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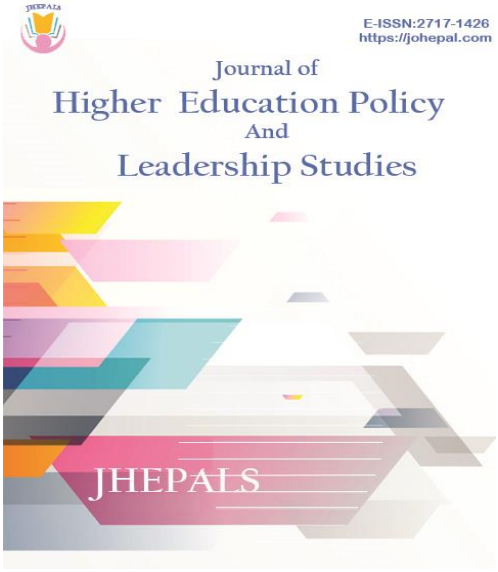

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A Framework to Create a University-based Innovation District under Anchor Approach

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Abstract

Implementing innovation districts as the next generation of Areas of Innovation (AOIs) is a global trend. This phenomenon emerged from university, technology, and innovation studies, as well as urban development notions. However, there are ambiguities regarding the shaping process, components, and necessary elements. Thus, a framework for innovation district implementation and development issues is necessary. This research aims to provide a comprehensive framework for implementing innovation districts under the anchor approach based on a university. The methodology adopted a two-step process: a systematic review to shape innovation district notions and a grounded theory approach using fourteen in-depth, semi-structured interviews. One hundred ten additional sources were also added to reach content saturation for a precise and complete insight into the innovation district shaping process. The concluded framework comprises four interconnected layers representing the anchor level (University), knowledge-based society, knowledge-based urban development (KBUD), and knowledge ecosystem. The findings also reveal the anchor institute's roles, interactions, and tasks to build an innovation district. Additionally, this study reveals the indispensable transformation of the ecosystem generator actor (Anchor Institute) to shape the innovation district. These findings provide a comprehensive insight for HEI managers, policymakers, businesses, urban researchers, and economy activists.

Keywords: Innovation District; Ecosystem; University; Anchor Approach; Knowledge-Based Urban Development (KBUD)

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Introduction

During recent years, the developmental notions in different dimensions of humankind's life became more complex and targeted the formation of innovation areas to achieve sustained socioeconomic growth (Esmaeilpoorarabi et al., 2020a; Sarimin & Yigitcanlar, 2012; Yigitcanlar et al., 2020). In this regard, many efforts worldwide have been conducted to transform the living ecosystems into new shapes that could cover the various layers of life and work together. Thus, cities and surrounding ecosystems around the universities or companies have transitioned to become knowledge-based entities by changing the strategies, forms, plans, and structures.

In this concept, a new phenomenon entitled "Innovation District" has emerged and become one of the main approaches for regional development globally. This concept emerged from the transformational movements in some upward paradigms such as urban development, technology management, and higher education development (Esmaeilpoorarabi et al., 2018; Goddard et al., 2013; Greco & Cresta, 2015; Han & Hawken, 2018). This phenomenon is crucial because it discusses an integrated and holistic view towards the implementation of necessary infrastructures in a limited geographical area to encourage innovational activities as a developmental model for the regions (Fritsch & Slavtchev, 2011). The innovation district phenomenon provides the solutions for the parallel development of its constituents, including cities, knowledge institutions, and business entities (Katz & Wagner, 2014). This development model highlights the co-creation of values that can boost the economy, create new opportunities, advance technologies and provide the better co-existence of work and life.

Innovation districts are shaped around the multidisciplinary concept of KBUD. The KBUD defines the strategies for the cities to enhance their infrastructures, life quality indicators, place-making plans, and knowledge programs in order to create an attractive environment for the talents (Esmaeilpoorarabi et al., 2020b). In this context, the growth process in such an ecosystem is attached to many actors such as knowledge industries, knowledge workers, system networks, knowledge-based products, and services. Many innovation ecosystems such as Silicon Valley, Boston area, Teheran valley are among the famous examples of innovation districts worldwide (Zou & Zhao, 2014).

Some researchers believe that innovation districts are newborn entities that could be implemented intentionally with direct investment in some infrastructures (Jafar et al., 2020). Conversely, some others stated that innovation districts are the phenomenon that are created through the interaction of many actors mostly implemented indeliberately in the same place (Nikina & Piqué, 2016). Some authors enlightened the innovation districts as the advanced and progressed generation of Science Parks. The followers of this idea believe that by enhancing the science park features and infrastructures, the next generations will be shaped into innovation districts (Dijkstra et al., 2019). Many others pointed out that the innovation districts are the building blocks of knowledge cities, smart cities, creative cities, and learning districts (Greco & Cresta, 2015; Rabiee & Rajabifard, 2017).

Despite the efforts describing the nature of the innovation district as the nexus of the innovation economy, the key characteristics of this phenomenon are varied due to the distinguishable local contextual factors and mainly the main implemented approaches (Asgari et al., 2020). Studying the previous literature about the innovation districts

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highlighted four principal categories among which, the anchor approach meaning the crafting of innovation districts based on a university (anchor institute) as an innovation generator of the area, is the most important and frequently used approach (Morisson, 2018; Pancholi et al., 2019). Blakely & Hu (2019) illustrated the different approach of crafting innovation districts in four rows; the current research developed their notions by adding the other approaches. Table 1 shows the various approach regarding the implementation of innovation districts.

