大数据里的景观

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打开手机上的微博，搜索“后滩公园”四个字，屏幕上便立刻出现了很多条关于后滩公园的信息。

6月14日，“@福娃一家亲”写到：“今天宝宝幼儿园春游，游玩后滩公园……”微博上配有9张娃娃们在水边嬉戏的照片——坐在竹木栈道上，在树下捡果子，把手伸到水里……我再点开她的主页，发现这是位热爱生活的母亲，每个周末都会带女儿去公园，她家住上海虹口区。我继续翻看她的其他相册和微博，大部分都是在记录她的宝贝女儿的生活，我甚至可以花一天的时间阅读她的网上日志。

5月31日，“@Juno爱喝牛奶”写到：昏睡了一天，下午在后滩公园找了椅子瘫坐着，这个跑了4年的公园，现在连走一圈儿都那么吃力……再看看那些当了父母的，再看看那些跟在后面的熊孩子们，不由苦笑。人真是一滴水一粒砂，充满了重复和循环……”看到这里，我的心有些紧张起来，再继续翻看这位网友的其他微博，我得知这是一位病入膏肓的中年女子，终日被病魔折磨，每天独自来到公园，在人生最后的旅程中留下了令人心酸的感悟。

5月23日，“@张青青Vvvictoria”发布了9张她在后滩公园盛开的野花组合中拍摄的写真照片。这是一位毕业于上海华东师范大学的美丽姑娘，她以往的微博透露出，她是一位爱好艺术和社交的校花。

5月23日，“@安安宝贝的小屋”写到：“后滩公园，下次记得带捞网。”微博中配有9张照片：一群小孩在捞水边的蝌蚪……

5月17日，“@ZEAL”写到：“摸鱼行动一天成果。后滩公园比其他公园真是有趣多了，人少景多不收门票、没有各种变异的自行车乱窜……”，照片是其捞鱼的成果。

5月17日，“@麦家的球”写到：“没素质的老太太在后滩公园采摘粽叶。”照片曝光了一位老太太在摘苇叶。

5月12日，“@张小哈-AHHA”写到：“度过宁静的一天，上海最爱的公园，没有之一。”微博中的9张照片都是后滩的风景。这是一位来自西安交通大学设计专业的女生。即将毕业，爱好音乐。

……

如此一页页地翻阅，我看到了后滩公园每时每刻都在不断变幻的风景：出现在人们的照片里的油菜花、向日葵、雏菊、金盏菊交替绽放；我看到人们在芦苇、蒲草、细叶芒丛中的笑容；我看到小孩们在最乐意逗留的水边；我也能看到他们捞上来的小鱼、小虾、蝌蚪——我甚至能辨别出它们的种类；我也可以看到什么鸟最近出没在公园里的什么地方——有观鸟爱好者列出了它们的物种名称。进一步，我也可以知道有什么人、在什么时间使用公园，有时能够了解他们的兴趣爱好与他们所欣赏的景观之间的关系。我甚至可以向公园管理者电话举报（或者并不需要，因为也许此时公园保安也在浏览这些信息）制止正在发生不良行为（比老太太摘苇叶更严重的事）；我也的确曾经通过网友的照片，及时向管理者反映，望尽快修复腐烂的栈道或损毁的栏杆……

地球外围轨道上的遥感卫星、全球定位系统、配有三维激光扫描设备的无人机、无处不在的摄像头、便携的数码相机、全球将近20亿的智能手机用户，加上射频识别技术、移动互联网、云计算……它们在每时每刻地摄取、储藏、传送和处理着海量的景观信息，这些信息包括关于景观系统（包括其格局及过程）、景观服务及其使用。这些信息在几十年前还需要通过昂贵的、系统的调查途径来获得——如通过取样调查来分析生物多样性，通过照片来进行景观的感知评价，通过专业勘察队伍来选择穿越景观的最佳路径，通过现场调查来进行城市公园的使用后评价等——在今天，这些数据正如汹涌的潮水夹杂着大量泥沙和杂物，从各种移动或固定端口涌入我们的办公室、卧室、餐厅、电梯，甚至卫生间。这便是我对大数据时代与景观及其设计和管理之间的联系的体会。

大量来自云端的历史和即时的关于景观和社会文化背景的大数据，为我们有效地设计以及管理景观带来无限的机会。但我们必须清醒地认识到，这样的大数据是一把锋利的双刃剑。首先，因为数据的来源本身并不系统、均衡，而是带有歧视性或偏差性的——如智能手机的使用群体并不能代表我们社会的全部人群——因此，根据这些信息所做的决策必然不是公平公正的；其次，数据如此唾手可得而廉价，海量的数据往往使珍珠被掩埋在泥沙里，没有含义的信息便是噪音，因此，处理这些数据需要超强的系统和巨大的成本；第三，数据和信息都只能告诉我们过去，最多也只能反映当下的状态，并不能告诉我们未来；而只有理论才能告诉我们未来。因此，我们的头脑不能被海量的数据和信息所淤塞，保持头脑有足够的思考余地和清醒的状态，才不致在浩瀚的数据海洋中迷失方向。

LANDSCAPE IN BIG DATA

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When I open Weibo (lit. “MicroBlog”) on my cell phone, and enter “Houtan Park”, a great deal of information about the park appears:

June 14, “@福娃一家亲” wrote, “Today, my baby’s kindergarten has a spring outing in Houtan Park....” Nine photos of children playing by the water accompany this text: sitting on the bamboo and wooden plank road; picking fruit under the trees; reaching into the water. I then open her homepage, and find that she is a loving life-mother who lives in Hongkou District, Shanghai, and that every weekend she visits the park with her daughter. I view her other Weibos, mostly her baby daughter in the show. I could spend the whole day reading her online journal.

