The Sustainability of North-South Transfer Technology in Public Transportation: Theory and Practice in sub-Saharan Africa

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Abstract

This article examines North-South transfer technology (TT) and its implications for transportation in developing countries. The focus is on the sub-Saharan African region. Of special interest are: the rationale, composition, main conduits, principal actors, and sustainability implications, of TT. Technology transfer in transportation is considered the source of a deluge of problems. The most potent of these problems include, ineffective and costly transportation services, insensitivity to the mobility needs of women and rural populations, high levels of unemployment, and unnecessary dependence. Reversing the situation will entail not only the ability to judge the suitability of any given technology to local conditions, but also the willingness to adapt technology to its host environment. It is argued that efforts to adapt technology possess the potential of making significant positive contributions to development, especially by creating job opportunities, lowering the cost of transportation and related services and promoting efficiency in resource utilization.

Introduction

Interest in improving living conditions in less developed countries (LDCs) has grown tremendously during the last three to five decades. One upshot of this growth has been the formulation of models purporting to either elucidate the causes of underdevelopment or guide the development process itself.[1] Arguably, none of the models has wielded as much influence on the development process in LDCs as modernization theory. Apart from being the most influential, modernization theory has been relatively more optimistic than alternative models about the development prospects of LDCs (Handelman, 1996). To develop, modernization theorists argue, LDCs need to simply follow the same path to socio-economic, cultural and political development taken by present day developed nations. One inherently flawed assumption underlies this argument. The assumption is that the conditions prevailing in LDCs are identical to those that characterized the developed world while they were at a comparable stage of development. In practice, heeding the suggestion of modernizationists has often resulted in the wholesale transfer of technology from developed to less developed countries. Although North-South transfer-technology (TT), as this practice is generally referred to, is not a new phenomenon, a lot of relevant questions such as the following are yet to be adequately addressed. The most important of these questions relate to the explicit and implicit

reasons for North-South TT, the principal elements of TT, the typical conduits for North-South TT, the main actors involved in the TT process, and above all, the sustainability of TT in host countries. Our main objective in this article is to attempt to address these questions. We focus specifically on the transport sector in sub-Saharan African (SSA) countries with a view to promoting comprehension of the effects of TT on: a) effectiveness in transport service delivery or supply, and b) the transport sector's ability to expand and/or create employment and other opportunities in these countries. Initially, we present an overview of the nature of the transportation problem—which we see as essentially the conundrum of matching transport service demand with transport service supply—in SSA countries.

The Transportation Problem in sub-Saharan Africa

Although most sub-Saharan African countries expanded their road network during the 1960s and 1970s—that is, the immediate post-colonial period in most cases—transportation infrastructure remains extremely scarce throughout the region. Support to this assertion resides in the fact that Mauritius, the country with the highest road density in the region has only approximately one kilometre of road for every square kilometre of land area (i.e., a road density of 0.99). The distant second in this connection is Seychelles, which boasts only about half a kilometre of road to every square kilometre of land area (i.e., a road density of 0.59). In fact, some countries, such as Mauritania, have only seven metres of road for every square kilometre of land area. To better appreciate the magnitude of the infrastructure problem in this region, it is necessary to peruse the statistics on paved versus unpaved roads, which appear on Table 1.

The under-supply of infrastructure is hardly the only problem facing transport planners and authorities in these countries. Another crucial riddle has to do with tailoring the infrastructure to contemporary development needs. This problem attains its pinnacle in the case of rail transportation, particularly because the few available railways in the region are remnants from the colonial era. It is important to note that the objective of colonial authorities in the transport sector was never to ensure the effective and efficient movement of people, goods and services. Rather, their goal was to facilitate the movement of agricultural products, mineral and other essential resources, from the hinterland to the seaports for onward transmission to the metropolis. Furthermore, the colonial infrastructure was, as Griffiths (1995) has observed, designed to support military action, sometimes against other colonial powers (such as was quite often the case in East Africa) or against Africans (e.g., the case in Kumasi, Ghana and Bulawayo, Zimbabwe). Consequently, colonial infrastructure development strategies never produced any effective rail or other transport network. Griffiths (1995: 184) notes that colonial authorities succeeded in developing a series of lines from port to specific inland sites, often mines, and occasionally, perceived strategic locations deemed important for the purpose of tightening the colonial grip over Africans and warding off potential threats from rival European imperialists. It is therefore not surprising that the railway

infrastructure of sub-Saharan African countries lack lateral linkages. The only exception in this case is Nigeria, where the Western, Southern and Northern parts of the country are connected by a railway system, which by the the way, also dates back to the colonial era.