Table 1.
Innovation district implementation approaches

Innovative place approaches	Major characteristics	Representative places
The anchor approach	Anchor facility: university, hospital, large-scale manufacturers Ecosystem to create new enterprises Innovation on the fringe Village atmosphere comprising innovative spaces, housing, and amenities Intensive public design and development	Silicon Valley Emeryville Teheran Valley Tsukuba Science City One-north
The hub approach	Urban environments transformed Location is the key Networking locations or incubators Proximity to universities Promotion of social entrepreneurship Networking for social good	Silicon Valley Emeryville Boston's Innovation District 22@Barcelona
The community approach	Community regeneration Utilizing existing facilities as platforms Improving local skills and community participation Relatively low cost and low resource demands	Boston's Innovation District Soho London
The stand-alone approach	Purposefully designed and built Intensive government investment Clear vision, strategy, and effective implementation 'Stand-alone' in terms of geography, function, and identity	Zhangjiang Science City Teheran Valley Tsukuba Science City
The Dedicated approach	Creating the districts intentionally and with purposeful planning Major governmental investment Defining the objectives, strategies, and proper deployment of infrastructure Established exclusively by location, functions, and identity of upward economic systems	22@Barcelona Teheran Valley Boston's Innovation District
The Complementary approach based on creative city	Creating urban and regional development programs Redesign and smartening of urban infrastructures Establishment of entrepreneurship facilitation centers and institutions Establishment of life support facilities and business investment institutions	Boston's Innovation District Emeryville Tsukuba Science City

Source: Authors based on Blakely & Hu (2019)

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University-based Innovation District & Anchor Approach

Previous studies rarely discussed this phenomenon in-depth, and there is no similar research regarding the implementation of innovation districts under the anchor approach. Therefore, the characteristics, shaping process, and architecture of an innovation district under this approach remained ambiguous. The research findings explore the elements, requirements, and the shaping process of the innovation districts under the anchor approach via a university as the anchor institute (Nikina & Piqué, 2016; Peters, 2010; Pino & Ortega, 2018). Therefore, this research's main achievement is to provide a framework for implementing an innovation district under the anchor approach.

To this end, this research addresses "which is a suitable framework to implement a university-centered innovation district under anchor approach?" The research framework illustrates the necessary infrastructures for the implementation of an innovation district around the university. It shows what kind of transformations are required in universities concerning the internal and external procedures to implement an innovation district. The findings also create a roadmap for the transition of universities and will provide the strategies for the policymakers and planners regarding the procedures of regional development through the implementation of innovation districts using an anchor institute.

Literature Review

The literature review was conducted by searching for the innovation district concepts in various databases (such as Scopus and WOS). To enrich the results, in the next step, we focused on the components and basic concepts of innovation and entrepreneurship ecosystems including the related concepts to university-based innovation district keywords as an additional research process in other databases (Scopus, Science Direct, WOS, and Open Access). The selection process started by first looking at titles, secondly at the abstract, and finally at each article's content separately. In this step, some inclusion and exclusion criteria were identified to process the resource pool regarding the research questions. After imposing the same criterions, the final appropriate sources have been selected for the research review. Table 2 presents the selection processes.

Table 2.
The selection process for research review

Core Key Concepts	Components	Rounds No.		
		1	2	3
Innovation Ecosystem	innovation system, regional development, innovative business, entrepreneurship ecosystem, innovation ecosystem	135	52	18
HEIs	3rd generation university, 4th generation university, university development, innovative university	64	37	8
Urban Development	Intelligent city, knowledge city, knowledge base urban development, learning district, creative city	55	14	9

Conceptual Foundations

Recently, the focus on the implementation process of innovation districts has been the subject of many scholarly works worldwide (Yigitcanlar et al., 2020). Tables 3, 4, and 5 show the results of the literature review section.

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Regarding the creation of innovation districts, there have been many roles played by transformational factors at various levels. All these transformational factors in the industry, business, education, and urbanism created an integrated and holistic platform called innovation district that facilitates the creation of innovation in regional ecosystems (Russo et al., 2007; Sarimin & Yigitcanlar, 2012). The innovation district is a dedicated area with its own management team whose primary goal is economic development by encouraging and attracting innovative talents and businesses in a way that particular services are provided or available to them in this area (Asgari et al., 2021). In this definition, this innovation area may have residential, cultural, and urban areas and facilities or be located near cities with such facilities (Nikina & Piqué, 2016). Recently, the innovation districts have been constructed much closer to urban centers to benefit the advantages of urban infrastructures such as place identity, multi-factor development ideas, heterogeneity, diversity, and authenticity (Esmaeilpoorarabi et al., 2020a; Ho, 2009).

This new era brought us new mixed paradigms in human lifestyle, covering work, life, and technology together (Blakely & Hu, 2019). The first generation of innovation ecosystems was born in the form of science technology parks to boost economic activities and employment levels (Yigitcanlar et al., 2020). Some of the specifications turned the science and technology parks into isolated, single-purposed, and introverted places (Esmaeilpoorarabi et al., 2020b). The next generation of those innovation areas emerged in the form of new entities entitled "innovation districts" as a novel idea covering previous weaknesses and generating new opportunities. In this new generation of innovation ecosystems, all higher and modern life and work requirements are integrated (Esmaeilpoorarabi et al., 2020b).

