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SIMURG: Performance-based Model for the Assessment of Sustainability: Synthesis of the Paradigmatic and Frame Models

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Abstract
Today decision-making processes of public authorities, who have the responsibility of developing sustainable policies for their built environment entities, do not support transparency, accountability, and consistency of their decisions. What societies require is a human-centric vision, a consistent philosophical/paradigmatic model that supports this vision, and the tools that increase the legitimacy of the whole decision-making process. The problem is the lack of these visions and tools that allow the citizens to meet their priorities in their lives with the identities of built environment entities and public authorities to accept/propose suitable projects by using "layers" such as historical/smart/ green/slow/safe, etc. Most of the studies in the literature deal with the sustainability assessment problem at only one environmental dimension of sustainability without considering interactions among the dimensions of 3D Cartesian system and their levels. A paradigmatic model and frame model, which will be used as a guide for developing further conceptual and practical models must be developed from scratch. The conceptual and practical models can only be developed in an iterative process by considering the interactions among these components. In this study, a bottom-up approach in an iterative process was adopted and practiced in the development process of the relationships among the components to propose the above-stated parts of the model of the research.
Keywords Simurg; sustainability assessment; framework model; philosophical model; conceptual model, performance-based assessment; certification-based assessment; 3D Cartesian system of sustainability.

1. Introduction
Traditional planning, design, and production processes of the built environment have their difficulties and limitations such as conflict of interests of shareholders, incomplete documentation, lack of coordination among the organizations at different phases of the production process, lack of control in the construction phase, etc., and for this reason, the outputs of this processes have serious problems. While the clients/entrepreneurs are taking all the critical decisions to increase their profits, the end-users, especially in developing countries, become aggrieved because of certain reasons such as inadequate codes and regulations, lack of information about standard performances that must be provided by-products, weakness of the mechanisms that are supposed to protect the society; moreover, losses at national and global scales of economy arise, limited resources are wasted and difficulties in terms of sustainable development process increase. Therefore, this process must be re-thought and replaced by alternative approaches, particularly with the support of computer-based tools to increase transparency and accountability of the decision-making process, primarily in developing countries.

2. Problem Statement
Today it is not adequate that the transparency, accountability, and consistency of the decisions of public authorities, who have the responsibility of developing sustainable policies for their built environment entities at all hierarchical levels. What the individuals, public institutions, private companies, and societies require in the world is a new human-centric vision, a consistent philosophical/paradigmatic model that supports this vision, and the tools that increase the accountability/transparency/legitimacy of the whole decision-making process. The problem is the lack of these visions and tools that allow (a) the citizens to meet their priorities in life with the identities of built environment entities, (b) public authorities and entrepreneurs to accept/propose suitable projects that have consistent identities by using "concepts/layers/labels" such as historical/smart/green/slow/ safe, etc., that are presented by specific KPIs and associated weights, for the built environment entities at all hierarchical levels. A comprehensive model can be used for the assessment of the entities' sustainability on the built environment dimension by considering the impacts of the other two dimensions, i.e., economic and social dimensions, on the built environment dimension of sustainability. There are numerous related studies and models in the literature;

however, they only deal with only one single or limited part of the problem and none of them proposes a holistic approach for the solution.
Most of the studies in the literature deal with the sustainability problem at only one dimension of environmental components of sustainability. Similarly, these studies deal with the entities in only one level on selected dimensions such as a. product-related dimension cities level, b. product-related dimension_ buildings level, c. process-related dimension_companies level, d. process-related dimension projects level, e. etc. Certainly, some studies deal with only one layer/label/concept for the assessment of selected entities such as a. green, b. smart, c. resilience, d. etc.
A comprehensive list which is the output of a meta-data analysis of the studies on the subject was presented by Ulker et al. (2021) in the SIMURG project to be able to see the state-of-the-art regarding the problem area. Examples can be extended to all of three environmental dimensions of sustainability in the 3D Cartesian system and dozens of entities/facts on these dimensions; however, they are focused on a single or a limited number of entities/facts, although the definition of a comprehensive framework model must be the first step before focusing on specific parts of the whole system.

3. The Aim and Objectives of the Research

As a result of the assessments conducted by the project team, it has been concluded that a framework model, which will be used as a guide for developing the conceptual and practical models of the solution must be picked up from currently proposed models in the literature or developed from scratch. Then, the components of the conceptual model, i.e., philosophical model, framework model, organizational model, integrational model, and computational model can be developed in an iterative process by considering the interactions among these components.