May 31, “@Juno爱喝牛奶” wrote, “Sleeping for a day, in the afternoon I find a chair and sit paralyzed in Houtan Park. I ran in the park for four years, but now even a walk around is so difficult…. When I look at these parents, and then those wild kids following behind them, I cannot help but smile sadly. People are really like a drop of water or a grain of sand, full of repetition and circulation….” My heart is now somewhat tense. I continue to read her other Weibos, and then realize that this is a terminally ill middle-aged woman, afflicted by illness all day. I see that she visits the park alone every day, and that she has left poignant inspiration at the end of her life.

May 23, “@张青青Vvvictoria” posted nine portraits among the blooming wild flowers in Houtan Park. This is a beautiful girl, a graduate from East China Normal University in Shanghai, whose other Weibos reveal that she is a campus belle who loves art and the social scene.

May 23, “@安安宝贝的小屋” wrote: “Houtan Park, next time remember to bring a fishing net.” Accompanied by nine photographs: a group of children at the water fishing for tadpoles….

May 17, “@ZEAL” wrote: “A day of fishing achievements. Houtan Park is really much more interesting than the other parks, fewer people, more scenery, no tickets, no worries about bike scurries…”, some photos show his fishing achievements.

May 17,” @麦家的球” wrote: “An old lady who lacks quality is picking reed leaves in Houtan Park.” A photo shows that an old lady is being caught picking reed leaves.

May 12, “@张小哈-AHHA” wrote: “A restful day, my favorite park in Shanghai, none can be compared to it”. Nine photos in this Weibo are scenes of Houtan Park. This is a girl from Xi’an Jiaotong University whose major is design. She is about to graduate, she is also a music fan.

….

I read page after page to see the changing landscape of Houtan Park in different moments: field mustard, sunflower, daisy, pot marigold... all emerge in people’s photos, blooming alternately. I see people’s joy in the reeds, and the bushes of narrowleaf cattail and maiden grass. I see kids by the water, where they like it most. I see fish, shrimp, tadpoles, which are just out of the water — I can even identify their species. I can see what kind of birds have been spotted recently — some bird watchers list their species, I can see who, and at what time, uses the park, and sometimes I can understand the relationship between their interests and their favorable landscapes. I can even report to the local administrators (or might not, because the park security also browse this information) to stop bad behavior taking place as I browse (more serious matters than picking reed leaves). I have also reported to the park administrators, helped by netizens’ photos, in time to have a rotten plank road and a damaged railing repaired.

Remote sensing satellites orbit of the Earth’s periphery, the Global Positioning System (GPS), unmanned aerial vehicles (UAVs) with three-dimensional lasers canning equipment; Below, there are ubiquitous digital cameras and nearly 20 billion smart phones, Radio Frequency Identification (RFID) technology, mobile Internet and Cloud computing. They incessantly generate / download, store, transmit and process vast amounts of landscape information, including landscape systems (patterns and processes), landscape services and their uses. A few decades ago such information could only be gained through expensive, systematic surveys, for example, analyzing an area’s biological diversity based on a sample survey, making evaluations of landscape perception through photographs, selecting optimal paths throughout the landscape by professional exploration crew, making post occupancy evaluation (POE) for a city park through field investigation and so on. Today, data, like a surging tide saturated with sediment and debris swarms into our offices, bedrooms, restaurants, elevators. Even into the bathroom.

A large amount of ordinary big data from the Cloud concerns landscape and socio-cultural background. This brings landscape architects and urban planners limitless opportunities to effectively design and manage landscapes. Yet, we must recognize that big data is a double-edged sword. First, the source of the data is not balanced, but has a discriminatory or biased nature — people who use smart phones are not representative of the general population — meaning that decisions made according to such information are not always fair and equitable. Second, the data is so readily available and inexpensive that the pearl often becomes buried in the sand: meaningless information is nothing but noise. Besides, this big data processing requires powerful systems and can incur huge costs. Third, data and information can only tell us the past, or reflect the state of the moment. It cannot predict the future: only theory can. Therefore, we must avoid a situation where our minds are silted up by vast amounts of data and information. We must keep enough thinking room and remain awake. Otherwise we may become lost in these vast oceans of data, rendering them without use.

数据作为设计的工具性：在新数据环境下探索城市秩序的可持续内涵

THE INSTRUMENTALITY OF DATA USED FOR DESIGN: EXPLORING THE SUSTAINABLE MEANINGS OF URBAN ORDERS IN THE NEW DATA ENVIRONMENT

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摘要

城市是一个复杂的自组织系统，其中充满了各种子系统的互动，其最终将影响不同时期所涌现出来的城市秩序。长期以来，由于对城市系统认知的不足，城市规划师和设计师不得不在一个相对简化的城市概念框架中工作。这种过度简化的认知方法一直以来影响着关于城市可持续性的讨论。新的数据环境提供了一种认识这种复杂关系的可能，但相关实践中仍缺乏面向未来的城市规划与设计的理论与方法。本文试图从城市秩序定量认识的角度出发，阐述在新的数据环境下，理解城市秩序及其可持续内涵的相互关系，进而建立一种数据增强的可持续性发展规划的方法框架，并重申如何通过数据的工具理性通向新时期的城市规划设计的价值理性。

关键词

大数据；城市秩序；可持续性；工具理性；城市规划设计

ABSTRACT

City is a complex, self-organized system, in which various sub-systems interact with each other whereby urban orders emerge dynamically. Due to lacking of sufficient knowledge about the urban system, urban planners and designers had to work within a simplified concept framework. This over-simplified methodology has been influencing the debate about the urban sustainability. Although the so-called new data environment now provides possibility to acknowledge this kind of complex interrelationship, future-proofed theories and methodologies of urban planning and design are still deficient in related practices. Base on the quantitative understanding of urban orders, this paper aims to explore the issues on understanding the relationship between the urban orders and the meaning of sustainability in the new data environment, to establish a methodological framework of data augmented sustainable planning, and to reassert how to achieve the value rationality in urban planning and design through the exploration on instrumental rationality.

