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Agile and sustainable cities in the era of the fourth industrial revolution:

"The case of Athens"

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Αθήνα, 2021

Τριμελής Επιτροπή

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Abstract

Within the past few years there has been an emerged term used to describe cities struggling to be able to quickly adapt to changing needs. This term “Agile Cities” is used to describe the new framework cities need to embrace to benefit from the opportunities and meet the changes their populations are facing. According to the WP Global Future Council Cities Urbanization report 2018, 54% of the global population already reside in cities while it is estimated that this percentage is about to reach 68% by 2050. Regarding this there is a great need and importance to identify what are the characteristics of an Agile City. Athens (wider area Attica) is the capital of Greece, where 3.8 million people live while the total population is 10.7 million inhabitants. It is quite impressive that 35.5% of the population is concentrated just in this region so it is highly important to record the performance of the city and indicate fields for further research as well as improvement.

The main objective of this dissertation is to discuss the key factors involved to the definition of agile and sustainable cities is to investigate what are the key elements required for a city to be agile and sustainable according to the bibliography as well as global Indexes and then investigate the case of Athens and record its performance according global indexes to indicate fields of improvement.

For this purpose we conducted qualitative research collecting secondary data from the official reports of 8 different indexes exploring the case of Athens. The data gathered indicated that the major pains of the city of Athens such as unemployment, depressed macroeconomic conditions, migration, lack of green spaces, low quality of air and green spaces as well as mistrust in governance.

Keywords: Agile cities, Smart Sustainable Cities, Cities Indexes, Athens ranking, urbanization

Περίληψη

Τα τελευταία χρόνια υπάρχει ένας αναδυόμενος όρος που χρησιμοποιείται για να περιγράψει πόλεις που αγωνίζονται να προσαρμοστούν γρήγορα στις μεταβαλλόμενες ανάγκες. Αυτός ο όρος «Agile Cities» χρησιμοποιείται για να περιγράψει το νέο πλαίσιο που πρέπει να ακολουθήσουν οι πόλεις για να επωφεληθούν από τις ευκαιρίες και να ανταποκριθούν στις αλλαγές που αντιμετωπίζουν οι πληθυσμοί τους. Σύμφωνα με την έκθεση WP Global Future Council Cities Urbanization 2018, το 54% του παγκόσμιου πληθυσμού κατοικεί ήδη σε πόλεις, ενώ εκτιμάται ότι το ποσοστό αυτό πρόκειται να φθάσει το 68% έως το 2050. Υπάρχει λοιπόν μεγάλη ανάγκη και σημασία να προσδιοριστούν τα χαρακτηριστικά μιας ευέλικτης και βιώσιμης πόλης. Η Αθήνα (ευρύτερη περιοχή της Αττικής) είναι η πρωτεύουσα της Ελλάδας, όπου ζουν 3,8 εκατομμύρια άνθρωποι, ενώ ο συνολικός πληθυσμός είναι 10,7 εκατομμύρια κάτοικοι. Είναι εντυπωσιακό το ότι το 35,5% του πληθυσμού συγκεντρώνεται μόνο σε αυτήν την περιοχή, οπότε είναι πολύ σημαντικό να καταγράψουμε τις επιδόσεις της πόλης και να αναδείξουμε πεδία για περαιτέρω έρευνα καθώς και βελτίωση.

Ο κύριος στόχος αυτής της διατριβής είναι να συζητήσει τους βασικούς παράγοντες που εμπλέκονται στον ορισμό των ευέλικτων και βιώσιμων πόλεων είναι να διερευνήσει ποια είναι τα βασικά στοιχεία που απαιτούνται για μια πόλη να είναι ευέλικτη και βιώσιμη σύμφωνα με τη βιβλιογραφία, καθώς και τους παγκόσμιους δείκτες και στη συνέχεια να διερευνήσει την περίπτωση της Αθήνας και να καταγράψει την απόδοσή της σύμφωνα με τους παγκόσμιους δείκτες ώστε να αναδειχθούν βελτίωσης.

Για το σκοπό αυτό, πραγματοποιήσαμε ποιοτική έρευνα συλλέγοντας δευτερογενή δεδομένα από τις επίσημες αναφορές 8 διαφορετικών δεικτών που διερευνούν την περίπτωση της Αθήνας. Τα στοιχεία που συλλέχθηκαν ανέδειξαν τις προβληματικές της πόλης της Αθήνας όπως η ανεργία, οι μακροοικονομικές συνθήκες, η μετανάστευση, η έλλειψη χώρων πρασίνου, η κακή ποιότητα του αέρα καθώς και η δυσπιστία στη διακυβέρνηση.

Literature Review

Sustainable development and global environmental change has increased very rapidly in recent years. According to the UN 68% of the world population is about to live in urban areas by 2050. Therefore interest in urban challenges is constantly growing. The human ecosystem relationships has been through four basic phases[1] from primeval phase in which human population differed little from other omnivorous mammals, to the early farming phase beginning 12,000 years ago spreading domestication and advancing farming techniques to the early urban phase initiating five thousand years ago in Mesopotamia and characterized by urban city density. The fourth phase began with the industrial revolution 200 years ago and is now leading us in a new era, since the fourth industrial revolution and the exploitation of innovations and technology leads to a merging of digital, physical and biological realms. New technologies are enabling societal shifts by affecting economics, values, identities and possibilities for future generations[2].

Cities are competing with each other creating global competition and therefore industry and governments must work together to support networks of transportations, telecommunications, services and knowledge centers[3].

The Fourth Industrial Revolution is transforming the way people live by merging biological, physical and digital worlds[4]. To respond to citizens' needs, city product makers need to adapt physical, digital and environmental elements of their cities.

Agile cities are flexible and have the efficiency to easily adapt to change for economic, environmental and social benefits[5]. Agility, a borrowed term from product

[1] Haughton, G., & Hunter, C. (2004). Sustainable Cities Regional development and public policy Regions and Cities. Routledge.
[2] World Economic Forum, Asian Development, & A. Bank. (2017). Harnessing the 4th Industrial Revolution for Sustainable Emerging Cities. World Economic Forum, 1–24.
[3] K., D., J., Rondinelli, & D.A. (1998). Innovative Infrastructure for Agile Manufacturers. Sloan Management Review Cambridge, 39(2).
[4] Agile Cities Preparing for the Fourth Industrial Revolution. (2018). Global Future Council on Cities and Urbanization. Published.
[5] W.W.C. (2007). Partnerships in creating agile sustainable development communities. Journal of Cleaner Production, 15(3), 294–302.

development, has been further used in the past years within the private sector and it is now increasingly adopted in the public sector literature and practices[6].

A main problem towards agile cities is the difficulty to measure the performance of the cities.

City rankings, benchmarking and indexes are a global phenomenon as public and private institutions across the world Foster City performance measures and can identify solutions to this problem. The idea of measuring performance can provide useful information by evaluating existing policies of local authorities and guiding them to new and they are especially prominent in the field of sustainability[7]. Therefore gathering those indexes and examining their purpose will help to identify the key factors involved in the definition of agile and sustainable cities.

Athens is a European city and the capital of Greece. It is also a city that resides 35.5% of the total population of the country therefore it is dealing with urbanization. Carrying a huge cultural inheritage the city is often branded as the cradle of western civilization due to their progress in the fields of philosophy, literature and even architecture but it is crucial to identify how it deals with urbanization and how it performs when facing the challenges of the fourth industrial revolution. Research for Athens often examines tourism development[8] but there is a great need to define the city's identity concerning its residents to further expand this knowledge for tourism development and other areas.

[6] Mergel, I., Bertot, J. C., & Gong, Y. (Eds.). (2018). Agile Government and Adaptive Governance in the Public Sector. Government Information Quarterly, 35(2), 161–348.
[7] Saez, L., Heras-Saizarbitoria, I., & Rodriguez-Nunez, E. (2020). Sustainable city rankings, benchmarking and indexes: Looking into the black box. *Sustainable Cities and Society*, *53*, 101938.
[8] Pastras, P. (2012). *The governance of tourism development in Athens: A strategic-relational approach* (Doctoral dissertation, University of Birmingham).

Methodology

The main objective of this paper is to examine the key factors involved in the definition of agile sustainable cities, the problems they are facing at the era of the fourth industrial revolution and record the performance of Athens towards that direction. Due to the significance of this matter several organizations public and private have created global indexes using different metrics and studying several fields to capture the performance of cities.

To achieve these goals a case study is conducted exploring the case of Athens through these indexes. A case study is an appropriate research design in order to gain concrete, contextual, in-depth knowledge about a specific real-world subject and explore the key characteristics, meanings, and implications of the case. It is the ideal approach when the topic is highly complex and explores different aspects of a phenomenon therefore it should not discard some of them just because they are infrequent[9].

The research has been conducted using secondary data. Secondary information consists of sourced data collected by others and stored in some form [10]. These sources may include government reports, industry studies as well as other official sources. To explore the case of Athens we have chosen to study and collect data from global indexes measuring cities performance towards several fields. There reason we chose to collect secondary data from these sources is the fact that there is a great amount of data measured by those that otherwise would take a lot of resources to collect and the fact that that is provided in comparison to other cities helping frame the position of Athens in the global map. The data were collected by the published reports from the organizations performing global indexes.

To analyze the data we perform qualitative content analysis. Content analysis is a research method used to identify patterns in recorded communication. In this case we gathered the performance and attempt to group the results according their appearance in the indexes to finally come to conclusions.

The first chapter explores the definition of agile sustainable and smart cities as provided by the literature. It tracks down the origin of agile, the appearance in the private and

[9] Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford publications.
[10] Stewart, D. W., & Kamins, M. A. (1993). *Secondary research: Information sources and methods* (Vol. 4). Sage.

public sector and how it migrated from a term used in software development to a key element of a modern city. It also studies what makes cities sustainable and smart.

The second chapter records the indexes used to measure cities performance. It mapps the origin of those indexes, the methodology they use, the pillars and the key areas they examine as well as the cities they study. City rankings, benchmarking and indexes are a global phenomenon as public and private institutions across the world foster city performance measures. Their purpose is to evaluate and also guide local authorities in many fields, especially those concerning sustainability. They provide a market-based perspective, can provide comparative information and be a very useful advisory tool for urban government and policymaking. For the research there have been chosen 8 different index streams:

- The Smart City Observatory shows how
- Culture and Creative cities monitor
- Innovation Cities program
- Resilient Cities Network
- World's Best Cities
- Cities in Motion
- Safe Cities
- The green city Index

The reason we chose those is the relevance towards agility and sustainability as indicated by the bibliography, the frequency of appearance, the accessibility of data and the presence of Athens in the rating. We recorded the purpose of each one, the organization, the main pillars of assessment, the key areas they explore as well as the number of the cities they rank

In the third chapter all data concerning Athens are gathered and the score the city performs on each of those indexes. We record the place of Athens compared with the first city of each index.

The idea of capturing the performance through the indexes has some limitations. We use secondary data so we only have access to the information published. Some indexes provide quantitative and qualitative data that are more comprehensive and it is easier to

understand the context while others are only quantitative and it is harder to exclude conclusions. Another limitation is that the provided data are not always up to date and this is because some reports do not publish annually as well as because the latest report is not provided yet.

