LTDR2202: TRANSPORT MODES

COUTSE OUTLINE

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Bibliography

-Ausubel, J.H. and C. Marchetti (2001)."The Evolution of Transportation", The Industrial Physicist, April/May, pp. 20-24.

-Berechman, J. (2003). "Transportation - economic aspects of Roman highway development: the case of Via Appia", Transportation Research Part A: Policy and Practice, Vol. 37, No. 5, pp. 453-478.

-Bogart, D. (2009) "Inter-modal network externalities and transport development: Evidence from roads, canals, and ports during the English industrial revolution", Networks and Spatial Economics, Vol. 9, No. 3, pp. 309-338.

-Henderson, J.V., Z. Shalizi and A.J. Venables (2000) Geography and Development, Journal of Economic Geography, Vol. 1, pp. 81-106.

-Lay, M.G. (1992). Ways of the World: A History of the World's Roads and of the Vehicles that Used Them. New Brunswick, New Jersey: Rutgers University Press.

-Lewis, T. (2013). Divided Highways: Building the Interstate Highways, Transforming American Life. Ithaca, NY: Cornell University Press.

-Lundgren, N.G. (1996) "Bulk trade and maritime transport costs: The evolution of global markets", Resources Policy, Vol. 22, No. 1, pp. 5-32.

-McQuaid, R.W. et al, ; (2004). The Importance of Transport in Business' Location Decisions, United Kingdom, Department for Transport.

-Taaffe, E.J., H.L. Gauthier and M.E. O'Kelly (1996). *Geography of Transportation*, Second Edition, Upper Saddle River, NJ: Prentice Hall

.

-U.S. Department of Transportation (1994). Assessment of Border Crossings and Transportation Corridors of North American Trade; Report to Congress, Washington, D.C.: Federal Highway Administration.

-Williams, A. (1992) "Transport and the Future", in B.S. Hoyle and R.D. Knowles (eds) Modern Transport Geography, London: Belhaven Press, pp.257-270.

-World Health Organization (2009). Global status report on road safety: time for action, Geneva: World Health Organization.

