CITIES
IN THE AGE OF EXPERIENCE
Position Paper

Cities not only face enormous challenges, they are also by their very nature ever-evolving environments that are becoming increasingly complex as sensor technology and hyperconnectivity become more pervasive. Fortunately, like all other dynamic, complex systems, cities can benefit greatly from 3D collaborative technology to model, simulate, visualize and experience complete cities in a virtual environment. The Dassault Systèmes answer to the growing challenges cities face is **3D**EXPERIENCE®City, powered by the **3D**EXPERIENCE® platform, a 3D collaborative environment that puts people—citizens, officials and business people—at the heart of urban renaissance.

URBAN CHALLENGES, RESILIENT CITIES

The facts are well known: by 2050, three billion additional people, or two-thirds of the world's population, are expected to be living in cities, which today produce 80% of global GDP, consume 75% of the world's natural resources and produce approximately 75% of the global greenhouse gases.

Globalization, urbanization, and climate change present significant challenges to cities worldwide. With the majority of the world's cities located on coastal waterways, cities are especially vulnerable to the effects of the extreme weather and rising sea levels.

In addition, with the increasing deployment of connected sensor technology, cities are rapidly growing beyond the capability of planners and city managers to administrate effectively. In parallel, urban residents and visitors, accustomed to the personalized experience of the web enabled by their smart devices, have ever-higher expectations for how technology will facilitate more engaging life, work and play experiences in the urban context.

This dynamic urban evolution presents a unique opportunity and challenge for city administrators, faced with the task of coordinating an ever proliferating field of specialized domains, each of which is itself constantly growing in depth and complexity.

While cities cannot predict the disruptions they will face, they can become sufficiently resilient to adapt to potential disturbances, learning from past events to better plan for the future. Resilient systems flourish during good times, and they withstand, respond and adapt more readily to shocks and stresses to emerge stronger after tough times. However, simply improving the individual systems that constitute a city is not enough to significantly increase the resilience of a city. Instead, a system-of-systems approach is needed that simultaneously strengthens individual systems as well as the overall system of systems in a city.

LOOKING TO INDUSTRY FOR ANSWERS

Facing the complexity of today's urban challenges, traditional methods and techniques of urban planning and design appear outdated. New approaches are needed to ensure the future success of cities. Lessons can be learned from Industry whose resourcefulness and innovation has blazed trails that could lead toward truly 'smart' cities.

For decades, designers and engineers have used collaborative 3D modeling, visualization and simulation to imagine, anticipate and test the behavior of complex systems in the virtual world before prototypes pass into production. Cities are clearly not ships or airplanes; however, today the same software tools developed to address product complexity are providing the foundation for the virtual technology used to create urban environments and objects, such as buildings, utility networks, mobility systems and other infrastructures.

3DEXPERIENCE CITY: ENDING SILOS TO MAKE CITIES 'SMART'

The multi-dimensional modeling, visualization, analytics and simulation in projects such as Virtual Singapore, a collaboration announced by the National Research Foundation Singapore and Dassault Systèmes on June 12, 2015, are revolutionizing the way cities address their challenges and democratize the urban renewal process. **3D**EXPERIENCE City powers Virtual Singapore and provides the platform where Singapore city officials, residents and businesses will meet to co-create a better Singapore: a healthier, more sustainable and more resilient city.

While Virtual Singapore is groundbreaking in its scope—it seeks to provide a comprehensive virtual environment for modeling, simulating, visualizing and experiencing the city of Singapore—it is more significant as the harbinger of holistic city models to come.

At present, traditional smart city approaches use virtual technologies primarily to capture, analyze and manage data of discrete city systems: public transportation, water management, waste collection, energy services and more. Much of the effort remains focused on single expert domains or silos. **3D**EXPERIENCE City provides a horizontal approach powered by the **3D**EXPERIENCE platform that links all players in a collaborative working environment and enables access to a single data referential, which dynamically updates as new data becomes available.

Consequently, data is exchanged and turned into information, in the literal sense of the word—it takes form. **3D**EXPERIENCE City's horizontal architecture is an integrative environment directly linked to the dynamic data referential that powers the modeling, analytics, simulation and visualization of the city in its past, present and future states. A marketplace presents the vast offer of content, applications and services to cities, businesses and citizens.

