The new core of the city: the community in the context of decentralization and ideal future community space model design

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Abstract. In the process of the previous industrial revolution, the emerging technology of the era has significantly reconstructed the urban structure. As the fourth industrial revolution is underway, a phenomenon called "decentralization" will appear in the coming days. This means that the core of cities will dissolve gradually, while the urban structure will become flat, and the community will be the basic unit of the new spot. During this process, a new type of urban cluster will emerge, promoting the revolution of the urban structure. In the future, flat urban areas will be composed of communities and relevant clusters will be the basic unit. Moreover, this research will propose spatial design guidelines for the "ideal future community" from the perspective of urbanism and multi-objective development systems.

1. Introduction

1.1. Technology is the driving force behind urban development

Although the concept of the "city" appeared in 8000 BC, modern cities mainly came into being after the industrial revolution. This research mainly discusses the development direction of future urban space based on the experience of modern urban development. Overviews of the history of urbanization, technology, and urban development have been closely linked. Two hundred years ago, the steam revolution prompted cities to expand along tracks and railway stations. One hundred years ago, the electrical revolution prompted urban sprawl by private cars and electric transportation systems. Fifty years ago, the third technological revolution, dominated by computer technology, intensified urban sprawl and density, while transportation and communication technology developed. Now, the fourth scientific and technological revolution is on the rise. The new technological revolution based on artificial intelligence, clean energy, blockchain technology, quantum computing technology, virtual reality, and biotechnology will have a great impact on the urban framework. To avoid fancy futuristic imagination, this research defines the "future" as the upcoming 20 years and proposes ideas for future urban space based on current technology trends.
1.2. Motivation

1.2.1 Thinking about the community

Since the concept of a “smart city” has already begun to emerge around the world, various think tanks, research institutes, consulting companies, etc. study how to improve urban life on the basis of different technical topics, such as intelligent transportation, renewable energy, high-speed networks, and the Internet of Things. Moreover, city governments have proposed different strategies in urban planning practice. Some are based on comprehensive development schemes, such as “one New York 2050”, to solve urban problems via resilient methods. Others are based on new district development, such as “Songdo International City, Korea”, which develops a new technology district through urban infrastructure construction. Some based on the new high-tech and wireless urban services, such as "Smart nation, Singapore", improve the quality of city life through the internet and digital technology-led convenience services. However, these two perspectives have limitations. They rarely consider the perspective of our urban life scenario, especially from the community perspective, closely related to civic life. In fact, there are still several projects that try to cut into the future city topic from the perspective of the community. Toronto sidewalks are a global eye-catching project. This project integrates new technologies into urban design and intuitively shapes a dynamic and forward-looking community rather than an abstract future goal and construction plan. It reveals an important perspective on shaping the future city from the community. This research believes that the community will be an important unit of the future city. Thinking from the community perspective can guide future urban spatial forms by meeting the real needs of urban residents.

1.2.2 Thinking about the space

Although the impact of new technology is frequently discussed, its outcome is mainly a specific civic service rather than a special development strategy. Such logic does not respond to the interaction between space and technology. Hence, by indicating the influence relationship between urban space and technology, this article sorts out the relationship of urban space and technological updates and then forms a spatial design guide for coordinating urban development with future technology. While the urban situation is quite different around the world, this article will propose a universal development model in the ideal development trend and situation and establish a flexible multi-objective system. It will provide an evolutionary strategy for urban space in different contexts.