4. Methodology

Model development studies require mostly iterative processes. Comprehensive models increase the complexity of these processes. Before attempting to develop a framework model it is concluded that the relationships among the components and the relationships between each component and the whole system must be understood very well. Thus, according to the draft version of the framework model proposed components of the system were studied in various research projects and master theses and Ph.D. dissertations. During these studies, lessons learned from the development processes of sub-models that are supposed to work with the main system, have been used for the design of the core part of the model that integrates the components. This way, a bottom-up approach in an iterative process was adopted and practiced in the development/investigation processes of the relationships among the components and core part of the model.
There is a limited number of studies, which have a holistic perception of the nature of the problem and attempts to propose an integrated solution of the complementary components, i.e. conceptual and practical dimensions. A comprehensive “systems approach” is essential for effective decision-making regarding global sustainability, since industrial, social, and ecological systems are linked (Mobaraki & Oktay Vehbi, 2022; Fiksel, 2006).
Several methods have been proposed for the determination of information requirements (Sey et al. 2002):
Normative analysis methods are based on the fundamental similarity of classes in objects systems, these fundamental characteristics load to a prescribed or normative set of requirements (Carlson, 1979). *Strategy set transformation* methodology is primarily for obtaining organization-level information requirements that are derived from the objectives of the organization (King, 1978). *Critical factors analysis* is a method for eliciting significant decisions or other factors that can be used in deriving information requirements (Rockard, 1979). *Process analysis* focuses on business processes (groups of decisions and activities required to manage each of the resources in the organization). An example of this methodology is the Business System Planning (IBM Corporation, 1981). *Decision analysis* is very useful in clarifying the information requirements with users in cases where the decision process is fairly well defined (Munro and Davis, 1977). *The socio-technical analysis* is oriented to application-level analysis and consists of two parts: social and technical analysis (Bostrom and Heinen, 1977). *The input-process-output analysis* is a system approach. The advantage of analysis based on inputs, processes, and outputs of systems is that it is systematic and comprehensive. Examples are ISAC - Information Systems Work and Analysis of Changes, DFD - Data Flow Diagrams and ADS - Accurately Defined Systems, ISASA – IS Analysis by System Approach (McLeod, 1993; Dressel, 1973).
The studies managing key components of the problem and its solution at different dimensions, i.e., product/process/social dimensions for different entities at various levels of the built environment from “components” to “cities” levels are being conducted as the sub-projects of the master project entitled as “SIMURG: A performance-based and **S**ustainability-oriented **I**ntegration **M**odel **U**sing **R**elational database architecture to increase **G**lobal competitiveness of Turkish construction industry in industry 5.0 era” while some of these projects are the subjects of dissertations and master theses, some of them are being studied in research and development

projects funded by the ITU Scientific Research Funding Unit and private manufacturing/design/construction companies in the construction industry.

SIMURG is the title of a Persian tale, which has corresponding versions in Turkish and western cultures as well. It means "*30 birds*" searching for their leader, named SIMURG. At the end of their journey, they eventually explore that there is no such bird named SIMURG; however, they are all SIMURG as a whole. Governance of the cities and the entities at all scales and levels of the built environment needs to use the language of human-centric approaches by locating the sustainability concept into the center of all problems and solutions.

SIMURG_ALKU & ITU Virtual Lab was established and announced in 2018. The lab aims to provide a scientific research and development platform for the research projects, master theses, and dissertations, which aims to develop conceptual and practical models for increasing the quality of the built environment and national/global competitiveness of the Turkish construction industry. The lab is currently working on the integrated model SIMURG, which is the subject of the master project being conducted by Kanoglu, A., from the department of Architecture of ALKU/Management Sciences in Architectural Design and Construction expertise area; Yazıcıoğlu D.A., from the department of Architecture of ALKU/Interior Architecture expertise area; and Özcevik, Ö., from the Department of Urban and Regional Planning of ITU, who are the co-chairs of the Lab.

The final output of the master project SIMURG, a relational database software, will be an open-ended model with numerous modules in all dimensions and levels of the 3D Cartesian system of sustainable assessment in the future.

5. Synthesis of the Conceptual Model

The basic components of the conceptual model of SIMURG is defined as follows (Figure 1):

