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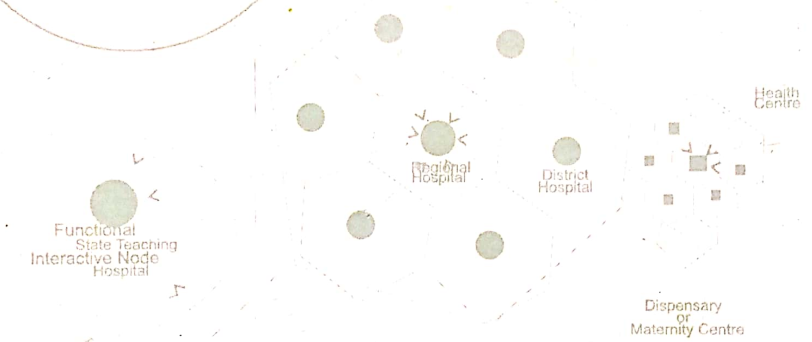
CONTEMPORARY CONCEPTS IN PHYSICAL PLANNING



EDITED BY

LAYI EGUNJOBI

VOLUME II

Compliments of the editor to
Mr. O.O. Idowu

26/09/16/

CONTEMPORARY CONCEPTS IN PHYSICAL PLANNING

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Volume II

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Preface

This is Volume II of *Contemporary Concepts in Physical Planning*. It is a follow-up to Volume I, which was introduced to the global academic cum professional market in 2015. As a pleasant appetizer to the present volume, it has presented an image of resounding success through acceptance inferred from the large volume of sales within a period of only one year. The motivation, as presented in respect of volume one, is contribution to advancement in urban and regional planning (URP) knowledge and practice. Enrichment in critical thinking, conceptualization and creativity has constituted our broad objective. Specifically, the objective is coming up with a list of concepts; defining those concepts in terms of origin, historical and philosophical development; and relating the concepts to urban and regional planning theory and practice.

The methodology adopted for the production of the book was a process of compiling over time, a list of the concepts through literature search, observation, attendance at conferences and consultations. This was followed by identifying potential authors by such variables as academic/professional qualifications, experience, competence in conceptualization, communication skill and time management. Indications of willingness to participate were followed by guidelines spelling out the authors' responsibilities and the publishers' obligations, especially in review, printing and funding. The outcome of this process, building on the 2015 experience, is volume two of *Contemporary Concepts in Physical Planning (CCPP)*. One special feature in this new volume is the colour of the book's cover page, which is off-white and deep green (the colours of volume one are gold and coffee). This is to make the two volumes easily distinguishable on a bookshelf.

Volume II of *CCPP* is made up of 51 chapters put together in 1077 pages by a total of 76 single and joint authors. The chapters, as in the first volume, are arranged alphabetically. They are made up of concepts that are regarded as directly related to URP, such as 'community', 'development', 'location' and 'region,' but now presented with new insights and ideas. There are also concepts such as 'ecology', 'vulnerability', 'crime', and 'matrix,' that would not have been seen as directly related to URP, but now convincingly presented as relevant to and, therefore, closely related to URP. Lastly, there are a set of concepts which hitherto would not have been thought of as relevant to URP, but have now entered into the purview of URP. These include 'exclusion', 'inclusion', 'values' and 'leadership'.

The essential value of this volume, as also stated in first volume, is that it cuts across the whole spectrum of the various categories of town planners or urban/regional planners. That is to say that the book is of value to planning students, planning educators, those planners in practice as well as those in the public sector. However, we have, in this volume included another category of planners: these are the emerging crop of 'entrepreneur planners'. (See, Egunjobi Layi, Zubairu Mustapha and Gunn Ezekiel (editors), 2016, *Entrepreneurial Opportunities in Urban and Regional Planning Practice*. Abuja: Town Planners Registration Council of Nigeria – TOPREC; 218 pages). In general, the book is about familiarity with the changing world much as the changes relate to URP. For instance, changes in technology are reflected in 'planning on the moon,' planning the artificial islands and coping with traffic situations involving the selfdriven and, even, flying cars.

Emerging from this book project is the fact that the concepts that are relevant to the theory and practice of URP are legion. This in itself is a reflection of the nature of URP, as embracing almost all conceivable aspects of human life, and all its supporting elements. It also confirms the general assertion that there can be no end to the pursuance of knowledge, even in a narrow segment.

