ABSTRACT

“SIMURG_CITIES” is the research and development project that is developed under the main project named SIMURG: “A performance-based and Sustainability-oriented Integration Model Using Relational database architecture to increase Global competitiveness of Turkish construction industry in industry 5.0 era”, is a relational database model that is currently being developed in a dissertation for performance-based development and assessment of sustainable and sophisticated solutions for the built environment. This study aims to analyze the key performance indicators (KPIs) at «Cities Level» for the smart city concept that is referred to as «Layers» in the master project. KPIs for the concept of a smart city are determined by using the meta-analysis technique. Hence, the three most reputable urban journals issued from 2017 through 2020 are reviewed in this study. In addition to this, models of smart city frameworks/assessment tools/KPIs are reviewed within the context of this paper; environment, economy, and governance were found to have domain themes on urban sustainability according to the literature review. Consequently, efficient and integrated urban management, environmental monitoring and management, public and social services of urban development, and sustainability are found to be the most important dimensions in urban and regional planning. SIMURG_CITIES evaluation models for urban projects can use the findings of this paper.

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1. Introduction

With globalization, individuals living within the same community which has different demographics structures, and understanding of life have increased and also lifestyles and expectations of these individuals have changed. The characteristics of built...
environment-related value systems have differentiated utilizing individuals’ age, culture, educational level, etc. Nevertheless, policymakers (individuals/companies/institutions/local authorities) have designed living spaces uniformly assuming there is a single type of individual according to their value systems. While policymakers are preparing urban policies, cities continue to grow depending on rent since there are no tools to help rational decision making and decision support systems that can be measured. At this point, performance-based design and building of built environments to evaluate alternatives in a comparative way seems to have increased attractiveness for individuals/companies/institutions/local authorities of policymakers. As a result of the examinations made, it has been concluded that the model which will be developed for the solution of the identified problem must include and reveal the components of the solution in the dimensions stated by Şenoğlu et al. (2018).

The United Nations (UN) assumed seventeen Sustainable Development Goals (SDGs) that are aimed to “stimulate action over the next 15 years in areas of critical importance for humanity and the planet” in the last publication of the global sustainable development agenda, “Transforming Our World: The 2030 Agenda for Sustainable Development”. Features as part of the targets referred to 3rd goal on “good health and well-being”, 4th goal on “quality education”, 8th goal on “economic growth”, 9th goal on “innovation and infrastructure”, and 11th goal on “sustainable cities and human settlements” (United Nations, 2015). Sustainability is the main concept among those that can be achieved by the integrated use of the other key concepts which are innovation, competitiveness, competition by design, performance-based building production process, integration of building production processes and interoperability supported by BIM (Building Information Modelling) and information classification systems (Kanoğlu et al., 2018). These concepts seem to be the key factors to design an integrated model that increases the competitive advantage of the national construction industry in the global market. Additional concepts that are not of less importance compared with the first set are transparency, accountability, and consistency. What the individuals, institutions, companies, and society need in Turkey are the practical and accessible tools that provide these concepts at all levels of decision-making. The problem is the lack of these tools that allow the governments and municipalities to propose suitable identities defined by the concepts or “layers” such as historical/smart/green/slow/safe/resilience etc., that are presented by specific KPIs and associated weights, for their built environments at all levels and to develop consistent policies for this purpose that helps individuals in matching up their attributes with social, cultural, economic, educational, etc., characteristics of the built environment they are supposed to live. Many more sub-components such as management, planning, energy, transportation, infrastructure resources, etc. of cities are needed to make a sustainable performance-based assessment, as well as KPI’s set, should be determined from its parameters for the design to be aesthetic, compatible with user needs and functions.

