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## Urban Synthesis: A Case Of Data Driven Practices In Urban Design

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### Abstract:

Urban areas or Cities are home to world's majority of population. There are no cross roads to the intense use of technology by humans for the smallest or the tiniest job in the everyday life. While unknowingly creating tons of data which could reasonably benefit themselves while negotiating with the space in the long run. Considering the recent trends and its human benevolence, use of technologies to demonstrate case specific urban issues and their investigation persist to be the newer avenue of research. The aim of this research paper addresses the deep understanding of the nexus between negotiation of humans in the urban realm and the digital technology. The idea here is to elaborate with the trending digital technology of data creation, data synthesis and data analysis.

Keywords: Urban Analytics, Urban Synthesis, Technology, Big Data, Urban Realm

### 1. Introduction

The synthesis of the urban sphere and the technology is the newer trend to the human realm. There have been very petite ideation and research being done where both these domains come together for a prospective better tomorrow. 'Urban Synthesis' as the word suggests, is the fusion or blend of human interaction with the urban realm and the lifestyle which in a way comprehends to the way of living which includes the technology in the minutest of the everyday activities. There has been an extensive urge to this fusion of research where we closely look at the betterment of the human society using technology without compromising the ecology and the environment. Having understood the basis of the human-computer interaction, it's important to recognize their future together and not as individual entities. Man has always been a producer of large quantities of data most often without knowledge but this has led to some technological heavy innovations. The research, discusses few of such ideations and technology led innovations and their future in the urban realm and urban design practices.

Technology advances at a breakneck pace. Technology is constantly improving, whether it's self-driving vehicles, robotics, or heavy autonomous devices. Both of these solutions, however, depend heavily on data, which has become the new oil for companies of all sizes and kinds, as well as sophisticated analytics technologies to analyze the data. Since big data is so important in driving digital change, data analytics helps leaders to interpret their data and gain actionable insights. While, in the new age times of the digital world, data are generated at high speed from various sources and the fast transition the digital technology has led to growth of big data (Gupta & Nimbire, 2019). Big data analytics has fascinated passionate interest from all academia and industry lately for its effort to excerpt knowledge, information and intelligence form big data. Big data and cloud computing, two of the most important trends that are defining the new emerging analytical tools (Chawda & Thakur, 2016).

The Users are producing massive quantities of data, but it isn't just humans. More items and computers are linked to the internet as a result of the Internet of Things (IoT), allowing companies to collect data on user use habits and product results. The rise of machine learning has resulted in still more details. Although big data has come a long way, its utility is just starting. (What is Big Data?, n.d.). Cloud computing has opened up many more opportunities for big data. To evaluate a portion of data, programmers may easily create ad hoc clusters, which provides fully scalable scalability. With their ability to view large volumes of data in a way that makes analytics quick and detailed, graph databases are also becoming more relevant.