The measure of success attributable to this endeavour was due to the collaborative and cooperative efforts of the 76 authors, whose names and brief profiles have been highlighted in the table of contents and authors' profiles; the reviewers, who are mandatorily anonymous; and Dr. Adesina Sunday of the Department of English, University of Ibadan, who was consulted for language editing. Others were Tpl. Olusegun Falola, Miss Oluwafisayo Abiodun and Mr. Ola Olaniyan, who, since the conception of the idea of this publication, constituted a formidable team working on the logistics and technical areas of production. Tpl. Ademola Adebayo, who had the responsibility of designing the cover page, and Mr. Paul Gbolagade Falodun, the master printer, closely worked with the technical team and the editor. The publisher, the Department of Urban and Regional Planning of the University of Ibadan, currently being led by Dr. Olusiyi Ipingbemi, supported our efforts towards advancement in knowledge and professionalism.

Professor Layi Egunjobi
5th July, 2016.

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MATRIX

J. F. Olorunfemi, O. O. Idowu and S. O. Medayese

32.1 Introduction

A matrix is basically an organized box (or "array") of numbers or other expressions. It is simply a rectangular array of numbers or expressions. In a general sense, it represents a collection of information stored or arranged in an orderly fashion. The mathematical concept of a matrix refers to a set of numbers, variables or functions ordered in rows and columns. Such a set then can be defined as a distinct entity, and it can be manipulated as a whole according to some basic mathematical rules (Abdi and Williams, 2010). According to *Cambridge Advanced Learner's Dictionary* 3rd Edition (2008), a matrix is a specialized group of numbers or other symbols arranged in a rectangle, which can be used together as a single unit to solve particular mathematical problems.

The applications of matrix have been widely explored to solve mathematical, algebra and computer puzzles. *Cambridge Advanced Learner's Dictionary* (3rd Edition) also defines a matrix as a development process that influences development. For example, it is a condition which provides a system in which something grows or develops. In line with this, the application of a matrix as a problem-solving mechanism cuts across other ways of life, including human geography, urban planning, design and development.

The application of matrix to human geography, urban planning, design and development is useful in describing a controlled environment or situation in which the people live and behave in ways that conform to the roles and functions that are predetermined by the professionals or the experts in urban planning or human interaction about this environment. The living within the environment (matrix) may also be referred to as "on the grid", with greater flexibility and choices available to those who venture off-the-grid. For instance, anyone living in the area has the right or freedom to opt out of the environment to any area of his choice as the situation warrants. The concentric model of city structure, as explained by Burgess (1925), maintains that invasion and succession process is the main transformation factor of urban structure. This analogy is best in describing the practicability of matrix, as urban population changes within the urban space.

The concept, elements, and principles of matrix have been considered relevant in explaining changing urban phenomena. Importantly, the contemporary issues and concepts in the field of physical planning have explored the philosophy of the matrix as a problem-solving mechanism, for economic, social, political, and physical inadequacies.

32.2 Literature Review

32.2.1 Meaning and Definitions

According to Wikipedia (2016), matrix is a rectangular array of numbers or other mathematical objects for which operations such as addition and multiplication are defined. Most commonly, a matrix over a field f is a rectangular array of scalars each of which is a member of F. This chapter focuses on the complexity of matrix and its applications in physical planning profession and education. The numbers, symbols or expressions in the matrix are called its entries or its elements. The horizontal and vertical lines of entries in a matrix are called rows and columns, respectively, just as the city structure are arranged in both vertical and horizontal arrays, as seen in Table 32.1.

Table 32.1: Size and Description of Matrix

Name	Size	Description
Row vector	$1 \times n$	A matrix with one row, sometimes used to represent a vector
Column vector	$n \times 1$	A matrix with one column, sometimes used to represent a vector
A square matrix	$n \times n$	A matrix with the same number of rows and columns sometimes used to represent a linear transformation of a vector space to itself, such as reflection, rotation, or shearing

Source: Wikipedia (2016)

The matrices which have a single row are called *row vectors*, and those which have a single column are called *column vectors*. A matrix which has the same number of rows and columns is called a *square matrix*. A matrix with an infinite number of rows or columns (or both) is called an *infinite matrix*. In some contexts, such as computer algebra programs, it is useful to consider a matrix with no rows or no columns, called an *empty matrix*

(Wikipedia, 2016).

