

工具与目标的混淆 ——重新审视规划设计行业 的数据革命

CONFUSION OF GOALS — RETHINKING THE IMPLICATION OF DATA ANALYTICS AND MODELLING FOR URBAN PLANNING AND DESIGN INDUSTRY

1 引言

身处第四次工业革命之中，我们从数据相对匮乏的时期走向数字化浪潮的时代。在这个时代，我们为创造更好的未来城市寻求灵感，而席卷全球且投入巨大的智慧城市建设即为其中之一。交通、医疗、零售等行业已经开始通过方案创新和用户体验优化收获数据带来的红利。然而，在英国，大数据分析很少被应用在规划设计领域^[1]。最新相

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摘要

数据分析和建模技术在中国的城市规划设计领域取得了快速发展。基于这一事实，本文旨在填补利用数据制定有效政策成果与获得技术产出之间的知识鸿沟，并将这种鸿沟置于更广阔的智慧城市建设的背景下展开讨论——虽然在该领域，技术应用并没有带来预期的政策成效。我们需要从早期实践中汲取经验，以防在中国各大城市上演的规划设计数据革命重蹈覆辙。本文提出的一大观点是，为了充分发挥数据分析在城市规划设计领域的潜力，亟需引入更加完善的技术框架，来重新审视规划设计行业在中国的关键角色和核心竞争力。从纯技术论调和学科/专业路径转变为社会-技术视角。通过提出一系列建议，本文期望引发更多关于城市规划设计中技术性行动计划的批判性讨论。

关键词

大数据；数据分析技术；城市建模技术；社会-技术；城市规划；城市设计

ABSTRACT

Inspired by the fast take-up of data analytics and modelling in urban planning and design in Chinese cities, this paper aims to address a serious knowledge gap in terms of using data to deliver better policy outcomes rather than technical outputs. Such a knowledge gap is discussed in the wider context of smart city development where technology deployment failed to deliver the expected policy benefits. Lessons thus can be, and should be, learnt from early experiments to prevent the data revolution in planning and design in Chinese cities from repeating the same failure. One of the key arguments is that, in order to leverage the potential power of data and analytics for the urban planning and design industry, a wider theoretical framework is required for rethinking the core role as well as core competence of the planning profession in China. It entails a diversion from the purely technical discourse and the disciplinary / professional silos, towards a socio-technical perspective. A series of propositions are proposed to evoke more critical discussion about the digital agenda for urban planning and design.

KEYWORDS

Big Data; Data Analytics; Urban Modelling; Socio-Technical; Urban Planning; Urban Design

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① 关于“北京城市实验室”的更多信息，请访问其官方网站。

① Please visit the official website of Beijing City Lab for more information.

关进展包括：规划申请流程的数字化^[2]、建筑信息模型在公共项目中的应用合法化^[3]，以及基于数据和数字工具的、贯穿设计、建造、运营全周期的信息价值链的出现^[4]。

在中国，数据和数字技术在城市规划设计领域发展迅猛。例如，龙瀛创立的城市数据研究网络“北京城市实验室”^①已成为具有领军地位的研究者网络，促进了中国定量城市研究的发展和资源共享^[5]。沈尧和龙瀛^[6]提出了与早期规划设计中的数据应用（如规划支持系统和参数化设计）截然不同的“数据增强设计”（DAD）概念，强调数据对知识生产——而不仅仅是信息校验和可视化——的重要作用。这篇前沿性文章试图探索一个根本性问题：数据分析能够为城市规划设计提供怎样的智力支持。然而，DAD概念的局限在于，其过度关注于如何利用数据优化分析方法，以导出更理想的设计结果，却忽略了设计结果和政策成果本质上的不同。我们需要借助更加完善的理论框架，来探究城市数据分析和建模技术（作为工具）与更加美好且可持续的城市（作为城市规划设计的最终目标）之间的关系。

社会转型趋势使通过规划设计建设更加美好的城市的任务变得更为复杂。这些未来工作和生活模式上的转变可能会带来巨大的社会—经济和环境的影响。因此，我们需要新的实证数据和理论来理解城市规划设计的内在机制和实质内容。“慢城市”等新兴城市设计概念看似为我们描绘了美好的愿景，但其理论内核和政策要点仍未明朗。我们期待数据

1 Introduction

We are living through the “Fourth Industrial Revolution,” moving from a period of relative data scarcity to an era of “digital abundance.” The sheer size of investments and efforts for building “smart cities” across the globe has epitomized the inspiration for future better cities in this digital era. Some industries such as transport, health, and retail have already begun reaping the benefits of data for developing innovative solutions and improving consumer experience. However, in the UK context, it has been observed that the active use of big data analytics is rather less for planning and design processes^[1]. Recent progress includes the digitalization of planning application process^[2], the UK Government’s mandate for applying Building Information Modeling for all public contract^[3], and the realization of the life-cycle information value chain from design, construction to operation through the use of data and digital tools^[4].

