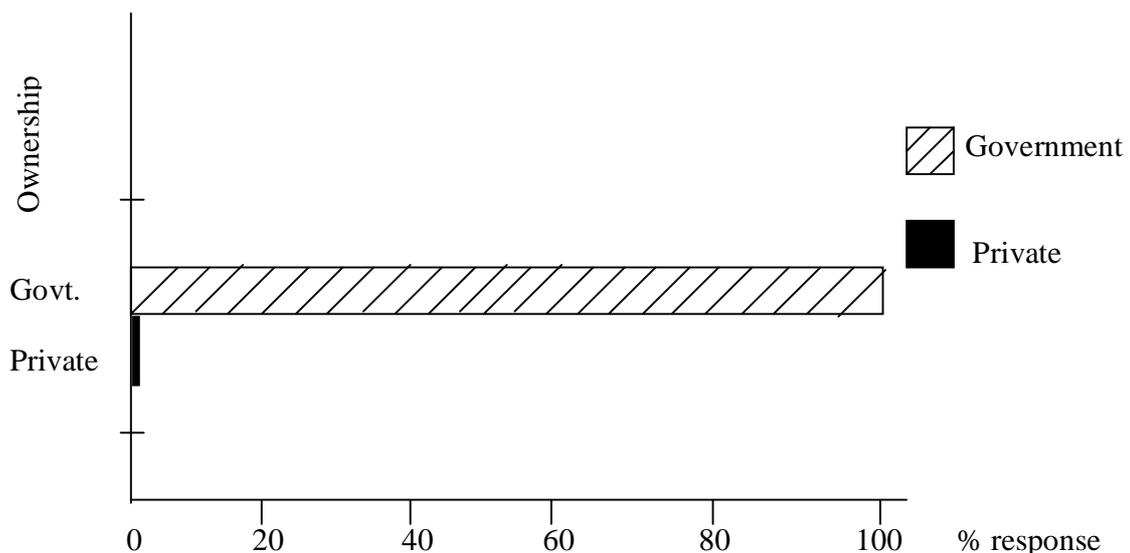


Figure 4.2 Ownership of RTOs in Nigeria

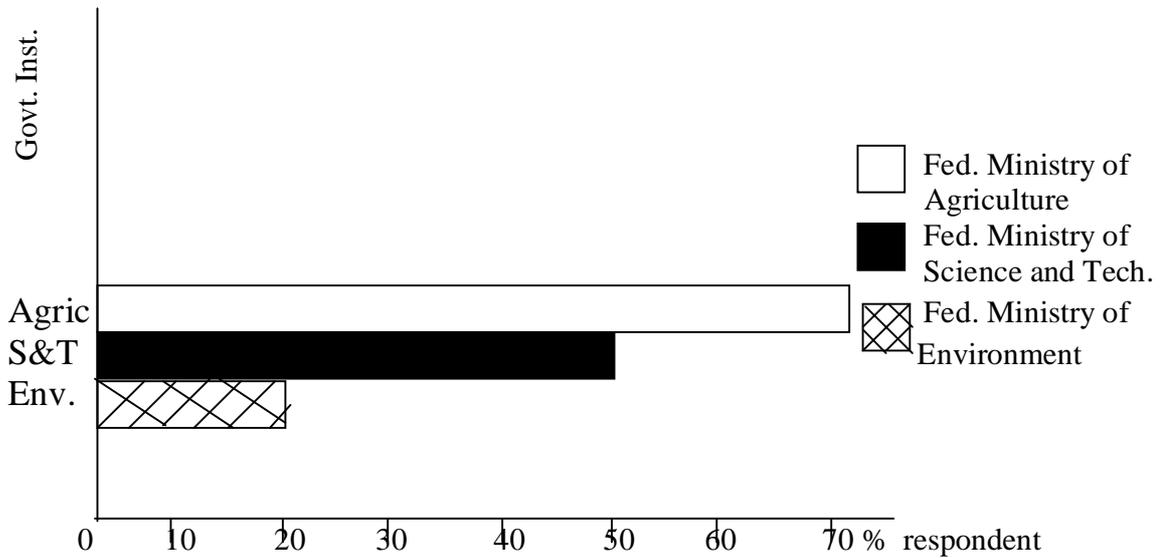


Figure 4.3 Legal structures of RTOs surveyed.

All the RTOs that responded to questionnaires are government owned and are being supervised by various Federal Government Ministries (Fig. 4.3). The decree establishing the RTOs are enshrined in Government Policy on S&T as represented by the supervising ministries. Three ministries were quite prominent based on the number of questionnaires completed and returned.

They are Federal Ministry of Agriculture (55.4%), Federal Ministry of Science and Technology (37.5%), Federal Ministry of Environment (7.1%). The Federal Ministry of Health has two research institutes under it but they never responded to the questionnaire, while Federal Ministry of Industry has no research institute under it.

It was obvious from this analysis that the RTOs are concentrated in two ministries, that is, Federal Ministry Agriculture (FMA) and Federal Ministry of Science and Technology (FMST).

Constitution of Board

When asked on how the Board of their institution is constituted and the size of the board, the following responses were made (Table 4.3)

S/N	Members of Board	No. of Respondents	Percentage Response
1.	Politicians	26	46.4
2.	Technocrats	8	14.3
3.	Industrialists	0	0
4.	All of the above	13	23.2
5.	No Board	4	7.1
6.	No response	5	8.9
	Total	56	100

Table 4.3 *Representatives of Board of RTOs*

The size of the board ranges between 6 – 8 members.

Mission, Vision and Level of Autonomy

When the respondents were asked if or not they have mission and vision, and the level of autonomy their organization enjoys their responses are captured in Table 4.4

S/N	Statements	No. of Respondents	% Respondents
1.	Mission/vision (Yes)	40	71.4
	Mission/Vision (No)	2	3.6
	Mission/Vision (Invalid)	14	25.0
Total		56	100
2.	Autonomy (No)	7	12.5
	" (Semi)	27	48.2
	" (Full)	4	7.2
	" (No idea)	18	32.1
Total		56	100

Table 4.4 *Mission Statement and Level of Autonomy*

Most of the respondents indicated that they have mission and vision. It was however observed that most of them could not differentiate between mission from vision, including mandate. In essence, they believed that mission, vision and mandate are the same.

On the level of autonomy RTOs enjoy, greater number of respondents (48.2%) reported semi or partial autonomy. They supported their statements by the fact that they are being supervised by a parent ministry.

While 7.2% of the respondents believed that they enjoy full autonomy, 12.5% felt that they have no autonomy, and 32.1% were not too clear on their level of autonomy (Figure 4.4).

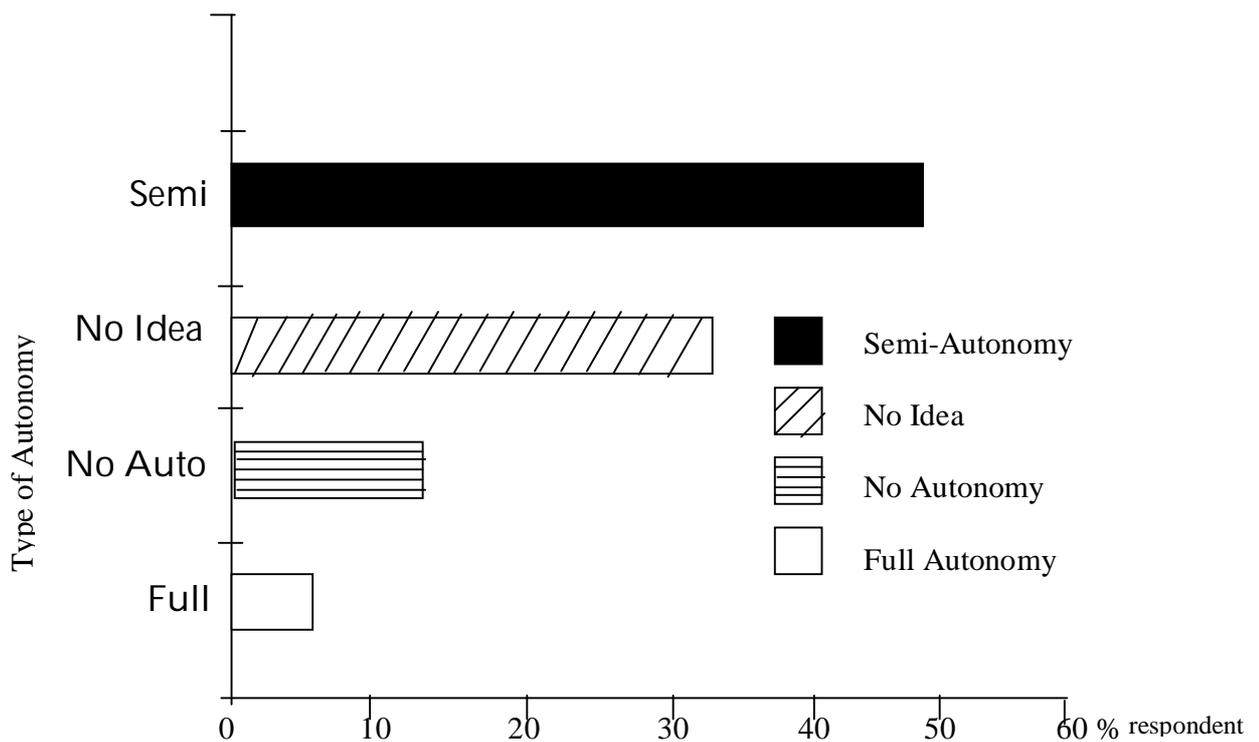


Figure 4.4 Level of Autonomy of RTOs in Nigeria

Decision Making and Change of Management

The process of managing the non-project related day-to-day affairs of the RTOs and ability to change management style with changing situations was examined.

The respondents were asked to identify the internal decision making process (Table 4.5)

S/N	Category of Management	No. of Respondents	% Respondents
1.	Chief Executive Officer (CEO)	3	5.4
2.	CEO and Directors	13	23.2
3.	Senior Management Staff	31	57.1
4.	No Idea	8	14.3
Total		56	100

Table 4.5 Assessment of the category of staff responsible for internal decision making

The responses indicate that senior management staff (57.1%), which include the CEO, Directors, and top management staff are responsible for internal decision making. In some of the RTOs, it is only the CEO and directors (23.2%) who are responsible for internal decision-making. The responses for CEO (5.4%) indicate a limited possibility of autocratic management style whereby only the CEO takes management decision.

When asked of the prospects to change management with changing situation, the respondents gave various opinions. While 57.2% of the respondents indicate that their institutions have the capability to change management with changing situations, 32.1% of them felt otherwise (Figure 4.5). Those that hold a contrary view supported their response with the explanation that the choice of management especially, the CEO is determined by the parent ministry that can effect change which often hardly happen except if the CEO tenure of office expires. Also, most CEOs hardly reorganize management structure. Officers remain in the same division or department in an organization for the rest of their career life.

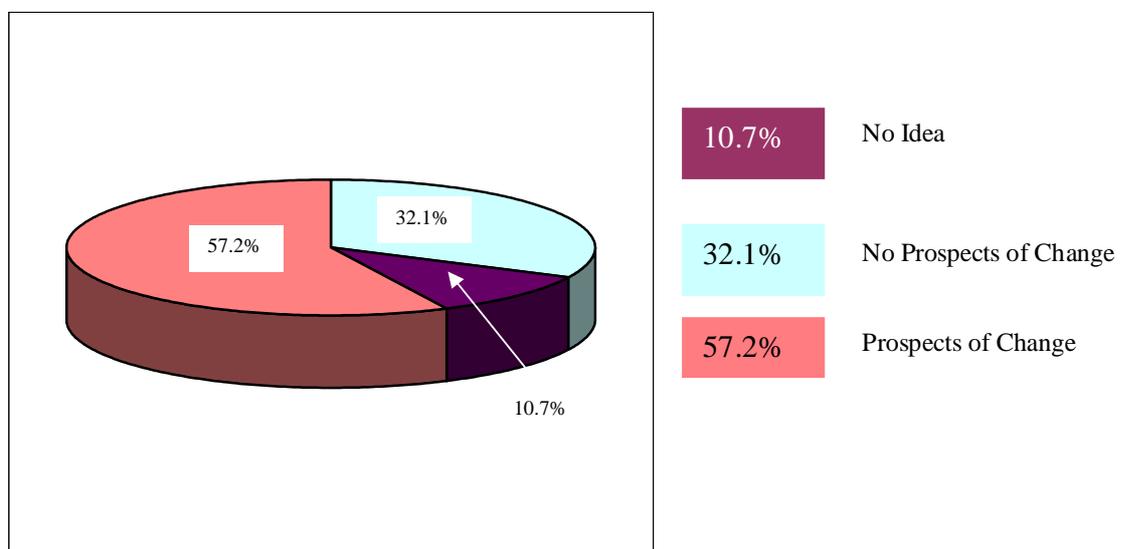


Figure 4.5 Prospects of changing management

Model A of management practices as it relates to Governance
The management practices assessment was carried out and models developed.

The prime aim of this aspect of the study is to identify the current practices of RTOs and compare them with similar practices considered best among similar organizations outside Nigeria. Through this process, a variety of RTOs management practices, which should be encouraged and sustained were identified. The model encompass the process, objective, practices used, performance indicators, findings and lessons learned (Box 1)

Using the responses to the questionnaire, efforts were made to learn how each management process was actually performed, through this method, proxy performance indicators (PIs) were developed. However, this did not measure the management process directly, but it provided a good indication of the effectiveness of the practice used in each case.

Model A:**GOVERNANCE****Box 1**

The Process:	The ownership structure and legality
Process Objective:	To provide information on ownership structure or mandating authority.
Practice used:	The ownership structure provides information on who should control RTOs a. What should be its legal structure b. Nature and size of board c. Need for mission, vision and mandate d. Need to change management

Performance Indicators (PIs)

1. Private or public sector control, based on mandate
2. Establishing a functional board
3. If mission and vision are client driven
4. Ability to change management with changing situation or needs

Findings:

The present ownership structure of RTOs showed government dominance without any role to play by the private sector. Even in the choice of Board members, politicians dominate the technocrats and industrialists. As a

result of this structure, the RTOs have partial autonomy with the government Ministries often interfering. Though there are prospects to change management with changing needs, this is not always feasible due to the existing ownership structure.

The issue of collective responsibility of senior management staff in internal decision-making is seen as a good practice by RTOs.

Lessons Learnt

When compared with practices in RTOs elsewhere as reported by World Association of Industrial Technological Research Organizations (WAITRO), the following lessons were learnt;

- RTOs should be controlled by the private and public sectors; industrial association, if serving industrial sector or by government if serving the public sector.
- Its legal structure should encourage financial and decision making autonomy.
- Representatives on RTO board should be industry, clients and technocrats.

- The mandate, mission and vision should be properly defined according to the role its clients serve in the innovation chain.
- RTO management must identify the need for change and have the power to address those needs.

Source: Field Report and WAITRO Report on Best Practices, 1999.

4.3 FINANCIAL MANAGEMENT

Funding, no doubt, plays a significant role in an RTOs management process. It is in recognition of this fact that effort was made to determine the source of funding of RTOs in Nigeria and the level of government financial support to make the organization viable.

SOURCE OF FUNDING

Respondents were asked of the sources of funding to their organizations. Four possible sources of funding were identified to include government, non-governmental organizations, private sector and any other sources.

The responses are presented in Table 4.5

S/N	Sources of Funding	No. of Respondents	% Respondents
1.	Government	43	76.8
2.	Non-governmental Organization	2	3.6
3.	Private Sector	0	0
4.	Others	11	19.6
Total		56	100

Table 4.6 Sources of funding of RTOs

Government was reported as the major source of fund (76.8%), while Non-Governmental Organizations (3.6%) provides financial support to RTOs either through funding of projects or international grants on research. Other sources of funds are indicated by respondents (19.6%) include internally generated revenue and donor collaborative institutions within and outside the country. It is pertinent to note that some of the respondents, who indicated government as the major source of fund, also mentioned other sources of fund.

GOVERNMENT FINANCIAL SUPPORT

In order to determine the level of government financial support to RTOs, respondents were asked to indicate if the level of support provided is sustainable to make their organizations viable and achieve organizational goals. The responses are captured in figure 4.6

S/N	Level of Financial Support	No.of Respondents	% Respondents
1.	Sustainable	5	8.9
2.	Fairly sustainable	20	35.7
3.	Not sustainable	31	55.4
	Total	56	100

Table 4.7: *Level of financial support*

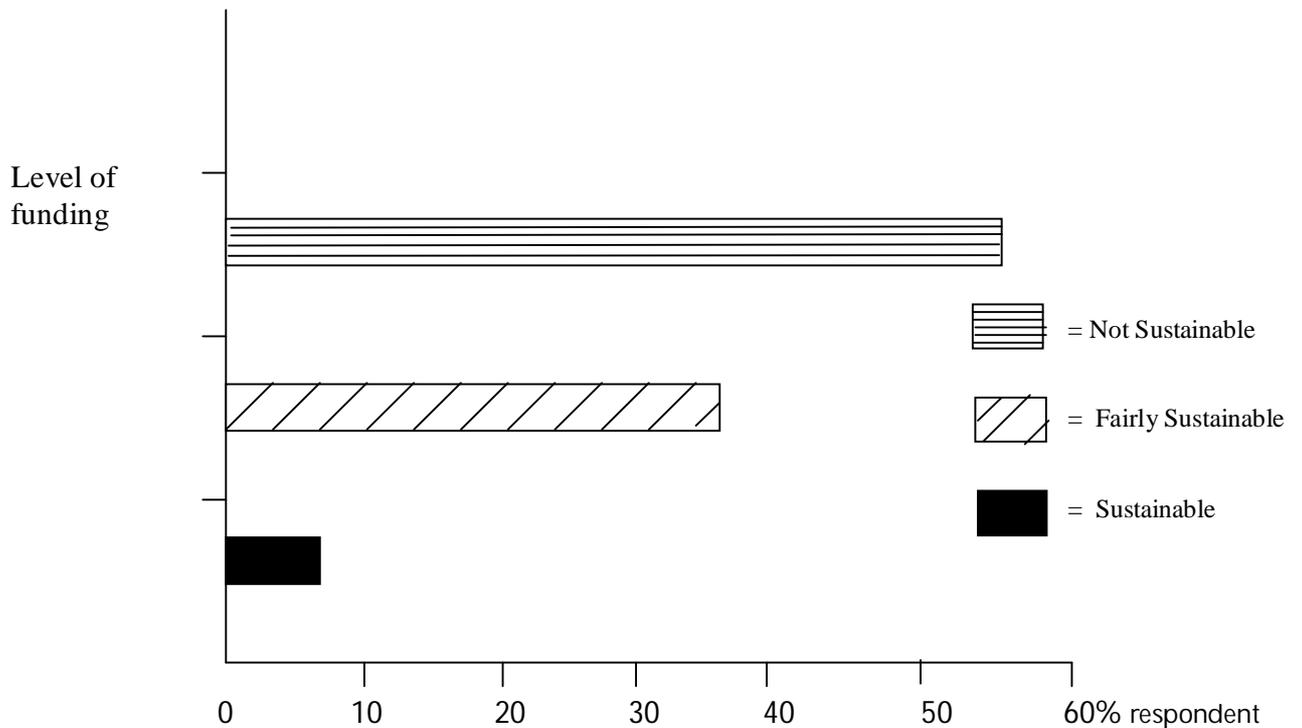


Figure 4.6 *Level of financial support by government to RTOs*

From the data analysis, 55.4% of respondents complained that government financial support to their organizations is not sustainable enough for meaningful R & D. Most often, capital

projects are poorly funded and always not released as and when required.