2. New Urban evolution

2.1. Relationships among technology, society, and space: two routes.

Technology can change space directly or simulate the revolution of society, leading to space evolution. Therefore, technology plays an important role in urban physical space, while the urban form is the reflection of technology and society in physical space. Neither the traditional space study nor society study can explain the city transformation and spatial evolution. Society and urban space influence each other. Technology is a powerful force for promoting urban space evolution, and urban space is the reflection of technology and society in the physical dimension. This process can basically be distinguished by two routes. Route 1 is “technology-space”. Technology updates will stimulate the emergence of new urban forms, such as during the steam revolution: trains and related rail transportation techniques led to the birth of the railway station, an urban space that had not previously appeared. Route 2 is from “technology-society-space”. Technology might not change the space directly, but it will promote social transformation and then stimulate the demand for new relevant space. For example, in Asian cities, metro stations usually attract a large number of people and capital. The vitality resource flow shapes the compact urban commercial area around the station with high-rise buildings. In fact, in the actual urban evolution process, these two routes are not operated independently but are intertwined to form diverse urban spaces.
These two routes will still be valid in the future, while some evidence can be found. In the last few years, Online To Offline (O2O) services have soared, changing citizens’ lifestyles significantly in a short time in China. For example, “food delivery service”, which was not common in city life before 2012, became an essential service among Chinese youth because of LBS popularization. O2O affects the layout of the catering industry in the city, breaking the traditional business logic, “set up close to the commercial center”. The new approach to restaurant layout is leaving the center and gathering at the edge. From the report of “Eleme”, the largest food delivery platform in China, delivered service became an important source of restaurant revenue, reaching more than 10% in 2018. Therefore, such restaurants aim to leave the city center to avoid high rental costs. Technology is continuously changing social life and urban space. Although significant urban transformation still has not appeared in recent years, the dependence of urban residents on physical space is declining, while cyberspace is unprecedentedly hot. After new technologies gestate new urban spaces and where these new forms emerge are discussed below.

2.2. The tendency of urban spatial structure: decentralization

Since the three elements of urban revolution, as mentioned above, technology, space, and society, not only interact with each other, they also indicate a similar tendency—decentralization. This means that the center linked with the sector will dissolve, and the connection of each sector will strengthen. In the history of urban development, the city center has always been a double-edged sword, which has both gathering effects and congestion problems. There have been several “centralizations” and “decentralizations” in the history of the development of certain cities. De-urbanization and re-urbanization in American cities are an example. Around 1970, the urbanization rate in the United States reached 70%, but the problem of urban center decline caused by crowding was also very serious. At that time, due to relatively low-cost motor vehicles, long-term food storage technology (such as refrigerators), new employment opportunities in suburban areas, etc., the residents reduced their dependence on urban centers in daily life, which led to the emergence of counterurbanization. However, in the past decade, with the emergence of extended commuting time and insufficient public service in the suburbs, the city center has increased its public resources through revitalization projects and once again has become active and attractive. Residents and companies are returning to urban centers, especially technology companies that previously preferred to set up industrial parks in the suburbs. This phenomenon is called "re-urbanization." Although counterurbanization has avoided the crowding of the city center, it has not improved the utilization of urban resources, resulting in the inefficient spread of the city. Re-urbanization benefits from the public resources and agglomeration effects of the city center, but it also is plagued by the problem of urban congestion. Whether counterurbanization or re-urbanization, it is a tradeoff between the advantages and burdens of the center. In the future, benefitting from technological innovation, the city will guide the organic dispersion and remote use of resources and reduce the concentration of resources and negative externalities. The functions originally concentrated in the city center were diverted to online or the community to ease the problem of high crowds in the city center. Therefore, the core attraction of the future urban center, public resources and gathering effect will be weakened, showing the overall "decentralization" trend. Decentralization is dynamic feedback from the urban system in regard to technology updates. In the following 20 years, decentralization will present different concrete manifestations in space, society, and technology. It should be noted that urban development is constantly changing; therefore, decentralization has become an important trend in the last two decades of the city.

2.2.1. Space tendency: mixed, groups, and topologization

Network location and fast city traffic extend residents’ perceptions of the city and reshape the city image. Residents can easily find destinations through navigation services and travel by various means of transportation, which can lead to time and space cognitive bias, making the urban image blurred and topological. Moreover, the specific space that was originally concentrated in the city center will be
dispersed to the noncenter urban space or online, and the functional space will begin to be mixed and blurred. As we can see, municipal space has been transferred from the municipal center to online and community centers, shopping space has diverted to the O2O platform, and even the workplace has been changing due to telecommuting or shared offices. This will promote the urban space to become mixed and multipurpose, forming many small and fully equipped groups.

2.2.2. Technology tendency: real time, automation, and stability
One direction of technology development is to reduce artificial control, but the task can be effectively subcontracted to the flat platform, not a control center run by a specific organization. With the gradual maturity of new technologies such as blockchain, artificial intelligence, Internet of Things, and quantum computing, automation and computational power can be greatly improved. Artificial intelligence has complex process computing capabilities and can feedback real-time outcomes. It is not a simple imitation of "human intelligence." Moreover, blockchain technology allows for tasks to effectively decompose subcontracting and ensure information stability and security, thus breaking the central information restrictions.

