THE TRIOLOGY OF ROAD DEVELOPMENT AND THE LOGIC OF PLANNING PROCESS IN NIGERIA: A POLYCENTRIC ENVIRONMENTAL PLANNING PERSPECTIVE

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Abstract
Good roads represent a common-wealth where all citizens draw for their day to day socio-economic interactions. However, when roads are dysfunctional, other sectors of the economy are negatively affected. Roads in Nigeria fall into state of disrepairs as soon as they are constructed or rehabilitated. Consequently, perennial road rehabilitation is the order of the day, a situation that not only drains government resources but at the same time hinders smooth socio-economic interactions of citizens due to obstruction and delay that are caused on the roads during rehabilitation exercise, thus engendering wide-spread poverty among the citizens. The wisdom of the logic of planning process demands utilization of local knowledge and environmental resources to resolving identified societal problems. One major problem that confronts Nigeria is that Knowledge Management (KM) tools are not properly utilized to transform local raw materials into construction materials. This, invariably, places the country as a technology consumer rather than a producer, thus, making the country vulnerable to external shocks. This paper uses the Institutional Analysis and Development (IAD) framework in tandem with Knowledge Management (KM) tools in analyzing problems that weaken the effectiveness and efficiency of road development in Nigeria. The paper derived data from Lagos and Osun States in Nigeria and used simple descriptive analysis to discuss factors that weaken the effectiveness of road development. The paper traces the ugly transport phenomena on Nigerian roads to three major factors: (1) lack of adequate data for design and construction; (2) corruption in contract 'market'; and, (3) lack of monitoring of road projects both during and after construction. Using polycentric environmental planning, this paper posits that the triology of road development - survey, construction and monitoring/maintenance (SCM) pre-conditions durable roads. Consequently, the paper designs a Nigerian Road Triology Model (NRTM) that can help in overcoming problems that are associated with lop-sided road development. The model establishes that road development should be placed on a tripod stand of survey, construction and monitoring/maintenance (SCM). Using the NRTM in conjunction with planning process, the paper designs an appropriate institutional mechanism that is capable of synergizing the efforts of all the stakeholders (government, universities/polytechnics, the private sector, road construction companies and local communities) in utilizing KM tools and local resources to the benefit of road development in Nigeria.

Keywords: *Road, Triology, Environment, Development, Polycentricity, Planning, Nigeria*

Background to the Study

The importance of road network in development is analogous to the role of blood vessels in the human anatomical system as it is the main frame and the medium of socio-economic, political and cultural interactions within every society (Akinola, 1998). Good roads represent a common-wealth where all

Using polycentric environmental planning, this paper posits that the triology of road development - survey, construction and monitoring/maintenance (SCM) pre-conditions durable roads. Polycentric environmental planning is a deliberate act of setting up multilayered and multicentred institutional mechanism that regards knowledge and self-governing capabilities of local communities as foundation for reconstituting order from the bottom up on environmental matters. It can also be described as the process of ordering the use of physical, human (knowledge), environmental and institutional resources as well as engaging the citizens in contractual relations with the public authority on environment (see Akinola 2009b, 2010a,i, 2011a). Consequently, the paper designs a Nigerian Road Triology Model (NRTM) that can help in overcoming problems that are associated with lop-sided road development. The model establishes that road development should be placed on a tripod stand of survey, construction and monitoring/maintenance (SCM). Using the NRTM in conjunction with planning process, the paper designs an appropriate institutional mechanism that is capable of synergizing the efforts of all the stakeholders (government, universities/polytechnics, the private sector, road construction companies and local communities) in utilizing local resources to the benefit of road development in Nigeria.

Access, "Bottleneck" and the Problematics on Nigerian Roads

The present crisis on Nigerian roads is best described as access "bottleneck". Access bottleneck is simply defined as the difficulty or constraint of moving on roads. The constraint is created by the presence of pot-holes, ditches and pool of water on roads. Other constraints include too many police check-points and queues at filling stations during the fuel scarcity. However, bad road condition due to pot-holes is a major concern. The implications of bad roads are well documented by Akinola as early as the middle of 1990s when Nigerian roads started experiencing depressing crisis. The effects of pot-holes on roads have been linked with depreciation of vehicles. Vehicles were affected structurally in terms of tear and wear of vehicles' parts. Besides, the passengers are inconvenient and series of accidents had occurred on such roads (Awotona and Akinola, 1996; Akinola, 1998).