In China, the rise of using data and digital technology for urban planning and design is remarkable. For example, the urban data research network “Beijing City Lab”^① established by Long Ying has become a leading network of researchers, promoting and sharing quantitative urban research for Chinese cities^[5]. In a manifesto paper by Shen Yao and Long Ying^[6], the concept of “data augmented design” (DAD) was proposed, which distinguished itself from early data applications in planning and design (e.g., the planning support systems and the parametric design). It emphasizes the instrumental role of data in knowledge production, as opposed to merely collating and visualizing data. Their thought-provoking paper addresses a fundamental question regarding the intellectual role of data analytics in urban planning and design. One limitation of the DAD concept however is its excessive focus on how data may enable a methodological improvement to design outputs while ignoring the inherent differences between design outputs and policy outcomes — a wider theoretical framework is thus required to investigate the link between urban data analytics and modelling (as the means) and better, more sustainable cities (as the ultimate goal for urban planning and design).

The trend changes observed in the society further complicate our goal of building better cities through urban planning and design. These changes relating to the future of work and lifestyle are likely to have profound socio-economic and environmental impacts, which call for new empirical data and theories for understanding the inner mechanisms and the implication for urban planning and design. Emerging urban design concepts such as the “slowing city” are aspirational but the theoretical and policy substance of these concepts is not clearly defined yet. It is

和数字技术能够有效驱动转型，从而能够从早期实践（如智慧城市建设）中获得新的启迪。

中国的智慧城市建设取得了长足发展^[7]，但其工具和目标之间仍存在知识鸿沟。这一现状涉及到一系列关键性研究课题，包括：技术在创造一个更加美好和智能化的城市的过程中的目标角色和实际角色分别是什么？早期的智慧城市实践有哪些经验可供汲取？以及，纯数据驱动型途径在推行优化政策成果方面的局限性包括哪些？对于这些问题的探究将有助于我们吸取前车之鉴，避免数据在城市规划设计领域的应用重蹈早期智慧城市实践的覆辙。本文对这些问题进行了初步研究，以期填补这种知识鸿沟。

2 文献综述

“智慧城市”概念最早出现于20世纪90年代，是一项供给驱动型计划，其利用工程技术与信息技术来促进城市社会—经济发展^[8]。一直以来，智慧城市的核心主张都是技术能够通过“数据”采集、共享、分析和实际应用来打造互联且智能的城市，即智慧城市^[9]。因此，利用硬件生成数据便成为早期智慧城市关注的重点。

罗伯特·G·霍兰德斯^[10]指出，很多既有的智慧城市试点项目最终都沦为了一次性的技术探索，对具体政策目标的实现鲜有助益。因此，仅凭硬件互联本身并不能将个人、企业和政府联系起来。近期对智慧城市实践的全球性评估^[11]进一步证明，技术应用情况与政策成果之间并无显著的直接联系。早期实践大多以购置硬件（例如传感器、网络与分布式计算机）为主要措施；但智慧城市理论基础的缺乏导致了单纯以硬件为导向的智慧城市建设无法实现预期的政策成果^[12]。这一点在城市规划设计行业体现得尤为明显：技术应用与政策成果之间的脱节使得城市规划设计行业难以为各种复杂的城市“慢性病”（如交通拥堵、空气污染和住房短缺）提供有效的政策解决方案。

蒂美阿·诺奇塔等人^[13]提出了审视智慧城市建设的前沿视角，即推动城市智慧化转型的数据和数字技术需要被视为一种社会—技术过

expected that data and digital technology will play a significant role in driving the transformative changes hence lessons from the early initiative i.e. the smart city movement may be useful for guiding the new aspirations.

Smart city development has made great strides in China^[7], while a serious knowledge gap remains between its means and goals. It relates to critical research questions such as what is the intended and actual role of technology in creating better and smart(er) cities, what lessons can be learnt from early smart city initiatives, and what are the limitations of a purely technology-driven approach for delivering improved policy outcomes. Investigation into these questions will help prevent the use of data in urban planning and design from repeating the failures of early smart city initiatives. This paper represents a preliminary study to address the gap.

2 Literature Review

The “smart city” concept first appeared in the 1990s as a supply-driven agenda for deploying engineering and information technologies to support the socio-economic development in cities^[8]. The smart city narrative has been, and still is, dominated by the idea that technology can create interconnected and intelligent (i.e., smart) cities by collecting, sharing, analysing and implementing of “data”^[9]. Producing data through hardware deployment thus has become the primary focus for early smart city initiatives.

Rorbert G. Hollands^[10] argued that it is mistaken to assume that hardware connectivity would naturally transform citizens, businesses, and governments into a connected whole. The criticism is based on the observation that many smart city pilots have ended up with one-off technology demonstrators, without discernable contribution to specific policy goals. A more recent global review of smart city initiatives^[11] further confirmed that links between technology deployment and policy outcome remain obscure and indirect. Given that smart city initiatives are often driven by technology suppliers, existing initiatives tend to be based on where sensors, networks, and computers can be deployed and sold, rather than being based on any distinct theory of how smart cities could and should function in different places around the world^[12]. The loose link between technology deployment and policy outcome is particularly relevant in the urban planning and design sector, where most of the urban policy issues (e.g., traffic congestion, air pollution, and housing shortage) are complex and chronic.