They further noted that grants are decided by the supervising ministry based on an agreed ratio, which is subject to the strength and scope of activities of an RTO and budget defence of capital projects.

When asked if they use funds released to them judiciously and what they do with surplus funds or shortfalls, the respondents made pertinent comments. They claimed that funds are utilized in the most effective manner despite the obvious constraints.

On surplus or shortfall, 55.4% said that they do not receive enough and as such, there is no surplus (table 4.7). Those who are of the opinion that their funding is sustainable (8.9%) stated that surplus funds are paid back to the federation account at the end of the year. In essence, any fund not utilized for capital projects before the end of the financial year “lapses” and is paid back to the treasury.

In order to ascertain the financial management system available in RTOs surveyed, the respondents were asked to specify the type of system that provides information and

controls. The majority of respondents explained that the current practice of financial information management is through the use of cashbooks, ledgers and vote books. There are also internal accounting and audit units who apply government financial regulations in financial management.

They also noted that their financial operations use manual systems as the available computers in some of the RTOs are not being used for financial information management purpose. There is therefore, no on-line arrangement as financial reporting is done quarterly and annually. Financial information was not provided to project managers always as the accounting is run as a closed system, exclusive only for the accounting personnel and perhaps, the CEO.

4.4 RTO SERVICES

One of the issues considered pertinent to this study, which will help to give insight into the performance of RTOs, is the issue of services rendered to clients.

Consequently, respondents were asked to identify the type of service they provide that target market needs. The type of services and users to RTOs are listed in Table 4.8

S/N	Service Type	Users	Service Provider
1.	Basic and applied research	Government, Agric Dev. Program (ADP), Farmers	Agricultural RTOs Science & Technology RTOs
2.	Production of foundation seeds, breeders and improved planting materials.	Farmers, government, NGOs, CBOs, entrepreneurs	Agric RTOs
3.	Development of livestock feeds, animal breeding	Farmers, government, public entrepreneurs	Agric RTOs, S & T RTOs
4.	Extension services to farmers and training services	Farmers, government, public entrepreneurs.	Agric RTOs
5.	Production of processing machinery and fabrication of equipment	Government, small scale industrialists, entrepreneurs	S & T. RTOs
6.	Registration of technology agreement patenting of indigenous inventions	Inventors and innovators, technology suppliers, small scale industrialists, entrepreneurs	S & T RTOs
7.	Business incubation and commercialization of R & D	Entrepreneurs investors, small scale industrialists, inventors and innovators	Technology Business Incubators (TBIC) S & T RTOs
8.	Consultancy services	Public, entrepreneurs industrialists, farmers NGO, CBOs	S & T and Agric RTOs
9.	Human Resource Development/Capacity Building	Government industrialist public, NGOs, CBOs	S & T and Agric RTOs

Table 4.8 RTOs service type and users in Nigeria

The respondents were asked whether they decide or not on the nature of services that should be offered to the target market. Their responses are captured in Table 4.9 and comparison made in Figure 4.7

S/N	Response	No. of Respondents	% Respondents
1.	Yes	32	57.1
2.	No	14	25.0
3.	No Comment	10	17.9
Total		56	100

Table 4.9 Choice of service(s) to target market

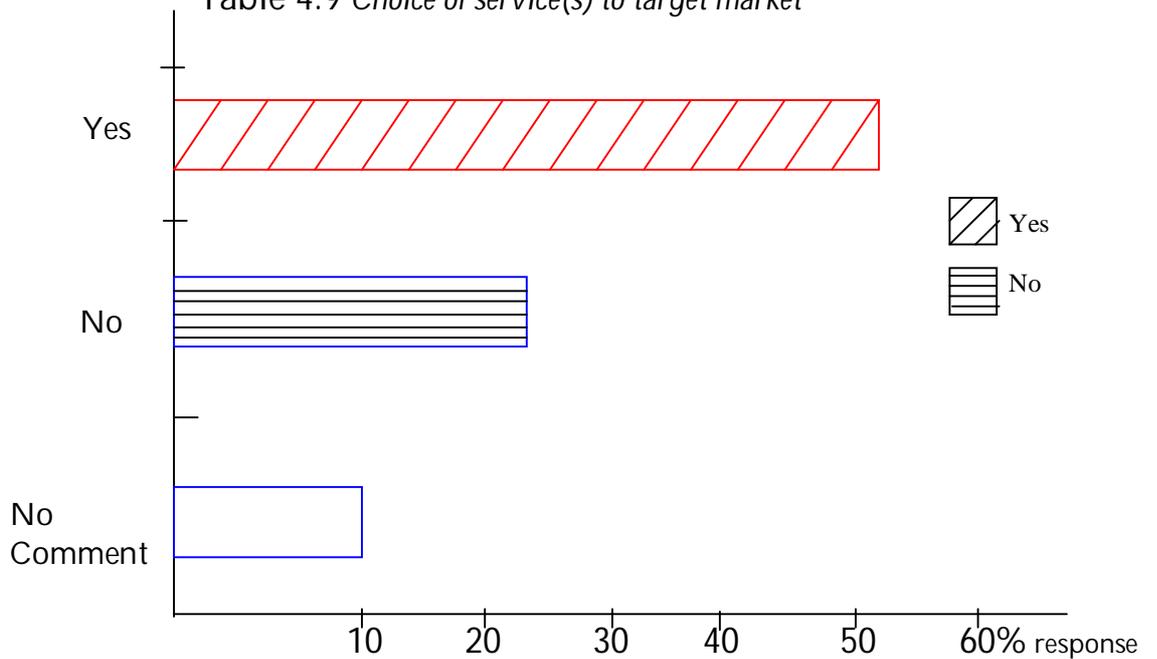


Figure 4.7 Decision on service type offered by RTOs

While majority of the respondents (57.1%) affirmed positively that they decide on which service(s) that should be offered to the target market, 25.0% of them are of contrary opinion.

Those who said yes justified their view by the fact that their institutional mandate does not give them the room to offer different services. Consequently, all their services are confined within the framework of their mandate.

Those that said no were of the view that irrespective of their mandate, they were free to seek out opportunities that will generate funds internally through services offered to different users. They believed that through this process, they generate funds to sustain some of their activities. In this group, most of the clients pay for services rendered even though, such payments are not often competitive. In both cases (Yes/No), respondents claimed that they do ensure that their clients are offered quality service(s).

Using the responses to the questionnaires a model of variety of practices was summarized as presented in Box 2. These practices were compared to what is obtained elsewhere.

Model of management practices as it relates to RTO services

Model B

RTO Services

Box 2

The Process: The type of services offered by RTOs.

Process Objective: To determine the services offered that target market needs.

Practices Used: The service structure provide information on the following:

- a. Type of services offered.
- b. Ownership structure determines services offered.
- c. Whether market demand is the best strategy to determine service type to offer.
- d. Feedback processes from clients guaranty service quality.
- e. Revenue generation from client service applied in service development than administration.

Performance Indicators (PIs)

1. Primary service types rather than multiple service types is preferable.
2. Market-oriented services preferable to government oriented services.
3. Service quality provided through continuous interaction with clients.

4. Fund provided in proportion to clients revenue and to fund viable projects.
5. Identifying appropriate technology desirable than developing new technology.

Findings and Lessons learnt

Providing the type of services that target market needs, such as basic research, applied research, experimental and pilot plant development, consulting, testing, training and information dissemination are common with RTOs studied.

While majority of the RTOs provided specific services, it was observed that those that provide mixed services have potential to survive adverse financial conditions, as they tend to generate revenue internally.

The lessons learnt include the following:-

- Market pull (Industry Committees, Consultations) is the best way to determine types of service to offer.
- Feedback processes from clients (Meetings, Surveys) are necessary to ensure service quality

Source: WAITRO, 1999 Survey Report

4.5 CLIENT BUSINESS DEVELOPMENT

Research and Technology Organizations (RTOs) have been accused of lacking business orientation in the conduct of their activities. This explains why research results are left on

the shelves without being commercialized. In order to ascertain the validity or otherwise of this assertion, respondents from RTOs were asked pertinent questions relating to having a business unit within their operational mechanism and how they manage their business development programmes. Respondents were asked if they create awareness for their services and how they identify the needs of their clients. Their responses are presented in Table 4.9

Statement	No.of Respondents	% Respondents
Create Business Awareness	47	83.9
No. Business Awareness Creation	6	10.7
Not Relevant	3	5.4
Total	56	100

Table 4.9 *Client business development awareness*

Majority of the respondents (83.9%) claimed that they do inform their clients and funders about their institutional capabilities, services and successes, including their failures. However, 10.7% of them are of the opinion that they need not

inform their clients of their capabilities and services. They explained that since their institutions are not profit-oriented, they need not disseminate such information. When asked about the medium of creating awareness, the following means of awareness creation were identified:

- Quarterly and annual reports
- Publications (News letters and Technical Briefs)
- Adverts and exhibitions
- Personal interaction with clients
- Extension services
- Consultancy and training
- Media outreach
- Linkage programmes such as meetings and monitoring visits.

On how they identify the needs of the client groups or individual clients in order to decide on what service to offer, most of the respondents emphasized on the limitations to the scope of services rendered. This is considered, as a factor that affected the identification of clients needs. Since their activities are research base, most of their clients are those that respond to their research findings. At times clients are identified at the grass root level through information exchange, extension service and surveys. Also, respondents

explained that they do encourage growth in client revenue by exposing them to improved and cheaper methods of production in order to improve on efficiency, productivity and ensure quality service.

The pricing of services rendered elicited interesting comments as most of the respondents reported that work done is highly subsidized. The basis of this are because their organizations are not profit oriented. Costing of projects is properly carried out following market survey and feasibility studies. Also, cost benefit analysis is carried out to determine the economic viability of a project. At times, the supervising Ministry places a limit to the costing of work to be done due to the same obvious reason of the non-profit nature of the organizations.

Following the various comments extracted from the respondents on the issue of business development, a model was developed. Business development is considered in this study as critical to the survival of RTOs, if they are to be self-reliant. This is why, it is given considerable attention and also, to compare the current practices with that tenable elsewhere. Mode of management practices with respect to business development.

Model of Management practices with respect to Business Development

Model: C	Business Development	Box 3
The Process:	Coordinating and conducting business Development activities as effectively and efficiently as possible.	
Process Objective:	To determine the approach to business development among RTOs.	
Practice Used:	The business development strategy provides information on:	
	<ul style="list-style-type: none">a. Unit specifically established for business development.b. Awareness creation on market and strategic planning.c. Client needs assessment and services offered.d. Market based pricing of services.e. Identification of methods for reducing cost of projects to client.	
	Performance Indicators (PIs)	
	<ul style="list-style-type: none">1. Availability of specialized unit for business development.2. Level of client involvement in project design and review.3. Which practice(s) bring in enough business.4. Identifying client needs in order to decide on services to be rendered.	
	Findings and Lessons Learnt	
	Although the respondents indicated some level of business activities, however, 71.4% indicated that there is no established unit for business	

development. (Table 4.11 and Figure 4.8) while 28.6% stated that they have a unit designated for business activity.

Clients needs identification in project design is lacking among RTOs studied. Also, most RTOs (78.3%A) are concerned with delivering good technical results only without recourse to generating profit from such activity (Table 4.12). This practice is termed "activity centre" approach to research management. Furthermore, some (73.9%B) emphasized on delivering good technical results on time and within budget as core area of activity. This practice is considered as "cost center " approach. For those concerned with revenue generation as well as delivering good technical results on time and within budget, 39.1% responded in the affirmative while 60.9% hold a contrary view (Table 4.12 C). This practice is considered as "profit center" approach. Figure 4.9 further illustrates the responses.

The lessons learnt include the following:

- A business unit is necessary in an RTO to handle awareness creation and strategic market planning for technical results.
- Awareness activities focusing on major client groups need to be conducted.
- Client needs should be identified based on input from staff, board and regular meetings with clientele.
- Market based rather than cost based pricing should be adopted.
- * Profit center approach to research management is considered better than activity center and cost centre.

Source: Questionnaire Analysis and WAITRO Best Practices Report, 1999.

Answer	No. Of Respondents	% Respondents
Yes	16	28.6
No	40	71.4
Total	56	100

Table 4.11 Availability of unit for business development

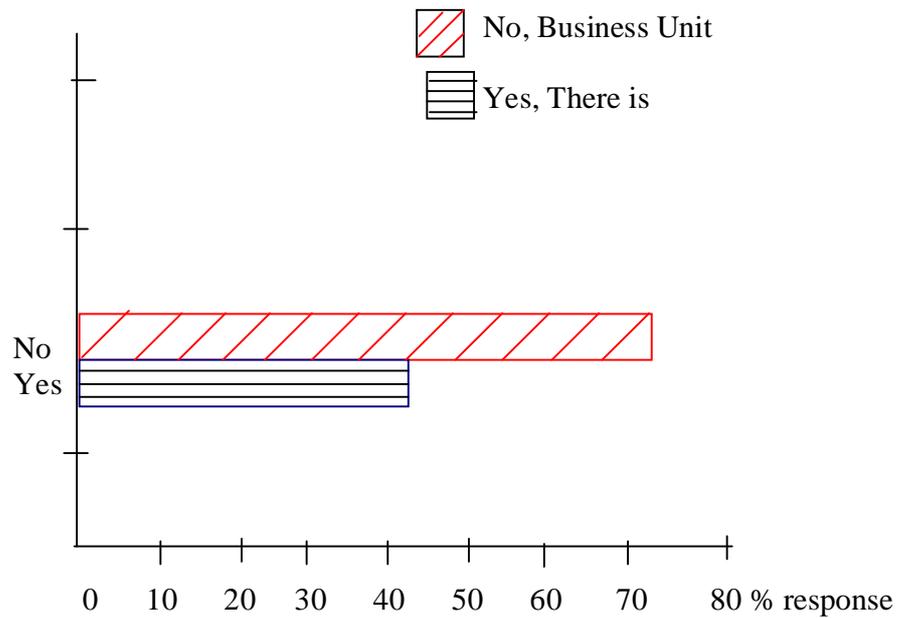


Figure 4.8 illustration of the availability of business unit

Statement	No. Of Respondents	% Respondents
A. Delivering good technical results only		
No	10	21.7
Yes	36	78.3
Total	*46	100
B. Delivering good technical results on time and within Budget		
Yes	34	73.9
No	12	26.1
Total	* 46	100

C. Revenue Generation and delivery good technical results on time and within budget		
Yes	18	39.1
No	28	60.9
Total	*46	100

- Only 46 respondents were recorded

Table 4.12 Assessment of RTOs focal business activity

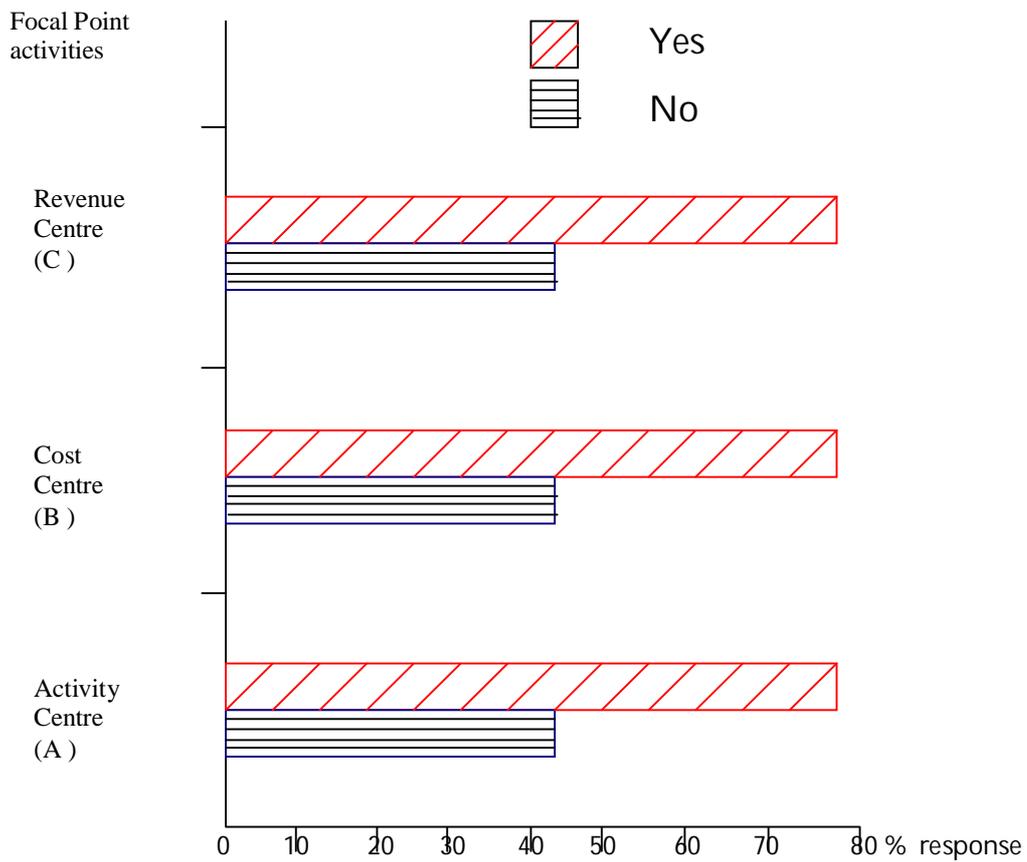


Figure 4.9 Illustration of RTOs focal point activities

4.6 ORGANIZATIONAL MANAGEMENT

There is no doubt that providing supervision, direction setting, support and communication to personnel to enable RTOs meet their goals are necessary steps towards achieving higher performance. In order to determine the organizational management of RTOs in Nigeria, this study examined how the RTOs have been able to address this aspect of management. Equally, concerted effort was made to examine organizational attributes based on the overall response to the questionnaire. The organizational attribute analysis are classified into two major groups:

- A. SWOT analysis
- B. Change factor or attribute analysis

The SWOT analysis includes the examination of their strengths, weaknesses, opportunities and threats, while change factor analysis include rigidity, conservatism, adaptability and risk taking.

Respondents were asked how their organizations meet their goals in terms of management style. Their collective responses indicated that often, they set targets, appraise efforts made in achieving the targets and ensure that the targets are met. Also,

delegation of responsibilities is their prime concern as well as team work and effective leadership style.

Furthermore, when asked if staffs are organized into groups to efficiently meet their goals, almost all the respondents answered in the affirmative (Table 4.12). In essence, 75% responded positively that staffs are organized into groups to efficiently meet their corporate goals.

Statement	No. Of Respondents	% Respondents
Yes (Staff Organized)	27	75
No (Lack staff organization)	9	25
Total	*36	100

** Only valid 36 respondents were recorded*

Table 4.13 *Staff Organization to achieve goals efficiently*

The levels of responsibility that result in best performance according to the respondents are the individual level, departments, research units and programme level.

In order to determine the nature of organizational management style practiced by the RTOs, respondents were asked to indicate if their institution practice hierarchical approach type of management or management by objectives. Majority (50%) opined that the current organizational

management style practiced is based on management by job description, which is the hierarchical approach.

Those that indicated that their institution practiced management by objectives (32.1%) were in the minority. Of all these, 17.9% had no idea of the style of organizational management currently being practiced. The responses of the RTOs are well captured in Table 4.14 and illustrated in Figure 4.10.