KEY WORDS

Big Data; Urban Order; Sustainability; Instrumental Rationality; Urban Planning and Design

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1 引言：当前规划设计的基本目的

1.1 一种新的城市认识观的诞生

虽然城市一直被认为是人类各种社会活动的载体，但是大部分规划者们至今仍不可避免地运用简化的概念来理解城市。几何化的城市形态造成了碎片化的城市空间，以及被割裂的当代城市生活。半个世纪以来，现代城市设计往往被认为劣于传统的有机城市形态，不仅仅因为其塑造了非人尺度的“钢筋水泥”丛林，更因为其无法承载有活力的城市活动而引发了诸多不可持续的城市问题。事实上，对于城市的各种概念化理解是一种“妥协的”城市认识观，尽管这种认识观有助于概念的演绎、叙述与自我证明。长期以来，当代城市规划与设计师运用这些简化的、取之即用的概念来对复杂的城市进行各种操作。在过去半个世纪中，许多的城市学者和城市设计理论家对此都进行了批判，并催生了后来的“新古典都市主义”。著名的城市理论家简·雅各布斯总结了如何通过塑造城市多样性的秩序进而激发城市活力[1]；而克里斯托弗·亚历山大则直接指出，城市并不应该被认为是一种简单的秩序，而是一种复杂的系统关系，并且这种系统关系是可以被计算的[2]。亚历山大在其后续的研究中将城市设计的操作内容进一步描述为城市秩序。这种城市秩序并不是简单的空间形态，而是形式语言的各种相关含义；同时城市秩序是一种发生器，它在城市演进过程中逐步影响整体的城市结构；此外，城市秩序因与文脉适应而最终达成其整体性[3]。对于传统城市演变过程中呈现的有机性的肯定，并不意味着需要否定城市规划与设计存在的合理，而是需要建立一种新的城市科学来理解城市的复杂秩序[4]。因此，城市认识论对于把握城市的复杂秩序至关重要，而描述式的定性概念则会限制城市认识相关理论与方法的发展，当然也会影响在规划设计中对其的操作。

1.2 城市规划与设计的科学性

近年来，复杂性与自组织理论已经在城市规划与设计领域得到广泛讨论和研究（特别是在城市模拟领域），然而如何将其进行转

1 Introduction: The Primary Purpose of Current Urban Planning and Design

1.1 The Nativity of Epistemology of City

Although city has been considered as the carrier of various kinds of social activities, nowadays most urban planners, the understanding of city is still unavoidably based on simplified concepts. The geometrized urban forms lead to the fragmented urban space and isolated modern urban lives. Over the past 50 years urban form created on modern urban design methodology has been considered inferior to the traditional organic one, not just because of the extensive, non-human scale “steel and concrete jungle”, but, more importantly, due to the unsustainablity problems caused by the failure in being a matrix for dynamic urban activities. In fact, current conceptualized understanding of cities is a compromising, urban epistemology, though that sometimes is helpful for the interpretation, description and self-proving. It has been a long time for the modern urban planners and designers applying these simplified conceptions in addressing complicated urban problems. Historically, many urbanists and urban study theorists have criticized on that, and subsequently, the neo-classical urbanism was raised. The well-known theorist Jane Jacobs summarized the ways to revitalize cities by designing the complex orders of urban diversity[1]; Christophe Alexander plainly argued that rather than a simple order, we should consider a city as a complex relational system which can be measured and calculated[2]. Alexander further described the object of urban design as creating meaningful urban orders. The urban order here is not a simple spatial pattern, but all kinds of related meanings of the formal languages creating the pattern. Urban orders are generators that impact the whole urban structure in the progress of urban evolution. Moreover, the holism of urban orders would eventually be formed by adapting the orders to the context where they imbedded in[3]. Praising the organic patterns in the evolution progress of traditional cities does not mean to deny the rationality in urban planning and design, but to claim the urgency to build a new urban study science to uncover the complex orders of cities[4]. Therefore, the epistemology of city is crucial for understanding the underlying nature of the complex urban orders, and these conventional descriptive, qualitative concepts would strongly limit to developing related theories and methods of a new epistemology, thereby impacting the operations in the planning and design.

1.2 Scientific Nature in Urban Planning and Design

In recent years, the complexity and self-organized theories have been widely discussed and studied in the field of urban

化，并应用在规划设计实践中仍需探索。但有一个问题是明确的：当前规划设计的对象不仅仅在于实体空间要素，而更在于实现这些空间要素的可持续的功能性。中国当前城镇化发展已进入新的阶段，接下来的规划对象将大量集中在现有的建成环境之中，而城市规划与设计也应很好地理解其所面临的诸多挑战——比如如何整合多个尺度的规划，如何为城市演变而设计，如何为信息化社会的实体城市生活而设计——因而对于提高规划设计科学性的呼声日渐高涨。伴随着相关学科定量趋势的发展，分析式设计、实证性设计等理念已经自20世纪60年代开始得到发展——甚至可以追溯到更早之前帕特里克·盖迪斯[5]以及卡米洛·西特[6]等人的研究——但是这些理念却也总是被批判由于缺乏整体的框架和理论体系[7]而看起来更像是一种“伪科学”[8]。因此，当前规划设计面临的基本问题是如何科学地规划一种城市秩序，使之具有可持续的功能性以满足当前和未来的各种城市需求。

