Public Lecture Series


# PHYSICAL INFRASTRUCTURE FOR SUSTAINABLE NATIONAL DEVELOPMENT

**J. B. Adeyeri**

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Corporate & Public Affairs Department
Covenant University, Km. 10 Idiroko Road, Canaanland,
P.M.B 1023, Ota, Nigeria
Tel: +234-1-7900724, 7901081, 7913282,7913283.
Website: www.covenantuniversity.edu.ng

**Professor J. B. Adeyeri**

*Professor of Civil Engineering and Head*
*Department of Civil Engineering*
*Covenant University,*
*Canaanland, Ota.*

# INTRODUCTION

First of all, I like to thank God for this opportunity to stand before all of you this afternoon to deliver the 29th in the series of Public Lectures organized by Covenant University. I like to thank the Chancellor, the Vice-Chancellor, the Registrar and all members of Management for giving me the opportunity to use this platform to express my views on the issue of Infrastructure development in our country and continent.

Secondly I like to acknowledge my faith in God and in his goodness to make available to us as a nation the possibilities of engineering for socio-economic development. As you all know, engineering is the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied to the efficient use of the materials and forces of nature for the benefit of mankind. Of the many branches of engineering, **Civil Engineering, to which I belong, plays a critical role in determining how our environment looks and functions.** Civil Engineering includes the planning, design, construction, and maintenance of structures and altering site topography to suit human needs. Some of the many subdivisions are transportation (e.g., highways, airport, railroad facilities, planning, design and maintenance); water resources (e.g., river control, irrigation, swamp drainage, water supply, and sewage disposal); geotechnical engineering (e.g. soil & construction materials, foundations, dam & earth retention systems,

stabilization and construction services); and structures (e.g., planning and design of buildings, bridges, and tunnels).
So we see that civil engineers are involved in a wide variety of projects, which affect virtually everyone. The whole built environment including water, energy, utilities, transportation and building systems is in the province of the civil engineer. That goes on to explain the basis of our topic for the lecture of today.

**Key Concepts**
The topic I will be speaking on is "Physical Infrastructure for Sustainable National Development". There are some terms in the topic which require our proper understanding in order to put this lecture in the proper context. These include infrastructure, development and sustainability. I will like to spend the next few minutes to elaborate on these terms to facilitate our understanding of what this lecture is all about. .

**What is Infrastructure?**
Infrastructure is a widely used term that describes a distributed system of interconnected services and transport mechanisms which support other functions, uses, or applications. For the purpose of this lecture, I have decided to limit the scope to what is commonly referred to as the physical infrastructure (PI) or what some people refer to as civil infrastructure systems (CIS). A nation's physical infrastructure consists of a broad array of systems and facilities that house and transport people and goods and provide services. Among other things, this infrastructure includes transportation networks such as roads, airports, rail, inland and ocean shipping and mass transit including their intermodal connections; housing: federal, state, LG and private buildings and facilities; collection, storage, treatment, transmission, and distribution systems for water; systems for natural gas, liquid fuels, and other industrial liquids and gases; and waste stream collection, treatment, transmission, storage and disposition,

including water and solid waste; as well as postal and telecommunications services. These systems and facilities do not exist in isolation: there is an interconnectedness between them. For example, decisions about where to build or expand roads affect decisions about housing and vice versa, and, in turn, these decisions affect the need for and location of public facilities and communications and energy services.

Historically, the government has been responsible for the construction of much of this infrastructure and has helped to ensure the safety of the services it provides. For example, the government builds, owns, operates, and maintains infrastructure such as government buildings, dams, airports, pipelines and waterways; financially assists local governments to build, own, operate, and maintain facilities such as roads, transit systems, and motor parks; and regulates public works. Local governments and the private sector also play significant roles in planning, developing, and maintaining this infrastructure.

Although these examples of physical infrastructure are radically different (e.g. rail transport compared with wastewater), they have several related characteristics. First, these infrastructure systems are responsible for the transport of physical quantities that are routed from an origin to a destination. Many of these infrastructures include the collection or generation of the quantities (e.g. fresh water) and the eventual end-use, and hence they are closely related to issues of sustainability. Another characteristic is that much of the physical infrastructure is highly regulated, typically for safety and economic reasons, but in some cases only for historical reasons. For all of these reasons, physical infrastructure requires enormous capital investment, with a mix of public and private ownership, over long periods of time (from at least decades to up to a century). The Appian Way in Figure 1 was constructed over 2000 years ago..


Figure 1: The cobbled Appian Way was constructed more than 2200 years ago as the primary route from Rome to Greece. Although these large lava blocks may not be the original material, the route itself has remained unchanged and in use since it was first paved.

However, I am going to limit this lecture to civil engineering infrastructure mostly. Even though our definition of the physical infrastructure may include the telecommunications infrastructure, telecommunication systems are not directly included in this lecture since the transmission of signals (wired or wireless) is fundamentally different from that for physical quantities. On the other hand, the electric power generation, conversion, transmission, and distribution systems are included in today's discussion of the physical infrastructure. Although the power system does not convey mass, it has many of the other characteristics of the physical infrastructure. Most importantly, the power system plays an important role because energy has an

enormous impact on all the physical infrastructure systems.

The construction industry builds offices, factories, and houses and constructs roads, bridges, harbors, and other parts of the transportation system. This is called the infrastructure of industry, and it is necessary for industrial development. The infrastructure includes power stations, electricity distribution systems, and communications networks. All the vital arteries of industry are grouped under this infrastructure.
In addition to the physical infrastructure, there is a need for a geometrically based infrastructure for positioning, accessibility and management of these systems. Therefore, Infrastructure in the context of this lecture comprises the built environment and basic geographical information.

**Development**
Development is used here to refer to the twin processes of growth and change which are aimed at improving man's working and living conditions. In this lecture, its meaning will not be restricted only to a consideration of man's material well-being, but will embrace the totality of man's welfare. Development has reached different stages in different countries. It is common usage to refer to countries in which development has advanced beyond a certain stage as developed countries, and to all the others as developing countries. African countries are mostly in the group of developing countries. However, this does not mean that in developed countries, development has run its full course and come to a standstill. Nor does it mean that in developing countries, development is necessarily progressing at fast speed. On the contrary, it is widely accepted that in several respects developed countries are developing at a faster rate than the developing countries.

## Sustainability

Sustainable growth calls for a development strategy that does not compromise the welfare of future generations. Until recently, the government largely neglected the issue of sustainability. Instead development was based mostly on external borrowing, inflationary financing, rapid depletion of natural resources, with the consequent degradation of ecological systems. Such growth cannot last. When growth depletes capital, it must eventually slow down especially when the capital itself is diminishing. Capital, in this context, includes not only plant, machinery, and infrastructure, but also natural resources such as land, water, and minerals and human capital in the form of knowledge, health, and social organizations. Thus to ensure sustainable growth, our development strategy needs to emphasize both sound environmental management and human resource development.

We should realize that environmental management and economic development are intimately connected. The environment consists of intricate ecological systems. Trees and grass, for example, not only provide fuel and fodder, but also build soil fertility, prevent erosion, provide water catchment, ameliorate climate changes, and provide wildlife habitats. These systems are the underpinnings for human welfare and survival. They need to be preserved to ensure that the development of our physical infrastructure is sustainable.

