Digital Era Influence on Neighbourhood Planning

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Abstract. New human needs have an impact on settlements planning and spatial organization. These human needs were subjected to new era requirements. The research aims to solve the knowledge gap about determining the change in neighborhood space planning caused by the digital revolution. The neighborhood is represented by smallest planning module (horizontal–vertical) that has services centre allocates about 10 minutes walking from neighborhood boundary which provides social interaction among residents. The digital revolution is defined as set of computer tests models through making a connection between reality and futuristic production. The research analyses the urban spaces that changed from physical to digital manner through the relations between neighborhood planning and digital revolution. Preliminary results demonstrate good performance on a global project tested.

1. Introduction

Neighbourhoods along with digital revolution have been centres of concern for city planning and urban theory. The research shows the relationship between neighborhood and digital revolution through urban spaces and their reflection on digital spaces. The digital revolution is defined as set of computer tests models through making a connection between reality and futuristic production. Previous studies emphasized the planning issues related to spatial organization, digital urban space and relations to physical urban spaces. Those studies on neighborhood and cyber urban space highlighted the importance of physical aspect and cybernetic urban space respectively. Cyber spaces are a set of spaces managed by technical operations that create a virtual urban space with no physical existence. A physical or virtual network of interacting people can achieve that. On the other hand, the physical spaces defined as public spaces, where social interactions are taking place same as the traditional urban space concept. Cybernetic urban spaces represent the need for a spatial concept that reflects physical life needs [1]. The main research question is how to fill the knowledge gap about determining the change in neighborhood space planning caused by the digital revolution. Thus, the research assumes that digital revolution effects cyber and physical neighborhood spatial organization. One of the most important matters is to propose a qualitative method to examine the relationship between neighborhood spatial organization and the
digital revolution to improve the cybernetic space concept in neighborhood that bears both physical and cyber properties. Neighborhood, urban spaces and digital revolution concepts are specified and measured mutual indicators, which derived from the previous studies using the following categories:

1.1. Neighborhood

Neighborhood is a geographically localized community within a larger city, town, suburb or rural area. It also typically involves social communities with considerable face-to-face interaction among members. Wheeler defined it as a basic unit of planning that includes both high rise and low rise residential units served by educational, cultural, and health activities [2]. Manuel implied the importance of the urban context that subjected to social, morphologic, and economic factors with the effect of average age of the residents and sense of place [2]. Aalbers stated that neighborhood could be the maximum walkable distances about 10 minutes between centre and boundary [4]. Moreover, neighborhood is a planning unit that contains urban spaces represented by parks, commercial, commuting streets etc., and the better neighborhood planning, the better life quality will be [5]. Pierson defined neighborhood as an urban setting unit among larger communities, this unit takes different appearances and complexity levels according to social and environmental structures phenomena producing an intersecting boundaries networks [6]. Neighborhood is a small geographical existence contains social relations between residents, mutual activities or organizations and context properties [7]. As we can see, neighborhood is a small planning unit constructed from residential units (high and low rise buildings) and have urban spaces such as (parks, commercial activities, and commuting streets). Also neighborhood fosters social connections between residents through enhancing the quality of life and providing walkable setting about 10 minutes between the centre and the boundary.

1.2. Urban Space

According to the United Nations program for human settlements and sustainable urban development (UN-Habitat), the urban spaces are defined as a set of nodes within higher residential density development that serves near walking distances [8]. Furthermore, it is known as a set of city spaces with various forms affected by social interaction along history [9]. Mangold showed that the urban space is an abstract continuous space differs from place in which reflects types, applications and social practices [10]. Urban spaces can be classified in to types: (i) physical and (ii) cyber spaces.

1.3. Spatial organization of neighborhood

The change of urban setting and the new human needs are related to new neighbourhood planning such as the need to create car streets within traditional fabric in order to fulfil the new era requirements. Then, neighbourhood is divided into four divisions called residential groups. These residential groups are served by a centre that contains daily life, for example, retail shops, elementary school, healthcare, police station, open spaces. The distance between the centre of neighbourhood and boundary is about (250-300) meters. Social impact is the main factor that lead to neighbourhood planning in order to enhance the social interaction and increase service efficiency. Traditional planning represents a good example as a reference to encourage social interaction and walking experience within neighbourhoods that have hierarchy of circulation [11].

Yassen in his study showed the importance of creating appropriate neighbourhoods on the level of Arab countries. He specified principles that are related to neighbourhood planning which are local and global. Local principles include (compact urban fabric, mixed land use, multiple transportation options, cultural and environmental interaction), while global principles include (integration with city master plan, functional activities zoning, visual variety and prohibition of visual pollution). Neighbourhood centre includes highest densities that encourages social interaction and provides daily life activities. It gains its importance from the relationship to other parts of neighbourhood [12]. It is important to address neighbourhood area limits as a planning unit to include walkable streets and public transportation rather than car based circulation and mixed land use. Previous literature that showed varied aspects including
(morphological phases along history, local ordinances, planning issues and sustainability). (Services centre, social interaction, and compactness, mixed land use, walkable streets and accessibility) represent the mutual indicators, which derived from the previous studies.