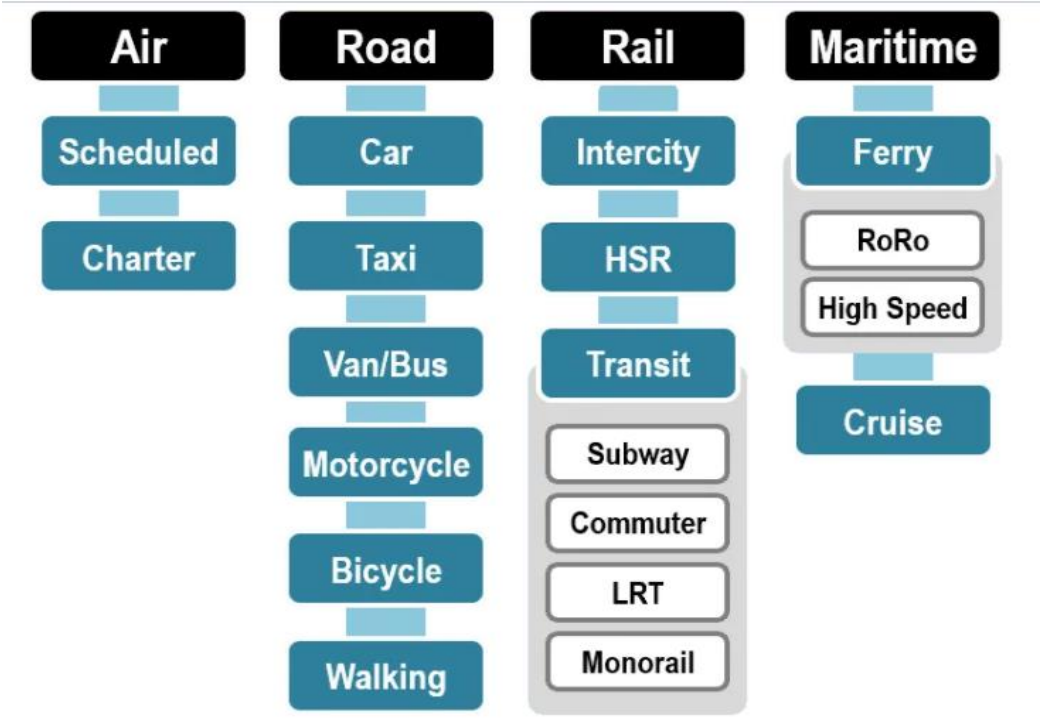
CHAPTER ONE: GENERAL INTRODUCTION

Transportation modes are essential components of transport systems since they are the means of supporting mobility. Modes can be grouped into three broad categories based on the medium they exploit: land, water, and air. Each mode has its own requirements and features and is adapted to serve the specific demands of freight and passenger traffic. This gives rise to marked differences in how the modes are deployed and utilized in different parts of the world. More recently, there is a trend towards integrating the modes through intermodality and linking the modes ever more closely into production and distribution activities. At the same time, however, passenger and freight activity are becoming increasingly separated across most modes. It is important to note that, each mode is characterized by a set of technical, operational and commercial characteristics: transport thus is the displacement of persons, goods or services on a given distant with appropriate means. transport is characterized by the nature of the goods or consignment, and the distance to cover. The flux and the modes or mean of transportation use are, road, rail, air, river and maritime. other modes also exist, including pipelines, cable transport, and space transport. Human-powered transport and animal-powered transport are sometimes regarded as their own mode, but never fall into the other categories. In general, transportation is used for moving of people, animals, and other goods from one place to another. It is important to note that, there is a different between mode and mean of transport. Means of transport is a term used to distinguish between different ways of transportation or transporting people or goods. The different modes of transport are air, water, and land transport, which includes Rails or railways, road and off-road transport. Other modes also exist, including pipelines, cable transport, and space transport. The means of transport, on the other hand, refers to the (motorized) vehicles necessary for transport according to the chosen mode (car, airplane, ship, truck and rail). Each mode of transport has a fundamentally different technological

solution, and some require a separate environment. Each mode has its own infrastructure, vehicles, and operations. The means of transport, on the other hand, refers to the (motorized) vehicles necessary for transport according to the chosen mode (car, airplane, ship, truck and rail). each mode of transport has a fundamentally different technological solution, and some require a separate environment. Each mode has its own infrastructure, vehicles, and operations.

1.2-A DIVERSITY OF MODES

Transport modes are designed to either carry passengers or freight, but most modes can carry a combination of both**.** For instance, an automobile has the capacity to carry some freight while a passenger plane has a belly hold that is used for luggage and cargo. In general, transportation is used for moving of people, animals, and other goods from one place to another. Each mode is characterized by a set of technical, operational, and commercial characteristics. ***Technical characteristics relate to attributes such as speed, capacity, and motive technology, while operational characteristics involve the context in which modes operated, including speed limits, safety conditions, or operating hours***. ***The demand for transport and the ownership of modes are dominant commercial characteristics, as transportation modes are used to support economic activities and generate an income***. Nevertheless, Human-powered transport and animal-powered transport are sometimes regarded as their own mode, but never fall into the other categories. Here below is a figure that picture diversity of modes and means of transport.



Transport modes and means

CHARTER 2- LAND TRANSPORT MODES

Two major modes are composing the land transport system ie roads and railways. But we equally have pipelines. Obviously, roads were established first, as rail technology only became available by the 18th century, in the middle on the industrial revolution. Historical considerations are important in assessing the structure of current land transportation networks. Land transport covers all land-based transportation systems that provide for the movement of people, goods and services. Land transport plays a vital role in linking communities to each other. Land transport is a key factor in urban planning.

2.1- ROAD TRANSPORT

The first land roads took their origins from trails (track) which were generally used to move from one hunting territory to another. With the emergence of the first forms of nation-states, trails started to be used for commercial purposes as trade expanded and some became roads, especially through the domestication of animals such as horses, and camels.

The use of wheeled vehicles encouraged construction of better roads to support the additional weight. The most common road vehicle in the developed world is the automobile, a wheeled passenger vehicle that carries its own motor. As of 2002, there were 591 million automobiles worldwide. Other users of roads include motorcars, motorcycles, buses, trucks, bicycles and pedestrians, and special provisions are sometimes made for each of these. For example, the use of bus lanes give priority for public transport, and cycle lanes provide special areas of road for bicycles to use. Motorcars offer high flexibility, but are deemed with high energy and area use, and the main source of noise and air pollution in cities; buses allow for more efficient travel at the cost of reduced flexibility. Road transport by truck is often the initial and final stage of freight transport.