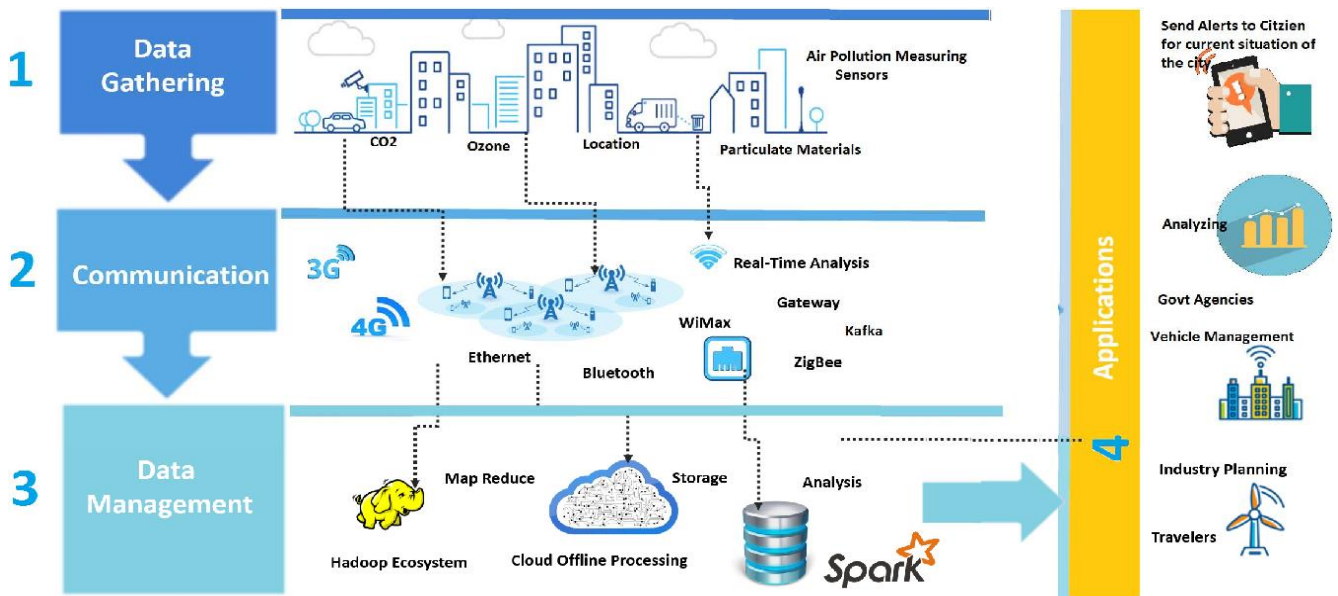
Instrumentation, ratification, and computing are rapidly pervading the very structure of cities, thanks to the big data movement. Cities have become increasingly reliant on big data technology. As a result, urban structures and activities are becoming increasingly sensitive to a form of data-driven urbanism that is the primary mode (Bibri & Krogstie, The Big Data Deluge for Transforming the Knowledge of Smart Sustainable Cities: A Data Mining Framework for Urban Analytics, 2018) of smart city development. In view of the accelerating urbanization pattern, certain forms are increasingly being geared toward addressing the problems of sustainability. While this research paper explores the very domain of big data, its usability and functionality in the urban realm while considering its accessibility and authenticity. Technology has no bounds and has been overarching impression to the development of cities, town and recently to the villages. Data has technologically driven the lifestyle of humans and it won't be obsolete in the current times. While data has been demonstrating improved solutions to the living conditions, easing human efforts without compromising the efficiency. The analytics of big data, where the actual data manifestation happens is the newer avenue of research making it more reasonable to explore with the changing time.

**Figure 1:** Big Data & Analytics

Source: Exploiting Big Data Analytics for Smart Urban Planning (10.1109/VTCFall.2018.8691036)

## 2. Objective

The research aims to understand the concepts of big data and analytics and its usability in the urban realm. Further, it



tries to explore the trending domain of researches like Internet of Things, Artificial Intelligence and Machine Learning and Urban Analytics. The idea here is to recognize various trends in the realm of technology and urban design. The research tries to resolve the following objectives –

- Understand the idea of big data and analytics
- Understand the latest trends in application of big data in urban design
- Analyze the approachability and usability of big data analytics in the arena of urban design
- Explore the need of urban analytics as an important part of urban research domain

## 3. Methodology

The research focuses on secondary data collection from various research articles. The research approach is very much exploratory where, research aims to explore the foremost aspects of big data and the subdued concern of its utility in everyday urbanism which happens to be neglected. The methodology of this review is divided into two parts: 1) manuscripts are collected that summarize the accessibility of big data in urban realm, 2) manuscripts are collected



that reflect the application big data in urban realm and also its usability in understanding the urban problems. It is a known fact that big data drives decision making and hence is responsible to curate urban life cycle. Big data as understood as unsegregated data is collated and further concentrated to form a subjective analysis for the desired case issue. The idea of big data analysis rests to resolve issues which require attention through systematic approach and investigation. The methodology hence included understanding manuscripts which highlighted the functionality of the data production, usability (modeling) and decision making.

