Analysis of Core Technical Issues in the Revitalization of the Nigeria Railway System

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Abstract— **The railway system is the most effective and safest means of transport for heavy goods movement in the economy with the additional advantage of lower cost per person per load as the train load increases. These factors notwithstanding the service delivery of the Nigeria Railway Corporation which played a significant role in the development and growth of the Nigeria economy deteriorated sharply with time leading to an inefficient, unreliable and uncompetitive transport system. Although a lot of studies have been carried out on the revitalization of the Nigeria railway industry, most of them concentrated on funding, rail line and wagon refurbishment, and management issues without much consideration given to core technical issues bothering on local capacity acquisition in the building of locomotives and rolling stocks, maintenance, spare parts sourcing, and other technical issues that will make the Nigeria Railway System economically viable and self-sustaining. In conjunction with the views of other stakeholders a rational plan was devised that will facilitate local capacity acquisition in the process planning, manufacture and maintenance of rail system components and equipments with Concurrent Engineering and Computer Integrated Manufacture under a Memorandum of Understanding with reputable railway operators and manufacturers. The paper concluded that the implementation of the local content capacity drive in technical competence in the operation of the Nigeria railway system will reposition the Nigeria Rail System to compete with other modes of transportation on both price and quality of service.**

Index Terms— **Nigeria, railway, revitalization, system, technical issues, transport**

I. INTRODUCTION

Transportation forms the basis of all socio-economic interactions and is an essential element in the economic growth and development of any nation. Economic transformation, and indeed, the development of any country are hardly possible without an efficient transport system [1]. The railway system is a vital component of the transportation system of the economy because of its effectiveness in the delivery of heavy good and lower cost per person as the train load increases. The Nigeria railway corporation played an important role in the agricultural and industrial development of the Nigeria economy right from inception. It provided the impetus for accelerated rural development by facilitating agricultural development, growth of cottage and large scale industries. It initiated the nucleation of residential, commercial, educational and recreational settlements and development along their corridors [2]. Its capacity which was further accentuated by its safety and security factors as well as its ability to travel longer distance with ease and lower unit cost placed it in good stead to serve as the hub of Nigeria transport system.

Nigeria's single-narrow-gauge railway line constructed in the colonial period was also for many years the only mode of freight movement between the northern and southern parts of the country. Nigerian railway particularly played a very active role in overland freight movement in the early years after 1960, to the extent that it accounted for approximately one-third of freight traffic [3]. At some point in time, the Nigerian railways played a key role in enhancing colonial administration, by maintaining links between the central seat of colonial government in Lagos and other parts of Nigeria. It was also a major mover of freight and passengers across the country, especially where the rail lines traversed.

The NRS is made up of 3505 km of narrow gauge (1067 mm) track, 30km of which is in double track while the rest is in single track. In addition to the foregoing is the 19km, 1067mm gauge extension from Port Harcourt to Onne deep-sea port and the 277km standard gauge rail construction (1435mm) from Ajaokuta to Warri [2].

Official neglect of the rail sector in favour of road and airport construction, mismanagement and graft greatly diminished the relevance and prestige of the railway sector. From ferrying 15.11 million passengers in 1984, Nigerian Railways Corporation, carried fewer than 1.5 million passengers in 1993 and far fewer by the turn of the century. The effects of the relegation of the rail transport sector are traffic congestion on urban roads, disorganised and unregulated use of articulated Lorries for freight services leading to fast deterioration of Nigeria roads, increasing rate of fatal road accidents and poorly maintained vehicles.

The economic transformation blue print of Nigeria in Vision 20: 2020 identified rail transportation as a key driver capable of putting Nigeria economic development on a high trajectory [5]. In this regard it has become imperative to examine why the enormous funds and efforts to resuscitate the Nigeria rail system has so far not yielded the desired results by examining the challenges and constraints plaguing it.

Some modern challenges in railway technology and operation includes the fast integration of electronics and control systems in rolling stock that used to be completely mechanical systems [6], [7]. Reference [8], surveyed the active application the active application of mechatronics and

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control in railway vehicles with focus on active primary and secondary suspension, and active parthography control. The work improved on the implementation of active suspension which is wide spread [9] in relation to the technology of vehicle body tilting and enhanced comfort in train movement. Also improvement in active parthography enhanced the operational efficiency and scheduling of high speed trains. active solution in railway technology have the capacity to reduce the cost of operation of railway systems [8].