SIMURG: “A performance-based and Sustainability-oriented Integration Model Using Relational database architecture to increase Global competitiveness of the Turkish construction industry in industry 5.0 era” is integrated with the subprojects conducted by Şenoğlu et al. (2018) within the SIMURG_ALKU&ITU Virtual Laboratory, established on the Research Gate Scientific Communication Platform (https://www.researchgate.net/profile/Alaattin_Kano slugg). Şenoğlu et al. (2018) designed the open-ended project that improvement for concerned models at all hierarchical levels of “performance-based design and construction” of the built environment manner in various sub-projects in two supplementary fields, i.e., “product” and “process” dimensions. “Building components”, “building elements”, “building premises”, “buildings”, “projects”, “lands”, “quarters”, “settlements”, “counties” and “cities” levels on “product side” and “operations”, “projects”, “departments”, “firms”, “groups of firms”, “sectors”, “national economies” and “global economy” levels on “process side” are the hierarchical levels of these dimensions. All the levels are required, specific KPIs and weights are determined together with organisational, computational, and computer models are designed. SIMURG_CITIES, the relational database model that is currently being
conducted by Ülker under the supervision of Kanoğlu et al. (2018) in her dissertation entitled SIMURG_CITIES: "A Performance-Based Integrated Model for Design and Evaluation of Sustainable and Sophisticated Solutions at Cities Level: Determination of Key Performance Indicators and Principles of Model at Conceptual Dimension". The main goal of the project is to determine the KPIs of performance of built environments at the city level in terms of the combinations of level-specific and layer/concept specific KPIs in both expert and user point of views and integrate the findings with SIMURG_INTEGRATED, the final output of the master project. This paper aims to analyse and determine the KPIs at "Cities Level" for the smart concept that is referred to as “Layers” in the master project. Also, the other aim of the paper is to review Models of smart city frameworks/assessment tools/KPIs on urban development and sustainability owing to the literature review.

2. Materials and Methods
The conceptual framework of this research is based upon an analysis of KPIs for the smart city concept. Meta-analysis is used to make a classification of the literature in the study. It also purposes to allow for a better understanding of the smartness of an urban framework acquired with the augmented use of sustainable thinking, particularly regarding urban studies. Hence, at first, this research demonstrates the descriptions of concepts and hypothetical basics of smart cities. Literature review link to the papers and researches is submitted, with the keywords "smart cities" or "smart city" and its integration with terms regarding urban planning and city assessment/framework/performance indicator/KPI. The literature review on the background of the sustainability approach indicated that research referring in related to the urban framework is based on the headings of “smart cities” or "digital cities". The research was carried out through a search of libraries and scientific databases, particularly Taylor & Francis Online, Scopus, Science Direct, Web of Science and the most respected urban journals, Cities, Journal of Urban Technology, Sustainable Cities and Society for the period of 2017-2020 to gather information and systematically review the hypothetical literature. As a result, fifty relevant papers were selected from these journals to analyse, determine, and categorize the concept of smart cities and their KPIs. The writers, subjects and methodologies of the reviewed fifty papers are presented in the Table 1 and 2. The purpose is to allow for better practical and accessible tools/performance-based assessment that provides this concept in all levels of decision-making in the future.

Table 1. Papers associated with KPIs of Smart City that have been issued in Urban Literature during 2017-2020.

| Writers             | Year | Journal   | Subject                                | Research Methodology              |
|---------------------|------|-----------|----------------------------------------|-----------------------------------|
| Lam & Yang          | 2020 | Cities    | PPP for SC projects                    | Multi-attribute utility analysis   |
| Wataya & Shaw       | 2019 | Cities    | Measuring soft assets in SCs development | Co-value creation evaluation       |
| Molinillo et al.    | 2019 | Cities    | Measurement of SC communication via SM  | Digital content analysis          |
| Montalto et al.     | 2019 | Cities    | Measurement of the cultural vitality of ECs | An empirical approach             |
| Huovila et al.      | 2019 | Cities    | Standardized indicators for sustainable SCs | Comparative analysis             |
| Lam & Ma            | 2019 | Cities    | Identifying potential pitfalls in SCs development | An exploratory analysis           |
| Heaton & Parlikad   | 2019 | Cities    | Infrastructure assets in SC framework | A conceptual framework            |
| Shmelev & Shmeleva  | 2019 | Cities    | Multidimensional sustainability assessment for SC | Performance benchmarking          |
| Yigitcanlar et al.  | 2018 | Cities    | Multidimensional sustainability assessment for SC | A systematic literature review     |
| Ruhlandt            | 2018 | Cities    | Governance of SCs                      | A systematic literature review     |
| Anthopoulos        | 2017 | Cities    | Performance analysis of international SC cases | A multi-methods approach          |
| Navarro et al.      | 2017 | Cities    | ICT use and capability on SCs          | Component analysis                |
| Ahvenniemi          | 2017 | Cities    | Assessment framework for sustainable SCs | Performance benchmarking          |
Table 2. Papers associated with KPIs of Smart City that has been published in Urban Literature from 2017 to 2020 (continued).