Table 3.
Innovation district creation frameworks

Creation Frameworks	Description
Infrastructural investment	• Creating innovation districts intentionally and based on design • Accumulation of industries and knowledge are required • Heavy investment on infrastructures
Entrepreneurial	• Creating the infrastructures needed to develop entrepreneurship and then creating districts naturally • Development of local entrepreneurship leading to innovation • Development of participatory and interactive networks
Hybrid	• Creating an innovation districts based on two approaches of infrastructural investment and entrepreneurship - the priority and latency of the approaches depend on the contextual requirements of the area
Gradual	• Innovation districts in this approach are created as an evolved form of economic zones and science and technology parks.

Source: Authors

The principal paradigms associated with the cultivation and molding of innovation ecosystems are presented in Table 4. These paradigms have been gleaned from a comprehensive review of preceding sources.

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Table 4.
Innovation district creation paradigms

Paradigms	Description	Sources:
Clustering	• Creating integrated industrial clusters or innovation clusters independently or in groups in a specific area • Creating the required value chains and supply chains for the development of clusters • Creating a specific geographical area for the aggregation or development of cluster activities	(Kuksa et al., 2019),Maggioni (2002)
Innovation spillover	• Innovation overflow process from a specific region with the accumulation of knowledge and technology to high potential areas in the periphery of the main region with the basic capacities to create and develop innovation. • Creating specific areas around an institution or geographical location with potentials for the commercialization of technology and knowledge • Establishing the mechanisms for the commercialization and operationalization of the accumulated achievements of a knowledge-compatible ecosystem in its vicinity	(Aldieri et al., 2018)
Open innovation	• Utilizing the collective and participatory potential of a specific geographical area with multiple and diverse actors that can create ecosystems based on the innovation economy framework • Use of internal and external collective and shared potentials (Inside-Out-Outside-In) to consolidate capacities and create an innovation creating mechanism	(Pustovrh et al., 2020),(Yun et al., 2018)

Source: Authors

We undertake a comprehensive examination of the innovation district creation model in Table 5. This analysis draws upon insights gleaned from a thorough exploration of the pertinent literature and previous studies in the field. We aim to provide a thorough and insightful overview of the intricacies surrounding the establishment of innovation districts.

Table 5.
Innovation district creation models

Models	Specifications	Sources
Quadruple and Quintuple Helix models	• The developed versions of the helixes are based on the triple Helix with some additional entities so that other roles such as non-profit organizations, public, social and private institutions emerged in the form of some new contexts called the context of society and context of the natural environment. • In the Quintuple Helix model, we have other major elements covering ecosystem-building procedures, including social communication and community-building programs. • This model is a fundamental simulation of innovation ecosystems that creates the basis for implanting natural reproductive ecosystems around the axis of innovation	(Carayannis & Campbell, 2019),(Carayannis & Campbell, 2010, 2019)

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National Innovation System (NIS) model	• The basic components and processes of creating an innovation ecosystem are summarized in some strategies and plans at a national level. This model depicts the ecosystems of innovation in which there are relationships among interconnected actors in a limited area at the national level. • The design and architecture of subsystem division and group segmentation in an ecosystem are illustrated in this model. • One of the main functions of this model is creating integrated innovation systems designed to boost economic factors under the knowledge economy framework.	(Miremadi, 2019),(Etzkowitz & Leydesdorff, 2000),(Suominen et al., 2019)
Regional Innovation System (RIS) model	• Establishing an innovation system at the regional level and creating a geographical ecosystem that, as an endogenous and development-oriented region, has economic and social goals. • Paying attention to the role of innovation in creating competitiveness and development characteristics of areas to create a special and growing region. • Paying attention to innovation economy models, including knowledge. Businesses, economic, technology, urbanization, education, and community building components in a specific region. • Defining the crowd-sourced governance system to regulate sub-ecosystems in a public context that is the basis of participatory governance in innovation districts.	(Pino & Ortega, 2018), (Uyarra et al., 2017), (Fernández-Esquinas et al., 2016)
Smart city model	• The evolution of innovative ecosystems through the theoretical lens of urbanization and livability focuses on smartening city elements, culture, and society to create an ideal and optimal human ecosystem. • Sequence of concepts related to innovation, technology, sustainable development, and smart products and services to increase the level of social welfare and urban production. • Illustrating the comprehensive approaches to cooperation and integration of innovation, technology, urbanization, and social life components in a geographical area to provide an innovative and technological human ecosystem.	(Greco & Cresta, 2015), (Vanolo, 2014)
Creative city model	• Development of innovative approaches to urbanization based on innovative and disruptive ideas • Integration of cultural, educational, economic, and technological approaches towards city building to optimize the human ecosystem by stimulating innovation and increasing creativity in the design, construction, use, and urbanization processes. • Paying attention to learning areas as an essential element in crafting the areas of innovation. • Paying attention to creative industries and the integration of humanities and technology to create optimal ecosystems for human beings.	(Landry, 2012), (Rezaeian Gharagozlo, 2013)
Science city model	• Interaction between science, culture, industry, intelligence, and knowledge in creating human living ecosystems. • Developing learning-related actors, especially in relation to educational institutions with a focus on higher education • Institutionalizing the position of higher education and knowledge in relation to urbanism • Paying attention to the axes of scientific and knowledge-based activities in development policies.	(Greco & Cresta, 2015), (Carrillo et al., 2014)