Accurate analysis of track damage for prompt corrective action is a prerequisite for the sustainability of track condition. Reference [10], proposed a model using multi body codes to enhance monitoring scheduling for track inspection which encompasses activity variation on the track by various vehicles. This enables of various vehicles on track damage and evolution to be easily assessed.

In order to eliminate phase splits which constitutes breaking point in the supply of power to high speed trains and limits power traction effectiveness, Reference [11], proposed the development of a traction power system without phase splits. The model has the advantages of offsetting negative sequence current, remove phase splits at section post and mitigate the effects of equalizing current on power grid, quick location and diagnosis of faults to improve on the economy and reliability of modern railway systems.

Reference [12], carried out an analysis of complex railway nodes to design novel solutions to assess the use of stations in synthetic modes to identify areas of improvement to existing systems. the study offers significance for the evaluation of new investment and management of existing railway resources.

Although a lot of studies have been carried out on the revitalization of the NRS, most of them concentrate on funding, rail line and wagon revitalization and management issues without much consideration given to some modern challenges in railway technology and operation bothering on railway systems, vehicles and tracks manufacture and maintenance, spare parts sourcing, and other technical issues that will make the NRS economically viable and self-sustaining.

This paper critically examines the challenges and constraints of the Nigeria Railway System with special focus on local capacity acquisition using Computer Integrated Manufacturing (CIM) and Maintenance in core technical issues that are vital towards the successful revitalization and sustenance of the railway system.

II. BRIEF HISTORY OF THE NIGERIA RAILWAY CORPORATION

The Nigerian Railway Corporation officially came into existence in October, 1912 when Frederick Lugard merged the pre-existing Lagos government railway and the Baro-Kano railway to become the Nigerian Railway. The railway line ran on two principal North and South trunks: one from Lagos to Nguru and Port Harcourt to Maiduguri, both tracts having branch extensions. In the 1950s, partly for economic reasons, the railway system in the country came under the coordination of the Nigerian Railway Corporation.

Since the 1980s, the Nigerian Railway Corporation had been bounded by technical and financial shortcomings. The Nigerian civil war depressed railway operations and in the following decade, the low interest in export commodities and coal resulted in reduced freight haulage. The corporation rarely placed commercial objectives as a priority and government changes in administration and policy resulted in structural and managerial problems. The use of tracks of narrow gauge strewn with curves and gradients coupled with low maintenance over the years resulted in slow speeds for trains. In 1978, the Nigerian ministry of Transport employed the services of an Indian group: Rail India Technical and Economic Services to operate the railways. The period also coincided with large capital outlays from the government to the railway sector, though a large amount of the money was diverted to an ill fated change to standard gauge. The contract resulted in modest positive changes but the contract was not renewed. By the end of the 1980s, reduced funding from the government, import bans and managerial problems decreased the performance of the railways. Employees of the railway corporation and pensioners at many times were owned many months of salary and pension arrears leading to low labour morale within the corporation and dwindling performance.

III. CHALLENGES AND CONSTRAINTS FACING THE NIGERIA RAILWAY SYSTEM

A. Management and Funding Problems

Poor management by the Nigerian Railways Corporation (NRC) and lack of sufficient budgetary provision by the Federal Government led to the deterioration in the operation and fortunes of the Nigeria Railway system. The Federal Government has disproportionately invested and allocated funds to the road sector leading to the marginalization of the railway sector. The rail transport subsector hardly gets up to one-fifth of the allocation to the road transport sector [13]. Due to paucity of resources and operational expenses, maintenance requirements to keep tracks and rolling stocks in reasonable working condition could not be sustained.

B. Stagnant Rail Track Development

The rail network in the country stands at 3, 557km with 3, 505km still on the narrow gauge. Only two seaports (Apapa and Port Harcourt) are served by the railways while none of the airports is connected to the railways. Only 19 out of the 36 states are served by the railway while the Federal Capital is yet to be connected by the Railways [14]. The last major rail track extension in Nigeria was the 640-kilometre Kano-Maiduguri line completed in 1964. Unfortunately, rail lines remained as they were until the early 1990s, which could be referred to as the third phase of rail line expansion, when the Itakpe - Ajaokuta-Warri rail line construction project began. It is a 277km standard gauge (1435mm) rail line. There is also the 19km standard gauge rail extension project from Eleme to Onne deep-sea port. This extension projects were not completed.

