WHITESHIELD PARTNERS
STRATEGY & PUBLIC POLICY ADVISORY

REINVENTING URBAN PLANNING

THE USE OF MORE ADVANCED TOOLS FOR SCENARIO PLANNING IN A DATA-RICH ENVIRONMENT

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SUMMARY: URBAN PLANNING MORE CRITICAL THAN EVER

The world is getting more urban, pulled by the allure of megacities. By 2050 two-thirds of the world's population will live in urban areas compared to 55% today, with 90% of projected urban growth in developing world cities in Asia and Africa[1]. Cities generate disproportionately higher rates of economic growth than rural areas. However, cities are also responsible for "bads" such as crime, congestion, and pollution. Meeting the needs of this burgeoning urban population, including housing, transportation, energy, education, healthcare services, and employment, is a challenge that makes urban planning more critical than ever. Without effective urban planning, these megacities risk becoming home to megaslums, megacrime, and megapollution.

Traditional urban planning has taken a narrow focus on the development of land and its uses to maximise economic, financial, and demographic goals. City planning was primarily focused on metrics such as return on investment measured in financial terms, or possibly the benefits associated with greater mobility or population capacity. Although important, these metrics fall short of the needs for current planners who must weigh and manage many competing interests and goals expected of urban development.

WHITESHIELD PARTNERS TOOLS: NEW THINKING IN URBAN PLANNING

Whiteshield Partners has developed four interconnected policy analysis and modelling tools to help policymakers navigate urban planning and address sustainable growth. Urban policy makers can use these tools to examine global best practices in urban design, run urban planning scenarios, and compare results.

- **The Navigator-City™** is an online and 3D city planning simulator that allows policymakers to insert individual building and infrastructure development, incorporate policies, and assess the broader socioeconomic impacts.
- **The Resilient Cities Index ("RCI" or "Index")** is a benchmarking tool that examines the strength of cities as clusters for competitiveness, smart capabilities, sustainability, and social inclusiveness. The **RCI** assesses the vitality of cities and offers urban planners alternative metrics to measure the success of policies and outcomes.
- **Space Productivity** is a new concept and metric designed to help policymakers ensure that land use maximises social benefits and generates prosperity.
- **Whiteshield Partners City System Modelling Approach** is an advanced system dynamics tool that evaluates the effects of urban policies and developments, such as immigration, tax policy, and changes in the labour force, on city outcomes.

[1] UN Department of Economic and Social Affairs.

CONTEXT: REINVENTING URBAN PLANNING

URBAN PLANNING IS NO ACCIDENT

Urban planning is the design, regulation, use, and development of space to optimise the economic, social, health, and geospatial aspects of a geographic area. The place of consideration is typically an urban centre, or some other space that shares common economic, political, cultural, or social dimensions, or in some way has strategic interdependence across some aspect. When urban planning is executed well it leads to efficient use of land that helps drive the positive development of the space. In contrast, when urban planning is not executed well, or when it is absent, it may lead to sprawl (in the case of a growing region), decay (in the case of a shrinking region), or generally negative outcomes. Amsterdam is notable as a city where planning was done right to make the city accessible and walkable. In contrast, cities such as Jakarta have sprawled and are choking under traffic and congestion.

The end results of urban development derive from complex processes. Nevertheless, the phenomenon of city planning hitherto has generally been a crude exercise, favouring simplicity over science. Moreover, luck and serendipity seem to play just as crucial of a role in development as planning and management. But luck and serendipity also favour plans that are well prepared and factually aligned. Neither Silicon Valley nor Wall Street were designed by policy makers. But they emerged thanks in part to decision makers that recognised their potential and then enacted policies that benefited their growth.

Urban planning is more than just designing the physical uses of land. It also entails (or should entail) the coordination of physical spaces with the social, economic, and mental well-being of the community. Historically, however, urban planning has taken a narrow focus on the development of land and its uses to maximise economic, financial, and demographic goals. Thus, city planning was primarily focused on metrics such as return on investment measured in financial terms, or possibly the benefits associated with greater mobility or population capacity. Although these are important metrics, they fall far short of the needs for current planners who must weigh and manage many competing interests and goals expected of urban development nowadays.

WHY CITIES MATTER

In 2007 the world reached a milestone of human civilisation: Over half of the world's population since then has lived in urban areas (defined as built-up areas of human settlement with high density and infrastructure). The great urban migration has been quick. Just 100 years ago less than 20 percent of the world lived in urban settings. By 2050 it is expected 70 percent of the world population will live in cities.