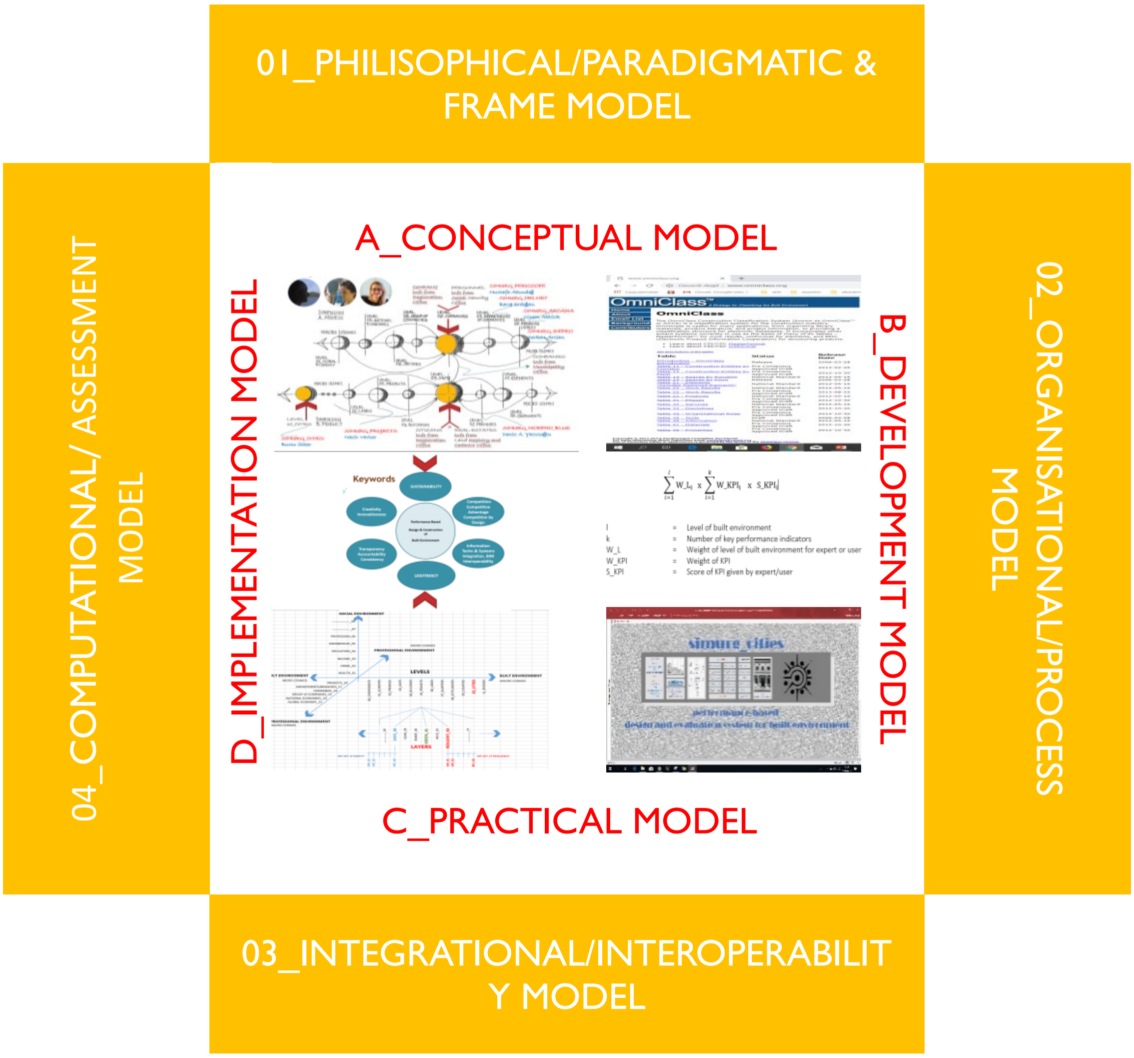

Figure 1. The components of the conceptual model as the objectives of the research of SIMURG.

- Philosophical/Paradigmatic Model: Proposal of a philosophical approach that accepts and supports "*sustainable planning, design, and building*" approaches instead of the initiatives, which is driven by individual interests and passions of entrepreneurs, such as making profit without considering common interests of society, is the first objective within this context.
- Framework Model: Proposal of a framework model that covers all dimensions required for the assessment of sustainability and allows multi-dimensional/multi-layer/multi-level interactions for computational and international parts of the model is the second objective within this context.
- Organizational/Process-Related Model: Proposal of the process of performance-based assessment and definition of supporting issues such as organizational entities, their functions and relationships, rights, and responsibilities, is another objective within this context to be able to implement the model.
- Integrational/Interoperability Model: Proposal of a "*multi-dimensional, multi-level and multi-layer*" structure requires the interactions among interrelated entities at different dimensions to be defined clearly and concisely. Solution of integration and interoperability problems of the model at conceptual and practical dimensions is another objective and challenge of the study within this context.
- Computational/Assessment Model: Definition of conceptual layers/sets of key performance indicators (KPIs), determination of design and production performance parameters/ performance criteria, development of a performance-based assessment system and its computational statements/equations for the performance-based assessment of the environmental dimensions of sustainability in the 3D Cartesian system is another objective within this context.
- Computer/Software Model: Identification of the processes, modules, and components for automation software and reporting system, which is based on the conceptual model to be developed is another and final objective of the study within this context.

6. Hypotheses of the Conceptual Model

Citizens are largely positioned as data points, consumers, users, players, testers, or people to be corralled, nudged, disciplined, and controlled (Cardullo and Kitchin, 2018). Occasionally they act as participants that provide feedback and suggestions, but rarely occupy roles of decision-makers, co-creators, or leaders (Kitchin, 2018). Instead of a chaotic order, which always cooperates with individual or organized entrepreneurs' ambition/greed, interest and initiatives motivated by only making higher profits and mostly supported by political power, who shares the benefits especially in third world countries, a philosophical approach, which is supported by a holistic paradigm of design/building/assessment approaches of sustainability at all hierarchical levels of the built environments. This philosophy must adopt the approach that global resources are our common heritage and all contracts and actions must protect future generations' rights. Moreover, it also must adopt innovative approaches supporting sustainability, which focuses on extending the competition in the construction industry to the entire building production process instead of limiting it with bid-price strategies in the tender process.