C. Poor State of Rolling Stock and Locomotives

At independence in 1960, NRC had 257 locomotives, 339 carriages and 3885 freight wagons to serve an estimated population of about 21 million people over 3505 route-km. However, by 1995, the rolling stock levels had dropped to 70 locomotives (with 50% daily availability from 1995–96), 150 carriages and 1500 freight wagons to serve an estimated population of about 88.5 million people. Rail transport under the NRC suffers from inadequate and poor condition of available locomotives and rolling stock due to poor

maintenance. In 2004, out of a total of 3,987 wagons available in the system, 57.5 per cent were defective, while 36.6 per cent were fit and operational. The remainder was beyond economic repairs. Out of available stock of 683 coaches, only 34.6 per cent were fit for use. As for locomotives, about 70 per cent of the NRC fleet were have outlived their lifespan and usefulness [13].

D. Configuration of Track and Facilities Problem

No major infrastructural changes have taken place in the structure of the NRS tracks since the 1960s. Lack of spare parts and adequate equipments for preventive, schedule and major maintenance activities constitute a key impediment to Nigerian railway system efficient service delivery. This left the rail lines in bad state of disrepair. The rail line is characterized by worn out rails, steep gradients, sharp and in some cases, reverse curves, leading to low speed of train, frequent derailments, poor turn-around time for wagons and coaches and even accidents. The effects of this on the railway operations are a reduction in the number of operational trains and disruption of train services [13].

Railway communication and signally facilities are inadequate, obsolete and dysfunctional which constitutes serious constrains to the efficient and effective service delivery of the railway. The track structure still consists primarily of jointed rails, whose weights vary from 30 kg/m to 40 kg/m, and the ballast cushion is up to 30cm. The lightweight rails continue to limit the axle loads that they could bear, to about 12.5 tonnes to 20 tonnes. Whereas, for any meaningful impact, a more superior track structure with heavy continuous welded rails of up to 60 kg/m is needed to move heavier train loads [15].

E. Deteriorating Patronage and Performance

The rail transport sector now contribute less than 2% of the land transport in Nigeria which represent a serious imbalance from what obtained after independence when the rail carry over 60% of the tonnage. The NRC carried 15.11 million passengers by 1984 but this dwindled to less than 1.5 million by 1993. Between 2000 and 2010, the rail passengers carried annually were barely up to 2 million, while the tonnage of the freight or goods conveyed was not up to 170,000 tonnes in any year [13], whereas, in the early 1960s, close to 3 million tonnes of goods were conveyed annually. Other important constraints were government interference with management structure, lack of freedom to set tariffs, huge wage and pension bills, inflexible bureaucracy and irregular staff training.

The fundamental issue is that as a result of inadequate, obsolete and dysfunctional operational facilities with serious maintenance challenges coupled with a huge wage and pension bill, the NRC was operating in deficit. This poor state of affairs necessitated the shifting of patronage and focus to the road transport sector with the complete relegation of the NRC to the background.

IV. EFFORTS TO REVITALIZE THE NIGERIA RAILWAY SYSTEM

In order to reposition the NRC to contribute effectively to the economic growth and development of Nigeria, the Federal Government of Nigeria made efforts to revitalize the railway systems by sinking funds and signing contractual agreement with some Indian and Chinese companies to modernize the rail system to bring it back on track. In pursuance of this plan, it unveiled a $35 billion four-phased project aimed at giving the railway system a facelift. Under the administration of former President Olusegun Obasanjo, the 25-year rail development project was to take off with the Lagos to Kano route at an estimated cost of $8.3 billion. Government initially released $250 million to China Civil Engineering Construction Company (CCECC), the main contractor of the project. The project was splitted up into 5 sections namely Lagos-Ibadan (181 km), Ibadan-Ilorin (200 km), Ilorin-Minna (270 km), Minna–Abuja–Kaduna (360 km), and Kaduna-Kano (305 km). Government had equally obtained a $2.5 billion loan from China to facilitate the project. Construction started, but the project was suspended in 2008 following a dispute.

The signing of a sino-Nigerian contract of US$528,697,000 with the China Civil Engineering and Construction Corporation (CCECC) in December 1995, for 36 months was also a move to rejuvenate the Nigerian railways (Adesanya, 2002). More specifically, the CCECC was to carry out necessary track surveys, repair and align rail tracks, eliminate sharp curves and renew existing sleepers with additional ballast. Other things expected of the CCECC included the supply of 50 locomotives, 150 coaches and 400 wagons. This particular intervention by the CCECC remained inconclusive at the expiration of the contract in 1998.