Pot-holes on intra-city roads cause traffic hold-up, as speed is reduced. This situation apparently causes impatience, tension and aggression not only among vehicle operators but also among passengers as well as private owners. Pot-holes on inter-city roads are associated with various types of accidents and because vehicles on inter-city roads move at high speed, such accidents tend to be fatal. At times, an attempt to escape running into pot-holes causes head-on collision with an on-coming vehicle, a situation which has claimed many lives on Nigerian roads. Analysis shows that the number of persons killed and injured were on the increase from 1994 to 1996. Apart from the 18,472 persons that died within the three years, some of the 41,784 persons injured were likely to be disabled and probably constitute social problems to the society (Akinola, 1998). Study shows that impairments that were traced to accidents constitute about 31.00% at disabled rehabilitation centers in Ibadan, Ibadan, Oyo State, Nigeria. This category of people thus become permanent dependants on other members of the society for their daily living, which represents a high cost to the economy (Akinola, 1997).

Statistics show that between 2007 and June 2010, a total of 4,017 Tankers/Trailers crashes were recorded on Nigerian roads with a yearly average of 1,148 cases and monthly average of 96 crashes. The rate of crashes involving Tankers and Trailers is on the increase. A total of 4,076 persons were killed in crashes within the same period, while 12,994 persons were injured. A total of 5,825 vehicles were involved in the crashes that generated 17,070 casualties involving 26,362 persons (FRSC, 2010, Akinola, et. al., 2013). The low quality of roads in Nigeria has been traced to various factors but most importantly to: (1) low quality of asphalt and (2) corruption of government officials and fake contractors - poor governance. It was gathered that the

citizens draw for their day to day socio-economic interactions. However, when roads are dysfunctional, other sectors of the economy are negatively affected. In developed societies, for instance, roads live up to their gestation periods as stipulated by the designers and contractors. Roads in Nigeria fall into state of disrepairs as soon as they are constructed or rehabilitated. Consequently, perennial road rehabilitation is the order of the day, a situation that not only drains government resources but at the same time hinders smooth socio-economic interactions of citizens due to obstruction and delay that are caused on the roads during rehabilitation exercise, thus engendering wide-spread poverty among the citizens (Awotona and Akinola, 1996; Akinola, 1998).

The wisdom of the logic of planning process demands utilization of local knowledge and environmental resources to resolving identified societal problems. One of the three important factors in understanding how a society functions is "the peculiar and accidental situation, which providence" places people. This could refer to the environmental and material conditions that are available to people in fashioning their lives. The second is "the laws" or institutions, while the third factor is the "manners and customs of the people" that determine their value, culture and technological outlook of the community concerned (Tocqueville, 1966). One major problem that confronts Nigeria is that Knowledge Management (KM) tools are not properly utilized to transform raw materials into construction materials. Though raw materials that are used in producing construction materials are available in large quantity in the country, they have to be exported to other nations where they are transformed into products for construction industry in Nigeria (Akinola and Ogunbiyi, 2013). Statistics confirmed that in spite of the existence of abundant natural resources in the country, over 80% of construction materials are imported (Okereke, 2006:13). This, invariably, places the country as a technology consumer rather than a producer, thus, making the country vulnerable to external shocks. The central argument is that: it is what people are doing at home that should form the basis of development in road construction. It is not enough to learn from abroad; development cannot be imposed from above or from outside. This requires a rethink on the current methods, approaches and strategies of operation in the construction industry.

Knowledge and its application are acknowledged as key sources of growth and development in the global economy, especially if they are adapted to specific circumstances and effectively utilized to generate significant opportunities for reducing poverty and promoting sustainable development. Nonetheless, lack of adequate attention to institutional mechanism to effectively adapt knowledge to the construction industry has engendered persistent gap between theories and realities in Nigeria. While scholars in developed societies have responded to their exogenous variables for the development of their respective countries, Nigerian leaders and scholars are yet to understand and apply it to their developmental drive (Akinola, 2010f).

This paper uses the Institutional Analysis and Development (IAD) framework in tandem with Knowledge Management (KM) tools in analyzing problems that weaken the effectiveness and efficiency of road development in Nigeria. The paper traces the ugly transport phenomena on Nigerian roads to three major factors: (1) lack of adequate information derivable from survey of the environmental factors along the corridor of roads in question; (2) the quality of roads constructed does not reach the expected standard largely as a result of the combination of the first factor (lack of survey) and the prevailing corruption in contract 'market' between the contractors and the government officials; and, (3) the absence of practical monitoring of road projects both during and after construction which gives room for error of omission and commission, a situation that has claimed lives of many innocent road users in Nigeria.

bitumen from Nigeria National Petroleum Company (NNPC) is adulterated by contractors at the batching plant where asphalt is produced. Reliable data from the engineers at the Ministry of Works reveals that the

(more than 8 months) is very grave and consequential. Most of the road repairs are given to contractors but the question is what is the work of Ministry of Works and Transport. While it is recognized that these problems have accumulated over the years, the common logic of maintenance suggests that pot-holes could be filled properly by the ministry to make life easy for tax payers before the entire job is contracted out. At the same time, shown in the Table 1, some of the roads are federal roads such as Osogbo to Okuku.