To simplify what matrix signifies from Table 32.1, it is a collection of numbers ordered by rows and columns. The elements are customarily enclosed in parentheses, brackets or braces. A matrix is primarily viewed as a set of numbers arranged in a table (Abdi and Williams, 2010). Gantmacher (1959), among others, claims that a matrix is an array of number in rectangular form. He stresses that the concept of matrix has been applied to the daily activities of man and in other professions, such as mathematics, mechanics, theoretical physics, and theoretical electrical engineering. The relevance of a matrix has also been acknowledged in the field of social sciences and environmental planning and management.

32.2.2 The Basic Concept of Matrix

A matrix comprises rows and columns, which must be arranged in the form of a vector or elements. The transpose of the column vector is the row vector. A vector can be represented in space as a directed line with components along the axes.

$$x_p \times 1 = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_p \end{bmatrix} \quad or \quad x' = [x_1 x_2 \ldots . x_p]$$

The basic concept of a matrix entails that, two vectors can be added together if they have the same dimension and can be contracted or expanded if a vector is multiplied by a constant 'c,' as multiplication is element-wise.

$$\mathrm{x} + \mathrm{y} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_p \end{bmatrix} + \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_p \end{bmatrix} = \begin{bmatrix} x_1 + y_1 \\ x_2 + y_2 \\ \vdots \\ x_p + y_p \end{bmatrix} \quad \textbf{or} \quad c\mathrm{x} = c \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_p \end{bmatrix} = \begin{bmatrix} cx_1 \\ cx_2 \\ \vdots \\ cx_p \end{bmatrix}$$

A better understanding of this procedure and its applications to urban system and physical planning and training will help in solving urban problems. Although the literature and materials harmonizing the need of the subject matter to physical planning is scanty, the flexibility of the components, in a matrix has made it possible to employ it in physical planning practice and training.

32.2.3 Evolution of Matrix

The idea of matrices first arose as a means to solving the problems in systems of linear equations. Such problem dates back to the very earliest recorded instances of mathematical activity (Gunawardena, 2006). The origins of the theory of matrices can be traced to the 18th century, although it was not until the 20th century that it became sufficiently absorbed into the mathematical mainstream to warrant extensive treatment in textbooks and monographs; it is truly a creation of the 19th century (Hawkins, 1974).

The historical background and development of the matrix has been attributed to several scholars (Hawkins, 1974; Gunawardena, 2006; Abdi and Williams, 2010). Many authors argue that, there are different views on the evolution of matrix. However, most authors have now agreed that a matrix is a problem-solving system, as it is being used in all branches of mathematics and the sciences and constitutes the basis of most statistical procedures (Abdi and Williams, 2010).

Hawkins (1974) notes that, when one contemplates on the evolution of matrix theory, the name that immediately comes to mind is that of Arthur Cayley. In 1858, Cayley published a memoir on the theory of matrices in which he introduced the term "matrix" for a square array of numbers and observed that they could be added and multiplied so as to form what we now call a linear associative algebra. Because of this memoir, historians and mathematicians have regarded Cayley as the founder of the theory of matrices. He laid the foundation in his 1858 memoir, and other mathematicians erected the edifice we now call the theory of matrices.

On the contrary, Benzi (2009) identifies some important contributions to the study of matrix, which were earlier than the work of Arthur Cayley in 1858. Benzi attributed the origin of the study of matrix to a scholar known as Gauss in 1823. He admitted that the earliest reference to an iterative approach to solving Ax = b appears to be contained in a letter of Gauss to his student Gerling, dated 26 December 1823, in the context of solving least squares problems via the normal equations. In 1826, Gauss gave a block variant of the method in the supplement to his famous work on least squares, Theoria Combination is Observationum Erroribus Minimis Obnoxiae, an English translation by Pete Stewart was published by SIAM in 1995 (Benzi, 2009). Other scholars identified by the same are Jacobi (1845), Nekrasov (1885), Pizzett (1887), and Nagel (1890).

Regardless of the incoherence and inconsistency in the documentation of the origin and pioneer in this area of knowledge, the concept, theory, principles and philosophy of matrix cannot be underrated in shaping the present world system and preparing the world for the future demand.