The scarcity of lateral linkages and roads implies enormous, almost insurmountable, problems for public transportation demand and supply in sub-Saharan Africa. The problems are compounded by yet another quandary, namely the ever growing population of countries in the region.[2] The importance of population in this regard hinges on the fact that travel constitutes a derived demand. Any hopes of significant additions to existing infrastructure within the foreseeable future are shattered by growing negative trends in the economies of SSA countries. These trends and concomitant attempts on the part of indigenous authorities, in collaboration with the World Bank and the International Monetary Fund (IMF), to remedy the situation, have magnified, rather than diminished, the demand for public transportation (cf., Njoh, 1995). It is important to note that the transport burden falling on the population as a result of this, is inequitably distributed. A disproportionately high percentage of the burden rests on the shoulders of women. One reason for this has to do with the fact that local norms and values heap most household chores, hence the attendant transport responsibilities, on women.[3] Women and the population at large in SSA societies depend less on motorized modes of transportation and more on non-motorized modes.

The transport problem in SSA countries is exacerbated by a number of other factors that constitute ubiquitous characteristics of developing nations in general. Five of these factors come readily to mind (cf., Njoh 1995; Thomson, 1983). First, there is the tendency to adopt inappropriate spatial design schemes. Such schemes typically possess two conspicuous features, namely the compartmentalization of land use based on some predetermined characteristic and a sparse, as opposed to a compact, land use pattern. Both features have far-reaching implications for transportation. The most salient of these implications are discussed below. The second factor relates to the unavailability of reliable data, and in some cases, the total lack of data of any quality. A third defining characteristic of the transportation policy field in developing nations is resource scarcity, particularly the abasence of qualified technical and professional staff. It is worth noting that most members of the slim pool of technicians and professionals in these countries have either been trained by experts from industrialized nations, or received their training in these nations. In some instances, professionals such as engineers and planners actually hail from developed countries. In either case, the result is often what we allude to here as a fourth defining factor of the transportation policy field in developing countries, namely the lack of political realism. This latter relates to ignorance of, or failure to appreciate, the political environment of planning in developing countries. A fifth factor, and in fact, one that dovetails very neatly into the foregoing, is the lack of cultural realism—that is, the general proclivity on the part of transport planners and other related professionals to ignore local cultures and values. The consequences of ignoring local cultures and values cannot be overstated. Conventional transportation projects and policies in Africa, for

instance, focus exclusively on motorized modes of transportation. Yet, as Philpott (1994: 39) notes, most African women cannot afford motorized transportation or have mobility needs that can be better served by non-motorized modes of transportation. Therefore, conventional transportation schemes, because they are conceived, formulated and executed by planners and professionals, who are either unaware of, or elect to ignore, the local cultures and values of Africans, invariably discriminate against women in the transportation domain.

In his characterization of the transport environment in developing countries, Yanaguaya (1993) includes a number of essential factors, which we consider very apt in the context of sub-Saharan African countries. These factors include (Ibid, p. 477)

- deficient road furniture with poor road-marking, signing and lighting
- poor driver behaviour;
- indiscriminate on-street parking;
- diversity of traffic composition with high levels of public transport vehicles;
- high incidence of pedestrian traffic; and
- proliferation of street vendors.

Another transport problem worth noting, especially for the purpose of the present discussion, relates to the exceptionally high incidence of faulty transport equipment, which partially accounts for the equally high transport-related accident rates in the region (see Table 2).