2.2.3. Society tendency: flexibility, professionalization, and crowdsource
Future social cooperation will become more independent and flexible because of intelligent technology and automation technology, from rigorously assigning tasks to flexibly claiming tasks. Enterprises will focus on a specific file or even an accurate process of the product in industries. The production process will be coordinated by the network and the platform, and vertical management production will be gradually transformed into horizontal subcontract production. A large number of online "platforms", such as Instagram, YouTube, and Facebook, appeared in the past couple of decades and have quickly gained popularity. Their members contribute to the activities of these communities without paying. They have a large workload and many people and even rival the productivity of a country. This kind of production relationship is different from the capitalist free market and communism government management.

Overall, the various changes will comprehensively lead to a significant phenomenon, which is called decentralization. Compared with re-urbanization and counterurbanization, this new tendency changes the urban center area core gravity, public resources, and aggregation effects. As technology progresses, social resources can be organically dispersed into the community, which helps reduce the negative externalities of concentration and bring vitality back to the community. Decentralization is the dynamic feedback of technology updates.

2.3. Urban structure evolution: The community will be the new city core
In the ideal situation, the center of urban areas will gradually dissolve and the community will take place at the core function of the center. The communities will connect with each other, forming clusters. In the past, for the exchange of information and resources, the urban structure was usually spread out with one or more central areas as the core of gravity. To date, the limitation of the urban edge depends on the ability of transportation connected to the urban center. It fundamentally reflects the essence of the city's dependence on the city center. As new technologies change the boundaries of time and space for human interaction, they weaken the gravity of urban centers. The lifestyle highly depended on the city center previously and is divided down into online and offline life. Technology has weakened the effect of urban centers, making them less attractive and gradually diminishing. While the community gradually replaces the functions of the core areas of the city via various facilities, with the original pleasant living environment and intimate atmosphere, people will be attracted to stay in the community. In an extremely ideal situation, the city center will continue to shrink until it disappears completely. The community center firmly attracts the surrounding residents to maintain a dynamic balance and will eventually lead to an infinitely homogeneous city. However, it does not actually develop into a completely homogeneous city.
2.4. Future Urban Unit: Community

In the Chinese context, “community” is the fundamental level of the admonitive system with clear boundaries, while in the Western context, it often refers to a social group or geographical space as a sociological item. This research defines the community as a space area composed of people who share a common goal and live together, and the starting point of future urban evolution will be this community. With the reform of the administrative system, the autonomy of the community will improve. Since the 1980s, the community and its related planning concept have drawn attention. It has become an important entry point for urban planning in the 21st century. The community, as the foundation of urban space, is gradually being developed with greater potential. The urban planning methods in China are mainly land use control from top to bottom by the government. As community awareness increases, there is a strong intention among residents to transform and plan the community. Compared with the top-down urban blueprint, the bottom-up approach will have a more obvious impact in the future. This means that the most relevant urban unit, the community, will play an important role in the future of urban evolution.

In the context of decentralization, urban centers are diminishing, but the community is becoming integrated and independent. The future community is connected closely through unmanned and customized traffic flows, material flows and service flows instead of relying on urban centers. Decentralization will provide complete urban service and relevant places to develop community characteristics. The core area of the community is a public space with community characteristics matching the specific lifestyles of community members. The mode of production is based on new information and communication technology; thus, labor relations are flexible. The community public space will be able to support this new social relationship. Compared with the current situation, which is based on the location of the community, future residents will tend to choose a community that is highly compatible with their personality.