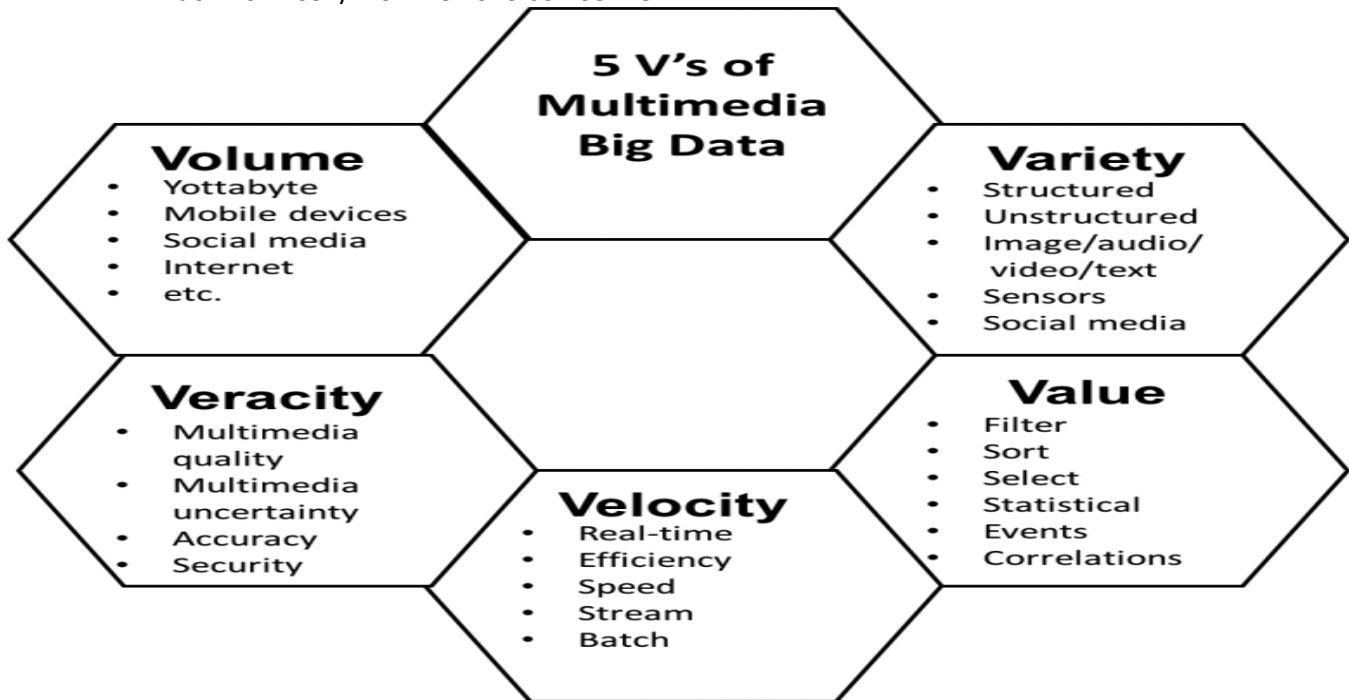
The idea here is to understand the newer trends in technology which in this research article highlights big data and its penetration in the urban realm. The methodology highlights the theoretical framework involved and its subjective analysis leading to a conclusive research problem. While understanding the cities at large it seems to be a data driven and technology oriented approach where human needs and apprehensions seem to be disconnected. The literature review beholds a dynamic overview of extensive research done by multiple researchers in the realm of technology, big data and urban analytics. The articles selected as a part of secondary research abetted in understanding the outreach of this evolving trend in the IT industry and its future impact. This research article highlights the common features across the researches and tries to exemplify the necessary need of big data in urban design. As mentioned above, this article tries to synthesize the two domains of technology and urban design.

#### **4. Big Data and Urban Realm**

Big data is a broad term for data collections so huge or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization and information privacy. (Big Data, n.d.). The origins of large data sets can be traced back to the 1960s and 1970s, when the world of data was only getting started with the creation of the first data centers and the advent of the relational database. People started to notice the quantum of data, the users created from Facebook, YouTube, and other online services around 2005. Hadoop (an open-source platform for storing and analyzing large data sets) was built. In the course of this time, NoSQL mounted to prominence. The development of big data was aided by the emergence of open-source systems such as Hadoop (and, more recently, Spark), which made big data easier to work with and store. The amount of big data has exploded in the years since then (What is Big Data?, n.d.).

Big Data makes available evolutionary developments in various fields with collection of big datasets. In general, it denotes to the collection of huge and complex datasets which are challenging to process by means of traditional database managing tools or data processing applications. The growing complexity of present-day urban design stretches traditional design approaches to their limits. Innovative methods and tools are obligatory to enhance upkeep of the urban designers in addressing environmental, organizational, and societal challenges. Designing sustainable, resilient, and livable urban environments is enabled by iteratively testing and evaluating the performance of a given design as part of the design process (Koenig, Miao, Aichinger, Knecht, & Konieva, 2019). The better amalgamation of urban analytics, optimization, and generative methods into urban design thus institutes one of the vital challenges that the development of design aid tools witness. Tools are required that can provide diverse phases of the planning design process and offer a malleable environment to address numerous design glitches and frameworks.