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Academic, regional development model	• Regional development by creating a knowledge and technology environment focused on the placement of a university that plays a key role in regional management. • Focusing on commercialization and application of academic outputs to create economic institutions. • Recognizing the centrality of the university in the form of the head of policy-making and responsible institution for creating cultural, social, economic, and livable ecosystems.	(Goldstein, 2010), (Antonelli, 2003), (Peschl et al., 2021)
Regional economic development model	• Focusing on the implementation of industrial clusters by creating special economic zones in some geographical areas. • Creating special facilities, infrastructures, and investment organizations to support the institutions that boost the economy in a specific area is the key driver of the model. • This model was created with special economic zones and then developed by other entities such as science and technology parks. This model does not pay much attention to the fusion of life, work, and urbanization.	(Fritsch & Slavtchev, 2011), (Iammarino, 2005)
Science and technology poles and hubs model	• Science and technology poles and hubs are the special areas that have been created for the scientific development and commercialization of a specific field, with the aim of industrial-scientific development created by corresponding values. • These ecosystems, which focus more on a specific topic, try to mature the knowledge of a cluster both scientifically and technologically and pay less attention to business aspects.	(Lyu et al., 2019), (Anttiroiko, 2009)
The fourth-generation entrepreneur university model	• The third generation university, known as the entrepreneur university, tries to achieve entrepreneurship and innovation-based goals besides education, research, and service as basic core tasks. • The fourth-generation university as an engaged university is more involved than the third generation with the innovation ecosystem, human life, and established communities • The fourth-generation university, as an engaged university, tries to integrate the social entities inside and outside of university with the innovation ecosystem entities under the values created by technology management principles. • The fourth-generation university emphasizes not only on its internal affairs but also through an ecosystem view, considers all ecosystem elements into consideration for any policy-making and strategy developing process.	(Zuti & Lukovics, 2015), (Lukovics & Zuti, 2013), (Elnadi & Gheith, 2021)
Innovation district model	• Innovation districts integrate the theoretical and practical aspects of the knowledge economy, urbanization, knowledge, and technology elements that try to create an optimal ecological environment for work and the life of the inhabitants of a specific geographical area. • Innovation districts present the first integrated approach regarding implementing an ecosystem that covers the multidimensional advantages and disadvantages of ecosystem constituents in a single entity.	(Yigitcanlar et al., 2020), (Yigitcanlar et al., 2019)

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Research Methodology

It is important to understand the foundation and purpose of this framework and how it can guide its further development. Therefore, this research aimed to answer the question of what makes a suitable framework for implementing a university-centered innovation district. Given the multidisciplinary nature of this research, a two-step approach was adopted. In the first step, an in-depth review of existing literature was conducted to extract key ideas related to the process of shaping innovation districts, including fundamental concepts and recent research findings. In the second section, this research used a grounded theory (GT) approach as a data gathering and analysis procedure to make a theory grounded in a set of data (Saunders et al., 2009). Some researchers defined GT as "a systematic, inductive and comparative approach for conducting an inquiry for the purpose of constructing theory" (Bryant & Charmaz, 2010). Some others believe in the usefulness of this method where there are insufficient or no theories about a phenomenon (Creswell, 2002). Generally, the GT-based research uses three distinctive approaches of grounded theory: The approach developed by Strauss and Corbin, the classical approach of Glaser, and the constructivist approach of Charmaz. Due to the specific nature of this research, it is mostly established on Charmaz (Charmaz, 2006). In this context, since the innovation district is a new phenomenon and we are investigating the implementing notions, the GT approach could be an excellent method to provide the ultimate goal of this study. Therefore, the pre-mentioned features of GT enlighten the path to provide an acceptable framework about the innovation district under the anchor approach.

Data Collection

The data collection was accomplished using social networks such as WhatsApp, Telegram, and Skype. Fourteen in-depth semi-structured interviews were also conducted to reach theoretical saturation. The selection process was based on purposive sampling at the first level and was continued by theoretical sampling to get the theoretical saturation. The data collection process involved different groups from academicians working on innovation ecosystems concept and the managers and activists in the field or the area of innovation. During this process, some additional or complementary sources were selected in order to enrich the dataset. This step helped us addressing the theoretical and practical constraints regarding the lack of information on the innovation districts' undiscussed topic. For this section, we used the internet searches to locate interviews, speeches, audios, videos, or texts related to the primary research domains (Table 6).

Table 6.
The additional sources

Total	Interview	Speeches	Texts	Audio	video	Others
110	28	29	38	2	2	11

Data Analysis

The coding procedure was based on the standard coding pattern of the GT method. To this end, the three stages of open coding, axial coding, and selective coding are done for the initial process of data. Simultaneously, the additional gathered sources (Table 6) were used concurrently to fix the content deficits. Data analysis was proceeded by identifying the main

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dimensions and components at macro and micro levels. We analyzed the statements to extract the dimensions, components, and possible sub-components. In this process, each code has been labeled with a specific name to be distinguishable. In the next step, each extracted code was compared to the previous codes.

Consequently, the final codes became clean by integrating similar codes and concepts and defining new codes. During the extraction process, some noteworthy concepts from memos are shaped. These concepts then have been analyzed and categorized into different ideas in coding procedures. The analysis procedure has been conducted in 5 rounds (Table 7). In the first and second rounds, 11 interviews have been considered to shape the initial theoretical saturation. The insufficient information about the overall inclusion of all concepts in two rounds led us to expand the stages to understand fundamental concepts. In this regard, we decided to continue the rounds along with covering the other additional resources. This expansion continued by considering the different components and sub-components for the main domains. The fourth round started alongside an overall quality check about the unity and inclusiveness of codes. The final structure of codes has been shaped in the fifth round. A gap analysis to find the shortages and missing components backing the literature has been conducted in this round. The data analysis structure is presented in Table 7.

