

Chapter 9 – The Next Form of Human Settlement: A Design for Future Yilong City

Abstract: As what we have described in chapter 1, advances in ICTs (Information and Communication Technologies) and intelligent manufacturing bring changes in daily life and urban space. A series of new technologies that have a disruptive impact on urban form, such as intelligent logistics, VR (Virtual Reality), AR (Augmented Reality), UAV (Unmanned Aerial Vehicle), AI (Artificial Intelligence), and sharing economies, are gradually reshaping our cities. This chapter embraces these emerging technologies and the trend of transitions in cities to create a future human settlement. This chapter reflects the core concept of the third type of Data Augmented Design (DAD). In this chapter, technological changes and trends of thoughts related to urban development in the past three hundred years have been comprehensively summarized to help understand the impact of technologies upon cities. As a result, the important concept and core value of the human settlements are identified and classified. This design concept is applied in the Yilong New District of Guizhou Province, China. Considering its remarkable karst landform with eroded lava, a new agenda for the future human settlement is proposed with five levels of rules - the code (essential future development concept), the background (natural environment), the area (including “living area” and “entertainment area”), the system (cloud computing infrastructure systems, functional systems and settlement systems), and the module (combining mobile module (functional cubes) and the fixed modules (Home, Hub)). It is expected to express the imagination of the future human settlement.

9.1 Introduction

Through reviewing the history of technological inventions that affected the form of human settlement, we gain insight into how upcoming new technologies will dramatically affect the future form of human settlement. As in the past, in the near future, human settlement will move from rural areas to urban areas and then further enter a new form. Moreover, in the era of globalization, the urbanization process is the focus of the next phase of balanced human settlement systems. The “Yilong Futuristic City International Design Competition” was held in 2017 and called for interesting ideas around the world on the futuristic city. This competition was hoped to spur the generation of new ideas on how to build a new modern urban life in a natural background and on the relationships between the local and the global, tradition and the future, the east and the west, the landscape and the city, nature and human habitation, protection and development, imagery and reality, etc.

This chapter, inspired by one awarded work in the competition, discusses the new form of human settlement, including a system that can integrate all the urban functions, the method that can be used to organize the built area, and the ideas that can be used to express a symbiotic relationship between the future city and emerging technologies. To better elaborate the design for Yilong, this chapter is organized as follows: first, through the literature review, the concept and the core value of human settlement are introduced, the critical elements that should be adopted in the further design are identified, and the map of related technologies and the related thought or theories is arranged to identify key inventions that have influenced human settlements. Second, a series of new agendas for design is created to show how the ideas outlined in the previous section are refined. Finally, based on information obtained on the competition website, the new agenda for design is further developed. In addition, we discuss the feasibility of the design for the next form of human settlement.

9.2 Literature Review

9.2.1 The Development of Human Settlements

Due to the rapid development of industrialization and urbanization, the large-scale agglomeration of industry and population, urban environmental pollution, ecological damage and the health of residents are becoming increasingly serious. Determining how to coordinate the relationship with the living environment and economic development has become a prominent problem in the process of human settlement development. At present, the urban human settlement environment is one of the hotspots of architecture, geography, environment, planning and other disciplines (Edward 2011).

Tracking back to the earliest discussion, the concept of “Ekistics” proposed by Constantinos Apostolos Doxiadis (1970) around the 1950s is one of the most well-known and systematic concepts. The word 'ekistics' is derived from the Greek adjective οἰκιστικός, which means "concerning the foundation of a house, a habitation, a city or colony; contributing to the settling". Ekistics concerns the science of human settlements, including regions, cities, community planning and dwelling design (Asher 1969). Ekistics involves every kind of human settlement but pays particular attention to geography, ecology, human psychology, anthropology, culture, politics, and occasionally, aesthetics (Doxiadis 1968).

Cities rely on the advance of related technologies and have become the dominant habitat of human beings. Human settlements have changed substantially. However, while the wave of urbanization is sweeping the world, an increasing number of problems, such as air pollution, water shortages, traffic congestion, and a deterioration in public security, are caused by rapid urbanization. Planners and urban residents are confused and ask the following questions: Can the city as a main settlement support people's simple and grand life ideals? What kind of settlement would be more flexible and sustainable?

9.2.2 Map of the Technologies Influencing the Form of Human Settlement

We reviewed almost all the techniques invented that have had a significant impact on human settlement since the 1700s and observed the evolution of human settlement over the past three centuries (Fig. 9.1). The results show that human beings have developed two typical types of human settlements, rural and urban. The maturity of the construction technology, the use of concrete, the emergence of elevators,

and the popularity of vehicles have been used to make systems, such as the road network system. The height of buildings and construction density differ in rural and urban areas. Naturally, we can foresee that the development of a series of new technologies, such as autonomous vehicles, smart logistics, virtual reality (VR), unmanned aerial vehicles (UAVs), artificial intelligence, and sharing technology, which will have a tremendous impact on the form of human settlement, is rapidly maturing, which will accelerate our progress towards the form of next human settlement. The following is a detailed introduction to several important inventions.