##### **4.1 About Big Data**



The definition of big data is data that contains greater variety, arriving in increasing volumes and with more velocity. This is also known as the three Vs. As such, big data refers to broader, more complex data sets, including those derived from new data sources. Since these data sets are so large, conventional data processing tools can't handle them (What is Big Data?, n.d.). However, these large volumes of data could be used to solve issues that you previously were unsolvable. Meanwhile, the exact definition for big data is not defined and there is a believe that it is problem specific; which means that it helps user in obtaining enhanced decision making, insight discovery and optimization while being innovative and cost-effective. (Kravchenko, 2019).

Big Data are available in structured, semi-structured, and unstructured format in petabytes and beyond (Gupta & Nimbire, 2019). It is generated naturally as a part of transactional, operational, planning and social activities, or the linkage of such data to purposefully designed data. (Thakuriah, Tilahun, & Zellner, Big Data and Urban Informatics: Innovations and Challenges to Urban Planning and Knowledge Discovery, 2016). The use of such data raises technical and analytical issues, as well as complexities in the science model and political economy that underpins investigation.

Big data has five attributes, according to the 5V definition: volume, variety, velocity, variability, or value. Data is the oil of the 21st century and organizations today in different industries are realizing this quickly. Insights obtained from high volume, high velocity and validated data collected from varied sources can add value to the overall decision-making of the company. (Sheriff, 2019). While most organizations today intend to use data, many are having difficulty capturing, storing, processing, or harnessing information effectively. Big Data broadly functions in the following three processes – Integrate – Manage – Analyze. Where the data is classified, filtered and brought to use. There are numerous techniques and software to gather, collect data, store, segregate data and further on to analyze data. Big Data has substantially seen unforeseen growth in various fields. The only point of concern remains whether the data collected is authentic and has adhered to the privacy regulations.

#### 4.2 Big Data and Technology

The introduction of autonomous vehicles (AV), robotics, machine learning (ML), internet-of-things (IoT), block chain, augmented reality (AR), and virtual reality (VR) technologies, in particular, has sparked widespread debate about AI's future (Yigitcanlar, et al., 2020). With this known, it's important to extensively understand their usability in today's realm. Most of the data collected or gathered is through sensors, IoT and other multimedia and social media channels



which in a way assist the global trends of technology. Reiterating the above mentioned, use of data has surged to very high. And its implications to gathering and computing data has led to new innovations in the field of technology.

#### **4.2.1. Internet of Things**

Internet has restructured global interrelations, the art of businesses, cultural revolutions and an unbelievable number of personal characteristics. Currently, machines are getting in on the act to control innumerable autonomous gadgets via internet and create Internet of Things (IoT) (Gupta & Nimbre, 2019). Thus, appliances are becoming the user of the internet, just like humans with the web browsers. Internet of Things is attracting the attention of recent researchers for its most promising opportunities and challenges (Gupta & Nimbre, 2019). It has an imperative economic and societal impact for the future construction of information, network and communication technology. The new regulation of future will be eventually, everything will be connected and intelligently controlled.

The concept of IoT is becoming more pertinent to the realistic world due to the development of mobile devices, embedded and ubiquitous communication technologies, cloud computing, and data analytics. Moreover, IoT presents challenges in combinations of volume, velocity and variety. In a broader sense, just like the internet, Internet of Things enables the devices to exist in a myriad of places and facilitates applications ranging from trivial to the crucial. Conversely, it is still mystifying to understand IoT well, including definitions, content and differences from other similar concepts. Several diversified technologies such as computational intelligence, and big-data can be incorporated together to improve the data management and knowledge discovery of large scale automation applications.

#### **4.2.2. Artificial Intelligence & Machine Learning**

The application of Artificial Intelligence in urban planning and management is decisive and indispensable. It assists to make the urban areas advanced with cutting-edge amenities and offer people an improved living environment. Cities are said to have a predominant liability for the impact on its inhabitants. Cities are harnessing the perks of technological advancements and utilizing the recent artificial intelligence (AI) technologies as part of the continuous need to enhance economic growth and development; the goal would be to massively increase sustainability through the effective use of energy and resources. Technologies that control AI are presently being used in many cities across the globe to augment their urban functionality and service proficiency. For example, the smart grid initiative acts as one of the foundations for the utilization of AI in cities; it facilitates spatial navigation in the form of interactive and automated systems that use data processing technology to reveal the dynamics of the urban grid (Yigitcanlar, et al., 2020). In this approach, digitalization has facilitated cities to categorize precise needs, leading to improved efficiency and economic performance; which further allows AI to offer a chance for better city governance.