S/No	Organizational Management style	No. Of Respondents	% Respondent
A	Hierarchical approach	28	50.0
B	Management by objectives	18	32.1
C	No Idea	10	17.9
	Total	56	100

Table 4.14 *Organizational Management style of RTOs.*

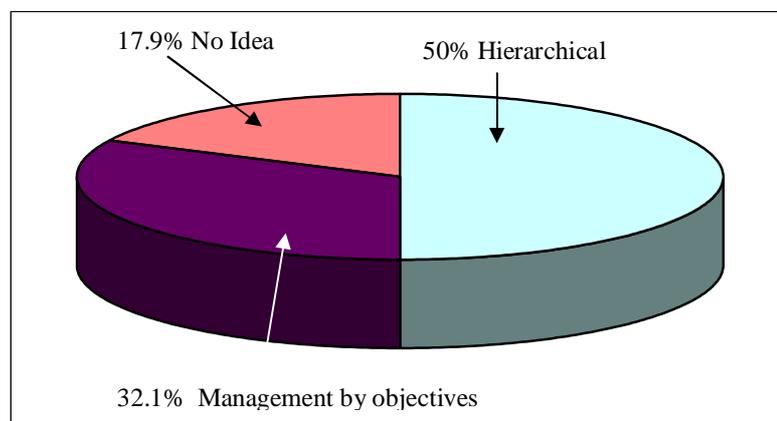


Figure 4.10 *Illustration of the organizational management style of RTOs.*

In view of the increasing need for adoption of medium management technique in the running of RTOs, attempt was made to find out if these institutions carry out attribute analysis from time to time. Consequently, respondents were asked if their organizations carry out activities such as SWOT analysis and periodic organizational change to meet customers needs. The responses are presented in Table 4.15 and Figure 4.11. The analysis of the responses showed that 44.6% of the respondents are not aware if organizational attribute analysis is occasionally carried out in their institutions or not.

S/No.	Organizational attribute analysis	No. Of Respondents	% Response
1	SWOT Analysis	15	26.8
2.	Change Factor Analysis	16	28.6
3.	No Idea	25	44.6
	Total	56	100

Table 4.15 *Attribute analysis study*

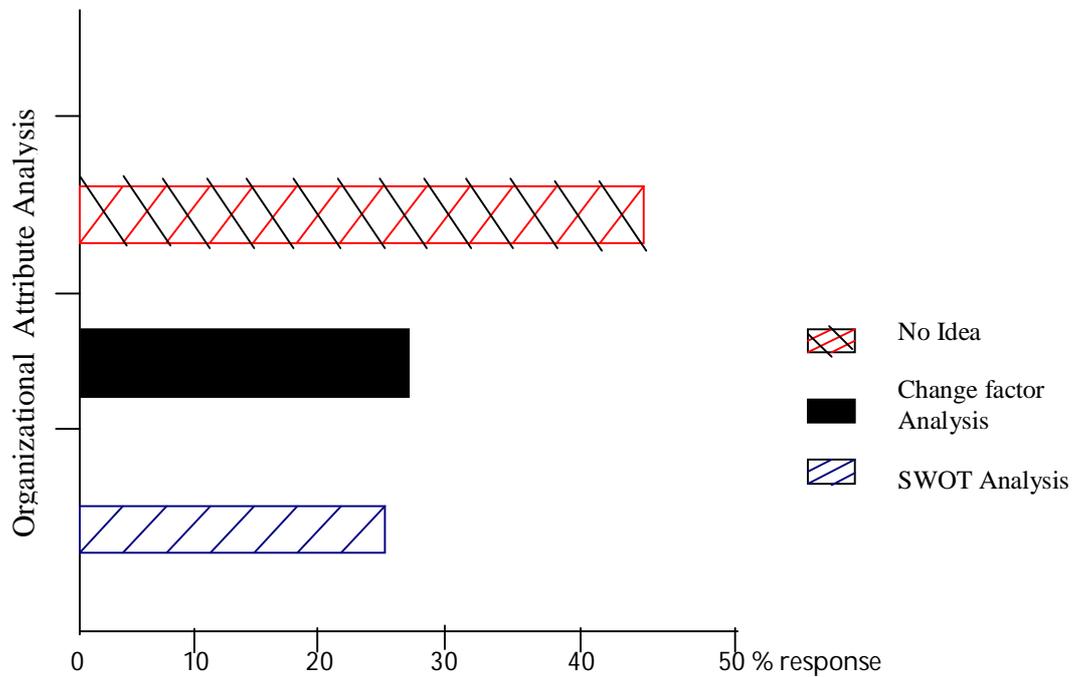


Figure 4.11 *Illustration of responses to attribute analysis by RTOs.*

While 28.6% of the respondents acknowledged that they occasionally carry change factor analysis 26.8% reported that they carry out SWOT analysis. The various components of the organizational attribute identified are illustrated in Figure 4.12. The components include the following, strengths weaknesses opportunities, and threats (SWOT) and rigidity, conservation, adaptability risk taking (change factor).

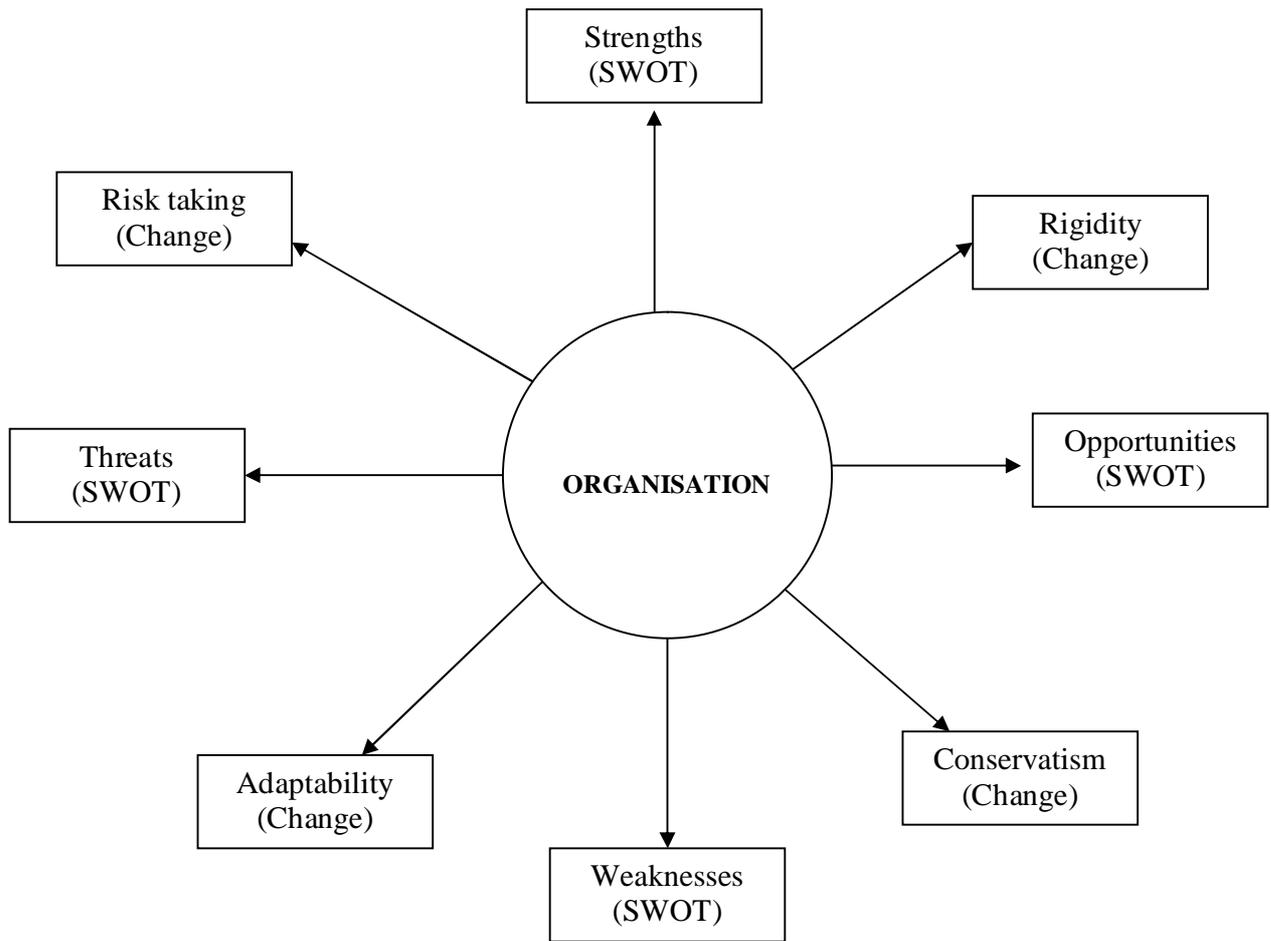


Figure 4.12 *Organizational attributes*

In order to extract more information and gain deeper insight into organizational attributes especially as it relates to their strengths, weaknesses, opportunities and threats, the respondents were asked to indicate which activity was their organizations best at, business management, project management and organizational management.

S/No	Activity Assessment	No. Of Respondents	% Respondents
1.	Business Management	5	8.9
2	Project Management	17	30.4
3	Organizational Management	20	35.7
4.	Not Applicable	14	25.0
	Total	56	100

Table 4.16 Activity Assessment of RTOs

From Table 4.16 above, it was found that majority (35.7%) acknowledged organizational management as their area of strength and followed by project management (30.4%). Business management recorded the least response (8.9%). The low response for business management supports the earlier findings on client business development. When asked to indicate their areas of weakness, the respondents were hesitant in offering information. However, the following areas of weakness were generally identified:

- financial control
- communication
- motivation
- inability to commercialize R&D results
- Inability to attract funds outside Government subventions
- Performance information generation and dissemination.

Opportunities that are available to RTOs in the course of pursuing their mandates were examined. Majority of respondents could not in absolute terms identify opportunities that are available to their organizations. However, few respondents were of the opinion that prospects exist to make impact if their viable R&D results are commercialized. They also acknowledged the prospects for opportunities if strong linkage is established with industry leading to more patronage.

In order to find out the factors within their operational environment that hinder them from achieving the level of performance they would have loved to, a lot of factors were identified. Inadequate funding and lack of patronage were quite recurring in the number of responses received. Some of these factors are analyzed in subsequent sections. On the issue of change factor analysis carried out, it was observed that due to the ownership structure and their legal status, the RTOs could not achieve dynamism in their management approach. Most of the respondents do not see the need to change management with changing times or restructure their system and procedures in order to meet increasing challenge posed by meeting customers need. Furthermore, it was found that RTOs are more concerned in addressing the needs and demands of its own system and that of the supervising

Ministry rather than the needs of customers. Based on comments from respondents there are glaring evidence of operational rigidity, lack of adaptability and aversion to risk taking among RTOs. They supported this by saying that their mandate does not permit organizational change and risk taking.

4.7 PERFORMANCE INFORMATION

To find out how RTOs are rated in terms of performance in-house, respondents were asked to rate their institutions' performance based on a five-point scale (1,2,3 4, 5). The least rating (1) is attributed to be very low performance while 5 signifies very high performance. In between the two extremes are low (2) moderate (3) and high (4) performances. The percentage responses were calculated and the result is presented in Table 4.16. The analysis shows that 72.4% of the respondents are of the view that their RTOs performed well in the past ten years.

S/No	Performance Rating	No. Of Respondents	% Respondents
1	V. Low	0	0
2	Low	2	4.2
3	Moderate	7	14.6
4	High	35	72.9
5	V. High	5	8.3
	Total	*49	100

* Only 49 valid responses were recorded out of 56 returned questionnaire

Table 4.17 Performance rating of RTO by in-house staff

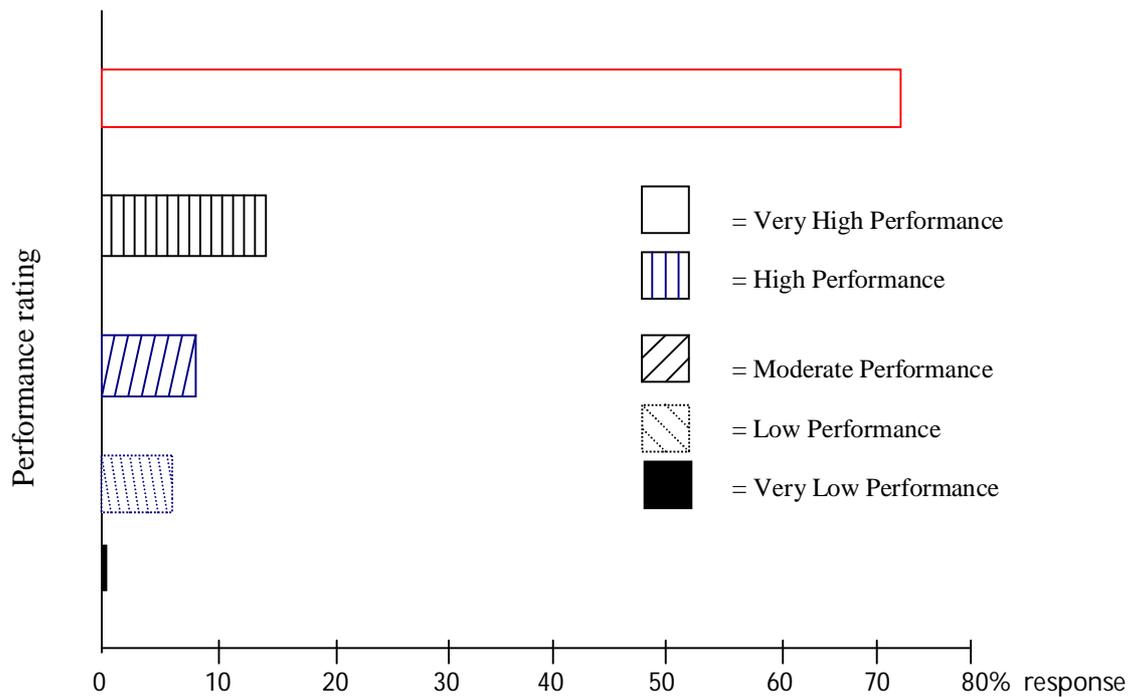


Figure 4.13 Illustration of performance rating of RTOs

Performance information has been recognized as a very able tool for ensuring better organizational performance. It equally provides a framework for development of criteria of success. To this end, the nature of performance information provided by the RTOs was studied. In order to extract information, a research question on what sorts of performance information are considered necessary across management cycle was asked. To capture the information provided, vividly, a framework was designed (Figure 4.14). There are two axes to the framework. The column defines the users of information comprising the Chief Executive, Committee of Directors and Senior Management. These constitute the internal stakeholders. Also, there are other users such as the funding agency (Ministry) and clients. These are described as external stakeholders. On the row axis, is the management cycle, which identifies the sequence of events where information users require specific types of information.

The information refers entirely to operational programmes (or activities), which is made up of two components; primary and support programmes. Primary programmes are externally focused and include client service programmes and fund raising programmes. Support spending programmes which include personnel management and general administration, provides internal services to the primary spending and fund

raising programmes. Prospective information is made up of strategic and operational planning comprising both primary and fundraising programme; planning information is translated into budgets made up of financial information and performance information. In accomplishing this task semi-structured interview were conducted on some RTOs. The interview respondents were asked to identify the kind of performance information they considered necessary for decisions and which of them they consider most critical. Responses were classified according to the following scale: 0=information as unnecessary +=information necessary but insufficient: ++=information necessary and sufficient.

Information Users

Information Across the management Cycle			Internal			External	
1.General stage of cycle	2. Specific stage of cycle		CEO	COD	Snr. Mgt. Staff	Funders	Clients
Prospective Information on operational programmes	Plans	Primary and support spending programmes	+	+	0	+	0
		Fund raising programmes	+	+	0	+	0
	Budgets	Financial	++	++	++	++	0
		Performance levels	+	+	+	+	0
		Financial	+	+	+	+	0
	Primary spending programme delivery	Performance levels	+	+	+	+	+
Ongoing information during delivery of operational programmes	Fund raising programme delivery	Financial	0	0	0	0	0
		Performance levels	0	0	0	0	0
	Support spending programme delivery	Financial	+	+	+	+	0
		Performance levels	+	+	+	+	0
Retrospective information on operational programmes	Year End Reporting	Financial	++	++	+	++	+
		Performance levels	+	+	+	+	+
		Financial	++	++	++	++	++
	Evaluation and Audit	Performance levels	0	0	0	0	0

Figure 4.14 *Performance information requirement of RTOs*

The findings as illustrated in Figure 4.14 showed that five groups of respondents were asked to use the three-point scale (0,+,++) to indicate what information was necessary and whether it is sufficient. Gaps in performance information were

identified when users indicated that they considered information necessary but insufficient to make decisions (48.6%). Each of the 70 cells in Figure 4.14 contains 0,+,or ++. Respondents made the following comments.

- 24 cells (34.3%) as unnecessary (0)
- 34 cells (48.6%) as necessary but insufficient (+)
- 12 cells (17.1%) as necessary and sufficient (++)

The groups of information users that are most in need of information are as follows:

- CEO = 11 of the 14 information categories
- COD = 11 of the 14 information categories
- Snr. Mgt.= 9 of the 14 information categories.
- Funders = 11 of the 14 information categories
- Clients = 4 of the 14 information categories.

From the analysis it is clear that the CEOs, COD and Funders are in need of more information. The area where information is required most is on finance. While it is acknowledged that CEOs and CODs need more and better information for planning, such information is considered for primary and support programmes. This analysis suggests that a strategic

planning process is the foundation of a successful formal management control system for both funding and spending programmes. It is believed that this process will establish organizational values, mission strategic objectives and priorities. Strategic programming is vital to the establishment of clear and consistent performance accountability across the management cycle.

4.8 PROJECT MANAGEMENT

Project management is critical to the overall performance of an RTO. In order to determine how R&D projects are managed an assessment of current practices was carried out. The management structure on ground and authority for projects were examined. Respondents were asked if they have teams running their projects effectively and efficiently. All the respondents acknowledged that teams are assembled to manage projects. On project direction, respondents reported that a line of reporting exists within their organization. Project teams report to management through departmental heads who give direction to the projects. At unit level, project team leaders give direction, although they do not have authority.

Project selection and personnel to execute projects are subject to the discretion of the Chief Executive Officers. Most often experienced staff are selected. Also, professional competence

and field of specialization determine who and who are selected. Respondents were asked if they do keep to project time schedules and budgets. Their responses are captured in Table 4.18.

S/No	Responses	No. Of Respondents	% Respondents
1.	Yes	26	72.2
2	No	10	27.8
	Total	36	100

Table 4.18 *Compliance with project time schedules and budgets*

Of the 56 questionnaires retrieved only 36 responded to this question.

Majority (72.2%) of the respondents reported that they keep to project time schedule and budgeting. Those that hold a contrary opinion (27.8%) informed that it was not possible to keep to schedule and budget due to delay in release of funds. Insufficiency in the amount of fund released also affects the project management cycle. When asked if their projects are effectively monitored and evaluated, 87.2% acknowledged that their projects were properly monitored and evaluated by both in-house staff and officers from the Ministry Table 4.19).

S/No	Responses	No. of Respondents	% Respondents
1	Yes	34	87.2
2	No	5	12.8
	Total	*39	100

* only 39 valid response were received.

Table 4.19 *Project monitoring and evaluation.*

In order to determine their efficiency and effectiveness in the successful implementation of projects, respondents were asked to indicate how many projects were successfully completed in the past 10 years as against the total number being executed. The findings are represented in Table 4.20.