However, a road transport system requires a level of labour organization and administrative control that could only be provided by a form of governmental oversight offering some military protection over trade routes. By 3,000 BC the first road systems appeared in Mesopotamia. However, the first major road system was established by the Roman Empire from 300 BC and onwards, mainly for economic, military and administrative reasons. It relied on solid road engineering methods, including the laying of foundations and the construction of bridges. Because of the lack of maintenance of many road segments, land transport became a very hazardous activity. It is not until the creation of modern nation-states in the 17th century that national road transportation systems were formally established. Many roads could now be used year-round. Road development accelerated in the first half of the 20th century. By the 1920s, there was the first all-weather transcontinental highway, the Lincoln Highway, spanned over 5,300 km between New York and San Francisco. It is important to notes that, the Germans were however the first to build the modern highway in 1932 with specifications such as restricted access, overpasses and road separation that would eventually become common characteristics of highway systems. History also reveals that, the post-World War II era represented a period of rapid expansion of road transportation networks worldwide. By the 1970s, every modern nation has constructed a national highway system, which in the case of Western Europe

resulted in a pan-European system. This trend now takes place in many industrializing countries. For instance, China is built a national highway system that expanded to 80,000 km in 2011, with construction taking place at a pace of about 2,000 km per year. Road transportation is the mode that has expanded the most over the last 50 years, both for passengers and freight transportation. Such growth in road freight transport has been fuelled largely by trade liberalization as modal shares of trade between the United States and partners. This is the result of growth of the loading capacity of vehicle and an adaptation of vehicles to freight (e.g. perishables, fuel, construction materials, etc.) or passengers (e.g. school bus) demand for speed, autonomy and flexibility.

Sample of road Transport

2.1.1-The Spatial Impacts of Road Transportation

Road transportation is the mode that has expanded the most over the last 50 years, both for passengers and freight markets. This represents a dramatic change in the built environment with the massive addition of road infrastructures supporting urban mobility and connecting cities. The spatial cover of road transportation is extensive, but its scope remains local and regional. Growth in road freight transport has been fueled mainly by trade liberalization. The growth of the loading capacity of the vehicle has improved, and vehicles have been adapted to freight market segments such as perishables, fuel, construction materials, and containers. An array of problems, such as the growth of fuel consumption, increasing environmental externalities, traffic congestion, and safety (accidents), have also emerged.

2.1.2-Functional hierarchy

Roads have a functional hierarchy depending on the role they play in the transport network. At the top of the hierarchy are freeways (highways), which are limited-access roads with no intersections. The connect intersecting highways, a large number of interchanges was built, leading to a variety of designs to mitigate traffic flow and required footprint. The cloverleaf interchange has become one of the most common. There are also arterials, which are roads having traffic signals at intersections, forcing vehicles to stop. These arterials are fed by collectors and local roads, which have the main purpose of connecting specific activities (residences, retail stores, industries). This network enables point to point services, a notable advantage that road transport has over other transport modes.

2.1.3-Challenges of road transport

This expansion has also brought its own shortcomings, which are a significant growth of fuel consumption, increasing environmental externalities, traffic congestion and a multiplication of road accidents. All road transport modes have limited potential to achieve economies of scale. This is due to size and weight constraints imposed by governments and also by the technical and economic limits of engines. In addition, there are serious limits on the traction capacities of cars, buses and trucks because of the considerable growth in energy consumption that accompany increases in the vehicle weight. For these reasons the carrying capacities of individual road vehicles are limited. Road transportation is characterized by acute geographical disparities in traffic. It is not uncommon that 20% of the road network supports 60 to 80% of the traffic. This observation is expanded by the fact that developed and developing countries have important differences in terms of the density, capacity and the quality of road transport infrastructures.

An enduring challenge for road freight transportation concerns empty backhauls. Due to imbalances in trade and commercial flows, about 20% of all truck flows are done empty. This characteristic is complex to mitigate since it is related to the fundamental structure of freight demand. For instance, all retail-related freight flows are usually in one direction, such as from the manufacturing plant to the distribution center and from the distribution center to the store or the consumer’s home for e-commerce. There are limited

opportunities for return cargo for these flows**.** The success of cars and trucks has given rise to several serious problems. Road congestion has become a feature of most urban areas around the world. In addition, road transport is behind many major environmental externalities linked to transportation, particularly CO2 emissions. Addressing these issues is becoming a significant policy challenge, from the local to the global. A symbiosis between types of roads and types of traffic with specialization (reserved lanes and hours) is to be expected.