## Brief Situational Assessment of Civil Infrastructure Systems

A civilization's rise and fall is linked to its ability to feed and shelter its people and defend itself. These capabilities depend on infrastructure--the underlying, often hidden foundation of a society's wealth and quality of life. A society that neglects its infrastructure loses the ability to transport people and food, provide clean air and water, control disease, and conduct commerce. In the last 100 years or so, most of the developed countries especially the United States invested heavily in canals,

fresh water, interstate highways, airports, rapid mass transit systems, and modern fiber optic systems, etc., Figure 2(a) – (f). It is the efficiency and effectiveness of these infrastructure systems that is making many people all over the world wish to live in and become American immigrants. As a matter of fact, it is what the US government is using to draw the cream of the international human capital into their country. I doubt if we could get any applicant if Nigeria were to initiate a Nigerian Immigrant Visa Lottery system today. That is a way to tell us that we should learn how to develop our country through the proper development of our infrastructure system instead of struggling to win US Immigrant Visa lottery.

Figure 2: Some Physical Infrastructural Facilities in the Developed Countries


Figure 2(a): Tomato Springs Toll Plaza, just south of the CA 241 / CA 133 interchange. FasTrack is an automated toll system that requires a transponder in the car.

Figure 2(b): The Pasadena Freeway Tunnel

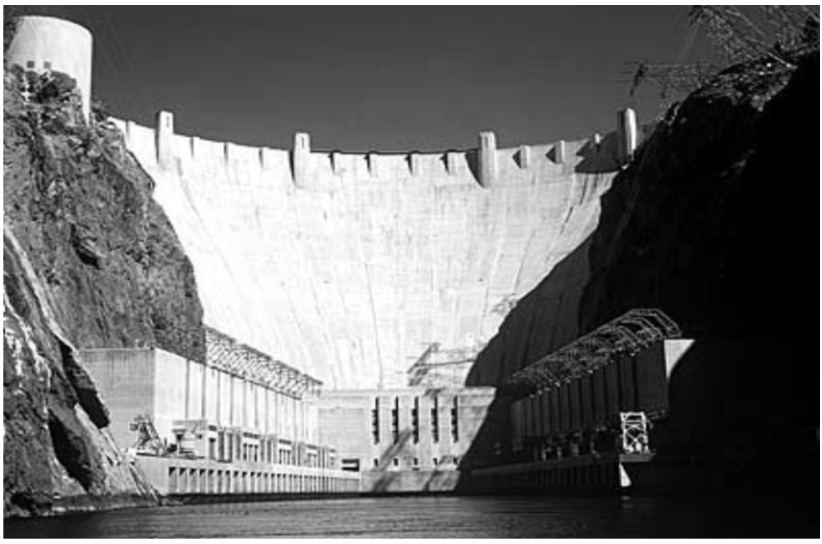

Figure 2©: Hoover Hydro Dam

Figure 2(e): San Francisco – Oakland Bay Bridge


Figure 2(f): The French high-speed train Train à Grande Vitesse travels up to 260 km/h (160 mph)

The World Bank identifies the development of the physical infrastructure sector as a key pillar for revival and sustainable

development of the economy and particularly the productive sectors (Agriculture, Industry and Education). Vision 2020 envisages that Nigeria would become one of the world's twenty most developed economies by the year 2020. That is all well and good. But we cannot achieve this just by wishing. It must be realized that such an aspiration requires that the country is able to generate at the least a stable 10 per cent annual growth rate between now and then and that major investments are made to improve roads, provide reliable water and sanitation services, bulk transportation such as railways and sea transport, efficient air transport services and investment in cost effective and reliable energy. Investment in the housing sub sector is also critical in ensuring that Nigerians live in decent houses.

It must be acknowledged that since the turn of the century, the government has made some strides in enhancing the quality and quantity of infrastructure facilities and services in this country. However, despite the heavy investment in the past, infrastructure services in Nigeria and indeed most of Africa still remain extraordinarily poor: poor in both quantity and quality. Most countries have very low levels of infrastructure for it to have any significant productivity effects on the economy. For example, the average road densities in Africa, according to the United Nation's statistics, are one-half to one-third of those in other developing regions and short of the critical density (threshold value) required to stimulate growth. We know that we are still developing but we can do better.

And the few roads that we have especially the rural roads and farm-market roads are in a deplorable state. There is the problem of erosion impacting on the road network. Whole sections of our roads are known to have been washed away by erosion because of poorly planned or non-existent drainage system. Additionally there are many bridges without any warning signs and no handrails. Vehicles have been known to plunge into some rivers with grave consequences.

Traffic congestion in many urban centers is a nightmare. Commuters are in trouble whether in the city of Lagos or on interstate highways as bad roads and/or traffic congestion make it impossible to plan a journey or predict arrival time. It sometimes takes over five hours to go from Lagos Island to Sango, a distance of less than 60 km. A passenger who boards the plane for London at the same time as the Lagos commuter would probably land at London airport before he (the commuter) gets to Sango. And what about the Sango – Ota road? You can sometimes spend over 2 hours to go from the Abeokuta – Idiroko road junction at Sango to Canaan Land, Ota, a distance of only ten kilometers. The Abeokuta road via Sango Ota is a scene of confusion with unplanned road works stalling the flow of traffic for hours. On the notorious Lagos-Benin route, a 4-hour journey was once accomplished in over 15 hours. A journey from Lagos to Port Harcourt that should take less than seven and half hours can sometimes take over one and half days.

To make matters worse, sizeable portions of the roads in our urban centers have been taken over by traders who openly display their wares on the sides of the street thereby blocking traffic and causing unnecessary traffic congestion. There are in most cases no sidewalks for pedestrians. And then is the problem of reckless driving with rickety *molues*, *danfo* buses, *kabukabus* and *okadas* which would be regarded as undignified means of transportation in other cultures.

Some of the roads including federal ones are in very deplorable conditions and have become death traps to motorists, Figure 3. Accidents involving trailers often lead to marathon hold-ups. It is common for armed robbers, and other miscreants to station themselves in bad portions of the roads where all vehicles virtually come to a halt, to carry out their nefarious activities.

Other modes of transportation are grossly underdeveloped. The facilities and number of sea ports are inadequate. The bureaucracy in these ports increases costs. Inland waterways are not developed and the riverine creeks are not dredged. Products and operations within these areas are often locked up. The water transport infrastructures are yet to be given serious thought by the Government. The Nigerian Railway had been virtually abandoned. The 30" gage is outmoded and neither fast nor adequate. Government owned civil aviation services are fragmented and suffer from lack of coordination. Planes have been reported lost from the Nigerian air space without a trace for several months. Even the management of the services of highways has been abandoned by the government to NURTW without a proper regulatory framework. The officials are a law unto themselves while the government often feels powerless in controlling their activities.

Figure 3: State of some Roads in Edo State, Nigeria: Courtesy of the Nigerian Punch Newspaper of Sunday 11th Nov 2007

(a) Ugbor Road

(b) Ihama Road

(c) Amadasun road

(d) Benin-Ore Road


Figure 3(e): Roadway converted to shops, vehicle repair workshop, pedestrian walkway, etc. near Sango-Abeokuta road along Sang-Idiroko road


Figure 3(f): Poor drainage at Ojuore along Sango - Idiroko Road

Figure 4(a) Eiffel Tower, Paris, France, built in 1887-1889

Figure 4(b): The new China Central Television headquarters building as seen in Beijing Thursday July 17, 2008. The building consists of two angled towers connected at the top to form a continuous loop of horizontal and vertical sections. The spectacular 230 meter (755 foot) building, one of Beijing's tallest, houses more than 10,000 staff. The building is one of a series of landmarks, notable for their futuristic design.