2.4.1. Main body: societies

The spatial form of the community will be determined by the relevant community nature. Societies are composed of a group of people who have a common emotional or psychological sense of identity and lifestyle. They respond to and participate in urban evolution from their individual perspective, shaping the community, from passive users to active creators. These societal activities will make communities free to grow and decay without strict size constraints, similar to metabolism. Regardless of how society changes, the community can provide enough working and living support. Different societies can transform community space according to their needs and habits. In the context of urban decentralization and community rise, the first group of people returning to the community from the city center will emerge. They are creative, possibly with the greatest value in creativity and mental work. They have flexible working hours, are able to work via communication technology and have less demand for their workspace. Therefore, they prefer to choose a place with perfect facilities and a nice environment, so the city center is not necessarily their only choice.
2.4.2. Texture: Community groups
In the future, community groups will form urban textures, while the community will be the fundamental space unit. Communities are connected by various methods. The physical contacts among people will be reduced in the future, and most communication can occur in immersive experience spaces. However, people who still have a strong demand for body contact or need a specific life scene will choose to live nearby and obtain as many opportunities as possible to meet. They will choose customized automatic modes of transport to reach their destination. Information flow and material flow can be smoothly transmitted between each community. The community group will also grow and decay according to the situation of the community, maintaining a dynamic balance. Future community groups do not mean functional segregation but a mixed state in both time and space. Due to the integration of more urban services and various types of functions, the state of the community will become complex, which results in a mixed land and multipurpose space.

3. Future Community Guidelines

3.1. Multi-Objective Systems and Design Guidelines
The development goals of different communities should be diversified. Although the internet and the global economy have synchronized global urban characteristics, different social environments and material conditions determine strong regional differences. To adapt multiple value orientations, future community space design guidelines should provide a multi-objective system with universality and flexibility. It can adjust and weigh the subitem according to the value orientation of different projects. It should balance the development model with practical guidance into the specific project with different situations and requests. First, a fundamental concept in the future community should be considered: “who the user is”. Based on the concepts of "homo urbanites", an abstract urban user is proposed, that is, a resident who rationally pursues the maximization of personal interests, on the premise that physiological and security needs have been met. Based on "homo urbanites", this research provides a framework for a multi-objective system that includes development goals with three basic universalities and corresponding spatial design guidelines.
3.2. Emerging technologies and corresponding spatial impacts

The following table summarizes the impact of new technologies on community space from the technical report. According to the above two impact paths and development goals, these new technologies will be arranged according to their different development goals and various impacts on space. The spatial design guidelines are listed below.

3.3. Space guide design

3.3.1. Connection: to increase the chance of contact between people.
Because contact is an important function of the city, the community space should meet the needs of such contact. As mentioned above, when a large amount of communication breaks through the space boundary by the network, does it mean that physical contact no longer exists? In fact, online communication does have a certain "scenario". Even if the mixed reality can provide a limited field of
the form, and it is not enough to meet all the needs of people for space; thus, contact in physical space is still very important. The future communication scene will have distinctive features to increase the chances of more contact.

a. Community space
According to the characteristics of the community, there are various forms of characteristic space customized, without standard spatial form. For example, extreme sports groups may create extreme sports venues such as climbing towers. The community's characteristic space can not only meet the development needs of the community itself but also attract members of other communities to stimulate the flow of residents in different communities.

![Figure 6. Community space schematic diagram](image)

b. Shared working space
The shared space mainly refers to the place that meets the needs of work and life, which have definite overlap with the community space. Shared working spaces, such as those of WeWork, will be embedded in future communities, providing residents with a place to work. This space can be mixed with the living space through modular construction, or it can be independent within the community to meet more specific space needs. Residents can solve employment problems within the community and reduce the congestion caused by daily work commuting.

![Figure 7. Shared working space schematic diagram](image)

c. Mixed reality space
Mixed real-world space can blur the boundaries between physical space and cyberspace and simulate face-to-face communication scenarios. Although mixed reality technology is limited by the physical form of the space itself, redefining a single attribute of space allows for the space to be used under different scenarios. The living space can become a place for work, and the outdoor space can become an interactive place. Mixed reality technology can make space versatility possible. Remote services such as distance education and telemedicine can all occur in the community through virtual space scenes, improve the quality of life and development of the community, and promote interpersonal contact.
d. Multidimensional mixed space

The spatial utilization of future communities includes flexible management in physical space and time dimensions. The future community will contain a variety of functional spaces, including medical, educational, commercial, office, residential, etc., and will be arranged by smart time management. The future of community building is not a pure residence or a simple combination of the business and residential house, but the building units of different natures are directly combined in one building. The impact of different spaces is monitored through different IoT sensors to ensure that community spaces can be mixed and efficiently used while also avoiding interference.