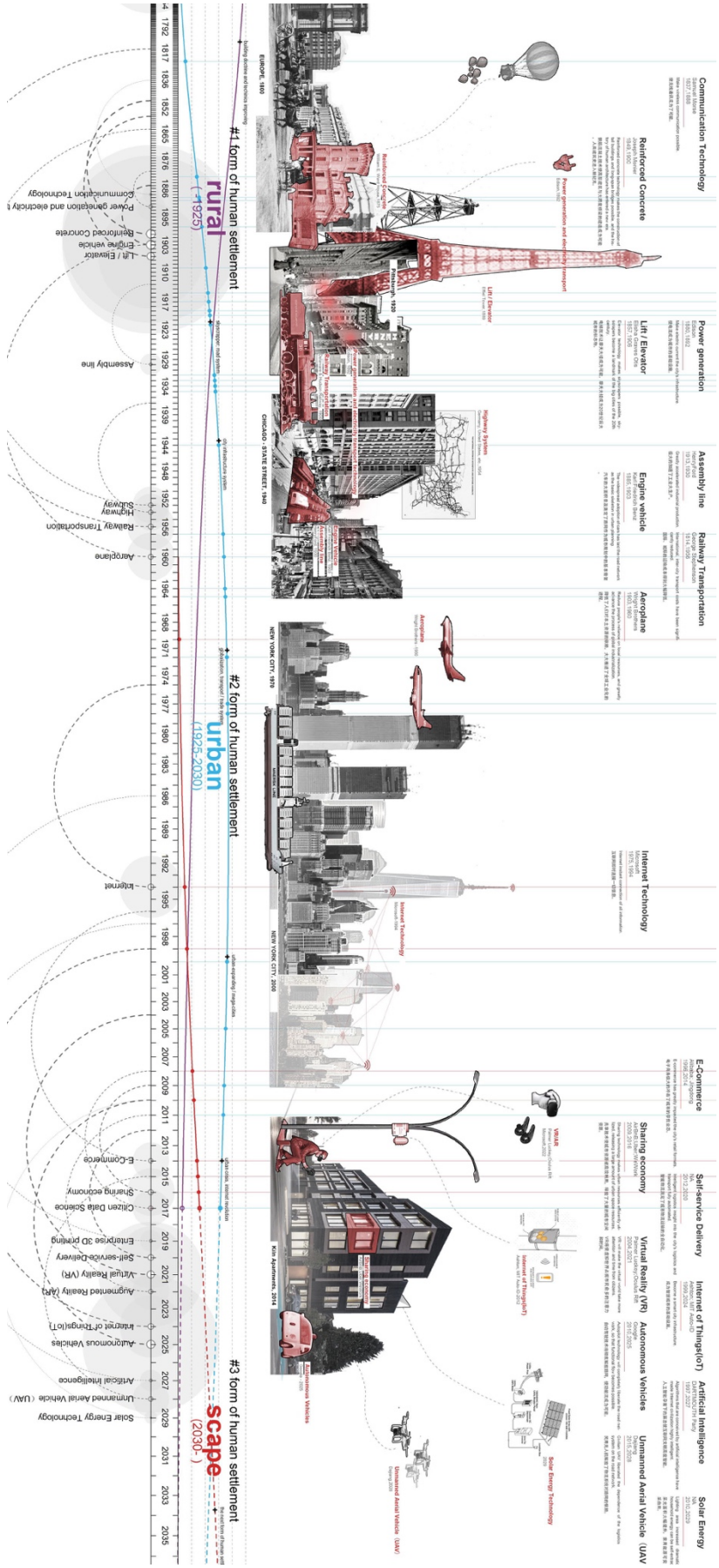


Fig. 9.1 The transformation of human settlements through emerging technologies

Through a review of the essential inventions that have influenced the form of human settlements, it is found that, specifically, the communication technology developed at the end of the 19th century made possible unlimited communication, and human society was able to rapidly expand the settlement environment. The technology of reinforced concrete allowed high-rise buildings and large-span bridges to be constructed and led the history of human architecture into a new era. Power generation and electricity transport technology advanced by Edison in the late 19th century defined the infrastructure of cities. Moreover, lift/elevator technology made skyscrapers possible, and skyscrapers became the symbol of the big cities in the second half of the 20th century. The assembly line devised by Henry Ford in the 20th century greatly accelerated industrial production and changed the places where people work.

The above technologies made horizontal and vertical extensions possible for urban areas. Since the end of the 20th century, the development of the Internet has had various impacts on the form of urban areas. Subsequently, new concepts and technologies, including the sharing economy, smart retail, the Internet of Things, artificial intelligence, etc., have been developing at an expeditious rate and has caused the original urban spaces to be faced with unprecedented challenges. According to the Gartner Hype Cycle for emerging technologies (错误!未找到引用源。), basically, the development of technology has five stages: the innovation trigger, the peak of inflated expectations, the trough of disillusionment, the slope of enlightenment, and finally, plateau productivity. We reviewed inventions that deeply influenced the morphology of the habitat over 300 years based on the concept mentioned above and identified their invention time and mature period of popularization. The results are shown in a “map of technologies affecting human settlement” (错误!未找到引用源。).

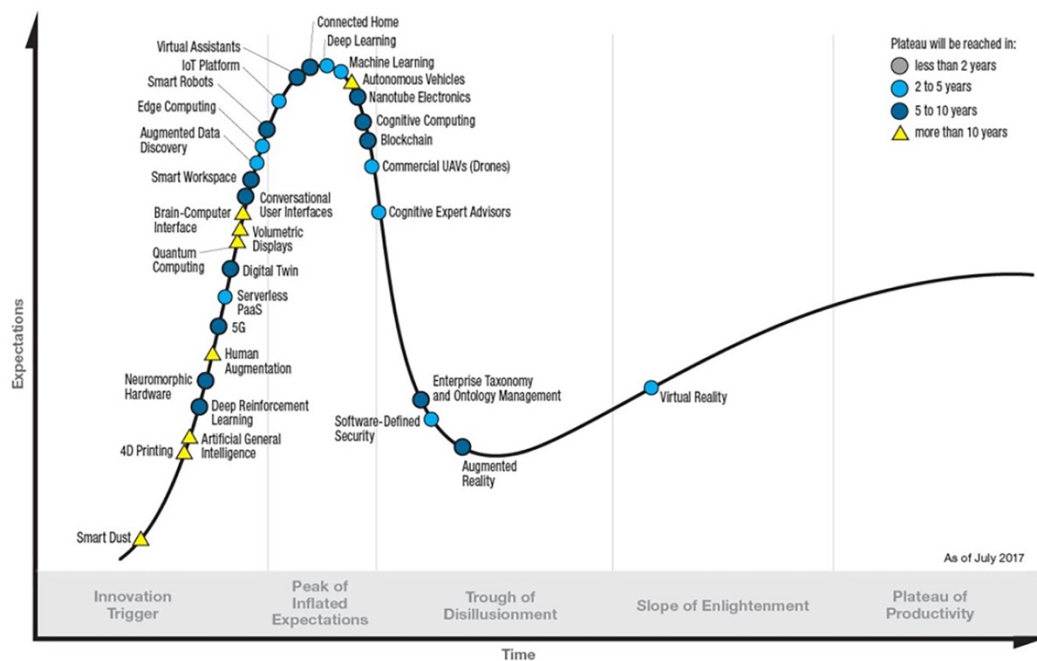


Fig. 9.2 Gartner Hype Cycle for emerging technologies (Source: Gartner, 2017)

9.2.3 Trends of Thoughts, Theories and the Different Forms of Human Settlement

The trend of thoughts about cities has been updated as technology has changed (Fig. 9.4). For example, cities began to become significantly efficient in the early 20th century; therefore, people began to focus on the rules of the new human settlements for the first time. A series of classical concepts, such as a garden city, an industrial city, a linear city, a broadacre city, and a gradient city, was born in that era.

