

Temporal Dimensions and Spatial Systems: The Resourceful Approach to Geographical Analysis

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Abstract

Traditionally, geographical analysis has been guided by chorographical and ecological systems approaches. These approaches have hitherto emphasised onsite geographical conditions of phenomena. The output has invariably been weighed down by static geometrical conditions of place, and change has thereby been difficult to capture in many geographical studies especially in the developing countries including in Africa. This article provides the temporal dimensions and spatial systems approach, as an alternative to chorographical and ecological systems approaches, for the analysis of geographical phenomena. Time is used to record the chronology of events over space. It has, therefore, an enduring effect on events on the earth's surface and how knowledge is preserved for future generations. Space is the material in which life processes are propagated and, it has positional and geometrical qualities. The notions of temporal dimensions and spatial systems should ideally be integrated to generate rich geographical knowledge. Based on a selected dominant variable of the space economy for a period, five temporal dimensions are proposed and their corresponding spatial systems are suggested. It is concluded that the ideas of time and space are not only inseparable in undertaking geographical inquiry but also that the spatio-temporal approach should be adopted in instruction and research in universities in Africa.

1.0 Introduction

In general, there is agreement on the importance of time in spatial thought (Soja, 1990; Peet & Thrift, 1989; Santos, 1984). This is essentially the focus of studies in human geography (Harvey, 1992; Mumford, 2006) and in monitoring ecosystems in biophysical geography (Wrieus *et al.*, 2007; Boyce, 2002; Blaikie, 1986). The study of the impact of humans on the environment, as a spatial process, concerns both human and physical geographers in the highest degree (Taylor, 1951). In developed societies, home grown innovations experienced an extensive diffusion for a very long time and the innovations left deep impressions more or less indistinct and intermingled over space (Johnson, 1983; Joerg, 1922). On the contrary, innovation diffusion in the developing countries was not only invariably orchestrated from abroad and a privilege of only a few selected regions but, it was also for privileged minorities (Abu-Lughod & Hay, 1979). The spatial impress of modernisation in the developing countries has only recently had wide diffusion vide the process of globalisation (Rugumamu, 2005; Pacione, 2003; Harvey, 2003; Gutkind & Wallerstein, 1986). In the African context, the types of innovations, the processes of innovation diffusion and the changing

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spatial patterns of national resources use can only be correctly captured and interpreted from an Afrocentric viewpoint using the temporal dimensions and spatial systems approach (Banyikwa, 2004). Time is used by geographers to record the chronology of events over space. It has, therefore, an enduring effect on events on the earth's surface and how knowledge is preserved for future generations. Space is the material in which life processes are propagated. It has positional and geometrical qualities. At each time of local, regional, national or world history, the action of the diverse variables facing one another on space depends on the conditions of the corresponding temporal dimension. The notion of spatial systems is thus inseparable from the idea of temporal dimensions. And, the temporal dimensions and spatial systems approach is, therefore, necessary to help geographers beyond ecological or chorographical analysis. The outline which follows demonstrates how a spatio-temporal systems approach works. The article serves also to justify the adoption of the spatio-temporal systems approach in teaching, learning and analysing geographical phenomena in universities in Africa.

2.0 Defining concepts

2.1 *Temporal (Time) dimensions*

Time is a continuous variable which is used to measure processes and outcomes of geographical significance. It is used to show three things: location, duration and succession. Locational time is used for classifying and distinguishing discreet units. It fixes, for geographers, when an occurrence took place. Durational time is used to measure the rate at which time passes. It helps geographers to record how long a phenomenon remained in vogue before it was assimilated or replaced by another. And, successional time is used to show the sequencing of events over space. It is used by geographers to record the chronology of events over space. Time has, therefore, an enduring effect on events on the earth's surface and how knowledge is preserved for future generations (Dikshit, 1999; Abler, Adams & Gould, 1972; Haggett, 1975).