## Values of Infrastructure

From all the above, it can be seen that a well developed and maintained infrastructure is a fundamental need for a modern

society, and its value and importance can be expressed in different ways. In most countries, the physical infrastructure is estimated to have a value of about 70 % of the national physical capital (fixed assets), and the necessary replacement costs can be in trillions of Naira. In Europe (the EU15 countries), the building and construction industry had about 14 million employees and a turnover of about EUR 1000 billion in 2004. Globally, more than 111 million people are working within the sector. Their activities contribute to about 10 % of the gross domestic product, and in 2002, global annual investments in the sector were estimated to a value of about USD 3000 billion.

At the global level, the built environment in each country is estimated to account for about

25-40 % of the energy consumption
30-40 % of the material resource consumption
30-40 % of the waste production
30-40 % of the greenhouse gas release

For most African countries, the figures are mainly at the lower end of the intervals given above.

Appropriate Infrastructure

All the above is to show that the contribution of PI to economic development is an important one and a pre-requisite for the continuing prosperity of any country. But that does not always mean that more infrastructure is necessarily better. Good quality infrastructure is necessary to avoid bottlenecks and service disruptions, and support a range of activities, but too much infrastructure, or infrastructure of an outdated or inappropriate sort, is a poor investment. Infrastructure can be very expensive. Investment in it involves deploying scarce resources, and so making informed and intelligent choices is very important for its development.

In all sectors (transport, energy, water and telecommunications) too much, too little, or poorly judged infrastructure may cause undesirable environmental, social and cultural impacts. Too much

- e.g. excessive road development in sensitive areas, or loss of heritage for water infrastructure - can cause unnecessary environmental, social or cultural damage. But equally, too little or inadequate infrastructure can mean the loss of opportunities to advance social, cultural or environmental goals. For example, "enough" and "appropriate" transport system can make an invaluable contribution to access, mobility and social connectedness as mentioned earlier.

To ensure that investment in infrastructure is appropriate, two key issues must be addressed. Firstly, all the wider benefits and costs of infrastructure investment should be considered: policy mechanisms should be designed to do this comprehensively. A second requirement is to ensure that its design undergoes a coordinated process of information gathering, analysis and decision making and this process should be open-ended and interactive. In other words, there should be an integrated management of demand and supply in the development of the PI.

Reasons for Poor Infrastructure Facilities and Services

There are many reasons for the poor state of Africa's infrastructure. First the countries inherited a very poor infrastructure base. But most African countries have been independent for almost 50 years and so there is no longer any basis for complaining. The real problem is that the agencies of public infrastructure have performed poorly and have generally failed to develop a professional cadre of managers and technicians for proper infrastructure development.

Another reason for the poor state of infrastructure is lack of maintenance. A speaker from the USA, at a recent International Seminar on Road Management and Maintenance held in Abuja, said that his State of Michigan could not afford to neglect the maintenance of their roads. This is because neglect of road maintenance multiplies the eventual cost of repair by over 400 percent and increases costs to vehicle owners and shippers by up to

50 percent for paved roads and much more for gravel and earth roads. The adage that "a stitch in time saves nine" is very appropriate in this context. As a result of past neglect, Nigeria now needs to spend billions of naira to clear the huge backlog of maintenance and rehabilitation and a further several millions of naira each year to avoid further deterioration.

Other obstacles which impede the proper development and operation of PI services include: lack of overall planning at both national and regional levels, lack of adequate terminal facilities, lack of standardization of, for example, transport network design and carrying capacity, inadequate local expertise and management skills, lack of growth and efficient management of internal shipping line, limited resources and inadequate funding, lack of region-wide transport network linking roads, railways, inland waterways and air services, inadequate indigenous research and development activities in the area of PI, and basic technological problems such as differences in technical specifications of, for example, railways, development of modern road construction and maintenance services at reasonable cost, improvement of the navigability of inland waterways, and development of technologies for the most efficient handling of cargo at modal interfaces.

Also, past policies have failed to emphasize financial viability and good service quality; under-pricing has led to decay and scarcity. Other reasons include shortsightedness and greed on the part of our political leaders who cannot see beyond their selfish interests, waste of enormous national resources which are squandered on projects that add little to national development, etc.

It cannot be overemphasized that sound infrastructure is particularly important for cities and towns to develop and function efficiently. In any society, rapidly expanding urban centers are

crucibles of acculturation to modernity and to the market economy. However, institutions to manage urban growth particularly the local government are not well-developed in our country and in most African countries. Urbanization is on the increase despite every attempt to modernize agriculture because rural areas lack basic infrastructural facilities.

**Issues and Challenges of Infrastructure Development**

The infrastructure exists to meet social and economic needs of a nation. As the needs change and the infrastructure itself evolves, there arise a number of challenges. These challenges may pose the threat of diminished public support to the system or act as opportunities for the engineers to contribute to the solution of social problems. Although these concerns vary depending on the type of infrastructure and its location, the following are worthy of note:

1. **The demand for infrastructure services is increasing**. In virtually all communities, the need to build and repair infrastructure tops the list of growth-related challenges. As the population increases, especially if the economy continues to expand, there is bound to be more demand for infrastructure services. For example, it should be expected that a rise in population and vehicle ownership would lead to increased traffic congestion. To address this congestion, new and expanded transportation networks and technologies are needed. It is also expected that rising incomes would increase demand for air travel. This demand will likely cause increased airport congestion and may strain an already troubled air traffic control system. At the same time, increasing numbers of low-income households will live in cities and older suburbs. This trend would no doubt lead to increasing demand for affordable housing and for more employment opportunities.

2. **There are insufficient resources** (especially financial) to support the infrastructure network. As a result, investment in maintenance of our national infrastructure has not kept pace with demands. The Infrastructure systems require regular maintenance and replacement as they wear or complete their useful lives. There must be a long-term strategy to enhance their performance through the provision of adequate resources.

3. **Issue of institutional arrangements**: The PI system often suffers from fragmented institutional framework, and stringent and inefficient regulatory frameworks. For example, it is not always clear whether a State has jurisdiction over maintenance of federal roads passing through its territory. And some of the government regulations sometime create barriers to innovation and economic expansion. The historic government role in regulating some infrastructure services has been too intrusive. We should encourage competition through deregulation as an incentive to foster economic efficiency and innovation. Also there ought to be ways to use federal infrastructure policy and investments to support state and local quality growth initiatives designed to avoid the negative consequences of urban sprawl development in major towns like Lagos, Enugu and Kano. And there is an urgent need for effective intergovernmental cooperation between federal, state, and local policymakers to address the dual challenge of managing growth while maintaining a minimum quality of life in all our communities nationwide.

4. **Others**: In addition there are challenges of safety and security; unfavourable contractual commitments; adverse weather conditions; lengthy procurement procedures and

processes leading to protracted delays; environmental protection and the issue of incorporating new technology in the development, preservation and management of PI.

All the above have limited the capacity of the governments to expand and maintain existing infrastructural facilities. In some countries where the physical infrastructure systems are being developed under bilateral arrangements, there have also been delays in the fulfillment of donor conditions precedent to disbursement of funds leading to delays in project implementation.