| Writers                  | Year | Journal                          | Subject                                      | Research Methodology                  |
|--------------------------|------|----------------------------------|----------------------------------------------|----------------------------------------|
| Yang et al.              | 2020 | Sustainable Cities and Society   | Smart Transportation                         | A coupled simulation method            |
| Shapsough et al.         | 2020 | Sustainable Cities and Society   | Smart Energy                                 | Performance measurement               |
| Tang et al.              | 2020 | Sustainable Cities and Society   | Smart Transportation                         | Machine learning methods              |
| Deveci et al.            | 2020 | Sustainable Cities and Society   | Assessment framework of SC projects          | Interval Agreement Method             |
| Sáez et al.              | 2020 | Sustainable Cities and Society   | Sustainbale City performance                 | Performance benchmarking              |
| Sharifi                  | 2020 | Sustainable Cities and Society   | SC assessment tools and indicator sets        | Performance measurement               |
| Yigitcanlar et al.       | 2019 | Sustainable Cities and Society   | Smart and sustainable cities                 | A systematic literature review         |
| Karji et. al.            | 2019 | Sustainable Cities and Society   | Assessment of Social Sustainability Indicators | A case study research                |
| Ghofrani et al.          | 2019 | Sustainable Cities and Society   | Smart building                               | Neural Networks approach              |
| Akande et al.            | 2019 | Sustainable Cities and Society   | Smart Sustainbale City performance           | Component analysis                    |
| Horgan & Dimitrijević    | 2019 | Sustainable Cities and Society   | Smart Citizen                                | A case study research                 |
| Nitoslawski et al.       | 2019 | Sustainable Cities and Society   | Smart Environment                            | A literature review                   |
| Wainum et al.            | 2019 | Sustainable Cities and Society   | Smart Energy                                 | Multi-attribute decisionmaking         |
| Mattoni et al.           | 2019 | Sustainable Cities and Society   | Smart Energy                                 | Performance measurement               |
| Zhu et al.               | 2019 | Sustainable Cities and Society   | Smart Energy                                 | Machine learning methods              |
| Michalec et al.          | 2019 | Sustainable Cities and Society   | Smart Environment                            | A discourse analysis                  |
| Zhang et al.             | 2018 | Sustainable Cities and Society   | Performance Evaluation for Smart Transportation | TOPSIS, A case study                  |
| Manupati et al.          | 2018 | Sustainable Cities and Society   | Urban renewal under SCs mission              | Multi-criteria decision making         |
| Ahmad & Chan             | 2018 | Sustainable Cities and Society   | Smart Energy                                 | Machine learning methods              |
| Silva et al.             | 2018 | Sustainable Cities and Society   | Sustainable SCs                              | A literature review                   |
| Alkhalidi et al.         | 2018 | Sustainable Cities and Society   | Smart Environment                            | The energy evaluation method           |

PPP: Public-Private Partnerships, SC: Smart City, SM: Social Media, ECs: European cities, Iss: Innovation Systems, CP: Civic participation.
3. Results: Meta-Analysis for KPI’s of Layer-Based Approach in Sustainability Assessment

This section elaborates on the reviewed fifty papers in the literature and seven key themes and forty-four sub-themes/dimensions which are referred to in the last studies by Sharifi (2019, 2020) for the smart city assessment. The “typology of smart city evaluation tools and indicator sets” of Sharifi (2019, 2020) is used as a base for the meta-analysis table. Specific KPIs determined for each paper were marked in the meta-analysis table according to relevant themes or sub-themes/dimensions which were conducted topics in the papers. The findings of the meta-analysis are indicated in Tables 3, 4, and 5 that show the ratings of themes and sub-themes/dimensions related KPIs of a smart city in urban literature. The rating of seven themes for related KPIs of the smart city in the literature (Table 6), the major result of this research is that: environment, economy, governance-institutional, and data management is found to be the most important themes in urban and regional planning. Besides, the themes which are people, living and mobility (transport & ICT) need to become as important as the other themes.