2.1.4-Advantages of Road transport

In spite of the presence of alternatives, road transport retains significant advantages over other modes:

- ✓ The capital cost of vehicles is relatively low, which makes it comparatively easy for new users to gain entry. This helps ensure that the trucking industry, for example, is highly competitive, but with low-profit margins. Low capital costs also ensure that innovations and new technologies can diffuse quickly through the industry since a fleet can be renewed over a decade.
- ✓ Road vehicles have a high relative speed compared with non-motorized forms of transportation and public transit, the major constraint being government-imposed speed limits.
- ✓ Road transportation offers the flexibility of route choice, once a network of roads is provided. It has the unique opportunity of providing door-to-door services for both passengers and freight.

These multiple advantages have made cars, buses, and trucks the modes of choice for many trip purposes and have led to their market dominance for short-distance trips.

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distribution center to the store or the consumer's home for e-commerce. There are limited opportunities for return cargo for these flows.

2.2-RAIL TRANSPORTATION

Rail Transportation and Rail Lines Although primitive rail systems existed by the 17th century to move materials in quarries and mines, it is not until the early 19th century that the first real rail transportation systems came into existence. Rail transportation has been the product of the industrial era, playing a major role in the economic development of Western Europe, North America and Japan. It represented a major improvement in land transport technology and has obviously introduced important changes in the movement of freight and passengers. Rail transport systems dramatically improved travel time as well as the possibility to offer reliable and consistent schedules that could be included in the planning of economic activities such as production and distribution. The coherence of economic activities and social interactions was thus substantially improved. Rail transportation brought scheduling and reliability to transportation systems.

According to the geographical settings, rail lines were established differently because of the variety of strategies to be achieved, namely access to resources, servicing regional economies and to achieve territorial control. Rail transportation is characterized by a high level of economic and territorial control since most rail companies are operating in situation of monopoly.

Rail transportation, like roads, has an important relationship with space, since it is the transport mode which is mostly constrained by the physiographic. These constraints are mainly technical and operational (space consumption, gradient and turns, vehicles, gauge. network structure). Railways or rail lines are known to have played a vital role for industrial revolution and industrial location. This is because rail ways were used to transport heavy materials. At the end of the Second World War, railway showed some limits at the level of cost and inefficiency to cover long distances. At this time Railway was useful for inter-urban migration which was very economically as compared to roads. It is from this moment that many innovations were introduced like production of train known as TGV (Train à

grand Vittesse) which covers 300km/hr on a specific route. Today, HSR (High Speed Rail) is perceived as an efficient alternative to highway and airport congestion.

2.2.1-Rail Transportation in the 21st Century

Although railways are a product of the industrial revolution, they have been affected by continuous innovations, technical, regulatory, and commercial changes, which have improved their capacity and efficiency. Rail transportation is thus as important in the 21st century as it was in the late 19th century. One innovation relates to the quality of the rail infrastructure, particularly rail tracks (e.g. better steel, concrete ties), which determines the operational characteristics of their use, such as speed, permitted weight, maintenance, and resilience to the environment.

Increasing electrification and automation also improve the efficiency of rail transportation, passenger, and freight alike. A few new rail lines are being built, but mainly in developing countries. Railway speed records have improved continuously with the introduction of high-speed rail systems. For instance, portions of the French high speed-rail system (also known as TGV: Tres Grande Vitesse) can reach speeds up to 515 km/hr. Variable wheel-base axles permit rail transport between different gauges. However, freight trains run at a considerably lower speed, in the range of 30-35 km/hr. In some cases, as the rail system gets more used, operational speed may decline because of congestion.

2.2.2- Rail Transportation relationship with space

Rail transportation, like roads, has an important relationship with space since it is the transport mode the most constrained by physiography. These constraints are mainly technical and operational:

- **Space consumption**

Rail transportation has a low level of space consumption along lines, but its terminals can occupy large portions of real estate, especially in urban areas. This increases operating costs substantially. Still, rail terminals tend to be centrally located and accessible. A major issue concerns the rights of way that represent significant sunk costs for rail, which

has fixed the network structure and impede future developments because of the difficulty of securing rights of way along high-density corridors. This leads to a paradox as passenger rail is well suited to service high-density areas, which are also imposing high costs for securing rights of way.

- **Gradient and turns**

Rail transport is particularly susceptible to the heterogeneity of geography, which imposes constraints such a gradient and track alignment. Rail transportation can support a gradient of up to 4% (about 40 meters per kilometer), but freight trains rarely tolerate more than 1%. This implies that an operational freight rail line requires 50 kilometers to climb 500 meters. The gradient is also important as it impacts energy consumption, particularly for freight trains traveling over long distances. For turns, the minimal curvature radius is 100 meters, but a radius of 1 km for a speed of 150 km/hr and 4 km for a speed of 300 km/hr are needed.