Plate 1: Cut hole around the rail line in Inisha, Osun State

Plate 2: Shows a pothole at the railway line road before Inisha town

Plate3: Ola Aina Street, 7-Up Area, Beside GTBank, Osogbo.

Plate 3 shows the situation of road repairs with the construction of drainage on both side of the street. The construction of drainage on both side of the street at the same time reduces the road space to accommodate one vehicle at a time. This means that on-coming vehicles have to wait for the other vehicles at available space that can accommodate two vehicles. This, invariably, prolongs travel time of motorists. Consequently, distance that should normally take about 5 minutes within the neighbourhood end up with about 30 minutes and this remained for over three months. The required thing to do is to construct one side of the street at a time and do the other one later.

Considering the increase travel time and transport fare due to bad road conditions, the road users pay more than necessary. Adversely, it implies that citizens pay higher prices for goods and services, resulting from the high transport fare paid by traders and businessmen in the first instance. Invariably, bad roads increase the cost of living, while standard of living falls. The effect of bad roads on vehicles is also traceable to a reduction in the number of vehicles on roads as vehicle operators visit mechanic workshops more frequently than expected. Some operators are likely to find it difficult to cope and hence, may go bankrupt. The resultant effect of this scenario is that the total number of operational and road worthy vehicles is reduced.

Results and Discussion of Findings

Table 1: Statistics on Pot-Holes and Cut-Holes in Lagos and Osun States

	Description and Location of Roads	Type of road	Distance in Km	No. of Pot-Holes and Cut-Holes	Road Ownership
1	7 Local Governments in Lagos	Intra-city	144.1	569	Federal, State and Local
2	Okuku-Osogbo road	Inter-city	25	112	Federal
3	Gbodofon/Isale Aro Junction	One Location		13 multiples	State/Local
4	Agana Ahmadia Road (from Igbona mkt to Sabo Junction	Intra-city	0.7	52 (18 big holes + 16 small holes + 18 {3 Multiples 6+5+7})	State/Local
5	GRA road Okefia	Intra-city	1.5	50 (23 cut +27 pot)	State/Local
6	Mubaraka Atelewo Road Failed road – collapsing bridge	One Location	-	-	State/Local
7	Isale Osun Junction	One Location	-	7 multiples	State/Local
8	Isale Osun - Gbodofon Junction	Intra-city	2.5	23	State/Local
9	Pa Oyinlola Heritage Road	Intra-city	0.5	15	State/Local
TOTAL			174.6	741	

Source: Survey, December 2011 and March – July 2013.

The result of the study conducted in December 2011, confirms access bottleneck in Lagos. The presence of pot-holes on highways (freeways), distributors (collectors) and access roads (local roads) in seven LGs (Agege, Alimosho, Ifako-Ijaye, Ikorodu, Lagos Island {Isale-Eko}, Oshodi-Isolo and Surulere) reinforce the notion that bad roads perpetuate urban poverty as time and resources are wasted by commuters on daily basis. A total distance of 144.1 kilometres with 569 pot-holes was covered in 8 hours 46 minutes. This implies that lack of road maintenance indicated by the presence of pot-holes is costing citizens productive hours in commuting as they spend 3.5 minutes to cover 1.0 kilometre. It still points to the same problem of truncating the welfare of the citizens since time is money.

Osogbo to Okuku is about 25 km with travel time of between 20 to 30 minutes depending on the average speed of the vehicle and any other road constraints witnessed along the journey. As at March, 2013, the study found that there were 47 cut-holes and about 65 pot-holes within the 25 km distance, thus making a total of 112 holes on road surface. The cut-holes had been in existence for the past seven months without any effort at filling them. The question is: why cutting the holes when government knew it was not ready to fill them? Is this a deliberate effort at creating problems for citizens? These holes engender several problems such as accidents, creation of opportunities for armed robbers to use the spots for their nefarious operations as motorists are bound to slow down. In May 2013, some cut holes were filled with asphalt but for some of them to be falling into state of disrepair as at July 2013, within the period of three months. This, invariably, confirms earlier findings of low quality of asphalt due to corruption among the public officials and contractors.