Table 7.
Data analysis process

Operation	Round 1	Round 2	Round 3	Round 4	Round 5
Interview	11	14	14	14	14
Additional sources	25	34	24	15	12
Main Categories	4	6	7	6	5
Components	12	16	17	18	12
Sub-components	35	40	52	58	35
Codes	120	162	186	195	140

Results

The research process resulted in comprehensive insights into the shaping framework of the innovation district under the anchor approach. This framework consists of 4 domains: The university layer (6 tasks), Knowledge-based society (3 dimensions), Knowledge-based urban development (4 areas), and knowledge ecosystem (5 factors). Figure 1 shows the final framework.

The Anchor Institute (University Layer)

This domain discusses the core component of the innovation district under the anchor approach. The university acts as an innovation generator responsible for creating and managing the innovation district. The university prepares the seedbed for other role-players to interact with each other to make a living ecosystem. According to this framework, the university manages its internal affairs and plays the facilitator's role in implementing the regional innovation system.

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- Knowledge economy framework: Since implementing the regional innovation system needs a framework that provides a knowledge-based ecosystem, the university as the ecosystem builder should create a culture and provide its procedures. To this end, the university's internal and external structures create the values and practical programs for all innovation district components to regulate the rules, process and provide a structural and behavioral plan for the parallel development of all district components.
- Problem-solving research: This task states the necessity of problem-solving characteristics for the educational and especially the university's research activities. The academic curriculums and research priorities must consider the real issues of the surrounding community. In this regard, the research scope, issues, and processes should consider district development needs as serious problems, providing practical solutions. In addition to its functions, this look at the university justifies its role as a hub for the problem statement, shaping the questions, finding the solution, and making them real through a university, Society, and Industry cooperative activity.
- Connectivity: It means preparing the connection gateways, relationship infrastructures, and dialogues between different areas. It discusses the tools, approaches, ways, and sometimes the places that increase district components' interaction rate in socio-economic dimensions. Some researchers believe in connectivity as a significant constituent of innovation ecosystems (Battaglia & Tremblay, 2011).
- Crowd-source governance: The university governance in innovation districts should be based on the participation of all individuals and institutions of the area. On the one hand, this governance approach lets the university benefit from distributes resources (Financial, HR, Social Capital); on the other hand, the district components could utilize the university as a hub, R&D center, mentor, supporter, and a talent pool for their recruitment procedures. In this context, a win-win mutual interaction is an approach used by many anchor institutes that guarantees the co-development of all district components.
- Innovation generation: The University's tasks traditionally include education, research, and services. The 3rd generation university added entrepreneurship as an added value (Clark, 1998; Maietta, 2015). The 4th generation university discussed the interrelationship of university, society, and industry more efficiently in the form of a living ecosystem(Zuti & Lukovics, 2015). The recent discussions revealed a new horizon for the university as the responsible for ecosystem building by implementing an innovation system in an adjacent geographical area. This new idea, in line with the previous roles, assigned another role to the university functions. This new role recognizes the university as the creator, handler, and developer of the area's innovation ecosystem. In this context, the university relationships, cultures, and administrative activities deploy a knowledge economy framework. Therefore, the university educations, researchers, and especially its linkage capacities create the knowledge flows bringing new innovative notions through research and development for the university and its surrounding communities.
- Value-based education: It is derived from the concept of lean education. This notion talks about the minimal but practical curriculum aimed at creating observable values

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for the community. As a value-based educational organization, the anchor institute should define the necessary values, address the questions, provide the contents, and prepare the tools that facilitate the regional development of that district. This lean but practical education attracts talents and educates them to create values in the area. The anchor institute must cover the framework of an engaged university. This notion establishes strong communication among the university and other district constituents.

The Knowledge-based Society

The knowledge-based society institutionalizes the knowledge values in innovation districts' social layer. This domain highlights any educational, financial, business, and communicative outcomes of innovation in society. This domain helps people believe that innovation paves development and transitions from the traditional communities to the digital era. The fundamental culture-building process to prepare the managers 'mindset for a transformational movement realizes in this layer.

- Innovation atmosphere: This dimension glorifies the innovation-based activity among people as a high-raked development element. This idea could encourage people and institutions to keep moving forward using out of box thinking approach. The culture shapes people's mindset; therefore, any transformation from traditional economy toward digital and knowledge economy needs innovative thoughts created in a society with culture building plans. Those societies care about any innovative activities for their achievements and the ways the people try to change the world.
- Community engagement: The shaping process of any innovation district is collaborative through all district components' participation. In this regard, one of the crucial ways to increase innovation-based activity is to increase the accidental interaction of people and ideas. The same notion in university could be realized by a strenuous effort to merge disciples and create multidisciplinary fields. Esmaeilpoorarabi et al. (2020) combine two models of socioeconomic engagement in the macro- (Hawkins & Maurer, 2009) and micro-scales (Bass, 1990) to establish an innovation district community engagement model. This model, besides the others, includes all community social levels. It means that a good community engagement model should have plans for all social layers of the district.
- Talent acquisition: The innovation districts attract knowledge workers and companies by creating exciting work and life infrastructures. These activities include comparative and valuable offers resulting in choosing the innovation districts instead of others. To this end, the district's educational, residential, research, business, and communicative opportunities should justify its top priority among other residential options, especially for knowledge workers and high-tech companies.