Thus, it will be possible to transform the role of the architect into a design professional, who does not act in line with the desires of the entrepreneur but, who protects the long-term benefits of the society in the context of "*competition by design*". The philosophical/paradigmatic model of the above-stated approach necessitates a new holistic approach at related dimensions of solution and sub-models such as integration/interoperability-related, organization/process-related, computation/assessment- related, computer/software-related models, which internalize the concepts of sustainability, innovation, competitiveness, integration/interoperability, accountability, transparency and legitimacy in the core part of the study as illustrated (Figure 2).

- A conceptual and practical model to achieve this goal must integrate all these concepts/keywords and re-thinking construction in this scope is inevitable. After developing a conceptual model, a relational database model including different modules for different levels, functions, and entities during the production process of the entities in the built environment is the main goal of this project.
- Our experience on the subject helps us to suggest the hypotheses listed below that drive us to design our framework model in the master project in solving the problem.
- Production is the total of product and process concepts and performances of these dimensions are influenced by human-related/societal/social facts on the third dimension of the 3D Cartesian system; an integrated approach is required in the assessment of sustainability.
- The entities in physical/built environment and professional/economic environment can be defined according to their hierarchical position at the "*levels*" of expansion of universal entities; they are in a relationship with each other in a hierarchical order.

- The levels of built environment entities at the product dimension might start at the "*subatomic*" level and end with the "*universe*" level in theory; yet, in our study, we start with the "*building components*" level and finish with "*cities*" level due to practical reasons.
- As for the entities at the process dimension, they start with the "*projects*" level and end with the "*national economy*" level, including "*departments of companies, companies, functional groups of companies and sectors*" levels in between.
- Social attributes and facts related to individuals and society such as creativity-related, health-related, crime-related, etc. facts in the social dimension must be integrated in addition to product and process-related dimensions stated above since the performances of built and economic environments are affected by these facts and it can't be assessed without considering the consequences of them.
- Assessment of the entities of the built environment must be based on both objective and scientific rules/principles/criteria and must be performed by both citizens, who are ordinary people, and specialty groups, who are experts of related levels and areas.