Notwithstanding the ancient times,[2] the first city to reach a population of 1 million was London in 1810. Today there are over 300 cities with a population over 1 million, and about 40 with populations of more than 10 million ("megacities"). By 2050 the number of so-called megacities is expected to reach 50. Rapid growth means another 50 years thereafter the count of megacities is expected to number 83.

The world is getting more urban, pulled by the allure of megacities. But why have cities become so popular? Chiefly, cities offer a high standard of living and jobs. Cities then generate self-reinforcing benefits from agglomeration and clustering effects. High wages, mobility, diversity, entertainment, and networking

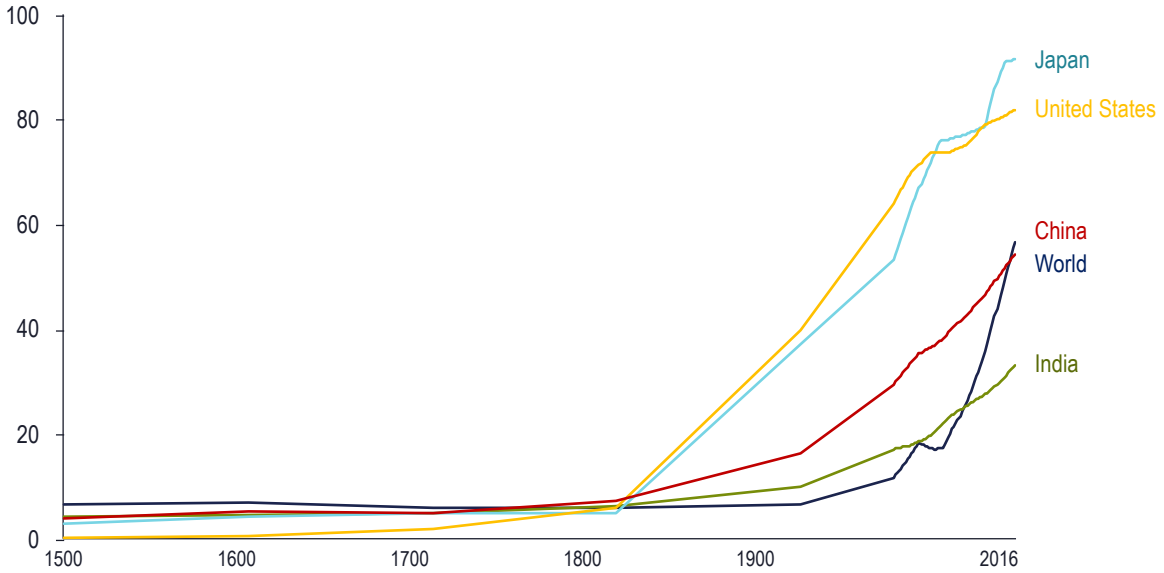
[2] Rome was reputed to have a population of over 1 million in 133 B.C.

all contribute to make urban centres magnets for people and talent. This then also has a bias towards attracting young and able-bodied people to the city; whereas older people and those with families may find more comforts in rural settings. Moreover, urbanisation is a natural consequence of development: People tend to move from rural to urban areas as a country develops and people grow richer.

Most of the expected growth is in the developing world. In 2050 it is expected that the five most populous cities will all be from the Global South. Within the 50 megacities in 2050, only seven cities (Osaka (48), Paris (40), Chicago (35), Los Angeles (17), New York City (9), and Tokyo (7))[3] are associated with countries that are economically developed presently. Without effective urban planning these megacities risk becoming home to megaslums, megacrime, and megapollution. In general, megacities will generate megaproblems if their growth is not effectively and intelligently managed.

Currently, approximately a quarter of the global population lives in the 600 most populous cities. These 600 cities account for half of global GDP. The top 100 among these account for 38 percent of global GDP. More than 80 percent of global GDP is generated in cities.

FIGURE 1: URBANISATION RATES 1500-2016



Source: Our World in Data

But the contribution of cities to society is more than just economic. Urban centres also contribute an outsized share of creativity, innovation, and knowledge. However, cities are also responsible for "bads" such as crime, congestion, and pollution. In fact, with regards to pollution, cities account for about 80 percent of greenhouse gas emissions, the primary driver of global climate change.

Like the population, the ascent of cities has been quick. In recent times it has been hastened by the positive spillovers associated with urban areas as global cities have become centres of innovation. Yet growth in many urban areas has been more characterised by sprawl than sensibility. This is in part due to a restricted view of urban planning that does not incorporate the entirety of outcomes.