**Meeting the Challenges of PI Development**

In spite of all the above listed obstacles and challenges, how can our governments hope to provide essential infrastructure services in meeting the needs of sustainable development? To meet the challenges facing the nation's infrastructure requires concerted efforts on the part of both the public and private sectors of the economy. Again, the approaches for resolving them are many and are interrelated and include the following:

**(a) More Regional Planning and Intergovernmental Cooperation in PI Development**

Most of the problems of urban congestion in Nigeria are traceable to lack of planning. Many of the existing private real estates, for example, were already developed before government thought of planning the regions where they are located. The result is that the infrastructure provisions required for optimal performance were not provided in those areas. Even where there is a plan, provision for open spaces and roads are often disregarded because of lack of enforcement. With the possible exception of Abuja, this is what obtains in virtually all our major towns with the resultant traffic congestion and chaos, poor environmental sanitation and inadequate provision of water, electricity, and other infrastructure facilities.

We need longtime planning. Information technology can be used to do this. For example, policymakers can project future demand through the analysis of infrastructure use rates and thereby efficiently plan the level of new investments over a 5 or 10 year period. The World Bank has developed some decision-making software that policymakers can use for investment priority-setting and to align investments with strategic goals. One of these is the **Roads Economic Decision Model (RED) for Economic Evaluation of Low Volume Roads (**Rodrigo S. Archondo-Callao, 1999)**.** RED performs an economic evaluation of road investments and maintenance options customized to the characteristics of low-volume roads such as:

1. high uncertainty of the assessment of traffic, road condition, and future maintenance of unpaved roads;
2. periods during a year with disrupted passability;
3. levels of service and corresponding road user costs defined not only through roughness;
4. high potential to influence economic development; and
5. beneficiaries other than motorized road users.

The federal, state, and local governments need also to cooperate in infrastructure development. Each state should develop urban and state wide plans which should dovetail from the national regional plans. We have a lot to learn from the developed countries on the place of planning in sustainable infrastructure development. The Intermodal Surface Transportation Efficiency Act of 1991 and the Transportation Equity Act for the 21st Century (TEA 21) of 1998 in the USA are examples of long range planning in action. TEA 21 was a continuation of the Intermodal Act and both landmark Bills embodied the ruling President's vision for the development of transportation. For example, the 1998 National Transportation Policy aims to maintain and expand the Nation's Transportation system; foster a sound financial base for transportation; keep the industry strong and competitive; promote safety; protect the

environment and improve the quality of life; and advance U.S. technology and expertise. Adequate financial resources were committed for the implementation of every aspect of the bill over the six-year period. The bills required each jurisdiction to prepare consolidated plans, including comprehensive housing affordability strategies, that is, plans for meeting low-income family housing needs. These plans were made regional in scope and merged with metropolitan transportation planning to better meet housing needs by taking advantage of region-wide housing opportunities.

**(a) More Priority on Preservation instead of Investment in new PI Facilities**

The government often finds it more appealing to expand facilities and undertake large projects than to invest in maintaining existing facilities. Too often government officials had relied on overly optimistic forecasts of demand and revenue to justify investments that later proved unviable. This is in most cases because of political pressure to construct new facilities that will benefit only a limited constituency. Such pressures should be resisted particularly when portions of the existing network are deteriorating. The preservation of existing facilities should always be accorded a great priority. And even in responding to proven cases of demand, Infrastructure improvements with high rates of return should be accorded more priority. These include water supply and rural roads serving areas with good agricultural potential or towns with strong economic links to the agricultural hinterland.

**(b) Cost of Infrastructure**

Another area that requires attention is the cost of providing infrastructure facilities. The unit costs of infrastructure investments are on the high side in Nigeria and many African countries: it is as much as twice that in Asia and higher for maintenance services. For example, the average cost of

reconstruction of bituminous road pavements is $326,481 per kilometer in East and Southern Africa while it is only $173,361 in East Asia, Table 1. Other unit rates can be found in that Table. These costs are high partly because domestic markets are small and fragmented. But it is also because of poor methods of public procurement and contract administration, low labour productivity and scarcity of indigenous machine production/shops and other support services. And corruption cannot be totally ruled out but we are happy about what EFCC is doing to curb this menace in the country. Besides, the country so far has failed to take full advantage of the available, small-scale, labour-intensive procedures for developing, maintaining and supplying infrastructure services. Attempts to use appropriate technologies have been too often quickly abandoned. This is an area which needs to be properly looked at in view of the funding challenges. Savings from inflation of contracts and poor and inefficient procurement and contract administration practices could be used to improve the quality and quantity of PI facilities.

Table 1: Comparative Average Costs of Road Projects per km in US Dollars Extracted from World Bank Average Costs – ROCKS (2002)

| 2 Lane Road | South America | East Asia & Pacific | East & Southern Africa | East Europe |
|---|---|---|---|---|
| Gravel Resurfacing | 10,268 | 11,278 | 28,914 | |
| Asphalt Mix Resurfacing | 73, 810 | 57,669 | 99,112 | 64,208 |
| Surface Treatment Resurfacing | 22,317 | 8,857 | 19,871 | 19,208 |
| Reconstruction | 181,263 | 199,392 | 294,821 | 103,710 |
| Asphalt Overlay 40 -59 mm | 85,552 | 60,761 | 99,112 | 64,042 |
| Reconstruction Bituminous | 181,263 | 173,361 | 326,481 | 103,710 |
| Single Surface Treatment | 19,095 | 5,295 | 24,441 | 19,208 |
| Strengthening | 122,822 | 91,252 | 132,241 | 203,306 |
| Widening & Reconstruction | 656,830 | 800,530 | 1,160,071 | |

## (a) Making greater Use of the Private Sector

And there is the need to make greater use of the private sector in infrastructure development.

Infrastructure is a long-lived facility and, as a rule, it is inherently monopolistic. Governments must therefore take overall responsibility for it. But an important distinction needs to be made between the **facilities** and the **services** they provide. While the government builds, controls and owns the facilities, the private sector can play a useful role in managing the services. This is what obtains in most developed countries.

Many governments are already relying more on the private sector in the provision of infrastructure services because of the inefficiency of most public agencies. Their policies range from outright privatization to divestiture of ancillary activities (e.g. stevedoring and freight forwarding) and management contracts. The BPE should be commended in this regard but it should extend its activities to PI services. The government should have no business running the services provided by the physical infrastructure systems. They should instead be content with providing policy to control and monitor such services.

## (b) Financial Commitment

One of the problems of planning and maintaining infrastructure is due to financial uncertainty. Contractors are often not paid on time for completed PI projects especially road maintenance. Many indigenous construction companies have become bankrupt because of erratic payments by governments. Even some utility companies have trouble collecting fess from ministries and parastatals. When government refuses to meet its own obligation of payment for past services, it becomes difficult to blame a contractor who abandons a project. In many cases, cash shortages are to blame for this situation which often makes the finance officials (accountants) to divert funds to seemingly more pressing

areas. This is a costly mistake which increases future demands on government funds and slows down economic growth. A timely and reliable funding is essential for sustainable infrastructure.