2.2 *Spatial systems*

Space is the material in which life processes are propagated. It has positional and geometrical qualities. Positional qualities are expressed as absolute location (site) and relative location (situation). Geometrical qualities are expressed as areal and volumetric dimensions of space. Space is real and it can be given recognisable dimensions and content. Geographers capture the positional and geometrical qualities of space using the concepts of location, distribution, interaction and pattern. The current situation at a given geographical area depends on superimposed influences of the past, and the working of a new spatial system is always conditioned by the preceding one. Some elements of a spatial structure may give way completely or partially to other more recent ones of the same kind. Other elements of a spatial structure may resist change and remain in place for a very long time. In some cases, elements from different time periods may co-exist side by side at the place. Also, some elements of space may disappear altogether without a successor and completely new elements may establish themselves over space. The evolution of the positional and geometrical elements of a spatial system is therefore a mosaic of elements from different eras. A spatial system can therefore be defined as a mosaic of elements of the life support system at a given geographical area, at a given time (Haggett, 1975:30).

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2.3 Temporal dimensions and spatial systems

A description and interpretation of a local spatial system cannot be valid at the static local scale. Events at the world scale at different time periods contribute more to the understanding of the structure of local sub-spaces than local events do. The local phenomena may be a result of forces, direct or indirect, whose stimulus occurred at a distance. The behaviour of sub-spaces of Africa has, for instance, historically been governed at various time periods by interests of nations at the centre of the world socio-economic systems, far removed from Africa. The introduction of the dimension of time in the study of space ought to be abstracted to the world scale in order to accommodate both exogenous and local drivers of change. At each time of local, regional, national or world history, the action of the diverse variables facing one another on space depends on the conditions of the corresponding temporal dimension. The notion of spatial systems is thus inseparable from the idea of temporal dimensions. And, the temporal dimensions and spatial systems approach is, therefore, necessary to go beyond ecological or chorographical analysis (Banyikwa, 2004).

To appeal in this manner to the realities of the past to explain the present and, perhaps, to predict the future does not always mean that one has correctly introduced the idea of time in the study of space. If the element so analysed is not considered as a given of the system to which it belongs (or to which it belonged at the time of its introduction), a spatio-temporal approach will not have been used. The mere reference to the historical relationship of a phenomenon or the search for partial explanations concerning one or the other elements of the geometrical elements of space cannot suffice because of two reasons. First, the meaning of the same variable changes in the full context of the history of a place; secondly, and from the spatial point of view, the succession of spatial systems should be regarded as a succession of systems and not isolated elements. Space is a result of the 'geographisation' of a set of variables and not the effect of an isolated variable. A single variable is deprived of meaning without the socio-economic system to which it belongs. When a variable passes through a process of localised interaction, it undergoes metamorphosis to create something else. In this way, the formation of space can be likened to a chemical process in which successive spatial structures which evolve extract their specificity exactly from a certain type of combination at a given time. The continuity of the new spatial system is a consequence of the dependence of the combination on the preceding one (Soja, 1990; Peet & Thrift, 1989).

3.0 Temporal dimensions of modernisation

At the global level, five temporal dimensions of innovation diffusion can be identified; these include i) primitive communalism, ii) large scale commerce, iii) artisan manufacturing, iv) the industrial revolution, and v) the contemporary technological period (Banyikwa, 2004: 4-5). The periodisation is governed, in each instance, on a dominant variable of the socio-economic system that determines behaviour of other variables in the space economy. These dimensions are described in the sections that follow.

3.1 Primitive communalism (from antiquity to end of 15th century)

Based on fragmentary archaeological evidence, it has been possible to pierce together data to prove that modernisation independently emerged in particular regions of the

world prior to the Christian era (Davis, 1959). One may agree with the dominant view that the conducive physiographical environments, the diverse technological innovations associated with the Neolithic era, the production of a social surplus product and the supportive social organisation were the conditions *sine qua non* for the emergence of new civilisations in selective physiographical environments in the World (Banyikwa, 2004). The earliest urban communities emerged in the Middle East, Southern Europe, Indian sub-continent, North Africa, the Orient and Middle America. The great towns in the Middle East were Babylon, Ur, and Erech. Babylon with its elaborate hanging gardens embraced an area of only 1.2 Km²; Ur occupied 0.73 Km² and Erech encompassed an area of just 0.77 Km². The great towns of Southern Europe and the Levant were Athens, Rhodes, Antioch, Carthage, Damascus, Byblos, Ugarit, Tyre, Sidon, Mycenae and Knossos. None of these towns boasted an area of more than 308 Km² (Palen, 1987). The great towns of the Indian sub-continent were Mahenjo-daro and Harrapa. The populations of each of these two towns have been estimated at just less than 15,000 people. The towns of North Africa were Thebes, Memphis, Tell-el Amarna and Alexandria. Thebes and Alexandria, the largest towns of ancient Egypt, had populations of 225,000 and 650,000 people, respectively (Palen, 1987). Farther afield in the Orient (in the Hwang Ho Valley of Northern China), existed the Anyang, Sian and Loyan towns. None of the Chinese towns of the old attained a population of 200,000 people (Palen, 1987). Across the Atlantic in Middle America, there existed the Mayan towns named Chan Chan (in Mexico) and Manchu Pichu (in Peru).