The Knowledge-based Urban Development

Regarding the role of knowledge in urban development, Yigitcanlar et al. (2017) stressed the necessity of knowledge-based urban development (KBUD) for city planning in the age of the global knowledge economy. Esmaeilpoorarabi (2020) defined the KBUD, according to previous researches, as a "sustainable socio-spatial strategy, firstly emerged at the global

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best practices such as Cambridge Science Park, Silicon Valley, and then adopted by leading cities in Europe, North America, etc." The KBUD creates and gathers the infrastructures that facilitate the opportunity-making programs in the district. This concept covers both life and work. This inclusion integrates the undiscussed development approaches that never have been stated in such form to make a living ecosystem. The implementation of KBUD is necessary to realize any innovation management theories in communities of a spatial geographical area to build an innovation ecosystem.

- Place-making: Previous thinkers, especially those who follow the KBUD, believed in the realization of innovation systems bounding to a geographical boundary (Almeida et al., 2011; Cosgrave et al., 2013; Katz & Wagner, 2014; Yigitcanlar & Lönnqvist, 2013). Place-making should consider the form, function, ambiance, and image in economic, cultural, social, and spatial aspects. The place-making needs and innovation support spirit, creating innovative values for the communities. The place-making process conceptualizes theoretical learning in the form of visible spatial elements.
- Investment: The innovation ecosystem as a living creature interacts with other internal and external entities. All these communications are based on rails. The investment as a powerful rail strengthens the innovation district implementation by creating new business entities and ensures the future development of all institutions within the area. The investment at the KBUD discusses urban development. But this entity exists at all domains of the framework. It is a crucial part of all innovation district components supporting educational, business, and life affairs.
- Lean regulation: The governance at the urban level should provide lean management regulations meaning light and agile, simultaneously low-cost administrative and decision-making procedures. This agility lets newborn institutions grow fast and encourage organizations to develop quickly.
- Networks: The networks are crucial for two reasons, firstly as the ecosystem vessels, the knowledge, and other assets circulate through them within the area. Secondly, those are recognized as one of the fundamental ways of innovation creation. Therefore, the better connection of innovation district components provides accidental interactions, as many researchers mentioned this as a practical innovation creation approach in social ecosystems.

The Knowledge Ecosystem

The knowledge ecosystem is the primary context in which all innovation district components are deployed. This is a seedbed and, at the same time, an incubator to make relational opportunities. The knowledge ecosystem is responsible for creating the internal domains with their entities within the innovation district. This responsibility is accomplished using an institution (Anchor Institute), previously mentioned as the area's innovation generator. The different innovation district components are connected through a knowledge network using knowledge flows. This network fulfills the development expectations of each role player. This is the main task that makes opportunities for the business creation and procures assets for development procedures. In this ecosystem, the decision-making process should be based on insights using big data analysis. According to this approach, all measures will be

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rational, highlighting the citizen's experience during policy-making in the area at all levels. Mutual participation is based on reciprocal benefits among service providers and district components. These shared benefits encourage the internal cohesion of components to make a win-win deal together. In this context, the anchor institute becomes valuable for its role as innovation creator and hander. The district institutions become worthy for their roles as production units.

Finally, the citizens are crucial because of their positions in a society where knowledge becomes a priceless value. Totally, all components follow structures that are deployed on economic values. In such a situation, the knowledge society would be prepared as a facilitator to create and develop businesses in the area. The companies in this area are identified under the corporatization framework. The corporatization idea talks about converting dependent assets to independent organizations but under one integrated mission. The knowledge ecosystem encourages each innovation district component to turn into a business entity under corporatization idea, maintaining stability to increase potential growth.

Consequently, in such an ecosystem, the components work together to gain more potentially valuable opportunities. In this context, besides the district role player, the managerial bodies need adaptability and flexibility at all social and administrative levels. The intelligent agents in this model refer to these characters in innovation district components. Finally, all these concepts create a competitive ecosystem. Competitiveness in regional development is defined as communities' efforts to increase the comfort of the inhabitants of a specific geographical area(Lengyel, 2008; Lenzen, 2015; Lindberg et al., 2014; Zuti & Lukovics, 2015). The competitiveness integrates all innovation district components to attract more resources, make more opportunities, interact widely and truly with others, and finally live and work simultaneously for a shared benefit and common goal.

Innovation Districts Framework

Knowledge flows through the different social layers within each innovation ecosystem, appearing in various forms and contents. This presence fosters communities that prioritize the social interactions related to knowledge, resulting in an educational system within Higher Education Institutions (HEIs) that encompasses all social layers of the district. This system facilitates the transmission of knowledge-based values to future generations, emphasizing critical, systemic, and rational thinking methods, as well as providing the necessary soft skills alongside technical skills education. The framework for shaping innovation districts is depicted in Figure 1.