To ensure consistent long-term financial support for PI development and maintenance, the World Bank recommends an annual infrastructure investment equivalent to at least 5 percent of GDP on the average and $10 per capita annually. Such an amount should be set aside as soon as the budget is approved by the legislature. Besides, spending for normal maintenance must keep pace with new investment. The gap between budgetary allocation and what is needed to support economic growth is huge because of past neglect. This gap must be bridged through a long-term commitment of public funds. An additional 1 percent of GDP should be provided annually over the next 5 years in Nigeria, for example, to catch up on the substantial backlog of deferred maintenance.

**(c) Use of Local Expertise**

The governments have in the past depended heavily on external agencies and foreign consultants for the analytical work on which key decisions on infrastructure have been based. For a self-reliant and sustainable development, our capacity to undertake this work for ourselves must be improved by building up local capacity to meet this need. We must make use of indigenous manpower particularly professionals and the graduates of our institutions who are available locally. The government must resist excessive dependence on foreign advisers, experts and contractors in the development of our infrastructure. We thank God for the establishment of an institution like Covenant University, an institution committed to raising a new generation of leaders for the African continent: with this type of institution, our dependence on foreign expertise may soon become a thing of the past. However, there should be more emphasis on the development of technical

skills: the 60:40 ratio of science : humanities graduates should be adhered to in all our universities. Besides the public and private institutions should be restructured to create a context in which skilled workers can function effectively and such institutions should not be politicized or used for narrow, sectional ends.

**(d) More Efficient Use of Existing PI**

We need to plan and use existing infrastructure more efficiently. For example, congestion exists when demand exceeds the capacity. The usual response is to build more capacity. This is however limited by the availability of funds and physical space. Hence there is a need for a more effective and efficient way to utilize existing facilities. One way to do this is to provide incentives for development in areas already served by adequate infrastructure systems to draw people away from areas with poor facilities. For example, providing tax credits for housing development in areas with adequate transportation services could help meet the need for affordable housing while taking advantage of existing transportation networks.

**(e) Introduction of Performance Management as Decision Making Tool**

According to *Fragile Foundation: A Report on America's Public Works to the US President and Congress (1988),* performance measures are necessary for gauging infrastructure needs more precisely, maintaining and expanding service capacity more effectively and efficiently, and supporting a growing and prospering economy. In the USA, federal infrastructure investment and regulations are monitored and assessed using the performance measurement requirements under the Government Performance and Results Act (GPRA) of 1993. Infrastructure performance is fairly measurable, and GPRA provides the US federal government with the framework for measuring results. Examples of measurable outcomes of infrastructure include

congestion time and accident rates on highways, availability of water, incidence of waterborne diseases in connection with water supply investments, and average delays and elderly/handicapped access for mass transit systems. It is on the basis of performance that further investments decisions on the PI are made.

### (f) Alternative Approaches to Infrastructure Development and Maintenance

Because there has been insufficient funding to address the backlog of government property maintenance and renovation needs, there is need to promote private-sector-like approaches for property maintenance and renovation. For example, government agencies could be permitted to keep and reinvest the proceeds from sales of government property and use part of accrued interest on maintenance. Agencies could also be allowed to enter into lease-with-option-to-buy arrangements if there is an appropriate enabling law. A different approach, in terms of government property, is allowing government agencies to tap some of their funds in equity by entering into public-private partnerships, in which developers would finance the renovation of government property in return for a percentage of the cash flow from the partnership. Another possibility is a planning oriented proposal to help state governments address deferred maintenance issues. For example, life-cycle costing could be promoted by requiring preparation of maintenance plans in conjunction with capital outlay plans.

Another way is to encourage market-based decision-making in the provision of infrastructure services. The historic government role in regulating some infrastructure services has been too intrusive and so we should encourage competition through deregulation as an incentive to foster economic efficiency and innovation. This can be seen in the introduction of competition into the telecommunications industry, which lowered prices and

significantly increased both investment and the number of wireless subscribers. Before the introduction of GSM in Nigeria, fewer than 20 percent of attempted telephone calls were actually completed; in many countries the figure for international calls by then was less than 10 percent. Also deregulation can lower costs for consumers, as evidenced by lower prices in many airline markets since deregulation.

**(g) Use of ICT for PI development**

The coming of the information age (ICT) has brought rapid access to data and new ideas worldwide. This is as true for Africa as anywhere else. One can no longer say, oh, yes, we know all about the system and then ignore most of the factors influencing it. Information technology makes it practical and necessary to consider all of the components of whatever infrastructure system we are concerned with. Information systems are already being integrated into infrastructure operations to exploit new technologies, compensate for capacity limitations, address regulatory changes, increase efficiency, and protect against natural, accidental, and deliberate threats. Integrated information-infrastructure systems drive traffic signals and variable message signs on roadways and bridges, monitor potable water quality at treatment plants, pump water and wastewater, and activate switches in telecommunications systems that command transportation and water networks. All of these capabilities are enabled by energy and power infrastructures, which, in turn, depend on even more information infrastructure. In short, information systems hold the key to the efficient planning, design, construction, operation, maintenance, and retirement of our nation's very valuable civil infrastructure assets.

In the developed countries, Integrated information systems have substantially improved unit-level and component-level operating efficiencies in transportation, water, telecommunications, and

power infrastructures, just to name a few. The benefits include increased accuracy, expanded and improved services and products, reduced capacity needs, higher utilization, and lower costs.

**(h) Cost Recovery:**

Recovering the cost of providing infrastructure services should ordinarily not be a problem. However, people are normally not willing to pay for services which are poor, unreliable and inefficient. Frequently people cannot see what they are getting for what they are being asked to pay; the officials themselves often subvert the cost-recovery process for personal gain. For example, it was reported that before the toll gates were demolished on some Nigerian highways, more than 50 percent of tolls collected went into private pockets while the roads were becoming worse and worse. The government could have instituted operational discipline to minimize losses and service leakages instead of canceling the toll system on our roads outright. The highway toll system should be reinstituted on specially selected roads under a PPP arrangement. Accurately metering water and electric power, highway tolls, enforcing motor vehicle regulations, and monitoring shipping and air traffic have been shown to be particularly cost-effective in the developed countries. These measures can add the equivalent of up to 50 percent to the capacity of many systems at relatively little cost.

**(i) Strengthening of the Local governments**

It would appear that as a result of the rural urban migration, urban growth has far outstripped planning and administrative capacity at both the central and local levels. The task of meeting mounting infrastructure needs has fallen on local governments which are ill-equipped for the task. Local Government Authorities provide infrastructural facilities which support industrial development,

provide markets for agricultural produce, promote trade and tourism and provide other social amenities. Even though they are the best suited to meet the needs of local communities, they are often weak and underfunded. This is true for the rural areas as it is for the towns. There is need to develop competent and responsible local governments with stronger powers to raise revenue locally and a clearer delegation of authority and responsibility. Many of the problems of the towns and rural communities can only be solved locally: solutions imposed by central authorities are likely to fail. The objective should be to capitalize on the energies and resources of the local people. However, the machineries of government must first be put in capable hands.