| Theme                          | Dimension                                      | Aghamolaei et al. 2018 | Dall’O’ et al. 2017 | Bibri & Krogstie 2017 | Hukkalainen et al. 2017 | Poggi et al. 2017 | Massana et al. 2017 |
|--------------------------------|------------------------------------------------|------------------------|---------------------|------------------------|----------------------|-------------------|-------------------|
|                                | Performance Evaluation for Smart Energy       |                         |                     |                         |                      |                   |                   |
|                                | The energy evaluation method                   |                         |                     |                         |                      |                   |                   |
|                                | SC assessment tools and indicator sets         |                         |                     |                         |                      |                   |                   |
|                                | Performance measurement                       |                         |                     |                         |                      |                   |                   |
|                                | Sustainable SC assessment tools/indicator sets |                         |                     |                         |                      |                   |                   |
|                                | A systematic literature review                 |                         |                     |                         |                      |                   |                   |
|                                | Smart Energy                                  |                         |                     |                         |                      |                   |                   |
|                                | Holistic energy analysis                      |                         |                     |                         |                      |                   |                   |
|                                | Performance Evaluation for Smart Energy       |                         |                     |                         |                      |                   |                   |
|                                | A case study research                          |                         |                     |                         |                      |                   |                   |
|                                | Performance Evaluation for Smart Energy       |                         |                     |                         |                      |                   |                   |
|                                | A case study research                          |                         |                     |                         |                      |                   |                   |

PPP: Public-Private Partnerships, SC: Smart City, SM: Social Media, ECs: European cities, Iss: Innovation Systems, CP: Civic participation.

| Table 3. Themes and Sub-themes of the reviewed papers on Urban Literature.
| Sharifi (2019) Assessment Tools & KPIs for Smart Cities | Relevant Studies for KPIs in Literature (2017-2020) |
|----------------------------------------------------------|-----------------------------------------------------|

| Theme                          | Dimension                                      | Lam & Yang (2020) | Wataya & Show (2019) | Montalto et al. (2019) | Hukkalainen et al. (2019) | Lam & Ma (2019) | Heaton & Parlikad (2019) | Smirneov & Shmelev (2019) | Yigitcanlar & Yigitcanlar (2017) | Ruhlandt (2018) | Anthopoulos (2017) | Navarro et al. (2017) | Alvarado (2017) | Gessa & Sancha (2020) | Kisi & Setliff (2019) | Costa-Ulubat et al. (2018) | Falco et al. (2018) |
|--------------------------------|------------------------------------------------|-------------------|----------------------|------------------------|---------------------------|----------------|--------------------------|-----------------------------|--------------------------|----------------|------------------|----------------------|----------------|------------------|--------------------------|--------------------------|------------------|
|                                | Innovation/innovation culture                  | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Knowledge economy                              | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Entrepreneurship                               | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Finance                                       | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Tourism                                       | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Employment                                    | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Local & Global Interconnectedness              | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Productivity and efficiency                    | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Flexibility of the labor market                | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Impacts                                       | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Education/ lifelong learning                   | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Level of qualification/ ICT skills             | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Cosmopolitanism/ open mindedness               | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Visioning and leadership                       | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Legal and regulatory frameworks                | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Participation                                  | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Transparency                                   | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
|                                | Public and social services                     | ✓                 | ✓                    | ✓                      | ✓                         | ✓             | ✓                        | ✓                           | ✓                         | ✓             | ✓                | ✓                     | ✓              | ✓                | ✓                        | ✓                        | ✓                |
Table 4. Themes and Sub-themes of the reviewed papers in Urban Literature (continued).

| Theme | Dimension |
|-------|-----------|
| Efficient & integrated urban management | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Environment | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| General infrastructure | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Built environment/planning and design | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Materials | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Energy resources | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Water resources | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Waste (solid waste, waste water, sewage) | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Environmental quality/pollution | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Living | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Social cohesion/inclusion | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Equity and justice | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Cultural development | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Housing/livelihood quality | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Healthcare | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Safety and security | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Convenience and satisfaction/well-being | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Mobility (Transport & ICT) | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Transport infrastructure | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Transportation management | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| ICT infrastructure | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| ICT management | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| ICT accessibility | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Data management | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Data openness | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Sensing and collecting | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Judging (analytics) | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Reacting | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Learning | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |

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Table 5. Themes and Sub-themes of the reviewed papers in Urban Literature (continued).

| Theme                | Dimension                                                                 | Total for dimensions |
|----------------------|---------------------------------------------------------------------------|----------------------|
| **Economy**          | Innovation/innovation culture                                             | 122                  |
|                      | Knowledge economy                                                         | 19                   |
|                      | Entrepreneurship                                                          | 18                   |
|                      | Finance                                                                   | 19                   |
|                      | Tourism                                                                   | 17                   |
|                      | Employment                                                                | 20                   |
|                      | Local & Global Interconnectedness                                         | 17                   |
|                      | Productivity and efficiency                                               | 40                   |
|                      | Flexibility of the labor market                                           | 16                   |
|                      | Impacts                                                                   | 32                   |
| **People**           | Education/lifelong learning                                               | 21                   |
|                      | Level of qualification/ICT skills                                         | 27                   |
|                      | Cosmopolitanism/open mindedness                                           | 20                   |
| **Governance** -institutional | Visioning and leadership                                                | 36                   |
|                      | Legal and regulatory frameworks                                           | 18                   |
|                      | Participation                                                             | 27                   |
|                      | Transparency                                                              | 19                   |
|                      | Public and social services                                                | 40                   |
|                      | Efficient & integrated urban management                                   | 44                   |
| **Environment**      | Environmental monitoring & management                                     | 41                   |
|                      | General infrastructure                                                    | 34                   |