32.2.4 Elements and Operations in Matrices

Basically, a matrix is an array or arrangement of numbers in a table for better expression of value and responses. In a matrix, row and column numbers are used to identify a specific element of a matrix. The numbers are called the element of the matrix.

$$A = \begin{bmatrix} 2 & 5 & 10 & 20 \\ 1 & 2 & 3 & 4 \\ 6 & 1 & 3 & 10 \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

For instance, in equation (1), the cell defined by Row 3 and Column 1 contains the value '6'. We write that a 3; 1 = 6. With this notation, elements of a matrix are denoted with the same letter as the matrix but written in lower case italic. The first subscript always gives the row number of the element (i.e., 3) and the second subscript always gives its column number (i.e., 1).

A generic element of a matrix is identified with indices such as *i* and *j*. So, a *i;j* is the element at the *i*-th row and *j*-th column of A. The total number of rows and columns is denoted with the same letters as the indices but in upper-case letters. The matrix A has I rows (here I = 3) and J columns (here J = 4) and it is made of I × J elements a *i;j* (here 3 × 4 = 12). We often use the term 'dimensions' to refer to the number of rows and columns; so, A has dimensions I by J.

As a shortcut, a matrix can be represented by its generic element written in brackets. So, A with I rows and J columns is denoted for either convenience or clarity. The number of rows and columns can also be indicated as a subscript below the matrix name.

$$\mathbf{A} = [a_{i,j}] = \begin{bmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,j} & \cdots & a_{1,J} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,j} & \cdots & a_{2,J} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{i,1} & a_{i,2} & \cdots & a_{i,j} & \cdots & a_{i,J} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{I,1} & a_{I,2} & \cdots & a_{I,j} & \cdots & a_{I,J} \end{bmatrix} \quad \text{.............................. (2)}$$

$$\mathbf{A} = \underset{I \times J}{\mathbf{A}} = [a_{i,j}] \quad \text{.. (3)}$$

The elements via double indices are referred to as follows:

(i) The first index represents the row

(ii) The second index represents the column

(a) Vector of a Matrix

A matrix with one column is called a column vector or simply a vector. Vectors are denoted with bold lower-case letters. For example, the first column of matrix A (of Equation 1) is a column vector.

$$b = \begin{bmatrix} 2 \\ 1 \\ 6 \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Vectors are the building blocks of matrices. For example, A (of Equation 1) is made of four column vectors.

(b) Transposition Operation for Matrices

If we exchange the roles of the rows and the columns of a matrix we transpose it. This operation is called the transposition, and the new matrix is called a transposed matrix. The A transposed is denoted A^T, for instance,

$$\text{if } \mathbf{A} = \underset{3\times4}{\mathbf{A}} = \begin{bmatrix} 2 & 5 & 10 & 20 \\ 1 & 2 & 3 & 4 \\ 6 & 1 & 3 & 10 \end{bmatrix} \text{ then } \mathbf{A}^T = \underset{4\times3}{\mathbf{A}^T} = \begin{bmatrix} 2 & 1 & 6 \\ 5 & 2 & 1 \\ 10 & 3 & 3 \\ 20 & 4 & 10 \end{bmatrix} \quad \ldots\ldots\ldots\ldots (5)$$

(c) Addition of Matrices

When two matrices have the same dimensions, we compute their sum by adding the corresponding elements. For example, with

$$\mathbf{A} = \begin{bmatrix} 2 & 5 & 10 & 20 \\ 1 & 2 & 3 & 4 \\ 6 & 1 & 3 & 10 \end{bmatrix} \text{ and } \mathbf{B} = \begin{bmatrix} 3 & 4 & 5 & 6 \\ 2 & 4 & 6 & 8 \\ 1 & 2 & 3 & 5 \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

we Find

$$\mathbf{A} + \mathbf{B} = \begin{bmatrix} 2+3 & 5+4 & 10+5 & 20+6 \\ 1+2 & 2+4 & 3+6 & 4+8 \\ 6+1 & 1+2 & 3+3 & 10+5 \end{bmatrix} = \begin{bmatrix} 5 & 9 & 15 & 26 \\ 3 & 6 & 9 & 12 \\ 7 & 3 & 6 & 15 \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots (7)$$

