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The Integration between Transportation Solutions, Economic Development and Community Development as an Approach for Sustainability – A Case Study of Curitiba, Brazil

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***Abstract*—**Sustainability and sustainable development have been the main theme of many international conferences, such the UN Rio de Janeiro 1992 Earth Summit This was followed by the appearance of the global conferences at the late of the nineties and the early of 2000 to confirm the importance of the sustainable development .it was focused on the importance of the economic development as it is considered an effective tool in the operations of the sustainable development. Industry plays a critical role in technological innovations and research and development activities, which are crucial for the economic and social development of any country. Transportation and mobility are an important part or urban economics and the quality of life. To analyze urban transportation and its environmental impacts, a comprehensive approach is needed. So this research aims to apply new approach for the development of the urban communities that insure the continuity and facing the deterioration. This approach aims to integrate sustainable transport solutions with economic development and community development. For that purpose we will concentrate on one of the most sustainable cities in the world (Curitiba in Brazil) which provides the world with a model in how to integrate sustainable transport considerations into business development, road infrastructure development, and local community development.

***Keywords*—**Community development, economic development sustainable development, sustainable transport

I. Introduction

POPULATION problems are considered one of the most complicated and important problems from which the cities suffer. This importance emerged in the light of the problems caused by social, economic and environmental problems which affect the society and impede its ability for urban development fulfillment and continuity. Thus, it was necessary to apply new entries for development that insure this continuity. The integration between sustainable transport considerations into business development, economic development and local community development acts as an approach for sustainable urban development.

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II. Sustainable Development

Sustainable development has been defined in many ways, but the most frequent definition describes it as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs [12]. In urban planning, as in other professions, this has meant a new recognition of how environmental and social aspects of development need to be integrated with economic development, as well as meeting basic human needs for the poorest parts of the world.

Because of the dominance of cities and towns, the term sustainable development means that builders, architects, designers, community planners, and real estate developers strive to create buildings and communities that will not deplete natural resources. The goal is to meet today's needs.

Sustainable development focuses on improving the quality of life for all of the Earth's citizens without increasing the use of natural resources beyond the capacity of the environment to supply them indefinitely [14]. It requires an understanding that inaction has consequences and that we must find innovative ways to change institutional structures and influence individual behavior. It is about taking action, changing policy and practice at all levels, from the individual to the international.

III. Sustainability Components

The concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources, in order to meet the needs of current and future generations. The three components of sustainability could be described as follows:

A. Environmental Sustainability

This requires that natural capital remains intact; this means that the source and sink functions of the environment should not be degraded. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity to the environment to assimilate wastes should not be exceeded. Furthermore, the extraction of non-renewable resources should be minimized and should not exceed agreed minimum strategic levels [5].

B. Social Sustainability

This requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met.

C. Economic Sustainability

Economic efficiency plays a key role in ensuring optimal consumption and production, this occurs when development, which moves towards social and environmental sustainability, is financially feasible. Economic progress is evaluated in terms of welfare (or utility) – measured as willingness to pay for goods and services consumed [11]. Thus, economic policies typically seek to increase conventional gross national product (GNP), and induce more efficient production and consumption of (mainly marketed) goods and services. The stability of prices and employment are among other important objectives.

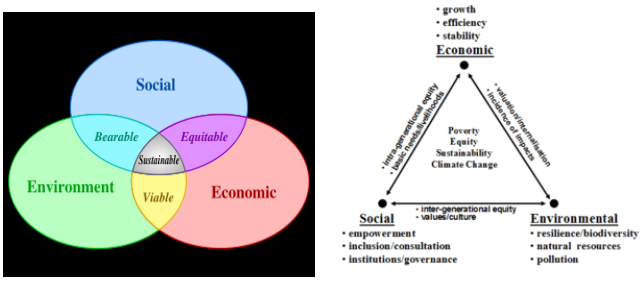

Fig. 1 Components of sustainable development

IV. Sustainability Indicators

Indicators are quantified information which helps to explain how things are changing over time. There are three basic indicators of sustainability [2].