## Infrastructure and the Environment

There is a mutual relationship between the physical infrastructure and the environment. The extensive activities within the building and construction sector throughout the entire lifetime of the infrastructure (construction, management, renovation and recycling) have a great influence on the environment due to the use of resources (materials, energy, water, land) and various environmental loads. On the other hand, the influence of the environment and the climate exposure on the infrastructure is equally important and can affect the location, design, material use, management and service life of the infrastructure. All these have a most important impact on the environment and sustainable development of a society. In Agenda 21 for sustainable construction from CIB (International Council for Research and Innovation in Building and Construction), it is stated that;

*" This sector of society is of such vital innate importance that most other industrial areas of the world society simply fade in comparison. The construction industry and the built environment must be counted as two of the key areas if we are to attain a sustainable development in our societies."*

**In other words, infrastructure is very important for industrial development but it must be built to make development sustainable. The infrastructure affects the environment just as the environment can affect the infrastructure. And so, the impact of climate change on the infrastructure and vice versa must be considered in the** location, design and use of the system.

Therefore the Government needs to recognize the importance of protecting and conserving the environment during construction and after construction of infrastructure projects. Environmental Impact Assessment should be mandatory before undertaking implementation of all projects to ensure that the activities carried out do not impact negatively on the environment. In this connection, PI projects should at least consider the following issues which can affect the level of environmental impact of the PI on the environment:

- Sustainable design and construction - e.g. energy and water efficient design, specification and equipment; use of recycled or secondary aggregates and sustainable materials; passive ventilation systems; and incorporating pollution prevention measures during construction
- Renewable energy technology - e.g. solar, wind and earth-energy technologies for on-site generation; and obtaining remaining energy requirements from off-site renewable sources
- Local sourcing - e.g. use of local suppliers and expertise wherever possible
- Waste management - e.g. on-site waste management and recycling facilities
- Flood risk management - e.g. sustainable drainage systems, brown/green roofs and river rehabilitation schemes

- Protecting and enhancing biodiversity - e.g. incorporating natural habitats as part of project design
- Connectivity with public transport, cycle ways and footpaths - e.g. green transport plans and creation of cycle-ways and footpaths and vehicle free zones in some business centers.

It is also noticed that most of the utilities have a negative impact on the appearance of the landscape. PHCN (Power Holding Company of Nigeria) power lines and NITEL telephone lines constitute an eyesore in many communities apart from being a source of unintentional danger during rain storms. An enabling law should be enacted to require that public-utility power lines for telephone, telegraph, and electricity be placed underground. Also some public utilities have destructive effects on the environment. For example, utilities, such as sewage-disposal systems, are directly connected to the rapidly increasing pollution of air, land, and water throughout the world. There is need for regulation to protect the environment from these negative impacts.

## Solution to Urban PI Problems

Rapid urbanization has created a number of problems in its wake. Traffic congestion is one of the most glaring. Congestion on Lagos roads for example, costs the average individual commuter over 20 hours in wasted time each week: the combined cost to the economy can be staggering! The problem is that most people in Nigeria do not place any value on their time. To ease the congestion, there should be a good and efficient public transportation system. Considering the nature of traffic congestion, Mass Transport is the best way forward. This can be it in the form of Buses, BRT's, Monorails, LRT or Subway/Metro Systems. Lagos State should go beyond the BRT and commence on plans for rapid rail transport (subway) or light rail service (LRT). Meanwhile the BRT services should be extended to the suburbs of Lagos.

The rapid rail transit (subway or metro) uses high-speed passenger rail cars that operate in tunnels, on elevated structures, or in exclusive rights-of-way that are grade-separated to avoid interference with traffic. It uses high-performance trains with running speeds of up to 120 to 130 km/h (up to 75 to 80 mph) and can carry as many as 40,000 passengers per hour in one direction, Figure 5(a). For a start, this system can run between Lagos Island and Ikorodu; between Lagos Island and Badagry; between Ojuelegba and Ifo along Ikeja - Abeokuta road in Ogun State, and between Lagos Island and Epe.

Figure 5: RRT and LRT in Use in some Countries


(A)A late commuter sprints to catch a train on the underground Metropolitan line in France. Subway systems have a wide variety of names: the Metro in France, the Tube in London, and BART (Bay Area Rapid Transit) in San Francisco. Underground rapid transit originated in New York in the early 1900s, and the network continues to grow as cities expand their transportation options.

**(A)**Many congested cities have turned to Light Rail Transport (LRT) because these systems offer relative simplicity and versatility. For instance, in areas that cannot geographically handle a subway system, the light rail may operate high above street level. This LRT services the London docklands, providing convenient transportation through the industrial network.

Light rail transit (LRT), also called streetcar or tram, is a metropolitan electric railway system characterized by its ability to operate single cars or short trains propelled by motors with power pickup from overhead catenaries. The distinguishing feature of LRT is its diversity of options for alignment, configuration, and design. In dense downtown areas it can be placed in tunnels or on the surface in pedestrian malls, Figure 5(b). Outside center cities, cars can run on the medians or reserved lanes of arterial highways or on abandoned railroad beds or utility corridors. Depending on the degree of separation from road traffic, average speeds range from 16 to 40 km/h (10 to 25 mph). The capacity of a moderate-size system is about 12,000 people per hour. This can operate along the same routes as recommended for subway above.

Besides, there should be a good traffic control system. Traffic control systems include laws and procedures, electronic and

physical devices such as radar, radio, markers, signs and signals, and people such as vehicle operators and traffic controllers. The system varies depending on its location and the type of transportation it controls. For example, cities and busy harbors have complex traffic control systems compared to small towns and the open sea.

The signal light is probably the most easily recognized traffic control device. Traffic signals direct streams of vehicles and pedestrians when to go, stop, or proceed with caution. The signals increase the traffic-handling capacity of most intersections. They can work independently on timers, or connect to a computer-controlled system that operates over several intersections. In a computerized system, traffic detectors are placed at several locations—generally in the pavement. A computer continuously scans the traffic information from each detector. The computer then selects the best timing for each signal to reduce traffic congestion and minimize delays, Figure 6.

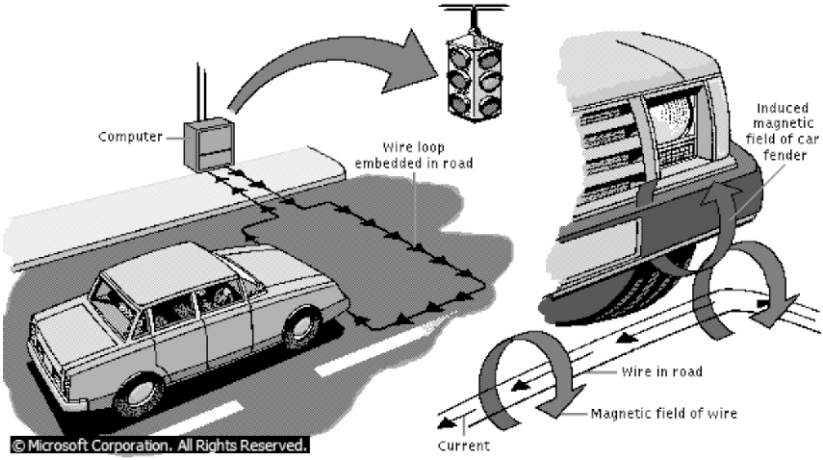


Figure 6: "Smart" traffic lights can sense and respond to traffic because of a wire loop embedded in the road. Electric current, run through the loop, creates a magnetic field. When a car bumper interferes with this field, a signal is sent to a roadside traffic computer. The computer monitors traffic flow, coordinating a light change as soon as it is safe.