The Concept of Transfer-Technology

Although the term technology-transfer (TT) is widely used within development circles, few attempts have been made to accord the term any precise definition. Some of the most notable efforts in this connection begin by disaggregating the term and separately defining the two words, 'technology' and 'transfer' comprising the term (Stewart and Nihei, 1987; Meier, 1984). Within this framework, technology is defined as comprising new and better ways of attaining preconceived economic objectives (Stewart and Nihei, 1987). Resonating the sentiment implicit in this definition, Meier (1984) views technology as embodying the skills, knowledge and procedures for doing useful things. A conspicuous feature of the foregoing definitions is their attempt to cast the term technology in an exclusively positive light. Yet, in practice, the effect of any given technology may be either positive or negative. Perhaps less contentious and more relevant definitions for the purpose of the present discussion are those that conceptualize technology as comprising physical objects, labour and managerial skills as well as cultural, social and psychological processes (Stewart and Nihei, 1987). The relevance of definitions of this genre here resides in the fact that they acknowledge the importance of elements of TT such as human resources, cultural, social and psychological environment—all factors that are often ignored in studies of TT. Yet, the importance of such factors especially in the context of developing countries can hardly be overstated.

The second prong of the term, TT is the concept of transfer. The literary meaning of the term transfer connotes moving, conveying or transporting something from one location to another; or

moving something—an artifact, idea or an object—from one place or region to another. Essentially therefore, the concept of transfer-technology can be seen as denoting the transplantation of tangible (e.g., essential artifacts and objects) and intangible (e.g., ideas, skills and knowledge) matter from one location (in this case, developed nations) to another (usually, LDCs). To appreciate the implications of TT for the performance of the transport sector in sub-Saharan Africa, it is not sufficient to simply explore the concept and nature of TT. Rather, it is crucial to seek to understand: a) the type or elements of technology most likely to be transferred; and b) the conduits through which the transfer occurs.

North-South TT in the Transport Sector

The need to analyze and/or promote understanding of North-South TT in the transport sector in developing countries is succinctly captured by Dimitriou (1990: 73) when he contends that: "an analysis of issues of technology transfer is especially important for urban transport planning practice because many dominant professional perceptions used in the Third World have their origins in the industrialized countries."

At the general level, technology transfer may occur either directly or indirectly (Robinson, 1988; UNCTAD, 1976). The direct transfer of technology often takes place through, for example, multinational corporations, the use of licenses and patents, turn-key operations, management contracts, equipment supplies, and consultative arrangements. The indirect transfer of technology usually occurs through, for example, scholarly and professional publications, conferences, and training programmes. In some cases, scholars and students returning to LDCs from advanced countries serve as effective conduits for transfer technology. While the conduits through which TT occurs are fairly well established, the exact processes involved are not. This is particularly true of the transport sector.

North-South technology transfer in the transport sector of especially sub-Saharan African countries usually involves several processes, prominent amongst which are (Spencer, 1988; Rimmer, 1984; Thomson, 1983):

- promotion of institutional ownership and operation of transportation facilities;
- introduction of transport planning models originally crafted for use in developed nations;
- negligence of non-motorized modes of transportation; and
- dependence on transport vehicles originally intended for use in developed nations.

Institutional ownership and operation of transportation facilities. The earlier part of the 1960s was characterized by a retreat of colonialism in most of sub-Saharan Africa. With most of the countries in the region having gained political independence, the overriding international concern was with improving living conditions. Overall, there was a high sense of optimism with respect to addressing this concern. At the heart of this optimism was the belief that the science and technology whose

utility had been proven in developed nations bore the potential for resolving the problems faced by the newly independent countries in particular and developing nations in general. Therefore, to elude the "unnecessary task of re-inventing the wheel", hence, save the enormous costs associated with researching and developing new technology, SSA countries were exhorted to simply import technology and know-how from the developed nations.