[3] Number in parenthesis is rank by population in 2050

URBAN TRANSFORMATION IN THE COVID ERA

In the march towards urbanisation, Covid-19 may disrupt or even fundamentally upend the trajectory of cities. Spurred by the pandemic and supported by modern telecommunications technology, working from home has become a reality for many, a phenomenon that seemed unrealistic just before the novel coronavirus forced the world into the Great Lockdown. With working from home now a common paradigm of work, will this obviate the need to cluster in cities? Is tele-working a new normal or just a temporary disruption in our work culture?

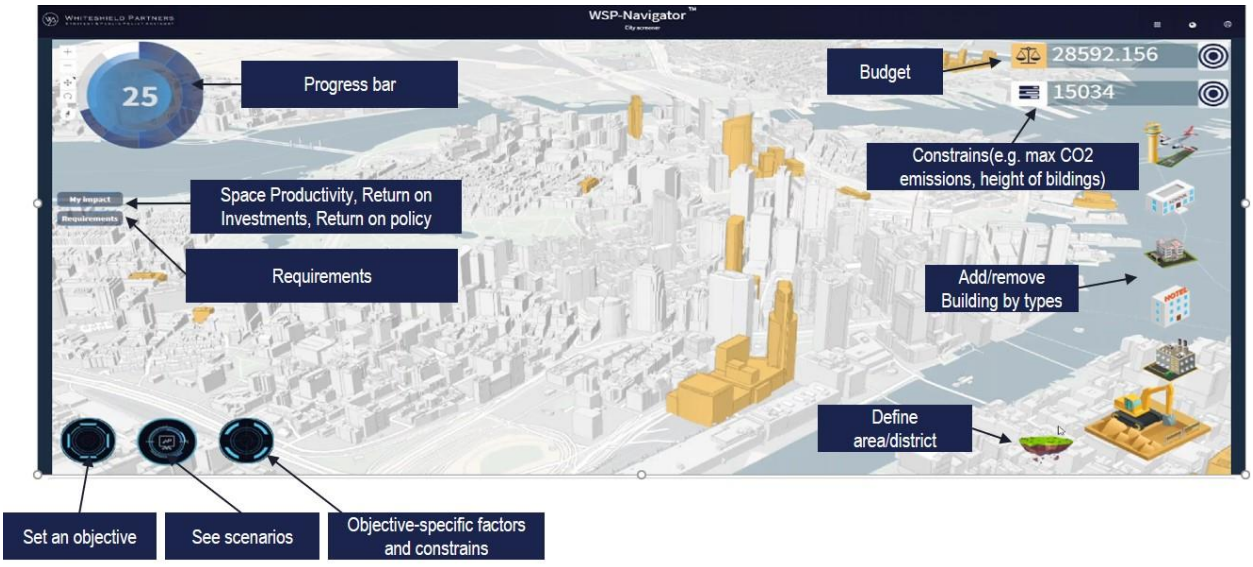
We will eventually discover a vaccine for Covid-19, but Covid-19 will not be the last virus and epidemic that will disrupt our lives. Will cities continue to be magnets for talent and people when social distancing and working from home are the norm? More importantly, how do we need to rethink urban development in an era of social distancing and limitations on large gatherings? How can urban planning respond to the new challenges of urban living?

ADVANCED URBAN PLANNING TOOLS

Rapid urban development and emerging new challenges associated with social distancing and limitations demand a completely new approach to urban planning. As a result, Whiteshield Partners has introduced new innovative tools for urban planning: The Navigator-City™, the Resilient Cities Index ("**RCI**" or "Index"), Space Productivity, and the Whiteshield Partners City System Modelling Approach.

THE NAVIGATOR-CITY™

FIGURE 2: NAVIGATOR-CITY SCREENSHOT



Source: Whiteshield Partners

Whiteshield Partners has developed a tool as part of its Navigator suite that helps urban planners optimize their planning. The tool considers outcome performance that spans the physical, social, economic, and mental outcomes. Instead of just calculating the "return on investment" of any project/plan, the WSP City Navigator is a way to calculate the performance for a broader set of goals. Notably, urban projects and policies should also be evaluated on the basis of "return on policy" and how they help develop the overall resilience and attractiveness of cities. The mechanism for this is the idea of space productivity. That is, urban planners can use the Navigator-City™ to play out urban planning scenarios (e.g. erecting a building; constructing a road; rezoning an area; etc.) and the benchmark of the return on the action is measured through space productivity. That is, does an action increase the space productivity of a land and its neighbouring areas? The tool is a city simulator that works on the basis of improving space productivity or taking policies to work towards a defined objective as measured through the RCI (or parts or modifications thereof).