Urban historians have emphasised that it were in these areas where supportive inventions, such as the ox-drawn plough, the wheeled cart, sail boat, metallurgy, irrigation and domestication of plants and animals first occurred (Banyikwa, 2004). The organisation of space during antiquity was conditioned by the amount of food, fibres and other bulky materials that could be obtained in situ by labour intensive methods. Apart from the synergies which existed between the towns of antiquity and their umlands, a number of distant trade links were fashioned to complement what could not be produced in situ. Since the towns of antiquity continued to significantly depend on the productivity of their umlands, they could not grow into large cities. Towns of antiquity were also not only walled for defence purposes but they were also dignified by palaces, temples and market places, tributes to both earthly and heavenly potentates (Davis, 1959; Banyikwa, 2004).

The great physical separation among the six domestic hearths of urban civilisations (the Middle East, Southern Europe and the Levant, the Indus Valley, North Africa, the Orient and Middle America) notwithstanding, the towns of antiquity were similar in character and population size (Hudson, 1977). Because the world had not yet developed any dominant epicentre of a socio-economic system, the earliest urban civilisations that emerged were independent of one another and they were separated by great distances. The organisation of space during antiquity was conditioned by the amount of food, fibres and other bulky materials that could be obtained in situ by labour intensive methods. Transformation and change in each of the six domestic hearths were governed by drivers that were specific-society based. It is important to point out here that none of the six earliest civilisations dominated the others, and societies in different continents of the earth were at peace with themselves (Hassan *et al.*, 2005).

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3.2 Large scale commerce (from end of the 15th century to about 1620)

For some, the history which is connected with the underdeveloped countries begins with the Arab conquests (Chami, 2009). However, the Arab influence was limited by the modes and means of transportation it could command, largely land transport on the backs of animals, which hampered exchanges and made spatial interactions difficult. This explains the formation of virtual trading colonies in the countries subjected to Arab influence, with the cities acting as the instrument of relations between the conquered spaces and the conquering nations. The commerce realised rested above all on the agricultural social surplus product which the conquering nation could not alter (Abu-Lughod & Hay, 1979). From this point of view, one can reconcile the system characterised by Arab rule with the European Feudal system since agriculture had an important driving role and the commerce, therefrom, maintained the links between the centre and the peripheral countries (Chami, 2009; Abu-Lughod & Hay, 1979). One difference between the European and Arab world colonial influences was that, while the Arab coloniser was not able to provide a centre of dispersion for innovations (Abu-Lughod & Hay, 1979), the European one did have a centre for the dispersion of innovations (Joerg, 1922). The modernisation of international commerce formed the foundation for the creation of the European epicentre of the world socio-economic system. This period corresponds to the increase in the capacity of transportation and of trade. The large capacity for transportation and commerce, therefore, replaces agriculture as the essential variable of the world socio-economic system. Similar modernisation of commerce did not take place in the Arab world. It is not by chance that the epicentre of the world socio-economic system rested on Spain and Portugal from end of the 15th century to about 1620.

Commerce was thus the mover of agriculture as well as of transportation and was responsible for the positional shift in favour of the Iberian Peninsula because the peninsula surpassed other countries of Europe and the Arab world in the speed and capacity of her vessels as well as in her political and commercial organisation. It was the creation of this world epicentre of the world socio-economic system that formed the beginning of the most profound spatial transformations in the world. One can thus arrive at the second period of the suggested periodisation scheme namely, the period of large scale commerce, dating from end of the 15th century to about 1620 (Joerg, 1922).

It was the creation of this world epicentre of the world socio-economic system that formed the beginning of the most profound spatial transformations in the world. International commerce was responsible for the creation of the first derived spaces in Africa and America through appropriation of slave labour from Africa to America, the establishment of sugar cane, tobacco and later cotton plantations in North and South America, whose proceeds began to impact on the profits of the European based entrepreneurs (Schumpeter, 1961). The European cities thus enriched were able to devote themselves with more investible means to an economic activity which was going to permit the establishment of manufacturing industry in Europe. This activity organised itself especially around the North Sea and the Baltic Sea so that Spain and Portugal, which were the poles of the preceding system, found themselves in the periphery of the new system, although they retained their role as relays – privileged relays – in connection with Latin America.