At chapter three we record Athens performance for each index as well as further analysis or data when provided.

Finally, after collecting the data we point out the highlights of the findings. Due to the nature of the data and the many factors they explore it is not possible to group them so we analyze them in a descriptive way pointing out main problems the city is facing, some key areas that Athens is performing well and then make some suggestions for improvements and further research.

Chapter 1 : Lean and Agile Cities

In 2015 UN member states developed a 15 year plan "the 2030 Agenda for Sustainable Development" enacting 17 Goals to be fulfilled till then. The Sustainable Development Goals are a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere.

The world is becoming increasingly urbanized and cities and metropolitans are concentrating economic growth contributing to global GDP up to 60 per cent which also results in 40 per cent of global carbon emissions and over 60 percent of resource use. The United Nations organization has dedicated "Goal 11" to cities. The target of that goal is segmented to ten clusters that summarize below:

- Upgrading slums by ensuring access to adequate housing and basic services
- Provide access to transport systems for all
- Enhance sustainable urbanization and capacity for participatory, and sustainable human settlement planning and management
- Protect and safeguard the world's cultural and natural heritage
- Reduce the number of deaths and the number of people affected by natural disasters
- Reduce the adverse per capita environmental impact of cities (air quality and municipal and other waste management etc)
- Provide universal access to safe, inclusive and accessible, green and public spaces
- Support positive economic, social and environmental links between urban, peri-urban and rural areas
- Increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency,

mitigation and adaptation to climate change, resilience to disasters, and develop and implement

- Support least developed countries, financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

Aligned to these goals the World Economic Forum has issued a report "Global Future Council on Cities and Urbanization 2018" about "Agile Cities Preparing for the Fourth Industrial Revolution". Agility at this report is described as the ability to quickly adapt to changing needs across all areas of urban infrastructure and processes and there are three levels on which cities have experimented and found innovative solutions: "Physical Components" referring to the transformation of current infrastructure, "Digital Elements" combining new technologies to better understand citizens needs as well as "Environmental Factors" and how to use innovative solutions to prevent negative effects. These three levels are examined in 8 areas. Agile Buildings follow the concept of Total Building performance and result well according to six key metrics: spatial, acoustic, visual, thermal, IAQ and building integrity. They meant to support a diverse mix of uses and activities as well as be carbon neutral and tech sophisticated. An interesting example of agile building is The Tower at PNC Plaza, Pittsburgh, USA which features numerous sustainable attributes such as an operable double-skin facade, an onsite greywater reuse system, locally sourced building materials, fixtures and furniture made from recycled materials, and numerous other green strategies to substantially reduce the environmental impact of the building. Some of these features enable the Tower's heating and cooling systems to operate in a "net-zero-energy state" up to 30% of the year. Agile Land promotes the idea that the land should be distributed among vehicles, people and open space and suggests ideas of repurposing space from converting roads in parks as in Melbourne and creating pedestrian walkways and cycling paths like Singapore, to promote agricultural projects like "Agrupar" in Quito.

Agile Energy, facilitates transition to renewable energy sources and creates smart energy systems that link production, storage and consumption to improve overall performance.

Agile Mobility focuses on accessibility, environmental benefits from decreasing greenhouse gases and harmful pollution and improving lifestyle, security and health issues in cities. Using data for Traffic can help cities find solutions about traffic, such as alternative

routes, innovative road pricing systems etc. Agile IT Assets could be promoted by using and connecting existing synergies and provide personalized and user centered IT solutions.

Agile Security involves smarter policing and prevention strategies as well as potential corrosion of civil liberties and crime prediction algorithms. It includes both technological approaches and policy moves to improve the security environment.

Agile Education moves away from traditional models based on memorizing and "collecting" knowledge and tend to create a different environment for students and educators where research investigation is promoted and involves testing ideas, allowing changesin focus, theme and parameters.

Agile Governance aims to exhibit distributed bottom-up leadership, transparent service delivery, permanent stakeholder engagement, open data sharing mechanisms, lean budgeting and speedy procurement processes.

1.1 Defining Agile

But where does the term Agile originally come from? Agile is a product management technique used to replace traditional methods of product management for delivering software. When trying to figure out how and when product or project management techniques were firstly used, we should take under consideration all the great achievements recorded from the beginning of humanity as known. While digging in history "Seven wonders of the Ancient World " could point out that project management existed long before Drucker, Fayol, Gant and Ford indicated their theories. To achieve mutual objectives, people had always gathered all necessary resources and coordinated all actions to successfully deliver the project requested. Unfortunately the techniques used were not recorded so there is very pure documentation for their methods. It was not until the 1950's that organizations began to apply systematic tools and techniques to complex projects. The emergence of project management was fired by technical and institutional factors. During World war II several complex operations such as radar, the German V-2 ballistic missile, the American B-29 bomber, and the atomic bomb required new methods of coordination and analysis. RAND Corporation, funded by Douglas Aircraft Corporation to study inter-continental warfare in

1946 became an influential force in the development of "systems approaches" over the next two decades (Smith, 1966). From Juhah's Project Plan for Building Pacific Railroad (1857) and Hoover Dam (1931-1936), modern project management methodologies were used for several projects: American Navy's Polaris project (1950s), Department of Defense, NASA(1960s and 1970s), and many construction projects. By the 1990s, the project management theories, tools, and techniques began to spread widely and were received by different industries and organizations. To capture the history of project management era four periods have been identified:

Prior to 1958, Craft system to Human Relations Administration

1958 – 1979 Application of Management Science

1980 – 1994 Production Center: Human Resources

1995 to present Creating a new environment

Period 1 refers to modern project management that is estimated between the 1900s and 1950s. Technology advancement and telecommunications during this period shortened the project schedule while automobiles allowed effective resource allocation and mobility. Henry Gantt invented the Gantt chart and the job specification, later became the basis of developing the Work Breakdown Structure (WBS). Period 2 (1958-1979) is referring to application of management science. The significant technological advancement in the computer industry from silicon chips and minicomputers to the development of the programming language UNIX and computer industry started to develop rapidly. The significant development of software and hardware as well as networking (Intel 4004, ARPANET, Artemis, Scitor, Oracle etc). For those needs several product management tools such as CMP/PERT, Material Requirement, Planning (MRP) were developed. The transition from mainframe computers to personal computers during the 1980s and early 1990s, as a result of the revolution of the IT/IS sector has favored managing and controlling complex project schedules. In the mid 80s, the Internet served researchers and developers, as well as local area networks and Ethernet technology started to dominate network technology (Leiner et al 2000).

Lean is a product development philosophy that revolves around cutting all the unnecessary work or effort and summarizes in the below:

- Eliminate waste
- Build quality in
- Create knowledge
- Defer commitment
- Deliver fast
- Respect people
- Optimize the whole

Agile is simply a way of applying the lean mindset to software development. It was not until early 2001 when 17 people , against the backdrop of the Wasatch Mountains, in Snowbird, Utah met to discuss the future of software development. The group's members shared a frustration about the current state of affairs, even if they disagreed about how to remedy the situation.

The problem was that companies were so focused on excessively planning and documenting their software development cycles that they lost contact with their clients and their actual needs while trying to stay stuck in schedule. Values such as integrity and excellence may be promoted by corporations but they were not quite explained or defined and did little to guide people, especially software developers toward a better way. There was about time to change. Many of the Snowbird 17 already had ideas about how to proceed in software development's new era. The trip to the mountains was their chance to hash it out.

The Agile Manifesto emerged from this extended weekend at just 68 words, and the short and sweet document went on to change software development forever. In the nearly two decades since its creation, these words (and the 12 principles that follow) have been embraced (in varying degrees) by countless individuals, teams, and companies.[11]

1. Customer satisfaction through continuous delivery of the product

2. Divide large chunks of work into smaller and achievable tasks for quicker completion and easier integration of changes

3. Adhere to the decided time frame for the delivery of a working product

4. All stakeholders must frequently collaborate to ensure that the project is going in the correct direction

[11] Fowler, M., & Highsmith, J. (2001). The agile manifesto. *Software development*, *9*(8), 28-35.

5. Create a supportive environment to motivate team members and encouraging them to get the job done

6. Prefer face-to-face communication over other methods

7. Working software is the primary measure of progress

8. Try to maintain a constant pace of development.

9. Maintain the quality of the product by paying attention to technical details

10. Maintain simplicity

11. Promote self-organization in the team

12. Regularly reflect on your performance for continuous improvement

These principles are gathered in 4 values:

1. Individuals and interactions over processes and tools

2. Working product over comprehensive documentation

3. Customer collaboration over contract negotiation

4. Responding to change over following a plan

1.2 Agility Beyond Software Development

Agile as a term has primarily been used as an iterative approach to project management for software development as described above. Yet, the principles of agile can be applied in several different fields. Some main definitions have been formulated such as:

"The ability to adapt to different changes and to refine and fine-tune development processes as needed" Henderson-Sellers and Serour (2005)[12]

"The ability to efficiently and effectively respond to and incorporate user requirement changes during the project life cycle" Lee and Xia (2010)[13]

"The readiness "to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value

[12] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.
[13] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.

(economy, quality, and simplicity), through its collective components and relationships with its environment." Conboy (2009:340)[14]

It seems quite clear that agility, innovation and resilience are holdhanding but to better understand the use of term "Agile" we have studied the relative literature;

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"The readiness "to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment." Conboy (2009:340)[17]

Agile as a term has been further used beyond software development as an adjective referring to the need of organizations – and especially bureaucracies - to become more flexible, adaptive, and rapid in their behavior (Alsudairy & Vasista, 2014). Relevant articles usually focus on the outcome of agility as the responsiveness to external threats and the adoption of new technologies. Using agile procedures organizations find ways of adapting rapidly to the environment. Agility gives them the ability to quickly redesign, as well as integrate stakeholders to the process, with development steps.

Agility has been further used in the past years within the private sector and it is now increasingly adopted in the public sector literature and practices. It seems quite natural that new generations that are raised in a user centric environment while using social media or e-commerce platforms would be easier to be approached through similar experience with government services. To achieve that governments need to implement agile management

[14] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.
[15] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.
[16] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.
[17] Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research.

techniques Agile innovation management refers to an holistic approach that focuses beyond software development or even project management but includes those processes adding organizational procedures, HR policies, culture and leadership, to support product delivery Mergel (2016).

Agile innovation management [18] refers to an holistic approach that focuses beyond software development or even project management but includes those processes adding organizational procedures, HR policies, culture and leadership, to support product delivery Mergel (2016).[19]

On the other hand agility has its own disadvantages such as Less predictability due to the inability to quantify the full level of effort required; More time commitment necessary due to the close communication required across teams involved in the effort;

3) Greater demands on developers and clients (e.g., training, participation);

4) Lack of necessary documentation due to the just in time nature of development; and

5) Potential for projects to get off track due to continually redefined needs.

Fridman (2016)

1.3 Agility in Public Sector

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1.4 Sustainable Cities

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it the concept of needs and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs [20]. More than half of the world's population lives in urban areas, so the use of energy, land and other resources is increasingly originating. The massive concentration of people in urban areas implies the importance of addressing issues of sustainable development. Sustainable urban development has become a prerequisite for sustainable development.