AI concepts and technology have the potential to impact and enhance how cities serve their residents, providing everyone with the desirable and sustainable urban futures. In recent years, there has been a lot of talk about AI across the globe. AI can aid with planning by binding together frameworks that include critical factors like culture, metabolism, and governance, and assuring that they are gratified. To attain a more comprehensive view of the urban fabric, data can further be gathered from a variety of sources. This aids planners and regulators to move away from complex systems (interconnected urban parts) and toward an accessible, splintered peri-urban fabric that has real-world associations for density fragmentation, cohesion, and compactness. As our urban spaces develop, AI seems to become a treasured part of the planning process – not simply as a tool, but as an informative and creative force that can help us understand our world and provide new ways to approach design.

### **5. Big Data & Urban Analytics**

The term urban analytics has arisen in the context of processing big data for a range of applications in cities, in particular 'smart' cities (Batty, 2019). "The City" cannot be defined as a singular entity. Each city or urban area is made up of smaller units—such as neighborhoods, blocks, council districts, wards, or school districts—each inhabited by individuals with particular needs and expectations. (Unsworth, Forte, & Dilworth, 2014). While, smart cities are assemblies of various conscious and associated built environments, which hold components that acquire from configurations of daily activity and acclimatize habitually to changes in such behaviours. This is made likely by the



scaling down of computers to the point where they can be embedded in the everyday objects and activities alongside advances in sensing and computing power, all of which allow for the ubiquitous integration of microelectronics into the physical world. (Kandt & Batty, 2021).

Considering the case example of CityScope platform developed by City Science group at the MIT Media Lab influences data-analytics, computation, visualization methods and spontaneous interface, to propose advantages over traditional planning and urban design practices. It permits for the quick assessment of urban interventions which integrates analytical and visualization mechanisms to aid vigorous or iterative, evidence-based decision making between traditionally siloed stakeholders extending from community members and government officials, to domain experts and technicians. These innate data-visualizations assist to streamline complex urban systems for users of varying disciplines and levels of expertise. (Alonso(B) , et al., 2018). The amalgamation of a tangible user interface and real-time response enables consensus-building through shared experimentation letting multiple stakeholders to address an extensive array of interests concurrently. Lastly, the analysis and models triggers the feedback allowing the planning process to become more apparent, data-driven and evidence-based.

Deriving from the above, there has been a growing research interest in the many parts of the world. Urban Analytics is the new trending domain where the data captured by humans can further be resolved to solve urban issues. Curating this can further help to understand the plausible micro-areas of investigation for a better accessibility to the urban design and city level problems.

## 6. Conclusion

New information technology proposes the citizens with innovative potentials of involvement in the urban design processes. Critical goals and tasks to realize with the use of different media be it to offer communication platform subduing a hurdle of non-professionalism, permit for distant contacts, manage a participatory planning process. Information and Communication technology is one of the many ways to build the newer and sustainable cities with the modest approach of participatory planning. People are the lifeline of the cities and hold an integral part in the planning and design process hence giving a chance to benefit their living seems to be a wiser decision. The idea of introducing use of big data and analytics or rather urban analytics is a way to induce the idea of futuristic model of technology in the restrained system of city governance and planning.

The urban design perspective brings in the question of “design in science”, how urban design decisions are made through systemic and scientific processes with consideration of driving ecological, social or economic factors (Yang & Yamagata, 2019). They comprise of standardized questions about how well the city forms are designed, and a progressive perspective for foreseeing cities as integrally flow-driven spatial organizations, a form of urban metabolism. It accords with how cities can be curated through stimulating performance and system resiliency. As a matter of fact, big data has a daunting impact on the creators and the users. It also has its own short comings but if utilized for a reasonable cause and motive it can create miraculous impact on the human lives. To conclude, it is important to rationale the idea of technology and urban design. And further associate the same to the immediate future and take it ahead to resolve the issues in planning and urban design.

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