3.3 Artisan manufacturing (from 1620 to 1750)

Artisan manufacturing for production of commodities aimed at national consumption was the trademark of the third period. This activity organised itself especially around the North Sea and the Baltic Sea and these became the new epicentres of socio-economic activity during the 1620s and the 1750s. Throughout the life-span of this period, the raw materials for artisan manufacturing were obtained locally. Since urbanisation and industrialisation were accompanied by increased productivity in the countryside of the now industrialised countries, the production of commodities was sufficient for internal consumption. After all, intercontinental transportation was not yet sufficiently developed to carry bulky raw materials and food stuffs over vast distances. This shortcoming notwithstanding, the period was the advent of a brutal change in circumstances in Europe and beyond (Abu-Lughod & Hay, 1979; Joerg, 1922).

3.4 Industrial revolution (from 1870 to 1945)

The fourth period corresponds to the application of new technologies and new forms of organisation not only to material production but also to energy and transportation. Europe ushered into the factory a system of production which allowed a daily disassociation of production and consumption. The impetus of urbanisation and exodus from the countryside in Europe created a big problem for the provisioning of the urban-based factories and populations. It was not possible to meet domestic supply of raw materials and foodstuffs from each nation's resource base in Europe. The possibility to import the raw materials for the factories and foodstuffs for the urban populations from far, using the achieved capacity of ocean navigation developed during the second period, was outstripped by demand (Joerg, 1922). The economy was threatened with collapse if alternative ways of supply could not be quickly found. If the cultivation of sugar cane and tobacco were borne from the needs of commerce during the second period, the cultivation of wheat and other tropical foodstuffs, the rise of ranching in Argentina, Uruguay, Brazil, Australia and New Zealand and the encouragement for production of staples in Canada, Africa and Asia were a response to the needs of industry during the fourth period. This response, which was the dominant variable of the period, commanded autonomy in comparison with other variables of the period.

The demand for technology accompanied its supply. There was a sort of coexistence between the activity of production and the activity of innovation. Industrialisation and capitalism became synonymous during the fourth period. England became the greatest power of the period because she possessed then a more advanced technology which allowed a greater accumulation of capital from within and abroad. In order to participate in the new industrial system, the other European countries were obliged to procure colonies abroad based on the law of the strong. Britain, France and Germany (Western Europe) became the new epicentre of socio-economic activity in the world (Joerg, 1922; John, 1988). The pattern of the partition of Africa was, for instance, a direct consequence of the differences in the industrial-cum-technological power of the shifted epicentre in the countries in Europe. The political and judicial status which each colonial power exercised over the colonised spaces was also connected to the technological factor. Stronger colonial powers used the crudest power to dictate resource use in the colonies. The dominant countries dictated, among other things,

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the pattern of exploitation of the resource base in the colony, the trading partners of the colony, wages in the colony, producer prices for raw materials and consumer prices of imported commodities into the colony. These mechanisms ensured a steady supply of raw materials to the European-based manufacturing industries and tropical foodstuffs to the coloniser countries. They also protected the colonial entrepreneurs in the colonies against competition from other countries. Protection was necessary against countries whose low costs of production and therefore prices would be a menace to the less protected markets in the long run (Davis, 1973). The pattern of resource use in the colonies was dictated directly by colonial interests. Spatial patterns in the colonies became derived spaces (Schumpeter, 1961).