A new, progressive perspective for examining the smart city agenda is provided by Timea Nochta et al.^[13] who

程，而非静态目标。这种社会—技术的视角借鉴自社会科学的成熟理论框架，它为应用数据分析和建模技术进行城市规划设计赋予了新的内涵。一方面，新的数据环境和先进的数据分析技术（如机器学习）的出现，对于规划设计行业来说远不止是技术上的进步——正如沈尧和龙瀛^[6]所说，还改变了我们审视、解读和规划城市的方式。这并不是说，城市规划师和设计师正面临着被时代淘汰的风险；而是意味着，我们需要重新审视和界定规划设计行业在数据革命中所扮演的关键角色及所拥有的核心竞争力。

另一方面，忽略社会—政治因素和制度流程的技术解决方案显然无法带来预期的政策成效。为了解决交通拥堵、房价飙升等城市“顽疾”，我们必须采取全面的政策措施，将数据和技术与价格激励/抑制手段等政策工具结合起来。城市规划设计鼓励将技术与现有城市理论和政策工具相结合。

此外，传统政策制定流程等社会—政治力量也可能会阻碍技术变革。如果数据驱动型手段无法促进决策制定，便可能会被规划师、市民和决策者弃置。回顾历史上的重大技术变革^{[14]-[16]}可以发现，技术和社会环境的良性互动能够在自我迭代中加速技术的应用，最终重构整个社会—技术体系^[17]。为了促进这种良性循环，规划设计领域应注重数据分析和建模技术的渐进式变革，逐步提升并扩展现有规划设计工具与流程，而非彻底推翻重建。

沈尧和龙瀛^{[6][18]}提出的DAD概念是城市规划师和设计师对新数据时代的积极回应。DAD的关键特点是强调对于新兴的多源数据的利用，以提高规划设计决策的合理性、原创性和灵活性^[18]。这不仅是技术层面上的进步，更是一种“本体论上的转变”，让基于特定背景的数据成为探索和理解城市复杂性的有效工具。因此，DAD与通过空间的抽

cogently argued that the use of data and digital technology for smartening cities need to be understood as a socio-technical process, rather than a static goal. This socio-technical perspective, as an established theoretical framework in social sciences, sheds a new light on applying data analytics and modelling for urban planning and design purposes. First, the new data environment and the advent of advanced data analytics (e.g., machine learning) is not a mere technical improvement for the planning and design profession. As pointed out by Shen Yao and Long Ying^[6], it represents a methodological shift in how we examine, understand, and subsequently plan cities. This is not suggesting that urban planners and designers are at risk of becoming obsolete, but emphasizing the need to rethink and redefine the core role and the core competence of the profession in lights of the data revolution.

Second, technology deployment without addressing the socio-political context is unlikely to deliver desired policy outcomes. To tackle “wicked” urban challenges such as traffic congestion and housing affordability issue, it requires a comprehensive policy package, incorporating not only data and technology, but also other policy instruments such as price-based disincentives / incentives. For urban planning and design, it calls for the integration of technology with existing urban theories and policy tools.

Third, socio-political forces including the legacy policy making processes may also resist the technological change. Backlash from planners, citizens, and policy makers may occur if the data-driven approach fails to demonstrate the capability of contributing to informed decision making. Studies into historical major technological transitions^{[14]-[16]} show that positive interactions between technology and social environment would speed up the technology adoption through a self-reinforcing loop and ultimately reconfigure the entire socio-technical systems^[17]. To foster the positive interaction, data analytics and modelling should consider incremental changes e.g. gradually upgrading and expanding existing tools and processes in planning and design, rather than a complete replacement of existing approach.

The concept of DAD proposed by Shen Yao and Long Ying^{[6][18]} represents a timely and active response of urban planners and designers to the new data era. The key characteristics of the DAD lie in the use of emerging, multi-source data to improve the rationality, originality, and elasticity of design / planning decisions^[18]. It implies not only a technological improvement but also an “ontological shift” where context-specific data becomes an additional and