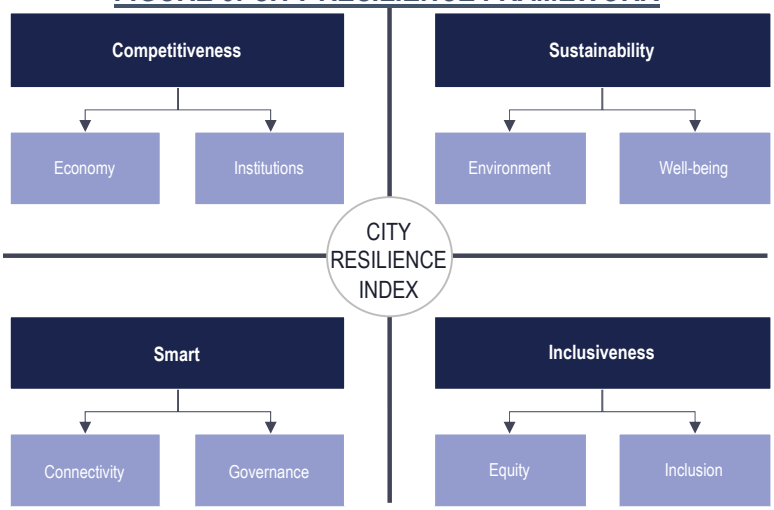
The Navigator-City™ tool gives a planner the ability to run through different scenarios/actions of urban planning and assess whether the actions work towards the defined goals of the planner. For example, if the aim is to make a city greener, then the user can change zoning and building regulations, add or remove buildings, etc. and the tool will calculate how the actions work towards the targeted values that are reflected in the RCI components, or through their benefits to space productivity. To achieve the goal of a greener city, the benchmark may be to reduce pollution or greenhouse gases by 25 percent from their current level. Then policies that increase the zoned areas dedicated to factories with no change in environmental regulations will show the user that the actions are not compatible.

Alternatively, the tool also allows the user to pre-define an outcome and it works backward to indicate what set of policies can be used to achieve the goal. For example, if the goal is to become a green city (defined as, say, with a level of pollution 50 percent lower than at current), then the tool is able to suggest a set of policies that can achieve the goal. The user defines constraints on the problem so that, say, the goal of reduced pollution must fit within a set budget, the need for keeping unemployment low, industrial land must be of a certain size, etc.

RESILIENT CITIES INDEX

The Resilient Cities Index ("RCI" or "Index") is a composite indicator developed by Whiteshield Partners to examine the strength of cities as clusters for competitiveness, smart capabilities, sustainability, and social inclusiveness. These four themes define the framework of the Index. The RCI is an assessment of the vitality of cities and offers urban planners alternative metrics to measure the success of policies and outcomes.

FIGURE 3: CITY RESILIENCE FRAMEWORK



Source: Whiteshield Partners

The RCI assesses the resiliency of 137 cities using 46 indicators grouped into four pillars of the Index. Each of the pillars is divided into two. Each subpillar contains between two and six indicators. Each successive order of aggregation is a simple average of its components. The cities assessed in the RCI represent 87 countries/ economies. The cities covered in the Index are typically global cities or an economic or political capital of their country. However, the list also includes smaller second-tier urban areas such Bayreuth (Germany) and Espoo (Finland).

TABLE 1: CITY RESILIENCE INDEX

	Overall	Competitive		Smart		Sustainable		Inclusive	
Rank	City	Economy	Institutions	Connectivity	Governance	Environment	Well-being	Equity	Inclusion
1	Copenhagen	Geneva	Geneva	Tokyo	Copenhagen	Geneva	Stuttgart	Helsinki	Tokyo
2	Stockholm	Zurich	Espoo	Copenhagen	Amsterdam	Zurich	Stavanger	Espoo	Osaka
3	Zurich	Los Angeles	Zurich	Vancouver	Singapore	Aarhus	Trondheim	Tampere	Prague
4	Geneva	New York	Philadelphia	Toronto	Stockholm	Copenhagen	Zurich	Budapest	Zurich
5	Västerås	Chicago	Helsingborg	Melbourne	Gothenburg	Helsingborg	Bayreuth	Prague	Geneva
6	Gothenburg	Boston	Aarhus	Stockholm	Luxembourg	Västerås	Bochum	Warsaw	Trondheim
7	Helsinki	Washington	Västerås	Montreal	Helsingborg	Gothenburg	Bergen	Aarhus	Stavanger
8	Aarhus	Philadelphia	Copenhagen	Boston	Sydney	Stockholm	Luxembourg	Copenhagen	Bergen
9	Helsingborg	Stockholm	Stockholm	Sydney	Västerås	Vienna	Geneva	Amsterdam	Oslo
10	Espoo	San Francisco	Washington	Seoul	Melbourne	Hannover	Helsinki	Stuttgart	Montreal