Cities are complex social–ecological–technological systems where numerous actors and processes interact, often across geographic, institutional and governance scales [21], therefore to achieve sustainability there are several factors that need to be taken under consideration. Capturing sustainability is a matter of perspective. In engineering sustainable city is defined when resources are used most efficiently while when it come to social science sustainable cities are often described in terms of the goal of 'social sustainability' [22] and perhaps environmentally sustainability is about behaving today in a way that ensures that future generations will have enough natural resources to maintain a quality of life equal to if

[20] Wangel, J., & Hojer, M. (2014). Smart Sustainable Cities: Definition and Challenges. *Advances in Intelligent Systems and Computing*, *310*, 1-16.
[21] Bai, X., Surveyer, A., Elmqvist, T., Gatzweiler, F. W., Güneralp, B., Parnell, S., ... & Webb, R. (2016). Defining and advancing a systems approach for sustainable cities. *Current opinion in environmental sustainability*, *23*, 69-78.
[22] Williams, K. (2010). Sustainable cities: research and practice challenges. *International Journal of Urban Sustainable Development*, *1*(1-2), 128-132.

not better than that of current generations. But the truth is that gaining sustainability includes all aspects of a city's existence. Understanding this multiplicity of sustainable urbanism is at the core of advancing research and practice and it involves even more challenges. It is very hard to define specific milestones because it is more of a vivid process very defined by the current condition of a city. If we were to set a path towards sustainability for Nairobi it will be very different from those for Paris. Some of the most interesting and critical challenges in sustainable urban development is understanding the vision or visions and developing a deeper understanding of the multi-faceted processes of change required to achieve more sustainable cities.

Performing a system approach would be a solution to fight this complexion. To define a system approach in cities we should frame important characteristics. Cities are open systems, exchanging resources, products and services, waste, people, ideas and finances with the broader world. They are complex, self-organizing, adaptive, and constantly evolving. Many responsibilities, capabilities and priorities, as well as processes are involved for a city to operate as they are embedded in broader ecological, economic, technical, institutional, legal and governance structures. All the processes are linked with interactions and feedback.

Targets for achieving Goal 11, Sustainable Cities and Communities, include reducing the adverse effects of natural disasters, ensuring everyone has access to green spaces and addressing the environmental impact of cities. Cities are finding innovative ways to respond to this challenge. Global warming is increasing the likelihood of extreme weather events, including floods. But some cities are fighting back, using the power of nature to mitigate the risks. Sponge cities are concrete neighborhoods interlaced with green spaces as they can naturally detain and filter water. Vertical forests as in Milan were architects have done the same with tree cover – creating a "vertical forest" on two residential tower blocks. Boasting 800 trees, 4,500 shrubs and 15,000 plants. The 20-minute neighbourhood, making it possible for inhabitants to find everything they need within a 20-minute public transport trip, bike ride or walk from home. Melbourne leads the way, it wants residents to always be within easy reach of things like shops, business services, education or leisure facilities. Miniature forests, the idea is to take brownfield sites, plant them densely with a wide variety of native seedlings, and let them grow with minimal intervention. Smatter Commuting In Israel, a new

app could hold the key to creating faster, cleaner and more convenient commutes. Users enter their location and destination, and an algorithm calculates the most efficient journey. Public transport is then rerouted accordingly. The system was introduced to help fight COVID-19, but if implemented permanently it's thought it could save $25 million a year.

1.5 Smart and sustainable cities

The smart city concept includes six axes: Natural resources and energy, Transportation and mobility, Buildings, Living, Government, Economy and people.

Cities can be made sustainable without the use of smart (ICT) technology, and smart technologies can be used in cities without contributing to sustainable development. Smart technologies can also be used for sustainable development in other cases than cities. It is only when all these three aspects are combined, when smart technologies are used for making cities more sustainable, that we can speak of smart sustainable cities[23]. ICT development is usually understood as technological development. But it is strongly indicated that development of Information and Communication Technologies (ICT) and urban growth are hand holding[24] as the development of ICT has had an enormous impact on how people live their lives and on how work, leisure and society are organized. Several products, services and business models resulted from the reduction of the costs ICT development brought. The transition from wires to wireless and the increasing number of devices being connected to the Internet has brought us towards a new era, "Internet of Things". A Smart Sustainable City is a city that meets the needs of its present inhabitants, without compromising the ability for other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT.For a city to be smart and sustainable it has to face main challenges. Accurate strategic assessment is required to identify which solutions are needed, and that takes a systems perspective on evaluating the effects of the proposed solutions. Cities must craft mitigating measures at the same time as they encourage technology for efficiency improvements, and they must closely

[23] Höjer, M., & Wangel, J. (2015). Smart sustainable cities: definition and challenges. In *ICT innovations for sustainability* (pp. 333-349). Springer, Cham.
[24] Townsend, A. M. (2013). *Smart cities: Big data, civic hackers, and the quest for a new utopia*. WW Norton & Company.

follow how ICT is shaping society. It is important for the development of the city to balance between top-down solutions that originate from large scale corporations but also bottom-up with small scale initiatives.

The competence when it comes to the use of ICT' since currently ICT knowledge among companies is much higher than among city governments and it can be hard for the second to stand peoples standards. The smart sustainable city calls not only for interconnecting devices but also organizations, requiring a reconsideration of which actors need to be involved in the planning and governance of the city.

There are several terms used nowadays to characterize cities where people enjoy living as well as have the opportunity to thrive. Cities being smart, sustainable as well as liveable, digital and creative. For a city to be agile it may include all the above since the whole idea is to be able to adapt in coming needs. If we had to design cities from scratch in a sustainable way we should determine the characteristics in a manner that is measurable and provides understanding of the interactions between the environment, the economy and society.

There has been a lot of research to identify the underlying areas of development, and this includes quality of life and lifestyle, infrastructure and services, ICT, communications, intelligence and information, people and society, environment and sustainability, governance and administration, economy and finance, and mobility and transportation.

Smart cities have some specific characteristics, Technological resources are important for the development of a smart city yet a digital city is not the same with smart city since Smart city is a wider and more holistic concept where technology is a necessary but not sufficient factor to solve problems, improve efficiency and develop citizens 'quality of life' (Jolías and Prince 2016).

Chapter 2. Cities Performance

Anyone can understand that we already live in an urban world so it is only natural to research and try to evaluate all areas of urban infrastructure and processes. For that purpose several attempts are made to index the performance of cities and indeed many many programs have been raised. Since 68% of people are estimated to live in cities until 2050 it is only natural to see several organizations develop observatories to study, advise and measure cities' elaboration and performance. To better capture a city's performance it is necessary to evaluate many aspects and evaluate policies implemented. City rankings, benchmarking and indexes are a global phenomenon as public and private institutions across the world foster city performance measures[25].

2.1 Smart City Observatory [26]

Smart city observatory is an initiative by IMD and Singapore University of Technology and Design (SUTD) who joined forces in 2017 and created an index offering a balanced focus on economic and technological aspects of smart cities on the one hand, and "humane dimensions" of smart cities such as quality of life, environment and inclusiveness, on the other. The aim was to produce an internationally recognized global smart city index.

The Smart City Index ranks cities based on economic and technological data, as well as by their citizens' perceptions of how "smart" their cities are. 2020 edition of the SCI, ranks 109 cities worldwide by capturing the perceptions of 120 residents in each city. The final score for each city is computed by using the perceptions of the last two years of the survey. The research is separated into 2 pillars, the Structures pillar referring to the existing infrastructure of the cities, and the Technology pillar describing the technological provisions and services available to the inhabitants. Each pillar is evaluated over five key areas: health

[25] Sánchez-Silva, M., & Gómez, C. (2013). Risk assessment and management of civil infrastructure networks: a systems approach. In *Handbook of seismic risk analysis and management of civil infrastructure systems* (pp. 437-464). Woodhead Publishing.

[26] Smart City Observatory - Home. (2017). IMD Business School. https://www.imd.org/smart-city-observatory/Home/

and safety, mobility, activities, opportunities, and governance. Cities are separated into four groups depending on the UN Human Development Index (HDI) score of the economy they are part of and each group Within each HDI group, cities are assigned a 'rating scale' (AAA to D) based on the perceptions-score of a given city compared to the scores of all other cities within the same group.

The results are presented to an overall ranking as well as a rating for each pillar and overall for each city.

The Smart City Index is a holistic attempt to capture the various dimensions of how citizens could consider that their respective cities are becoming better cities by becoming smarter ones. Part of the SCI's uniqueness is to rely first and foremost on the perceptions of those who live and work in the cities covered by the index, while providing a realistic recognition that not all cities start from the same level of development, nor with the same set of endowments and advantages. In SCI's context, a 'smart city' continues to be defined as an urban setting that applies technology to enhance the benefits and diminish the shortcomings of urbanization for its citizens.

2.2 Cultural and Creative Cities Monitor [27]

The Cultural and Creative Cities Monitor is a european observatory designed to help national, regional and municipal policy makers identify local strengths and opportunities and benchmark their cities against similar urban centres. It uses both quantitative and qualitative data. The Cultural and Creative Cities Monitor is thus an instrument to promote mutual exchange and learning between cities. The second edition of the Cultural and Creative Cities Monitor covers 190 cities in 30 European countries. 98 cities which have been or have been shortlisted to become European Capitals of Culture, 33 UNESCO Creative Cities, 59 cities hosting at least two international cultural festivals.

[27] European Comission.. Composite Indicators. European Commission - Joint Research Centre. https://composite-indicators.jrc.ec.europa.eu/

Concerning the quantitative data, information is captured in 29 indicators relevant to 9 dimensions reflecting 3 major facets of the cultural, social and economic vitality of cities.To measure those facets Composite indicators (CIs) are used which compare country performance and are increasingly recognised as a useful tool in policy analysis and public communication. The number of CIs [28] in existence around the world is growing year after year. The composite indicators have some major advantages as they can summarize multidimensional realities with a view to supporting decision makers, are easier to interpret than many separate indicators, can assess progress of countries over time can reduce the visible size of a set of indicators without dropping the underlying information base. Place issues of country performance and progress at the centre of the policy arena and they facilitate communication with the general public (i.e. citizens, media, etc.) and promote accountability they also help to construct/underpin narratives for lay and literate audiences and enable users to compare complex dimensions effectively. On the other hand they may send misleading policy messages if poorly constructed or misinterpreted. May invite simplistic policy conclusions, be misused, e.g. to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles. Also the selection of indicators and weights could be the subject of political dispute and could disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent. Inappropriate policies could be taken if dimensions of performance that are difficult to measure are ignored.

The 3 main facets are Cultural vibrancy, Creative Economy and Enabling Environment.

Cultural vibrancy is divided in Cultural venues and facilities and the indicators are exploring the assets such as landmarks, museums, galleries, cinemas, music halls and theatres and cultural participation and attractiveness which counts tourist overnight stays, museum visitors, cinema attendance and satisfaction with cultural facilities. Creative economy is studied under 3 dimensions: Creative and knowledge based jobs as in arts, culture and entertainment, media and communication as well as other creative sectors. intellectual property and innovation, counting It patent applications and community design applications

[28] Joint Research Centre-European Commission. (2008). Handbook on constructing composite indicators: methodology and user guide. OECD publishing.

and new jobs in creative sectors summing up Jobs in new arts culture & entertainment enterprises, new media and communication enterprises and jobs in new enterprises in other creative sectors.