This line of reasoning explicates the proclivity on the part of authorities in sub-Saharan African countries to attempt to duplicate the model of government- and/or other institutionally-owned and operated public transportation systems commonly employed in developed nations. In this regard, there was a move to groom large corporations that were to eventually take over the small and individually operated public transportation services that are commonplace in sub-Saharan African countries. The term "modernization and incorporation" have been employed to characterize this process. According to Spencer (1988: 1027, citing Dick and Rimmer, 1980), modernization and incorporation denote a process in the evolution of transport systems. However, it is misleading to construe the introduction of the Western model of public transportation in sub-Saharan African countries as a process in the evolution of the transport systems of these countries. More appropriately, the model's introduction constitutes an attempt to supplant the local transport systems. This is despite the fact that the utility of the Western model of public transportation, even in the developed nations for which it was originally designed, is contestable. In fact, in most cases, these systems are unable to survive without exorbitant subsidies, which have continued to rise with increasing car ownership and decreasing public transit patronage. For example, in Great Britain, whose public transportation system is one of the most elaborate and effective of the developed world, government subsidy for public transportation increased by a factor of 13 in real terms from 10 million pounds (sterling) to 520 million pounds (sterling) in one decade, from 1972 to 1982 (Banjo, 1994).

Western transport planning models. Apart from the model of institutionally-owned and operated public transportation facilities, a number of other models originally designed for use in advanced industrialized nations have been adopted in LDCs. For example, traffic engineering models such as Area Traffic Control (ATC) and transport planning models such as those typically employed to determine trip generation, trip distribution, and modal split, with European and/or North American origins, are widely in use throughout LDCs (Yanaguaya, 1993; Thomson, 1983). It is important to note that modeling as a fundamental part of urban transport planning was almost unknown in sub-Saharan Africa until the late 1950s and early 1960s. Prior to that time, urban transport planning consisted of little more than estimating future traffic demand through the projection of growth rates. In the late 1960s, and following the lead of developed nations, urban transport planners in LDCs adopted more scientific methods, which sought to compute traffic demand as a function of socio-economic factors such as land use and modal choice. The methods were developed in the United

States and first used in Detroit and Chicago, "where the object was almost exclusively to provide roads for private transport, with very little attention to public transport" (Thomson, 1983: 12).

Non-motorized modes of transportation. Borrowing from their counterparts in especially North America and Europe, the political leadership and planners in sub-Saharan Africa have attempted to address mobility needs with plans, projects and policies that have motorized traffic as their locus. As Philpott (1994: 39, citing Musa, 1993) notes: "The region's transportation sector uses 20 to 40 percent of public investment funds, with over 80 percent of these funds for road construction. More than 20 percent of loans from the African Development Bank between 1973 and 1989 were targeted to transport projects, of which 90 percent went for roads mostly in urban areas."

In fact, as much as 80 to 90 percent of the region's passenger and freight transport is carried by surface roads alone (Africa Transport, 1994). This, notwithstanding, we contend that authorities in the region have placed undue emphasis on very few, but extremely expensive, urban based showcase road projects, designed to serve the elite members of society. As a result, the transport needs of the poor and majority members of the population, who depend mostly on non-motorized modes of transportation, are ignored. Also, as noted earlier, the planning models borrowed from advanced countries for use in the region, were originally designed with motorized traffic in mind. For instance, transport planning models such as those originating in the United States (see above) place enormous emphases on private and individualized modes of transportation particularly, the automobile while ignoring public modes of transportation, especially shared taxis.

Use of transport vehicles designed for developed countries. It is common knowledge that sub-Saharan African countries depend on countries in the North, particularly Japan, France, Britain, Germany and the United States of America, for transport vehicles. The problem here has little to do with the fact that these countries must import transport vehicles. Rather, our concern revolves around the fact that the imported vehicles were never manufactured with the peculiar conditions characteristic of the region in mind. Consequently, it is not unusual to find luxury buses or coaches, with a surface clearance of about 10 centimeters—obviously designed for the well-surfaced roads of advanced countries—serving as public transit vehicles on the pot-hole-plagued roads of sub-Saharan African countries.

Discussion: Effectiveness and Sustainability Issues

Transportation planners in developing countries are now, more than ever, faced with the need to find appropriate ways of meeting the ever growing demand for public transport services. Beyond this, and given current negative trends in the economies of these countries, there has also been an increasing need to strengthen the ability of activities in the transport sector to create and/or expand opportunities for employment, education, and the reduction of socio-economic inequities as well as overall economic development. However, transport-related technology transfer (TT) has been counter-productive to these efforts. In other words, we believe that TT in the transport sector has

had, and is likely going to continue having, negative implications for public transportation in less developed countries.4 The most portent of these implications, especially in the context of sub-Saharan Africa, can be summarized as follows:

- overall ineffectiveness in transport service delivery;
- unnecessarily high cost of transportation services;
- negligence of the mobility needs of women and the rural population;
- ineffectiveness of the transport sector to create and/or expand employment and other opportunities;
- impediment to innovation and resourcefulness in the transport sector;

Ineffective transport service delivery. One aspect of transport-related transfer technology that has been adopted in sub-Saharan African countries is related to the institutionalized supply of transportation services. It is important to note, as intimated earlier, that the formal and institutionalized provision of public transportation usually means one, two or all of the following (Spencer, 1988: 1027, citing Rimmer, 1984): a) supplantation of informal, individual and/or small transport operations by formal, often large, integrated, and bureaucratic companies; b) replacement of small vehicles with flexible schedules, routes and stopping points, by large vehicles with fixed schedules and stopping points; c) elimination of competition among different transportation modes and vehicles in favour of an undifferentiated service; d) following from the former, a reduction of the degree of flexibility necessary to respond to varying user demands; and e) supplantation of a large force of petty entrepreneurs functioning largely in the informal sector, by a large formal sector class of employees, who are sometimes unionized, and usually wage-earning as opposed to profit-making. Not only is there a general proclivity towards the institutionalized provision of public transport services, in sub-Saharan African countries, there has always been a tendency on the part of governments in these countries to own and operate such services. This is another variant of transfer technology—particularly, a facsimile of the traditional public transportation model operating in Europe and North America. One effect of such, often highly subsidized, operations is, as discussed earlier, to discourage the informal and individualistic provision of public transportation services. Apart from eliminating opportunities for entrepreneurial ventures and growth (see below), this results almost invariably, in ineffective and inefficient transport service delivery. More specifically, the formal and institutionalized provision of transport services often results in, amongst other problems, polarizing the traveling public into "bus users and car users", with alternative modes of transportation being phased out; depriving the user of a choice of modes; and sub-standard services as large, often monopoly operators generally have no incentive to improve service quality (Spencer, 1988).

In contrast, as Table 3 shows, the informal and individualistic operation of public transportation services has the following advantages amongst others (Banjo, 1994), a) ability to make transportation services highly accessible to the clients; b) it is very personalized; c) it costs relatively

less, especially because, the low overhead and running costs involved; and d) it operates on variable, as opposed to fixed, routes.

Not only are privately owned, or informal and individualistic operations more customer-oriented, they are also more efficient than their institutionalized counterparts, which often require subsidies to function. In Cameroon, for instance, government's inability to continue to subsidize the para-public transit bus agency, *Société de Transports Urbains du Cameroun* (SOTUC), is the primary reason for the agency's demise in 1994. This contrasts sharply with the fact that in the same country, despite government's increasing regulation of the inter-city, inter-regional, and township taxi industry, the industry continues to flourish. Similar tales have been registered in other parts of the developing world. For example, in Hong Kong, as part of the reform measures that were implemented in 1967, the government legalized public light buses (PLBs) as a form of public transportation. These buses, not known for their history of profitability whilst operated by the state, immediately became a highly profitable enterprise to the point that owners were able to recover as much as two-thirds of a vehicle's purchase price in a single year (Urban Edge, 1982). In Calcutta, India, while the state-owned Calcutta State Transport Corporation (CSTC) requires monthly subsidies of US $1,000,000 to operate, the city's privately operated bus service functions without any financial support from the state. In the Argentinean capital, Buenos Aires, state-operated urban transportation services failed in the 1950s, while parallel services provided by individuals and other private entities continue to flourish. By the 1980s, as many as 13,000, 23-seat privately-owned and operated micro-buses or "collectivos" as they are called locally, were already in operation throughout the city (Urban Edge, 1982).