Afterwards, in the 1950-1960s, as the basic form of human settlement was almost fixed, the trend was to praise the successes of cities and to discuss more details concerning the urban morphologies, human design (Jacobs 1961), and even the highly hailed skyscraper (Koolhaas 1978). However, in the past few years, with the increase in Internet development and the intellectual manufacturing revolution, planners and citizens obviously feel that cities lack efficiency and adaptability in terms of Internet access. Negative space, retail withering, and local cultural civilization crises began to occur in cities, which seems to no longer be a sustainable form for further human settlement (Kelly 1995). Many scholars began to focus on sustainable development, low carbon processes, and the relationship between the city and the Internet (Castells and Himanen 2003), and even think about the future urban form. This somehow indicates that the urban form revolution is taking place, and the next human settlement is coming.

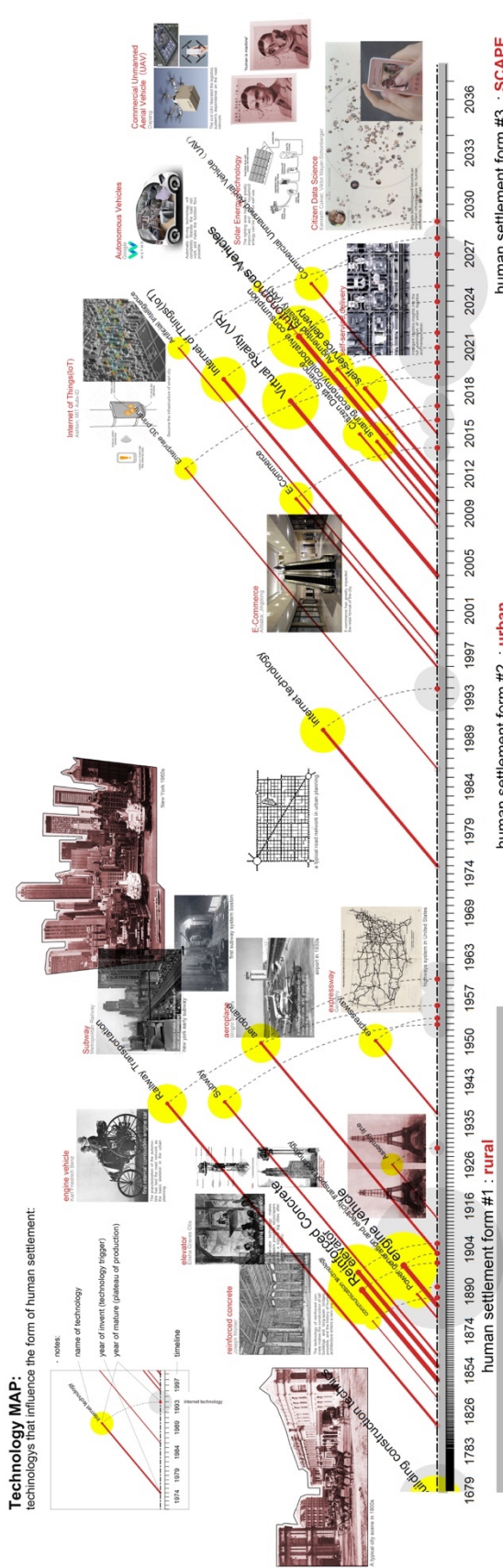


Figure 9.3. Map of technologies affecting human settlement (left)

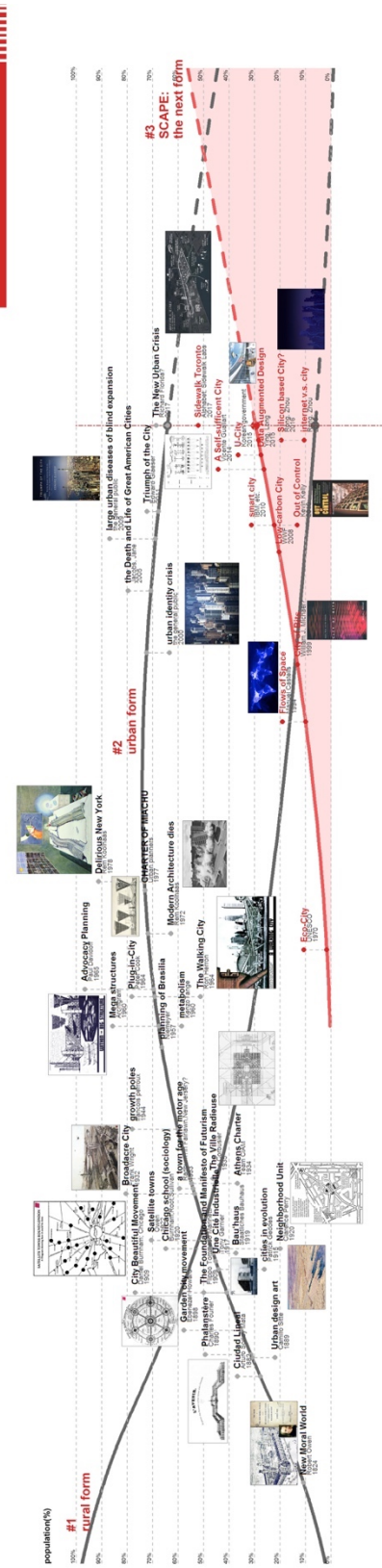


Fig. 9.4 Timeline of theories affecting human settlement (right)

9.3 The Design Framework

9.3.1 Design Site

The site of the competition is the Yilong New District, Guizhou Province, China. Founded in June 2013, Yilong New District is located in the center of Xingyi, Anlong and Xingren counties. It is a commercial distribution center at the junction of the three provinces of Yunnan, Guangxi and Guizhou (Fig. 9.5). There are two provincial-level economic development zones and nine towns with a land area of 1258.5 km² and a planned control area of 236 km². The existing population is 339,600, and the predicted population is 800,000. Yilong New District is positioned as an international ecological smart city and a national new district with an output value of 100 billion yuan. The design site is located in a mountain region of Guizhou Province, China, which is now facing an economic recession. The investment in government construction in the new district, this condition could have a positive effect on the balanced development between the city and countryside. This process will make it possible to develop a sustainable relationship between the natural environment and human society development and the next form of future human settlement.