Enabling environment is studied under four aspects: human capital and education counting graduates in arts and humanities and ICT as well as average appearances in university rankings. Openness, tolerance and trust, studying foreign born population and graduates, tolerance and integration of foreigners and people trust. Local and international connections measuring accessibility by road, by rail and to passenger flights and finally quality of governance.

The *qualitative* component includes key facts and manifestations of cities' cultural and creative assets to support quantitative data. Cultural and Creative Cities Monitor [29] is a tool supporting cities in shaping their policies and measuring the impact of culture launched by the European Commission. The project is co-funded by the Creative Europe programme of the European Union and managed by a consortium of ten non-profit and public organisations led by Trans Europe Halles, the European network of non-governmental cultural centres. Seven urban labs in seven european cities supply this project with the goal to address local challenges together and find participatory and common solutions to them.

The project indicates that culture and commoning practices can transform neighbourhoods and cities into more sustainable places, catalysing better lives for their communities. There are three key objectives to achieve this goal. Explore, learn, research disseminate & sustain. Explore and test how to best approach current urban challenges through commoning practices, co-creation and policy development, facilitating and learning, exchange and training within and among cities, research and document the outcomes.

The second edition (2019) provides evidence of the value of cultural investment and illuminates the importance of culture and creativity for cities increasingly competing on a global scale. The aim is to help cities identify their strengths and opportunities, benchmark their performance, and push for policies that boost their cultural, creative and innovation potential. The tool has inspired local governments across Europe and been used to tailor their

[29] Montalto, V., Tacao Moura, C. J., Langedijk, S., & Saisana, M. (2017). The cultural and creative cities monitor. *European Commission, Joint Research Centre: Ispra, Italy*, 114.

policies and investment in culture and creative spaces. The methodology for the research was divided into five phases. The preparation phase included analysis of current policies, recommendations and best-case examples in Europe, mapping of relevant European cultural and creative spaces and local stakeholders as well as introduction and training on core methodologies and approaches for the project partners the implementation phase included 21 workshops with local stakeholders, 14 Traineeships for Urban Labs and their Handshake Partners, An open call for participants to join five Urban Explorations and three co-creative policy events, 4 thematic Urban Explorations, a series of hybrid Co-creative Policy Events in Ghent, Belgium and a Digital Conference. The research phase of the project was a close collaboration between the researchers' team from the University of Antwerp (UA) and the European Cultural Foundation (ECF).The research design and methods used in the project followed innovative 'convoking' method developed by the Canadian social scientists Max Haiven and Alex Khasnabish (2014) for their research into social movements. The dissemination phase delivered the outputs, conclusion, recommendations and dissemination of results including A digital knowledge base platform for 'Urban Regeneration through Industrial Heritage Sites', a digital benchmarking system for cultural and creative spaces, publications and reports, 3 policy reports out of the co-creative policy events including Policy Analysis and Recommendations, a synthesised final study,a research book, an Online Toolkit and a new postgraduate programme—"Curating the City" offering international Master's students, PhD students and professionals courses in urban cultural politics. As for the results CCSC aims to lay the groundwork for cultural policies to be implemented in future societies through development of hands-on cultural policies, alternative organisational models, better synergies, helping culture and creative industries contribute to new urban and sustainable developments, Co-created policy development for cities and regions and Recommendations on P2P learning, co-creation and cultural policy including funding at local and EU levels.

The key findings are summarized to the below:

- Leading cultural and creative cities: compared to other cities with a similar population

- Culture, creativity and prosperity: better performance on culture and creativity is linked to higher income per capita.
- Growth drivers: cities in more-developed regions are the highest fliers although creative jobs grow just as quickly in less-developed areas.
- Macro-regional performance: on average, cities in northern Europe lead on the C3 Index while those in southern and western Europe are equally as good on the number of cultural venues and tourists attracted.
- Fairness of cultural participation opportunities: Europe's cultural venues can generally be reached within a 30-minute walk and are very much accessible by public transport.

2. 3 Innovation Cities Program [30]

The Innovation Cities Program is an evidence-based city development program, for economic and social development of cities. The program provides resources for building, offering full city benchmarking data, segment case studies and other resources. Innovation Cities Index 2019 studies three main factors, Cultural Assets, Human Infrastructure and Networked Markets divides them into thirty one segments which cover all economic, industry and social functions of an economy, and one hundred and sixty two indicators designed to cover all critical economic, industry and social functions of a city necessary to enable innovation.

Cultural Assets are measured by arts communities, civic organizations, museums, music events, galleries, political protests, books, media, availability of information, and sports.

Networked Markets is a measure of a city's power and linkages in global markets, taking into account geography, economics (such as exports and imports), technology, market size, geo-political factors, and diplomacy.

[30] Home - Innovation CitiesTM Index - City Rankings. (2021, July 7). Innovation CitiesTM Index -- City Rankings. https://www.innovation-cities.com/

Human Infrastructure includes the soft and hard infrastructure of mass transit, finance, universities, hospitals, rail, roads, law, commerce, start-ups, healthcare, and telecommunications.

Benchmark Scores provides a simple performance reference 0-5 for each city on any indicator while for each indicator a global ranking is generated for all cities in the set. Each indicator consists of a few Data Points, with sources and date of data. Most indicators contain around 4 standard data points (as few as 2) and as many as 10.

Data points are global on almost any cities starting with the 500 cities in the index and are available at the city level or Metropolitan Area. There is a massive range of data which is up to date standardized, quick and clear, labeled in units.

Index classifies all cities into 4 classes for innovation. "Upstart Cities" are moving towards being globally competitive, "Node Cities" are globally competitive with competitive performance across many innovation segments, "Hub Cities" are dominance or influence on key economic and social innovation segments based on current global trends and "Nexus Cities" are cities at the top few percentage globally for multiple economic and social innovation pre-conditions across multiple industry segments.

2.4 Resilient Cities Network [31]

Resilient Cities Network is an urban resilience network. It brings together global knowledge, practice, partnerships, and funding to empower the members to build safe and equitable cities for all. The Resilient Cities Network consists of member cities and Chief Resilience Officers from the 100 Resilient Cities program, sharing a common lens for holistic urban resilience and with thousands of projects in implementation. It was pioneered by The Rockefeller Foundation in 2013, as part of its Global Centennial Initiative. The network is City led, Cities, represented by their CROs, participate in the governance of the network, Impact-focused prioritize resilient projects that aim to improve the lives of city dwellers, regionally driven, activities are designed with more flexibility to cater to member cities'

[31] Resilient Cities Network. (2021, June 23). Home. https://resilientcitiesnetwork.org/

needs and partnership based, Cities' resilience activities aim to become self-sustainable in the near future.

100RC defines urban resilience as the capacity of individuals, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses, and acute shocks they experience. Chronic stresses are Challenges that weaken the fabric of a city on a dayto-day or cyclical basis like sea level rise, increasing pressures on healthcare services, unemployment, and deeper social inequality while acute shocks are Sudden events that threaten a city such as earthquakes, heat-waves, flash-floods, and cyber attacks.

As cities grow larger, the likely consequences of unexpected events are ever greater for individual cities. Cities are also more numerous and increasingly interdependent, meaning the effects of events in one place can be felt around the world. Meanwhile, climate change increased the likelihood of great numbers of catastrophic events happening.

100RC supports the adoption and incorporation of a view of resilience that includes both shocks and stresses that weaken the city. This way cities become more agile and capable to deliver basic functions even when in crisis to all populations. Cities in the 100RC network are provided with the resources necessary to develop a roadmap to resilience along four main pathways: Financial and logistical guidance for establishing an innovative new position in city government, a Chief Resilience Officer, who will lead the city's resilience efforts, expert support for development of a robust resilience strategy, access to solutions, service providers, and partners from the private, public and NGO sectors and membership of a global network of member cities who can learn from and help each other. 100RC does not just help cities become more resilient but also sets the stage to globally practice resilience among governments, NGOs, the private sector, and individual citizens.

The program uses a framework "the City Resilience Framework (CRF)" developed by Arup and the Rockefeller Foundation, which breaks down the complexity of city systems and analyses their specific function in the drivers that contribute to city resilience and it consists of four main dimensions and 12 drivers. The resilience strategy is framed by 65 actions and 53 supporting actions:

- Knowledge for leadership and strategy: Promotes leadership and effective management,empowers a broad range of stakeholders, fosters long-term & integrated planning

- People for health and well being: Meets basic needs, Support livelihoods and employment, ensures public health services
- Place, Infrastructure and environment: Provides reliable communication and mobility, ensures continuity of critical services, provides & enhances natural and manmade assets
- Organization for Economy & society: Fosters economic prosperity, ensures social stability security and justice, promotes cohesive & engaged communities
- Resilient cities also stand for seven qualities:
- They are reflective- meaning past experience is used to inform future decisions
- Resourceful- finding alternative ways to use resources,
- Inclusive- prioritizing broad consultation to create a sense of shared ownership in decision making, integrated- bringing together systems and institutions,
- Robust- with well-conceived, constructed, and managed systems,
- Redundant - spare capacity purposively created to accommodate disruption
- Flexible- have the ability to adopt alternatives strategies in response to changing circumstances

2.5 2021 World's Best Cities[32]

Resonance is a global consultancy of strategic and creative place makers.The advisory portfolio lies in fields such as real estate, tourism and economic development. Resonance combines expertise in research, strategy, branding and communications to make destinations, cities and developments more valuable and more vibrant. The aim is to help places understand market trends, assess their strengths and weaknesses, engage local communities, plan for the future, and create branding and communications in order to realize their full economic potential.

[32] 2021 World's. (2021, June 26). Best Cities. https://www.bestcities.org/reports/2021-worlds-best-cities/

The “Best Cities Report” is used by companies and government agencies to help design, develop and promote the best locations around the globe, the research services include consumer research, market analysis, destination assessments and performance Benchmarking. They provide strategic plans and marketing strategies for tourism, real estate and economic development organizations in order to uncover and capitalize on opportunities for long-term sustainable growth. strategic plans and marketing strategies for tourism, real estate and economic development organizations in order to uncover and capitalize on opportunities for long-term sustainable growth. They create communication strategies to engage audiences ranging from local residents to international investors.

Resonance Consultancy ranks the world’s cities (principal cities of metropolitan areas with populations of more than one million) by using a combination of statistical performance and qualitative evaluations by locals and visitors in 25 areas grouped into six core categories.

Principal cities are defined as the largest city in each metropolitan statistical area.