A. Economy

One of the objectives of sustainable development is to promote a healthy economy in order to generate the resources to meet people's needs and improve environmental quality. This in turn can further the protection of human health and the natural environment. Indicators used for this could be: Gross Domestic Product, Structure of the economy, Expenditure components of GDP and personal savings, Consumer expenditure, Inflation, Employment, Government borrowing and debt, Pollution abatement expenditure, Infant mortality and Life expectancy.

B. Transport Use

An effective transport system is a necessary part of modern life. Industry and commerce depend on it, and increasing use of the car has shaped today's social and recreational lifestyles. The key sustainable development objective is to strike the right balance between the ability of transport to serve economic development and the ability to protect the environment and sustain quality of life, both now and in the future. Indicators used to measure transport use include: Car use and total passenger travel, Short journeys, Real changes in the cost of transport, Freight traffic.

C. Energy

The key sustainable development objectives are to ensure supplies of energy at competitive prices, to reduce adverse impacts of energy use to acceptable levels, and to encourage consumers to meet their needs with less energy input through improved energy efficiency. Indicators relevant to these objectives concern the depletion of fossil fuel reserves, the capacity of nuclear and renewable energy sources, energy usage by sector, and fuel prices. Indicators include: Depletion of fossil fuels, Capacity of nuclear and renewable fuels, Primary and final energy consumption, Energy consumption and output.

V. Principles of Sustainability

A. Sustainability

All human settlements shall be planned, developed and improved so as to ensure sustainability.

B. Equity

The deficiencies of the current global economic system with regard to gender, environmental and poverty issues should be addressed at the community, local and national levels to create a more balanced and equitable global system.

C. Livability

Human settlements should be places where individuals and families can live in a vibrant cultural environment in conditions of safety and freedom.

D. Partnerships

Partnerships between and among all actors from public, private and community organizations and individuals are essential to the development of sustainable human settlements and the provision of adequate shelter and basic services for all, as a means of improving urban management and developing urban and rural production and services.

E. Peace

A just, comprehensive and lasting peace is a prerequisite and an essential condition to achieve sustainable human settlements development.

F. Family

The family is the basic unit of society, and as such should be strengthened.

G. International solidarity, cooperation and assistance

To safeguard the global interest of present and future generations in human settlements development is one of the fundamental duties of the international community [4].

H. Government Responsibility and Civic Engagement

Governments at all levels are responsible for the creation of

conditions for meeting the shelter needs of people and for promoting the development of sustainable human settlements.

VI. Economic Development

Many conferences confirmed the issue of sustainability like agenda 21 in the conference of earth summit, 1992. This was followed by the appearance of the global conferences at the late of the nineties and the early of 2000 to confirm the importance of the sustainable development .it was focused on the importance of the economic development as it is considered an effective tool in the operations of the sustainable development.

A. Definition of Economic development

Economic development is the development of economic wealth of countries or regions for the well-being of their inhabitants. This is the short definition of Economic Development. It also can be defined by the process of creating wealth through the mobilization of human, financial, capital, physical and natural resources to generate marketable goods and services. It also refers to development and adoption of new technologies, transition from agriculture based to industry based economy, and general improvement in living standards [10].

Economic development, according to Harvard Professor Michael E. Porter is the "long-term process of building a number of interdependent microeconomic capabilities and incentives to support more advanced forms of competition." These capabilities and incentives, which were originally identified in Porter's The Competitive Advantage of Nations, 1990, include the nature and extent of the inputs required by firms to produce goods or services; the rules, incentives and norms governing the type and intensity of local rivalry; the quality of demand for local services; and the extent and quality of local suppliers and related industries.

B. The goal of Economic development

The main goal of economic development is improving the economic well being of a community through efforts that entail job creation, job retention, tax base enhancements and quality of life. As there is no single definition for economic development, there is no single strategy, policy or program for achieving successful economic development. Communities differ in their geographic and political strengths and weaknesses. Each community therefore, will have a unique set of challenges for economic development.