象和归纳过程进行城市研究的早期方法截然不同，它能够整合不同的空间尺度^[18]，并且衔接自下而上和自上而下的规划手法。

除上述优势，DAD也存在一些缺陷。首先，关于DAD的讨论主要局限于专业/学科领域。毋庸置疑，数据能够改善城市规划设计的技术成果，但真正需要加强的是应对交通拥堵、空气质量低下、社会不平等问题的政策成果。所以，我们必须摆脱专业/学科的束缚来审视数据的角色，并钻研探索数据分析技术的应用和政策成果之间的直接关联。其次，从治理层面来说，DAD与基于实证的政策制定密切相关。这种政策制定模式自20世纪90年代以来在经济合作与发展组织成员国中十分盛行^[19]。实践证明，虽然在某些情况下技术进步能够增强实证基础，但并不意味着这些信息就能够被充分应用于规划决策的制定过程中^[20]。在实际决策过程中，相关主体往往有着不同的背景、立场和利益诉求，在采纳何种实证经验这一问题上亦存在天然的壁垒。在一些极端情况下，基于实证的政策制定甚至有可能呈现根据政策筛选信息的趋势。因此，数据量大并不代表实证基础的完善；同样，完善的实证信息也不见得会带来更合理的政策成果。换言之，数据不足未必是中国传统城市规划设计失败的根源^[18]。

龙瀛等人^[21]、万励和金鹰^[22]、万励等人^[23]以及龙瀛和沈振江^[24]开发了一些有望提高数据在城市规划设计中的应用的分析工具。其中，“大模型”——即用于分析地理意义上的大面积区域的高精度城市和区域模型^[21]——是大数据时代运用城市建模技术的早期实践之一。虽然大数据驱动型工具具有广阔的应用前景，但也面临着一系列技术挑战。首先，城市规划设计领域现有的数据分析多聚焦于动态格局识别^{[25]-[27]}和地理特征分类^{[18][28][29]}。研究结果多为描述性结论，虽然能

perhaps more effective lens for discovering and understanding the complexity of cities. The DAD thus contrasts to the early approaches of studying cities through spatial abstraction and generalization. It can integrate different spatial scales^[18] and link both the bottom-up and top-down approaches for planning.

Despite of the novelty, the DAD concept has the following limitations. First, the discussion is predominantly confined by professional / disciplinary silos. Data can indeed augment the technical outputs of urban planning and design, but what should be augmented is the policy outcomes, e.g., less congestion and air pollution and better social equality. The role of data thus must be examined beyond the professional / disciplinary silo and direct links should be explored and elaborated between the application of data analytics and policy outcomes. Second, from a governance perspective, the DAD is closely associated with the concept of evidence-based policy making, which has been widely adopted in OECD (Organization for Economic Cooperation and Development) countries since the 1990s^[19]. The practice since then has shown that technological advancement, though enabling better evidence base in some cases, does not guarantee better utilization of evidence in planning decision making^[20]. Actual policy making processes involve a variety of actors with different backgrounds, perceptions, and interests, which incurs an inherent challenge for agreeing on what is the right evidence to be collected and used. In the rather extreme yet not unusual cases, the evidence-based policy making may turn into policy-based evidence making — bigger data is hence not equivalent to better evidence, and even better evidence does not necessarily lead to better policy outcomes. In other words, lack of data might not be the root cause for the failure of conventional city planning and design in China^[18].

Long Ying et al.^[21], Wan Li and Jin Ying^[22], Wan Li et al.^[23], and Long Ying and Shen Zhenjiang^[24] discussed the analytical tools that potentially support the use of data in urban planning and design. In particular, the “big model,” i.e., fine-scale urban and regional models for a large geographical area^[21], represents an early proposal of applying urban modelling techniques in the big data era. Despite the untapped potential, the big-data-driven approach is subject to a few technical challenges. First, existing data analytics for urban planning and design tends to focus on activity pattern recognition^{[25]-[27]} and classification of geographic features^{[18][28][29]}. The research findings, albeit revealing interesting spatio-temporal dynamics of people and the geography, are mainly descriptive thus see limitations in providing causal explanation of the identified patterns.

够反映出人与地理空间之间有趣的动态时空关系，但却仍无法从根本上解释既有空间格局，需要利用多源数据并结合因果模型来分析其基础行为机制。基于相关性而非因果关系的预测也存在一定问题，且尤其不适用于中长期政策的制定。

其次，相较于结构化调查等传统数据来源，城市大数据往往存在采样偏差和测量误差^{[30][31]}。虽然有时可以通过数据修正来纠偏，但有些偏差难以识别，且可能会导致严重的分析失误。将多源数据彼此关联起来能够有效甄别并有望修正数据偏差^{[32][33]}；另一种有效方法是大数据分析与城市系统模型相结合。万励等人^[34]开展的北京通勤人流预测研究便体现了城市大数据对于系统建模的提升和改进作用。

此外，中国现有的城市数据分析和建模实践往往推崇数据先行，研究课题、方法和范围都是取决于可获取到的数据类型，而非政策问题的本质。这种研究方式的基本风险在于，得到的政策结果并非基于代表性样本的可信数据，因此无益于甚至可能误导政策制定。由此引出的另一个关键问题是：针对特定的政策问题，应该采集哪些数据？本文将在第三章中对这一问题进行简要论述。

需要指出的是，DAD概念仍处于不断完善之中。正如龙瀛等人^[35]的研究结果所示，中国已经通过一系列专业、学术和教育项目探索并检验了DAD概念及其在设计实践中的应用。例如，一年一度的中国DAD大会和清华大学新近开设的“大数据与城市规划”研究生课程。由此看来，DAD已经产生了一定的影响力，并在城市规划与设计应用中初见成效（如基于实证的决策制定重新引起重视）。此外，中国近年出台的相关政策强调通过统一的国土空间规划方案改善国家规划体系，要求地方政府开发国土数据平台，整合多源地理数据，运用先进信息

To investigate the causality, it is necessary to consider the underlying behavioural mechanisms, which in turn require multi-source data and the combined use of data and causal models. Predictions based on correlation rather than causality are also problematic, particularly for medium- to long-term policy forecasts.