The categories are place, product, people, prosperity, programming and promotion. Within the place category, the report evaluates the perceived quality of its natural and built environments such as weather and the average number of sunny days, safety(Homicide rate), sights and landmarks, parks and outdoors and for 2021’s report COVID-19 Infections. They gather data from national Climatic Data Center, Weatherbase, United Nations Office on Drugs and

Crime, UN-Habitat, Eurostat, FBI, National data sources, Centers for Disease Control and Prevention as well as private travel apps tripadvisor. Product category studies a city’s key institutions, attractions and infrastructure and for this they study Airport Connectivity, Attractions, Museums, University Ranking and Convention Center. Human capital is often a city’s most valuable resource. To evaluate the relative strength of human capital from one city to the next, they consider the diversity of the city’s population tracking Foreign-Born Residents Percentage of foreign-born residents and Educational Attainment Percentage of the population with a bachelor’s degree or higher. Beliefs about the wealth and prosperity of a city are shaped by statistics such as the income of citizens, the standard of living and the presence or absence of large, recognizable corporations. To evaluate that the report studies GDP Per Capita GDP per capita, Income Equality The city’s Gini Index, a simple measure of the distribution of income across income percentiles in a population and Unemployment Rate

The city's latest unemployment rate that captures job losses as a result of the economic recession caused by COVID-19. Programming measures the experiential pillars of a great visit: food, shows, shopping and nightlife. To identify this they record the number of quality performing arts and cultural experiences, number of quality nightlife experiences, number of quality restaurants and culinary experiences and number of quality shopping experiences, all recommended by locals and visitors. Promotion is about The number and frequency of media coverage, online articles, references and place-based recommendations influence our perception of cities.

2.6 Cities in Motion [33]

IESE Cities in Motion Strategies is a research platform that was launched by the IESE Business School Center for Globalization and Strategy and the IESE Department of Strategy. The initiative connects a worldwide network of city experts and specialized private companies with local administrations all over the world, with the goal of developing valuable ideas and innovative tools that can generate smarter cities and promote change at the local level. The main strategic lines are to develop a comprehensive approach to smart governance strategies, conduct research and bring innovation to governance strategies all over the world, connect urban leaders to powerful ideas through events and networking, as well as identify and communicate international best practices. The CIMI focuses on the population of cities in the largest countries around the world. The inclusion of cities is directly related to the size of the population and to criteria of economic and cultural relevance within the international arena. The basic model on which the process for creating the indicator is based is the weighted aggregation of partial indicators representing each of the 10 dimensions.

$$CIMI=qs1+qs2+qs3+\cdots+qs10$$

in which $q = 1/m$ is the weight assigned to the standardized indicators; Si is the value of the synthetic indicator for dimension i; and m is the number of dimensions, which in this case is 10. Thus, dimensions are equally weighted.

[33] Berrone, P., & Ricart, J. E. (2020). IESE Cities in Motion Index 2020. *IESE Business School University of Navarra: Barcelona, Spain.*

The CIMI ranks 8 fields: Governance, social cohesion, urban planning, mobility and transportation, international outreach, environment, human capital, technology and economy.

2.7 Safe Cities Index [34]

The Safe Cities Index 2017 is a report from The Economist Intelligence Unit sponsored by NEC. The report is based on the second repetition of the index, which ranks 60 cities across 49 indicators covering digital security, health security, infrastructure security and personal security. Cities have become global economic and social hubs, but the bigger the success of a city towards that the more vulnerable it gets. The size of a city plays also an important factor and affects that while cities are constantly growing. In 2016, there were 31 megacities, cities with more than 10m inhabitants but this is projected to rise to 41 by 2030. While cities generate economic activity, the security challenges they face expand and aggravates as their populations rise. Economic activity in such population sizes creates dispersion among incomes and this can contribute to violent outbursts. The rapid deployment of digital technologies in pursuit of the so-called "smart city" brings, of course, huge benefits but also creates vulnerabilities. Climate change is also a threat to the security of cities and people's health. Cities are defined by the complex, interlinked nature of their systems and infrastructure so to be safe and secure several aspects should be taken under consideration.

The index measures 4 different aspects of security concerning cities. Digital security, health security, infrastructure security and personal security.

In addition to data from The Economist Intelligence Unit, which has produced a number of similar indices that measure cities on livability, risk and other issues, publicly available information for the latest available year from official sources has been used where applicable. Primary sources include the World Health Organization, Transparency International, Kaspersky Lab and various others (see table below). Where available, the data used is city-specific; otherwise, proxies using regional or national data were used instead.

Digital security evaluates the ability of urban citizens to use the internet and other

[34] Index, S. C. (2019). Urban security and resilience in an interconnected world. *The Economist Intelligence Unit Limited: London, UK*.

digital channels without fear of privacy violations or identity theft. On the input side, cities are scored on their awareness of digital threats, the level of technology employed and the existence of dedicated cyber security teams. On the output side, the index measures the frequency of identity theft and the estimated number of computers infected with a virus.

More and more cities are moving towards open digital platforms that leave them vulnerable and naked to cyber attacks which can be very serious since there are critical things to lose such as control over water supply, transport and electricity grids. This means smarter cities may be more exposed than others and ironically cities that have multiple communications systems and highly disaggregated networks are going to be much less vulnerable so consequently safer. A response to cyber threats has been to establish dedicated units within the police force and also invest in cyber security. The wealth of the city also seems to affect the index, often lacking technology skills and competing challenges such as tackling infectious diseases and poverty can push cyber security lower on the list of priorities. Cities in developing countries are generally more exposed to cyber threats because of the rate at which they have adopted digital technology. However, even in cities in mature economies, municipal leaders may be rushing to adopt technology at the expense of cyber security considerations. Going to the next level in being a smart city, it is important to acknowledge that cyber Security is one of the fundamental cornerstones of the entire process. With the benefits of technology to urban operations there come the threats to safety and security. Innovation still plays a key role in that and mobile devices can become safety tools providing users with innovative apps to contribute to safety and crime detection. Some apps are designed to help individuals protect themselves and their peers while others also contribute to solving crimes.

Health security, measures how cities maintain the natural environment as well as the level and quality of care available. On the input side, cities are scored based on their environmental policies and access to and quality of healthcare services. Output indicators include air and water quality, life expectancy as well as infant mortality among other sub-indicators. A new sub-indicator focusing on the number of chemical, biological and radiological attacks on a city was also included to incorporate the impact of terrorism on urban health systems. Income levels certainly affect health security but are not always the

main factor of which cities keep their residents healthy. Towards protection of the cities a priority for policymakers is to ensure that their cities offer adequate access to healthcare, whether that is provision of emergency services and hospitals or the operation of social care services. However, cities also need to deliver a healthy urban environment for traffic management schemes, adequacy of green spaces and other measures.

The results of the report have shown that poorer cities struggle to deliver adequate health services. Ttechnology can help manage urban health and wellbeing more efficiently and at a lower cost especially for cities with ageing populations, elderly residents can live independently for longer thanks to technology that remotely monitors their health. While many factors, criminal, tribal, social, cultural and environmental lies behind violence, studies have linked mental health and violence.

Infrastructure security considers the built physical environment, such as city infrastructure and its vulnerability to disasters and terrorist attacks. On the input side, the index takes into account sub-indicators such as the quality of infrastructure as well as the enforcement of transport safety, while on the output side the number of vehicular accidents and pedestrian deaths are included, as well as number of terrorist attacks on facilities and infrastructure.

Personal security considers how at risk citizens are from crime, violence and other man-made threats. Input indicators in this domain take into account policies and decisions such as the level of police engagement, the use of data driven crime prevention and the overall political stability of the country where each city is located. On the output side, the index takes into account the prevalence of petty and violent crime, safety perceptions, as well as new sub-indicators assessing the threat of civil unrest, military conflict and terrorism.

In order to be able to compare data points across cities, as well as to construct aggregate scores for each city, the project team had to first make the gathered data comparable. To do so, the quantitative indicators were normalized on a scale of 0-100 using a min-max calculation, where the score is the standard deviation from the mean, with the best city scoring 100 points and the worst scoring 0. Qualitative indicators were normalized as well. In some instances, those scores were on a scale of 0-100. In others, a scale of 1-5 was used, with 1 being the lowest or most negative score, and 5 being the highest or most positive score—these were normalized in a similar manner to the quantitative indicators.

Other indicators were normalized as a two, three or four-point rating. For example, "dedicated cyber security teams" was normalized so that neither a national- or city-level cyber security team scored 0, a national team only scored 50, and a city-level team scored 100.

While using normalised values (that is, a score of 0–100) allows for direct comparability with other normalised indicator scores, min-max scoring also leads to changes in scores from the 2015 Index, even without a change in actual performance. For example, in an indicator with normalised scoring, if the score of the worst-performing city is lower than that of the previous index, the scores of other countries will be affected regardless of actual performance.

The index is an aggregate score of all the underlying indicators. The index is first aggregated by domain—creating a score for each domain (for example, personal security)—and finally, overall, based on the composite of the underlying domain scores. To create the underlying domain scores, each underlying indicator was aggregated
according to an assigned weighting. Sub Indicators are all weighted equally, as are the four main indicator domains.

2.8 The Green city Index[35]

The Green City Index series is a research project conducted by the Economist Intelligence Unit (EIU) and sponsored by Siemens. The series began in 2009 and covers more than 120 cities in Europe, Latin America, Asia, North America and Africa Australia and New Zealand. The cities were chosen based on their size and importance by the Economist Intelligence Unit. Most are capital cities, large population hubs and business centres. This includes 27 cities in the US and Canada, 42 cities in Europe with 12 of them being in Germany, 22 Asian cities, 12 Asian and & in Australia and New Zealand. The Green City Index methodology was developed by the Economist Intelligence Unit (EIU) in cooperation with Siemens. The cities were picked independently, rather than relying on requests from city governments to be included or excluded, in order to enhance each Index's

[35] Siemens, A. G. (2012). The Green City Index. A summary of the Green City Index research series. *Corporate Communications and Government Affairs: München, Germany*.

credibility and comparability. The index measures 30 indicators across eight to nine categories depending on the region. It covers CO2 emissions, energy, buildings, land use, transport, water and sanitation, waste management, air quality and environmental governance. Half of the indicators in each Index are quantitative, usually data from official public sources, for example, CO2 emissions per capita, water consumption per capita, recycling rates and air pollutant concentrations. The remainder are qualitative assessments of the city's environmental policies – for example, the city's commitment to sourcing more renewable energy, traffic-congestion-reduction policies and air quality codes.

Each city receives an overall Index ranking and a separate ranking for each individual category.

More than 20 global experts in urban environmental sustainability advised the EIU in developing the methodology for the Green City Indexes. North and South America are the most urbanised regions, with slightly over 80% of residents on both continents residing in cities. Europe is not far behind at just over 70% while Asia and Africa is about 40% but it is estimated that this percentage could even double by 2030.

Cities are the growth engines of the future, offering opportunities for education, employment and prosperity, but they also lead to negative effects like traffic congestion, informal settlements, urban sprawl, environmental pollution, exploitation of resources and contribution to climate change. Many of these challenges can be faced with efficient technology. The research series now covers more than 120 cities worldwide. It has helped city stakeholders to better understand their specific challenges, provides them insights into effective policies and best practices and supports their decision making. This Green City Index summary report aims to provide knowledge on how to build a greener city and a number of global comparisons between regions and cities.

Towards Greener cities there are seven pillars we should focus on. Good governance and leadership at the metropolitan level the Green City Index series also demonstrates that the national legislation needs to leave enough autonomy to cities to address their most pressing issues and make their own investment decisions and also have the funding to implement them.

Top-performing cities take a holistic approach to environmental problems, recognising that performance in one category, such as transport, is linked to success in others such as air quality.