3DEXPERIENCE CITY: CONFLATING THE VIRTUAL AND REAL

While traditional urban digital models are static, 3D geometrical models that are at best enriched with geographical information system (GIS) and building information model (BIM) data, **3D**EXPERIENCE City's dynamic data model presents a 3D geometry model as just one of many possible data visualizations. A diverse set of different data sources are captured in a single referential—that increasingly becomes the virtual equivalent to the real city.

With **3D**EXPERIENCE City, the virtual model is further enhanced with the flow of real-time, real-world data from Internet of Things (IoT) and Internet of Experiences (IoE) technologies. In addition, as IoT/IoE increasingly permeates industry and urban environments, the real-world data generated increases the accuracy and reliability of the virtual models, rendering them even more powerful.

The potential of such smart city solutions to drive innovation, optimization and automation of services and infrastructures is in fact skyrocketing: analysts such as Frost & Sullivan are forecasting the market for smart city technology to reach US$1.6T by 2020.

URBAN CHALLENGE: MANAGING SYSTEMS OF SYSTEMS

Cities are not orderly, predictable entities that can be readily planned and controlled. Instead, cities are and always have been complex, living systems. With the rise of the IoT/IoE, the city's systems, which constitute a system of systems, are becoming even more complex and organic, with an interplay of dependencies and interactions that are challenging to anticipate, identify, understand and manage.

In the IoT/IoE world, for example, objects in one system are increasingly required to 'talk' to objects in another. Autonomous vehicles must talk to roadways, to signal systems, to bicycles and buildings, and of course to passengers, drivers and pedestrians. Silos of systems are thus giving way to a complicated, continuously evolving exchange between intimately connected people, places and things.

3DEXPERIENCE City federates those disparate elements through its integrated platform. It links the stakeholders from all city domains in a collaborative working environment and enables access to a single data referential, which constantly updates as new data becomes accessible, and is linked to the **3D**EXPERIENCE City marketplace offering, which includes content as well as applications, services and business opportunities.

3DEXPERIENCE CITY SUPPORTS EACH CITY DOMAIN

Perfected by decades of expertise gained through working with industry leaders, **3D**EXPERIENCE City and the **3D**EXPERIENCE platform offer value to the specialized domains found in every city:

eGovernment
Actors: City Councils, Information and Communication Technology Organizations, Businesses, Citizens

As cities grow physically and in population, this growth brings with it increased complexity as individuals and communities seek a forum for more participation in city affairs and demand greater responsiveness on the part of city administrations. Traditional methods of communication and interaction with residents cannot meet current demands, while rising generations of digital natives expect ever more participation in shaping the nature and future of the urban environment. To manage business and resident expectations, cities must embrace digital technologies to collect and manage available city data in order to improve decision making and service provision.

3DEXPERIENCE City helps cities deliver a unified management tool to facilitate efficient city operations, and enables:

- Improved business and resident participation and experiences
- Increased transparency, reliability, scalability and sustainability of services
- Omni-channel access (mobile and social support) to city programs, services and data
- A single data referential to ensure efficient and effective collaboration among all city stakeholders

Security & Pubic Safety

Actors: City Authorities, Public/Critical Infrastructures, Utility Operators, Security Agencies, Intelligence & Information Services, Emergency Services, Businesses, Citizens

As cities play an increasingly prominent role on the stage of world affairs, drawing new residents and visitors from across the globe, city managers face growing pressure to comprehensively plan for the potentially negative consequences of global interconnectedness for city businesses and residents. In addition to anticipating and preventing external threats, city managers must also provide for internal order and stability, ensure the safety of businesses and residents, and prepare for the eventuality of emergency situations. Digital technologies enable city administrations to redefine how they can proactively protect business and resident security and safety, as well as accelerate detection of and response to emergent incidents. Successfully addressing the full range of security and safety challenges that face contemporary cities requires a shared referential to facilitate inter-agency collaboration, enable close coordination to provide rapid incident responsiveness and to encourage citizens to see themselves and act as partners in ensuring safety and security in the urban environment.

3DEXPERIENCE City helps cities provide security and safety awareness for improved planning, operation, and response, and enables:

- Rapid common situational awareness without a large IT migration
- Cross-service collaboration capabilities
- Real-time decision support across multiple data sources
- Robust planning and preparation for seamless emergency response
- Locating, identifying, qualifying and monitoring active threats
- Increased safety and security in both physical and virtual settings

Environment & Planning

Actors: City Councils, Regional and Urban Planning Departments, Urban Planners, Regulatory Agencies, Architects, Engineers, General Contractors

As cities face the demands of rapid urbanization, they need to plan carefully to provide for growth which is smart and sustainable, and takes a holistic approach to the design of the urban environment. The exponential complexity of the contemporary city exceeds the capacity of traditional modeling and visualization methods and requires more sophisticated technologies that can enable professionals to collaborate across disciplinary boundaries and diverse data sets. A data-driven virtual universe created from a base of existing city morphology, updated in real time to reflect and incorporate the constantly evolving urban environment, can provide a solid foundation for coherent urban planning and management and provide a better means for visualizing and testing the repercussions of future planning choices.