No	Total No. of Projects Executed	No. of Projects completed in last 10 years	No. of Respondents	% Respondents
1	< 5	< 5	7	18.9
2	>5<10	>5<10	1	2.7
3	>10	>10	6	16.2
4	Not specific (many)	Not specific (many)	23	62.2
	Total		37	100

* only 37 valid responses were received.

Table 4.20 *Assessment of project completion rate.*

The responses to this question were not encouraging as majority (62.2%) of the respondents were not specific on the number of projects they embarked upon and how many were successfully completed. Nevertheless, 18.9% indicated that they completed less than five projects in 10 years due to fund constraint, while 16.2% said that they completed more than 10 projects within the same period. From the data, it was not possible to compute the efficiency and effectiveness of the project management, as specific figures were not given. To give a proper picture of findings from the analysis of the questionnaire on project management practices, a model was developed (Box 4).

Model on management practices as it relates to project management.

Model D:	Project Management	Box 4
The Process:	Effective R&D Management	
Process Objective:	To identify critical activities that guarantee effective R&D management.	
Practice Used:	Each department within the RTO is responsible for the following:	

- a. Selecting and planning R&D projects.
- b. Generation new ideas and maintaining the quality of the R&D.
- c. Getting R&D officers to play an effective role in commercializing technology.
- d. Coordinating R&D and market.
- e. Transferring technology to manufacturing.
- f. Linking R&D to business planning.
- g. Facilitating communication among R&D personnel.

Performance Indicators (PIs):

1. Level of personnel involved in project idea generation, selection and planning
2. Level of staff involvement in commercialization of technology and transfer to industry.
3. Percentage of projects delivered on time and within budget.

Findings and Lessons Learnt:

The findings from the study show that many RTOs appreciate the importance of team work in project management and have adopted such practice. There is no doubt that they need to form project teams that have the appropriate expertise for each project, regardless of whom the individuals report to in the organization. Furthermore, project managers were observed to lack autonomy.

Managers should be given the authority with a matching responsibility to manage projects after management approval. Project formulation was found not to be client-driven. It is therefore necessary that individuals at all levels are encouraged to interact with clients and conceive projects. Financial management of projects requires discipline and accountability, which was observed to be lacking among RTOs. Project managers often do not have any control over their project funds. Project managers therefore need a financial management system that monitors expenses against the project budget and progress against the project plan. Also, project follow-up with the client is an essential component of project management.

Twelve critical activities relating to R&D management were identified:

- selecting R&D,
- planning R&D,
- generating new ideas.
- maintaining R&D quality,
- motivating R&D personnel,
- involvement in commercializing technology,
- facilitating communication among R&D personnel,
- coordinating R&D and marketing,
- transferring technology to manufacturing,
- linking R&D to business planning,
- evaluating the financial aspects of R&D, and
- maintaining teamwork,

Source: Questionnaire analysis and WAITRO Report on Best Practices, 1999.

Factors Affecting R&D Management

Respondents were asked to list in the order of importance, factors that affect R&D in their organization. The obstacles to R&D management are listed in Figure 4.15 using fishbone (cause and effect) diagram. When asked to rate the obstacles on a four-point scale whether they are insignificant, slightly significant, significant or highly significant, the following data was extracted from their responses (Table 4.21 and Figure 4.16).

OBSTACLES TO R&D MANAGEMENT IN RTOs

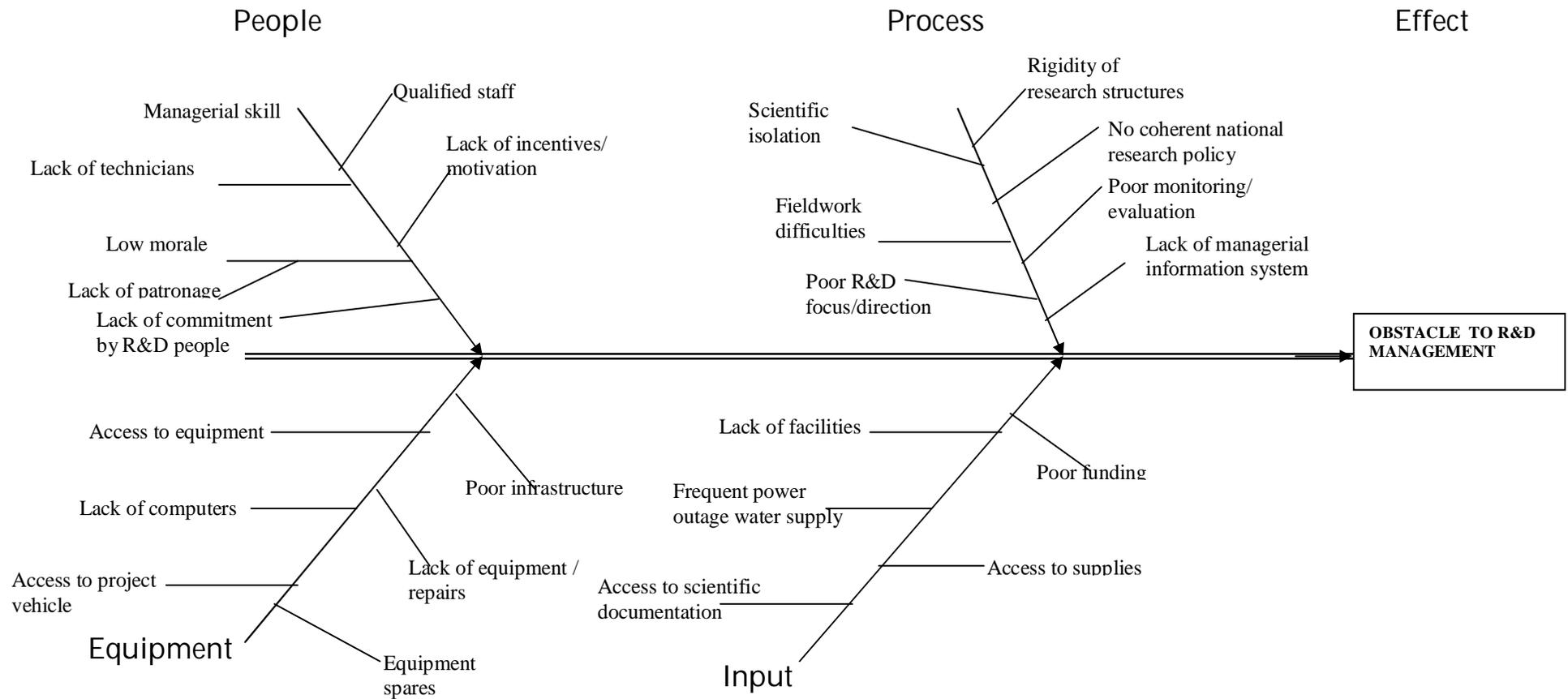


Figure 4.15: Fishbone diagram of the Obstacles to R&D Management

S/No	Reasons	No.of Respondents	% Respondents
1	Poor funding	40	8.3
2	Lack of managerial skill	26	5.4
3	Lack of qualified staff	28	5.8
4	Access to equipment	36	7.5
5	Lack of technicians	25	5.2
6	Lack of facilities	37	7.7
7	Equipment repairs	31	6.5
8	Field work difficulties	30	6.3
9	Access to supplies	30	6.3
10	Lack of monitoring and evaluation	31	6.5
11	Access to project vehicle	23	4.8
12	Access to scientific documentation	36	7.5
13	Low morale	32	6.6
14	Lack of motivation	38	7.9
15	Lack of patronage by business	37	7.7
	Total	480	100

Table 4.21 Factors affecting R&D management

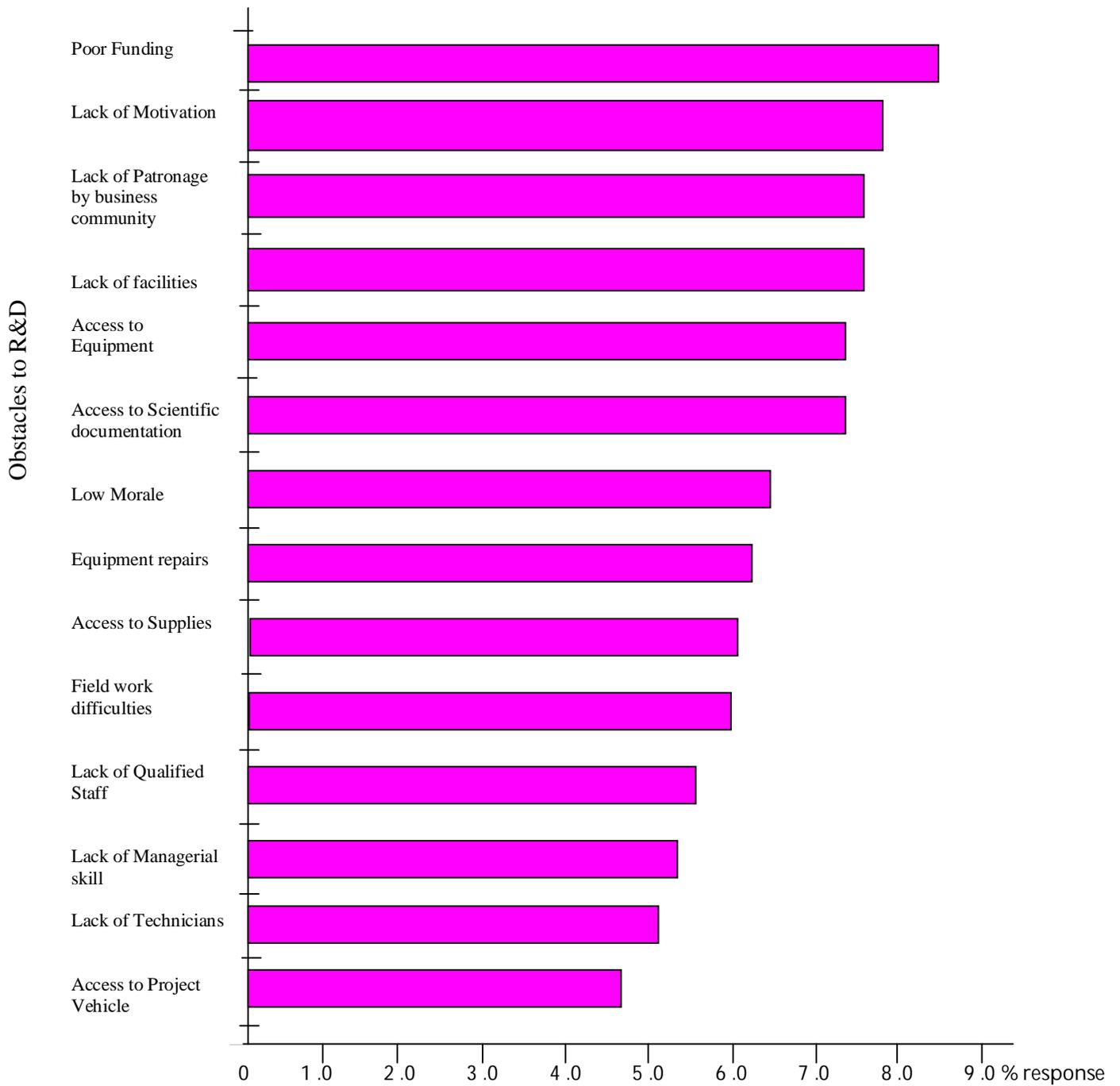


Figure 4.16 Obstacles to R&D management

4.9 PERSONNEL MANGEMENT AND CAPABILITY BUILDING

Personnel management and capability building are two distinct functions necessary for effective performance of an RTO. Issues such as identifying needs for developing new skills or acquiring staff with the required expertise are of importance in the study of management of RTOs. In order to determine the role of personnel management and capability building in the effective performance management system, respondents were asked to identify the authority for staff recruitment and capability building. Respondents identified the Chief Executive Officer (CEO) as responsible for staff recruitment and capability building. Where a board is in place, they also participate in the exercise of recruitment.

For training, the head of department often times recommends staff for training. Some respondents reported that skill gap analysis is occasionally carried out to determine areas of need.

Opportunity for capability building are identified through project activities by re-examining constantly, their mandate mission and vision. At times, it can be identified through research projects; and programme needs.

Furthermore, the recruitment system is often through internal process of selection or use of consultants, adverts and interviews. Funding of staff improvement takes place through sponsorship for training programmes, seminars and workshops. The current practice of reward or motivation to staff is through letters of commendation and performance award certificates. Through yearly evaluation of performance and appraisal, the need for staff promotion is realized. When respondents were asked to comment on the possibility of removing non-performing staff, they observed that it is not usually easy, especially senior management staff.

The following practices were identified as appropriate for RTOs adoption in order to enhance performance.

A. PERSONNEL MANAGEMENT

- A flexible recruitment system, which uses input from relevant segments of the organization.
- RTOs should offer market-competitive salaries and reward high performance in order to reduce staff turnover.
- Non-pay based rewards are also effective means of motivation.
- Compensation packages should be based on results of individual performance evaluations.

- RTOs should have the authority to dismiss staff that no longer meets their needs.

B. CAPABILITY BUILDING

- Input from the industry, client- majority board are necessary for identifying capability-building opportunities.
- Capability building plans should be a collective (team) responsibility.

4.10 NETWORKING, POLICY AND PROGRAMMES

It has been recognized that networking is a veritable means of improving management performance of any organization. Developing mutual relationship with other technology providers is a necessary means of ensuring improved management practices and competitiveness. It is in recognition of these facts that efforts were made to examine networking between RTOs and other organizations and clients. Also, policy issues impinge directly or indirectly on overall performance of RTOs. Inconsistent government policies will definitely stand as a threat to the survival of RTOs as the ownership structure is in the hands of government.

To appreciate these obvious issues, respondents were asked if they develop mutually beneficial relationships with each other and technology providers. Also, intra and inter-institutional relationship was studied. The findings from their responses are presented in Table 4.21

S/No	Networking	No. Of Respondents	% Respondents
A	Technology providers		
	Yes	29	74.4
	No	10	25.6
	Total	*39	100
B.	Industry		
	Yes	25	83.3
	No	5	16.7
	Total	*30	100

* Indicates only the number of valid responses

Table 4.22 *Networking with Technology Providers and Industry*

The respondents generally claimed that they do establish beneficial linkages with other technology institutions and industry (74.4% and 83.3% respectively). However, it was observed that for Industry, only RTOs under the Federal Ministry of Science and Technology have institutional linkage with industry. Those under the Federal Ministry of Agriculture expressed the opinion that their mandate limits their interaction with industry. Some of the RTOs under

Science and Technology Ministry stated that they do occasionally attend meetings of the organized private sector (OPS).

In order to determine the level of interaction among researchers in RTOs and other relevant agencies, respondents were asked to rate their level of interaction (1=never, 2=rarely, 3=annually, 4= monthly, 5=more often). The findings are presented in Table 4.23 and Figure 4.17

S/No.	Communication on R&D	Frequency of Responses	Mean frequency of responses
1	Scientists in your institution	30	31.3
2	Scientists from other institution in Nigeria	20	20.8
3	Scientists from outside Nigeria	14	14.6
4	Industry	12	12.5
5	Funding Agency	10	10.4
6	Private clients	10	10.4
	Total	96	100

Table 4.23 *Communication on R&D among scientists*

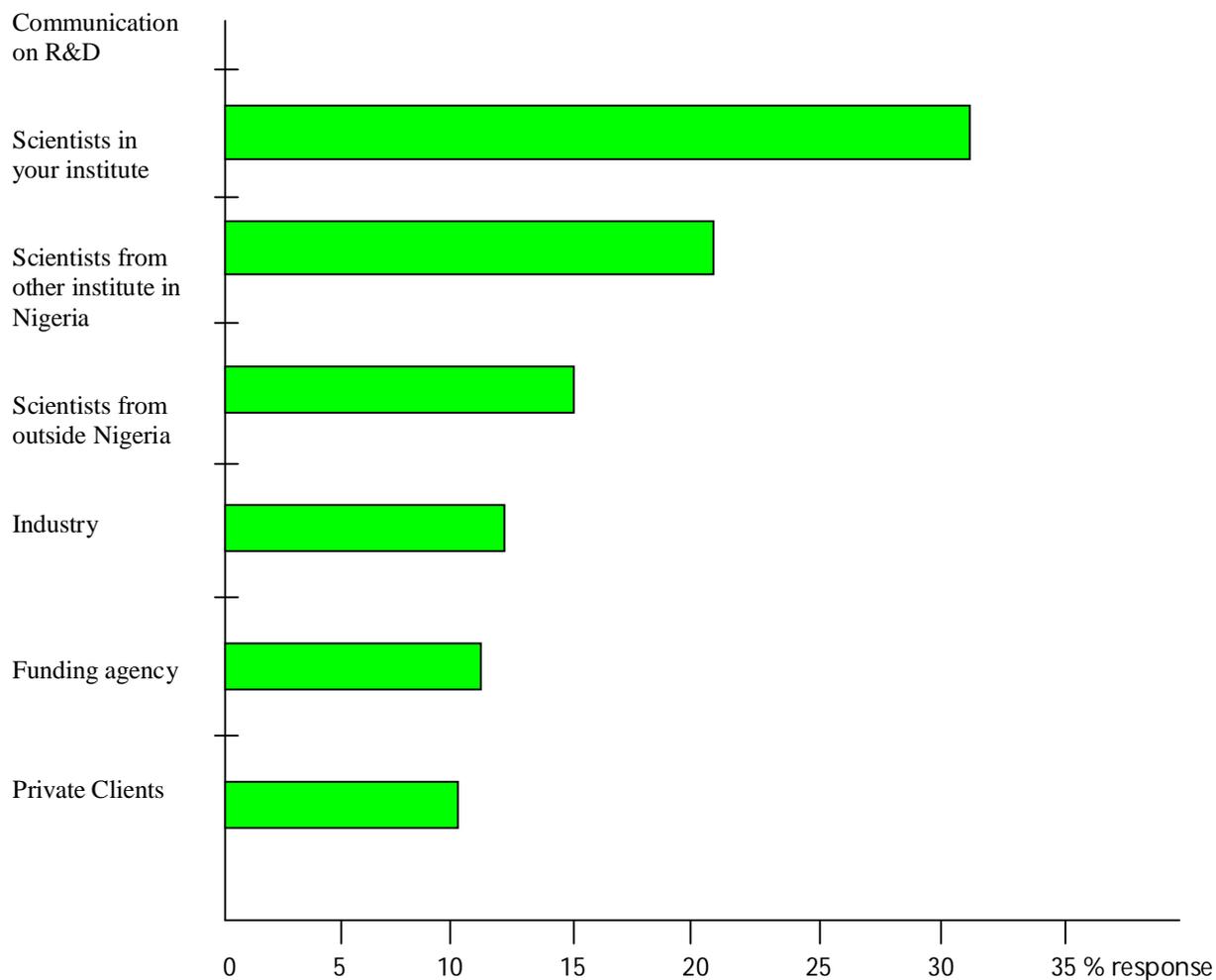


Figure 4.17 *Communication on R&D with scientists and others*

From figure 4.17, it is clear that industry, funding agency and private clients formed the group that are seldomly being communicated with. On policy issues, respondents were asked of their role in determining the focus of national R&D policy. Various responses indicating the following were expressed:

- Promotion of indigenous technology development.
- Promotion of adaptation of foreign technology.
- Development and commercialization of R&D.
- Provision of science and engineering infrastructure.
- Nurturing SMEs development and
- Human resource development on science and technology.