Singapore and Copenhagen, both leaders in their regions, also plan holistically. Singapore has the Inter-Ministerial Committee on Sustainable Development, which brings together many different departments to set an integrated strategy on sustainable development. Copenhagen has co-ordinators in each environmental department who meet regularly to exchange information.

Wealth and better environmental performance weem to have a clear correlation since more affluent cities can invest more money in infrastructure and set aside more generous budgets for environmental oversight. However, in each Index some cities with a below-average income clearly outperform their peer cities with higher incomes. This shows that less-well off cities can adopt policies or low-cost projects to improve environmental sustainability. For example, tree planting is becoming a common environmental activity in Asia, especially for cities with lower incomes. Wealth can even be counter-productive in the early stages of economic development, when more affluence often correlates with more emissions, more urban sprawl, lower density and more cars. A central issue for cities in the developing world is to work towards limiting the environmental impact of rising consumption today, rather than waiting for attitudes to change as incomes grow. This can be done by investing in efficient infrastructure, initiating public education campaigns and setting targets – for example, for more renewable energy, green spaces and air quality as well as addressing the growth of informal settlements.

Environmental performance is also a matter of civic engagement. The study measured the level of voluntary participation in organisations. The comparison found that the more volunteerism in the city, the better the score in the Index. Out of more than 120 cities evaluated, just over half receive full marks for involving their citizens in important environmental decisions. It is clear that more needs to be done across the world to engage the public in sustainability issues.

Technology plays an important role in reducing environmental impacts. CO2 emissions, water or waste disposal waste-to-energy plant employs advanced methods to enhance water quality, including ozone and membrane filtration systems technology can help

cities in the developing world “leap-frog” less sustainable infrastructure in the developed world

The green and brown agenda need to go hand in hand. Brown agenda focuses on human health and poverty reduction, as distinguished from the “green agenda”, which looks to improve the sustainability of eco-systems. Among the benefits, adopting environmentally sound policies reduces municipal waste and sewage (and the spread of disease), improves the efficiency of energy and water provision, and creates jobs and wealth through investment in infrastructure.

Unfortunately, in many parts of the developing world, the immediate demands of survival in some cities tend to prevent officials from integrating sustainability into their plans

Informal settlements are key to the environmental agenda because they exist outside of formal planning policies and often lead to pollution through inadequate sewerage and waste management. cities have different approaches, but many experts favour upgrading and integration over removal.

Chapter 3: The Case of Athens

3.1 Smart City Observatory[36] *observing Athens*

The Smart City Index ranks cities based on economic and technological data, as well as by their citizens' perceptions of how "smart" their cities are. Singapore, Helsinki and Zurich have come top in the 2020 Smart City Index, in a year that saw many European cities fall in the rankings. 2020 has been a year with great challenges, and while it is very early come into conclusions about the pandemic we could see that Smart cities closer to the top of the rankings seem to deal with unexpected challenges of the devastating pandemic with a better outcome. In the 2020 edition of the SCI Athes ranked 99 out of 109 cities, dropping 4 places from the previous edition (2019). The Smart City Index ranks cities based on economic and technological data, as well as by their citizens' perceptions of how "smart" their cities are. Referring to people's perception, from a list of 15 indicators, survey respondents were asked to select 5 that they perceived as the most urgent for their city. Security(63%), unemployment (62.2%), health services (52.8%), corruption(41.1%), road congestion(41.1%) are the major problematic areas according to the research, followed by green spaces(36.6%), fulfilling employment(30.9%), recycling(27.6%), air pollution(27.2%) public transport(25.6%), affordable housing(24.4%), school education(24.4%), basic amenities(22.0%), citizen engagement(14.6%), social mobility (7.7%). They were also called to rate how strongly they agree or disagree with the below statements:

- You are willing to concede personal data in order to improve traffic congestion 59.8%.
- You are comfortable with face recognition technologies to lower crime 58.9%.

[36] Smart City Ranking. (2018). Smart Cities Competitive Assesment. Published. https://www.abiresearch.com/market-research/product/1028389-smart-city-ranking/https://www.imd.org/file:///C:/Users/user/AppData/Local/Microsoft/Windows/Temporary%20Internet%20Files/Content.IE5/ZWIMTQE1/athens.pdf

- You feel the availability of online information has increased your trust in authorities 46.3%.
- The proportion of your day-to-day payment transactions that are non-cash 67.3%.
- The percentage refers to % of respondents who agree or strongly agree with the statement.

The index ranked 5 fields, Health & Safety, Mobility, Activities, Opportunities (Work & School) and Governance under two scopes, structures and technology as shown in diagram. Major problems for Health and Safety seems to be quality of air as well as the high rents according to salaries when it comes to structures, and the role of CCTV cameras as well as connectivity. For mobility traffic congestion is the major problem while the use of bicycle hiring does not seem to reduce it. For activities, green spaces are far behind satisfactory when online purchasing tickets to shows and museums has made it easier to attend. Concerning opportunities there is a great need for businesses creating new jobs and online services made by the city are not quite a leverage. Finally when it comes to governance corruption of city officials is a great issue of concern and citizens do not contribute to the decision making of local government.

3.2 Athens in Cultural and creative cities Monitor

Cultural and creative Cities index evaluates cities under Cultural Vibrancy, Creative Economy and Enabling Environment. Athens scores 28.1 overall. For Cultural Vibrancy cultural venues and facilities score 60.4 (15.8 for sights and landmarks, 35.3 museums and art galleries, 91.2 cinemas, 40.1 concerts and music halls, 84.8 theatres). On the other hand Cultural Participation and Engagement scores just 17.8.(27.3 tourists overnight, 6.2 museum visitors, 32.3 cinema attendance and 10 satisfaction with cultural facilities. This indicates the lack of engagement of people and visitors to the cultural wealth of the city.

At Creative economy Athens has an overall score 20.4. Creative and knowledge based jobs score 35.6 with jobs in arts, culture and entertainment having the better evaluation (54.2) followed by jobs in media and communication (30.4) and jobs in other creative sectors(22.2). Intellectual Property and Innovation has a very poor score (1.4 for ICT patent applications and Community design applications). Concerning new jobs in creative sectors it scores 14.3 (jobs in new arts, culture and entertainment enterprises 19.5, Jobs in new media & communication enterprises 6.6, Jobs in new enterprises in other creative sectors 16.8). It is indicated that while creative and knowledge based jobs especially in arts, culture & entertainment bring Athens to a good position. There is a big gap when it comes to intellectual property and innovation.

For Enabling Environment Athens scores 21.6 overall with Human capital and education scoring 31.2 (graduates in arts and humanities 17.9, graduates in ICT 28.9 and average appearances in university rankings 46.8). For openness and tolerance it scores very low at just 11.4 and besides there is a lot Foreign born population (41.3) a problem has emerged here since there is zero tolerance or integration for foreigners, very few foreign graduates(5.7) and low people trust(10). Local and international connections scores 22.8 (Accessibility to passenger flights 17.5. Accessibility by road 34.3, accessibility by rail 16.5. Finally, the quality of governance scores 22.9.

The European Capital of Culture programme, founded in 1985, is now regarded as the most prestigious and popular European cultural initiative. Athens was awarded as Capital of culture in 1985.

Athens is a Role Model city in the Horizon 2020 project ROCK having the aim to promote an accessible-to-all concept among citizens and visitors. In particular, the city is supporting the development of sociocultural entrepreneurial projects to address cultural heritage as a basis for urban regeneration and to facilitate the shift towards a knowledge-based society and actually ranks 2nd in Cities where the majority of inhabitants is not more than 2 km from the closest cultural venue(s) with 94.92. Although in nearly half of the European cities analysed people are, on average, no more than 2 km away from the cultural facility closest to their home, the average minimum distance to the closest museum/theatre/cinema considerably varies across Europe. It would take less than 10 minutes for people living in Athens (Greece) and Paris (France) to reach the closest venue

(i.e. less than 1 km away) while in Norrköping (Sweden) the average minimum distance is not really walkable, being almost 10 times higher (9.6 km).

3.3 Innovation Cities Program [37] the place of Athens

As mentioned above Innovations City Program aims to measure which cities have the best conditions for innovation and for that purpose it studies three main factors,Cultural Assets, Human Infrastructure and Networked Markets divides them into thirty one segments which cover all economic, industry and social functions of an economy, and one hundred and sixty two indicators designed to cover all critical economic, industry and social functions of a city necessary to enable innovation. Then the cities are scored and into 4 classes for innovation. "Upstart Cities", Node Cities", "Hub Cities" and "Nexus Cities". Innovation Cities Index 2019 is the 12th annual classifications & city rankings. At this report New York ranked first scoring 59, followed by Tokio(58), London(57), Los Angeles (56) and Singapore(55) all classified as NEXUS. Athens ranked 78th out of 500, scoring 44 and classified as HUB meaning, dominance or influence on key economic and social innovation segments based on current global trends. It has dropped 16 places compared to the previous year.

3.4 Counting resilience in Athens [38]

In recent years Athens has experienced significant shocks concerning the social economic crisis. The crisis exposed weakness underlined many years as well revealed strengths, resources and talent. The closure of many businesses resulted in sudden declining incomes, unemployment and growing personal debt, combined with austerity measures and high taxes that became a big hit for vulnerable populations. Climate change has also affected the city since the lack of updated legislation on energy and environmental protection for buildings and other urban infrastructure and there is insufficient climate protection at the

[37] Sacha. (2021, July 7). Innovation CitiesTM Index 2019 - Global City Rankings by 2thinknow. Innovation CitiesTM Index -- City Rankings. https://www.innovation-cities.com/index-2019-global-city-rankings/18842/
[38] City of Athens. (2017). Redefining the city: Athens Resilience Strategy for 2030. 100 Resilient Cities. Published. http://www.100resilientcities.org/strategies/athens/

existing buildings. These resulted in an increase in the urban heat island effect. Athens had to face many more challenges such as the sharp decline in population, the large influx of refugees Increasingly aging infrastructure, threat of earthquakes, violence, and civil unrest, fragmented government structure and overlapping jurisdictions combined with aged problems like public transportation and urban mobility, air quality and the city's green infrastructures.

Capturing Athen's resilience challenges this report records as the number 1 acute shock for the city earthquakes since over 30% of buildings in the City of Athens were constructed before the first building code for earthquake protection, which is a major problem in a country with the 6th highest seismic activity level in the world considering that the city's urban environment is densely populated, with narrow streets and only few public open spaces.The city seems totally unprepared to confront another serious seismic event.

Climate shock is indicated as the second acute shock, there has been observed a gradual increase in the length and level of high temperatures as well as the frequency and intensity of heat waves and other related phenomena such as flash floods and bad air quality. The Athenian Urban Heat Island, intensified by the rising heat, exhibits severe temperature differences reaching 6°C, 7°C, even 10°C between the city center and its suburbs. The density and bad quality of built, as well as the lack of green open spaces are the main disorders.

Civil unrest seems to be the third shock with demonstration taking place almost on a daily basis organized by several collectivities such as labor unions, political parties, anti-authoritarian groups, student groups etc. They take place in the city center interrupting the city's daily functions, logistics and infrastructures and in some cases they become violent riots that can last for several days.