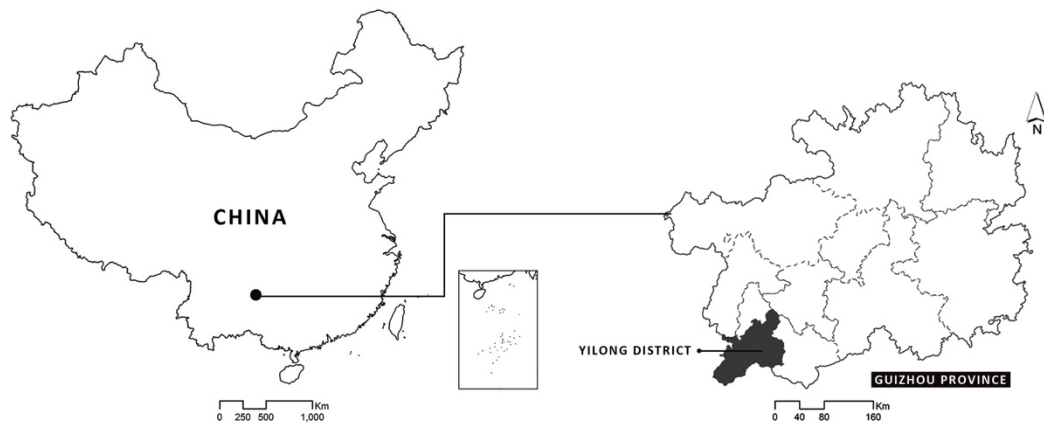


Fig. 9.5 The location of the design site

9.3.2 Design concept

Yilong District is the most promising area in Guizhou, China, and its core area, Qiushui Lake, is facing a revolution in terms of urban design, which also creates an opportunity to build a futuristic city from scratch¹. As the competition calls for interesting ideas for the futuristic city, considering advanced technologies and theories, we envisage that in the future, the human settlement environment will respond to technology, and all functions can be carried out by drones and through unmanned driving. People will no longer need to move a large number of vehicles but will conduct their activities in standardized functional cubes, which are modular, have a variety of functions and directly connect to the person's location. By considering the characteristics of both the region and the environment, a new set of rules for the future of human settlements is proposed. These rules include the code, the background, the area, the system, and the module. This design will reorganize the construction of human settlements through technological innovation, improve the efficiency of urban development, and simultaneously create more sustainable human settlements.

1 Introduction to the Yilong Futuristic City International Design Competition:
http://futuristiccity.uedmagazine.net/en_index.html

9.4 New Agenda for Design

9.4.1 Code

Under the background of the popularization and development of new technology, as well as the debate on the conflict between the protection of the natural environment and the development of human society, it is believed that the next form of the human settlement would be more flexible and intelligent. The following judgments are essential when discussing the future of human settlements:

(1) Autonomous vehicles will evolve into the basic functional unit of future human settlements, and people can conduct most of their everyday lives and working within pedestrian sphere.

As self-driving vehicles begin to transform the way people move around, urban planners around the country are beginning to think about how they will remake cities and change the way we live. Many planners say they see an opportunity to prevent and correct the 20th-century mistakes of the auto's reign: congestion, pollution, sprawl, and roads designed to move vehicles rather than people. At first, the car driver was liberated under the technology of autonomous vehicles, and then people will be in the automatic vehicle conducting other activities such as working, meeting, film-watching, entertainment, catering and so on. Finally, these autonomous "boxes" will be a kind of "functional flow" containing plenty of activities, which could be plug into people's home, drift on the plaza, or even just wander on the road. Based on these trends, people can embed functional streams (business, food, entertainment, clinics, education experts) into their residences. Embracing sophisticated logistics technology (takeaway, e-commerce express) and sophisticated VR technology (meeting, real-time interaction), most people can complete most of their living and working content in a limited space.

(2) Digitally driven virtual and real environments will support the infrastructure of the entire human settlement.

As residential units become the smallest unit of human living, a large amount of space is released in the entire urban system. The entire urban system will become an infrastructure that serves human beings. UAV logistics systems, distributed warehousing systems, autonomous driving functions under cloud control, urban digital infrastructure in the cloud, and distributed energy supply systems will serve as a new infrastructure system for people.

(3) The space of flows becomes one of the key elements of future society.

The space of flows is a high-level cultural abstraction of space and time and their dynamic interactions with digital age society. The concept was created by the sociologist and cybernetic culture theoretician Manuel Castells, which means "reconceptualizing new forms of spatial arrangements under the new technological paradigm", and a new type of space that allows distant synchronous, real-time interaction (Castells, 1989). Castells then defined the specific concepts as follows: "the material arrangements that allow for simultaneity of social practices without territorial contiguity. It is made up first of all of a technological infrastructure of information systems, telecommunications, and transportation lines" (Castells, 2000).

(4) The importance of ecosystems will increase, and ecological experiences will become an important way of life for human beings.

People will be aware of the scarcity and importance of natural ecology. The ecosystem will infiltrate into the living space and become a new skeleton of the habitat. Therefore, people will tend to engage in more experiential activities that could contact the natural environment, such as camping and cycling mountain climbing. These would become one of the most important human leisure modes.

9.4.2 Background

Future human settlements should be able to respect the natural environment and primitive humanities, and the ecological environment outside the scope of human settlements should reduce artificial construction and activities as much as possible. Therefore, the base of the human settlement environment must be considered with the natural environment in a large proportion. Through the preservation of the natural environment, the ecological environment that needs to be preserved is defined, as well as the scope of the living environment, and the encroachment and cracking of the natural environment are reduced (Fig. 9.6). This concept would also help retain more priority for the local ecological landscape, cultural landscape, and historical features to ensure that there is more space to conserve and preserve the unique style and temperament of the field.