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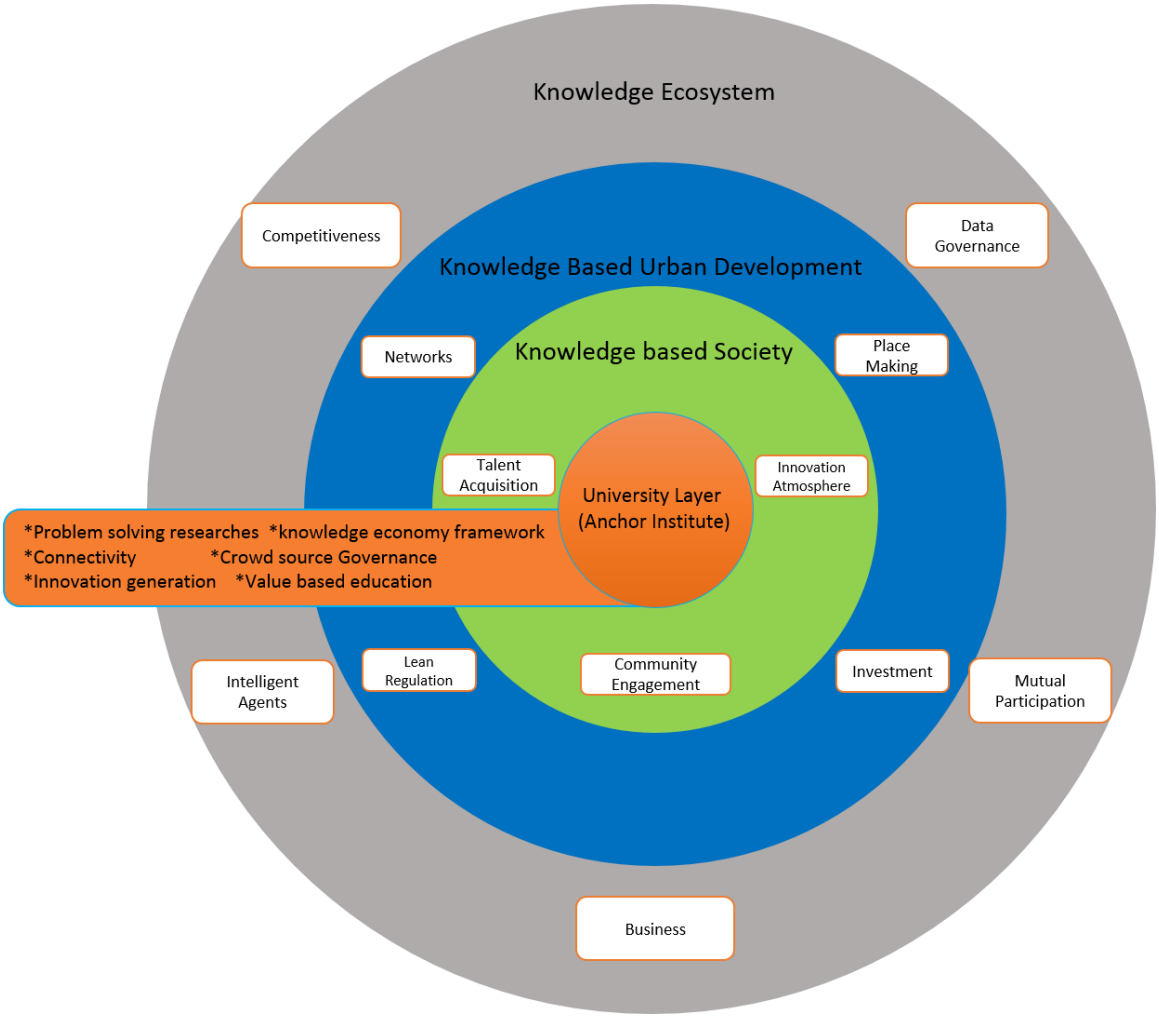

Figure 1. Innovation district shaping framework under anchor approach

Discussion

A holistic view of different innovation district implementation approaches reveals many similarities despite nuances. All approaches share the fixed position and existence of an anchor institute, although the tasks in the ecosystem value chain and assigned roles may differ. According to the anchor approach, the research findings suggest that the university, as an innovation generator, is at the center of this framework and responsible for creating a knowledge ecosystem through two main activities: internal and external. In the internal area, the university's structure, curriculum, governance, plans, and behaviors should be transformed into a lean system, practical curriculum, partnership (crowd-source) governance, and adaptive strategies and actions. In the external area, the university should extend its internal borderlines to the district borders.

In such a situation, the university enriches the ground with accumulated knowledge, technology, and talented people. This accumulation causes its surplus to overflow into adjacent areas, creating innovative networks, creativity, and new companies within the region. To achieve this, the university must establish a crowd-sourced governance platform, inviting all district stakeholders to share ideas equally. Over time, the university's role as the creator of the innovation district will transform into that of a facilitator. This facilitation task

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helps develop the district in the next generation at various innovation district maturity levels.

The grounded theory approach provides comprehensive insights into the definition and conceptualization of innovation districts that have not been studied before. This research focused on the university as the anchor institute because it is the most frequent institute to implement innovation districts.

Based on the results, this research aimed to address the gaps that have never or rarely been discussed in in-depth research on the innovation district phenomenon. Here are some of the key contributions of our research to these gaps:

- This research emphasized the importance of crowd-sourced governance in the innovation district phenomenon. Previous researches had discussed governance models, but this research highlighted the need for an inclusive and participatory governance model that involves all stakeholders equally in decision-making processes.
- While previous researches mainly focused on the success factors of innovation districts, this research identified the challenges and barriers that can hinder the implementation and sustainability of innovation districts. It also provided solutions to overcome these challenges and barriers.
- This research integrated the macro and micro levels of analysis to provide a holistic view of the innovation district phenomenon. It identified the main dimensions and components at both levels and highlighted their interdependence and interaction in shaping the innovation district.
- This research started precisely where other in-depth systematic reviews and related sources about the innovation district ended (Esmaeilpoorarabi et al., 2018, 2020a, 2020b; Yigitcanlar & Lönnqvist, 2013; Yigitcanlar et al., 2019, 2020). Therefore, this notion's infrastructures are based on the contents and legacies of those multidisciplinary works.