3.5 Contemporary technological period (from 1945 onwards)

This period began in 1945 after the Second World War and was called the era of imperialism (Arrighi, 1999). This was the period of the capitalism of multinational corporations, sewed together by extremely rapid and widespread means of transportation and communication. Technology constituted its autonomous variable and all other variables of the system were subordinated to it in terms of their operation, evolution and possibilities of diffusion. Communications technology allowed innovations to appear not only together but they acted also in a form of solidarity with one another. This solidarity of innovations was a peculiar nature of the fifth period which had not been observed in the earlier periods. One can talk of invention of invention during this period because the propagation of innovations was in large part a consequence of a technique which fed itself (John, 1988). This technique whose realisation had become relatively independent was called research. Utilisation of the most recent research findings in production and marketing had become an essential condition to growth. Countries which possessed advanced forms of technology (USA, Canada, Britain, Germany, France, and Japan) were also socio-economically the most advanced. The industries and activities which were served by advanced technology were likewise endowed with greater dynamism. These industrial countries spent close to 66.0% of their research budget on the more advanced industries and only 34.0% of their research budget on non-dynamic industries (Fellman *et al.*, 1997). The less developed countries, on the other hand, spent less than 30.0% of the research budget on dynamic industries and more than 40.0% of their research budget on stagnant industries (Simon, 1992). When one considers that the advanced industries require much more effort in invention than intermediate and stagnant industries, one sees the size of the difference in the situation between the advanced and the less advanced countries (Hassan *et al.*, 2005). It is true that the less developed countries can purchase licenses but this is a dangerous way of using up their reserves of currency or of running themselves into debt by means of enormous technology payments and/or technology fix. Needless to say, it is not sustainable to import the results of basic research because one must go beyond the stage of pure research and arrive at that of applied research whose cost is relatively higher (Amin, 1990). It is also important to point out that the technologically advanced countries guard their technological inventions very jealously.

The contemporary period distinguished itself clearly from the preceding ones in that individually owned manufacturing industry was quickly replaced by multinational

corporations as the principal driving force of production. Technology became the autonomous factor of the period in place of industry itself. External forces transmitted from the major epicentre of the world economy (currently the USA), experienced renewed kinds of support like air transportation, long distance communications, advertising, new means of control of economic mechanisms, possibilities of concentration of information, new monetary techniques, revolution in consumption which rests on the supports themselves, and the conditions of spatial re-organisation in the world. Through the intermediaries of communications, the period impacted on all humanity and in all parts of the earth (Harvey, 2003; Rugumamu, 2005). Spaces which escaped the influence of the preceding periods were all brought in the sphere of influence of globalisation. The new techniques of processing and exploiting innovations brought about the possibility of geographical dissociation of activities. To this phenomenon were added many others: new forms of the internationalisation of the division of labour, the creation of footloose economic activities which located in the peripheral economies to exploit underpaid labour, and the creation of the semi-peripheries, i.e. Brazil, Argentina, South Africa, South Korea and India, in the lowly developed countries (Banyikwa, 2004). The current technological period is thus characterised by the multinational corporations which have over time shared the world among them and called it the global village (Harvey, 2003; Rugumamu, 2005). This situation should be placed alongside the society which made the Nations of The Hague and the states which made the United Nations (Stead & Stead, 1992). The complexity of conditions in the contemporary period assigned the multinationals power which one could not have previously imagined. The development of new techniques of processing and exploiting information placed increased concentration of power to command in the hands of the multinationals. The multinational corporations often became more powerful than some states (Harvey, 2003). The difficulties encountered by some countries in the periphery to transform their space economies are partly explained by the dictatorship of the multinational corporations (Chomsky, 2000).

4.0 Behaviour of innovations over space and time

The organisation of space over time can be defined as the result of forces of concentration and dispersion at a given moment of spatial history. The factors of concentration are, on the one hand, the size of enterprises, the indivisibility of investments, the economies of scale and the externalities necessary to implant the activities from foreign countries into desirable locations in the peripheral countries (Castells, 1993). These conditions of concentration govern the realisation and concentration of foreign controlled enterprises in selected points over space. The factors of dispersion, on the other hand, are the conditions of diffusion of innovations and models of consumption (Harvey, 2003).

Remarkable difference in the behaviour of innovations over space and time can be identified among the five temporal dimensions. Temporal dimensions 1, 2, 3, and 4 were characterised by forces of concentration of innovations over space. Until the mid-1940s, innovations of the four preceding periods reached only a few highly localised geographical areas and very few individuals in the peripheral countries. The societies and spaces of the peripheral countries were not widely touched by innovations transmitted from the epicentres of the world socio-economic systems.