1.3 新数据环境带来的机会

当代城市是“信息城市”，拥有更高覆盖面和高精度的、即时且多维的数据正在改变我们对城市复杂性的认知方式，为理解城市的复杂结构体系带来了契机，并引领了以人为本的城市研究方法。在新的数据环境下，对现有城市系统的现状评价和问题识别，正在给未来规划设计提供一种数据增强的分析方法和工作框架[9]。这为理解城市复杂秩序的构成及其可持续的含义提供了一种途径。基于此，本文试图从城市秩序定量认识的角度出发，阐述和理解在新的数据环境下城市秩序如何与其可持续的内涵联系起来，最终建立一种数据增强设计的理论方法，并重申如何通过数据的工具理性迈向新时期的城市规划设计的价值理性。

2 城市秩序的可持续性：规划设计的内涵

城市规划设计最终总是不可避免地呈现为空间干预。城市资源的稀缺性导致了空间配置的不均衡，并会影响人们的活动以及随之出现的社会及经济现象。著名的城市规划学者彼得·霍尔将城市规划定义为“一种广义的行为，用创造秩序的活动为手段以实现特定的目标”[10]。而城市的广义可持续性就蕴含在其所依赖的城市空间秩序中，城市规划设计的理论便是因地制宜地理解城市空间秩序与其对应的可持续含义之间的自然关联[11]。在当代城市中，城市的可持续性可以从多个维度理解，大致可以被概括为空间、社会文化、经济、生态以及管治五个维度（表1）。当然，任何的分类都只能是一种梳理，而事实上不同维度之间也总是存在动态的互动。在这里，城市秩序的可持续性仅存在于“未规划的秩序”中——一种自然的互动联系，而非规划或设计过的物理空间秩序中。因此笔者认为通过对这种“未规划的秩序”的解读，并以规划设计手段达到城市的可持续性，正是规划设计的核心内涵。

为了准确地理解城市秩序的可持续内涵，仍旧有几个问题需要在规划设计研究中妥善地理解和应对。首先，需要明确城市秩序的复杂性而警惕单向因果的简单总结。传统的对城市秩序的理解时常构建于研究者的研究视角和自我证明，进而使得对复杂城市秩序的理解在很大程度上成为了一种“中心化的认知”[12]。这样的认知使得人们认为一种城市现象一定有一种主要的驱动力而忽略了其他复杂的潜在逻辑。因此，对于城市秩序的探索需要秉持一种“去中心化”的认知方法，并基于所在的文脉与社会经济环境中来准确估计。其次，需要明确理解城市动态性的重要性。城市的复杂性源自于城市演进的动态性，对于城市秩序及其效应的理解需要与城市持续的演变进程的周期保持一致。再次，需要明确城市中人作为主体的重要性。城市可持续性的潜在逻辑与城市人相关，他们的集群行为构建了可见的城市秩序，因

表1：城市秩序的可持续性维度
Table 1: Five Dimensions of the Sustainability of Urban Orders

维度 Dimension	内容 Content
空间 Space	基础设施、交通、景观、美学等 Infrastructure, transportation, landscape, athletics, etc.
社会文化 Social Culture	生活质量、公共健康、教育、犯罪、住房、公共服务等 Quality of Life (QoL), public health, education, crime, housing, public service, etc.
经济 Economic	就业、就业能力、税收、房价等 Jobs, employability, tax, housing price, etc.
生态 Ecology	噪音、空气质量、生物多样性等 Noise, air quality, biodiversity, etc.
管治 Administration	参与度、管理体系、公私企业比例等 Engagement, administration system, ratio of public to private sectors, etc.

planning and design (especially in the field of urban simulation); however, how to transform and apply those ideas properly on the side of practices still needs to be explored. For current urban planning and design, it is clarified that what we are planning and designing are not only physical space forms, but also the sustainable functions of these spatial elements. Now Chinese urbanism is on a new stage, the planning would concentrate on the built environment in the very near future, and different challenges should be well addressed in urban planning and design, such as integrating urban planning at diverse scales, designing for the urban transformation and vitalizing the physical urban lives in the informational society. Thus, the need of enhancing the scientificalness of urban planning and design is increasingly pressing. Along with the quantification-oriented development of related disciplines, ideas such as Analytical Design and Evidence-based Design have been developed since 1960s, and the earliest pioneers can be traced back to Sir Patrick Geddes[5] and Camillo Sitte. However, the pseudoscience of these concepts have been criticized for lacking of integral framework and theoretical spine[7][8]. Consequently, the essential issues what we are facing in the current urban planning and design is that how to scientifically choreograph urban orders to arouse their sustainable funcationalities, and to meet different kinds of demands in the current, and future cities.

1.3 Opportunities in the New Data Environment

Modern cities are “Information Cities” where multidimensional, real-time data with lager coverage and higher resolution are benefiting the way of understanding the complexity of cities and urban structures, leading towards human-oriented research methods. In the new data environment, the evaluation and issues identification of existing urban systems are helping form a data augmented analysis method and operation framework for future urban planning and design[9]. These efforts provide an approach to understand the composition of complex urban orders and their meanings of sustainability. In this sense, this paper explores how to quantitatively understand the relationship between the urban orders and the meaning of sustainability in the new data environment, develop a theoretical method of so-called “Data Augmented Design” (DAD), and reassert that how to achieve the value rationality in urban planning and design through the exploration on instrumental rationality.