Traffic signals often allow certain types of vehicles, such as ambulances, fire trucks, and police cars, to trigger light changes. This control over signals helps speed emergency vehicles along while reducing the chances of collisions with other traffic in intersections, Figure 7.

Computer technology may eventually lead to intelligent transportation systems (ITS). In ITS, automobiles equipped with onboard computers and display terminals would automatically receive route location and traffic information. Predictions for the future include fully automated systems with traffic completely controlled by computers. Drivers would instruct traffic control computers where they want to go and the computers would operate the car, delivering it to its destination.

Then there should be "Priority Control" in some business areas of Lagos to restrict or ban vehicles from the area during daytime. This will allow pedestrians to move more freely around the city. Provisions should be made to improve facilities and safety for bicycles and pedestrians in all major towns. There should be pedestrian walkways in all urban roads and footbridges particularly at bus stops by major highways. The government should ensure the consideration of bicyclists and pedestrians in the planning process and facility design. In addition, the government should ban or restrict truck travel through certain neighborhoods in Lagos town.


Figure 7: Various rules, regulations, and signs are used to keep traffic flowing smoothly. The city street shown here is governed by stoplights, crosswalks, parking meters, several signs, and the conventions understood by pedestrians and drivers. The school bus and the ambulance (which is shown crossing the double yellow line; this is illegal for other drivers) travel under special rules that other motorists must know and observe.

In the design of highways, interchanges should be introduced where two major roads cross each other to make for smooth transfer from one road to the other (Figure 8 is a good example). There should be bus stops on all major township roads for picking and dropping passengers. The bus drivers should be made to pass a written test on the Highway Code before they are issued driving license. Decent markets and shops should be provided for women traders to prevent them from converting the roads into markets. And the police and Mopole should no more be allowed to convert major highways to tollgates. For security purposes, they could be made to operate at night between 7.00 pm and 7.00 am.


Figure 8: This complex freeway interchange near Los Angeles, California, shows a typical cloverleaf pattern that facilitates continuous and smooth route changing.

## Safety and security

Infrastructure systems are exposed to many hazards because of their distributed nature and the fact that they may be transporting hazardous materials. The hazards range from natural ones to, increasingly, manmade hazards from terrorism and intentional disruption. Safety of the systems is of paramount importance. As recent history has shown, disruption and attack of infrastructure systems is not difficult, and new approaches of protection and mitigation must be developed through research. The events of September 11, 2001 in the US brought into focus the vulnerability of any nation's infrastructure to terrorist attack. However, the tragic hurricanes of 2005 in the USA also remind us that disasters and vulnerabilities arise from a variety of sources, and we ignore the natural world at our peril. The civil engineering profession provides leadership for planning, designing, building, and maintaining the nation's physical infrastructure. The profession

should develop new planning, design, construction and operation and maintenance strategies and technologies to mitigate the impact of future events on the physical infrastructure.

## Research Directions for the Physical Infrastructure

Research is the base for building and preserving a twenty-first century physical infrastructure. According to Donald Stokes, the research should be "use inspired," to address the significant challenges in PI development and preservation. A CIS research effort should be however developed with two thrusts: one for performing basic research, and another for addressing knowledge diffusion--enabling research results to be turned into products and services for industry. And the efforts should systematically address issues of deterioration science, assessment technologies, and renewal engineering. According to the ASCE, the major areas requiring research include

*Materials*

Materials and infrastructure components made from the materials are subject to deterioration from cyclic loading, other loading (such as ground movement), environmental conditions leading to corrosion and deleterious chemical reactions. The service life can vary from 20 to 50 years. Research is urgently needed to develop economical materials that can be in service for 100 years or more. Innovations in nano-engineering of materials for example could have an enormous impact on improving the durability of infrastructure components. The ability of materials to sense condition will enable self-diagnosis and decision-making. Since materials are energy intensive, issues of sustainability must be addressed because manufacturing of materials for the infrastructure is one of the biggest users of energy and producers of waste. The Department of Civil Engineering, Covenant University, is looking into the development and use of laterized

concrete and blocks for low-cost housing. The department will also soon commence a research project on the recycling of asphalt pavements in Nigeria.

*Flexibility and adaptability of Infrastructure Systems*
Many of the problems with the twentieth century infrastructure are related to its lack of flexibility and the inability to adapt it for changing needs. This is where the contrast with the telecom infrastructure is interesting, since the telecom industry goes through regular cycles of massive changes in the communication infrastructure. Granted, the transport of vehicles or water, for example, is radically different from data packets. However, creative research is needed to look at ways to make the physical infrastructure more flexible and adaptable as needs, often unforeseen, develop.

As energy resources shift to a highly diversified portfolio, which may change over time (e.g. types of bio-based fuels and renewable energies), a new energy infrastructure will need to be built. How should this infrastructure be created so that it will adapt to fuels and energy usage fifty years from now? Research is needed to create analog concepts for the physical infrastructure that are the norm for the telecom infrastructure, such as modularity, forward compatibility, and redundancy.

*Distributed sensing and control*
Most of the infrastructure is operated with little knowledge about the condition of the system.
Infrequent inspection is entirely inadequate to meet safety and security goals, or even for optimal maintenance and operation. As a counter example in another domain, jet engines are continuously monitored and data telemetered to a center that uses the data to identify abnormal conditions, fuel efficiency, and the schedule of maintenance. This type of sensing and control has the potential for

making the physical infrastructure more efficient, safe, and secure. Dense, distributed sensing of infrastructure operation and condition is needed, which will require a scalability and reliability unavailable with technology currently under development. Data alone will not improve infrastructure systems; rather it must be an integral part of a control system that abstracts the information from massive data sets and enables control or decision making about operation, abnormal conditions, safety, and maintenance. Research is needed ranging from distributed closed-loop control systems for distributed infrastructure to decision-making, all within the probabilistic framework because of the uncertainty inherent in sensed data, expected conditions, and impacts of control and decisions.

*Modeling and simulation*

Dense sensing and control of infrastructure systems allow diagnosing condition, and coupled with models provide a predictive estimate about future operations and capacity. Infrastructure systems will need living models that are continuously updated as new data is available. This will provide owners and operators information needed for economic operation, managing risk, and handling exceptions and extreme conditions. Innovative research is needed for creating robust models and simulation methods, along with breakthrough methods of computing. The latter could take advantage of the distributed computing power available with new sensors and having the modeling and simulation as distributed as the infrastructure system itself. This would contribute to the resiliency of the system to disruption or attack.

*Economic operation and risk management*

As infrastructure systems move more from the public sphere to a competitive private sphere, sound economic models are needed for operation and managing risk. The highly capital intensive needs of

infrastructure systems will demand new approaches for decision-making, pricing, and risk mitigation. Economics, operation, and risk management decisions will need to be made in real time to optimize not only functionality but also the rate of return as market conditions change.

*Construction and maintenance*

The capital intensive and time consuming processes for infrastructure systems may be reduced with creative research on new design, construction, and maintenance process. Modular and adaptable construction methods, lean production, and leveraging infrastructure for new functions can provide new opportunities for dramatic reduction in resources needed for the physical infrastructure.