Fig. 9.6 The natural environment of the design location as an important background

9.4.3 Area

Due to the development of technologies such as unmanned vehicles, drones, and information communication networks in the future, many previous classification methods and boundaries of functions will gradually become blurred, and the areas of human settlements should be redefined, no longer like existing cities. Settlement areas will be divided into simple residential areas, business areas, commercial areas, etc., but will be based on a more flexible and floating classification. Therefore, this

design proposes a floating area classification based on “function ratio” and “privacy level”. The design is not rigid and fixed but may be subject to changes because the modules can change over time and accommodate various space conditions. People can define the state for a certain time period, and the settlement has three parts: the abovementioned “natural area”, which has been defined as being in the background, and the “living area” and “entertainment area”, which can contain the rest of the construction area (Fig. 9.7). Specifically, if the area needs to be more private, there are modules that can be used for residential services, such as residential, office and other modules, which can be considered as “living areas”. This type of area can be used for various functions, such as general life, a residence, an office and other functions. If there are many public modules, such as leisure and public office modules, the building modules or spatial patterns of this area will be more open, allow for more face-to-face interaction, and be more recreational; therefore, it is defined as an “entertainment area”. The services that can be provided in this area will mainly be entertainment, leisure, catering and other functions.

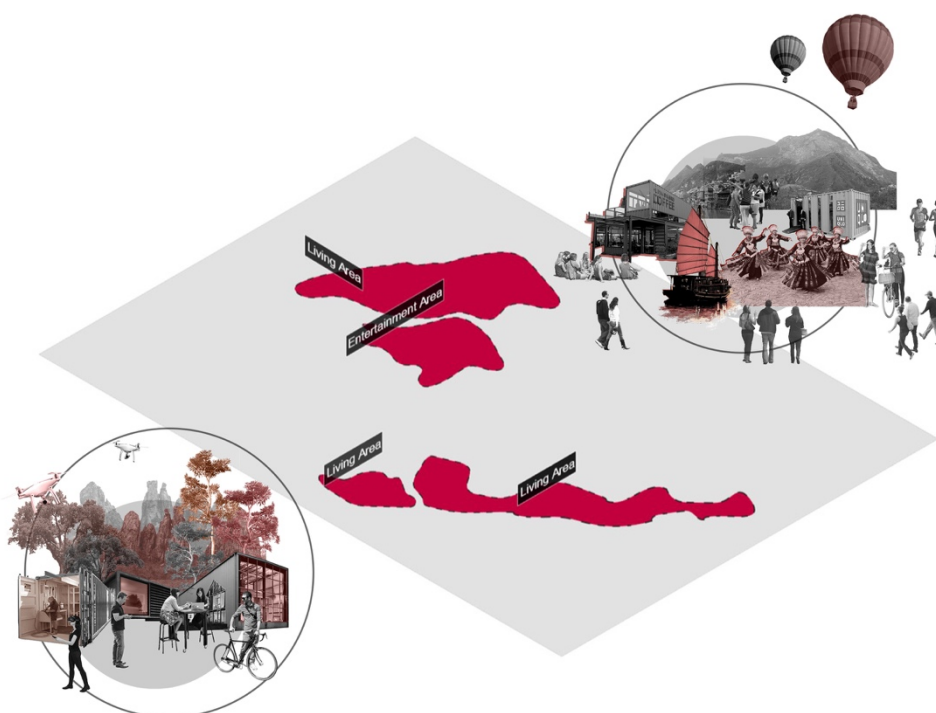


Fig. 9.7 Three types of areas defined by their function ratio and privacy level

9.4.4 System

Due to the development of this design, it is believed that the mobility of urban space in the future will become increasingly obvious, so a system framework is needed to organize the flow space. Therefore, in this new form of human settlement, systems use a formula in which all kinds of modules are embedded, including cloud computing infrastructure systems, functional systems, and settlement systems (Fig. 9.8).

The cloud computing infrastructure system provides the most basic support and improves the living environment through a more efficient use of space that effectively reduces the size of dwellings. The future human settlement will be connected by ubiquitous smart sensors through the Internet to realize a comprehensive perception of the real environment. In this system, intelligent processing technology

is used to process and analyze massive sensing information and discover objective laws, including government affairs, people's livelihood, transportation, and public issues. The intelligent response and decision based on the technology will also support various needs, such as security. In this way, the cloud computing infrastructure system can be regarded as a complex system with multiple applications and multiple industries. This system can implement information interaction and sharing and jointly extract data for comprehensive calculation and present calculation results. To fundamentally support the safe operation of this system, a cloud-based network should be installed in architectures.

The functional system is responsible for arranging and shipping all functional cubes (the detailed idea is discussed in the next section) to ensure that the functional modules of the human environment operate smoothly.

The settlement environment system is established based on the current human society, which can be divided into four layers, namely, community, district, town, and big city. This system is suitable for a better resource allocation system.

These three systems interact with each other in this design. Specifically, the cloud computing infrastructure system supports the operation of the functional flow system, while the functional flow system further defines the hierarchy of the human settlement system.

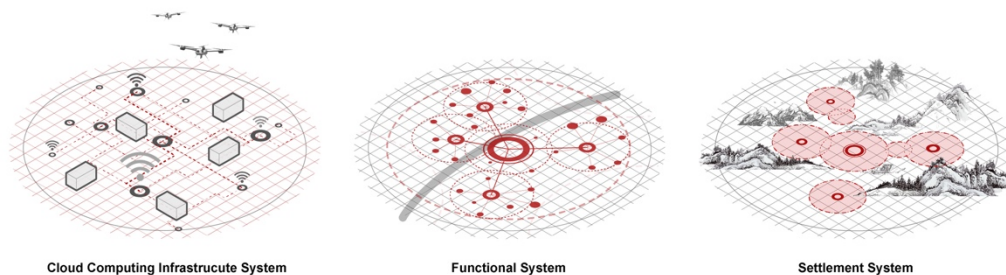


Fig. 9.8 System is a formula for arranging Module, including cloud computing infrastructure system, functional system, and Settlement system

9.4.5 Module

We assume that in the future, the living environment supported by new technologies such as UAVs and IoTs (Internet of things) will be more flexible and humanity. To achieve this, we design two types of modules: the mobile module and the fixed module (Fig. 9.9). Instead of those vehicles we use now, such as cars and trains, mobile modules with various functions would be the main tools that both contain plenty of activities and take people wherever they want to go. A series of standardized and detachable functional cubes are designed to carry these functions. These mobile functional cubes can carry functions required by daily life, such as bedrooms, bathrooms, restaurants, kitchens, etc. and other functions containing leisure activities, such as theaters, cafes, exhibition venues, libraries, etc. The latter type, the fixed module, is actually the collection center of the mobile module, which can be divided into home and hub according to the degree of privacy. Home is a collection center for families and individuals. It is a living type of functional cube that will gather together to form a living space that meets different family units and customers. Hub can be divided into different levels according to the service radius. Generally, smaller community units will correspond to smaller Hubs. Conversely, larger

areas will have larger hubs to serve human society better and more efficiently.