3.3.2. Efficiency: to minimize travel time

Traffic capacity limits the expansion and efficiency of a city. Therefore, reducing travel time will be an important development goal. In the future, the new drive system communities will improve road use efficiency. The delivery system and innercommunity services will help reduce travel frequency.

a. Real-time interactive road

Future community roads will adapt to automatic unmanned vehicles, with no lane and direction distinctions. The vehicle operates according to a real-time transit control system, supported by sensors and computers. The road space can be very narrow, but two cars can be driving side by side. The hierarchy of roads is no longer strictly distinguished, which means that most roads are of the same size. This will reduce fuel consumption and improve road utilization. Therefore, other road signs for vehicles will also be removed, and only pedestrian and bicycle guide signs will remain. Sidewalks and bicycle lanes will be flexibly transformed according to real-time request interactive means such as display signals, mixed reality, and personal devices. There will be a harbor-style parking space on the roadside for pick-up and deliveries.
b. Multidimensional delivery space

A multidimensional delivery system will be set up in the future. There will be delivery robots on the ground, logistics pipes underground, and transport aircraft above ground. The multidimensional delivery system meets the demand for material resources within the community. It transfers the method of obtaining material from shopping by themselves to receiving them by delivering service. Therefore, a delivery center will appear in the community, connecting the underground delivery pipeline, unmanned ground vehicles (UGVs), and unmanned aerial vehicle (UAVs). Then, packages will be distributed to recipients.

c. Municipal facility space

Public services in the future community will be integrated into the community with high intelligence. By applying smart devices, community public services will enable self-service and remote management. Managers can provide assistance and communication in a remote manner. Residents can enjoy uninterested public services in the community space without relying on specific urban spaces or spending much time commuting.
3.3.3. Sustainability: to increase internal material circulation

a. Modular building unit

Future community life places more emphasis on individual characteristics, and customized modular building units can balance individual needs with architectural space constraints. The building of the future community is composed of various unit modules. After the construction of the building framework, residents can create their own personalized space through 3D printing and other advanced industrial production methods to meet various space needs.

b. Resource recycling space

There will be a relatively complete internal resource recycling system in each community, including the energy cycle and material cycle facility. Each building will be equipped with clean energy power generation equipment and reclaimed water collection equipment to provide part of the daily energy. Resource processing centers, such as energy towers and biological treatment warmhouses, will be built within the community. They will convert waste to energy and fertilizer through biological treatment and purification. At the same time, the energy tower will also integrate the hardware equipment of most community municipal facilities, such as information processing centers, power distribution centers, and logistics distribution centers.
4. Conclusions

While technology is developing at an amazing speed, urban lifestyle is changing constantly, surpassing our expectations. However, the response of urban space to technological development is relatively slow. Currently, some developing countries and regions are experiencing urbanization. Both the development process and the pattern are quite different from historical experience. Therefore, we should rethink the relationship between technology and urban space along two impact paths. In this process, the community is an urban space with great development potential.

1. In the era of new technology explosion, “decentralization” is a representative urban evolution trend. The fourth industrial revolution will have a great impact on urban space evolution. Technology has made the social division of labor flexible. The function of space has become blurred, and online and offline life are intertwined together, shaping the “decentralization” of urban space.

2. The urban center has begun to dissolve, the community unit has become the new core to undertake decentralization, and the urban structure has begun to flatten. The characteristic of “decentralization” is that the city no longer has a strong urban center. The core functions of the city center have been gradually converted into the community. After the urban center is dissolved, the community that absorbs the resource advantage will become the core of the small scope. The new spatial advantages and social characteristics of the future community will cause urban residents to choose to return to the community.

3. In the future, the city will be formed with the community as the main unit and the various societal groups. Residents who choose to return to the community will spontaneously form a new society cluster. The community organization can grow relatively freely, and the characteristic community gathering effect is the main reason, attracting residents to stay and gather. Communities will be connected organically, and the materials and information will be able to be communicated smoothly, forming a flexible community and shaping the texture of the city.

4. Future communities need space design guidelines that are adapted to different goals. According to different city contexts, future communities need to be able to adapt to different target development systems. Among them, “contact, communication and sustainability” are important development goals of a city, which can improve the efficiency and quality of life and meet the development needs of the future city. In actual urban development, it is still necessary to adjust the goal weight and add new goals according to the specific city situation.

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