Shanli (2019) Assessment Tools & KPIs for Smart Cities Relevant Studies for KPIs in Literature (2017-2020)
The highest and lowest ten ratings of forty-four dimensions for related KPIs of a smart city in the literature review are defined in Table 7. The other critical result of this research is efficient and integrated urban management, environmental monitoring and management, public and social services, productivity and efficiency and data management in urban development and sustainability are found to be the highest important dimensions. However, housing/livelihood quality, the flexibility of the labour market, smart tourism and smart healthcare are found to be the lowest ratings of dimensions. Smart/sustainable city planning has been revealed for the development of the lives of urban citizens and increasing civic development and sustainability.
services/assets; also, given the closeness of modern technology, citizens’ requirements and tools of interacting with their regional administrations is changing (Nitolslawski et al., 2019). At this critical point of change, cultural development, innovation, and entrepreneurship are the main dimensions to be considered. Since, culture is a concept that social, emblematic, and economic implications can mention people’s customs, religions, and attitude, or economic activities based on symbolic values, artistic creation and creative skills also are a key for involved improvement, strengthening social ties and solidarity, and promoting innovation and creativity (Montalto et al, 2019).

4. Discussions
Modern cities tackle numerous economic, social, and spatial troubles, together with which they perform in an extremely volatile environment, which pushes them to seek an optimum development model. Nowadays, countless concepts/models (such as eco/green/compact/smart/slow/resilient/agile/sustainable city etc.) of urban development have been discussed by researchers. In this section, the model/concept of smart city frameworks/performance indicators/assessment tools is researched and discussed in detail in the literature.

Cities act a crucial part socioeconomically and environmentally at a global level. The city infrastructure appeals to numerous people looking at the advantages of urbanisation over the conventional rural lifestyles inside various cultural contexts. The United Nations (UN) estimates that almost 7 billion people will inhabit in urban fields by 2050 (Streitz, 2015). Some other 1.3 million people around the world move into a city every week (Carter, 2020). Consequently, cities and their executives are meeting myriad difficulties and opportunities as their facilities and infrastructure are placed under ever enhancement levels of pressure (Breetzke and Flowerday, 2016). A rising trend is that manage the impact of these difficulties and opportunities in the usage of Information and Communication Technology (ICT) among an accessible integrated infrastructure for a concept of smart city (Ismagilova et al., 2019). Numerous cities are focusing their struggles to be “smarter” by using ICT to develop different ways of city management and operation, including regional traffic control, offer upscale life for people, transportation, economy, online applications of public services and environment (Li et al., 2017). Smart cities are innovations for the improvement of targets in the quality of life and development by the utilization of smarter approaches and technology (Lim et al., 2019). Smart cities have been researched extensively for almost three decades and there are many ways of looking at them. Smart city studies first arose in the year 1992 in which “The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks” (Gibson et al., 1992). Then, Graham and Marvin (1996) began the research of the link between ICTs and urban fields with “Telecommunications and the City”. Some studies in this recent field of knowledge are from Mitchell, 1995, 1999, 2003; and Castells, 1996). In the early 2000s as the best efficient research was “urban ICT studies”, Graham (2004) accomplished to research “the complex and poorly understood set of relationships between telecommunications and the development, planning and management of contemporary cities”. In the study of ICT-driven urban development and innovation have engaged the attention of researchers (Mora et al., 2017). The key centre of smart cities is on the act of ICT infrastructure. The plentious environmental concerns as a significant motive of urban development at the part of relational/social capital and education/human capital (Komininos, 2002; Shapiro, 2008; Deakin, 2010).