Combining the mobile module (functional cubes) and the fixed modules (Home, Hub), the human settlement environment is flexible to meet the needs of human society, reducing the waste of space resources.

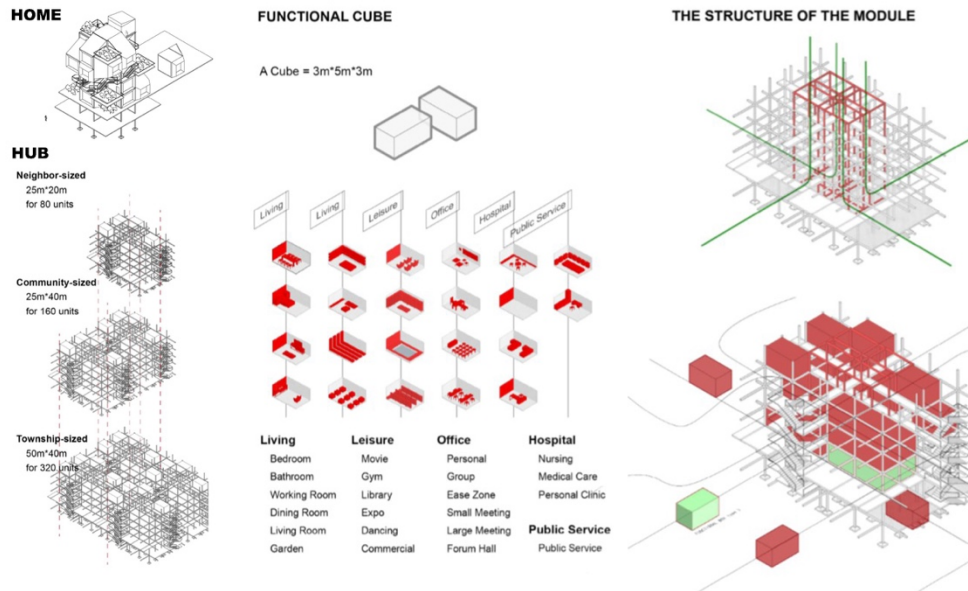


Fig. 9.9. Form, classification and structure of the Modules

9.5 Design in Detail

9.5.1 Design Generation

(1) Characteristics and potential of the site

The Yilong New District is surrounded by the remarkable karst landform, with eroded lava, a humid climate, an eroded landform, and complex groundwater tunnels and is subject to soil erosion and rocky desertification. Due to the increasing development intensity of human beings, construction land expansion is urgently needed. The pressure of cultivated land protection is great, and the contradiction between people and land is particularly prominent. The design site is a typical ecologically sensitive and vulnerable area. The hinterland of the southwest, the mountains and rivers, the coexistence of multiple cultures, and the geographical location of southwestern Yunnan make this area unique when discussing the frontier and inland areas. Today, this area is faced with the change from a closed city that belonged to the agricultural era to a new global era. The original ecological scenery, the localized ethnic customs, and the diversified southwestern area face urban development under the trend of globalization. In summary, Yilong New District is one of the most promising new districts in southern China and provides the opportunity to build a new form of human settlement with sustainable and flexible design to face future challenges in the new era.

(2) Local landscape and future form of human settlement

The mountains and rivers surrounding the Yilong New District have their unique “regional character”

from natural erosion and dissolving limestone, which provides abundant materials to discuss the relationship between the pressure on the preservation of typical agricultural land and the development of urban construction, as well as the ancient landscapes and modern lifestyles. The landscape culture system is once believed to be a network of meanings that Chinese people practice for the traditional space of mountain habitats. The value of contemporary space practice is reflected in the traditional Chinese sense of security, belonging, comfort, pleasure and history based on various means of modern space creation and a series of aesthetic activities, ethical activities and philosophical activities.

(3) Customized module designed for local conditions

As the mountain is a major feature of the Guizhou region, traditional local buildings will “grow” in terms of geographical and hydrological differences, forming a unique geographical and cultural landscape. In this design, we use “sloping roofs” and “modularization” to adopt to the space and deepen the design to form the unique local image of “karst topography” in Guizhou. Specifically, prefabricated buildings will be rationally metabolized and converted according to the different needs of different periods, including the transformation methods of plugin, extract, subtract, etc., and combined with the overhead frame structure (Fig. 9.10). The hollow frame is mainly used to connect functional cubes from different places, allowing each building unit to integrate with the overall living environment system (Fig. 9.11). For example, homes will be constructed using more functional modules, such as rooms, living rooms, and kitchens, and hubs will connect more entertainment modules, such as coworking offices, libraries, and theaters, that will be used by the public. This design is expected to help protect the national culture and environment while meeting the needs of human society.