2 The Sustainability of Urban Orders: The Significance of Urban Planning and Design

Ultimately and inevitably, urban planning and design are some kinds of spatial intervention. The scarcity of urban resources leads to the spatial unevenness of urban services, impacting on various human activities, and social and economic realities. Sir Peter Hall defined urban planning as “a general activity (that) is the making of an orderly sequence of actions that will lead to the achievement of a stated goal or goals”[10]. In this sense, we can argue that the generalized meaning of urban sustainability is contained in urban spatial orders. Theories of urban planning and design are to specifically reveal the natural linkage between the urban spatial orders and the associating sustainable meanings[11]. In modern cities, urban sustainability can be unfolded on multiple dimensions that can be summarized into five categories, including space, social culture, economy, ecology, and administration (Table 1). Frankly, this is just one way to understand the urban sustainability, and dynamic interactions occur among elements in different dimensions. Rather than planned or designed physical spatial orders, where the sustainability of urban orders exists is the “unplanned orders” — the natural, dynamic relationship between urban elements. Thus, the essence of urban planning and design is to well interpret the so-called “unplanned order”, and then realize the urban sustainability by the means of spatial interventions.

In order to understand the sustainability of urban orders properly, several more issues still need to be addressed comprehensively in the studies of urban planning and design. First, we need to acknowledge the complexity of urban orders, and be vigilant to simple summarization of one-way causality. The conventional understanding of urban orders is often based on the researcher’s views and his / her self-proving, which leads the understanding of complex urban orders being “centralized”[12] to a very large extent. This makes people easily believe that any certain urban phenomenon must be driven by a major motivation, while ignoring other complex potentials. Therefore, urban orders should be explored with a “decentralized” epistemological method, and be explicitly detected in the cultural context and socioeconomic environment. Secondly, the importance of urban dynamic needs to be paid more attention. The complexity for city stems from the dynamics of urban evolution; the understanding of urban orders and their effects should be keeping in accordance with the certain running cycle within the continuous process of urban evolution. Thirdly, human scale needs to be further emphasized in relevant urban studies. The underlying logics of urban sustainability are associated with the people whose collective behaviors have shaped recognizable urban orders. “Humanistic concern” in urban planning can be only realized by understanding and studying the sustainability of urban orders on the human

而以人为本的角度来理解城市秩序的可持续性才能做到真正的人文关怀。此外，对于城市秩序的理解还需要恰当地整合相关理论知识，以构建一个完整的研究体系。上述议题需要更强大的基础资料、分析手段、理论方法等方面的支持，而新数据环境提供了这样的契机。

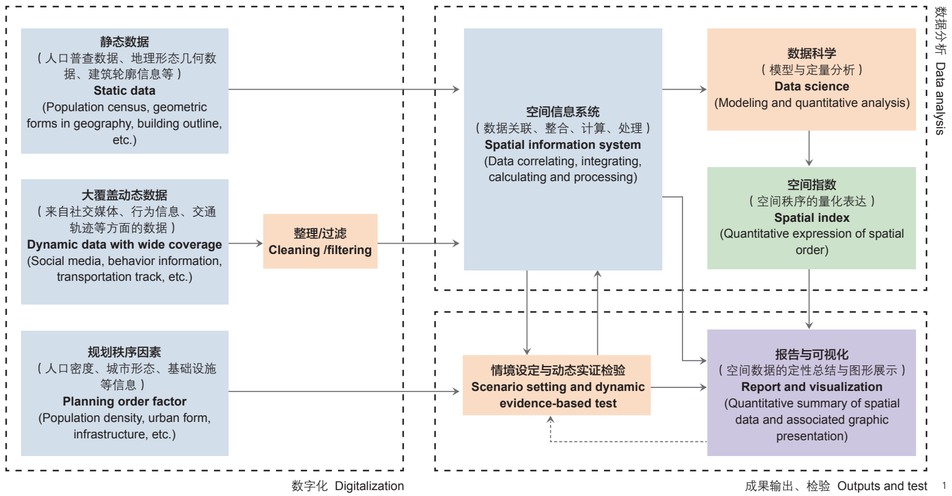
3 新的数据环境下对城市秩序的理解

新的数据环境下对城市秩序的理解是一种定量认知论，并体现为4个方面的变革（空间尺度、时间维度、研究粒度以及研究方法）[13]。这些变革促进了规划设计的科学性，并提供了一种无差别的沟通媒介，联系了不同专业领域的知识，同时回应了上文提及的城市秩序及其可持续内涵理解上的困境。图1描述了如何在新的数据环境下认识城市秩序，及其与可持续性之间的关系。第一步是将各种不同的数据收集并数字化。这些数据包含了传统的静态数据（部分被称为调查数据），

scale. Besides, we need to integrate related theories and knowledge properly to form a comprehensive research system. All these issues above should be supported by sufficient basic information, advanced quantitative theories and methodologies — such opportunities are currently provided in the new data environment.