- **Vehicles**

For traction, locomotion technology ranges from steam (almost abandoned) to diesel (mainly for freight) and electric (primarily for passengers). Rail transportation is very flexible in terms of vehicles, and there is a wide variety of them filling different purposes. Among the most common vehicle assets are open wagons (hopper cars) used for bulk cargo (e.g. minerals), boxcars to carry general and refrigerated goods, and tank cars to carry liquids. Intermodal transportation has also permitted the development of a new class of flat railcars that can carry containers and trailers (less common). The trend has thus been towards a specialization of freight wagons, such as hopper wagons (grain, potash, and fertilizers), triple hopper wagons (sand, gravel, sulfur, and coal), flat wagons (wood, agricultural equipment, manufactured goods, containers), tanker wagons (petrochemical products), box wagons (livestock, paper, manufactured goods, refrigerated goods), car wagons and passengers' wagons (first class, second-class, third-class cabins, sleeper cars, restaurant cars).

- **Gauge**

They are heterogeneous across jurisdictions since, because of historical and political reasons, different nations and regions have adopted different gauges. The standard gauge of 1.435 meters has been adopted in many parts of the world, across North America and most of Western Europe, for example. It accounts for about 60% of the tack mileage. But other gauges have been adopted in other areas, such as the broad gauge (1.520 meters) in Russia and Eastern Europe, accounting for about 17% of the mileage. This makes the integration of rail services complex since both freight and passengers are required to change from one railway system to the other. As attempts are being made to extend rail services across continents and regions, this is a significant obstacle, for example between France and Spain, Eastern and Western Europe, and between Russia and China. The potential of the Eurasian land bridge is impaired in part by these gauge differences.

- **Network structure**.

Relates to the ownership of tracks and rolling stock, maximum train length, signaling equipment, maintenance schedule, and traffic mix. These factors will influence the capacity of the rail system, particularly if well managed. When tracks are privately owned, the operator is free to allocate its services without much competitive hindrance. However, if the tracks are publicly owned, they are often reserved for a national rail carrier, and service slots can be leased to private operators through a bidding process.

Other factors that obstruct the movement of trains between different countries include signaling and electrification standards**.** These are particular problems for the European Union, where the lack of interoperability of the rail systems between the member states is a factor limiting the broader use of the rail mode. There is also a trend where the passengers and freight markets are being separated. First, it is occurring at the management level. The liberalization of the railway system that is being forced by the European Commission is resulting in the separation of passenger and freight operations. This had already taken place in the UK when British Rail was privatized. Second, the move towards high-speed passenger rail services necessitated the construction of separate rights

of way. This has tended to move passenger train services from existing tracks, thereby opening up more daytime slots for freight trains.

2.3: Pipelines Transportation

Pipelines are an extremely important and extensive mode of land transport, although very rarely appreciated or recognized by the general public, mainly because they are buried underground or under the sea, as in the case of gas pipelines from North Africa to Europe. In the United States, for example, there are 215,000 miles of pipelines that carry 17% of all ton-miles of freight. Two main products dominate pipeline traffic: oil and gas, although locally pipelines are significant for the transport of water, and in some rare cases, for the shipment of dry bulk commodities, such as coal in the form of slurry. Pipelines can even be used to carry small quantities of freight, such as in pneumatic tubes, but this use remains marginal and for short distances Pipelines are almost everywhere designed for a specific purpose only, to carry one commodity from a location to another. They are built mostly with private capital, and because the system must be in place before any revenues can be generated, they represent a significant capital commitment. They are useful in transporting large quantities of products where no other feasible means of transport (usually maritime) is available. Pipeline routes tend to link isolated areas of production to major refining and manufacturing centers in the case of oil, or major populated areas, as in the case of natural gas. To fulfill their role pipelines, have four main functional properties:

- **Collecting pipelines**. Their purpose is to move oil and natural gas from for extraction fields to processing and storage facilities. The growth in offshore oil and gas extraction facilities has favored the setting of underwater collective pipelines moving products to shore-based facilities.
- **Feeder pipelines**. They move products from processing and storage facilities to transmission pipelines. Their purpose is to ensure that a sufficient volume of products is collected to justify the larger diameter of transmission pipelines.