3DEXPERIENCE City helps cities plan for growth by providing a holistic tool for effective design and management of the city realm, and enables:

- A holistic approach to ensure regulatory compliance, maximum sustainability and resilience
- A collaborative environment and single data referential for a coherent approach to planning for business and design
- Analytic and simulation environments to study if/when scenarios
- A communication tool to inform businesses and residents about city planning and engage all stakeholders in the future development of the city

Facilities & Management

Actors: Building Inspectors, Regulatory Agencies, Building Owners/Operators, Engineering, Procurement, and Construction Managers, Architects, Analytic/Engineering Service Providers

The continuous growth of the world population is paralleled by an increased demand for resources, making more strategic planning and management of cities and facilities critically necessary. Rising population growth in the urban environment requires new construction; however, since construction-related processes consume more than a third of the world's resources and are responsible for 60% of global CO_2 emissions, it is crucial that the CO_2 footprint of our buildings and cities be reduced significantly, shifting to a 'cradle to grave' model for the lifecycle management of resources. Buildings and cities are comprised of complex networks of systems that require a different type of thinking, one which takes into account and comprehensively manages the complexities in a holistic manner to improve natural resource efficiency, lower operating costs and bridge the disconnect between designer, builder and manager/operator.

Full scale, rich data referentials of existing facilities powered by computation and data analytics—virtual equivalents—enable city managers to envision, analyze, simulate, realize and manage cities and facilities simultaneously in both the virtual and the real dimensions, allowing for every aspect of a given environment to be examined and evaluated.

3DEXPERIENCE City helps cities by offering a holistic tool for effective design and management of facilities, and enables:

- Efficient and sustainable natural resource usage
- New business and revenue opportunities
- Enhanced experiences and improved quality of work-life balance
- Greater safety and resiliency as well as more reliable planning and design of the urban realm

Mobility

Actors: City Mobility Quality Managers, Transport Operators, Citizens

In response to rapid urbanization, increased environmental consciousness, technological advancements of mobility devices and the desire for enhanced traveler experiences, cities are redefining their mobility policies, while at the same time the mobility industry is launching new business models that view vehicles as an interface with marketplaces. However, in the midst of this growth, many challenges remain to be addressed. Much existing infrastructure has reached its maximum capacity (while also nearing the end of its planned lifespan), and fossil-fuel-dependent legacy mobility technologies tend to produce unacceptable amounts of pollution. Solutions to address these challenges will require a holistic platform that can foster and support innovation by enabling collaboration between cities, businesses and residents.

3DEXPERIENCE City helps cities optimize sustainable multimodal mobility operations and services, and enables:

- Enhanced commuter experiences
- Reduced travel time and cost
- Integrated planning and operations
- New business models and opportunities

Utilities

Actors: City Mayors, City Departments, Utility Network Providers; District Heating/Cooling and Waste Companies; Water, Power and Telco Networks

With rising populations placing ever greater demands on already scarce natural resources, it is more crucial than ever to plan cities effectively for efficient delivery of utilities based on existing fossil fuel technologies, and to best prioritize the shift to more sustainable resources. Utility providers are working intensively on programs to reduce loss and waste in the delivery phase and to manage demand in the consumption phase. However, the success of these efforts hinges on the modernization of existing utility infrastructure and the development of innovative monitoring and optimization technologies. New modeling, visualization, simulation and planning technologies are necessary to enable cities and utility providers to monitor utility networks in real time, predict and address potential failures before they occur, and to ensure that regulations and conservation benchmarks are met and city, business and resident expectations are satisfied.