In order to revive the ailing Nigerian railways, concessioning has also been suggested [16]. This would involve segmental concessions of routes to two or more concessionaires. Under this arrangement, railway infrastructure will remain the property of the Federal Government, while the concessionaires are expected to lease the rolling stock or bring in additional rolling stock for their operations. The concessionaires are also expected to participate in the rehabilitation and maintenance of relevant infrastructure. The concessions were planned to be granted for between 25 and 30 years. The planned concessioning in the rail transport subsector is aimed at injecting private sector investment and expertise to rehabilitate the existing line and also expand the rail network to cover other parts of the country in line with the 25-Year Strategic Rail Development Plan.

Since 2009, the NRC has been rehabilitating the existing narrow gauge railway, purchased 25 new locomotives, in addition to refurbishing a few locomotives and rolling stock (coaches, vans etc). The signaling and communication system is also being upgraded at booster control base in the 7 District Centres and along the rail route.

For proper coordination and overseeing the implementation of the railway reform process among other things, the National Council on Privatization (NCP) established the Transport Sector Reforms Implementation Committee (TSRC). The TSRC came up with a reform agenda that will culminate into the concessioning of the NRC. In Africa, private financing of railways became a reality in 1995 with the concession of the railway operations between Abidjan (Cote d'Ivoire) and Ouagadougou (Burkina Faso) [17]. This transaction has since been followed by a series of railway concession agreements between the private and public sectors in countries such as Cameroon, Gabon, Madagascar, Côte d'Ivoire, Zimbabwe, Mozambique, Senegal and Mali among others.

V. PROPOSED PROGRAMS FOR NIGERIA RAILWAY SYSTEM SUCCESSFUL REVITALIZATION

Experts in railway management have suggested various options for the repositioning of the NRS. Some of the options include;

i. Better and sustained funding for more locomotives, rolling stocks and improved **conditions of workshop**.
ii. The enactment of the Nigeria railway act to stimulate private investments into the NRC.
iii. Implementation of the plan for the development of the rail sector which should include the extension of the existing rail network to connect major sea ports and Inland Container Depots (ICDs), container freights station and the East – West rail connection.
iv. Promotion of Intra –Urban rail transport services to ease problems of severe vehicle traffic congestion
v. Developing of local capacity to build and maintain locomotives, rolling stocks and rail tracks.
vi. Formulate and implement a new transport policy for Nigeria
vii. Creating a new legal and regulatory framework for the NRS
viii. Restructuring of the NRC
ix. Divesting NRC non-core assets
x. Introduction of private participation, by granting concessions for both freight and passengers operators

VI. CORE TECHNICAL ISSUES ON NIGERIA RAILWAY SYSTEM SUCCESSFUL REVITALIZATION

Giving the limiting success achieved by the concessioning of Africa railway systems in other countries, the successful revitalization and the sustenance of the NRS as an economically viable and competitive entity depends on an innovative approach which must take into cognizance core technical issues that are vital toward its efficient operation. This issue involves the following pertinent technical issues;

i. Staff training in the planning, design, manufacture and operation of locomotives, rolling stock and tracks with compliance in Concurrent Engineering (CE) and CIM
ii. Development of a manufacturing base dedicated to the production of spare party for the Nigeria rail industry.
iii. Revitalization of the Nigeria comatose Iron and steel sector to develop material for the design and manufacture of rails, wagons and spare parts to support the Nigeria rail industry.
iv. Development of strategic railway engineering and maintenance policies, procedure and packages to service the Nigeria rail industry.
v. Development of product and safety standard to conform to Nigeria Industrial Standard (NIS) and ISO Standards.
vi. Formulation of realistic development programs for the development and upgrade of the Nigeria Railway Corporation to a standard rail system and network under a regulatory frame work.

A. *Training in the Planning, Design, Manufacture and Operation of Locomotives, Rolling Stocks and Tracks*

A comprehensive program should be developed and implemented to achieve local content capacity building in the use of CE AND CIM in the manufacture and operation of locomotives, rolling stock and tracks. Concurrent engineering integrate the design and manufacture of products with a view towards optimizing all elements involved in the life cycle of the product [18]. This extends to the use of simplified method of products analysis through Computer Aided Design (CAD), Computer Aided Engineering (CAE) and Computer Aided Manufacture (CAM) of railway systems. This capacity will empower the indigenous engineers to integrate the design process of rail and train components with materials, manufacturing methods, process planning, assembly, testing and quality assurance of locomotives, rolling stock and rail tracks. This will make the railway and train engineering team to acquire a fundamental understanding of the characteristics, capabilities, and limitations of materials, manufacturing processes and relates operations, performance of machineries and equipments involves in rail system network.