- **Transmission pipelines**. Major conduits, mostly transporting crude oil and natural gas over long distances and commonly across international jurisdictions.
- **Distribution pipelines**. Small conduits that deliver natural gas to homes, businesses, and industries. This also applies to water distribution pipelines, but the supply systems are usually local in scale.

2.4-CABLE TRANSPORTATION

The globalisation of communication, improvement of transport modes, and information movement with conspicuous emerging of internet in our society, the world has become a global village. Again, transport has always played a vital role in space organisation which ensures the characteristics of economic globalisation of activities and the reduction of production cost. The comprehension of the space notion here is important to analyse the flow and network which is supported by the space.

This was thanks to the technical progress linked to the optic fibres, telecommunication, satellites and computers. The evolution in this domain has been very rapid than in the past. For instance, telex has permitted the exchange of typed documents in the whole world. This was thanks to a specific network like tele-copy or fax. Today most of the mail passes through an internet frame known as Email (Electronic mail).

Telecommunication system uses telephone network which permits the immediate transmission at a lower cost. The electronic mails also use telephone network to transmit documents or ideas with the use of computer machines.

Tele-magnetic today permits individual consultation of data bank or base. Other places are concentrated with communication and information technology (video, camera, GPS etc). The multiplication of personal machines and network permits inter connection to engender the conclusion in these activities. The entire multimedia networks help for the transmission of images, sounds and information of all sorts. This is of great important as far economic activities are concern.

CHAPTER THREE: EVOLUTION OF TRANSPORT MODE

Since 1945, transportation geography has witnessed development thanks to the continuous technical progress in the communication system. This evolution can be studied on speed, capacity or space, extension and employment.

3.1: SPEED

The evolution of transport system first of all started with speed; it began by contraction or reduction of time in space. This was done and it enables the possibility of crossing or covering long distances in a shortest time. The different speed evolution was noticed in each of the transport modes and their travelling equipment. For instance, in 1960, the air planes speed double and today they can cover 900km/hr with normal vehicles and in good transport modes, they can cover 60km/hr. In France TGV has an operational speed of about 300 km/h. High-speed passenger trains require special lines, but can also use the existing lines at a lower speed. In many cases it permitted a separation between rail passenger traffic rolling at high speed and freight traffic using the conventional rail network.

3.2: CAPACITY OR SPACE

The capacities were also used and the cost also reduces. The specialized vehicles also permitted to gain in time and reduction of space occupation. Complete and comfortable vehicles were also made. The end of 19^{th} century saw the coming of combined transport (inter-model or multi-model). This permitted transportation to be compatible with the normalisation of the content and techniques. These techniques rendered transport less cumbersome and at the same time resulted to economic of different scale, again of time and finally the reduction of transport cost.

3.3: EXTENSION

This is more glaring with the rail transport system. It gained grounds because it was extended to the international scale. The emergence of high-speed rail networks and

increasing rail speed had significant impacts on passengers' transportation; it permitted the passage from rail to road transport modes. This was remarked by some specialized charges on the wagons.

3.4: EMPLOYMENT

The technical progress witnessed within transport modes also brought much as far as employment is concern. Many persons have gained employment on different sub sections connected to transport. This was noticed in the construction of roads, vehicle building, repairs or maintenance, driving, economic activities etc. In brief, there was general progress as far as transport mode was concerned. This is seen in terms of time, space, cost and employment.

TRANSPORT NET WORK

Transport network here refers to the organization of space it comes across. It is presented as the total axis of circulation, a sphere where man interacts, where there is information, capital and goods found in a geological unit. Transport network leads to a specific space which is always characterized by the nature of linkage found between the cores of communication. i e town constitutes the essential hub of communication by or through the intermediary of parks, ports, air ports or teleports.

Transport networks are put in place progressively. The morphology of the future network is not only determined by geographical activities or population concentration because the frequency of each line depends on unforeseen evolution of the user's vis à vis the new possibilities.

The characteristic and the quality of transport network are always appreciated thanks to many parameters among which the major ones are;

THE DENSITY: Density is compared to the world or original scale.

THE CONNECTIVITY: This is the capacity of taking off from any point (core) and the ability to join another point with ease.

THE HOMOGENEITY: The coherency in terms of distance or speed within the different core of common place. A perfect homogenous network is that type where all the directions are equivalent.

THE SECURITY AND FORMS: Security is another factor found within the transport network as well as safety. Through the forms we can have rectangular network or orthogonal type. We can equally have forms like star which is mostly found around the town and at the same time permitting the multiplication of flux. Lastly, there are network that diffused from a unique source.