In general,

$$\mathbf{A} + \mathbf{B} = \begin{bmatrix} a_{1,1}+b_{1,1} & a_{1,2}+b_{1,2} & \cdots & a_{1,j}+b_{1,j} & \cdots & a_{1,J}+b_{1,J} \\ a_{2,1}+b_{2,1} & a_{2,2}+b_{2,2} & \cdots & a_{2,j}+b_{2,j} & \cdots & a_{2,J}+b_{2,J} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{i,1}+b_{i,1} & a_{i,2}+b_{i,2} & \cdots & a_{i,j}+b_{i,j} & \cdots & a_{i,J}+b_{i,J} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{I,1}+b_{I,1} & a_{I,2}+b_{I,2} & \cdots & a_{I,j}+b_{I,j} & \cdots & a_{I,J}+b_{I,J} \end{bmatrix} \quad \ldots\ldots\ldots\ldots (8)$$

A matrix addition behaves very much like usual addition. Specifically, matrix addition is commutative: (A + B = B + A); and associative: (A + (B + C) = (A + B) + C).

(d) Multiplication of Matrices

In order to differentiate matrices from the usual numbers, we call the latter scalar numbers or simply scalars. To multiply a matrix by a scalar, multiply each element of the matrix by this scalar, for example:

$$10 \times \mathbf{B} = 10 \times \begin{bmatrix} 3 & 4 & 5 & 6 \\ 2 & 4 & 6 & 8 \\ 1 & 2 & 3 & 5 \end{bmatrix} = \begin{bmatrix} 30 & 40 & 50 & 60 \\ 20 & 40 & 60 & 80 \\ 10 & 20 & 30 & 50 \end{bmatrix} \quad \text{.................................... (9)}$$

(e) Special Matrices

The unit matrix, I, is a square matrix whose only non-zero elements are on the diagonal and are equal to one, for example:

$$\mathbf{I} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad \mathbf{I} = \begin{pmatrix} 1 & 0 & 0 & \dots & 0 & 0 \\ 0 & 1 & 0 & \dots & 0 & 0 \\ 0 & 0 & 1 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & 1 & 0 \\ 0 & 0 & 0 & \dots & 0 & 1 \end{pmatrix} \quad \text{.............................. (10)}$$

All elements of the zero matrix, 0, are equal to zero, for example:

$$0 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}, \quad 0 = \begin{pmatrix} 0 & 0 & 0 & \dots & 0 & 0 \\ 0 & 0 & 0 & \dots & 0 & 0 \\ 0 & 0 & 0 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & 0 & 0 \\ 0 & 0 & 0 & \dots & 0 & 0 \end{pmatrix} \quad \text{.............................. (11)}$$

A diagonal matrix only has non-zero elements on the main diagonal. These non-zero elements that can have any value are square diagonal matrices, as shown below:

$$D = \begin{pmatrix} d_{11} & 0 & 0 \\ 0 & d_{22} & 0 \\ 0 & 0 & d_{33} \end{pmatrix}, \quad D = \begin{pmatrix} d_{11} & 0 & \dots & 0 & 0 \\ 0 & d_{22} & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & d_{n-1,n-1} & 0 \\ 0 & 0 & \dots & 0 & d_{nn} \end{pmatrix} \quad \text{.................... (12)}$$

32.3 Relationship and Relevance to Urban and Regional Planning Practice

Matrix, as a problem-solving mechanism, is described as an 'array of numbers' or other expression. This is simply interpreted as an arrangement, organization, and coordination. Obateru (2005) rightly observes that the physical planning profession is concerned with the organization, design and management of space or land. In relation to this, the content of a matrix has to do with collection of information, processing it and storing the information for relevant uses. In achieving its primary objectives, planning makes use of spatial and non spatial information for predicting the future. According to *Cambridge Advanced Learner Dictionary* (Third Edition) (2008), matrix is simply posited as a process that influences development or a condition which provides a system in which a settlement grows or develops. This points to the relevance of the concept of matrix to the practice and training of urban and regional professionals in Nigeria and in other parts of the world.

Relationship of matrix to urban and regional planning practice is unquantifiable. The scope of planning is believed to entail use of reasoning ability to balance the situation of physical elements based on the information on the ground, or the past events and the future expectation. The definitions of planning encompass things that are relevant to the use of the mechanism in physical planning. For instance, Davidoff and Reiner (1962) claim that planning is a process of determining appropriate future action through a sequence of choices. Faludi (1973) opines that planning is the application of scientific methods to policy making with a view to increasing the validity of the policy concerned with the present and the future of the environment. Robert (1974) argues that planning is the process of making a choice among options that appear open for the future and then securing the implementation, which depends on the allocation of the necessary resources.