C. Economic Growth and economic development

Economic Growth & development are two different terms used in economics. Generally speaking economic development refers to the problems of underdeveloped countries and economic growth to those of developed countries [1]. Economic development is not possible without growth but growth is possible without development because growth is just increase in GNP It does not have any other parameters to it. Development can be conceived as Multi-Dimensional process or phenomena. If there is increase in GNP more than the increase in per capita Income then we can say that Development is possible. When given conditions of population improves then we can say that this is also an indicator of economic Development.

D. Industrial development

Industry plays a critical role in technological innovations, research and development activities, which are crucial for the economic and social development of any country, as well as in the development, diffusion and transfer of environmentally sound technologies and management techniques, which constitute a key element of sustainable development.

By addressing the economic and social causes of poverty, industry can play a major role in helping to overcome it. The indirect contribution of industry through its promotion of economic growth, which is a necessary condition for a sustainable reduction of poverty, is undisputed. The direct contribution of industry to poverty reduction, though more narrowly defined and thus limited, is nevertheless significant, and includes the creation of jobs for clearly disadvantaged groups like unskilled workers. For most developing countries, the greatest benefits can be derived through a pattern of industrial specialization in accordance with the principle of comparative advantage. In addition, an industrialization strategy meeting the needs of rural development can also be expected to have positive effects with respect to poverty reduction in the affected areas [3].

There is a mutually reinforcing relationship between social and industrial development, and industrialization has the potential to promote, directly and indirectly, a variety of social objectives such as employment creation, poverty eradication, gender equality, labor standards, and greater access to education and health care. In this regard, the overriding policy challenge is to promote the positive impacts while limiting or eliminating the negative impacts of industrial activities on social development.

VII. Community Development

In biological terms, a community is a group of interacting species sharing a populated environment. In human communities, intent, belief, resources, preferences, needs, risks, and a number of other conditions may be present and common, affecting the identity of the participants and their degree of cohesiveness. Traditionally a "community" has been defined as a group of interacting people living in a common location. The word is often used to refer to a group that is organized around common values and attributed with social cohesion within a shared geographical location, generally in social units larger than a household.

There are complementary definitions of community development. It defined as "A set of values and practices which plays a special role in overcoming poverty and disadvantage, knitting society together at the grass roots and deepening democracy. It can also define as “both an occupation (such as a community development worker in a

local authority) and a way of working with communities. Its key purpose is to build communities based on justice, equality and mutual respect [13].

Community development involves changing the relationships between ordinary people and people in positions of power, so that everyone can take part in the issues that affect their lives. It starts from the principle that within any community there is a wealth of knowledge and experience which, if used in creative ways, can be achieve the communities' desired goals.

A. Participation as an approach to community development

Participation in planning can empower communities and build social capital, lead to better design of urban projects and allow for participants' concerns to be incorporated within strategies. Physical planning is often accused of neglecting the social and economic dimensions of projects, and participation is a mechanism for addressing this. This approach to participation is based on the involvement of users in the design and planning of their environments. Participation has been strongly promoted in the developing world by non-governmental organizations (NGOs) and international development agencies. Participation and Partnerships have, to a greater degree, become important elements in all of the innovative planning approaches.

Participatory planning at the community level has, in recent years, taken many different forms, with varying outcomes. A variety of terms are used for these approaches, although in practice they have common characteristics, especially a focus on identifying needs and priorities, devising solutions, and agreeing on arrangements for implementation, operation and maintenance. The process of identifying needs and priorities is often called participatory urban appraisal, while arriving at proposals and implementation arrangements is frequently called community action planning [14].

The overriding task facing Governments is to maximize the positive influence of industrial activities on economic and social development, while minimizing the negative impact of production and consumption on the environment. To this end, Governments should review their regulatory policies and systems of economic incentives and disincentives and undertake other actions such as capacity-building, environmental data collection and enforcement that support the environmental protection efforts of industry and civil society. Governments should encourage the wider dispersion and implementation of industry's voluntary initiatives and agreements and sharing of best practices.