High transport service cost. As we have already hinted, transport cost is a function of factors such as overhead and running costs. It is also a function of the cost of the transportation vehicle including freight (cost to transport the vehicle from overseas), custom duties and other miscellaneous fees, particularly the fees associated with registering the vehicle for public passenger transportation purposes. The fact that the transport vehicles must be imported accentuates the costs problem. For one thing, all the equipment and spare parts necessary for maintaining the vehicles must be imported, resulting in further costs associated with international monetary exchange. The government of one country in the region, Mauritius, is cognizant of this problem and has enacted official policy waiving custom duties on buses or kindred vehicles imported for the purpose of passenger transportation (Banguant, 1996). For another thing, there is more often than not, a need to fly in highly paid technicians with the skills necessary for repairing such sophisticated vehicles as luxury air-conditioned buses of which some of the passenger bus fleets of the region are comprised. The case of Mauritius, mentioned above, is however the exception and not the rule. In other cases, the state sees importation as one of the few viable and dependable avenues for revenue generation, especially given the negative economic conditions characteristic of most of the countries in the region. In fact, it is not unusual to have import tax rates of as much as 90 percent

associated with vehicle importation. Additionally, as in the case of Cameroon, the freight cost is also heavily taxed. One effect of this has been to significantly reduce the number of public transport vehicles that would otherwise be in circulation. The simple economic law of demand and supply suggests that under these circumstances (i.e., less transport vehicles and a growing number of passengers), ceteris paribus, the cost of public transportation services will rise. Quite often, the state would intervene to keep the cost artificially low through price control policies. When this results in significant reductions in the profit margins of private operators of public passenger vehicles, they often opt to exit. Again, this results in further scarcity of public transport vehicles, hence a further rise in the cost of transport services.

Negligence of the mobility needs of women. A transport planning strategy that fails to adequately account for the transport needs of its users is unlikely to yield any significant positive results (Philpott, 1994). Yet, ignoring user needs is exactly what the leadership and planners in sub-Saharan African countries effectively do when they blindly adopt the automobile-biased transport planning models of developed nations. Perhaps even worse, is the fact that authorities in developing countries in general seldom have any stated policy on passenger mobility per se. As Khisty (1993: 43) suggests: "the main focus is on the movement of freight traffic to fulfill output targets set by the countries in their 5-year plans . . . . Most ironically, developing countries seem to focus on encouraging motorization and appear to be indifferent or even opposed to low-cost, nonmotorized modes despite the role they play in the local economies and the mobility and accessibility they provide for low- income inhabitants."

Decisions that constantly favour motorized, over non-motorized, transportation development strategies are difficult to defend given that a disproportionately high percentage of the population in sub-Saharan Africa depends on non-motorized modes of transportation, especially walking. As intimated earlier, such decisions may result from a lack of knowledge of the culture, values and other relevant variables characteristic of African society. The decisions may also be a function of the fact that the decision makers are non-Africans, who are probably unaware of the importance of non-motorized modes of transportation such as walking in Africa and other developing regions. According to some estimates, as much as 50 percent of the trips in cities in developing countries are made by walking alone (Khisty, 1993). The figure is a lot higher, and in fact close to 100 percent, in the rural areas of sub-Saharan Africa. To be sure, poverty, rather than choice, accounts for this phenomenon. An identical explanation is given by Philpott (1994: 39) in the following words: "Given that the price of a medium sized car is the equivalent of 12 to 15 years' salary for the average person, only a few people own automobiles in the region."

To the extent that sub-Saharan African countries adopt transport policies formulated with developed nations and motorized modes of transportation in mind, thereby neglecting non-motorized modes, we contend that the policies possess an inherent bias against women. Although women are not the only members of society in sub-Saharan Africa who depend on non-motorized modes of

transportation, they tend to be more negatively affected by any policy that ignores these modes. To appreciate this line of argument, one must first understand the fact that the mobility needs of women are greater than, and quite different from, those of their male counterparts. The gender-based division of labour mentioned earlier places the responsibility for hauling water, firewood, food for family consumption, and moving from farm to market food surpluses, on women. Thus, women account for a disproportionately high percentage of household-related transportation demand in sub-Saharan Africa. The following examples are illustrative (Philpott, 1994). In Tanzania, while women spend, on the average, 1,648 hours on transportation-related activities, men spend on the average only 531 hours completing similar chores. In Burkina Faso, girls between the ages of 11 and 17 spend three times as much time on transport-related activities than boys in the same age-group. Women in Northern Nigeria spend as many as 7 hours per day traveling to and from the fields. Furthermore, it is important to note that "many women work in the child care and domestic sectors and therefore have a wide variety of destination points throughout the city that are not necessarily on a public bus route" (Philpott, 1994: 40). Therefore, to reduce the burdens associated with alternate, and especially non-motorized modes of transportation is to reduce the transport burden of women in sub-Saharan Africa.