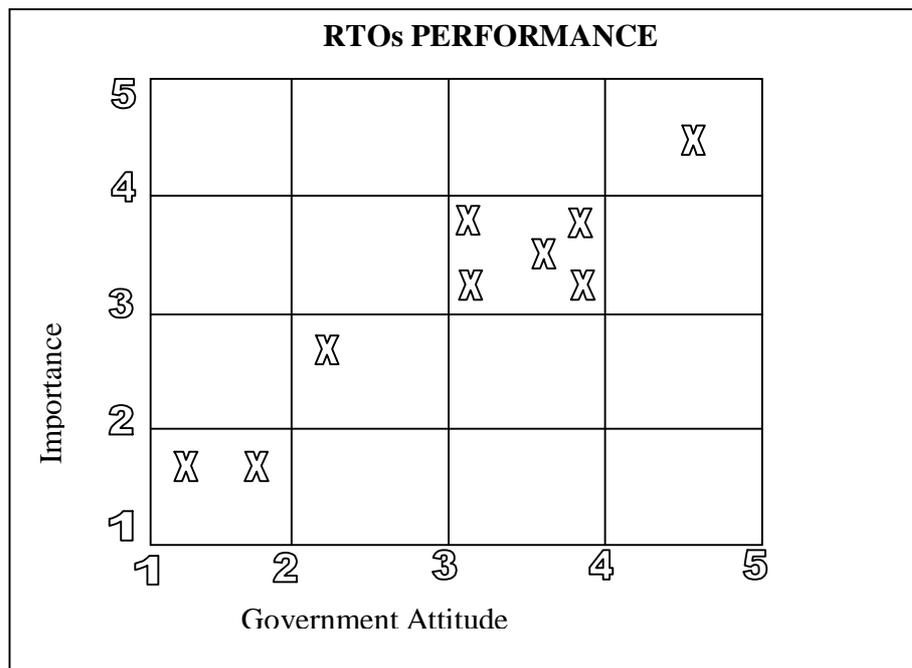
The respondents were further asked if there is any existing R&D policy guiding their R&D. Their responses are presented in Table 4.24

S/No	R&D Policy	No. of Respondents	% Respondents
1	Yes	8	14.3
2	No	34	60.7
3	Not applicable	14	25.0
	Total	56	100

Table 4.24 Availability of R&D policy

Majority (60.7%) of the respondents indicated non-availability of R&D policy while 14.3% reported of the existence of R&D policy, apparently referring to science and technology (S&T) policy. Most of the respondents acknowledged that their organization usually take advantage of government

programmes that can help them meet their goals. However, when asked to rate on a 5-point scale how they perceive government attitude to RTOs performance, the rating varied from very negative (1), negative (2) not too positive (3) positive (4) to very positive (5). The findings are presented in figure 4.18.



Note 1= v. negative, 2= negative, 3= not too positive, 4= positive 5=v. positive

Figure 4.18 *Perceptual Map of Government attitude to RTOs performance*

Majority of the respondents felt that government perception of the performance of RTOs is between not too positive and positive as shown by the cluster of response around 3 and 4 in the map. Some supported their rating by informing that government funding support, which is dwindling, is a reflection of their perception of government attitude to RTOs.

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CHAPTER FIVE

DISCUSSION OF THE RESULTS

5.1 INTRODUCTION

In this chapter, attempt has been made to discuss the various findings from the study as presented in the preceding chapter. The essence is to establish if the findings are consistent with existing knowledge or there are new frontiers of knowledge or information resulting from it, which will be of interest to the public. Also, the hypotheses stated in this study will be tested and validated. The discussion of the findings is based on the study of the management practices of RTOs in Nigeria.

Consequently core issues such as governance, financial management, services, business development, organizational management, project management, capacity building and personnel management, networking, policy and programmes are discussed.

5.2 RESPONSES TO QUESTIONNAIRES

Conscious of the need to determine the threshold sample size in order to undertake statistical analysis, a sample size of 100 was considered. From the analysis of the responses about 95% level of certainty is achieved which is considered in line with

the views of other researchers (Saunders *et al*, 1997: 128-129). This gives a marginal error of 5%. With this level of response, it is obvious that at least 95% of the samples would be certain to represent the characteristics of the population. The estimate for the population characteristics will be within $72 \pm 5\%$. This is considered a representative sample size of RTOs in Nigeria.

Furthermore, response rates between 50% and 92% for questionnaire surveys have been reported as valid (Duman, 1978: 10-16, Saunders *et al*, (1997: 131) reported a response rate of 52% of a questionnaire survey they carried out for a multinational organization. The response rate from this study gives credibility and validity to data used.

5.3 MANAGEMENT PRACTICES OF RTOs

Research and Technology Organizations (RTOs) exist in different contexts and are established for different purposes. From this study the current management operations of RTOs were grouped into major process areas such as illustrated in figure 5.1. These management operations were compared with what is tenable outside Nigeria as contained in WAITRO model figure 5.2. It was obvious that business development and marketing are areas that require strengthening of RTOs management operations.

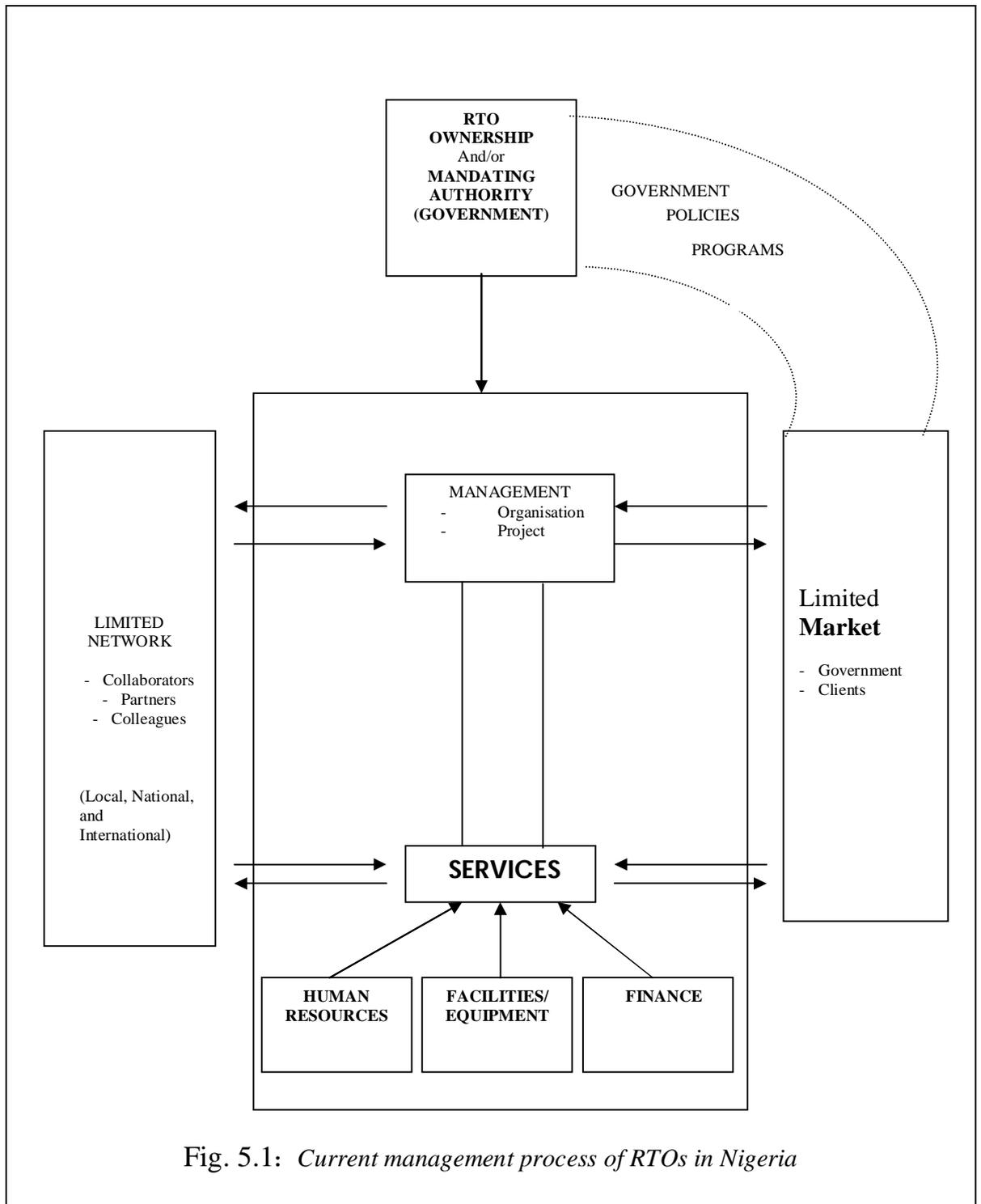


Fig. 5.1: Current management process of RTOs in Nigeria

Source: Adapted and modified from WAITRO, 1999

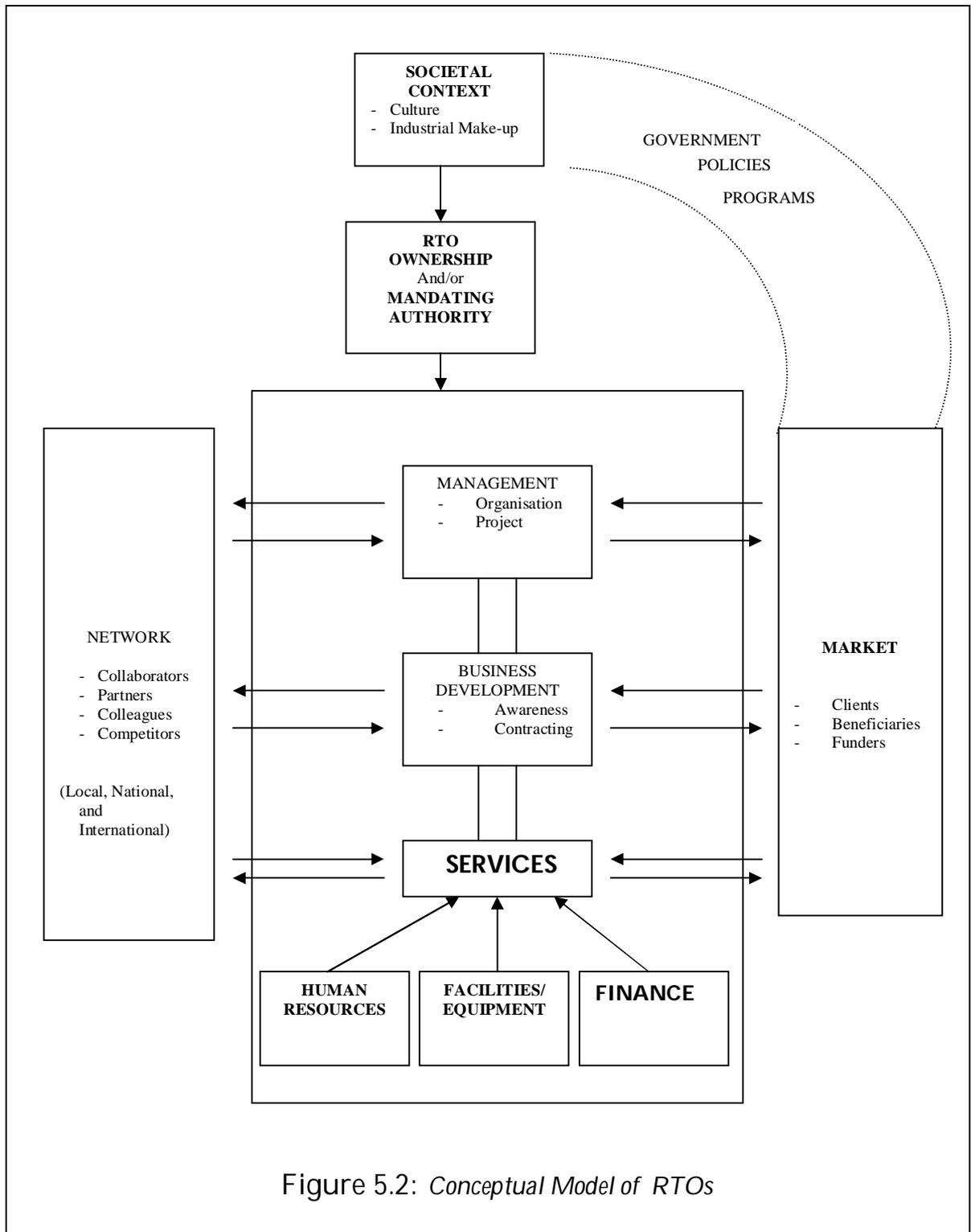


Figure 5.2: *Conceptual Model of RTOs*

Source: WAITRO, 1999

Also, network from the responses it was found that government is the major body responsible for the establishment of research and technology organizations (RTOs) in Nigeria. Most of the RTOs owe their legal structure from the decree establishing them under their parent Ministry. The Federal Ministry of Agriculture and Science and Technology are the prominent Ministries supervising the RTOs. There are 35 core RTOs and programmes in Nigeria with considerable number of R&D training institutions (15).

Government ownership of RTOs in Nigeria is similar to practices in other parts of the world. Pradosh and Mrinalini 1999: 1-7) observed that in most countries, both developed and developing countries, governments have played active role in establishing considerable numbers of RTOs for the promotion of domestic science and technological capability. In Canada for instance, some RTOs are under government control despite increasing pressure for government to pull out (Mc Dugall et al 1999: 1-7).

It is obvious from this study that government ownership of RTOs in Nigeria is not out of place. However, with increasing pressure on government finances, emphasis is globally being shifted to the private sector. The traditional (government)

sources of support to RTOs is shrinking and is constantly being challenged hence the call for restructuring of RTOs (Granger and Little, 1999: 1-8). For instance, in Europe the large State funded national institutions have been faced to greater or lesser extent, with governments that are increasingly unwilling to continue to support them at traditional levels.

This change in attitude towards government owned RTOs informed the present shift in emphasis to private sector. The RTOs are expected to be controlled by industry associations if serving an industrial sector or by government if serving a government interest (WAITRO, 1999: 27). Consequently, its legal structure should be such that it has financial and decision making autonomy. On the issue of Board membership of the RTOs, it was found that politicians are more in number as Board members than technocrats and industrialists. This apparently reflect the over bearing influence of government in managing RTOs affairs.

For meaningful impact to be made, it is the view of some researchers that majority of representatives on the RTO Board should be industry clients and technocrats. The Board of an RTO must comprise people that can make positive contributions towards the achievement of the organization's

objectives (Ohaba, 2001: 195-6). Ohaba further observed that appointment to board of organizations in Nigeria is often based on societal status, political patronage and other considerations. In an organization, the Board and top management are considered quite strategic to overall organizational management. They give direction and focus to the organization and consequently, should be involved in the strategic management process. One of the primary responsibilities of the Board is to establish or approve the organization's mission, vision, objectives, strategies and policies.

It is obvious from the findings on mission and vision of RTOs, that majority of them seem to have mission and vision but their internal stakeholders are not able to differentiate mission from vision or even mandate. This implies that concerted efforts were not made to educate staff on the importance of mission and vision. Mission and vision must not only exist, but must be communicated to all those that can positively influence its attainment (Baguley, 1994: 34-35).

To be effective, the vision contained in the organization's strategy must be concerned with overall task of the organization, which is meeting clients' needs. At the Board level considered also as a strategic level, vision is developed

and should be shared by internal stakeholders at the administrative and operating levels (figure 5.3).

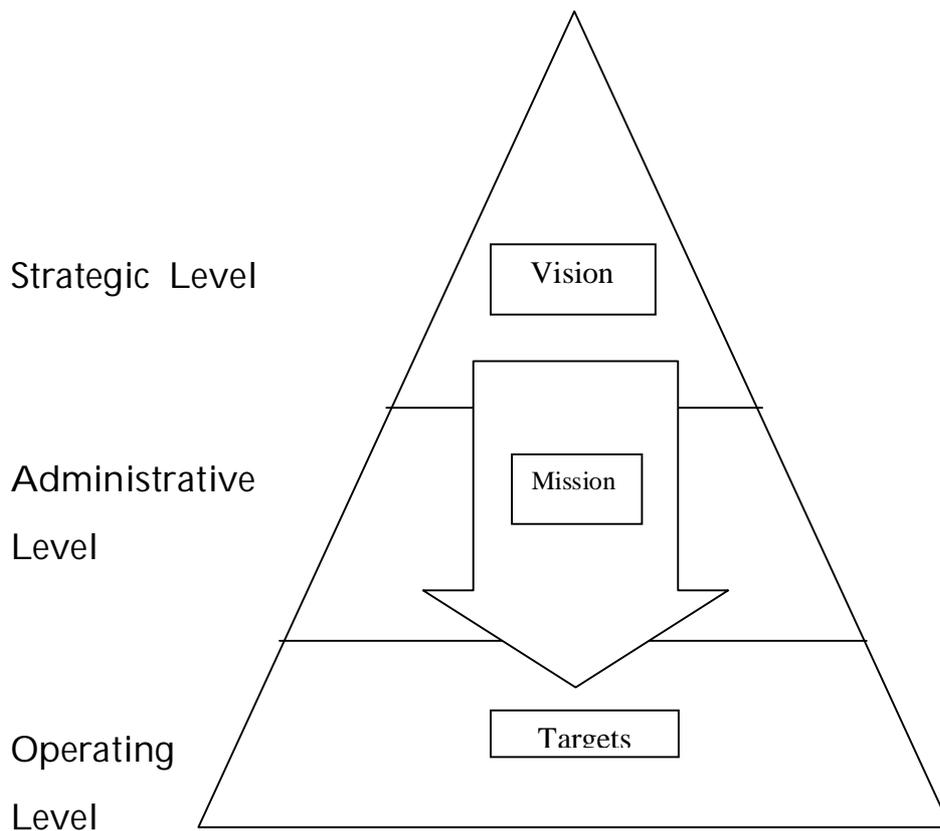


Figure 5.3 *Illustration of relationship between vision, mission and targets.*

The study on decision-making process and change management elicited some interesting findings based on comments from personnel of RTOs interviewed and responses to the study instrument. The internal decision making process is in the hands of senior management staff of most RTOs comprising the Chief Executive Officer (CEO), Directors and senior staff. The findings support the high functional role

accorded to senior management staff in the organizational management strata of any institution. There is no doubt that an ineffective team in which members operate through autonomous sometimes mutually hostile silo organizations can destroy an organization.

Beer and Eisenstat (2000 p, 29-40) described this group as “silent killers” that CEOs must be weary of and guard against. In fact, they constitute the dysfunctional organizational behaviours deeply rooted, largely unrecognized and seldom confronted. They severely limit organizational effectiveness. The collaboration efforts in a mutually reinforcing and synergistic way among CEOs, Directors and senior management staff will strengthen the operational management of RTOs while CEOs should provide courageous leadership, senior management staff should support them in such a way as to engender courage and good governance. CEOs should surround themselves with staff capable of thinking better and smarter than themselves (Akerman, 2000: 2-6). The issue of change management as it relates to RTOs provided interesting information for consideration. Though it is recognized that RTOs have the capability to change management with changing situations it was realized that their capability is limited due to lack of full autonomy. Also, rigidity and lack of adaptability were found as inherent

factors in RTOs management. The fact that RTOs are subject to external controls makes change extremely difficult. This finding corroborates the views expressed by Bozeman and Rogers (2002: 2-18) in their comparative study of public sector and private sector RTOs.