## Multidisciplinary Research Effort

Civil infrastructure research is a multidisciplinary effort that requires contributions from all engineering disciplines--and the earth, physical, chemical, biological, mathematical, computer, and social sciences, as well as education and human resources. This is because the solution to Infrastructure challenges involves social, political, environmental, and economic elements as well as technical considerations. The general public and elected officials are often reluctant to support infrastructure projects because of high, uncertain direct costs; disruption and costs to neighborhoods and businesses during construction; the impact of projects such as freeways on familiar environments and valued lifestyles; and effects on the natural environment. Technology could better target these concerns. For example, microtunneling is far less disruptive than open trenching for installing utility lines, and research on lowering the cost of large-bore tunneling could permit transportation corridors to be moved underground economically.

The nation should invest more in infrastructure research because of the valuable benefits to be gained: this includes greater

durability and enhanced performance for the physical infrastructure, the training of a new generation of infrastructure professionals, environmental protection, greater economic productivity, and improved quality of life for everyone who uses the infrastructure. However innovation and infrastructure improvement can be achieved through research only if results are put into practice. Therefore there is need for more cooperation and collaboration between the government agencies, the private sector, and academic researchers in the quest for cross-cutting new knowledge and technology in the development of the PI.

**Other Recommendations**

In order to further enhance the performance of the institutions charged with the provision of physical infrastructure facilities and services, **the government should commission a number of position papers to guide its development**. Key reforms are required to streamline its operations and to enhance its institutional efficiency and competitiveness. Such reforms should include: concessioning; commercialization of operations and management; sub-contracting of certain non-core services; introduction of competition; tariff liberalization in key utilities; financial and management restructuring of state enterprises providing infrastructure facilities and services; and public private partnerships in the development of PI.

**An Integrated Transport Policy, linking the road, rail, air, and water systems, should be developed and implemented by the government**. Urgent reforms are required to improve the efficiency and safety in the delivery of transport services. More priority should be paid to the provision of mass transport in urban areas to relieve traffic congestion. Attention should be given to rehabilitating and modernizing the rail system. Key reforms would include concessioning of the Nigerian Rail network for operational efficiency. This is very important to relieve the roads of the enormous freight being carried by trailers and the consequent damage to the

highway pavements.

In the Roads sub-sector, there are some policies and institutional reforms that are already in place. The establishment of FERMA is a step in the right direction. However, **there should be new autonomous agencies or units within existing ones to oversee the development and maintenance of urban and rural roads in the country.** This is to increase efficiency and service delivery in terms of expansion, maintenance and rehabilitation of the road network. Adequate provision should be made for the completion of all abandoned and on-going road projects. The government should encourage private sector participation in road development especially in financing, and the management of its services.

The government should **facilitate the availability of low-cost housing units in urban areas and improvement of housing units in rural areas**. The focus should be on the development of low-cost housing and slum upgrading schemes, coordination of housing incentives to enable more private public partnerships (PPPs) in housing development, and promotion of appropriate building materials and technologies.

**Every Nigerian should have the right of access to potable water and at affordable costs**. The government should ensure that regional water basin authorities are functional and capable of managing water and sewerage services in their respective areas of jurisdiction. **Public health** aspects of urban water supply should be regulated and properly monitored by the Ministry of Health through appropriate standards and the public health grading of the source, treatment and distribution (reticulation condition, management, and actual water quality) of community drinking water supplies.

**The treatment of urban wastewater is an important component in protecting the quality of Nigerian streams, rivers and coastal waters**. Other components are the treatment of point sources of industrial and agricultural waste and the prevention of diffuse sources. There should be adequate control of discharges of treated sewage effluent into any stream through appropriate legislation. State governments should have set environmental quality objectives for freshwater bodies and coastal waters in their areas. Operating standards for sewage treatment plants must stipulate effluent limits low enough to respect these receiving water quality objectives.

**An irrigation and drainage policy for all parts of the country needs to be formulated**. The policy should aim at improving the development and management of irrigation and drainage schemes in the country.

**The government should ensure the provision of clean and reliable energy services in the country.** The decision of the Federal government to declare a state of emergency on this subsector is to be commended. But the government should move beyond rhetoric to visible commitment. The foot-dragging in breaking the subsector into semi-autonomous units with separate Agencies for generation, transmission and distribution of energy should be stopped. The power holding company (PHCN) should be unbundled into two separate entities, one for Transmission and the other for distribution of electricity. In addition, the law should be liberalized to allow other players other than PHCN in the power distribution segment. In order to improve the quality of energy supply, there is need for the rehabilitation and upgrading of the energy infrastructures, implementation of new electricity consumer meter connection and acceleration of investments in rural electrification. In addition, a special agency for the development of renewable energy should be established to

underwrite the risks associated with solar energy and geothermal exploration and steam development. The BPE should extend its privatization efforts to the energy sector.

**Enabling Environment**

Finally the government needs to create an enabling environment for Infrastructure development.

**The Legislature/Government should enact a National Infrastructure Improvement Act to establish the National Commission on Infrastructure of Nigeria (NACIN).** The Commission would study the present condition of the nation's various infrastructure systems and report to government and the legislature annually on the capacity of our infrastructure to support the national economy, the age of the systems, maintenance needs and possible methods to finance improvements.

In addition, the **National Infrastructure Bank** should be established to finance infrastructure projects in the country. The National Infrastructure Bank should be an independent entity of the Federal government to provide funding for qualified infrastructure projects. As part of the infrastructure fund, there should be a Special Highway Fund similar to the Education Trust Fund into which at least one percent of fuel sales (from source) would be put for the development and preservation of the nation's road network. Special attention also needs to be paid to rehabilitation and replacement of aging bridges. Cather bridge, for example, is structurally deficient or almost functionally obsolete and needs rehabilitation. We should not wait for it to totally fail before doing something about it. The second Niger bridge at Onitsha (which the government has been talking about for years) should be built without any further delay.

## Physical Infrastructure Stimulus Investment to combat Global Meltdown

Physical Infrastructure system is an important catalyst of private sector activities because of its facilitative role in enhancing the operations of the private sector. The current global recession has put hundreds of thousands of people out of work all over the world and left critical infrastructure improvements unattended to. Experts say that the situation is likely to get worse. That is why for example, the US President, Barack Obama, recently proposed an ambitious plan to combat unemployment and foster continued economic growth through infrastructure investment. This investment will create and sustain jobs, in addition to addressing their nation's infrastructure challenges because PI is an engine for the creation of employment and income generation.

Nigeria does not need to wait for the world economic recession to bite harder before taking action to protect its economy. As is the case in the US, there should be an economic stimulus investment for improving and maintaining the nation's infrastructure. The investment should be in projects that would create and sustain employment increases; provide long term benefits to the public (such as congestion relief); deliver measurable improvements in public health, safety and quality of life; be designed and built in a sustainable and cost-effective manner; and have a significant environmental benefit. Besides the long term maintenance and upkeep needs of all the infrastructure projects – existing and new – must be taken into account; and an auditing program should be established to review the program and measure the desired outcomes on a regular basis

## Conclusion

The PI is the life wire of a nation's development and the key in any government's effort to accelerate its economic growth. It is the tool for transforming and modernizing the economy and the vehicle

that can be used to achieve Vision 2020 target. Major investments are therefore required to nurture and sustain the system through increased budgetary allocations for planning, design, construction, rehabilitation and maintenance of the various infrastructure facilities, optimal utilization of available resources, enhanced performance of technical departments in the PI subsectors, implementation of key reforms e.g. the establishment of National Commission on Infrastructure of Nigeria (NACIN) and increased participation of the private sector in the provision of certain PI services through public private partnership.

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