VIII. Sustainable Transportation

Transportation is expected to be the major driving force behind a growing world demand for energy. It is the largest end-use of energy in developed countries and the fastest growing one in most developing countries. Furthermore, adequate, efficient, and effective transport systems are important for access to markets, employment, education and basic services critical to poverty alleviation [9]. Sustainable transportation can be defined as transport systems that meet people's needs equitably and foster a healthy environment requires putting the automobile back into its useful place as a servant. With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling, and walking are all viable options.

Transportation problems are among the most pressing strategic development Problems in many cities, often a major constraint for long-term urban development in General and very closely related to land development, economic structure, energy Policies and environmental quality. Since all citizens are either enjoying the Transportation system or, and often at the same time, suffering from it, it is an Important element of the urban quality of life.

Fig. 2 Sustainable Transportation

The initiative of early studies in sustainable transportation came from the Organization for Economic Cooperation and Development (OECD) who in 1994 set in motion the so-called Environmentally Sustainable Transport (EST) project. Nine countries contributed to the project with the case studies based on internationally recognized and accepted six criteria: (I) noise, (ii) land use, (iii) emissions of carbon dioxide, (iv) emissions of nitrogen oxides; (v) volatile organic compounds, and (vi) particulate matter.

The problems to be solved are the Inefficiency of urban transportation systems and underlying land use patterns, which Negatively affect quality of life, economic efficiency, and the environment; the high (And often hidden) costs of urban transportation in both socio-economic and Environmental terms; and in particular the environmental consequences both in terms Of physical aspects that include land and resource use, ecological aspects, and Human health problems. Technically, and for the limited scope of transportation and emission control, there're different options for controlling the environmental impact of traffic in cities that Work both on the demand side as well as the supply side of the system. Measures Include changing transportation demand by appropriate spatial planning; to induce Different user behavior, like using public transport; to better control traffic efficiency, Sustainable Urban Transportation to introduce new technologies with reduced or zeros Emission. Some policies can be a mixture of these options like the introduction of Shared electric cars for urban short travels. Other policies could consist in providing Incentives for using

reduced emission technologies for urban transport.

The use of public transport instead of private vehicles is considered as a focal point of the sustainability of an urban transportation system. The penetration rates of new vehicle propulsion technologies can be affected by incentives or other regulatory mechanisms, in addition to market forces.

IX. The Case of Curitiba City, Brazil

Curitiba is a city in southern Brazil and the capital of Paraná state (estado) since 1854. It was founded in 1654 as a gold-mining camp. Population: 1, 8 million (2007 estimate). From the early 19th century it received many German, Italian, and Polish settlers, and immigration continued during the 20th century with the arrival of Syrians and Japanese, as well as a massive influx of internal migrants from rural areas.

Fig. 3 Curitiba site location in Brazil

Due to agricultural mechanization from the 1950s to the 1980s, cities across Brazil experienced rapid growth with the migration of people from rural areas to urban areas. Curitiba, the capital city of the State of Paraná, experienced some of the highest growth in the country with population increases reaching an estimated 5.7% a year during those decades. This uncontrolled increase in population presented circumstances that demanded effective city planning in areas ranging from social services, housing and sanitation, to the environment and transportation. Apart from the damage caused to health by the pollution from cars, people suffer psychological problems.

Curitiba grew dramatically in the past few decades and a majority of its new residents lived in favelas. The town garbage collection trucks could not even get into the favelas because there were no streets suitable for them. As a consequence, the rubbish piled up, rodents got into it and all kinds of diseases broke out because they did not have the money to apply 'normal' solutions, such as bulldozing the area to build streets.

A. Economic development

As a result of the effective implementation of the well conceived master plan, the city's 30-year economic growth rate is almost 3% higher than the national average over that timeframe (7.1% compared to 4.2%), and per capita income is now two-thirds higher than the national average. Curitiba's economy stands as one of the finest examples of how economic and industrial development can be carried out with thought for environmental and social needs, recognizing that the triple-bottom lines of sustainability are complementary [15]. The city is now the second largest car manufacturer in the country, and the city economy is based on industry, commerce and service industries. The government has worked hard to attract inwards investment and has succeeded. Knowledge economy sectors are also growing; in July 2001, Curitiba was recognized for the performance of its technology-based companies.