They further observed that agencies (RTOs) that are under some departments within a supervising body must be attuned to the priorities of officials in the department hierarchy. These officials must in turn respond to the dictates of political office holders or superiors. Thus, the leadership or CEO of an RTO is highly constrained.

From the literature review it was learnt that RTOs all over the world are confronted by an overwhelming need for change. Although some failed to survive in the heat of this transformation, others are struggling to survive. In Nigeria, RTOs studied seem not to be conscious of this changing situation and threat to their survival. Irrespective of the fact that government funding is no longer sustainable, thereby limiting their operational activities and overall performance, RTOs are still rigid in their approach to management. Even though they complained of hard times, they failed to seize the compelling opportunities that abound to be creative in the development of management practice, that are appropriate

globally for successful performance. Today's environment of shrinking fiscal resources and global interaction require more effective R&D management methods. RTOs must respond to this by applying a variety of strategic management tools to increase their effectiveness and performance.

5.4 FINANCIAL MANAGEMENT

Funding plays a fundamental role in the management of RTOs. The level of performance could be attributed to the level of funding and its judicious use. Also, ownership structure determines the nature of funding and the orientation of RTOs. For instance, RTOs studied are owned and funded by government and that explains why their research orientation is pro-government. It has been observed that RTOs that receive more than half of their money directly from industry, or in a manner that its use is controlled by industry, become industry focused (WAITRO, 1999: 27). Consequently, they conduct work that is respected and valued by industry. Even, industry will always rise in support of their continued existence. In contrast, those that receive more than half of their money from government without any mechanism whereby industry directs or influences the work conducted by them are not valued by industry (WAITRO 1999: 28). Even where an RTO is conducting research that might be relevant to industry, such research is often not valued because they do

not know about the work. This factor has a tremendous influence in the research-industry relationship.

Looking at the current funding pattern where government is the main source of funding to RTOs, it was found that government funding is not sustainable. With the present drive of government to bring its spending on public sector to the barest minimum and in line with available revenues, there are indications that RTO funding will continue to be restricted. It is in line with this prevailing circumstance that the benefits of publicly funded R&D are no longer taken for granted and are actually being challenged. From the interviews the genesis of poor funding of R&D was traced to the structure of the Nigerian economy. In Nigeria, as was found in the analysis of data, government traditionally fund all the research work both in RTOs and Universities. Industry in all cases, has played little or no role. It was also discovered that there has been a significant degree of foreign ownership of industrial concerns particularly in capital-intensive natural resource development. Much of the research in these fields that was funded by industry was done elsewhere outside Nigeria.

Over the last four decades, large sums of public money were poured into research at both RTO and University levels. The value obtained from this investment is still unclear because

traditional R&D management approaches focused on measuring effort-based inputs, such as level of spending and number of people involved, rather than results and commercial applications. Intermediate outputs such as patents and publications were also measured, but such measures have little to do with ultimate utility and benefits arising from them. Most government R&D expenditures were made without defined priorities or objective strategies against which performance could be assessed. As a result of this, long-term socio-economic and result-based indicators have largely been ignored. Whereas private sector R&D is measured in terms of company's internal rate of return on investment, the benefits of public sector sponsored R&D tend to be more diffuse with respect to both type and impact (Bozeman and Rogers 2003). Even a more fundamental issue is the fact that past performance is not considered as a reliable guide to future performance. Faced by a measurement problem that is both difficult and important, R&D analysis and management have evolved over a considerable length of time. R&D is currently seen as a creative enterprise and its management left in the hands of R&D CEOs. The main financial metric is annual budget, a tool considered basically inadequate to evaluate an investment (Boer, 2002: 23-35). The budget is fully determined by government benchmarks such

as R&D expense as a product of inventions, innovations and breakthroughs irrespective of their commercialization.

Furthermore, it was observed that accounting conventions treat R&D as an expense rather than an investment. This observation corroborates the observation made by others (Boer, 2002: 23-35). Mc Daugall et al (1996: 1-7) observed that Government research budgets are more of a convenient slush fund than a strategic investment. Also, Oragwu (2000: 1-8) commenting on the current budget practice of RTOs in Nigeria noted that the civil service approach to the design and implementation of R&D programme budget often fail to set up quantifiable and measurable goals. Bozeman and Rogers (2003: 5-18) noted that government budget processes are less flexible and there is only a limited ability to rollover funds. This supports the findings on what happened to surplus or shortfall of funds in which RTOs return funds not utilized before the end of the financial year to the federation account. Also, lack of autonomy limits the capability of RTOs in Nigeria to source for fund outside Government. There are indications that as fiscal pressure grows, the new driving force in research will be accountability and value for monies expended by RTOs. This therefore requires priority setting process, strategies to achieve priorities and indicators to assess and measure results.

Testing of Hypothesis on Funding of RTOs

In order to validate the hypothesis stated earlier, respondents were asked to evaluate the effect of funding on performance of RTOs. Their responses are presented in Table 5.1A. Three groups of RTOs responded to the question on whether or not inadequate funding militates against their effective performance.

Funding	Agric RTOs	S&T RTOs	Env. RTOs	Total
Inadequate Funding	10	19	0	29
Adequate Funding	13	10	4	27
Total	23	29	4	56

Table 5.1 *A Impact of funding on RTOs Performance*

The following hypothesis was tested for this distribution:

H₀: Inadequate funding of RTOs does not militate against their effective performance

H₁: Inadequate funding of RTOs militates against their effective performance.

Using the equation $E_{ij} = \frac{n_i \times n_j}{n}$

$n_i = 56$

$n_j =$

where i = row total

j = column total

A. Inadequate	Agric	S&T	Env.
	<u>29x23</u>	<u>29x29</u>	<u>29x4</u>
	56	56	56
	(11.91)	(15.02)	(2.07)
B. Adequate	Agric	S&T	Env.
	<u>27x23</u>	<u>27x29</u>	<u>27x4</u>
	56	56	56
	(11.09)	(13.98)	(1.93)

Expected frequencies are therefore given as:

S/No	Funding	Agric	S&T	Env.
1.	Inadequate	11.91	15.02	2.07
2	Adequate	11.09	13.98	1.93

Table 5.1B *Expected frequencies of Respondents*

Using the equation
$$X^2 = \sum_{j=1}^{nc} \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

For Inadequate = $\frac{(10-11.91)^2}{11.91} + \frac{(19-15.02)^2}{15.02} + \frac{(0-2.07)^2}{2.07}$

Funding 11.91 15.02 2.07
= 3.43

For Adequate = $\frac{(10-11.09)^2}{11.09} + \frac{(10-13.98)^2}{13.98} + \frac{(4-1.93)^2}{1.93}$

 11.09 13.98 1.93
= 3.68

$$X^2 = 3.43 + 3.68 = 7.11$$

Decision Rule

We reject H_0 at $\alpha = 0.05$ if the computed value of X^2 exceeds the tabulated value of $X^2_{0.95}$ for $(r-1)(c-1)$ degree of freedom.

where $r=2$ and $c=3$

$$c=3$$

$$(r-1)(c-1) = (2-1)(3-1)$$

$$= 1 \times 2 = 2 \text{ degrees of freedom}$$

$$\text{at } X^2_{0.95}(2) = 5.991$$

Since 7.11 is greater than $X^2_{0.95} = 5.991$ we reject H_0 at the 0.05 level of significance and accept alternative hypothesis (H_1). It is therefore concluded that inadequate funding of RTOs militates against their effective performance. This also confirms an earlier finding on level of financial support to RTOs by government.

5.5 RTO SERVICES

The study on RTO services was quite revealing. The findings indicate that for RTOs to achieve the purpose for which they were established, they must be client focused. This implies that the research, technology transfer, testing and information dissemination activities they conduct must be addressing industry's needs (WAITRO 1999: 26-27).

In other words, every identifiable functional aspect of the RTOs management system such as governance, organizational management, project managements, capability building, etc.,

must be structured in such a way that enhances their capability to meet the technological needs of its client industry. It is only when RTOs are primarily concerned about meeting clients' needs that their impact can be felt within the environment where they operate. The need for RTOs to be client-driven informed why an effort was made to look further down into the circumstances surrounding their emergence.

Pradosh and Mrinalini (1999: 1-7) reviewing the emergence of RTOs in less developed countries noted that the assumption behind the establishment of RTOs has been that when a pool of R&D infrastructure and skilled manpower is provided, industries would automatically make full use of these resources. Bell (1993: 1-10) gave a historic account of the genesis of RTOs in developed and developing countries. He stated that RTOs in developed countries had grown incrementally on the basis of the objective conditions provided by growing technology needs and competitiveness among industries. However, in less developed countries while the same organizational structure was initiated, similar objective condition was not established consequently, over the years these institutes preferred to define their R&D problems on their own without any formal or informal interaction with the potential users. This scenario supports the findings from

this study which indicate limited interaction between RTOs and their potential clients industry. The only exceptions have are the Agricultural RTOs that have some level of interactions with their clientele who are mainly farmers, NGOs, CBOs and Government agencies. It was also found that often, half hearted efforts are made to transfer technologies developed at laboratory level.

The overall system has been to expect industries and entrepreneurs to approach RTOs for off the shelf technology, which hardly takes place. Invariably, the RTOs were isolated from the possible end users of their research results. This situation no doubt created the current unbridgeable distance between them and industries. This situation has been reported to be prevalent in most developing countries. (Pradosh and Mrinalini, 1999: 3-7). For a proper understanding of the managerial practices of RTOs in Nigeria, there is a need for benchmarking. Benchmarking would imply the identification of organizational processes that are critical to developing closer and effective interactions between RTOs and their clients. Although benchmarking is beyond the scope of this study, nevertheless, it offers opportunity for the extension of the study on management of RTOs in Nigeria. Generally the findings reflect the need to foster and strengthen RTOs client service relationship. Market forces (pull) should determine

the type of service to be offered by RTOs. There is also, a constant need to establish unbroken linkage with clients through meetings, surveys, seminars/workshops and other interactive media.

5.6 CLIENT BUSINESS DEVELOPMENT

Client business development has been recognized as a new frontier of performance related operations of RTOs. In other words, any RTO desirous to perform must think business and act business. Through this study it was established that RTOs in Nigeria lack business orientation even though they claim to create business awareness. The RTOs are not industry focused and are mostly fashioned in discipline-oriented research whereas the global trend is a shift from discipline to industry and technology oriented R&D. This finding confirms the report of Chiang (1993: 351-57). The structure, mandate and culture of the RTOs do not encourage business development, as they are not profit-oriented. The new challenge for RTOs is to integrate technology development into the business. The R&D unit needs to cooperate with the business unit to achieve this goal. A business structure assigned to capture, manage, develop and commercialize RTOs research findings or proprietary technology platforms need to be established alongside a strategy for international technology acquisition and marketing (McDaugall et al 1996: 1-8). The current

practice whereby the supervising Ministry determines through the mandate of RTOs, the type of clients is not considered a good management practice. This practice limits initiative to identify client needs and encourages over-dependence on government patronage. It equally explains why research findings are not commercialized. Practices that contribute to RTO interaction with industries and other clients should be encouraged. It was realized from the study that to achieve an active customer relationship, RTO employees must actively relate with their customers to identify the problems they face and provide the technology solutions required. This must be within budget in a one stop-shopping environment. It has been suggested that the inclusion of clients in the decision-making system of RTOs will effectively facilitate the process of internationalization of the marketing of RTO services. (Pradosh and Mrinalini, 1999: 2-6). Relating the concept of business development to the current problem of poor funding of RTOs, the need for them to expand their services became quite imperative. Pradosh and Mrinalini (1996: 2-6) observed that there is continuous pressure on RTOs to increase their earnings from their services. Such stipulations are being justified as an instrument for increasing their interaction with industries. The basic thrust of the findings on business development aspect of this study is that the business process approach of RTOs should encourage

them to deal with clients and try to develop their capability and services. Constant track of its client must be kept. Moran (1999: 12-9) identified two core issues that should occupy the minds of many RTOs to include the following:

- Getting the greatest return on R&D investment through appropriate R&D spending priorities and;
- Listening to the voice of the customer in order to increase market awareness.

Today's RTOs must therefore work smarter as working harder is simply not enough. With increasing financial pressure, the only way to survive is to change, to aggressively look for new tools, approaches and strategies to improve the management of R&D processes.

5.7 ORGANIZATIONAL MANAGEMENT

For the survival of any organization irrespective of its size, nature, history or purpose, it must respond to the social economic, political and technical changes which pull and buffet them from all sides in today's constantly changing world (Baguley, 1994: 7). Consequently, organizations must respond to these changes and restructure in order to remain relevant and competitive too. Also, customer's demands for

improved and quality services have risen to heights in recent times, which pose greater managerial challenges to organizations. For the RTOs studied, there are indications of good practices in the area of target setting teamwork and effective leadership. However, the organizational management style currently being practiced is the hierarchical (Eiffel Tower) style. This is also called management by job description. This style of management has been described as unconventional (WAITRO, 1999: 29). The project-oriented management by objectives style guided missile is considered the best for RTOs. Ohaba (2001: 25-30) observed that most RTOs in Nigeria concentrate on routine work activities than achieving their objectives. He noted that effective management practice emphasizes concentration on establishing and attaining measurable goals.

Testing of Hypothesis on Organizational Management of RTOs.

Three core areas of management have been identified in this study to be the determining factors to the overall performance of RTOs. These are organizational management, business development and project management. In order to establish which of these core areas lies the strength of RTOs in Nigeria, the hypothesis stated below was tested.

Response	Agric RTO	S&T RTO	Env. RTO	Total
Yes	20	5	1	26
No	10	17	3	30
Total	30	22	4	56

Table 5.2A Comparative assessment of core management processes of RTOs.

H₀: RTOs are not effective in organizational management when compared to business and project management.

H₁: RTOs are effective in organizational management when compared to business and project management.

Using the equation $E_{ij} = \frac{n_i \times n_j}{n}$

n

i = row total

j = column total

where $n = 56$

		Agric Rtos	S&T Rtos	Env. Rtos
1.	Yes	$\frac{26 \times 30}{56}$ (13.93)	$\frac{26 \times 22}{56}$ (10.21)	$\frac{26 \times 4}{56}$ (1.86)
2.	No	$\frac{30 \times 30}{56}$ (16.07)	$\frac{30 \times 22}{56}$ (11.79)	$\frac{30 \times 4}{56}$ (2.14)

Table 5.2B Expected frequencies.

Using the eqn.
$$X^2 = \sum_{j=1}^{nc} \frac{(\text{Observed}-\text{Expected})^2}{\text{Expected}}$$

for Yes = $(\underline{13.93})^2 = 2.65$

13.93

+ $(\underline{10.21})^2 = 2.66$

10.21

+ $(\underline{1-1.86})^2 = 0.40$

1.86

Total = 5.71

For No = $(\underline{10-16.07})^2 = 2.29$

16.07

+ $(\underline{17-11.79})^2 = 2.30$

11.79

+ $(\underline{3-2.14})^2 = 0.35$

2.14

Total = 4.94

$X^2 = 10.65$

Decision rule

Reject H_0 at $\alpha = 0.05$, if the computed value of X^2 exceeds the tabulated value of X^2 0.95 for $(r-1)(c-1)$ degree of freedom.

$r = 2$

$c = 3$

$(r-1)(c-1) = (2-1)(3-1) = 2$ of freedom.

At X^2 0.95 d. f (2) = 5.991

Since X^2 tabulated is less than X^2 calculated, we reject the Null Hypothesis (H_0) at 0.05 level of significance and therefore the alternative hypothesis (H_1) is accepted. This implies that RTOs in Nigeria are quite effective in organizational management than in business development and project management.

Attitude Analysis

From the above tested hypothesis it is obvious that the area of strength of RTOs in Nigeria is in organizational management when compared to business development and project management. This finding explains partially why their performance in recent times has been rated lowly. The core issues for which their performance is rated such as number of successfully completed viable projects, the level of linkages made and support services rendered to the private sector were not attended to by RTOs. It equally explains why project results are not commercialized by RTOs as they limit their activities within the operational base rather than reaching out to potential clients. Consequently, their impact is not being felt.

It was identified from the study that the areas of weakness of RTOs in Nigeria include financial control, communication/networking, motivation, identifying sources

of fund outside government and information dissemination. These factors are considered quite critical to successful performance of any organization. These areas therefore need to be strengthened if RTOs are to meet the needs and aspirations of its funders and clients.

The major obstacles to RTOs performance are discussed under project management. The illustration of the SWOT analysis carried out is shown in figure 5.2

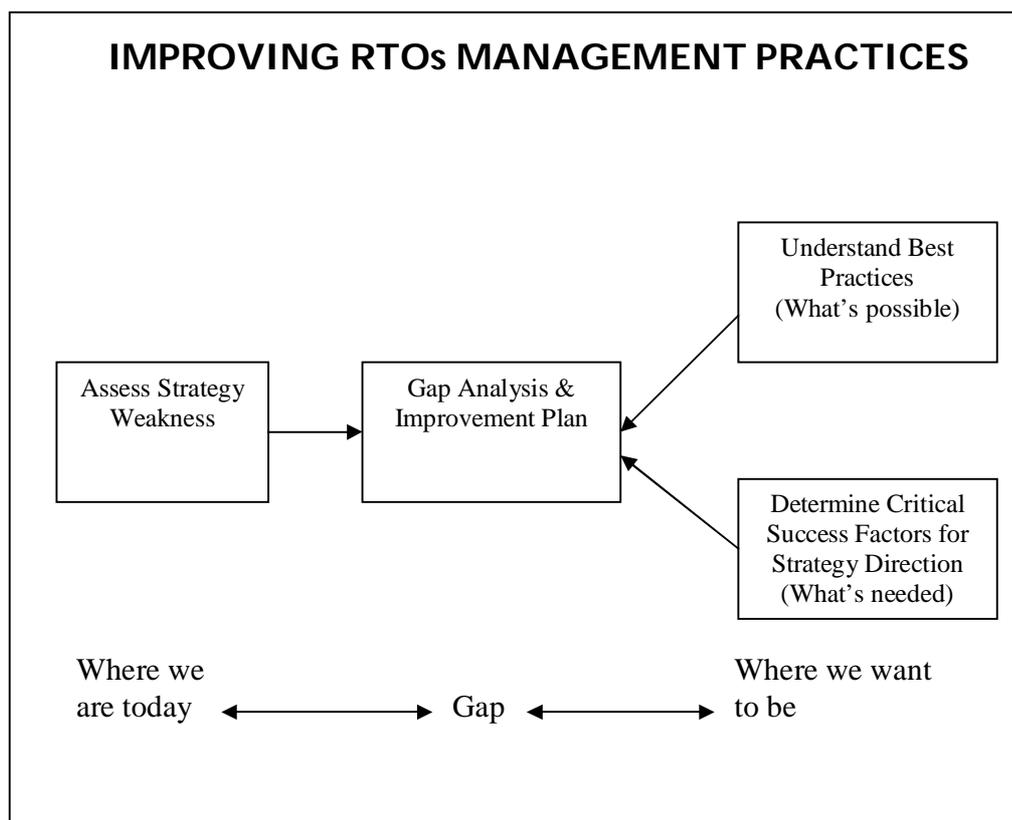


Figure 5.2: SWOT Analysis for Improvement of RTOs Management Practices

On the issue of change factor analysis, it was found that operational rigidity, lack of adaptability and inability to take risks are quite common among RTOs studied. When further examined, certain key factors responsible for these were identified based on respondents' comments. The factors include resistance to change among staff and leadership problem.