Obateru (2004), citing Hall (1962), provides a logical illustration and interpretation of physical planning. He presents planning as coordination that characterizes forecasting the future implications. From the views of these reputable scholars, three major inferences could be drawn, about physical planning, namely that planning is:

i. a sequential procedure in making choices between and implementing the most preferred option by the physical planners;
ii. the involvement of methodological and scientific approaches for data gathering, analysis, and plan presentation; and
iii. making choices for alternative future options.

The profession of planning is prompted by problems; such problems may exist or be anticipated. To practise physical planning requires a medium for its operation. The summation of Keeble (1969) on what planning is all about seems relevant to explaining the relationship of the physical planning profession to the concept and principles of matrices. Keeble defines urban and regional planning as the art and science of ordering the use of land and the character and siting of buildings and communication routes, so as to secure the maximum practicable degree of economy, convenience, function and beauty.

Keeble's definition can be viewed in line with the concept, elements and principles of matrices as highlighted below. These are:

i. the art and science approach involves the reasoning ability of physical planner; the creativity and the use of social and scientific methods in solving the numerous problems facing the urban environment;
ii. the ordering or arrangement of land uses is non-negotiable; a content of array in a matrix;

iii. the other character in physical planning has to do with human activities with the social, economic and political environments, which are jointly attached to the physical environment;

iv. siting of buildings is the arrangement of buildings and the conformity of uses with the environment;

v. communication routes entail leakages and interrelationship of the land uses or accessibility for convenience;

vi. practical degree of economy, convenience, depends on the economic importance of the uses created and the benefits for optimum use of facilities at appreciable measure; and

vii. functional and aesthetically pleasing' relates to the purpose and composition of beauty, which make the environment adorable for healthy living and visual attractiveness.

The four ways by which the concept of a matrix is useful to physical planning practice is as follows:

a. the promotion of accessibility from homes to workplace, shops, schools, as well as source of labour, power and raw materials;

b. the easy employment of resources, so as to achieve the greatest possible measure of improvement on the environment with limited mean;

c. the separation of incompatible land uses from others and the association of compatible or mutually helpful uses; and

d. carrying out of all development in a way which is usually pleasant and practicable.

In Nigeria, the practice of urban planning lies within the organization and administrative machinery of the institutional and regulatory bodies. The Nigerian Institutes of Town Planners (NITP) and the Town Planning Registration Council of Nigeria (TOPREC) are saddled with the responsibility of coordinating the activities of the profession. This principle will be useful in coordinating the goals of the profession as well as preserving the resources of the public who are directly concerned with the use and development of land. The framework for effective service delivery in the physical planning profession is the policy and programme. Application of matrix in physical planning policies will promote quality professionalism. The concepts of a matrix, such as row, column, vector, elements and transpose, are potent rudiments in the formulation of physical planning policies and programmes, for a good design and development of design

32.4 Implications of Matrix for Physical Planning Training

Essentially, the ultimate goal of planning education is to produce sound physical planners that are well equipped as well as technically and professionally sound to meet the current and future urban challenges. To achieve this, the concepts, principles and elements of matrix are vital and applicable in physical planning training. The application of matrix to physical planning training will achieve the following:

a. development of balanced training programme in planning education;
b. encouragement of the development of a sustainable manual for training of physical planners in Nigeria and promoting an adequate arrangement of theoretical work and practical work;
c. a better approach in the development of studio design criteria, for the design courses;
d. ensuring best studio design management and practices, through: strong commitments of both the trainers and the trainee, and promotion of a well structured criteria for grading; and
e. teaching the new trend in urban and regional planning, as well as global best practice.

32.5 Conclusion

The term town planning is used to indicate the arrangement of various components or units of town (Rangwala et al., 2012). Thus, training and development of manpower in the field of town planning helps in making use of the best possible advantages of solving the problems facing human settlements. The applications of the concepts and principles of matrices, to certain extent, is relevant in achieving most of the physical planning objectives.

The use of the term 'matrix' has appeared in certain areas of studies in urban planning, but the scope and usage has been limited. With the exposition in this chapter, matrix can now be employed in physical planning. The application of matrix idea enhance the reasoning capacity of those that are involved in practice and training within the profession.

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