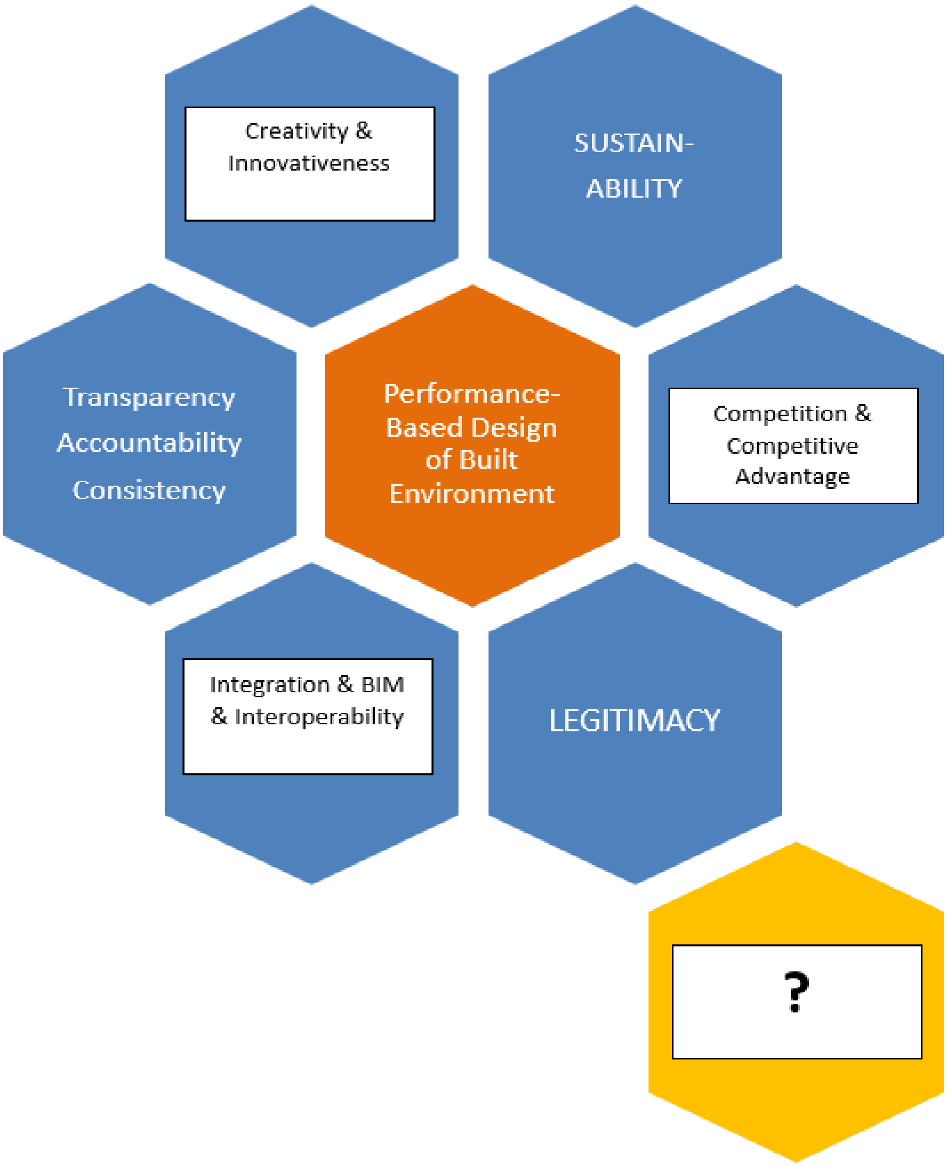

Figure 2. The keywords driving the study.

- The value systems of end-users, even if they are based on their subjective perceptions, inadequate experiences, and incomplete/inconsistent knowledge, must be considered in addition to an assessment of experts as well.

- The assessment model must provide the opportunities of using various sets of concepts and their key performance indicators such as slow, smart, safe, green, historical, resilient, etc. These concepts will be defined in the model as "*layers*" that are classified as basic patterns including concept-specific KPI sets associated with their impact factors referred to as "*weights*".
- Occupants and their social attributes of built environment entities at each level of built environment dimension in the 3D Cartesian system may increase or decrease the performance-based scores of these entities with their social, cultural, educational, health-related, crime-related, etc. activities and attributes, and they must be taken into consideration in calculation and assessment in the performance of the entities at different levels in the built environment.
- The model must address the assessment requirements of individuals and corporate level entities such as entrepreneurs, municipalities, ministry of construction, governments, and global assemblies such as UN, WHO, ILO, etc. in their assessment and decision-making processes for various levels in the built environment.
- The model must propose this three-dimensional (product/process/social) and multi-level/multi-layer approach by KPI sets in the calculation of performances of built environment entities by taking into consideration the mutual effects on each other.
- Interoperability, standardization, unification, and integration concepts must be considered and information classification systems such as OmniClass, MasterFormat, etc., are inevitable in the design of the model to be proposed.
- The computational model must support the assessments both in detail of level of entities in all dimensions of the 3D Cartesian system separately and total performance of the selected entity by considering the effects of the entities at other dimensions.

7. The Philosophical/Paradigmatic Model

Sustainability is not a concept that can be used by the triangle of the corrupted political system, entrepreneurs, and financial institutions, who tend to abuse it since the built environment is one of the most profitable investment areas in most places of the world; however, the main concept among those that can be achieved by the integrated use of all key concepts given in Figure 2, for the well-being of society. It can be achieved only by matching the basic requirements of life, for not only human beings but also all living creatures in nature, with their expectations and attributes appropriately and balanced to some extent. Today, in our society we can't achieve matching up requirements/ expectations/identities of individuals with the attributes of built/professional/social environments; i.e. children are misled by their parents to the professions that are supposed to provide high income during their professional lives, individuals invest their financial resources to houses that are only supposed to be highly profitable investments, municipalities support the investments of built environment entities that do not match with the identities/souls of the cities, etc., because of an ill-defined value system imposed to the individuals of the society, especially during the last four decades in Turkey.

It is seen that resident structures have the difficulties of evolving since they keep resisting all innovative initiatives all the time; yet, the existence and sustainability of life are at stake, where these evolutions could not be achieved. Some of us may think that the common sense and consciousness of the society can find the way outs sooner or later before unrecoverable damages arise; however, public authorities seem to be not affected by the efforts of individuals or weak non-governmental organizations to take timely steps. Today, after all, futile endeavors, which had limited effects on a solution by now since they do not have a holistic approach and an integrated strategy supported by a strong philosophy it is seen that we still have a very long way to go. Because of this, we have lost our past and now we are losing the future of our children, unfortunately. Duncan (2005) reports that neither national building codes nor those of today's new-build clients are adequately protecting the interests of the society and building users of the future; thus, the emergence of concepts/labels/layers such as smart/green/safe/slow, etc., are just being seen as a "market force" pressure on building owners.