3 The Interpretation of Urban Orders in New Data Environment

The interpretation of urban orders in the new data environment can be considered as a quantitative epistemology, which is reflected through the revolution on four aspects (space scale, time dimension, research granularity and research methodology)[13]. These revolutions inform the scientificalness of urban planning and design, generate a unified format for communication, connect knowledge in various disciplines, and respond to the dilemma in understanding urban orders and their sustainability, as mentioned above. Figure 1 describes to the general process of producing meaningful results of the urban orders in the new data environment, and the relationship between urban orders and their sustainability. The first step



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1. 新数据环境下对城市秩序理解的一般流程

1. General Process of understanding of urban orders in the new data environment

大覆盖、高精度的即时数据（或者被称为感知数据）以及与规划秩序因素有关的数据。这些数据进而在一个高效的空间信息系统中被有效地关联起来，并依据要求而选择各种分析方法和建模软件。基于输入及数字化的数据，以及规划情境设定，空间信息系统将提供最合适的数据分析技术来对不同城市子系统的相互依存关系进行建模。最后输出定性报告以及可视化成果。通过理解分析成果，情景设定又将有所调整，各项输出成果将在比对中得到最终检验（也可以理解为对于数据分析结果的反馈与检验）。这样的流程能够将规划与设计（不仅仅是空间设计）所调控的空间要素与其功能特点联系起来，并最终确定精准的相互关系。

4 数据增强型城市设计：面向未来可持续性的城市考古学

任何当下发生的事情都将是未来的历史存证，因此对当下的认识即是对未来的认知[14]。因此，我们基于当前的定量城市研究进展以及上文提及的城市秩序理解的一般流程，提出了DAD的工作方法[9]。数据增强设计是现有规划设计体系下的新的规划设计方法论，其目的在于在新数据环境下，基于模型工具集，结合不同异构数据源的提取、分析以及预测，进行针对城市规划设计各环节的数据支持，最终提高规划方案的合理性、创新性以及弹性。在这一规划方法下，对城市秩序及其可持续内涵的探索影响了规划设计的整个流程，具体体现在：持续动态地帮助理解可持续性所嵌入的文脉；持续地帮助建立替代认识方法并比较择优；即时地调整对要素的提取和数据化；整个流程可以以较低成本不断迭代，以促进具体的规划设计方案制定。因此，我们认为DAD是一种对当下城市数据的考古学，一种城市定量认识观和一种

is collection and digitization. The datasets employed include traditional static cross-section data (some of which called surveyed data), real-time data with wide coverage and fine scaled resolution (or sensed data), and data related to the factors of urban ordering. On the following stage, these datasets are effectively interconnected in an advanced spatial information system in which diverse analytic methods and modeling software are selected according to specific requirements. Based on the inputted and digitized data, combining with the planning scenario setting, the advanced spatial information system conducts modeling depending on the interdependent relationship between different urban sub-systems by adopting different analytical techniques. Finally, outputs including qualitative reports and visualized results can be produced. The scenario setting would be further iterated and adjusted according to the analysis of the results, and the outputs would be tested through comparison (we can also understand that this process is to provide analytical feedback and test of the results). Such process is capable to connect the spatial elements in urban planning and design (not only spatial design) with their functions, to accurately identify the underlying interactive relationship eventually.

4 Data Augmented Design: Urban Archaeology towards Future Sustainability

Everything that happens now would be a historical evidence in the future. In other words the accurate understanding of the present would be the cognition of the future[14]. So, based on existing quantitative urban research and the general process of understanding of urban orders, we propose a operation framework called DAD[9]. DAD is a new quantitative planning and design methodology raised from the current planning and design system. It can provide support to each phase in the process of urban planning and design by employing modeling toolsets to extract, analyze and predicate on the basis of the various data sources, and eventually, to increase the rationality, creativity and resilience of planning in the new data environment. The exploration on urban orders and their sustainability in this methodological framework would impact the entire process of planning and design, for instance, it would continuously and dynamically help with the interpretation of the context where the sustainability imbedded in; it would be continuously helpful to establish alternative epistemology and to compare and select appropriate ones; it would benefit the timely adjustment of the extracting and digitizing of factors; and its overall procedure could be iterated with low cost to assist the decision-making in specific planning and design. Therefore, the

面向未来的规划设计方法。在数据环境日趋成熟以及技术发展快速的今天，不断地落实DAD的研究框架将有助我们动态地理解未来城镇化发展的可能方向。

在DAD的框架内，对城市内复杂秩序及其可持续性的理解可以被看成是一种决策过程，其中包含多个阶段进而最终提炼最合适且有效的空间干预决策。城市可持续性的最终实现绝不可能一蹴而就，而是需要在一个规划设计的决策循环中对城市秩序与可持续性的相互关系进行优化。图2展示了DAD框架中，如何在一个规划设计决策循环中联系、落实不同空间设计及其可持续内涵，并构建一个动态的城市可持续性定量框架。

在上图所示的框架中，数据提升了城市秩序的规划设计流程以及可持续性发展评价过程，而最终通过将这两者相结合，展示了一种定量的可持续发展战略制定流程。首先，数据将帮助可持续发展相关问题的识别与主要干预路径的推导，以此确定以何种方式干预何种城市秩序。其次，通过总体设想与对规划秩序的具体效应评价来确定最终的发展设想。而后，不同空间干预与可持续性的关系被着重分析以

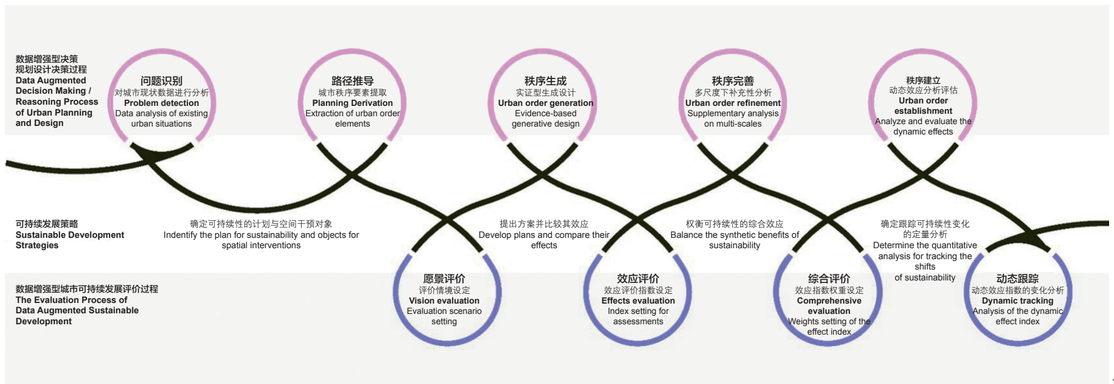
DAD can be considered as an archaeology of current urban data, as well as a quantitative epistemology of city and a future-proofed approach of urban planning and design. As the data environment becoming mature and techniques are developed rapidly, it would be helpful for us to explore the possibilities of future urbanism by implementing the research framework of DAD.