In the 1970s and 1980s, there were plans by the NRC to establish a rolling stock manufacturing plant in Kaduna, in conjunction with Daewoo Corporation of South Korea. The NRC Diesel workshop in Enugu also met the specification for diesel locomotive manufacturing, according to the feasibility studies carried out by General Electric of the United States of America [19]. These plans should be pursued with vigour using the right technological approach.

This thorough understanding of the process planning, manufacturing, operation and performance of rail systems and machines is required to able to produce and operate equipments that are adaptable to local services and conditions in the NRS.

A framework should be initiated to ensure all lower skilled and mid-skilled roles in the NRS are occupied by competent Nigerians and with formidable plans to staff high skilled positions with Nigerians over a period of 10 years of program implementation [20].

B. *Development of a Manufacturing Base Dedicated to the Production of Spare Parts for The Nigeria Railway Industry*

Easy access to high performance, cost effective and durable spare parts is vital to the successful operation of the Nigeria Railway System in a competitive economy driven by profit maximization. This require the efficient operation and management of the following manufacturing sector,

i. Forming and shaping process of locomotives, rolling stock and rail tracks components and equipments
ii. Casting of locomotives, rolling stock and rail tracks components
iii. Machining process and machine tools operation for the production of locomotives, rolling stock and rail tracks components and equipments
iv. Joining processes and equipments for the assembly and maintenance of locomotives,

rolling stock and rail tracks components and equipments

Forming and Shaping Process and Equipments.

In the forming process a work piece in the shape of a plate, sheet, bar, rod or wire is formed into various parts configuration by plastic deformation using various forming processes and machines. In this process various component and parts used in the rail and train system, automotive industry, construction, aircraft components and parts are produced. The forming and shaping process consist of the following processes;

i. Flat and shape rolling of metals
ii. Forging operations
iii. Extrusion processes
iv. Drawing and sheet metal forming processes
v. Powder metallurgy
vi. Processing forming of plastic and composite materials
vii. Others include bending, shearing, spinning, squeezing, etc.
viii. Forming and shaping of ceramics.

Metal Casting Process and Equipments

The casting process basically involves the pouring of a molten metal into a mould patterned after the part to be manufactured allowing it to solidify and the removing of the part from the mould. A large variety of parts and components are made by casting, such as engine blocks, locomotives and rolling stock components, crankshafts, automotive components and power trains, agricultural and railroad equipments, etc. Advanced machinery and automated process control have replaced traditional method of casting due to increase demands for high quality castings with close dimensional tolerance. Rapid advances in computers and modeling techniques have led to important innovations in modeling various aspects of casting which include fluid flow, heat transfer, and microstructures developed during solidification under various casting process conditions [18]. This level of expertise is required for the production of rugged and versatile parts and component for the Nigeria rail industry to withstand the operational stress and exertion they will encounter in operation for optimum service delivery.

Machining Process and Machine Tools Operations

A well stocked, standard and functional machine tools workshop is fundamental to the optimum operation of machineries in any service delivery and machinery process like the rail industry. Components and parts produced by casting, forming and shaping process require further machining operations into parts with close tolerance and dimensional accuracy before the product is put into use. Machining is economical in the production of small quantity of machine parts or components which material and parts shapes allowed to be machined at high rates and quantities and with high dimensional accuracy. Computer controlled machine tools and modern techniques are now available which are capable of making functional parts of any dimension of rail system components.

Joining Processes and Equipment

Many machines in the railway system consist of components that are systematically joined together so that the machine can function reliably and be produced economically. Joining is an all inclusive term, covering processes such as welding, brazing, soldering, adhesive bonding, and mechanical fastening. Joining of parts is required for various technical reasons which include;

i. Many products are impossible to be manufactured in a single piece.
ii. Products such as locomotives, rolling stocks and rails are designed to be taken apart for maintenance or replacement of their parts.
iii. Ease of Packaging, transporting and assembly at the site of usage of machines.