Second, compared with conventional data sources, e.g., structured surveys, urban big data is prone to sampling biases and measurement errors^{[30][31]}. While some biases are amenable to statistical corrections, some are difficult to identify and may result in significant analytical errors. Linking data from multiple sources is an effective way to detect and potentially correct data biases^{[32][33]}. Another useful approach is to combine big data analytics with urban system models. Wan et al.^[34] demonstrated the complementarity of urban big data with system modelling through the case study of estimating commuting flow in Beijing.

Third, existing urban data analytics and modelling exercise in Chinese cities tends to follow a data-first strategy in the sense that the thematic focus, methodology, and the scope of the research is defined by whatever data that is available, rather than the nature of the policy question. There is a fundamental risk associated with this approach — policy implications drawn from it are not based on the appropriate data input from representative samples, thus are less useful or even misleading for policy making. It also leads to a critical question in terms of what data is required given a specific policy question. It will be discussed shortly in the next section.

It is worth noting that the development of the DAD concept is progressive. As demonstrated in the study by Long Ying et al.^[35], the DAD concept and its various applications in design practice have been explored and tested through a series of professional, academic, and educational programmes in China, such as the annual DAD conference in China and the newly-established “big data and urban planning” postgraduate course at Tsinghua University. It seems that the DAD initiative is gaining traction and starts to drive positive changes (e.g., a revival of evidence-based decision making) across the urban planning and design industry. Recent policy initiatives in China to improve the national planning system through a unified territorial and spatial planning scheme is another driver of change: it includes a mandate for local governments to develop territorial data platforms by integrating multi-source geographical data and applying advanced information technology for policy analysis and monitoring. The new data platform, if properly established and managed, can create a shared evidence base for improving policy coordination in

技术进行政策分析和监管。如果开发和管理得当,新的数据平台将为空间规划的政策协调改进提供共享实证基础。DAD概念作为将大数据运用于城市规划领域的早期实践,有望为国土空间规划方案的实施提供有益指导。

3 具体建议

基于上述文献综述,笔者就如何加强数据分析和建模技术在中国城市规划设计领域的应用提出了5项建议,并基于社会—技术框架对这些建议进行了进一步探索^[36]。

(1) 重视政策实效,而非技术产出

在城市规划设计领域引入数据的目的在于收获更好的政策成效,而非技术产出。因此,应该从社会—技术视角思考如何生成、分析、解读数据并将其用于规划政策的制定和实施。

第一个建议是,在城市规划设计中,数据及建模方式的应用应基于恰当的理论框架。早期智慧城市实践^[13]的经验表明,纯技术视角(即仅关注技术实施而忽略社会—政治环境)在方法论上存在明显缺陷,无法充分发挥数据分析的潜力。要想真正取得政策成效,在应用城市数据分析和建模技术的同时,必须对治理结构和流程进行制度性改革。数据分析技术和城市治理相互影响:城市数据分析和建模技术需要、同时也推动着制度性改革,由此才能有效发挥其对政策制定和实施的支撑作用;城市分析和建模技术的开发和应用应着眼于治理体系的具体特点,且必须制定更具前瞻性的政策措施,以规范数据使用,降低潜在风险。

鉴于中国的城市规划背景,数据所蕴含的巨大潜能极大地改变了我们研究、规划以及管理城市的方式。城市大数据集正被应用于越来越多的城市规划之中。一方面,为改善规划政策成效,必须将城市数据分析的技术产出转化为有效的政策措施,针对性地解决具体的城市问题。另一方面,为了充分挖掘数据的潜力,必须进行制度性改革

spatial planning. The DAD concept, as an early attempt to use big data in urban planning and design, is expected to provide useful insights for implementing the territory spatial planning scheme.

3 Propositions

Based on the literature review, the authors propose five propositions about advancing the use of data analytics and modelling in urban planning and design for Chinese cities. These propositions are inspired by the observation of the recent surge of big data in the planning industry in China and are further explored through the socio-technical framework^[36].

(1) Deliver policy outcomes rather than technical outputs

The role of data in urban planning and design should aim at delivering better policy outcomes, rather than technical outputs; a socio-technical perspective is thus required for examining how data is generated, analysed, interpreted, and utilized in planning policy making and implementation.