Given the findings, our focus on the anchor approach resulted in a framework that has multiple implications. First of all, it can be considered a structural map for policymakers, enlightening planning, implementing, and developing a well-designed innovation district. Likewise, the shaping process and the requirements of an innovation district are discussed for all activists where there is motivation to implement an innovation district around an anchor institute. They can easily acquire comprehensive and detailed insights into this concept by following the aforementioned definitions and gathering the prerequisites. Second, the findings can help innovation district role players recognize their proper roles, procedures, and futuristic plans. Third, the better positioning of innovation district components, quality control, and an evaluation process to assess critical indicator factors could be easily comprehended based on these research findings. Fourth, the findings could enlighten the path for other researchers who intend to conduct in-depth research about all extracted domains of the innovation district.

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Conclusion

This research used an ecosystem analysis approach for three reasons. First, we conducted an in-depth analysis of all the innovation districts' constituents to extract the ecosystem role-players and interrelationships. Second, we intended to consider a multilayered view regarding the study of innovation district components and their internal and external connections. Third, since the shaping process of innovation districts emerged from multidisciplinary studies, therefore, an overall systemic thinking method can cover all upward paradigms to investigate the research questions. This approach paved the path of a holistic look at the innovation ecosystem constituents, aiming to shape an innovation district. The findings stressed the role of university transformation as an indispensable phase of innovation district implementation. According to this study, the university accepts another task entitled “Innovation Generator” in line with traditional tasks such as education, research, service, and employability (entrepreneurship). The findings explain the university transformation in terms of internal and external activities in three points: (1) integrating its activities with the anchor approach (crowd-sourced policy-making), (2) creating a collaborative network with actors in innovation ecosystems (distributed university), and (3) facilitating the process of building innovation capabilities in the innovation ecosystem (mutual benefit). These points highlight the crucial role of the university in fostering innovation in the region and creating a sustainable innovation ecosystem.

- First, this study discusses university governance through a "crowd-sourced policy-making" approach. This approach encourages all innovation district components to participate in the policy-making procedures of the university. Then, this created policy-making platform will be extended to cover all district affairs under the supervision of the university as headquarter. In this approach based on the crowd-source notion, the university creates a collaborative social place for all district stakeholders. Such a paradigm seriously emphasizes the participatory role of all stakeholders in the economic development of the area. In this regard, innovation is generated by increasing the active participation of district citizens in defining development strategies, sharing assets, empowering competitiveness, and finally implementing an integrated value chain for the innovation district as a consistent system.
- This study also presents a new kind of university structure entitled “distributed university.” The structural analysis of successful universities' administrative and managerial processes (anchor institutes) in innovation districts shows a significant decrease in bureaucratic affairs. In these institutes, administrative, interactive, and regulatory procedures have been reduced from the university level to the department level for agility goals. This restructuring aims to integrate specialized departments more widely with industrial, social, and commercial environments. This notion criticizes the difference between traditional complex universities and distributed universities. According to the current notion, while shaping innovation districts, the complex universities' interaction with external institutions will face structural entropy, resulting in spatial separation (partially or entirely). In such circumstances, the departments intend to be relocated to become closer to specialized and social institutions. Such a structure may seem complicated at first

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glance because the university is no longer a wide and long integrated and centralized complex in a geographical area with distinct walls. In such a framework, the university will be a wide network of actors with diversity and plurality of inputs and outputs that require a more specialized administrative system and distinguishable governing methods.

- Third, this study defined the "mutual benefit" approach as an interactive dialogue between the university and districts' components. The study's findings indicated that all innovation district actors interact with each other in a conceptualized framework under the win-win deals by considering all actors' overall interests. In this approach, the district's components recognize opportunity sharing as an indispensable rule in a living innovation ecosystem. This notion deploys the fundamentals of co-creation and co-competitiveness as the core values of innovation districts. In this approach, the innovation district role-players can simultaneously accept the roles of supplier and producer in the innovation district value chains.

Based on the analysis, it appears that creating an anchor institute for innovation within higher education systems cannot be achieved by a single institution alone. Instead, it requires a collective effort driven by internal demands within higher education institutions to collaborate beyond their established boundaries to access resources, diversity, pluralism, and innovations. Additionally, external demands and expectations from institutions to utilize accumulated knowledge and knowledge-based assets to create value within the innovation district are necessary. To implement an innovation district successfully, the principle of removing university walls is essential. The findings of the analysis highlight five domains, with the university situated at the center. The university's role is to facilitate and interfere to enable the creation of an innovation district. The university's dominance in all domains is evident through its overlap with the other four domains, indicating its essential role in making an innovation district a reality.

Consequently, interactions with each independent domain could be the topic of future research. Furthermore, our research findings can expand our understanding of multidimensional innovation ecosystems by discussing the district's hidden components and role players. The results are also helpful in understanding how different scientific and multidisciplinary fields contribute to building an innovative concept. This information may be of interest to interdisciplinary researchers and policymakers studying innovation.

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