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The transfers of innovations were accomplished by the accumulation of innovations in selected geographical areas and the relative dispersion of induced innovations from the earlier contact points. But, the spaces touched by induced and transferred innovations were compulsorily contiguous (Abu-Lughod & Hay, 1979). The growth of all these spaces was neither homogeneous inside the same country nor between countries. During the prior periods, the advanced countries led the peripheral countries in diffusion of induced innovations by conformity to the needs of the developed countries themselves. Incorporated innovations were the consequences of the contribution of localised induced innovations but, they were always limited in spatial extent. The possibility of importing incorporated innovations was itself in part conditioned by the capacity to create induced innovations. Because of the lowly developed level of transportation and communication in the prior periods, innovation diffusion depended on existing centres in the peripheral country. The conditions of the impact varied also with time because variables of growth changed with time and types of modernisation (Castells, 1993).

In the contemporary period, all spaces of the world are reached instantly by a certain number of innovations. This instantaneity and universality of the propagation of certain innovations upset the organisation of space. It constitutes above all a factor of dispersion which combats, in a very clear way, the factors of concentration known in the preceding periods. Generalised information is diffused in the same way that models of consumption are diffused from the developed countries. To be modern is to ape the consumption pattern of societies in the advanced countries. The USA was at the centre stage of this transformation. After the Second World War, the USA became the champion of the bourgeois order around the World. With Europe forming an economic union of combined strength equal to the United States of America in the 1980s, and China fast becoming the mother of all domestic markets in the 1990s, the dominance of the USA in world economic affairs was put to the test (Harvey, 2003). To counter threats to its dominance, the USA flexed its muscle. It began with control of petrodollars by American banks, but expanded over time through trade agreements, underwritten by loans from the International Monetary Fund and World Trade Organisation, and other policies that have come to be known as neo-liberalism. Internally, the balance of power shifted from the capacity to produce to the capacity to invest and otherwise control the movement of capital. At the same time, advancements in the organisation of production and growth of information technology set the stage for the outsourced, downsized and contingent workplaces of today's post-industrial global economy (Harvey, 2003). The USA has gone further to protect its economic and political supremacy by resorting to military power and this new phenomenon has been called the new imperialism (Harvey, 2003).

The dialectic of forces of dispersion is also responsible for the great migration streams in developing countries. The streams of migration appear at first, as a defensive reaction of groups of people whose original space has been invaded by techniques which they can only partially or not at all assimilate (Mbonile, 2006). Migrations are viewed also as the bearers of new technologies (Rossi & Rizzi, 2010). The intensity of migration depends on the type of technology imported into an area or type of technology imposed on the people and thus on the historical conditions of the introduction of new technologies in an area (Brahim, 2009; Mbonile, 2006; Cardoso, 1993).

Primate cities and small-sized towns are also consequences of forces of dispersion characteristic of the contemporary period. Due to the progress made in transportation and communication, the installation of incorporated innovations no longer depends on the role of existing urban centres in a country in the periphery. New urban centres can receive incorporated innovations independently of the expansion zones of induced innovations. The increase in the importance of incorporated innovations in the destination areas ceases to have as a condition a preliminary or parallel expansion of induced innovations. Improvements in transportation and communication exercise a liberating effect on innovations originating from the epicentres of the world economic system in the contemporary period (Daily & Matson, 2008). Examples of newly created commercial, industrial and politico-administrative metropolises and cities created from whole cloth are too numerous to mention (Mengisteab, 1996). The creation of mining towns outside previously settled areas in response to new technological and consumption needs is also a case in point. To this, can also be added the cities which sprang up at road or railway network intersections or at the edge of pioneering commercial zones, newly created administrative and industrial towns. What remains of the growth pole theory and the growth centre strategy in inducing regional development belongs to history (Davidson, 1991).

5.0 Modernisation and polarisation

In each of the five temporal dimensions, the system seeks to impose characteristic modernisations from the centre to the periphery. This operation is not a chance operation and the spaces which are reached are those which respond, at a given moment, to the need for growth or to the functioning of the system in the core of a periphery. The changes in a period imply changes of method: either diffusion is characterised and controlled by a different process in each phase or the role of the particular factors is different in the different phases of diffusion. Each modernisation at the world-scale represents a different set of possibilities for the countries capable of adopting it. One could not talk of a culture requiring chemical fertilisers before the chemical industry had established itself in some part of the world. Modernisation create new activities responding to new needs.

Two hypotheses can be proposed – either, new activities benefit from new possibilities or local modernisation represents quite simply the adaptation of already existing activities to a new degree of modernism. Undoubtedly, different combinations are possible between these two hypotheses. The fact that at each moment not every space can receive all modernisation explains why certain spaces are not the object of all modernisation and that there are time-lags in the appearance of modernising variables at different spatial scales. The results are in a tight relation with the interests of the system at the world, regional and local scales. Through this relationship, one can explain the differences in levels of modernisations among continents, countries and the interiors of countries.