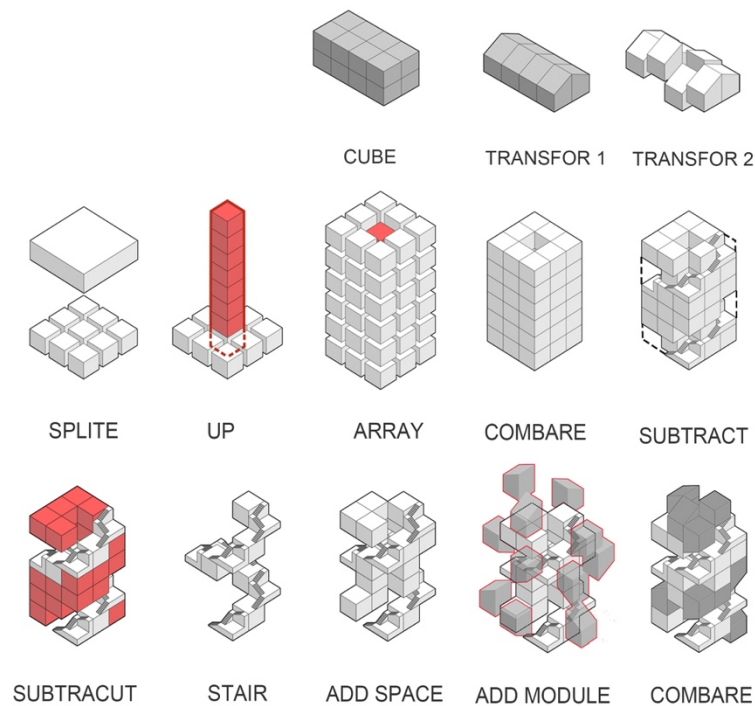


Fig. 9.10 The transformation methods used for the modules

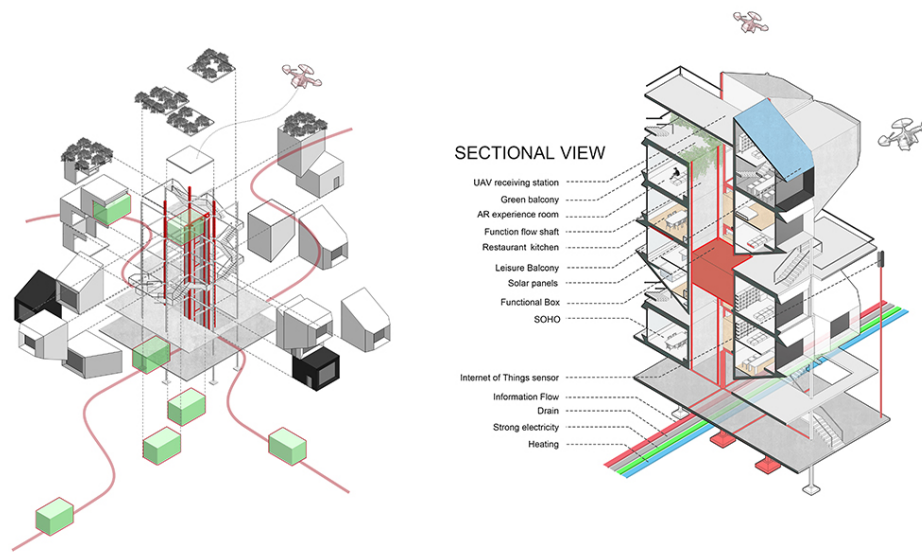


Fig. 9.11 Module combination method and the section of an example

(4) Location decision of the functional system node

The rich terrain characteristics and the lake in the middle make the target site a very pleasant and unique place. This design draws on these features, taking the highway road around the site as the boundary and using a main road throughout the base as the central spine of the area. The different levels of the modules are arranged separately to organize the function flow and operation mode of the whole site. The design considers the environmental characteristics and the existing topography in the selection of three large hubs inside the site, corresponding to the three major areas.

9.5.2 Design Layout

Based on the generation of the design elements above and the analysis of the existing conditions of the site, the practical planning of the Yilong New District of Guizhou used for the proposed design will involve three steps. First, the natural area and the living environment area were delineated to maximize the protection of the natural environment. Then, according to the condition of the site, different types of systems are laid out. The settlement system will be distributed according to the geographical conditions, while the functional system and the cloud computing infrastructure system will be further organized. Finally, building modules are designed and set according to the characteristics of the site. These steps make the whole area more organic and environmentally friendly (Fig. 9.12 and Fig. 9.13). This process is expected to enhance the achievement of the comprehensive goals of reducing living space, saving time and resources, and providing a greater proportion of and better access to nature (Fig. 9.14).

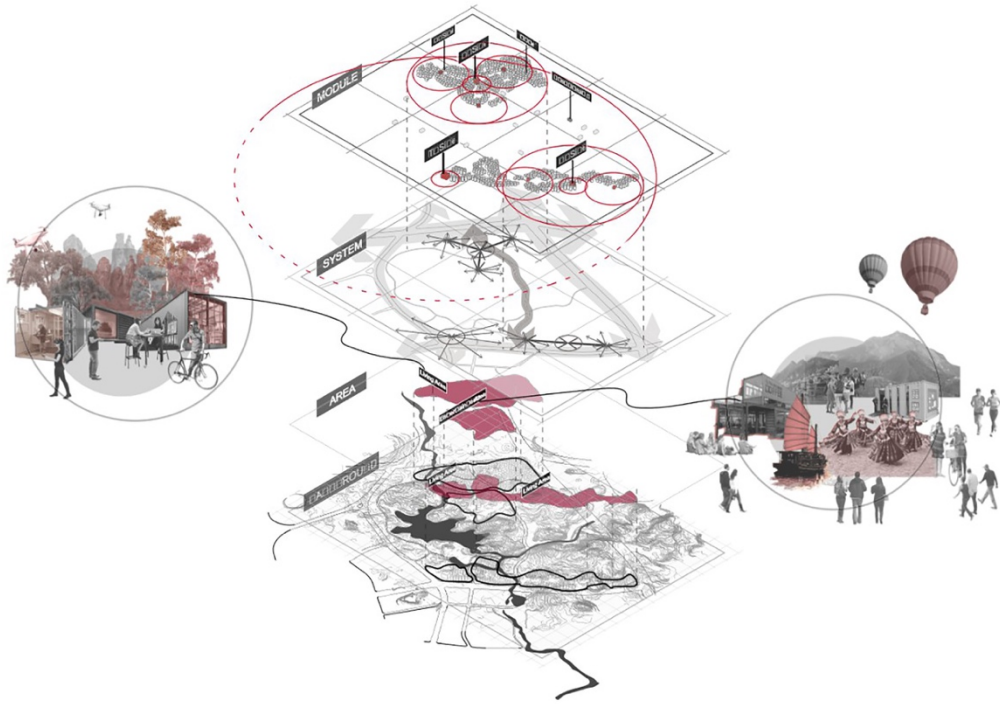


Fig. 9.12 The final design layout of the Yilong New District with four essential layers of the next form of human settlement