B. Industrial development

The industrial city in a world of cities, states, and nations increasingly whipsawed by the demands of business, perhaps the best example of the value of Curitiba's independence is its Industrial City. The industrial city of Curitiba (ICC) was built in 1973 and has become an integral part of the city's economy. Whereas most industrial centers are far from the center of the city, the ICC is located in the western part of the city and is connected to other municipalities by Curitiba's public transportation system, which makes it easily accessible by workers. The ICC provides basic services and housing to its workers so that they do not have to travel far to meet their needs. The ICC has numerous preservation areas surrounding the industries. There are as many forests as there are factories in this area. Several of the industries that Curitiba has recruited are non-polluting. Volvo built a factory, lured in part by the chance to work out improved bus designs with city planners. And new businesses continued to arrive throughout the 1980s, drawn as much by the quality of life for executives fleeing São Paolo as by the ease of doing business with nearby Argentina and Paraguay. Even in the teeth of Brazil's endless recession and inflation, the number of jobs continued to increase. By 1990 there were 346 factories in the Industrial City, generating 50,000 direct jobs and 150,000 indirect ones – and 17 percent of the entire state's tax revenue.

C. Community development

Curitiba created a new currency recyclables in garbage for bus tokens; biodegradable materials in garbage for a food parcel of seasonal fresh fruit and vegetables; and a school-based garbage collection programme also swapped garbage collected by students for notebooks. Soon the neighborhoods were picked clean by tens of thousands of children, who learned quickly to distinguish even different types of plastic. The parents used the tokens to take the bus downtown, where the jobs were, so they were drawn into the formal economy. What the city did was invent Curitiba money. The bus tokens, food chits and notebook credits were a form of complementary currency. Today, 70 per cent of all Curitiba households participate in this process. The 62 poorer

neighborhoods alone have exchanged 11,000 tonnes of garbage for nearly 1 million bus tokens and 1200 tonnes of food. During the past three years, more than 100 schools have traded 200 tonnes of garbage for 1.9 million notebooks. The paper recycling component alone saves the equivalent of 1200 trees each day [8].

Curitiba also has another complementary currency in its planning system that is commonly used by many cities, but is not thought of as a complementary currency. The system is called sol criado (literally,' created surface') and it is similar to what many cities do by providing 'development or density bonuses', which are a form of money given whenever a developer does something that the local government wants But cannot always require (e.g. heritage restoration, conservation of green spaces, social housing or social infrastructure).

Curitiba does not neglect the needs of its citizens. The city adopted a Slum Relocation Plan to assist low-income families. The Public Housing Company of Curitiba built low-income housing near the center of the city instead of far away from the center, which is typical of US cities as well as major cities around the world. The incorporation of public housing with the rest of the city has created socially integrated neighborhoods that provide public health, education, day care centers, and recreational services.

D.Basic structure of the Curitiba transport system

From the 1940s to the 1960s urban planners in Curitiba began the process of creating an urban Master Plan. Part of that plan included constructing a consolidated public transportation system to move people easily throughout the metropolitan area and its surrounding municipalities. An efficient transportation infrastructure is vital to the success of a city. Curitiba is widely recognized for its efficient and widely used bus system. When it came time to renovate the existing transportation system, the city planners decided to work from the bus system already in place, around which the city had been built. The buses are locally assembled by Volvo, reducing transportation costs for the city that would be inflated if buses were imported from abroad.

Curitiba redesigned their transportation infrastructure. It was designed to function like a subway system in terms of the amount of people it could transport and the frequency between routes. It has proven a good decision because the economic and time costs would have been significantly greater if the city had opted to construct a subway system; excavation for a subway can take years if not decades. The money that Curitiba has saved has been allocated to other social causes. The city layout itself has encouraged the wide use of the bus system because it is reliable and easier to use than a private car. The architects replaced the old, noisy, and polluting buses with those that were cleaner and more efficient [6].