The 4rth shock Cybercrime a rising challenge for Greece in general and since Athens is at the center of many operational decision making procedures while also hosting several critical infrastructures and public utility networks are considered a high-risk target for cyber attacks.

When it comes to chronic stresses, depressed macroeconomic conditions have brought severe cuts in social and public services and high unemployment and it is considered the major Stress of the City. The economy has shrunk by 25%, poverty and homelessness has

risen and so did taxes and private debt and many Athenians end up struggling with delinquent loans and the threat of home repossessions.

Aging Infrastructure is the second stress as many buildings besides being old, they also don't comply with the regulatory guidelines for the Greek Building Code, have unsafe structural elements, and are not energy efficient. Besides buildings all infrastructures in Athens are suffering from lack of proper maintenance, lack of proactive long term planning, lack of data and data driven policies.

The third stress is migration, since 2015 over a million people crossed through Greek territories on their way to a better and safer life in the European Union. The initial shock has become a stress for the city neighborhood and systems that were already struggling with unemployment, poverty, budget cuts and aging infrastructures. By the end of 2016 about 60.000 newcomers – refugees and immigrants - were recorded as living in Greece. Around 20.000 of them are currently living in Athens.

The 4th stress appears to be mistrust Athenians seem to have towards all levels of government, administrative or elected as a result of centuries of political partisanship and mismanagement of resources, corruption and clientelism, lack of transparency and accountability.

3.5 Athens at 2021 World's Best Cities

In the 2021 report London ranked first scoring very high at Promotion and programming, followed by New York, Paris, Moscow and Tokyo. Athens ranked 79 out of 100 scoring 40 at place 61 at product 32 at programming 140 at people 129 at prosperity and 85 at promotion.

According to the report nightlife, museums and archeology are cities' stronger assets.The report refers that besides the economic and social crisis Athens suffered it has now recovered with the sustained investment blooming as jobs trickle back and tourist numbers snap back to levels better than before the crisis. The relative affordability of a European capital concerning real estate as well as the ingrained openness of Athenians are highlighted as assets. The report also refers to the Grand Promenade.

3.6 Athens in Motion

As analyzed before IESE Cities in Motion Strategies was launched by the IESE Business School Center for Globalization and Strategy and the IESE Department of Strategy. The initiative connects a worldwide network of city experts and specialized private companies with local administrations all over the world, with the goal of developing valuable ideas and innovative tools that can generate smarter cities and promote change at the local level.

At this index Athens ranks 96. The index is further segmented into 9 areas of interest. The major problematic according to the index seems to be “Governance” and “Social cohesion" since they both score (148) as well as urban planning (142). “Mobility and transportation” has the best score (41) followed by “International Outreach” (52)and “Environment”(57). Human capital ranks 71, technology 83 and economy 109.

3.7 Safe Cities Index for Athens [39]

The safe cities index ranks cities in 4 categories, digital, health, infrastructure and personal security. Overall results bring Tokyo in the first position followed by Singapore, osaka, Toronto and Melbourne while we can see Karachi in the last position. Concerning digital security Tokyo ranks first followed by Singapore, Chicago, Amsterdam and Hong Kong while Jakarta comes last. In health security Osaka has the lead while Tokyo, Frankfurt zurich and seoul come after and Karachi stands last. In Infrastructure security Singapore, Madrid, Barcelona, Stockholm and Welligthon fill the first five and Dhaka comes last. Finally in personal security Singapore, Wellington, Osaka, Tokyo and Toronto complete the first 5 and Karachi scores last.

Athens ranks 33 out of 60 overall in the safe cities index 2017 and 15th out of 21 when clustered by population (<5 million). It ranked 35th at digital security, 21th at health security, 21th at infrastructure security, 41 at personal security.

[39] Borkowski, R. (2018). Safe Cities Index 2017. Security in a rapidly urbanising world. A report from The Economist Intelligence Unit [Indeks bezpieczeństwa miast 2017. Bezpieczeństwo w gwałtownie urbanizującym się świecie. Raport Wywiadowni „The Economist”]. *Bezpieczeństwo. Teoria i Praktyka*, *33*(4), 215-218.

3.8 Green City Index [40]

As seen in many developed cities we can see in Athens a shift from industrial production to business-related services, such as shipping and tourism, over the past decade. In 2001 industry accounted for 16.7% of total gross value added in Athens. By 2006 this figure had fallen to 13.2%. Athens ranked 22nd out of 30 countries in the European Green Cities Index with a score of 53.09 out of 100. Air quality, performance on waste and land use, and the green credentials of its buildings have brought Athens to that place. There is a complexity around environmental policies in Athens since it is divided among the city and several ministries at national level. This seems to delay the planning and implementation of programmes. On the other hand environmental policies on water and transport have supported its ranking.

Besides there is no precise data available on carbon dioxide emissions for Athens it seems to emit 6 tonnes of CO2 per inhabitant per year ranking 17, while the average for the 30 European countries is 5 tonnes. The subway extension planning helps reduce transport-related emissions.

Energy consumption is nearly 89 gigajoules per inhabitant and less than 4% is derived from renewable sources which puts the city in 15th position. To boost the availability of renewable energy wind turbines have been established around Athens.

Athens ranks 22nd overall for buildings.The city's lack of energy-efficient building standards or incentives. With residential buildings consuming an estimated 695 megajoules per square metre per year, Athens ranks behind other cities with high average temperatures.

The city has an extensive network of buses, many of which are fuelled by compressed natural gas (CNG), yellow trolleys (electric trams) and subway train network, yet it ranks 17 since there is currently no network of cycle lanes or fast lanes for car-pooling while a high degree of personal vehicle use persists, resulting in severe congestion.

[40] Unit, E. I. (Ed.). (2009). *European green city index: assessing the environmental impact of Europe's major cities.* Siemens AG.

Concerning water the city consumes nearly 105 cubic metres per person per year anks slightly worse than average for water system leakages, with an estimated leakage rate of 25% (the average is about 23%). It ranks 15th overall.

Athens ranks 23rd for waste and land use due to its poor green land-use policies, concerning waste production it comes 12 with around 465 kg of waste produced per inhabitant per year. It also has a policy to contain sprawl in the city centre, but this does not apply to the suburbs, so there is a significant degree of suburban sprawl. Athens has highlighted recycling as the core of its environmental agenda. Separate bins have been provided for glass, metals and batteries since 2005.

The city has a very poor performance for air quality ranking 25, however while Athens has high nitrogen dioxide and particulate matter emissions, it has low levels of ozone emissions. Athens has attempted to improve air quality by limiting traffic within the city.

The city's environmental program is divided between the city authorities and various ministries in the national government, creating some confusion with respect to the boundaries of jurisdictions. Many issues relating to the environment are dealt with by the Athens division at the Ministry of the Environment or by the Ministry of Transport. Consequently, the city's environmental programme is piecemeal and provides few actual targets.

Conclusions

We have seen that cities grow as higher and higher percentages of the population come to live in them. Urbanization is a very crucial matter that has already interested nations,governments, municipalities, organizations and academics since urban populations interact with their environment and change it through their consumption of food, energy, water, and land. The prosperity of the population lies within the best administration of the resources. The ability to quickly adapt in a world that constantly changes using technology and providing facilities to the residents is under the microscope of city product makers. The first step is to identify the problematics as well as the position of the cities to proceed to improvements and further development. Global cities indexes help stakeholders of the cities towards that direction.

The global population already resides in cities, and it is estimated that this phenomenon will further increase within the next few years reaching 68% from 54% it is now. It is very crucial for peoples prosperity as well as environmental sustainability to come up with ways and solutions not to get disrupted by this repositioning but also to fix what's broken. Knowledge comes above all that. Mapping the problems and acknowledging what it has to be done is the first step. The pain to this step is the complexity of cities and the numerous factors that need to be taken under consideration towards this direction. In an era where everything changes in a blink of an eye, we have to be prepared to constantly be able to adapt as well as preserve the environment for future generations. We have to become more agile and sustainable. Private and public organizations, nations and academics have identified the importance of capturing the performance of cities and have established benchmarks and indexes to record them. There are different approaches depending on the organization and it is very important to take into consideration as many as possible to fully understand the scenery of a city. The big benefit of the indexes is that cities are compared to other cities, exchange information and frameworks and learn from each other quicker since they become aware of different approaches that have actually been established and measured and they are not at an implementation stage with doubtful results. For this research there have been chosen 8 different streams and the pillars they examine are summarized on tables 1 and 2.

Table 1 : Pillars Indexes

Index	Pillars				Key areas
Smart City Index	Structure	Technology			Health and safety, mobility, activities, opportunities, governance
Cultural and Creative Cities Monitor	Cultural vibrancy	Creative Economy	Enabling Environment		Venues and facilities Creative and Knowledge Based Jobs Intellectual Property and Innovation Human capital and education Openness, tolerance and trust Local and international connections
Innovation Cities Program	Cultural Assets	Human Infrastructure	Networked Markets		31 segments about Economic, Industry and social functions of an economy 162 Touch Points
Resilient Cities Network	Knowledge	People	Place	Organization	Chronic stresses, Accute Shocks Towards Open, Green, Proactive, Vibrant Cities
World's Best Cities	Place, Product	People, Prosperity	Programming, Promotion		Natural and built environments, key I*nfrastructure,human capital, income,* experiential pillars of a great visit,number and frequency of media coverage
Cities in Motion	Sustainable ecosystems	Innovative activities	Equitability	Connected Territory	
Safe Cities Index	Digital security	Health security	Infrastructure security	Personal security	49 indicators
The Green city Index	Average GDP Green Spaces	Energy Intensity Modal Split Population Density	Population Density Water System Leakage Water Consumption Recycling Rates	Sulphur Dioxide Particulate Matter Nitrogen Dioxide CO2 Emissions,	CO2 emissions, energy, buildings, land use, transport, water and sanitation, waste management, air quality and environmental governance

Table 2: The Indexes

Index	Organization	Cities Ranked
Smart City Index	IMD and Singapore University of Technology and Design (SUTD)	109 Cities Worldwide
Cultural and Creative Cities Monitor	European Commission	190 European cities
Innovation Cities Program	Private Organization	500 Cities Worldwide
Resilient Cities Network	The Rockefeller Foundation	101 Cities Worldwide
World's Best Cities	Resonance Consultancy	109 Cities Worldwide
Cities in Motion	IESE Department of Strategy	174 Cities Worldwide
Safe Cities Index	The Economist Intelligence Unit sponsored by NEC	60 Cities Worlwide
The Green city Index	Economist Intelligence Unit (EIU) sponsored by Siemens	120 Cities Worlwide

The Smart city observatory by IMD and Singapore University of Technology and Design (SUTD) has established Smart City Index evaluating five key areas: Health and safety, mobility, activities, opportunities, and governance under two pillars: The Structures pillar referring to the existing infrastructure of the cities, and the Technology pillar describing the technological provisions and services available to the inhabitants. It is based

on economic and technological data, as well as by their citizens' perceptions of how "smart" their cities are.