8. The Frame Model

Proposing a framework model to define the components of the conceptual model and integrate all dimensions of the assessment process of sustainability with a holistic approach must be the first step of the study. There is a limited number of framework models for the assessment of sustainability in the literature; i.e., Harrison and Donnely (2011), Nam and Pardo (2011). Yigitcanlar et al. (2018) report that not many of them adequately addressed a balanced and sustainable approach. One of the well-known framework models is the EU model, which proposes economy, people, governance, mobility, environment, and living issues as dimensions.

Unlike the others, the SIMURG proposes a multi-dimensional, multi-level, and multi-layer framework model to be able to determine the relationships among the dimensions and entities on various levels of the dimensions of the 3D Cartesian system (Figure 3).

It is necessary to develop a comprehensive and holistic framework model to be able to increase the accuracy of the assessment process of the performance of the entities not only on the built environment dimension but also on the other two dimensions of the 3D Cartesian system in the framework model of the SIMURG. Achievement of this goal enforce the researchers to deal with a trade-off problem between the level of complexity and versatility of the model proposed and this endeavored study is supposed to result in a model that can measure/assess/understand/explain the performance of environmental dimensions regarding sustainability concept, more accurately and successfully compared with the other models reported in the literature and professional practice. In other words, the comprehensive/complicated character of the models does not guarantee the success of the solution and the "less is more" statement that was one of the popular mottos of the architectural practice in the 60s must be considered in the design of the framework model to be proposed as well. This study aims to propose a holistic model that means using "the system approach" to define the relationships of the related entities and to design *a*. multi-dimensional, *b*. multi-level, *c*. multi-layer/label architecture to express these relationships among the dimensions of the Cartesian system of sustainability and the entities on various levels of these dimensions. This approach imposes us to analyze the basic components of the system in four main folders: *a*. environmental dimensions of the sustainability, *b*. entities on each level of these dimensions, *c*. layers/labels/concepts of assessment of sustainability, *d*. methods/tools of assessment of sustainability. After clarifying our perception of the above-stated problem by these classifications, the conceptual model can be interpreted more accurately.