C. Revitalization of the Nigeria Iron and Steel Industry.

The iron and steel industry produce steel bars, rods, plates, wires and sheet metals for the forming and fabrication of components, parts and machines. A functional and highly productive iron and steel industry is fundamental to the economical and successful operation, and maintenance of any machinery base service delivery process and manufacturing operation such as the railway sector. In this respect the revitalization of Nigeria steel industries is vital to the successful operation of the NRS. The Ajaokula and Delta steel complex and the National Iron Ore Mining Company, Itakpe, must be repositioned for the local supply of the required materials for the spare parts base development sector of the NRS.

D. Development of Strategic Railway Maintenance and Engineering Policies, Procedure and Packages to Service the Nigeria Railway Industry.

Railway maintenance is the general upkeep of the railway which keeps the train running, such as looking after tracks, signals and power supply. Railway engineering is the larger scale infrastructural work, such as track replacement. Effective railway maintenance and engineering is required for a safe and reliable rail network for passengers.

Getting maintenance right in a railway industry is a key issue because the infrastructure can extend over hundreds of miles, and machinery keep moving about. Added to that is the breakdown in remote locations, public safety issues and penalty clause for late running and disruption of network. Therefore a routine maintenance, handling of emergency issues and a good supply chain for spare parts and materials are highly desired.

Traditional method of dealing with non critical failure is for the driver to leave a written comment for the maintenance team when the train is next in depot. Advances in computer engineering have made it possible for the maintenance team to notice the fault, watch it develop and analyze it for repairs using the train tracer system. This facilitates train repairs. A train tracer module added to the train's control system monitors changes in its major components and report via

radio transmission to a ground base receiver. Engineers can remotely analyze, anticipate problems or troubleshoot failures. Other train maintenance programs are Spear, Ramsys, DeltaRaclXV etc. Ramsys operation is not limited to rolling stock. It captures all the components in a railway down to individual line weld. The training and acquiring of expertise in these aspects of advanced train system monitoring and maintenance system could go a long way to enhance the operational efficiency, reliability and integrity of the NRS.

E. *E. Development of product and safety standard to conform to Nigeria Industrial Standard (NIS) and ISO Standards*.

Products safety and standards are essential elements for the reliable and effective operations of a railway system with high performance and integrity. Local content manufacturers of rail systems and components should be encouraged to build safety and quality in to products to conform to the ISO and NIS standards. Rail systems and components standards should be developed in partnership with the Nigeria Standard Organisation (NSO) and building of test centres for validation of the integrity of rail systems and components.

F. Formulation of Realistic Development Program for the Nigeria Railway System.

The Nigeria railway system needs a program of development that will elevate it to the status of a modern international railway corporation. Programs of development with adequate resources should be worked out and strictly implemented. These developments plan should include the following;

i. Upgrading the narrow gauge tracks, rolling stock and locomotives to standards ones
ii. Provide for training programs for indigenous engineers and technicians in partnership with reputable operators and manufactures of railway system components.
iii. Establish a conducive climate for the generations of funds and private sector investment through public – private sector programs in perspective of an economic viable and competitive rail system transport within a regulatory frame-work.
iv. Develop policies to support the initial assembly of rail system components and equipments for the utilization of the Nigeria railway system.
v. Develop an agenda for the provision of essential funds and equipments to the Nigeria steel industry to develop the materials for the consumption of the Nigeria railways system equipment and spare parts manufacturing base.
vi. Develop and provide the necessary policy back up and funds for the establishment of the Nigeria railway system manufacturing base. This sector should have capability in the manufacture of locomotives, rolling stocks and tracks with CE and CIM, and advance maintenance requirements and technology of rail systems. In this regard a policy framework should be established to consign heavy goods and containers transport to the rail sector to save our roads from the deterioration and road carnage associated with excessive use of articulated vehicles.

VII. ANALYSIS OF FINDINGS

Some of the critical challenges facing the NRC and its transformation to a sustainable and competitive and responsive railway system in the Nigeria transportation sector have been documented. The various palliative measures revolve around funding, upgrade and management of the NRC with investment injection from the private sector. This paper gives focus to core technical issue besetting the operation of the NRS in the form of low level local capacity in railway system planning, engineering and maintenance, out dated workshop facilities, reliance on foreign expertise for railway engineering work and system upgrade, and absence of adequate and qualitative spare parts supply chain and stock.