Within the framework of DAD, the interpretation of complex urban orders and their sustainability can be considered as a decision-making process in which different phases are included and the most appropriate and effective spatial intervention decision would be generated and proposed. The urban sustainability can never be implemented overnight. Therefore, the relationship between urban orders and sustainability needs to be optimized within the decision-making cycles of urban planning. Figure 2 shows the process of connecting and implementing different spatial designs and their sustainable meanings within a decision-making / reasoning cycle, thereby establishing a dynamic qualitative framework of urban sustainability within the DAD system.

In the framework as shown in Figure 2, data augments the planning and design process of urban orders and the evaluation process of sustainable development. By combing these two, we can introduce a quantitative process of making sustainable development strategies. First, data would be helpful to identify the problems of the current development of sustainability and to deduce the main intervention methods, so that decision makers can choose appropriate intervention approach for changing / designing

2. 面向可持续性的城市规划设计决策流程

2. Decision making / reasoning process of urban planning and design towards sustainability



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确定亟待解决的问题等级。最后，根据评价建议完善具体城市秩序规化或者设计方案的灵活性，以确保既定可持续发展目标的实现。通过将城市规划设计影响的城市秩序数据化，并将其与评价过程对接，有力地对可持续发展战略的制定提供了支持，并有效地建立了基于数据的透明协商机制。尽管这样的框架研究仍然可能在解决实际问题时面临细化问题，但是这对于在城市秩序中建立一个基于数据的长效工作机制来说至关重要。数据增强型设计研究框架作为一种对现状的“考古”，在我们看来是一种面向未来的科学认识体系，不仅可以有助于提出理性的规划愿景，更能帮助明确已规划/未规划的秩序的可持续的功能效应。

5 通向数据启发的价值理性

在前文的分析介绍中，我们展现了数据作为一种工具是如何帮助客观地理解城市的潜在秩序以及其所对应的可持续内涵。在今天，大量涌现的城市数据不仅是可供分析的新材料，更是探知未来的工具。但是在明确数据作为规划设计的工具理性的同时，我们仍迫切地需要明确数据使用中的价值理性问题。

首先，我们需要在城市定量研究中梳理一种价值伦理。城市定量研究的成果，特别是可视化成果帮助了规划设计的概念阐释、论述，它们的“高明”的外衣甚至给他人一种“无可争辩”的印象。然而需要注意的是，一个看似客观的研究，却也十分容易被其他目的利用而塑造一种权威。因此，对于数据分析的应用需要更多的基于社会学的思考，以明确不同数据定量分析服务的主体是谁，目的是什么。保证不同的群体意愿通过定量研究得到妥善的理解是保证社会可持续性的一个重要方面。

certain urban orders. Secondly, by clarifying the overall object and evaluating the specific effects, decision makers can properly determine the final development strategies. Then the relationship between different interventions and sustainability would be analyzed to identify the priorities of the issues to be addressed. Lastly, people can adjust and further enhance the flexibility of specific urban ordering plans or designs to secure the implementation of the given goals of sustainable developments. The digitization of urban orders affected by the urban planning and design, and its connection with the evaluation process would strongly support and augment the making of sustainable development strategies and the establishment of a transparent data-based negotiation mechanism. Although details of such a framework need to be further considered when we deal with specific problems, it is critical for building up a long-term data-based working mechanism among urban orders. In our opinion, DAD research framework is a scientific future-proofed epistemology system, which conducts “archaeological studies” on contemporary urban situation. Such a framework does not only contribute to rational planning proposal, but also be helpful to understand the sustainable functionality that underlying in the planned / unplanned orders.

5 Towards the Data-informed Value Rationality

In the text above, we introduce a way in which data analysis are adopted as a tool to explain the underlying urban orders and their corresponding sustainable meanings. Nowdays, the massively emergent big data is not just new materials available for urban analysis, but more of an advanced tool to discover the future. However, while the instrumental rationality of data as a tool of urban planning and design has been defined, the value rationality of applying data still urgently needs to be clarified.

First, we need to find out the value ethic in the quantitative researches of urban study. The efforts of quantitative urban studies, especially the achievements in the feild of visualization that contribute to the interpretation and discussion of planning and design concepts; sometimes, their “brilliant” appearance impresses people as “indisputable”. However, it is worthy to note that a research that seems objective may easily be used for other premeditated purposes in order to establish certain authority. So, thoughts based on social theories should be brought into existing application of data analysis to identify the subjects and the purposes of different quantitative analysis of data. To ensure different collective visions of various social groups can be appropriately understood is absolutely a vital aspect of the social sustainabilities.