Analysis shows that while the radius of the pot-holes and cut-holes varies; it can be sometimes as long as 60 cm with an average depth of about 25 cm. which was responsible for several fatal accidents on the roads. Multiple pot-holes are several holes on one location. They are common at junctions or cross-roads as contained in the Table 1. Besides, sordid road construction that demands frequent road rehabilitation engendered ecological deficit as pollutants such as fuel and other heavy metals are released into soil and water during construction, especially with the use of excess kerosene in adulterated asphalt. In summary, findings show that there are 172 pot-holes and cut-holes within a distance of 30.5 km of inter-city and intra-city roads in Osun State. The concern about intra-city pot-holes that remained unfilled for several months

It also implies that supply would be lower than demand and consequently, an increase in price of transport fare. In essence, the existing transport fare (which is high) is jacked up and which worsens the welfare of citizens. Transport problems spark ripple effects on other sectors of the economy which impinge on the capital power of citizens, erode their welfare and perpetuate poverty.

Among the problems confronting Lagos, urban mobility presents the greatest challenges as the major causes of traffic congestion in Lagos are traced to pot-holes. This confirms that there has not been significant improvement on road development that will respond to the demand in Lagos State since 1998. This is because the rate of urbanization in Lagos is very high. Though the present state government has taken some good steps to transform the city, the rapidly growing population in Lagos makes infrastructures such as road networks to be deteriorating fast. The current population of Lagos (11.2 million), for instance, is more than triple the populations of other state capitals in the country (UN, 2011). For example, the study of 1998 by Akinola shows that there are pot-holes that are as deep as 0.5 cm. (Akinola, 1998). About 167% increase in transport fare and 260% increase in travel time were generated due to bad road conditions in Lagos with the implication of rising cost of living, while standard of living falls (Akinola, 1998, calculated from Table 3). Transport problems spark ripple effects on other sectors of the economy which impinge on the capital power of citizens, erode their welfare and perpetuate poverty. The growth of urban productivity which depends on swift and cheap connections and movements between homes and workplaces is sacrificed on the altar of bad roads. The city's growth has overtaken planning and this is posing serious problems for the city's overall development. Most people in Lagos who reside in the peripheral shanty communities paid more in terms of accessibility to social services.

In addition, the Lagos-Benin-Onitsha highway that connects Lagos to the eastern part of the country and the Lagos-Ibadan-Ilorin-Jebba highway that connects Lagos to the northern part of the country are always in state of disrepairs in spite of several billion of Naira that has been spent on these federal roads. For example, a journey from Lagos to Benin that should take 3 hours took 9 hours between 2007 and 2008, 7 hours between 2009 and 2011 and now takes 5 hours, while Lagos to Ibadan takes up to 4 hours as against 1.5 hours. The reason for these elongated journey time is due to bad roads which represent access bottlenecks and cause accident of trucks and big lorries that sometimes block roads completely. About eighty per cent (80%) of the Nigeria's national road network is in a state of disrepair with dire consequences on the economy (Leadership, 2008). The present morphological structures in Nigerian urban regions – cities, towns and villages – are highly disordered, lopsided, chaotic and impoverished. Inter-city (federal), inter-town (state), and inter-village (LG) road networks are death traps due to governance deficit, corruption and outright stealing of public resources by politicians. A case of a former governor of Delta State in Nigeria who was jailed for 13 years in London on Tuesday, 17 April 2012 for stealing $250 million in state assets confirms the degree of diversion of public resources for personal aggrandizement (Rubenfeld, 2012).

As a matter of fact, plundering of public resources led to the derailment of rail system. As a result, all heavy trucks and trailers move freight on roads; thus accelerate the rate of road disrepairs. The habitual manner of road-side parking of these trailers complicates movements in places like Ibadan where a distance of 5 kilometres on federal road within the city takes up to 3 hours or more. Whereas these heavy trailers are owned by few individuals who are connected with government officials and some officials, they hardly use these roads that their operations have destroyed because they can afford flying in space. Invariably, it is the poor citizens that bear the brunt of the illegal operations of some of these leaders in terms of road accidents and causalities. Available data shows that 15,860 cases of accidents were reported to the Police in 1999,

while 6,759 persons were killed and 17,471 persons injured; and this trend has been on the increase. From 1960 to 2006, official reports by the Federal Road Safety Commission of Nigeria and the Nigeria Police confirm that 293,000 people were killed through road traffic accidents, yet no concerted efforts have been made to mitigate the carnage. Current statistics shows that Nigeria loses 162 persons per 100,000 population annually to road accidents, thus making the country to be ranked second out of 193 countries in the world in terms of fatality from road traffic accidents (Leadership, 2012). Nigeria is a large country with over seven million vehicles plying its 200,000 km roads with 400 people killed monthly by road traffic accidents (NGO News Africa, 2010). Nigerian leaders, due to high level of apathy, have neglected the plight of road users that constitute 80% of Nigeria population (NGO News Africa, 2010).