In as much as adequate funding, facility upgrade, private sector investment injection and control, are vital instrument for the repositioning of the NRC, the core technical issues highlighted above form the bedrock of NRC operation, reliability and sustainability.

A modern railway line should have easy access to resource persons with expertise in planning, design and manufacture of locomotives, rolling stocks and rail tracks. A well stocked and qualitative spare parts supply chain with a local base coupled with a robust routine and prevented maintenance schedules with dedicated staffs having access to modern advanced computer systems and programs for enhanced railway maintenance operation is equally vital.

The situation today is that the NRC relies on foreign expertise from Indian and china for supply of locomotives, rolling stock and maintenance which consume huge foreign exchange. This foreign expertise will only configure the NRS in a way that their relevance will continue to be appreciated and will conceal most of the technical knowledge from indigenous engineers and technicians. The results will continue to be an inefficient, unreliable and uncompetitive NRS.

Resource persons with local human capacity in the planning, design and manufacturing of railway parts and components in CE and CIM, supported with virile spare parts manufacturing base with expertise in the manufacturing considerations and requirements of primary forming and shaping process, reinforced with a versatile joining process and equipment technology form the basis for the successful revitalization and sustenance of the Nigeria railway system operation.

This railway engineering and technological base will create massive job opportunities in the Nigeria Railway system and other ancillary industries, act as a wealth creation tool to the Nigeria economy and save hard earned foreign exchange. It can also serve as a source for the manufacturing of automobiles and their spare parts. The Nigeria Automotive Council estimated that ₦500B was spent on spare parts importation for the automobile industry alone in 2012 [21]. The production of rail road equipment offers an opportunity to add value to Nigeria manufacturing industries and attracts foreign investment of international rolling stock manufacturers. The adoption of local content requirement and an enabling environment to protect foreign investment will stimulate the development of the Nigeria rail sector by utilizing the expertise of reputable manufacturers in rail

system component and equipments under an appropriate Memorandum of Understanding (MOU) for the development of local capacity in rail systems planning, building and operation. This will give the needed boost for youth employment, engagement and reduction of youth restiveness in social vices, armed robbery and kidnappings.

A Nigeria rail way system equipped with modern monitoring, communication and maintenance equipment and software will play a vital role in impacting efficiency, availability and reliability to railway services and operations. These equipments are very effective in the avoidance of accidents and deterioration of rail system components and equipments. They have the capacity to bring about significant savings in the early detection of problems in railway system and early repairs. This will minimize cost of operation and lead to profit maximization.

Since rail transport have advantages in heavy good transportation, lower transport cost, safety and reliability relative to other land transportation system, these core technical issues besetting the NRS should be addressed to provide low cost and easy good transportation, intra-urban mass transit, easy container movement, cheap and reliable means of transportation within Nigeria. This will stimulate the economy, lower the cost of production, provide massive youth empowerment opportunities, save lives and our roads from fast deterioration due to the activities of articulated lorries. This will also fast track the development of the Nigerian economy towards the achievement of the Vision 20.2020 development goal.

CONCLUSION

This paper carried out an analyses of the challenges and constraints of the with a focus on core technical issue that are fundamental towards the successful revitalization, operation and sustenance of the NRS as a virile entity that can deliver safe, responsive and reliable rail services to the Nigeria economy. In the achievement of the above objectives the acquisition of local content resources and human capacity in locomotives, rolling stock and rail track planning, design and manufacturing and maintenance with CE and CIM facilities is an imperative. A Nigeria railway system that relies on foreign expertise and entities technically for sustenance of its operation cannot continue to deliver qualitative services that will extricate the Nigeria economy form foreign dependence and manipulation.

In the true spirit of national development the government should establish the necessary policy framework and funds in a public - private partnership program to enhance local content capacity development and resources acquisition in core technical issues that have been highlighted to reposition and sustain the activities of the Nigeria Railway System as an economically viable entity to deliver qualitative and efficient services to the Nigeria economy.

The implementation of the local content capacity drive in the operation of the Nigeria railway system in conjunction with adequate funding, passage of the Nigeria railway bill and establishment of a responsive regulatory frame work will reposition the Nigeria Rail System to compete with other modes of transportation on both price and quality of service and facilitate the achievement of the Nigeria Vision 20: 2020 development goal.