1.4. Spatial organization of neighborhood
The digital revolution is the shift from mechanical and analogue electronic technology to digital electronics which began in the latter half of the 20th century. The digital revolution of late years has greatly transformed people's lives and businesses by enabling unprecedented organizational and networking capabilities with significant results for work processes and daily life [14]. Digital revolution is an influential wave that affected cities in a cause and effect relationship the way that any change in communication technologies will effect city development [15]. Cindio defined digital revolution as a set of technologies that build what is called augmented city which contains physical and virtual spaces are related to each other [16]. Moreover, digital revolution in architecture can be known as the tool that opens the way to a newer visions and constructions [17]. To sum up, the digital revolution is a set of communication technologies related to the development of computers that control city development and neighborhood, which has physical and virtual existence. Based on all mentioned above, the research problem can be depicted as the knowledge gab about determining the change in neighborhood space planning caused by the digital revolution. Accordingly, the research points to consider the relationship between neighborhood spatial organization and the digital revolution to improve the cybernetic space concept in neighborhood that bears both physical and cyber properties.

2. Methodology
In order to fill the gap about neighbourhoods, the research will study cities equipped with digital existence where cyber spaces reflect physical spaces and vice versa. The research adopted two projects (pilot study of two cities) involved in digital development, as it includes the physical and digital aspects, and examining of the extent of the achievement of the previously proposed indicators. Amsterdam and Kyoto Digital City represent the virtual reality of Amsterdam and the Japanese city of Kyoto, which represents a cultural and historical centre. The selected projects distinguished from other digital cities by including the two and three-dimensional sides of a city of physical existence in all activities (street networks, shopping centres, historical heritage...etc.). In order to allow the user to interact with the virtual environment and to add the social interaction between residents as shown in Figure 1 and Figure 2.

![Figure 1. Kyoto digital city.](image)
The research aims to study the relationship between neighbourhood spatial organization and the digital revolution to improve the cybernetic space concept in neighbourhood with the relationship to the city to support both physical and cyber properties. Furthermore, to demonstrate indicators extracted from previous studies. The spatial organization indicators represented by (centre, accessibility, walkability, mixed use, compact design, social interaction), while digital urban space indicators represented by (social interaction, accessibility, digital development, hierarchy, privacy). Mutual indicators will be demonstrated in the following items.

2.1. Accessibility
Accessibility according to physical dimension can be defined as the ability of people to access a certain point or place. It is a spatial term that considers all influences during circulation to access available resources [21]. Accessibility can be defined conceptually by constructing a property or feature of converging spaces so that all of users can test and evaluate space. The converging spaces comprise all the spaces of the urban system, and the conceptual dimension branches out into structural and functional elements. In terms of the structural elements, it includes the spatial distribution of people and opportunities and distribution of electronic communication networks. As for the elements of the function, it includes the diversity of user characteristics such as preference for their time, their resources and more. All elements are related to space, time, and available technologies [22]. Digital accessibility is determining the locations of the physical and logical components of virtual space within space. Physical, such as identifying internet hubs and host domain and domain name. The accessibility indicator can be measured physically by measuring the dimensions between the nodes that represent the residential centre.

2.2. Walkability
Physical pedestrian spaces are measured by the maximum distance of the pedestrian walking distance, and are linked to the sides [23]. In terms of health, environment and economics, about 10 minutes or 500 m. As for digital pedestrian spaces, they represent electronic applications in the mobile computer devices or smart phone devices that calculate walking degrees in each space or axis of people [24]. In addition to obtaining Correlational values for axes in a program Space depth (UCL Depthmap).

2.3. Mixed use
A financially and functionally integrated development for three or more productive uses that fall within the scheme. Coherent and planned use of residential with commercial and service use. Mixed use is represented by calculating the ratio of the residential area to the other uses in the residential community. The mixed use is at maximum value when the two areas are equal, which is value of 1 [25].
2.4. Compact Design
It is the design resulting from the integrated development. That is, the development which organized around a specific centre with medium to high density. Also, includes a coordinated use and accessibility with open public spaces [26]. The solidarity in the neighbourhood centre can be measured through calculating the area and perimeter of the neighbourhood and the value is vary from (1-7).

2.5. Hierarchy
It consists of six types of circulation paths that reflect the topography of the location (main roads, secondary roads, highways, service streets, internal streets, pedestrian roads). The gradient of the road networks in the residential camp is related to the flow of movement. The movement within the campus from the service centre to the residential compound, where the whole number of roads is interconnected by the digital centre [27]. The urban area relative to the external border is the global integration plan. Global integration is represented by the space depth diagram and the relative depth ratio of any space linking two nodes is calculated. The (UCL Depthmap) program will be adopted to measure this indicator. As for the digital hierarchy, it is measured by tracking the hierarchical digital networks and its relations to physical urban spaces [28].