Polycentric Environmental Planning and Triology of Road Development

Using polycentric environmental planning, the logic of planning process advocates road development that conceptualizes citizens' welfare as the driver of development in all ramifications. This paper, therefore, posits that the triology of road development - survey, construction and monitoring/maintenance (SCM) pre-conditions durable roads. This paper recommends the adoption of African Road Triology (ART) that could be applied to overcome the problems that are associated with lop-sided road development. The triology of road development – survey, construction and monitoring/maintenance (SCM) – pre-conditions durable roads as it serves as efficacy of providing solution to road related problems. The model establishes that road development should be placed on tripod stand of survey, construction and monitoring/maintenance (SCM). By painstakingly addressing the three major components of this model, the six essential stages of road development – survey, analysis, construction, monitoring, evaluation and maintenance would be completed. The complete circle of road development process means that the hitherto overlooked aspect of road project – survey and monitoring – which are very crucial would come to the limelight and become the focus when contracting out road projects.

The triology approach to road development is considered integral and as a remedial step at solving the identified problems by paying attention to survey, construction and monitoring/maintenance rather than focusing on construction alone. African Road Triology (ART) establishes that road development should be placed on tripod stand of survey, construction and monitoring/maintenance (SCM). The ART is designed to overcome problems that are associated with lop-sided road development. The triology of road development pre-conditions cost effective and durable roads and serves as efficacy in providing solution to road related problems in Africa. By painstakingly addressing the three major components of this model, the six essential stages of road development – survey, analysis, construction, monitoring, evaluation and maintenance would be completed. The complete circle of road development process means that the hitherto overlooked aspect of road project – survey and monitoring – which are very crucial would come to the limelight and become the focus of government when contracting out road projects. Hence, the proposal argues for the adoption of the concept of the triology of road development as it would provide sound footing not only for highway/road construction/rehabilitation but also for detecting error of omission and commission.

Applying this to Nigeria, this paper designs a Nigerian Road Triology Model (NRTM) that can help in overcoming problems that are associated with lop-sided road development. The model establishes that road development should be placed on a tripod stand of survey, construction and monitoring/maintenance (SCM). Using the NRTM in conjunction with planning process, the paper designs an appropriate institutional mechanism that is capable of synergizing the efforts of all the stakeholders (government, universities/polytechnics, the private sector, road construction companies and local communities) in utilizing local resources to the benefit of road development in Nigeria.

In this context, each spatio-political entity within a country – state/province and local government – should prepare road master plan for its geo-political area. At each level of road master plan, using GIS, data relating to all roads should be generated, analysed and projected into the future. The data, should of course, be updated in the light of some socio-economic changes that are bound to occur (see for details, Akinola, 1998; 2007i). At any specific time, when a road is to be constructed or rehabilitated, all the data pertaining to that road should be made available to the contractor who will use the data to determine the types of materials as well as the methods of construction to be used for the project. However, the preparation of master plan is sine qua nom for the realisation of the benefits of ART model. To this end, Nigerian governments should commission the preparation of master plan for road transport – construction of new road; rehabilitation of existing portions of roads; patching of pot-holes etc. The master plan will contain all information pertaining to survey, construction and monitoring/maintenance.

The model differentiates between road projects to be contracted and those to be done by direct labour. In order to improve the performance of road contracting, engineers in the ministry should be allowed to embark on concrete projects from time to time to enable them update their experience and be current with new methods and materials in their profession. This, invariably, would place them on better ground to supervise projects that are handled by contractors. Also, their projects will serve as reference points for contractors. The adoption of this model will, in no doubt, enable road projects to be constructed on sound footing, with ability to contain pressure of population growth in the foreseeable future. The model suggests the need for the introduction of sanction or punitive measure into road contracting, especially where rules and conditions that undergird contract are disregarded by either of the parties, otherwise, the quality of work done by the contractor may not be up to the required standard. It is also important that effective monitoring of construction/rehabilitation is done by experts. More importantly is the accountability of the civil servants as service providers to the citizens. The adoption of this model will, in no doubt, enable roads to be constructed on sound footing, with ability to contain pressure of population growth in the foreseeable future (see for details, Akinola, 1998).