Transfer technology and employment generation in transportation. A good measure of the utility of a transport project must account for the project's ability not only to effectuate the movement of people, goods and services, but also its contribution to wider development objectives such as the creation of jobs. The chances of attaining the specific objective of job creation are however significantly reduced while there continues to be an indiscriminate dependence on borrowed technology on the part of sub-Saharan African countries. Such dependency renders useless the transport sector's ability to generate jobs in the local economy through its backward and forward linkage mechanisms. This is because, by borrowing technology from developed economies, where the factor market has a strong capital bias, developing countries deny themselves the opportunity to maximize the utility of one resource, which they possess in abundance, namely labour. In contrast, the use of more appropriate technology invariably guarantees the creation of jobs not only in the manufacture, maintenance, and operation of transport vehicles, but also in the infrastructure development, particularly the construction sector. It is common knowledge that the construction industry in developing countries has enormous and largely untapped potential to contribute to ongoing efforts to reduce prevailing high levels of unemployment. Thus, in macro-economic terms, construction ranks very high as an employment creator. The ability of this sector to generate jobs partially results from the backward and forward linkage mechanisms alluded to earlier. The former enables the creation of jobs in the construction material and related industries, while the former ensures employment generation in sectors dealing with transportation-induced consumer goods such as transport vehicle accessories. Another employment-related problem that is often caused by transfer technology in the transport sector in sub-Saharan African countries has to do with

functional differentiation. This problem arises when, for instance, there is a significant difference between the wage entitlements of workers skilled in the so-called modern techniques necessary for maintaining more technologically complicated transport vehicles and related gadgets, and those whose skills are limited to working with less sophisticated, especially non-motorized vehicles. In this case, it can be safely argued that TT contributes to socio-economic disparities in developing countries.

Innovation and resourcefulness in transportation. As mentioned earlier, sub-Saharan African countries have almost totally neglected the essence of non-motorized transportation modes in favour of automobile-related projects. One consequence of this has been the abysmal lack of innovation in the transport sector in the region. In fact, compared to other developing regions, especially Asia, sub-Saharan Africa is terribly deprived as far as transport vehicle variety is concerned. In this regard, a study of Sierra Leone concluded that the only alternative to travel by bus, truck, or combined passenger goods pickup is walking (Carapetis et al., 1984). An identical observation is made by Njoh (1997) in the case of Cameroon. Yet, the list of alternative transport vehicles, especially of the non-motorized variety is quite long. For instance, the pedal powered bicycle rickshaw, pedicab, or "becak" and animal-drawn carts, are commonly used to move passengers, goods and services in cities throughout low-income Asian countries. Apart from constituting an aspect of innovation, low technology vehicles such as those mentioned above have the following two major advantages amongst others. First, they are inexpensive and are capable of creating jobs for the poor. Finally, they are easy to operate and very maneuverable in tight spaces, which gives them an advantage under the conditions of high traffic density and rough roads typical of cities in sub-Saharan Africa in particular and developing countries in general.

Recommendation and Concluding Remarks

Central to the discussion in this article is a concern with the practice of indiscriminately transplanting transportation technology from developed to developing countries. The question is not whether "to transfer or not to transfer technology". Certainly, we are aware that some level of transfer technology is absolutely necessary and should be encouraged. The question however, has to do with identifying the brand of technology or attributes thereof that are suitable candidates for transfer. A measure of "suitability" or "appropriateness" in this case must take into account two important factors. The first is the technology's ability to maximize utility while minimizing damage in the host country—that is, the country in which the technology is employed. The second is the extent to which the technology contributes positively to efforts designed to accomplish other development objectives.