Source: Whiteshield Partners

PROFILE OF THE MOST RESILIENT CITIES

The most resilient cities according to the RCI are typically smaller urban centres. None of the top-20 cities are megacities. The largest of the top-20 has an urban population of 6.2 million (Berlin), while none of the

top-10 cities has a population over 2 million. All of the top-10 RCI cities are in Europe. The lone non-European city in the top-20 is Singapore.

Although "global" cities and "megacities" are expected to see strong growth (population and economy) in the 21st century, the RCI shows that smaller cities tend to offer a more balanced and resilient environment. Yet people are voting with their feet as large cities are outgrowing smaller cities. This begs the question: What is it about smaller cities that makes them more resilient?

Given that large cities and megacities are attracting the most people/talent, what can urban planners do to replicate the benefits and resilience found within smaller cities in large cities? Tokyo, which is currently the largest city in the world (ranked 25th according to the RCI), is recognised as a megacity that is really an amalgamation of many smaller cities within its borders. This suggests the benefit of urban planning that takes into effect the return on policy for not just the city, but also measured at the local/district level within cities.

SPACE PRODUCTIVITY

In addition to the development of the Resilient Cities Index, Whiteshield Partners has pioneered a new perspective on the outcomes of land use. The goal of urban planning is to increase the productivity of land. That is, city planning should optimise the efficiency of land use so that it maximises social benefits and its usefulness to generate prosperity. Productivity is a simple measure that is broad in nature and captures many of the elements that define resiliency. Land should be zoned, and structures erected so that it improves the resiliency of a space. Working with the available data, resiliency can be mapped to productivity, so that actions are taken to improve the productivity per unit of space. Space productivity is the intangible benefit of land that helps to enhance total productivity.

Whiteshield Partners has developed the idea of **"space productivity"** as the productivity associated with the unadjusted raw space. It can be defined or calculated as the total productivity of land divided by the size of the land. Land derives productivity from its inherent functionality. Space productivity can then be thought of as a component of multifactor productivity. It is a variable that enhances labour and capital and acts similarly to the technology factor in the neoclassical production function: $Y = SAL^{\alpha}K^{\beta}$. Where *Y* is GDP (output), *S* is space productivity, *A* is technology (the residual), *L* is labour, *K* is capital, and α and β are parameters in the range [0,1].

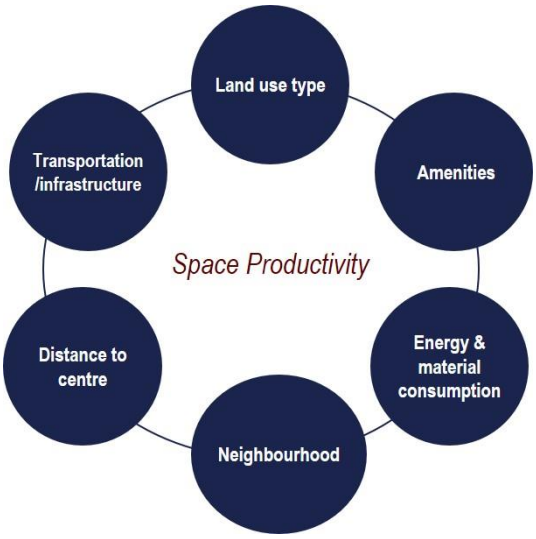
Space productivity can thus be linked with variables such as:

1. Land use type
2. Amenities
3. Energy & material consumption
4. Neighbourhood quality/attractiveness
5. Distance to centre/core
6. Transportation/infrastructure

The influence of these factors on land is then the productivity associated with space. In this way, if a factory is developed in residential neighbourhood the space productivity effect would be negative. That is, the

construction of the factory would diminish the productivity/functionality of adjoining or adjacent land and buildings. By contrast, building a school in a residential zone is likely to improve the space productivity of the neighbourhood as it would reduce commuting costs for families with school-aged children.