The first proposition relates to the selection of an appropriate theoretical framework for examining the use of data and modelling in urban planning and design. Lessons from early smart city initiatives^[13] suggest that a purely technical perspective, i.e., merely focusing on implementing the technology without explicitly addressing the socio-political environment, remains a major methodological drawback in utilizing the full potential of data analytics. In order to make a real policy impact, urban data analytics and modelling must be accompanied by institutional changes in the governance structure and processes. The relationship between data analytics and urban governance features a two-way interaction: Urban data analytics and modelling require and drive institutional changes so that the analytical power can effectively support policy making and implementation; The development and application of urban analytics and modelling should address specific characteristics of the governance system while proactive policy measures are required to regulate the use of data and mitigate possible risks.

In the context of urban planning in China, the emerging data capability has made a discernible impact on how we study, plan, and manage cities — more and more city plans incorporate inputs from urban big data sets. On one hand, for improving planning policy outcomes, the technical outputs of urban data analytics need to be translated into robust policy insights into specific urban challenges. On the other hand, institutional changes (for example, changes on the administrative procedure of urban planning and on regulating

(如改变城市规划管理流程、规范个人数据使用方式和共享机制)。从社会—技术的视角出发将更有助于理解这种数据分析技术和城市治理间的双向作用。

(2) 以发展的眼光审视规划技术方法的改进

数据分析与城市规划设计的结合是一个渐进式进程，技术手段的优化与政策制定过程的完善必须齐头并进。

这项建议主要关注数据分析技术与支持并运用这项技术的社会体系之间的关系。这涉及到一个基本问题：城市数据分析和建模技术能够为规划行业和社会带来哪些智力贡献。一方面，我们关于城市的既有知识决定了我们使用和评估城市数据分析结果的方式；另一方面，新兴数据科学——特别是人工智能（AI）的应用——将会更新我们对城市的认知，甚至会产生一些超出人类认知的发现。因此，理论上讲，AI赋能下的计算机算法也许会用于指导人类进行城市规划和管理。但我们不能寄希望于让AI“自动”解决城市问题，原因有二：首先，城市规划是一种公共政策制定过程，需要各方根据实际情况反复讨论权衡；AI或其他分析工具能够促进但无法取代这种利益相关方之间的沟通协商。第二，在城市规划设计领域中的AI应用发展依赖于当代规划师和设计师的投入和合作。大多数规划师/设计师已经认识到了数据的潜力，但仍未就如何将数据分析技术融入现有决策过程达成一致。这些从计算机科学领域借鉴而来的技术在城市规划领域拥有广阔的前景，也已应用在诸多城市之中，但规划师和设计师不应将城市数据分析技术等同于解决城市问题的工具。数据分析技术的应用必须与规划决策流程的完善，以及城市规划和设计从业者的核心素养培养齐头并进。

(3) 采用政策导向型研究方法

为了更好地指导规划政策制定过程，需要进行战略转型：对不加筛选地使用所有能获取到的数据的现状进行意识与观念转变，倡导针对性地采集恰当的数据。

城市数据研究和实践的目标和范围往往取决于数据获取的难度，而非对具体政策问题的回应。部分城市大数据分析仅是在其所能获取

the use and share of personal data) are required to exploit the new capability of data. The socio-technical perspective provides a useful framework for investigating the two-way interaction between data analytics and urban governance.

(2) See the promotion of planning technology with a developing perspective

The integration of data analytics and urban planning / design is a progressive process; technical apparatus and policy making process must co-evolve with each other.

This proposition is about the intellectual relationship between data analytics and the social system that builds and uses it. It addresses a fundamental question — what intellectual value urban data analytics and modelling can offer to the planning profession and the society. On one hand, our existing knowledge about cities defines how well we could use and evaluate the analytical outputs of urban data; on the other hand, the emerging data sciences, particularly the application of Artificial Intelligence (AI) could potentially produce new knowledge that complements or even surpasses ours. Therefore, there is a possibility in theory that computer algorithms, empowered by AI, could tell us how to plan and manage our cities before we know how. But perhaps we should not get too excited by the alleged prospect that AI could solve city problems “automatically” for two reasons. First, urban planning is a public policy making process where evidence-based debate over complex trade-offs is essential. AI or other analytical tools can facilitate, but should not replace stakeholder debates. Second, the advancement of AI applications in urban planning and design relies on the inputs and cooperation among planners and designers. Presumably, the majority of planners / designers recognize the power of data, but a consensus of how to integrate data analytics with existing plan-making processes is not necessarily evident. The technology adopted from computer sciences to urban planning seems promising, as reflected in numerous AI applications in cities, but planners and designers should not consider urban data analytics a means to solve urban issues as the end. The application of data analytics thus must co-evolve with the plan-making processes, as well as the core competence of urban planning and design professionals.

(3) Apply policy-oriented approach

To better inform planning policy making, a strategic transition is required from using whatever data available to ethically collecting appropriate data to address specific policy issues.