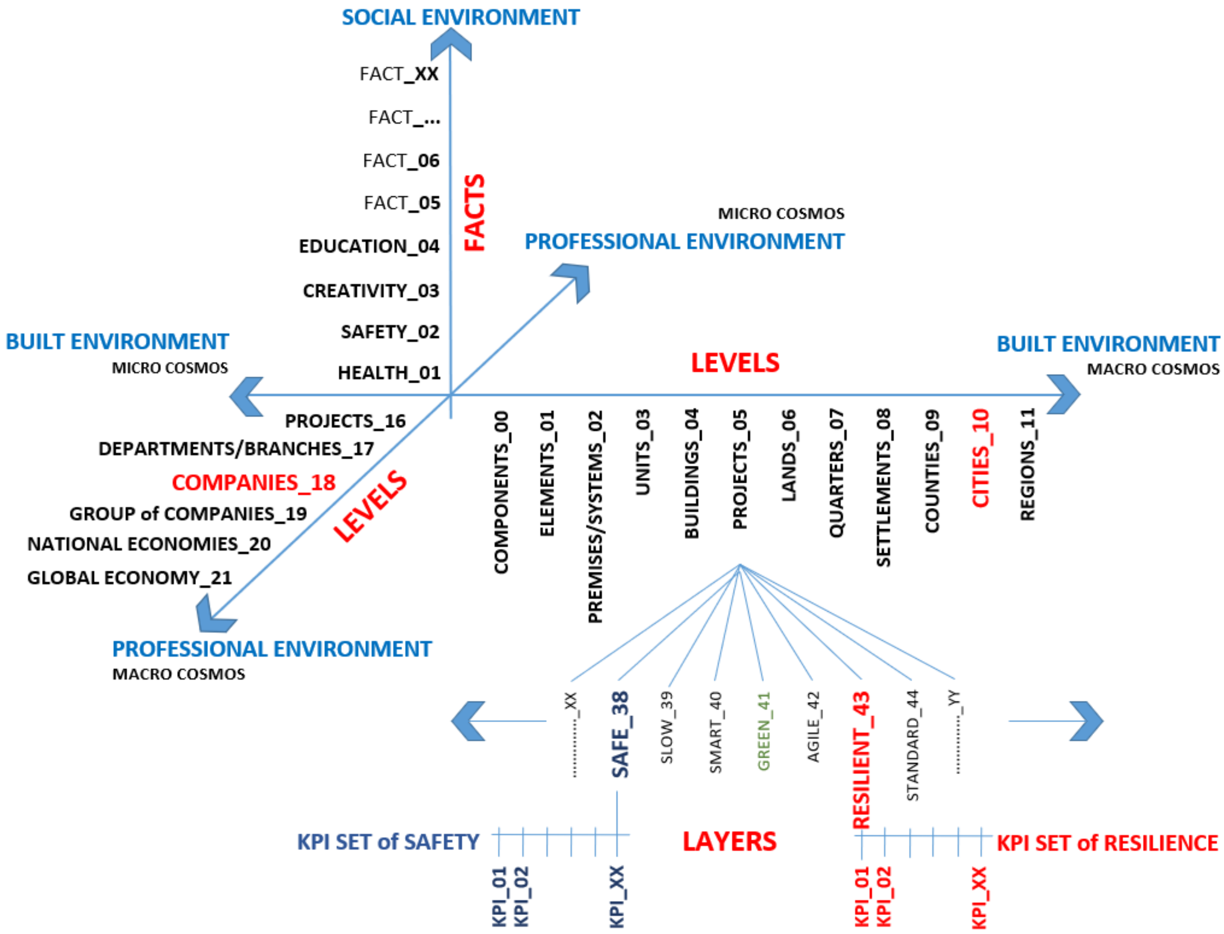

Figure 3. Generic example of the multi-dimensional, multi-level, multi-layer, and performance-based assessment model of sustainability proposed by the study.

9. Environmental Dimensions of the Sustainability

Studies within the context of sustainability concept, are still being conducted in three different but interrelated environmental dimensions in this study; built environment, professional environment, and social environment. For this reason, it is reasonable to classify these environmental "dimensions" of the sustainability concept as explained below.

- Product-Related/Physical/Built Environment: It comprises of consecutive and hierarchical levels of built environment starting from the "premises" level; and the entities at "elements" and "components" levels that form the premises are also included in this succession similarly the other levels that can be extended up to the cities, countries and even to the globe. All the entities at each level of the built environment can be the subject of assessment for several shareholders.
- Process-Related/Professional/Economic Environment: Unlike the other studies in the literature, the term "economic environment" in our framework model is not related to product-related/physical/built environment entities but the organizational entities (companies) that take place in the production process of all designed/engineered/ manufactured-produced-constructed items in all segments (sectors) of the national economy as well as the companies in the construction industry, which undertakes basic roles of the production process of the built environment stated above. All the corporate level entities that are involved in the production process of the built environment such as local authorities, manufacturers, suppliers, designers, contractors, etc., has a direct effect on the total performance of the built environment due to the experience of their personnel, level of specialty, competitiveness, innovativeness, etc., in short, the organizational and economic performance of the company. It is inevitable to assess the performances of these entities to be able to assess the entities at all levels of the built environment. Just like the hierarchical structure of built environment levels, the entities in professional dimension are in a relationship with each other in a hierarchical structure; and each level's performance can be calculated as the weighted average of the performances of subordinate entities in addition to the assessment value of level-specific KPIs as it is in the built environment dimension.
- Human-Related/Societal/Social Environment: It is necessary to consider the effects of social facts such as quality of education, safety level, density and quality of cultural activities, etc., of human beings in the society, who utilize the entities of the built environment at all levels, on the performance of the built environment. Unlike the other dimensions, the facts to be assessed in this dimension do not have hierarchical levels and relationships.

10. The Entities/Facts on Dimensions of 3D Cartesian System of Sustainability and the Levels

The hierarchical levels of product-related dimension can be defined as 00_components of composite building elements, 01_composite elements of premises, 02_premises of building units, 03_units of buildings, which are defined by ownership records on cadastral systems, 04_buildings, 05_projects (group of buildings/gated communities), 06_lands, 07_quarters, 08_settlements, 09_counties and 10_cities levels as it is seen in Figure 3. The left side of the built environment dimension could have been extended down to subatomic levels, while the right side is possible to be extended up to the universe level theoretically. Yet, for practical reasons the levels start with the "00_components of composite building elements" level and end with "10_cities" level.

As for the hierarchical levels of process-related dimension, the entities and their levels can be defined as 00_projects, 01_departments of firms, 02_firms, 03_functional groups of firms (manufacturers/suppliers/designers/contractors, etc.), 04_industrial segments (sectors) of the national economy, 05_industrial segments of the global economy, and 06_global economy levels. Each level needs its own level-specific & layer-specific KPIs to be developed and associated impact factors/weights to be determined.

The facts on the social dimension can be defined as 00_health, 01_crime, 02_income, 03_education, 04_culture, etc. During the assessment process of sustainability, all these facts can be included by assigning them certain weights or desired facts can be eliminated by assigning the weights of these facts as zero.

11. Layers/Labels/Concepts/Sets of the KPIs

All the entities, which take place on the 3D Cartesian system of environmental components of sustainability can be assessed by using a performance-based assessment approach using various sets of Key Performance Indicators (KPIs). These sets are expressed by some well-known terms such as smart, slow, safe, green, resilient, etc., and are referred to as "*layers/labels/concepts*" in this study. In this context, an assessment can be made for a given set of cities by using, for example, "*smart city*" KPI set or "*safe city*" KPI set, and resulting performance values of these both entities at "*cities level*" will be different at the end of a comparative assessment process regarding the KPI set used. Just like the entities on Product-Related/Physical/Built Environment dimension; i.e., cities in this example, it is possible to assess the entities at, for example, "*departments*", "*companies*" or "*sectors*" levels on Process-Related/Professional/Economic Environment and so on. This way, all the companies at "*contractors*", "*designers*", "*manufacturers*" or "*suppliers*" categories can be assessed, ranked, compared internally; just like all the industrial segments (sectors) in national economies or all the national economies in the global economy can be assessed the same way.