To meet these suitability criteria, most technology will require some degree of adaptation. Such adaptation does not have to be extensive. Rather, it may entail simply effectuating a few alterations to an imported technology to make it suit the unique environment of the host society. One case in

point relates to novelties such as transport planning models typically imported from advanced nations (see above) that can be made useful in developing countries with a few simple, but ingenious modifications. In this connection, Timberlake (1988) demonstrates that the conventional doubly balanced gravity model can be slightly modified to produce a log-linear direct demand model capable of determining trip generation and distribution characteristics in developing countries. The log-linear model resulting from this modification is definitely useful in the rural sector of developing countries especially because it includes a lot fewer parameters than the classical doubly balanced gravity model. A second has to do with significantly transforming an imported technology or artifact to suit local conditions and needs. An example of this relates to the practice of adding detached or attached multiple passenger compartments to vehicles such as bicycles and motorcycles originally designed for single or double passengers. As mentioned above, such adaptation is commonplace in Asian cities but almost absent in sub-Saharan African towns, where they are seen as a manifestation of "backwardness". Yet, the ability of such adaptation to facilitate mobility at a cost most members of the population in these towns can afford can hardly be exaggerated. A third case of ingenious tinkering with imported technology concerns the practice of mounting heavy duty truck chassis with locally manufactured bus bodies so that they can transport not only goods but also passengers across the rugged terrain of developing countries.

In the Democratic Republic of Congo (formerly, Zaire), the chassis of four-wheel-drive vehicles such as Toyotas, Land Rovers, and Mitsubishi Pajero, are transformed into large passenger-carrying vehicles, locally known as fula fula, capable of transporting as many as 60 passengers at a time (White, 1990). Similarly, chassis of heavy-duty trucks (such as the M.A.N. Diesel, Bedford, and Mercedes Benz trucks) are fitted with bus bodies and used as passenger-carrying vehicles in Nigeria (where they are locally known as *'ngongoros'* or *'mammy wagons'*) and Ghana. While countries such as the afore-named in the region are able and willing to undertake such necessary adaptation, others are not. This instance is therefore one in which South-South technology transfer can be actively encouraged. In other words, countries currently unable to adapt or modify imported technology will do well to borrow the know-how from their contemporaries with experience in this regard.

Efforts to adapt borrowed technology are likely to encourage innovativeness and frugality in the use of scarce resources. The case of two-wheeled hand carts that can be used for carrying water vessels or farm produce, and two-wheeled animal-drawn carts constructed of scrap automobile or light-weight truck rear axles exemplifies such innovativeness. Apart from encouraging innovativeness, as mentioned earlier, efforts in this regard, are capable of significantly reducing the high levels of unemployment characteristic of sub-Saharan African countries.

In addition to adapting tangible technology, it is important for transport planners to alter their normative view of 'good transportation planning' or what constitutes a 'good transport plan'. For instance, it is not uncommon to find transport planners, who blame what they label, "indiscriminate

on-street parking and the proliferation of street vendors as well as high pedestrian interference", for considerably diminishing the capacity of the road network (Yanaguaya, 1993: 478). Thus, borrowing from the more advanced societies, the multiple use of transport infrastructure, particularly streets, is considered a debility. Yet, it is arguable that the multiple, hence intensive use of facilities in resource-scarce economies such as those of sub-Saharan Africa constitutes a judicious use of resources. To the extent that this argument is persuasive, it underscores the essence of avoiding the blind, indiscriminate or wholesale North-South transfer of technology.

Notes

1. Efforts in this connection have resulted in the formulation of models such as the "dependency model", which holds that underdevelopment in LDCs is caused largely by their dependence on the developed nations. For instance, as argued in this paper, LDCs typically depend on developed countries for transportation technology.
2. Some of the highest population growth rates in the world are associated with countries (e.g. Kenya) in the sub-Saharan region.
3. Paradoically, gender based division of labour is a phenomenon that is not indigenous to sub-Saharan Africa. The origins of gender based division of labour in the region are traceable to the colonial era. To appreciate this line of argument it is important to note that colonial rule in Africa coincided with a period in European history when women's roles were rather restricted and in most cases, confined to the home.
4. We are not issuing a blanket condemnation of transfer technology here. To be sure, it is inconceivable that developing countries can "develop" without borrowing some technology from abroad. In fact, horizontal TT, that is, the transplantation of technology from one developing country to another, holds enormous promise for LDCs.

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