Massive road construction has depleted once plentiful aggregate supplies and continuing to exhaust the valuable resources to rebuild existing roads only propagates and accelerates the problem (Hanks and Magni, 1989). Mostly, aggregates either from distant quarries, at great expense or from local sources offers only marginal quality and conserving virgin construction materials through recycling with lime make not only smart but economic and strategic sense. Additionally, if old asphalt and road base materials are not recycled, they must be disposed of or stockpiled, increasing transportation cost; and utilizing valuable land space and increasing environmental and health hazards. Recycling with lime makes the reconstruction of old roads a largely self-sustaining process. Due to the excessive cost of new materials, a new method of design had to be sought and new materials introduced. Some researchers (Ola, 1983; Schroeder, 1994; Osinubi, 2000; Osinubi et al., 2009; Osinubi and Edeh, 2011) tried with soils, which are available everywhere Examples of creative innovations from Nigeria that can be replicated to enhance the development of the construction sector abound. Scholars in the Department of Civil Engineering, Ahmadu Bello University, Zaria and University of Agriculture, Makurdi, Nigeria evaluated the characteristics of palm kernel shell ash (PKSA) stabilized reclaimed asphalt pavement (RAP) and found that 90%RAP/10%PKSA mix can be used as sub-grade material in flexible pavements. This saves cost as recycling of asphalt pavements is a beneficial approach from technical, environmental and economical perspectives. The use of stabilized RAP as sub base and base materials of pavement leads not only to economic solution but also offers a potential use of the RAP treated with cemented materials like sawdust ash, thus reducing the amount

of waste materials requiring disposal and providing construction materials with significant savings over new materials (Edeh, et. al., 2012a; Edeh, et. al., 2012b).

Road Survey:

The main objective of road survey is to determine the volume and weight of vehicles as well as the problem areas and hydrological conditions of the soil along the road in question so as to determine the types of designs and materials to be used and other safety measures that need to be taken. Roads should not be constructed/rehabilitated without adequate preparation and planning. The necessary inputs into the planning mechanism of road construction/rehabilitated at the preparation stage include data that are derivable from road survey and they include: (a) the number and types of socioeconomic activities along the corridor of roads in question and/or their economic importance; (b) the average number and types of vehicles plying the roads under consideration; and (c) the average weight of vehicles plying the particular roads; These data would help: (i) to know area(s) of the road that is (are) associated with problems; (ii) to establish the causes of accident; and (iii) to determine the water content (hydrological condition) of the soil along the road. If, however, the project is a new road, special effort should be made to estimate appropriate data (from data bank if it exists) for deciding on the road construction/rehabilitation.

An important element of the collection of basic data is the survey of existing transport facilities. It is, in effect, a stock-taking of the major highway and public transport networks, the existing demand for and supply of parking accommodation, and the present-day traffic volumes and travel times. This can be categorised as follows:-

1. Main Road Inventory: A survey of the physical characteristics of the main or primary road network is made as to the number and frequency of frontage access, carriageway widths, traffic regulations, visibility conditions, junction spacing and capacities. Analysis of this survey data will highlight the practical capacities of road bottlenecks on the network.
2. Public Transport Inventory: Principal routes, stopping places/stations, current passenger volumes carried, fare structure and travel times can be derived from route maps, time table and other records of the public transport operator.
3. Traffic Volume Census: Information on traffic volumes and composition for all parts of the networks will be required as a check on other survey data.
4. Travel-Time Survey: Travel times and speed - flow relationships for both peak and off-peak periods are used as a basis for determining the present level of service performed by the system, and in the distribution and assignment stages of the transportation planning process. This information for motor vehicles is usually collected by the use of a technique known as the "moving observer method" whereby observers in cars moving in the traffic stream record rimes for each link and intersection delays for the whole network.
5. Parking Survey: As part of the transportation planning process, parking surveys are undertaken to collect information about the physical location, type, capacity, layout and operating characteristics of existing on-and-off-street parking facilities within the central area. The existing parking demand within the district, including record of occupancy and turn-over of parking spaces.

At the end of the survey exercise there is need for the production of different types of maps - topographical map, hydrological map, and geological map. However, there is strong connection between information collected during the survey and the utilisation of such data during the construction. Data collection without utilisation by the contractor in charge is equated to waste of time and resources.

Data on any road to be awarded as contract (whether new construction, rehabilitation or patching of pot-holes) should be made available to the contractor who should use the data to determine the types of materials as well as the methods of construction to be used for the project. In order to improve the performance of road contracting, there are some decisions to take. First among these is that engineers in the Ministry should be allowed to embark on concrete projects from time to time. This will enable them to update their experience and be current with new methods and materials in their profession, which consequently will place them on better ground to supervise projects that are handled by contractors. Also, their projects would serve as models and references for contractors. The adoption of this model will, in no doubt, enable road projects to be constructed on sound footing, with ability to contain pressure of population growth in the foreseeable future (see for details, Akinola, 1998; 2007i).

Road Construction/Rehabilitation:
Road construction/rehabilitation requires some basic information that need be input into the planning mechanism. Such information include: (1) the load the road is expected to carry for at least five years in future which is determined by survey result; (2) the bearing capacity of the soil upon which the road will situate; and (3) the water content (hydrological condition) of the soil throughout the year. Also, the periodic hydrological condition of soil should be considered as well. This is because the variation in water content of certain area is periodic, say every three years, five years or ten years interval.