It has been observed in urban data research and practice that the aim and scope of exercise is often explicitly defined by

的所有数据的基础上做研究，然后再反向去看研究结果可能解决哪些政策问题（即数据先行的研究方法）。与之相对的是政策导向型研究方法，即根据具体的政策问题来确定并不断调整研究的数据需求。这类似于气象学中的天气预报建模，预报模型的完善不仅依靠运算能力的提升和数据的积累，还依靠对于有助于改进预测结果的数据的不断探索。

规划研究中的数据先行问题在发展中国家尤为突出。这些国家对于数据采集和使用的监管相对松散，有些数据在采集时可以不基于特定的政策目的，也不用考虑相关的隐私/安全问题。在政策制定的信息收集阶段，也存在非法、不道德或片面（即使目的相关）使用数据的问题。因此，从数据先行向政策导向的研究方式的战略转型至关重要。我们要开展更多研究，探索具体政策问题的数据采集范围，并建立起相应的符合伦理规范的数据采集和共享方式。

（4）重视规划决策的风险评估

通过推进跨学科/跨专业的合作（而非依赖单一的模型方案优化），合理利用城市数据和建模技术判断系统性风险和效率问题，从而有效应对复杂的城市问题。

政策问题，特别是与城市相关的问题往往非常复杂，需要跨学科的系统性解决方案。以解决这些城市挑战为目的的城市数据分析和建模技术，已用于有效评估新型政策方案的优劣势，揭示出政策制定的过程中由缺乏协作所导致的系统性风险和效率低下问题。系统性优化虽然是商业数据服务的常用卖点，但对于城市“顽疾”往往成效甚微。原因之一在于数据分析师通常是技术背景出身，他们对于非技术因素（如政策制定者所面对的决策制定层级、制度性限制，以及决策过程中的反复权衡）的理解不够全面。这些非技术因素往往非常重

data availability, rather than the actual needs of answering or informing a specific policy question. Some urban big data analytics use whatever data that is available and subsequently explore how the findings may be relevant to certain policies (namely a data-first approach). It contrasts to a policy-oriented approach where data requirement is defined and progressively refined according to the policy questions of interest. A useful analogy perhaps is the weather forecast modelling in meteorology, where the advancement of forecast modelling is driven not only by the increasing computing power and the amount of data collected but also by a progressive understanding of what data is required to improve the prediction.

The issue of data-first approach in planning research is particularly relevant in developing countries, where regulation on the collection and use of data is relatively loose. Sometimes, data is collected without an explicit policy purpose or privacy / safety considerations. The value of data for informing policy making may be compromised by using illegal, unethical, or partial (though relevant) data. The strategic transition from the data-first approach to the policy-oriented approach is thus critical. More research is required for identifying the right data inputs given specific policy issues, and developing an ethical and coordinated approach for collecting and sharing data.

（4）Strengthen risk assessment of planning decision making

To help solve complex urban challenges, a realistic use of urban data and modelling is to identify system-level risks and inefficiencies by promoting trans-disciplinary / professional collaborations, as opposed to through a singular model-based optimization.

Policy challenges, particularly those pertaining to cities are cross-cutting and require a systematic, inter-disciplinary approach. Urban data analytics and modelling, once purposefully constructed and validated, provides a useful policy simulator for exploring the strengths and weaknesses of alternative policy options. Furthermore, analytics and modelling may reveal system-level risks and inefficiencies which are usually caused by the lack of coordination in policy making. System-level optimization, though being a typical selling point of commercial data services, may be not an effective approach to those “wicked” urban problems. One of the reasons is that data analysts, given their technical background, often do not have enough understanding of the non-technical factors (e.g., the hierarchies of decision making, institutional constraints, implicit trade-offs faced by

要，但却很难整合到分析模型之中——如果模型方案优化不考虑这些非技术限制，那么就将毫无意义可言。因此，城市数据与建模技术的一种现实应用价值在于诊断政策制定过程中的主要风险和效率问题。

(5) 不过于依赖数字技术

即便有了数据分析和建模技术，所有城市问题也未必会迎刃而解；一些特定问题也未必一定要依赖于数字化解决方案。

新兴的数据源虽然为城市规划和管理提供了更多可能性，但我们不应将之视为解决所有政策问题的“万金油”。城市建模能够为城市政策制定提供有效的模拟环境，测试各种政策方案，弥补现实的不足。虽然在模型算法中植入AI有助于政策设计，但在可见的未来，设计政策仍然会由人类主导。对于社会不公平和住房短缺等城市问题，数字化解决方案往往因其无法直接回应潜藏的社会—政治问题而收效甚微。事实上，这些问题也不会仅仅依赖于数字化解决方案。虽然在数字技术和数据方面的投入有助于采集实证信息，但探究问题的内部机制和根源因素亦不容忽视。