Boyett and Boyett (1998: 50-65) reported that most estimates, 50% to 70% of all corporate change initiatives launched in the 1980s and 1990s failed to achieve their objectives. He ascribed this to resistance to change and gave the following reasons why people resist change:

- The organization does not adequately communicate why the change is necessary, what the benefits of the change will be and how the change will progress once it begins.
- The traditional organizational structure business systems, technology, reward and so on are not aligned with change efforts, so people operate to oppose the change.

They however, suggested what is needed to be done for change to succeed, to include:

- Leaders of organizations should establish and communicate a compelling reason for change.
- the vision for the future of the organization must be clear and communicated to staff.
- There must be adequate information by the leadership team.
- Change must be total and comprehensive.
- Everybody must be involved in a management way.

Change is therefore, desirable for RTOs to be able to meet the growing challenge for their relevance and existence.

5.8 PERFORMANCE INFORMATION

The result of performance assessment showed high performance rating of RTOs. The high performance rate recorded indicates the possibility of bias among respondents. The general impression outside RTOs environment is that some of them are not performing. The findings therefore contradict this view. However, it could be possible from the point of view of loyalty to the organization and justification for their continued existence that the respondents reacted accordingly. Performance information was found to be very important for organizational management. The CEO and senior management staff constitutes the highest decision making body in an organization. There is need for

performance information flow among these groups of management staff for effective organizational management. Though standards for performance reporting are not standards of performance, however, they are desirable for better accountability and better organizational performance (Cutt and Murray, 2000: 76-77). They equally provide a framework for the next logical stage, which is the development of success criteria.

From the study, 10 attributes were crystallized and they include the following:

- management direction – the extent to which organizational objectives are stated and understood.
- relevance – the relevance of RTO programmes and projects to societal needs.
- appropriateness – the extent to which programme design and efforts made are logical in relation to organizational objectives.
- Achievement of intended results – the extent to which the goals and objectives of their programmes have been achieved.

- Acceptance – the extent to which the stakeholders are satisfied with the programmes and projects.
- Costs and productivity – the relationship between costs, inputs and outputs.
- Responsiveness – an organization’s ability to adapt to changes in such areas as business development (market) competition, available funding or technology.
- Financial results – accounting for revenues and expenditures and assets and liabilities.
- Working environment – the extent to which an organization provides an appropriate work environment for its staff and staff are motivated to achieve organizational objectives.
- Monitoring and reporting – the extent to which pertinent information relating to performance and organizational strength are identified, reported and monitored effectively.

These findings are in line with findings from a study carried out by Cutt and Murraray (2000: 85).

This study brought into focus the associated difficulties faced by RTOs in Nigeria in accommodating the varied and changing information requirements of the public and government funders including NGOs, clients and management staff.

5.9 PROJECT MANAGEMENT

Research efforts benefits considerably from thoughtful management practices specifically tailored to enhance relevance, importance, research quality coordination, participation, flexibility, productivity and communication (Baguley, 1994: 27)

The essence of studying project management practices in RTOs is to identify current practices that are good and make suggestions on strategies that could enhance RTOs management of their programmes and projects. Majority of the RTOs studied carry out good practices such as formation of project team, setting project direction and targets. Projects are implemented by selecting qualified and experienced personnel to execute such projects. Furthermore, with adequate funding, projects are implemented within a specific

time frame and budget. Apart from the above good practices, it was also observed that projects are effectively monitored and evaluated by both in-house personnel and officers from the supervising ministry. Certain practices were found to be inimical to the successful performance of RTOs. They include lack of accountability, lack of autonomy of project managers and project formulation not being client-driven.

Research focus of projects is more often than not basic research. There is limited applied research. The ideal situation should be both applied and basic research. Types of research output identified include scientific contribution measured in terms of articles published and technology development measured in terms of patents and licenses. These output types should be maximized fully by RTOs since they contribute to knowledge. On efficiency and effectiveness of project management, it was not possible to measure the performance of RTOs based on successfully completed projects. This shortcoming was associated with the nature of government sponsored R&D which tend to be more diffuse with respect to both type and impact. The traditional outputs of R&D in the RTOs such as articles and patents are difficult to measure in terms of impact to the society as well as their contributions to scientific and technical human capital. However, it is believed that the patents could be translated into viable economic

ventures if the RTOs are business like in their approach to R&D management. A new approach to measuring R&D effectiveness has been proposed (Szakonyi, 1995: 10-17). The new approach emphasizes on management of critical functions related to R&D. This is a departure from an earlier approach that emphasizes on R&D output or outcome. Measuring R&D effectiveness helps to indicate changes required in organizational processes of critical functions of R&D.

R&D selection must be business oriented. Client interest must be taken into consideration. There must be business plan for the implementation of the project. Planning process needs to be designed so as to have a system for tracking the time lines of all of their projects. For RTOs to remain competitive idea generation must be encouraged. There must be excellent climate for idea generation within RTOs. Best practice in the management of projects is considered a good practice that RTOs should emulate. Technical staff should not spend most of their time reacting to needs of their clients and have little chance to be creative. R&D personnel are observed to be too distant from the market place for their products, which is affecting their performance.

The quality of R&D of RTOs, which they claim to be high, needs some strengthening. To this end, RTOs should establish standard operating procedures for all of the repeatable activities that take place within the laboratory such as conducting tests and documentation of results. Some other activities that are considered quite critical to effective management of R&D include motivating R&D people, ensuring that R&D personnel play effective role in commercializing technology, facilitating communication among researchers, coordinating R&D and marketing, evaluating financial aspect of R&D and maintaining teamwork. These activities are briefly discussed. Motivating R&D people is desirable in order to sustain the driving force for R&D. Project managers must be people who can inspire others to achieve results. They must motivate and challenge project officers.

One critical area RTOs have failed to measure up to is commercializing technology and technology transfer. It was observed that RTOs function as if they are working in an academic environment. The CEOs and Directors rather than be project managers carry out the business marketing functions of the organization. Consequently, researchers do not fully understand the business implications of their research. In addition, they have little understanding of how

their research should be viewed as an investment. Technology transfer to manufacturing is a multidisciplinary process. The current practice in RTOs studied showed lack of competence in transferring technology to manufacturing. The capabilities of the technical services people in translating laboratory findings to semi-commercial manufacturing plant are in doubt. Some of the RTOs technical services people lack the skills needed to design the manufacturing processes appropriately for the R&D result.

The issue of coordinating R&D and market evoked a lot of interest as it was found to be the only option for RTOs to survive the changing funding landscape. In order to validate the importance of market driven R&D focus, the hypothesis stated below was tested.

Testing of Hypothesis on absence of market driven R&D thrust

H₀: Absence of market driven R&D thrust is not a major weakness of RTO activities.

H₁: Absence of market driven R&D thrust is a major weakness of RTOs activities.

Using the equation $E_{ij} = \frac{n_i \times n_j}{n}$, the expected frequencies are determined as follows:

$n = 56$, $i = \text{row total}$, $j = \text{column total}$

Response	Agric	S & T RTOs	Total
Yes	11	20	31
No	16	5	21
Total	27	25	* 52

* No response from Env. RTOs (hence 52 responses)

Table 5.3 A Observed frequencies

	Expected Frequencies		Chi-square calculation	
Yes	$\frac{31 \times 27}{52}$ 16.10 =(16.10)	$\frac{31 \times 25}{52}$ 14.90 =(14.90)	$\frac{(11-16.10)^2}{16.10}$ 1.62 =(1.62)	$\frac{(20-14.90)^2}{14.90}$ 1.75 =(1.75)
No	$\frac{21 \times 27}{52}$ 10.90 =(10.90)	$\frac{21 \times 25}{52}$ 10.10 =(10.10)	$\frac{(16-10.90)^2}{10.90}$ 2.39 =(2.39)	$\frac{(5-10.10)^2}{10.10}$ 2.58 =(2.58)

Table 5.3B Expected frequencies and chi-square determination

$$X^2 = 1.62 + 1.75 + 2.39 + 2.58 = 8.34$$

$$(r-1) (C-1) = (2-1) (2-1) = 1 \text{ degree of freedom}$$

Decision rule

At 1 degree of freedom $X^2_{tab} = 3.841$

Since X^2 calculated (8.34) is greater than X^2 tabulated (3.841), we reject the Null Hypothesis (H_0) and accept the alternative Hypothesis (H_1).

This implies that the absence of market driven R&D thrust is a major weakness of RTOs activities. It has been established that there is no business unit in most RTOs and consequently, R&D is not market-driven. RTOs need to have business unit to enable them sell the products of their R&D. Business planning is imperative for the survival of RTOs. The CEO of an RTO must show commitment to the business aspect of project management and communicate the business direction of his organization to staff. Senior management staff must understand where the organization is going.

The obstacles to R&D management identified showed that poor funding, lack of motivation, lack of research facilities and patronage by business community are the major ones. These findings corroborate a similar report in the study of African Scientists (Gaillard et al, 2001: 41) Also, in a similar study on research organizations in Common Wealth Countries, funding was identified as a major constraint.

5.10 PERSONNEL MANAGEMENT AND CAPABILITY BUILDING

The study on personnel management and capability building identified certain practices that are not considered good for RTOs. The issue of recruitment which was in most cases, the responsibility of the Chief Executive Officer was highlighted.

Recruitment however, should be a collective responsibility with inputs from other senior management staff and the Human Resources Unit. Selection criteria must be properly spelt out to avoid ambiguity. Some of the practices considered good are identified in section 4.27. The need for capability building cannot be overemphasized. A shortage or lack of trained manpower and requisite material and financial resources persistently constrain efficient research management in Nigeria.

In the context of R&D management, capability building answers a society need to identify and solve its research and development problems. This includes training and educating, as well as organizational and institutional development. A wide- range of activities were identified that could be used to strengthen RTOs which include the following:

- training and human resources development – is the most common manifestation of capability building.
- redefinition of institutional mandates – it entails clarification of the roles and responsibilities of all stakeholders including supervising ministries, NGOs and the private sector.
- improvement in internal management systems – This includes making institutional organizational

structure, budgetary and auditing systems and internal communication systems more accountable and “transparent”.

- Redefinition of organizational objectives – it requires linkages between strategic goals and activities, as well as institutional goals. These must also, be clearly defined.

Given the limited resources available to most RTOs, the effectiveness of these activities can be best ensured by a judicious combination of measures designed to achieve cost – effectiveness, efficiency, and progress. The overriding concern, however, should be good performance, which is the ultimate goal of capability building.

5.11 NETWORKING, POLICY AND PROGRAMMES

The study on networking, policy and programmes established the fact that RTOs in Nigeria do network with similar organizations both within and outside the country. However, the level of linkages varies both on institutional and client basis. The level of communication on R&D with industry and private clients, which is low, further justifies earlier findings that RTOs in Nigeria are not really client-industry focused. With the call for RTOs to be market- driven, there are foreseeable problems. For instance, the business plans of the

potential client industry and the R&D priorities of the RTOs are structurally and organizationally independent. For market driven R&D to materialize, it implies the institutionalization of linkages with the client industry sector in a suitable organizational structure.

Pradosh and Mrinalini (1999: 2-7) observed that linkages between organizations are not easy or automatic since mutual benefit from such partnership is not certain, tangible or easy to assess. The current status of RTOs whereby they enjoy government patronage and funding limits networking. These institutions as far as accountability for their performance is concerned, enjoy an autonomous status. They are accountable only along the line of organizational hierarchy and not to the users of their R&D results.

To make RTOs more oriented towards networking with client – industry or market, there is a need for business process approach to their operations. It was also, established from this study that there is no national R&D policy per se. However, the existing science and technology policy took into consideration the issue of R&D. The RTOs contribute to the implementation of the S &T policy through the implementation of their various mandates.

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CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY OF FINDINGS

RTOs in Nigeria have a prime mandate to support the public interest in two ways;

- to carry out R&D to meet statutory policy and or regulatory responsibility and
- to contribute to industrial development.

The landscape of activities of RTOs is changing globally. Both excellence and relevance are now critical in determining project priorities and resource allocation. Collaborating with the private sector partners is the norm which should be imbibed by all RTOs. This study was informed by the need to examine the management practices that made RTOs in Nigeria unable to perform and contribute significantly to the overall industrial development of the country.

The summary of findings from the study is presented as follows:

1. The characteristics of the population surveyed are representative of the RTOs in Nigeria. Of the 35 RTOs identified to be engaged in applied research 25 were studied.
2. The ownership structure confirmed Government as the major owner of RTOs in Nigeria. Also, government is the major financier while industry, NGOs and others contribute minimally to the funding of RTOs. The level of funding is not sustainable.
3. The membership of Boards of RTOs is skewed towards more politicians than industrialists and technocrats. However, it was found that representation on RTO Boards should favour participation by client industry and technocrats than politicians. This finding reflects the influence of government on the management of RTOs.
4. The mission and vision of RTOs are not clearly defined and staff do not show deep understanding of their existence. Effective communication of mission and vision among staff of RTOs is necessary. Mission and vision should be defined according to the role its client serves in the innovation chain.

5. The current structure of RTOs limits their autonomy as they take directives from the supervising Ministry. Thus, the leadership of RTOs is constrained by the dictates and priorities of supervising bodies and political office holders.
6. RTOs have the ability to change management with changing situations. However, this ability is also affected by lack of full autonomy. Also, rigidity and lack of adaptability were identified as contributing factors limiting capability to change management.
7. There is no financial autonomy for RTOs. Also, financial management information system is lacking. There is no on-line financial reporting, considered as the best financial practice.
8. The services provided by RTOs are not client-driven even though they offer a lot of services, which the public patronises. This implies that their services do not target market needs. It was observed that those RTOs that offer mix services have potential to survive limited funding, as they tend to generate funds internally through services.

9. RTOs in Nigeria generally lack a defined business unit for marketing of their services and project identification. Most of them are concerned with delivering good technical results without profit generation from such activities. It was also discovered that they are more concerned with delivering services within time schedule and budget without inclination to profit making. However, profit center approach to research management was found to be a good practice for RTOs.

10. The management of RTOs was found to comprise the administration, finance and technical (R&D) units or departments and support services departments. The existing structure emphasized disciplinary specialization and has proved effective in human resource utilization but not on project management and business development. Also, it does not encourage industrial partnership and commercialization of R&D results. The prevailing organizational management approach is hierarchical (or management by job description) rather than management by objectives. Irrespective of the lack of strategic management practices, it was found that organizational management is their area of strength. They were also found to be more concerned in addressing the needs and demands of its own system.

11. Performance information which is highly needed by the Chief Executive Officers (CEO)s, Committee of Directors (COD) and Funders is lacking. It was established that strategic planning process is fundamental to successful formal management control system for both funding and spending programmes of RTOs.

12. Researchers in RTOs enjoy more autonomy in choosing their research projects, a practice that is similar to that of University researchers. Consequently, the research focus is specialized and narrow in focus. Project selection process is affected by external factors. However, good practices such as formation of project team, setting project direction and targets and monitoring and evaluation are carried out by RTOs in Nigeria. Types of research output identified from the study include published scientific articles, patents and licences. These outputs types unfortunately are not being utilized. The capability of the technical services people to translate laboratory findings to semi-commercial manufacturing activity is in doubt. R&D generally is not market driven which is considered a major weakness of RTOs in Nigeria. Most of their R&D expenditures are made without defined priorities and objective strategies against which performance could be assessed. Obstacles to R&D management indicate poor

funding, lack of motivation and patronage by the business community as the major problems facing RTOs.

13. The study identified that R&D management requires highly qualified and skilled personnel. This caliber of skilled personnel requires substantial resources to develop and maintain staff morale, which when low, is inimical to effective R&D management. Also rigid staff recruitment system negates effective R&D management. It was also established that activities such as training and human resources development, redefinition of institutional mandates, improvement in internal management system and redefinition of organizational objectives are key to strengthening RTO management strategy.
14. It was discovered that there is minimal level of networking among RTOs in Nigeria, which might impinge on communication. Lack of awareness among RTOs on what each other is doing (in terms of R&D) leads to duplication of efforts. The level of interaction on R&D between RTOs industry and private clients is poor which justifies the conclusion that RTOs in Nigeria are not client – industry focused.

15. It was established from this study that there is no specific national R&D policy in Nigeria. However, the national S & T policy addressed some issues on R&D, which might not be adequate to give a sense of direction to RTOs. Also, government attitude to RTO performance is not too positive and this is reflected in the level of funding support.

6.2 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, RTOs all over the world are facing new challenges brought about by the unprecedented global challenges that have marked the last decade of the 20th century. The Nigerian RTOs are no exception. RTOs are faced with problems brought about by the peculiar economic circumstances of their country as well as challenges of a fast changing global environment. In view of this prevailing situation, there is a growing pressure for RTOs to restructure in order to remain relevant. This pressure is primarily due to two main reasons; money and mission. Money obviously is less and less available from the traditional sources; so new funding sources are needed. Also, the original mission of RTOs is increasingly being challenged. Restructuring simply means change in direction of management or a total transformation in ownership, strategy, management processes, resources, organization and culture. The

implementation of the restructuring program is an imperative for the efficient management of RTOs resulting in increased productivity and measurable impacts. Therefore, the streamlining of RTOs is a fundamental step to take in order to ensure the removal of duplication of functions. Three core areas need to be considered in this restructuring process.

- upgrading laboratory practice and methodology;
- launching a promotion and marketing programme for RTOs' corporate image, market their existing services and identify and evaluate new opportunities and
- enhancing staff capability in priority areas through an intensive programme of technical training and industrial exposure.

Their operational philosophy after transformation shall be to continue to carry out demand-driven research and development and maintain it at a sustainable level to meet the demand of industry and the nation and at the same time continue applied research in areas of expertise of the staff with funding obtained from local and foreign funding sources. By following this philosophy, RTOs will soon demonstrate their commercial orientation and market drive by a

significant increase in their earnings from industry support services.

From the study, there is no doubt that RTOs in Nigeria are increasingly under pressure to restructure and assist industry through the transfer of both technology and knowledge. Consequently, RTOs are now expected to work closely with industry to establish cost and risk sharing partnerships. Their research agendas are being broadened to include more applied research projects that can easily be transferred to industry and lead to spin-off technologies. Furthermore, they are expected to act as information brokers to assist industry especially, small and medium enterprises. In line with this new thinking, RTOs are expected to strive to achieve a partnership with industry in order to provide demand-oriented technology support services by way of consultancy, technical training, technology transfer and quality assurance services to meet and solve industrial short and long term needs. This new direction becomes imperative considering the fact that there is lack of conscientious effort and support to upgrade and adapt indigenous technologies to a level of mass production in industry. The situation is further compounded by the seeming constraints that hindered local enterprises from contributing to the development of local R&D capacity which include:

- Lack of incentive packages to attract the productive sector to the training of professionals and to encourage its involvement in risky ventures such as commercializing indigenous inventions and innovations.
- Lack of close involvement of industry in government planning process.

Linking R&D to industry is therefore a desirable strategy for technology development and achievement of industrial growth. Industrial R&D, no doubt, plays a key role in industrialization. It also facilitates the identification, characterization and development of material bases, new products and new processes for industrial activities. Its application in generating improved technologies will influence effective utilization of local resources. It is pertinent to note that public-sector R&D achievement is measured by the development of intellectual property such as the following:

- licensing of technology.
- spinning – out of new companies and service-based activities (such as consulting firms, venture funds).
- moving people and skills (technology transfer) to realize incremental improvements in products and processes.