Based on the outcome of analysis of the relevant data, there should be a careful selection of construction materials that could withstand all stresses for a long (specified) period of time. For instance, the type of cement that could withstand the chemical composition of the water in a particular environment should be selected. Second, there is the need for soil treatment as the need may arise to improve the bearing capacity of the soil. One way of doing this is through cement grouting. Cement grouting is similar to cement injection, which is useful in reinforcing weak soil and thereby increasing its bearing strength. Thirdly, it is essential to select the appropriate asphalt grade that could withstand the load the road is expected to carry. There are some basic strategies which can be used to prevent problems on roads and these are: construction of efficient drainage system; netting of rock surface where there had been blasting of rock during construction; and paving of embankment and cutting. Each of these strategies is discussed in turn.

Construction of Efficient Drainage System: Efficient drainage system protects road base from the effect of run-off water.

Netting of Rock Surface: The cut surfaces of rock along the roads need be covered by iron net. Holes should be created in the mother rock by drilling. The holes should be filled with cement and iron rod should be inserted which will hook the iron net.
Paving of Embankment and surface of cutting: Planting of grasses may not be the best solution because after some years erosion may set in and therefore affect the road. What could be done is to pave the affected area with concrete slab.

Monitoring of Roads: The purpose of monitoring is to close the gap between the set goal for a project and the result of the implementation of the project. That is, the difference between "what should be" and "what is existing". Monitoring is a devise that is intended to constantly keep the project on course. Since all projects designed by man are not natural, tendency exists that the interaction of the natural and artificial forces is bound to create some unimaginable problems. Such problems can only be identified at monitoring stage.

Monitoring/Maintenance:

The monitoring stage is very crucial in order to ensure road sustainability. The objectives of monitoring are:

1. To identify areas of inevitable errors (commission) requiring immediate remedy. Such error might be at the survey or construction stage. Errors at construction stage may be linked to either the factory or the site operation.
2. To identify areas of deliberate errors (commission) at reducing the quality of materials from factory or that of the project on site.
3. To discover new developments which are beyond predictions/forecast e.g. the location of new industry which will increase the number and types of vehicles plying the road.
4. To discover new developments that are too near the right of way which may cause conflict of interest in future if roads are to be expanded.
5. To discover damages that are caused by accident or hoodlums.

Maintenance: All the discoveries (from 1-5) would form the focus of the maintenance activities.

Analysis and discussions so far demonstrate that road development should be placed on tripod stand of survey, construction and monitoring/maintenance (SCM). The SCM could be used to improve road development by carrying out an inventory of the existing stock of roads, quality, possible number of vehicles using the roads, weight of vehicles vis-à-vis needed road materials and the condition of soil in relation to its bearing capacity. The Ministry should commission the preparation of master plan for road transport as may be decided by the Ministry – construction of new roads; rehabilitation of existing portions of road; patching of pot-holes etc. The master plan will contain all information discussed under survey, construction and monitoring/maintenance.

The adoption of triology approach at solving road problems is considered efficacious in the sense that the hitherto overlooked aspect of road programme - survey and monitoring - will come to the limelight and become the focus when contracting out road projects. Data relating to all roads should be generated, analysed and projected into the future. The data, should of course, be updated in the light of some socio-economic changes that are bound to occur. At any specific time, when a road is to be constructed or rehabilitated, all the data pertaining to that road should be made available to the contractor who will use the data to determine the types of materials as well as the methods of construction to be used for the project. In addition, the contractual aspect of road development requires a re-visit. The work of civil engineering contractors, according to McCaffer, et. al., (1984), can be crudely represented as: (a) getting the work at the right price and (b) doing the work within that price. Some questions are raised and they are: Why contracting road projects when there are engineers in the Ministry? If it becomes necessary, however, to contract road projects, the question is: what types of road projects should be contracted?

The engineers like all professionals should practice to up-date and augment their experience and not only to supervise projects. Technology is advancing everyday and road construction technology is not excluded. Similarly, construction materials are undergoing innovative process which makes them to be changing. Hence, it becomes necessary for engineers in the Commission to practice and work with the new materials and new methods so as to be able to carry out a thorough supervision if need be. A good supervisor is current in his field since experience is the best teacher. Under the general law of contract, when a party makes an offer to provide goods and/or services for some certain consideration and the party to whom the offer is made accepts it, then, provided it does not involve any illegal act, a contract exists which is enforceable at law (Ramus, 1981). The offer is made by a contractor who tenders to carry out specified works in return for a money payment and upon the acceptance of that offer by the client promoting the project, a binding

contract comes into being.