According to the observatory, when it comes to the structure pillar some of Athenians main concerns has to do with the austerity since people struggle with unemployment and don't have options for finding new jobs while they also have difficulty in finding housing with rent equal to 30% or less of a monthly salary. House rentals may be considered low compared to other European cities but have risen in the past years with the rise of short term rentals. Traffic congestion and lack of green spaces downgrade citizens' life while they also don't contribute to the decision making of local government and they consider city officials corrupted. On the other hand people think that basic sanitation meets the needs of the poorest areas and they find cultural activities (shows, bars, and museums) satisfactory.

For the technology pillar people don't seem to believe that health or safety have improved through technology especially when it comes to CCTV cameras. They also don't find bicycle hiring or other apps very helpful for congestion, probably because of the lack of proper infrastructure. Referring to opportunities, online services provided are not considered to have made it easier to start a new business and there is not a satisfactory online platform for residents' interaction. On the other hand people find information for congestion through mobile apps, have online access to job listings and it is easy to purchase activity tickets online. It is interesting to mention that the above are mostly developed and provided by private tech companies. The main concerns and strengths are presented on table 2.

Table 3 : Smart city observatory for Athens

Smart City Observatory	Main Concerns	Main Strengths
Structures		
	Rental Prices	Basic sanitation
	Traffic Congestion	Cultural activities
	Green Spaces	
	Unemployment and new jobs	

	Residents decision making and officials corruption	
Technologies	Safety through CCTV cameras	
	Congestion reduction ex.Bicycle hiring	Online tickets purchasing
	Online platform for citizens interaction	Online access to job listings
		information on traffic congestion through apps

The Cultural and Creative Cities Monitor, designed by the European observatory to help national, regional and municipal policy makers identify local strengths and opportunities and benchmark their cities against similar urban centres. The information is captured in 29 indicators relevant to 9 dimensions reflecting 3 major facets of the cultural, social and economic vitality of cities. To measure those facets Composite indicators (CIs) are used which compare country performance and are increasingly recognized as a useful tool in policy analysis and public communication. Cultural Vibrancy, Creative Economy and Enabling Environment.

The Innovation Cities Program studies three main factors:

Cultural Assets, measured by arts communities, civic organizations, museums, music events, galleries, political protests, books, media, availability of information, and sports.

Networked Markets, a measure of a city's power and linkages in global markets, taking into account geography, economics (such as exports and imports), technology, market size, geo-political factors, and diplomacy.

Human Infrastructure that includes the soft and hard infrastructure of mass transit, finance, universities, hospitals, rail, roads, law, commerce, start-ups, healthcare, and telecommunications. Innovation Cities Index 2019 is the 12th annual classifications & city rankings. At this report New York ranked first scoring 59, followed by Tokio(58), London(57), Los Angeles (56) and Singapore(55) all classified as NEXUS. Athens ranked

78th out of 500, scoring 44 and classified as HUB meaning, dominance or influence on key economic and social innovation segments based on current global trends. It has dropped 16 places compared to the previous year. While we can see Athens is quite high at this ranking (78 out of 500) it is quite concerning that it has dropped 16 places. As we have seen before, cities are competing with one another and this fall may be a result of that. It is crucial for a city to constantly develop towards innovation.

Resilient Cities Network pioneered by The Rockefeller Foundation defines and measures urban resilience as the capacity of individuals, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses, and acute shocks they experience. Chronic stresses are challenges that weaken the fabric of a city on a dayto-day or cyclical basis like sea level rise, increasing pressures on healthcare services, unemployment, and deeper social inequality while acute shocks are Sudden events that threaten a city such as earthquakes, heat-waves, flash-floods, and cyber attacks. Athens' acute shocks according to the report are Earthquakes, climate change, civil unrest and cybercrime, while the chronic challenges seem to be depressed macroeconomic conditions, aging infrastructure, migration, and mistrust. The challenges are gathered in table 3.

Table 4 : Athens' resilience challenges

Athens' resilience challenges	
Acute Shocks	**Chronic Stresses**
Earthquakes	Depressed Macroeconomic Conditions
Climate Change	Aging Infrastructure
Civil Unrest	Migration
Cybercrime	Mistrust

Best Cities Report by Resonance, a global consultancy of strategic and creative place makers. Having an advisory portfolio that lies in fields such as real estate, tourism and economic development studies cities in a more product management way. The categories are:

- Place: evaluates the perceived quality of its natural and built environments such as weather and the average number of sunny days, safety(Homicide rate), sights and landmarks, parks and outdoors.
- Product: studying a city's key institutions, attractions and infrastructure
- People: tracking the diversity of the city's population foreign-Born residents, percentage of foreign-born residents and educational attainment percentage of the population with a bachelor's degree or higher.
- Prosperity: examines the income of citizens, the standard of living and the presence or absence of large, recognizable corporations.
- Programming: experiential pillars of a great visit: food, shows, shopping and nightlife
- Promotion: The number and frequency of media coverage, online articles

IESE Cities in Motion Strategies launched by the IESE Business School Center for Globalization and Strategy and the IESE Department of Strategy. It studies 8 fields:

Governance, social cohesion, urban planning, mobility and transportation, international outreach, environment, human capital, technology and economy. At this index Athens ranks 96. The index is further segmented into 9 areas of interest. The major problematic according to the index seems to be "Governance" and "Social cohesion" since they both score (148) as well as urban planning (142). "Mobility and transportation" has the best score (41) followed by "International Outreach" (52)and "Environment"(57). Human capital ranks 71, technology 83 and economy 109.

The Safe Cities Index report from The Economist Intelligence Unit sponsored by NEC that measures 4 different aspects of security concerning cities. Digital security, health security, infrastructure security and personal security.Athens ranks 33 out of 60 overall in the safe cities index 2017 and 15th out of 21 when clustered by population (<5 million). It ranked 35th at digital security, 21th at health security, 21th at infrastructure security, 41 at personal security. The ranking of Athens for each aspect of the index compared to the first and the last city is shown on table 4.

Table 5 : Athens Safe Cities

Safe cities index 2017	**Ranked 1st**	**Athens Position**	**Ranked 60th**
Overall	Tokyo 89.80	33 Athens 71.90	60 Karachi 38.77
Digital security	Tokyo 88.40	35 Athens 61.94	Jakarta 36.60
Health Security	Osaka 87.15	21 Athens 74.57	Karachi 39.92
Infrastructure security	Singapore 97.05	29 Athens 82.05	Dhaka 38.42
Personal Security	Singapore 94.94	41 Athens 69.03	Karachi 31.85
Ranking by population <5 million	Melbourne 87.30	15 Athens 71.90	Yangon 46.47

The Green City Index series is a research project conducted by the Economist Intelligence Unit (EIU) and sponsored by Siemens. The index measures 30 indicators across eight to nine categories depending on the region. It covers CO2 emissions, energy, buildings, land use, transport, water and sanitation, waste management, air quality and environmental governance.We can see at this Index that Athens is not really competitive when it comes to Green cities. It ranks very low at buildings and air quality as well as waste and land use, while it seems to have poor environmental governance. Concerning energy, transport and water is ranked average and there seems a lot has to be done. The ranking of Athens compared to the first and the last city is shown on table 5.

Table 6 : Athens Green Cities

	First City	Athens	30 City
Energy	Oslo 8,71	15 Athens 4,94	Kiev 1,50
Buildings	Berlin 9,44	22 Athens 4,36	Kiev 0,00
Transport	Stockholm 8,81	17 Athens 5,48	Dublin 2,89
Water	Amsterdam 9.21	16 Athens 7.26	Sofia 1.83
Waste and land use	Amsterdam 8.98	23 Athens 5.33	Kiev 1.43
Air quality	Vilnius 9,37	25 Athens 4,82	Kiev 3,97
Environmental governance	Brussels 10,00	21 Athens 5,44	Bucharest 2,67

Exploring Indexes that examine different aspects of a city makes it hard to cluster into groups and summarize the results but we can see that they come around 3 Pillars.

People and Culture, City infrastructure and Environment, as well as Governance and Technology. Those pillars are connected and sometimes examined one within another. We gathered some key areas that Athens have scored very low or better than average and clustered them under those pillars. (Table 7)

Table 7: Main Findings

	Pain	Index	Better Performance	Index
People and Culture				
	Unemployment	Smart City Observatory	Education	Cultural and creative cities monitor
	High rentals	Smart City Observatory	Jobs in Culture	Cultural and creative cities monitor

	Macroeconomic Condition	Resilience index	Museums and archeology	Worlds Best Cities
	Openess	Cultural and creative cities monitor	Cultural activities	Smart city Observatory
	Social Cohesion	Cities in Motion	Venues and Facilities	Cultural and creative cities monitor
	Personal Security	Safe cities index		
	Civil Unrest	Resilience index		
	Innovation	Cultural and creative cities monitor		
Infrastructure and Environment				
	Earthquakes	Resilience index	Energy	Green Cities
	Climate change	Resilience index	Health Security	Safe Cities
	Urban planning	Cities in Motion	Basic Sanitation	Smart City Observatory
	Air quality	Safe Cities, Green Cities		
	Green Spaces	Smart City Observatory,Green Cities		
	Buildings	Safe Cities, Green Cities, Resilience index		
	Traffic Congestion	Smart City Observatory		
Governance and Technology				
	Mistrust	Resilience index, Cities in Motion Smart City Observatory		
	Cybercrime	Resilience index		

For people and culture we can see that a major problem for Athenians is emanated by the general austerity the country deals with, since unemployment and high rentals comparing to salaries are highlighted by the "smart city observatory" index as well as depressed macroeconomic conditions and migration indicated as a chronic stress in "resilience" index. At the "cultural and creative cities monitor" we observe that city scores well in education but not in openess since foreign people don't seem to have the same opportunities. "Cities in motion index" also indicates social cohesion while migration is characterized as a

chronic stress by “resilience index”. Innovation also has a very low score at the cultural and creative city monitor comparing to other European countries.

The city of Athens is often characterized as the cradle of western civilization. It has a great amount of culture venues and activities and the branding of the city often seems to summarize around that, probably aiming for tourism development. Therefore it scores very well at cultural activities by the “smart city observatory”, and venues and facilities by the “cultural and creative cities monitor” yet the engagement of people towards those activities seem to be low by the same index. Museums and archeology is also highlighted by “worlds best cities report”.

About city Infrastructure and Environment, “resilience index” indicates earthquakes and climate change as accute shocks for the city. The lack of green spaces(Smart City Observatory,Green Cities) is not just worsening residents life but also burden air quality increase vulnerability in climate changes. Air quality is highlighted as a major problem from both “safe cities” index and “green cities” index. The same indexes also highlight the low quality of the buildings which is also recorded as a chronic stress by “resilience index”. Traffic congestion as a result of poor urban planning is noticed at the “smart city observatory”. While it doesn’t score very high Athens seem to perform better at health security(safe cities), basic sanitation (smart city observatory), and energy (green cities).

For the third pillar governance and technology we can see mistrust highlighted by “resilience” and “cities in Motion” index as well as “smart cities observatory where corruption of city officials is a great issue of concern. Cybercrime is also considered as an acute shock by resilience index since there is no strategic plan or knowledge to avoid such attacks.

We can see that while the indexes measure performance from a different scope and explore different elements they often come to similar conclusions. City elements are entangled within one another and therefore it is important to take under consideration all the parameters for urban planning. This research aims to provoke interest on indicated fields of improvement and lead to further research.

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