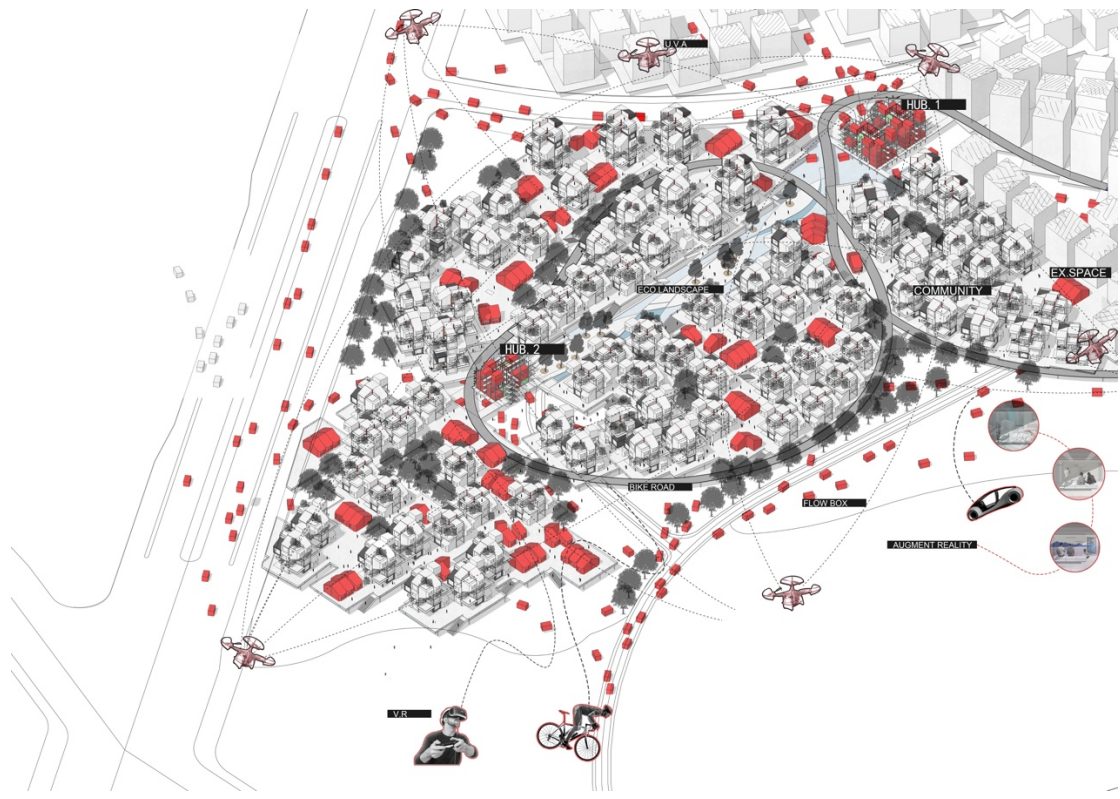


Fig. 9.13 The aerial view of Yilong New District

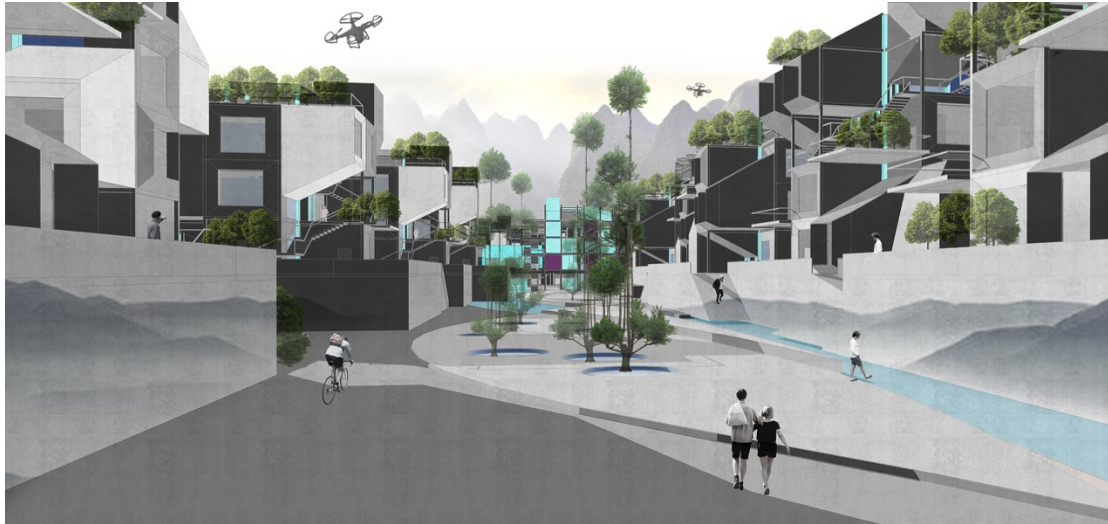


Fig. 9.14 Imaginary scene of the next form of human settlement

9.6 Conclusions

This chapter discusses the third type of applications in DAD, which fully embraces advanced technologies and helps cities better transition to improved sites. The history of technologies and their great impact on human settlement are reviewed, and thus, an illustration of the trend of the technology-based transition of human settlement is provided. As the design site Yilong is expected to become a futuristic city, the proposed design fully takes advantage of its unique landscape and develops its next form by putting forward a new agenda, which includes five layers: the code, the background, the area, the system and the module. This design is based on some emerging technologies, such as UAVs, prefabricated buildings, VR, and IoTs, and focuses on human settlement, which involves various types of activities, such as living, working, recreation and transportation. Thus design applies new technologies, such as unmanned vehicles and drones, to the whole process to better shape a sustainable human settlement. A new form that involves organizing various functions influenced by emerging technologies is also introduced in this design, which reflects the core concept of the third application in DAD.

By introducing the design case in this chapter, we show the future-oriented design framework in DAD, which is different from the former two types, namely, redevelopment-oriented DAD and expansion-oriented DAD. The third type fully embraces cutting-edge technologies to imagine future urban life and create future urban forms. However, this design is not meant to be pure fantasy but is based on emerging technologies that we can see or foresee in the near future. Urban life will be influenced by these technologies, some of which are reviewed in Chapter 1 and are already available and some of which we see through the lens of technology. In other words, rational ingenuity and thinking about future life and future space are important parts of DAD.

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