2.6. Privacy
The privacy concept related to preventing crime in neighbourhood. As well as achieving comfort and freedom for the residents of the residential compound, where the spatial urban system ranges from public spaces to private and semi-private spaces that keeps residents eyes on the street and restrict strangers. The visual connection between semi-private spaces in residential buildings including (central courtyards, vertical movement, etc.) with public spaces generates a form of control in addition to road signs and elements of external spaces that deviate from a form of privacy in the residential compound [29]. The privacy indicator is similar to the hierarchy in terms of physical and digital aspects that allow control over the physical and digital spaces. However, it emphasizes on the separation between public and private spaces [30].

3. Results and Discussion
3.1. Accessibility
The results of the accessibility indicator of physical access varied between the residential neighbourhoods of Kyoto, with a maximum value of about 18,766 km/min. The districts were equal in all values (percentage of ownership of the car), however; it varied in areas and the maximum distance to reach. In addition to the time taken, based on private transportation, is less based on public transport due to the limited public transport to the external borders and specific areas that mainly depends on the private transportation. As for digital accessibility, it reached the value of about 76,478 people / hour in the neighbourhood. Amsterdam city accessibility value is 53 km/min while digital accessibility value is 761.15 people / hour.

3.2. Walkability
The results showed that the maximum distances of a path from the services are supportive to the vehicle movement. As well as, the relational values in the main axes that share the pedestrian traffic and the driving is more than the other interconnectedness of use. Kyoto walkability values are (17-30) minutes related to distances about (1-2) km and connectivity values are shown in Figure 3. In terms of digital city, it supports virtual roaming in pedestrian spaces through the three-dimensional feature as shown in Figure 4 and the internet speed in Japan is (17.11) MPs.
Amsterdam city walkability values are (6-35) minutes related to distances (4.20-12.47) km and connectivity values are shown in Figure 5. Internet speed in Netherlands is (17.90) MPs.
3.3. Mixed Use
The results showed that the value of mixed use for both (physical and digital), represented by the residential use ratio in relation to other uses, is about 0.872 which is close to the value of 1. That is, the neighbourhood supports mixed use without isolating between uses. Kyoto mixed use value is (0.87) while Amsterdam mixed land use value is (0.81).

3.4. Compact Design
The value of the compact design (for both physical and digital) is about of 4.50, which means that the neighbourhood achieve the compact design within the values (1-7). Amsterdam compact design value is (6.24).

3.5. Hierarchy
The results showed that the main axes in Kyoto included higher values of integration about (2.47 -1.92) and less of an integral range (1.68 -0.65) indicating the existence of a clear hierarchy that starts from the part that contains commercial uses towards the residential area. Hierarchy starts also from the vehicle axes towards the pedestrian axes. See the Figure 6.

![Figure 6. Kyoto city (Global integration values).](image)

Amsterdam lower integration values are (0.76-0.90) and higher values are (1.51-1.71) which indicates the dependency on public transportation that connect city boundaries with the centres as shown in Figure 7.

![Figure 7. Amsterdam city (Global integration values).](image)
3.6. Privacy
The results showed that the genotype of Kyoto city is an integral heart that forms a tree-like pattern that connects the centre with the outside and leaves, across the city, two large areas of isolated spaces that cannot be accessed by the stranger. As for the isolation cores, they were associated with residential and clustered use, which corresponds to the movement of residents, as shown in Figure 8.

![Figure 8. Kyoto integration and isolation cores](image)

Amsterdam city genotype represents a wheel-like pattern, where the center is connected to the boundary and the higher integrated paths are located on the boundary. Figure 9. shows integration and isolation cores.

![Figure 9. Amsterdam integration and isolation cores.](image)

4. Conclusions
Spatial organization of neighborhood is subject to new era needs, when physical spaces have a cybernetic existence. Several indicators have mutual characteristics. Kyoto city is the example of a city that has multiple transiting choices, services and accessible paths and spaces with the relationship to cybernetic existence. Thus, make it possible to provide users with services and walking through the digital city of Kyoto. Amsterdam on the other hand has sophisticated public transportation means and services that can be controlled through the Amsterdam digital city. The centre of physical neighborhood
is important to be eligible and has main services. Accessibility can be achieved by connecting physical neighborhood services with cyber existence that make it possible by any user to achieve their needs through internet connections.

Walkability is related to people’s preferences in neighbourhoods, by adding an internet service to physical spaces to record user’s actions and translate it to new facilities. Mixed use is important and offer a complete platform when every building have various functions and accessible services. Compact design in physical and cyber neighborhood increases density and take advantage of the land and internet connections by fostering services in the centre of development. Social interaction physically and virtually increased because of social media websites, the same concept can be added to digital city users’ information about their names, addresses and numbers for statistics researches or recording a certain need. The hierarchy provides control over physical and cyber systems when higher authorities of the city restrict certain access, allow others with connection to physical behavior of residents, and provide electronic records. The privacy indicator was linked financially to the use of the land in the residential district, which distinguished two types of uses. A public user, which represents commercial and service. An articulated uses, in which the resident and the stranger participate in the movement.

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