The fact that spaces are not equally reached by all modernisation at the same time, introduces a criterion of spatial differentiation within countries and among countries. Also, the fact that there are time lags in the establishment of modern variables explains the differences of situation within countries. What happens when a variable of a

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modernisation period, having reached the first contact point or zone in the periphery, propagates itself only after delays to the other points or zones? This is in essence the problem of the subordinate or secondary pole. The problem of delayed diffusion is not only relevant at the world scale but, it is also relevant at the regional and local scales. The point in the core of the periphery that receives a beam of innovations corresponding to a modernisation in the core of the core economies is in a position to influence others in the peripheries that are not that advantaged especially when the beam is typified by the more dynamic variables of the dominant system. The diffusion of innovations is responsible for appreciable differences within every country, through the creation of internal cores in the periphery. Modernisation always occurs accompanied by specialisation of functions which are responsible for a functional hierarchy, which itself generates a hierarchy of places (Harvey, 2003). Indeed the points which are pioneers in receiving innovations are the ones able to receive even more innovations. This creates the conditions for polarisation in the periphery. At the world level, the epicentre of the socio-economic system is represented by a country or countries which have the best combination of variables of modernisation. These countries are the cores of the world socio-economic system. The countryside of each core country becomes the periphery of the core. At other levels, it is likewise the areas which had earlier contact with modernisation from the cores which will assume the status of the cores in the periphery. Also, the countryside of the cores in the periphery assumes the status of the periphery of the periphery. There are thus ranges of systems and of spaces which are representative of the dominant socio-economic systems in the world. The peripheral countries will be externally integrated but internally disintegrated (Slater, 1977).

6.0 Temporal dimensions and spatial systems in peripheral space economies

All that has been presented on temporal dimensions shows that the formation of space presupposes accumulation of variables of modernisation at a place in different periods. This process poses a theoretical problem of transferring the relations of time to the relations of space (Harvey, 1992). The evolution of spatial systems can be expressed as a succession of different geometrical situations of a place in a state of permanent interaction, each successive situation being a function of the preceding one. To take account of this diachrony, analysis of variables requires the introduction of the time dimension in the study of space. When it is done otherwise, as it is in ecological and chorographical approaches, space becomes a sub-product of time and, in this sense, spatial structure becomes insufficient as an object of study. To get out of this cul-de-sac, spatio-temporal structures should be the objects of geographical studies. One cannot achieve the objective of spatio-temporal analysis without understanding the behaviour of each variable of modernisation throughout the historical periods which affect the history of the space one may be studying (Banyikwa, 1989). Undoubtedly, the space chosen for study will have had own history before contact with foreign forces (Molles, 2007). Foreign forces will undoubtedly alter the geometrical attributes of the space that has been impacted on. In order to go beyond explanations based on particular cases, the actions of influences based at a scale larger than the place must be accepted (Santos, 1984). The problem would then be to rightly grasp the mechanisms of the spatial transcriptions of the temporal dimensions (Banyikwa, 1989).

If the impact of the temporal dimension on a portion of space was not recurrent, each temporal dimension would be able to completely impart its imprints on the portion of the space considered. Since however the actions of preceding temporal dimensions leave their signatures behind (Banyikwa, 1990), one is immediately confronted by superimpositions, and space becomes a mosaic from previous and current periods. A single sub-space is in reality the theatre of action of many socio-economic systems at different scales. These scales correspond to the strength of the countries commanding the epicentres of socio-economic systems, at a particular time, at the global level. The implication of modernisation is to generate specialisation and, by extension, of domination. The more specialised places therefore become 'poles' and the less specialised become 'peripheries' (Banyikwa, 2004; Santos, 1984).

The sub-system corresponding to a given sub-space is dependent on several sub-systems of higher echelons. While the sub-spaces at the higher echelons are linked by ties of coexistence (Harvey, 2003; Rugumamu, 2005), the sub-spaces situated at the lower echelons are always dependent on those at the higher echelons (Abu-Lughod & Hay, 1977). There are, therefore, hierarchies of spaces and of systems. Since in each system there is a combination of variables from different eras and scales, each system transmits differently-dated elements. However, the receiving sub-spaces are themselves selective. All the modern variables are not received everywhere at the same time and all the received variables are not necessarily of the same generation. Here lies the foundation not only of the differentiation of biophysical landscapes on the globe but also of the behaviour of dependent human activity sub-spaces, their ability to transact business, their reach in spatial interactions and also their individuality on the earth's surface (Walden, 2002; Pelling & Wisner, 2009).