RECOMMENDATIONS

The following recommendations were made,

i. Staff training in the planning, design, manufacture and operation of locomotives, rolling stock and tracks with CE and CIM.
ii. Development of a manufacturing base dedicated to the production of spare party for the Nigeria rail industry.
iii. Revitalization of the Nigeria comatose Iron and steel sector to develop material for the design and manufacture of rails, wagons and spare parts to support the Nigeria rail industry.
iv. Formulation of realistic development programs for the development and upgrade of the Nigeria Railway Corporation to a standard rail system and network under a regulatory frame work.

REFERENCES

[1] O. Lingaitiene, 2006. Application of a general model of multimodal transportation in logistics. Transport and telecommunication. 7(1), pp. 92-96.
[2] K. R. Okanlawon, 2006. Towards enhancement of light rail system in efficient transportation of commuters in Lagos State, Journal of Social Policy and Society, 1(1), pp. 22 - 27.
[3] H. Robinson, S. R. Smith, and K.G Clare, 1961. The Economic Coordination of Transport Development in Nigeria, Stanford Research Institute, California.
[4] S. I. O Elechi, 1998. Rail Transport in Nigeria: Problems and Prospect in Eniola, J.O., Transport: A Developmental Catalyst. in Lagos, Tranec Nig Limited, pp. 241-256.
[5] National Planning Commission, 2009. Nigeria Vision 20:2020: Economic Transformation Blueprint, NPC, Abuja.
[6] R. Goddal,l 2011. Control Engineering Challenges for Railway Trainsportation of the Future, Measurement and Control, 44 (1), pp. 16-24.
[7] S. Bruni, R. Godall. T. X. Mei, H. Tsunashina. 2009. Control and monitoring for railway vehicles dynamics. Vehicle Systems Dynamics, 45(7), pp. 743-779.
[8] R. M. Goodal, S. Brunai and A. Fachineti. 2012. Active control in railway vehicles. International Journal of Railway Technology. 1(1), pp. 57-85.
[9] R. Person, R.. M. Godall, K.Sasaki. 2009. Car body tilting-technologies and benefits. Vehicle Sysytem Dynamics. 478(8), pp. 949-981.
[10] N. Bosso, A. Gugliota, and N. Zampieri. 2012. A comprehensive strategy to estimate track conditon and its evolution. International Journal of Railway Technology, 1(2), pp. 1-19.
[11] Q. Li. 2015. New generation power supply and its key technologies for electrified railway. Journal of Modern Transportation. Available: http//link.springer.com/article/10.1007/340534-015-0067-1/fulltext.html.
[12] G. Malavasi, T. Mulkova, S. Ricci, F. Rtolli. 2014. A synthetic approach to the evaluation of the carrying capacity of complex railway nodes. 4(1), pp. 28-42
[13] A. Adesanya, 2002. Declining fortunes of rail transport in Nigeria: response and direction of policy, NISE Monograph Series No.8, NISER, Ibadan.
[14] E. Edward, (2001, October – December). Taking railways to a new standard, in rail news. Quarterly Journal of Nigerian Railway Corporation, 2(3), , pp. 15 - 25.
[15] A. F. A. Babatunde, 1988. The technological problems of railways transportation in Nigeria, Nigeria:Transport-Aviation and Tourism' Information

Handbook, Directory and Who's Who', A Media Research Publication, Lagos, pp. 128-136.

[16] K. Khalidson (2005) International Comparative Analysis of Rail Privatization and Concessions, Paper presented at the National Workshop on the Reform, Restructuring and Concessioning of Nigeria Railway Corporation. Held at Crystal Garden Hotel, Kaduna pp. 11 -12 July.

[17] A. A. Thiam (1998) The Story of Railway Concession, The Courier, No.169, May-June.

[18] S. Kalpakjian, and S. R. Schimd, "Manufacturing Engineering and Technology", 5th ed. London: Pearson: Prentice Hall, (2006), pp. 11 – 40.

[19] Media Research, (1988). Nigerian Railway Corporation. Nigeria: Transport-Aviation & Tourism,Information Handbook Directory & Who's Who? A Media Research Publication, Lagos, pp.108-117.

[20] Nigeria Automotive Council. (2013). Measures to Transform the Nigeria Automotive Industry and Attract Investment into the Sector. Available: http: www.nac.org.ng/AUTO_PLAN

[21] L. Binyat (2013, November 10). Nigeria Spent NI.05 Trillion on Imported Cars Last Year- Automotive Council. Vanguard. Available: http: www.vangaurdngr.com/2013/11/