These outputs cannot be easily associated with the current efforts of RTOs in Nigeria. To this end, concerted efforts need to be made to quantify the output of research activities in the country, for it to be relevant and meet societal needs. Furthermore, the present gap between basic research and market development should be bridged. If RTOs should handle more of applied research than basic research, it is prudent that a mechanism be put in place to facilitate its advancement. This may be achieved through the development of capability for translating the applied result into commercializeable products. From the study it was realized that considerable number of R&D conducted by RTOs were hardly commercialized. The major reasons identified for this include;

- that research is aimed mainly at meeting academic objectives.
- That it is not market-driven was due to poor linkages and lack of collaboration between the RTOs and the local industry,

This scenario equally explains why research results end up on the shelves of RTOs. The current situation leads to unnecessary wastage of lean resources. To address this problem, there must be established effective linkage between RTOs and domestic industry. Though such linkage looks

difficult to attain due to differences in organizational goals, it should be encouraged and strengthened. RTOs should, in close consultation with the industry and together with government, establish the technological needs of the industry that requires R&D intervention. In view of this, industry and RTOs may then undertake joint venture projects. Joint implementation of projects from problem identification to project formulation, experimentation and research, product and process development, pilot and market trials are feasible under this arrangement. This will ensure that only technologies or R&D projects that are relevant to industry and are likely to find direct application are researched on and developed.

Recommendations

From the preceding discourse, it is therefore recommended that in fashioning a project, RTOs should ask and answer the following pertinent questions:

- is the project market-driven ?
- does it provide immediate solution to existing national or industrial problem(s) ?
- is the solution to the problem a high priority matter?
- do adaptable solutions to the problem exist elsewhere?
- how does the project impact on the environment ?

Based on the answers to these questions, a rational decision will be reached at identifying a viable project. RTOs should be encouraged to undertake contract R&D work for the industry. In the process, funding of RTO R&D activities by the industry will be facilitated.

The issue of funding was found to be a recurring problem facing RTOs in Nigeria. It was established that three major sources of funding for R&D which include government, donor agencies and industry (to a limited extent) exist. Other sources include foundations; NGOs, levies and internally generated revenue, equally exist.

It is pertinent to note that, levies are no longer a sustainable source of funding. Membership subscriptions by industries are declining. As earnings of the industries are shrinking rapidly, they are no longer willing to pay membership fees. Consequently, this process of funding RTOs is gradually fading out.

Government is the major source of funding and contributes more than 90% of the R&D funding. Since government is not the major consumer of R&D results, it continuous funding should be reconsidered.

RTOs receive government funding with little direction on how it is to be used. This requires that R&D expenditure should be refocused on those areas in which private sector will be unable to invest but are of importance in building long term technological capabilities.

With tighter fiscal constraint, there should be a new science and technology goal and reporting structure, which will require RTOs to develop focused business goals and strategies. Furthermore, the inadequate funding of R&D projects resulting from lack of an integrated approach that links expectation with adequate levels of resource inputs (such as equipment, consumable etc) should be addressed.

At this juncture, it is desirable to note that though government might still remain the main financier of R&D in Nigeria, RTOs should explore opportunities of supplementing government funding from other sources. Government should encourage and assist to underwrite support funding from development banks and other agencies that require government authorization. Venture capital fund scheme should be established to assist in commercializing viable R&D results. Human and physical capacity for R&D need to be improved as well as communication networks.

Lack of satisfactory working conditions and inadequate remuneration and incentives resulting in high turnover of personnel have been observed to be prevailing in RTOs. Even, the issue of “brain drain” is reminiscent of the RTO environment today.

Formal and informal networks of association linking scientists and engineers in industry with those in RTOs constitute important channels for the distribution of knowledge. It is also a means of integrating all the factors, financial, industrial, scientific, technical and educational that help industries turn research into commercial success.

Findings from this study revealed that better coordination and monitoring of science and technology activities would lead to more purposeful and focused technological development application. While government is involved in R&D/S&T policy formulation and funding of R&D, the private sector acts as the consumer of the technologies. Nigeria therefore should endeavour to develop indigenous capabilities for undertaking strategic analysis in priority sectors. This is necessary in order to determine the desirable orientation for national development policies especially S&T policies and policy instruments. Also, RTOs must at all times sensitize government on the significance of a particular R&D

project to national development. This will contribute positively in formulation of policies that are favourable and to provide adequate funding for R&D.

For S&T to succeed in promoting development, formulation and implementation of R&D policy should occupy a central position in government policy machinery. A new pattern of R&D management within the policy framework of S&T is proposed which should embody the following:

- Emphasis on an integrated approach to the industry requirement for technological capacity.
- Definition of clear stages of R&D activities so that continuous technical changes can be measurable and
- Promote a balanced programme of basic research, applied and development research

Domestic technological capabilities should be improved in order to boost the absorptive capacity of the economy. This should focus on achieving efficient practices at low technology end of industry and setting the base for long-term competence in medium technologies. Appropriate policy issues need to be put in place to encourage greater investment in R&D by industry. The contribution of the private sector in support of R&D should be enhanced and even supercede that

of government. Government should put in place policy instruments such as tax incentives for R&D in order to encourage and promote private sector expenditure on R&D. These tax incentives could come in form of tax rebates, special concessions, reduction of tariff on R&D equipment and inputs.

Finally, the importance of imbibing modern management techniques by RTOs cannot be overemphasized. RTOs should undertake processes to reorganize their management structures through strategic planning in order to improve the efficiency and quality of programmes. Promotion of strategic planning is imperative, as it will enable RTOs to undertake self-analysis and introspection leading to a review of their management structures. RTOs in Nigeria should develop a strategic business plan to guide them in attaining the new goals and challenges by;

1. Enhancing the competitiveness of Nigeria's agriculture, forestry and biotechnology industries. They should identify opportunities for Nigeria's industry in the value chain for each sector. R&D programmes to address these needs should be established in collaboration with partners in the private and public sector.

2. Providing a specialized and sustainable R&D capability. RTOs should build intellectual capital around core competencies. Critical scientific, engineering and business skills should be accessed through a combination of hiring strategic alliances and twinning arrangements.
3. Developing and commercializing technologies. A business structure to capture, manage, develop and commercialize RTOs proprietary technology platforms should be developed along with a strategy for international acquisition and marketing. They should equally seek for opportunities to spin-out new technology-based enterprise and capital to finance the development and commercialization of their technologies.
4. Implementing management process to support corporate goals. RTO staff must share the vision of the organization, understand the key business strategies and contribute individually to corporate goals. RTOs should ensure that all activities, particularly the hiring of new staff and the acquisition of equipment and facilities are aligned with their strategic direction. RTOs offer their staff limited exposure to business

environments that stress short-term product development, marketing and cost consciousness. There is evidence from this study that exposure to private sector could foster more successful performance of RTOs. The establishment of a business unit in RTOs to promote R&D market and client industry relationship is recommended.

5. Developing global partnerships growing changes of global scientific and business environment demands global partnership for future survival. RTOs should reach out to other global institutions and seek opportunity for international projects and partnerships.
6. Encouraging RTOs customer engagement. To achieve this goal, all RTO staff must actively be engaged with their customers in order to identify the problems they face and provide the desired technology solution on time and within budget:

Conclusion

This study has made significant number of findings and proffered solutions where possible. However, in today's' changing fiscal climate, RTOs globally are facing increasing pressure for transformation. To achieve this, RTOs must use a

number of management tools, the core of which is strategic planning. The tools include the following:

- benchmarking against like-organization in order to develop and adapt best practices,
- utilizing competitive intelligence to stay ahead,
- promoting intellectual capital growth,
- developing global partnerships and
- active customer engagement.

Progress made towards the realization of business goals must be measured and monitored on continuous basis. The benefits of their experiences must be shared with other organizations using the management tools.

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Appendix 1

QUESTIONNAIRE

This Questionnaire is aimed at collecting data for the purpose of appraising the MANAGEMENT PRACTICES IN RESEARCH AND TECHNOLOGY ORGANISATIONS IN NIGERIA

This research work is purely an academic exercise and all information provided will be treated with strict confidentiality.

Kindly respond as vividly as possible to the following questions:

1.0 GOVERNANCE

1.1 NAME OF RESEARCH ORGANISATION... ..

ADDRESS:.....

.....

1.2 OWNERSHIP: Who owns and is ultimately responsible for your organization?

(a) Fed. Government (b) State Government (c) Private
sector

1.3 LEGAL STATUS: From whom does your organization get its overall direction?

1.4 CONSTITUTION OF BOARD: Who are members of your board?

(a) Politicians (b) Technocrats (c) Industrialists
(d) All of the above

1.5 SIZE AND CHOICE OF THE BOARD: What is your board size and who chooses the members of the Board?

.....

1.6 MISSION AND VISION: What is your mission and direction for the future?

.....

1.7 LEVEL OF AUTONOMY: What level of autonomy does your organization enjoy?

.....

1.8 MANDATE: What are your core mandates... ..

1.9 INTERNAL DECISION MAKING: Who is responsible for your internal decision-making?

- (a) The Chief Executive alone
- (b) The Chief Executive and Directors alone
- (c) The entire Senior Management

1.10 CHANGE OF MANAGEMENT: Are there prospects to change management with changing situations?

- (a) Yes
- (b) No

If No, give reasons... ..

2.0 FINANCIAL MANAGEMENT

2.1 FUNDING SOURCES: What are your sources of funding?

- (a) From Government
- (b) From Non-Governmental Organizations
- (c) From the Private Sector
- (d) Any other source (specify)

Who are your Clientele?

3.2 DETERMINATION OF SERVICES: Do you decide on which service(s) that should be offered to the target market and what are your reasons?

3.3 ENSURING SERVICE QUALITY: Do you ensure that your clients are offered quality service?

3.4 3.4 FUNDING AND SERVICE PROVIDED: Do your clients pay for the services rendered?

4.0 CLIENT BUSINESS DEVELOPMENT

4.1 MANAGING BUSINESS DEVELOPMENT:

Is your organization concerned with any of the following?.

- i. delivering good technical results only Yes or No
- ii. delivering good technical results on time and within budget Yes or No
- iii. Generating revenue while delivering technical results on time and within budget Yes or No.

4.2 REWARD FOR SUCCESS: Do you encourage growth in client revenue

4.3 AWARENESS CREATION STRATEGY: Do you inform your clients and funders about your capabilities, services

and successes, including your failures?

and how do you do this?

4.5 IDENTIFICATION OF GROUPS AND INDIVIDUAL NEEDS:

How do you identify needs of client groups or individual client's needs in order to decide on what service to offer?.. .. .

4.5 PROJECTS COSTING METHODS: How do you price the work done for clients to enable you best meet your financial targets?

4.6 BUSINESS UNIT: Do you have any unit or department responsible for business development? Yes or No

5.0 ORGANISATIONAL MANAGEMENT

5.1 ORGANISATIONAL MANAGEMENT: How does your organization meet its goals in terms of management style?.. .. .

5.2 GROUPING OF CAPABILITIES: Are your staff organized into groups to efficiently meet your goals?

5.3 UNIT RESPONSIBILITY: What level of responsibility do you think results in the best performance of your organization?.. .. .

5.4 LINE OF REPORTING: Which of these best describes your organizational management approach.

- a. Hierarchical approach (management by job description)
- b. Management by objectives
- c. No Idea

5.5 How do you rate your performance since inception? Min.

= 1 Max. = 5

1	2	3	4	5
v. low	low	moderate	high	v. high

5.6 How do you perceive government attitude towards the performance of RTOs? Indicate your response by circling one number between "very negative (1) and very positive (6)

5.7. INFORMATION ACROSS THE MANAGEMENT CYCLE.

Kindly use the three-point scale 0, + and ++ to indicate what performance information in your organization was necessary and whether it was sufficient or not (0=not necessary, + = necessary but insufficient, ++ = necessary and sufficient)

Information Users

Information Across the management Cycle			Internal			External	
			CEO	COD	Snr. Mgt. Staff	Funders	Clients
1.General stage of cycle	2.specific stage of cycle						
Prospective information on operational programmes	Plans	Primary and support spending programmes					
		Fund raising programmes					
	Budgets	Financial					
		Performance levels					
		Financial					
	Primary spending programme delivery	Performance levels					
Ongoing information during delivery of operational programmes	Fund raising programme delivery	Financial					
		Performance levels					
	Support spending programme delivery	Financial					
		Performance levels					
Retrospective	Year End	Financial					

information on operational programmes	Reporting						
		Performance levels					
		Financial					
	Evaluation and Audit	Performance levels					

5.8.i Do your management carry out the following activities from time to time?

- a. SWOT analysis Yes No
- b. Periodic organizational change to meet customers need
 Yes No
- c. No Idea

ii. Identify opportunities and threats to your organization

- a. opportunities.....
.....
.....
- b. threats.....
.....
.....

5.9 Please indicate by circling the options if your organization is more effective in organizational management than in business and project management Yes or No

6.0 PROJECT MANAGEMENT

6.1 PROJECT MANAGEMENT STRUCTURE: Do you have a team that most effectively and efficiently carry out your projects?

.....

6.2 AUTHORITY FOR PROJECTS: How are the project activities directed in a manner that best enhance their success?.....

.....

6.3 PROJECT ASSIGNMENT: How do you select person(s) to carry out projects so as to achieve your goals?.. ..

.....

6.4 PROJECT MANAGEMENT METHOD:

i. Do you keep to project time schedule and budgets?

.....

ii. Do you release funds as and when due?.....

.....

6.5 PROJECT FOLLOW-UP:

i. Are your projects effectively monitored and evaluated?

.....

.....

ii. Do you ensure that your client is satisfied with completed work and exploring opportunities for future work?

.....

.....

6.6 Please indicate the number of projects your organization has successfully established/completed in the past 10 years.

- a. <5
- b. >5
- c. >5 <10

6.7 What are the main factors in order of importance affecting R&D in your organization.

6.8 Certain obstacles have been listed below as affecting R&D management generally. Indicate by circling the relevant number (1,2,3,4) whether they are 1= insignificant, 2= slightly significant, 3= significant or 4= highly significant.

1 2 3 4	Poor Funding	Lack of managerial skills	1 2 3 4
1 2 3 4	Lack of qualified staff	Lack of technicians	1 2 3 4
1 2 3 4	Access to equipment	Field work difficulties	1 2 3 4
1 2 3 4	Lack of facilities (eg.electricity-water)	Lack of monitoring and evaluation	1 2 3 4
1 2 3 4	Equipment repairs	Access to project vehicle	1 2 3 4
1 2 3 4	Access to supplies	Access to scientific documentation	1 2 3 4
1 2 3 4	Low morale	Lack of motivation	1 2 3 4
1 2 3 4	Lack of patronage by the business community		
1 2 3 4	Others (Specify).....		

6.9 What were your sources of research funds?

Sources	%
Government	
Industry or Private Organization	
International Organization	
Others (Specify)	
Total	100

6.10 Absence of market-driven R&D thrust is a major weakness of research and technology organizations Yes or No

7.0 CAPABILITY BUILDING

7.1 DECISION ON CAPABILITY BUILDING: Who identifies the need for developing new skills or acquiring new staff?

7.2 CAPABILITY BUILDING OPPORTUNITIES: How are opportunities for capability building identified?

7.3 FUNDING STAFF IMPROVEMENT: Do you undertake and fund activities that build staff capability (please specify how).....

7.4 FUNDING CAPITAL INVESTMENTS: How do you fund the acquisition of equipment needed to deliver clients services?

8.0 PERSONNEL MANAGEMENT

8.1 RECRUITMENT/HIRING: How do you acquire staff with the required expertise?

.....

8.2 PROMOTION TO MANAGERIAL POSITIONS: Do you always encourage hiring the most appropriate persons' in supervisory and managerial positions? ,

.....

8.3 ADVANCEMENT OF TECHNICAL STAFF: Are you always promoting technical staff within their technical or professional stream?.. .. .

.....

8.4 COMPENSATION: How often do you compensate employees for their contribution to your organizations' success, to encourage high performance and to attract appropriate talents?.. .. .

.....

8.5 DECISION ON COMPENSATION PACKAGE: How are decisions made regarding your organization?

.....

8.6 NON-PAY BASED REWARDS: Do you encourage and reward high performance in any other way than salary and bonuses

.....

8.7 STAFF EVALUATION: How often do you identify the need for staff improvement?

.....

8.8 STAFF DISCHARGE: Do you have the ability to remove staff that are not performing or needed?

.....

8.9 INTERNAL COMMUNITIES: Do you instill an understanding of common purpose in the employees?

.....

9.0 NETWORKING

9.1 RELATIONS WITH TECHNOLOGY PROVIDERS: Do you develop mutually beneficial relationships with other technology providers?

.....

9.2 RELATIONSHIP WITH INDUSTRY: Do you develop mutually beneficial relationships with industry in order to better understand its needs?..

.....

9.3. How often do you communicate with the following people regarding your R&D? (1=never, 2=rarely, 3= annually, 4=monthly, 5=more often)

1 2 3 4 5 Scientists in your institution

1 2 3 4 5 Scientists from other institutions in Nigeria

1 2 3 4 5 Scientists from other institutions outside Nigeria

1 2 3 4 5 **Industries**

1 2 3 4 5 **Funding agencies**

1 2 3 4 5 **Private clients**

1 2 3 4 5 **Others (Specify).....**

10. POLICY AND PROGRAMMES

10.1 **ROLE OF YOUR ORGANISATION IN S & T POLICY:**

What is your role in helping the country in science and technology and industrial development policies?

.....

10.2 **R&D Policy:** Please indicate if or not there is a national R&D policy that guides your organization Yes or No

10.2 **USE OF GOVERNMENT PROGRAMMES:** Do you take advantage of government programmes that can help you meet your goals?

.....

Appendix 2

RESEARCH AND DEVELOPMENT AGENCIES/PROJECTS

1. African Regional Centre for Engineering Design and Manufacturing (ARCEDEM), Ibadan.
2. Centre for the Adaptation of Technology (CAT) Awka.
3. Energy Commission of Nigeria (ECN), Lagos.
4. Hydraulics Equipment Development Institute (HRDI), Kano.
5. National Agency for Genetic Research and Biotechnology (NACGRAB), Moor plantation, Ibadan.
6. National Centre for Remote Sensing (NCRS), Jos.
7. United Nation Centre for Space Science and Technology Education, Obafemi Awolowo University, Ile-Ife.
8. Sheda Science and Technology Complex (SHESTCO), Abuja.

Appendix 3

RESEARCH AND DEVELOPMENT TRAINING INSTITUTIONS

1. College of Animal Health and Husbandry, Vom (NVRI).
2. College of Chemical and Leather Technology, Zaria (CHELTECH).
3. Federal Fisheries School, Lagos (NIOMR).
4. Federal Freshwater Fisheries School, Baga, Maiduguri (LCRI).
5. Federal Freshwater Fisheries School, New Bussa (NIFFR).
6. Federal Mechanization School, Afaka (FRIN).
7. Federal School of Agriculture, Umudike (NRCRI).
8. Federal School of Forestry, Jos (FRIN).

9. Federal School of Wildlife Management, New Bussa (FRIN).
10. School of Agriculture, Akure (IAR &T).
11. School of Agriculture, Moor Plantation, Ibadan (IAR &T).
12. School of Animal Health and Husbandry, Ibadan (IAR & T).
13. School of Forestry, Ibadan (FRIN).
14. School of Medical laboratory Technology, VOM (NITR).