7.0 Conclusions

The temporal dimensions and spatial systems approach has contributed five basic findings to geographical knowledge. First, because the world had not yet developed any dominant epicentre of socio-economic system, the earliest human civilisations that emerged were independent of one another and they were separated by great physical distances. Transformations and changes in each of the identified six hearths of development were governed by drivers that were based on specific societies. None of the six earliest civilisations dominated the others, and societies in different continents of the earth were at peace with themselves (Hassan *et al.*, 2005).

Secondly, the modernisation of international commerce in the period between the 15th century and the 1920s formed the foundation for the creation of the first epicentre of the world socio-economic system. The large capacity for transportation and commerce associated with this period replaced agriculture as the essential variable of the world socio-economic system. It was not by chance that the epicentre of the world socio-economic system rested on Spain and Portugal. South-Western Europe expanded its economic reach to the Americas during this period. The cultivation of sugar cane and tobacco in Latin America and the transportation of the outputs to Western Europe were borne from the needs of international commerce during the second period. Land use in the large parts of Latin America was dictated by the needs of the Iberian Peninsula.

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Thirdly, artisan manufacturing for production of commodities aimed at national consumption was the trademark of the third period. This activity organised itself especially around the North Sea and the Baltic Sea and these two geographical areas became the new epicentre of socio-economic activity during the 1620s and the 1750s. Not much widespread transformation of the economies of the peripheral countries was associated with this period.

Fourthly, industrialisation and capitalism during the fourth period became synonymous and the period was named the industrial revolution period. England became the greatest power of the period because she possessed then a more advanced technology which allowed a greater accumulation of capital from within and abroad. In order to participate in the new industrial system, the other European countries were obliged to procure colonies abroad based on the law of the strong. The rise of ranching in Argentina, Uruguay, Brazil, Australia and New Zealand and the encouragement for production of staples in Canada, Africa and Asia were a response to the needs of industry during the fourth period. Britain, France and Germany became the new epicentre of socio-economic system in the world and the colonies became the periphery of the world socio-economic system (Joerg, 1922; John, 1988). The economies of the colonies were, in each case, effectively integrated in the economies of the coloniser countries.

Fifthly, the period after 1945 was called the era of imperialism (Arrighi, 1999). The era of imperialism distinguished itself clearly from the preceding ones in that individually owned manufacturing industry was quickly replaced by multinational corporations and technology became the autonomous factor of the period in place of industry itself. External forces transmitted from the major epicentre of the world economy (the USA), like air transportation, long distance communications, advertising, new means of control of economic mechanisms, possibilities of concentration of information, new monetary techniques, the revolution in consumption which rests on the supports themselves and the conditions of spatial re-organisation in the world, experienced renewed kinds of support. Through the intermediaries of communications, the period impacted on all humanity and in all parts of the earth (Rugumamu, 2005). Spaces which escaped the influences of the preceding periods were all brought in the sphere of influence of globalisation (Harvey, 2003). The new techniques of processing and exploiting innovations brought about the possibility of geographical dissociation of activities. To this phenomenon were added many others: new forms of the internationalisation of the division of labour, creation of footloose economic activities which located in the peripheral economies to exploit underpaid labour, and creation of the semi-peripheries (Banyikwa, 2004). The current technological period is thus characterised by multinational corporations which have over time shared the world among them and called the world 'The Global Village' (Harvey, 2003; Rugumamu, 2005).

Overall, one may conclude that a geographical study that imbibes the temporal dimensions and spatial systems approach will be capable of explaining the spatial shifts in epicentres of world socio-economic domination, the history, drivers and patterns of modernisation, the distribution of types of natural resource exploitation and forms of organisations under different temporal dimensions, drivers of

urbanisation over time and associated pervasive spatial patterns, and the difficulties encountered in articulation of disengagement and transformation in the ex-colonial countries. The temporal dimensions and spatial systems approach is very resourceful and it should be embraced by physical and human geographers in instruction and in research at universities in Africa.

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