4 结论

数据分析和建模技术在中国的城市规划设计领域取得了快速发展。基于这一事实，本文旨在填补利用数据制定有效政策成果与获得技术产出之间的知识鸿沟。这种鸿沟最初来源于早期世界各地的智慧城市建设，在该领域，技术应并没有带来预期的政策成效。我们需要从早期实践中汲取经验，避免在中国各大城市上演的规划设计数据革命重蹈覆辙。

沈尧和龙瀛^{[6][18]}关于DAD的相关文章是中国城市规划师和设计师对新数据时代的积极回应。虽然DAD看似为我们描绘了美好的愿景，但也存在一定的局限性和技术挑战。本文提出的一大观点是，为了充分发挥数据分析在城市规划设计领域的巨大潜力，亟需引入更加完善的理论框架，来重新审视规划设计行业在数据时代所扮演的关键角色及

policy makers)。These non-technical factors are usually highly influential but tend to be very difficult to be incorporated in the analytical model. A model-based optimization which does not consider such non-technical constraints would have little meaning. Thus, a realistic use of urban data and modelling helps identify major risks and inefficiencies in policy making.

(5) New possibilities, but not a panacea

Data analytics and modelling do not necessarily provide direct solutions to city problems, and certain problems do not lend themselves to a digital solution.

Although the emerging data sources open up new possibilities for planning and managing our cities, it should not be seen as a panacea for all policy challenges. For city-scale policy making, urban modelling provides a useful simulation environment to test various policy options, which is rarely possible in real world. Nonetheless policy design is likely to remain a task for humans in the foreseeable future, even if the AI embedded in the model algorithm may eventually be able to propose policy designs. For some urban challenges, such as social inequality and housing crisis, a digital solution tends to be less effective as it does not directly address the underlying socio-political causes. In fact, these issues may simply not lend themselves to a digital solution. The investment on digital technology and data, albeit being helpful in terms of collecting evidence, should not overshadow the efforts of investigating the inner mechanism and root causes of the issues.

4 Conclusion

Inspired by the fast take-up of data analytics and modelling in urban planning and design in Chinese cities, this paper aims to address a serious knowledge gap in terms of using data to deliver better policy outcomes rather than technical outputs. In fact, such a knowledge gap has emerged in early smart city development across the globe where technology deployment failed to deliver the expected policy benefits. Lessons thus can be, and should be, learnt from early experiments to prevent the data revolution in planning and design in Chinese cities from repeating the same failure.

The papers on the DAD by Shen Yao and Long Ying^{[6][18]} represent a timely response from Chinese urban planners and designers. Despite of being aspirational, some limitations as well as technical challenges of the DAD concept are discussed in the paper. One of our key arguments is that, in order to leverage the power of data and analytics for the urban planning and design industry, a wider theoretical

所拥有的核心竞争力。跳脱出纯技术论调（即掌握了数据，所有城市问题便迎刃而解）和学科/专业路径，本文提供了一种审视该问题的社会—技术视角。为了进一步填补这种理论和实践上的鸿沟，本文还提出了一系列建议，期望引发更多关于城市规划设计中的数字化浪潮的批判性讨论。

本文批判了城市规划研究和实践中存在的数据先行倾向，这种研究方式的根本风险在于，其所得出的政策结果并非基于代表性样本的可信数据，因此无益于甚至可能误导决策。我们需要引入政策导向性策略，即充分考虑政策问题的本质，在适宜的时空尺度上选择恰当的数据，并建立起相应的符合伦理规范的数据采集和共享方式。

同时，本文建议未来研究应该更多地关注中国城市，分析那些通过针对性地提高规划体系效率对数据进行有效利用，创造了良好的政策成效的最佳实践。规划师和设计师也应该积极涉猎地理学、经济学、生态学、管理学和政治学等城市学科的知识，利用这些学科的方法论和理论框架进行真正的跨学科实践，从而在数字时代背景下对“慢城市”等新兴设计理念进行积极探索。LAF

framework is required for rethinking the core role and the core competence of the planning profession in the data era. It entails a diversion from the purely technical discourse (i.e., data being the panacea for all city problems) and from the disciplinary / professional silos, towards a socio-technical perspective. To address the knowledge and practice gap, a series of propositions are proposed to evoke more critical discussion about the digital agenda for city planning and design in Chinese cities.

The paper also criticizes the tendency of a data-first approach in urban planning research and practice. It leads to a fundamental risk that policy implications drawn from it are not based on the appropriate data input from representative samples, thus are less useful or even misleading for policy making. It calls for a policy-oriented strategy — given the nature of the policy question of interest, collecting the right data at the appropriate spatial-temporal scale and managing / sharing the data in an ethical and coordinated manner.

In terms of suggestions for future research, it seems important to re-identify best practice across Chinese cities where discernable policy contributions are made by effective use of data through a purposely streamlined planning system. It may be also beneficial for planners and designers to reach out to other urban disciplines, e.g., Geography, Economics, Ecology, Management, and Politics, the established methodology and theoretical frameworks from which may contribute to a truly inter-disciplinary approach for exploring novel design concepts such as the “slowing city” in the digital era. LAF

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