FIGURE 4: SPACE PRODUCTIVITY RELATIONSHIPS



Source: Whiteshield Partners

SYSTEM DYNAMICS: A TALE OF TWO CITIES

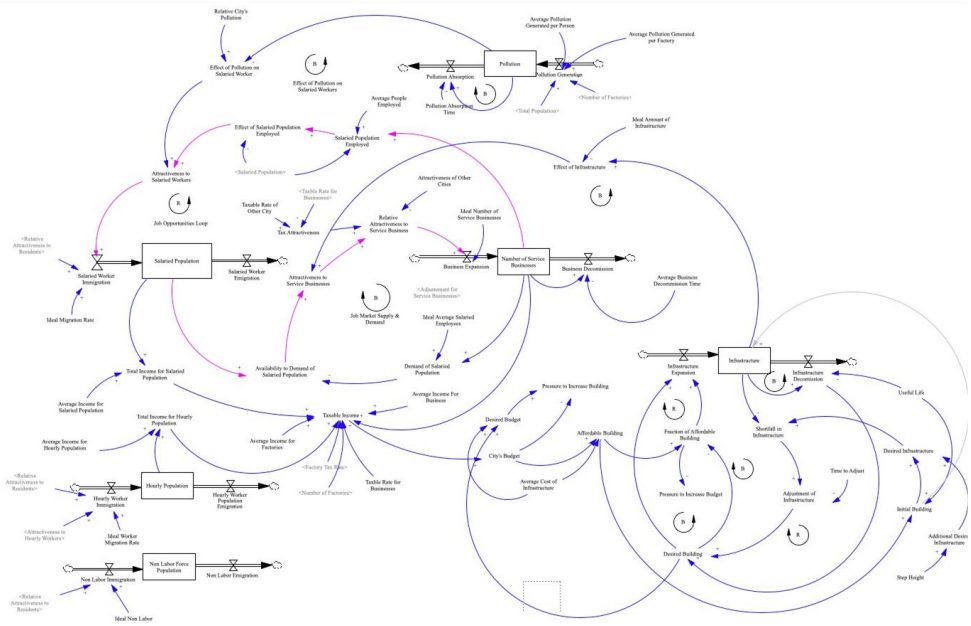
Whiteshield Partners in conjunction with a team of researchers at Brandeis University in Boston developed a systems dynamic model (SDM)[4] to evaluate the effects of urban policies towards the development outcomes of two hypothetical cities. One city was characterised as a service city; the other city was characterised as an industry city (The model assumes workers are either salaried or paid on an hourly basis according to employment type). In the WSP-Brandeis model there are two cities defined by sectors: one is a service city where workers are paid hourly, and a manufacturing city where workers are salaried. The model is used to examine the effects of immigration, tax policy, and changes in the relative composition of the labour force/economy.

The SDM simulation showed that city growth rates are a key determinant to resiliency. If growth is too slow then the city stagnates. Conversely, if growth is too fast then certain areas cannot keep up. The ideal outcome is then to strike a balance to develop a sustainable model for city growth. The model also shows that limiting immigration holds back the ability of businesses to grow, while adequate infrastructure is also needed as a driver for business growth.

The SDM can be represented diagrammatically as in **FIGURE 5** below. The arrows show the linkages between variables of the model and, in particular, feedback loops.

[4] Systems dynamics is a modelling approach that is used to analyse complex systems that are linked by stocks, flows, feedback loops, and time delays.

FIGURE 5: SYSTEMS DYNAMICS MODEL OF SERVICE AND INDUSTRY CITIES



Source: Brandeis University, Whiteshield Partners

The simulations focused on six areas of policy (as represented by the boxes in **FIGURE 5)**:

1. Tax rate
2. Service business expansion
3. Population
4. Pollution
5. Prices
6. Crime

The SDM shows the interrelationships across the sectors of the economy. For example, when the tax rate is decreased on factories the number of factories will increase and ergo also job opportunities. However, when this happens in service city the demand for workers will outstrip the supply of workers and we get too much growth for the city to handle.

The key insight the SDM model offers for policy makers is that the more balanced a city is, the more taxable income the city possesses, and therefore the greater the ability of the city to grow. Furthermore, immigration is not a threat to the original residents of the city as they do not displace jobs but rather fulfil otherwise unmet demand.