其次，我们仍需警惕定量分析的滥用有可能导致另一种庸俗。数据无法驱动所有的城市规划设计活动，时至今日，学术界仍旧在许多问题上存在定量与定性研究的角力。定量研究中注重提炼城市理论，同时注重理论的多样性发展和实证研究是理解城市秩序的前提之一。同时，对于城市定量研究存在一些解释力不足的维度，比如都市美学方面，则需要妥善地在定量研究中思考，并努力创造文化意义与功能性兼备的城市秩序。

再次，新数据环境下的定量研究需要与设计相结合，激发更多基于数据的规划设计的创想。规划设计的思维因其在很大程度上依赖于规划师或设计者自身的知识与创新能力，而被认为是感性的、直觉的，甚至个人的。而数据研究被认为是科学的、客观的。二者之间存在一个似乎不言而明的分野。然而事实上这个分野也许并不存在，因为城市的高度复杂性给了定量研究很大的发展和想象空间，更多灵感的启迪也许就蕴含在定量研究自身之中。

与此同时，数字化的交流式规划实践仍需在现有规划理论体系内确立一个恰当的位置。新的数据运用带来了多专业的协作与交流，然而许多专业还在现有的规划体系长期缺位。一些定量研究相关的专业在传统实践领域的职业话语权需要被更多地讨论，以创造一种适应数据环境的规划管理体系。

此外，虽然涌现的海量数据带来了“向现状学习的时代”，但仍需要注意新数据环境下，满足人们在未来现实世界与虚拟世界中的新需求才是城市研究的真正目标。理解这些未来的需求，将为规划与设计创造新的契机，也有助于我们判断数据应用的社会和经济效应，以避免对现有问题进行过度的数据研究。

Secondly, we need to be alert to the abuse of qualitative analysis that may lead to philistinism of urbanization. Data is not capable to drive all kinds of urban planning and design activities. Until now the wrestle between quantitative and qualitative researches still exists in academia and has left many issues debatable. Abstraction of urban theories is highly emphasized in quantitative research, while one of the important preconditions for studying urban orders is to focus on the diversification of theoretical development and the evidence-based research. Meanwhile, some dimensions in which explanatrability of the quantitative research is inadequate, such as urban aesthetics, need to be considered appropriately throughout quantitative research. It is very necessary to create the urban orders that are both culturally and functionally meaningful for humans.

Thirdly, in the new data environment, the quantitative research needs to be incopreated with design in order to productively inspire the data-based deisgn ideas. Conventionally, the thoughts of planning and design largely depends on the designers' knowledge and innovation ability, therefore they are normally considered to be sentimental, intuitional or even personal. On the other hand, data-based research is thought to be scientific and objective. It seems that there is an self-evident boundary gapping them. However, perhaps the boundary does not exist at all since that the complexities of cities shed the light on the varius possibilites for quantitative studies, offering a great potential that the quantitative research itself can be a source of inspirations for the reaearch.

At the same time, the practice of digitalized interactive planning needs to be appropriately positioned in current theoretical system of urban planning and design. The application of new data initiates interdisciplinary cooperation and communication, however many disciplines are not included within the current planning system. The authorities of the disciplines which are strongly related with quantitative research should be re-examined in order to create an adaptive management system in the new data environment .

Besides, the emerging massive data leads us towards “the age of learning from the existing”. However, in the new data environment, the new needs in the future real and virtual world should be the true aims for urban studies. Understanding these needs sufficiently would bring new opportunities for urban planning and design, and also help us estimate the socioeconomic effects of the application of data to avoid excessive investment of data research on current issues.

6 结语

城市的复杂性迫切地要求不同以往的解读方式，以确保不同规划手段干预下的城市发展的可持续性。新的数据环境带来了理解城市秩序与其可持续性之间的联系的崭新契机。当今规划设计面临日趋复杂的建成环境，城市秩序影响下的城市可持续性正成为规划设计的内涵，并对城市认识论提出了新的要求。城市大数据分析作为一种规划设计的工具理性在城市定量研究的框架内展现了其巨大的潜力，并直接回应了当前规划设计以空间干预的功能性为目的的核心诉求。通过总结定义，分析、评估的一般定量分析流程，笔者倡导运用数据分析框架（DAD）来理解潜在的城市自然发展的原则，并提出构建一种规划设计决策流程，从而实现城市的可持续性。但是，在充分肯定数据作为规划设计的工具理性的积极意义和可能性之余，我们仍需注意探索数据应用在城市规划中的价值理性。在正确的价值理性的指引下，充分、有效地利用数据的工具理性能够启发我们在城市未来演变进程中理解城市秩序及其效应的作用关系，并最终实现城市的可持续发展。**LAF**

6 Conclusions

The complexity of city urgently demands to be properly unfolded in an alternative way, which can ensure the sustainability of urban development by different planning interventions. The new data environment is bringing unique opportunities to understand the natural connections between urban orders and their sustainabilities. The built environmrnt what current urban planning and design are confronted with is becoming more and more complicated. In this sense, the sustainability influenced by urban orders is becoming the essential connotation of urban planning and design, making new demands for urban epistemology. As the instrumental rationality of urban planning and design, big data analysis of cities showcases the huge potential within the qualitative research framwork that directly responds to the core demand of current urban planning and design as seeking the functionality of spatial interventions. By defining, and analyzing and evaluating the general processe of quantitative analysis, we propose that the data analysis framework — Data Augmented Design can be used to understand the underlying urban orders and principles of the spontaneous development of city, to realize the urban sustainability by establishing a decision making procedure of spatial interventions. However, though the significance and potential of taking data as the instrumental rationality of urban planning and design should be fully appreciated, the value rationality of data application in urban planning still needs to be further explored. Guided by the right value rationality, we can be inspired by applying the instrumental rationality sufficiently and effectively to better understand the functional relations between urban orders and their effects in the process urban evolution, thereby realizing urban sustainability in a very long term. **LAF**

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