The glass tube stations provide citizens with a clean, protected area in which to wait for the bus. The platform of the tube station is parallel to the platforms of the buses, so there are no awkward steps to climb and the bus is handicap accessible.

Fig. 4 Tube elevator for special needs users in Curitiba

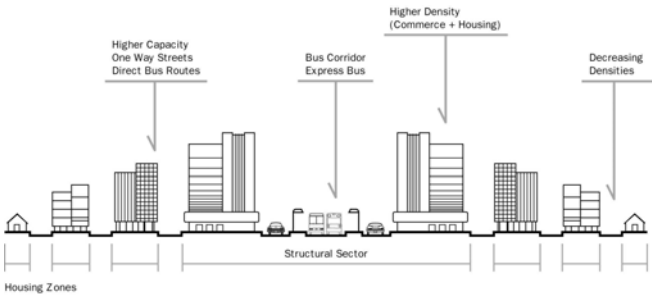

Fig. 5 Hierarchy of the streets and transportation routes in Curitiba

Approximately 1,100 buses make about 15,000 trips daily. The ternary street system has an exclusive bus lane and bus drivers control the traffic lights, giving the buses priority. The architects has designed five different buses that are used for different jobs so that there are fewer empty seats: express buses run only along the arteries; rapid buses operate on the main arteries and on other main streets; double- or triple-length buses operate on high capacity routes; inter-district buses carry passengers between the main arteries; and feeder buses operate on the city streets. The main function of the feeder buses is to bring passengers to district terminals or transfer stations [7]. During rush hour, buses can leave once every minute, carrying up to 20,000 passengers per hour, similar to the capacity of a subway.

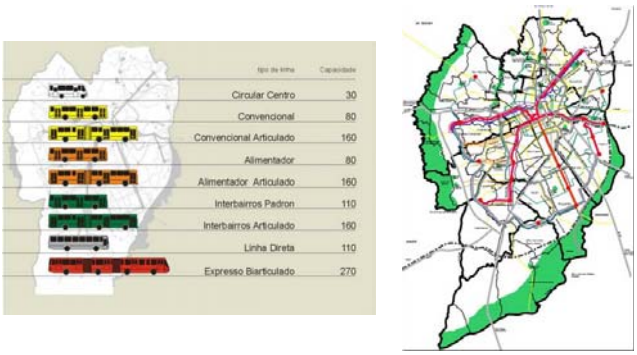

Fig. 6 Curitiba's transportation system

Curitiba's transport system is known throughout the world as an example of a pragmatic, integrated, cost-effective, and

efficient transport system. A system of median bus ways along five "structural axes" is complemented by "direct" express service on parallel arterial roads, and by an extensive feeder bus network.

Curitiba must be one of the World's most sustainable cities due to the following facts:

1) Curitiba has the highest recycling rate in the World – 70%.
2) Curitiba has bus system that is so good that car traffic decreased by 30% while the population trebled in a twenty year period.
3) Curitiba has the largest downtown pedestrianised shopping area in the World.
4) Curitiba has built large numbers of beautiful parks to control floods rather than concrete canals. So many that they use sheep to cut the grass as it's cheaper than lawnmowers.
5) Curitiba is a city where 99% of inhabitants want to live. In comparison, 70% of Sao Paolo's residents want to live in Curitiba.
6) Curitiba's average income per person has gone from less than the Brazilian average in to 66% greater than the Brazilian average.

We can say that the city of Curitiba provides the world with a model in how to integrate sustainable transport considerations into business development, road infrastructure development, and local community development.

X. Conclusion

Sustainable development is maintaining a delicate balance between the human need to improve lifestyles and feeling of well-being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend. Sustainable development focuses on improving the quality of life for all of the Earth's citizens without increasing the use of natural resources beyond the capacity of the environment to supply them indefinitely. It requires an understanding that inaction has consequences and that we must find innovative ways to change institutional structures and influence individual behavior. It is about taking action, changing policy and practice at all levels, from the individual to the international. The achievement of sustainable development requires the integration of its economic, environmental and social components at all levels.

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