12. Methods for the Assessment of Built Environment and Performance-Based Approach

It is necessary to use a combined unit of measurement in the assessment of various attributes of entities in the built environment. Cost, quality, or performance can be stated among the options. Although Life Cycle Assessment (LCA), Life Cycle Inventory Analysis (LCI), and Life Cycle Cost (LCC) based models are proposed in the literature, it is stated that they lack in the assessment of the facts of sustainability on the social environment dimension (Ahmad and Thaheem, 2015). As for the computation process, various studies propose to use various methods such as Multi-Attribute Utility Analysis (Lam and Yang, 2020; Walnum et al. 2019), Performance Benchmarking (Shmelev and Shmeleva, 2019; Ahvenniemi et al. 2017; Sáez et al. 2020), Technique for Order Preference by Similarity to Ideal Solution/TOPSIS (Gok and Yigit, 2017; Zhang et al. 2018), Multi-Criteria Decision Making (Manupati, 2018), Machine Learning (Ahmad and Chen, 2018).

On the other hand, performance-based assessment is a comprehensive approach and can be used as an effective conceptual tool to deal with the assessment problem of built environment entities. The conventional methods and tools of controlling the content of the built environment almost by the beginning of the 21st century were specifying requirements in prescriptive terms and it was based on central control of how a built environment would be created regarding the basic dimensions of production; i.e. products and processes. Since the traditional descriptive approach does not allow a responsive control system some countries decided to use performance-based specifications and regulations. Duncan (2005) reports that a third voice is now clear, from the “sustainability” corner.

A performance-based approach is inevitable to support and utilize the benefits of innovation; the most common universal motivators of a performance-based approach appear to revolve around a desire for more flexibility, more innovation, and cheaper construction (Lovegrove, 2005). The author further emphasizes that there is a developing awareness that the performance approach is not just about the development of technical codes; rather it is a holistic system, a legislative, regulatory package that is complemented by expertise, accountability, and responsible allocation of risk.

13. Discussion

Sustainability is the key concept of integrating various aspects of life; that’s why numerous studies are being conducted by research teams from various disciplines. It is not unusual for these disciplines to define the problem within the boundaries of their domains. Dividing the problem into its smaller components is also one of the basic rules of scientific research and that’s why most of the studies related to sustainability concept have their limitations. However, the outputs of these fragmented studies do not provide us with a comprehensive perception of the big picture and convenient tools for policymakers to be able to increase the transparency and accountability of their decision-making processes. The SIMURG, as the master project of dozens of prospective sub-projects related to the entities in all dimensions of the 3D Cartesian system of sustainability, made the cooperation and participation of multi-disciplinary teams possible in the conceptualization phase. Thus, it proposes a multi-dimensional, multi-level and multi-layer framework model that covers the whole space of solution for the problem. In addition to civil engineers with construction management and informatics expertise; academicians from an architectural domain with construction management and informatics, architectural philosophy, architectural history, and preservation expertise, academicians from interior architecture domain with the design expertise of building premises level entities, academicians from urban and regional planning domain with sustainability expertise, all research team contributed to the design of conceptual and practical models of the SIMURG.

14. Conclusions

The paradigmatic model of the SIMURG proposes a human-centric governance approach and accepts sustainable development goals (SDGs) defined by the UN. The framework model proposes a 3D Cartesian system as the dimensions of sustainability. The organizational model is based on a distributed system of roles and functions and proposes rethinking these roles and relationships by considering the functions of information providers and accredited labs and institutions in the certification process of the entities by specialty areas in the design of built environment entities. The integration and Interoperability model proposes integration and interoperability of information sources of public services. OmniClass information classification system and BIM 6D tools are proposed to organize the information needed in the built environment dimension. The calculation model is based on a solar system simulation algorithm that is inspired by gravity equation and performance-based assessment. And finally, the computer model is based on relational database architecture that allows integration of required information sources to be plugged in the frame model.

The master project and its components are currently being conducted in the research lab SIMURG_ALKU & ITU, in both institutions; Alanya Alaaddin Keykubat University (ALKU) and Istanbul Technical University (ITU). This article is the first paper of a trilogy and tries to explain the framework of the proposed solution by defining the essentials of the philosophical/paradigmatic model and framework model parts of the conceptual model developed in the study. Two more papers will be published to explain the complementary components in detail; the first one for the organization/integration-interoperability/computation models in the conceptual dimension, and the second one for the computer model in the practical dimension.

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Conflict of Interests
The authors declare no conflict of interest.

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