It is desirable that the client's acceptance should be in writing and that it should be given as soon as possible after receipt of tenders. If there is any appreciable delay of, say, one to two months or more, then it would be necessary to obtain the contractor's confirmation that his price still stands or what the increase in his price is, due to rising costs. There are several types of contracts in common use for construction projects, differing principally in the way in which the sum to be paid to the contractor is determined. Which one is suitable in a particular instance usually depends upon the size and the nature of the project. According to Ramus (1981), there are three main types of contract, namely:

1. Lump Sum: In a lump sum contract, a specified sum of money is stated in the contract as payment for the construction works.
2. Schedule of Rates: There is no prescribed total sum but a schedule of unit rates is included in the contract documents to be used as the basis for calculating the payment to the contractor.
3. Prime Cost: The contractor is reimbursed the total costs incurred plus a fee for his services to cover overheads and profit.
4. Variations: Variation may arise in any of the following situations:

a) when the architect or road designer needs or wishes to vary the design or the specification;
b) when a discrepancy is discovered between any two or more of the contract documents;
c) when a discrepancy is discovered between any statutory requirement and any of the contract documents;
d) when an error in or omission from the contract bills is discovered.

Decision to contract: There is need to differentiate between road projects to be contracted and those to be done by direct labour. The Ministry should have model projects for contractors. It then means that both direct and contract methods should be combined. After the decision is made to contract out certain project(s), the next stage is invitation to tender. It might be necessary to select two or three contractors who will be requested to present collateral in case they fail to deliver as appropriate. There is the need for the introduction of such a sanction or punitive measure into road contracting, otherwise, the quality of work done by the contractor may not be up to the required standard. Agreements need be signed by both parties (the Ministry – client and the road contractor) and it needs be adhered to by both parties. The breach of agreement on the part of any of the parties should warrant compensation in form of fines payable by the defaulter. A breach of agreement on the part of the Ministry may take the form of not supplying the contractor adequate data on the road to work upon. In other case it may be due to the failure of the Ministry to pay the contractor as agreed.

The contractor may breach the agreement in various ways as listed below:

1. Inability to deliver or reach the target (percentage of work) at a stipulated time.
2. The use of low quality materials which can result into low quality of road project.
3. Non-compliance with the required quantity of work like inadequate parking space, lay-by, width of
r oad, visibility, inadequate or lack of drainage facilities at the appropriate places.
4. Non-usage of appropriate methods of preventing spoilage. (The appropriate methods include: netting of stone surface, paving of embankment and cutting).

Conditions: Both parties must agree on the expected quality of work. The contractor with the highest collateral, with other factors considered, should be given the job. The contractor should be made to be aware of monitoring stage. If a problem is discovered and the fault is traced to the contractor, then he has to take responsibility for repair and compensate the Ministry. If it is manufacturer's (from factory) fault, then

the manufacturer could be sued for producing sub-standard products. The method or rate of compensation should be agreed upon by both parties. The compensation rate should be reviewed from time to time to reflect the prevailing market situation.

Conclusion

The paper concludes that the logic of planning process advocates road development that conceptualizes citizens' welfare as the driver of development in all ramifications. The paper has established that road development should be placed on tripod stand of survey, construction and monitoring/maintenance (SCM). The emphasis of one over the others or at the expense of others is a manifestation of lop-sided road development programme. However, the adoption of triology approach at solving road problems is considered efficacious in the sense that the hitherto overlooked aspect of road programme - survey and monitoring - will come to the limelight and become the focus of the Ministry when contracting out road projects. Information on any road to be awarded should be made available to the contractor who will use the information to determine the types of materials as well as the methods of construction to be used for the project. It is, however, suggested that there is the need for the Ministry to prepare road master plans.

In order to improve the performance of road contracting, there are some decisions to be taken. First among these is that engineers in the Ministry should be allowed to embark on concrete projects from time to time. This will enable them to update their experience and be current with new methods and materials in their profession, which consequently will place them on better ground to supervise projects that are handled by contractors. Also, their projects will serve as models and references for contractors. The adoption of the suggestions contained in this proposal would, in no doubt, enable road projects to be constructed on sound footing, with ability to contain pressure of population growth in the foreseeable future.

Using polycentric environmental planning, this paper posits that the triology of road development - survey, construction and monitoring/maintenance (SCM) pre-conditions durable roads. Consequently, the paper designs a Nigerian Road Triology Model (NRTM) that can help in overcoming problems that are associated with lop-sided road development. The model establishes that road development should be placed on a tripod stand of survey, construction and monitoring/maintenance (SCM). Using the NRTM in conjunction with planning process, the paper designs an appropriate institutional mechanism that is capable of synergizing the efforts of all the stakeholders (government, universities/polytechnics, the private sector, road construction companies and local communities) in utilizing KM tools and local resources to the benefit of road development in Nigeria.

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