3DEXPERIENCE City helps utility providers deliver accountable, reliable and predictable performance, and enables:

- Efficient and effective lifecycle management in the Design-Build and Build-Run phases
- Real-time visibility into utility systems to catch trouble before it starts
- Safe, efficient and reliable utility delivery that complies with regulations at all levels
- New business models to enhance utility experience and maximize the use of sustainable methods and resources

Education & Culture

Actors: City Mayors, Departments of Education, Cultural Institutions, Online Universities, Education Providers, Cultural Event Planners

Cities are magnets for innovation and experience, drawing together communities of active, engaged individuals eager to learn, create new knowledge and share that knowledge with others. Where learning was once relegated to the static environment of the classroom, now education pervades all aspects of the city, making the city itself a broad space of learning. Additionally, education, once limited to a preparatory phase early in life, is now spread across people's entire lives, with educational opportunities offered as entertainment, as opportunities for personal growth, as means and support for ongoing employment and as the foundation of community. A unified platform for bringing together traditional and innovative educational and cultural experiences enables businesses to access a well-trained and motivated workforce, facilitates greater interpersonal connection between residents and encourages personal development as well as the establishment of new cultural economies and experiences.

3DEXPERIENCE City helps cities deliver engaging and personalized educational and cultural experiences, and enables:

- Enhanced quality of life for residents and visitors alike
- Increased educational and cultural experiences and employment opportunities
- Integrated platform for content development and delivery
- An innovative environment for residents, business and cities themselves to transform and compete

Health & Social Services

Actors: City Mayors, Health Departments, Health Agencies, Physicians, Medical Analysts, Epidemiologists, Citizens

The density of the urban environment fosters innovation by bringing together professionals from a range of fields to collaborate on finding solutions to contemporary challenges. This, in turn, draws more people to live and work in cities, where they can access a wider range of health and social programs, making the city 'ground zero' for both the detection of new health crises and the development of new programs for healthy living. Wearable sensors and portable devices, combined with analytics hosted on a robust data platform, can enable cities, businesses and residents to capitalize on the productive density of the urban environment and bring together all the resources best suited to healthy living, customized for individuals and their particular environments.

3DEXPERIENCE City helps cities analyze, predict and prevent health risks, and enables:

- A comprehensive reference for health and wellness offers in the city context
- Patient-centered solutions that focus on healthy living and preventative care
- Increased responsiveness and effectiveness of emergency services
- Lower cost of health care and social services through efficient delivery, but also by enabling residents to create healthier lifestyles

Economy

Actors: City Mayors, City Departments, Businesses, Citizens

With the growth of the digital economy, cities need to pay greater attention to the effects of rapid urbanization, and the shift to new retail strategies related to the rise of the experience economy (IoT/IoE), which includes a rise in sharing assets enabled by apps and online marketplaces instead of individual ownership. These new modes of consumer activity have the potential to dramatically alter the urban experience and produce enormous disruption in urban economies. To effectively mobilize these new economic strategies, cities will need robust technologies that enable planners and businesses to understand and predict consumer behavior, enabling a wide range of innovative products and services crafted to suit the urban consumer, while at the same time safeguarding both individual privacy and public safety.

3DEXPERIENCE City helps cities personalize services and experiences, and enables:

- Enhanced economic opportunities and experiences for cities, businesses and residents

- An integrated platform for analyzing business opportunities and planning, simulating and optimizing business operations

- A one-stop-shop marketplace for services and experiences customized to the urban context

- An innovative environment to enable urban businesses and cities themselves to transform and compete on a global scale

A COLLABORATIVE PLATFORM FOR INNOVATION

The ability to model, analyze, simulate, visualize and experience complete cities in a virtual environment is at hand, and as in the world of manufacturing, the use of 3D visualization offers a critical additional benefit: it greatly enhances collaboration and communication across disciplines and communities.

If a picture is worth a thousand words, digital technologies like 3D modeling, augmented reality and virtual reality are worth more than a million words; they bring urban planning and management to life in a very real and remarkably intuitive way, enabling people to connect and interact across social, economic, political, disciplinary and linguistic boundaries, and are enabling everyone to understand—to experience—the choices and possibilities before them in a very human way.

This type of compelling virtual environment is even more effective when it is made available via a cloud-based collaborative platform, the **3D**EXPERIENCE platform, which is accessible to everyone, everywhere, 24/7, and provides the critical knowledge capture and sharing needed to strengthen collaborative innovation.

Faced with serious urban challenges, city officials, business people and citizens can now, as industry leaders did before them, leverage the power of working on a collaborative platform with virtual technologies to co-create innovative and integrated urban solutions for more livable, resilient cities and a more sustainable future.

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes' collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 210,000 customers of all sizes in all industries in more than 140 countries. For more information, visit **www.3ds.com**.

3DEXPERIENCE®

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