Many definitions for “Smart Cities” in use globally, but smart city defines as “a new concept and a new model, which applies the new generation of information technologies, such as the internet of things, cloud computing, big data and space/geographical information integration, to facilitate the planning, construction, management and smart services of cities” according to SAC (ISO/IEC 2015). In literature, meanwhile, there is not any certain description of a smart city, a few basic dimensions of a smart city have been described (Giffinger et al., 2007; Fusco Girard et al., 2009; Van Soom, 2009). These dimensions cover “smart” governance/environment/mobility/economy/living/people. Briefly, “education” (e.g., egovernment or e-democracy), “technical infrastructure” (e.g., transportation or logistic), “industry” (e.g., business parks or districts), “participation” (e.g., government
administration, citizens), and various “soft factors” (e.g., security/safety, green, efficient and sustainable energy) are defined in the literature regarding smart city (Giffinger et al. 2007; Lombardi et al. 2012). In addition to them, Anthopoulos (2015) and Anthopoulos et al., (2016) have defined seven utilization areas of smart cities: “resource, transportation, urban infrastructures, living, government, economy, and coherency” thus they founded the theoretical structure of smart cities. While academics maintain to qualify smart cities as a recent and up-and-coming subject of research, the study of conceptualising and describing is still on-going (Townsend, 2013; Kitchin, 2014; Christopoulos et al., 2014; Greco and Cresta, 2015; Albino et al., 2015; Fernandez-Anez, 2016). On the other hand, the technology-focused vision of smart cities generally positions smart cities like cash cow and expects to produce a lot of money (Zanella et al., 2014). This rising market provides an opportunity for various growth initiatives, especially in a period of recession (Paroutis et al., 2014). big firms such as ABB, Fujitsu, IBM apply information and communication technologies as tools for smart-city development to motivate urban innovation. Nevertheless, this “corporate smart-city model” is condemned since it has not successfully explained the cultural and social developments of smart-city manner except for technological terms (Mora et al., 2017). Regarding this censure, Shin (2010) showed the failure of this model empirically and highlighted the shortcomings of the firm and technology-focused development for smart cities. Likewise, Shwayri (2013). Townsend (2013), Yigitcanlar & Lee (2014) and Yigitcanlar (2016) reported in some samples of these smart cities. On the other hand, from the recent studies, a holistic approach of smart cities has risen to base on human-centric vision, the balanced integration of economic, social, cultural, technological, environmental, and human sides (Townsend, 2013; Hemment and Townsend, 2013; Komninos, 2014; Christopoulos et al., 2014; Angelidou, 2014; Concilio and Rizzo, 2016; Hollands, 2015, 2016). After all Mora et al., 2017 have underlined that “the knowledge necessary to understand the process of building effective smart cities in the real world has not yet been produced, nor have the tools for supporting the actors involved in this activity”. In a nutshell, smart cities have factors such as “community”, “technology”, “policy”; the inclusive conceptual vision of the framework centres on finding the results in the development areas, i.e., “economy”, “society”, “environment”, “governance” which are associated with five results “productivity”, “sustainability”, “accessibility”, “wellbeing”, “liveability”, “governance” (Yigitcanlar et al., 2018). In addition to them, Sharifi (2019, 2020) has examined the strengths and weaknesses by evaluating thirty-four topics/schemes between smart city indicators. The results have shown that the widely known topics/themes are: “economy”, “people”, “governance”, “environment”, “mobility”, “living” and “data”.

5. Conclusions
SIMURG_CITIES, the relational database model of performance-based development and evaluation of built environment entities at cities level with an emphasis of “sophisticated solutions" such as slow, green, safe, smart, resilient, etc. in a comparative way have been developed. This study analysed the KPIs at Cities Level for smart city concept by using meta-analysis technique and literature reviewed that has been issued in three best reputable urban journals from 2017 through 2020. Environment, economy, governance and data management were found to have domain themes, as well as efficient and integrated urban management, environmental monitoring and management, public and social services in urban development and sustainability, are found to be the highest important dimensions of urban and regional planning. In addition to these, smart tourism, smart healthcare, smart people, smart transportation as well as the dimensions of cultural development, innovation, creativity and entrepreneurship are also open to development. This detailed study presents a crucial understanding of the key basic research topics/themes in smart cities, emphasizing the restrictions of the latest improvements and potential further aspects. The results of this research might be used in SIMURG_CITIES to assess/evaluate urban development models by related target groups such as smart city policymakers/planners/developers to prefer the best appropriate tools for their requirements, can be used as a foundation for performing future crucial analyses of
assessment/evaluation framework, may also lead the performance-based development and assessment of sustainable and sophisticated solutions in the future.

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Conflict of interests
The authors declare no conflict of interest.

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