JOURNAL OF ENVIRONMENTAL MANAGEMENT & SUSTAINABILITY

REVISTA DE GESTÃO AMBIENTAL E SUSTENTABILIDADE – GeAS

Received: 22 Sept. 2020 - **Approved:** 15 Feb. 2021
Evaluation Process: Double Blind Review
https://doi.org/10.5585/geas.v10i1.18231
e-ISSN: 2316-9834
Special Issue - Urban commons in dispute
Guest Editor: *Maria Carolina Maziviero*

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Contributions to Knowledge-Based Development through commons theory, using data as a common good[1]

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Cite as
American Psychological Association (APA)

Marques, M. A. J., Sabatini-Marques, J., Garcia, B. C., Cortese, T. T. P. (2021, Special Issue, April). Contributions to Knowledge-Based Development through commons theory, using data as a common good. *J. Environ. Manag. & Sust., 10*, 1-25, e18231. https://doi.org/10.5585/geas.v10i1.18231.

Abstract

Objective: Knowledge-Based Development (KBD) is a multidisciplinary scientific field based upon the endogenous value-creation process of knowledge sharing. Ostrom's Commons Theory, in turn, explains how a community of people manages to share a common limited resource subject to social conflicts. This paper reviews the available literature on both fields and intends to answer the research question of whether and how Commons Theory may contribute to a better understanding of the field of KBD.
Methodology: A qualitative analysis was made looking for similarities and differences on both, as well as other empirical studies that could bring different lenses to assist in the analysis and identify the contributions of the Commons Theory to the KBD field.
Originality: The recent analysis of articles published in high-impact journals reveals the lack of connection between commons and KBD, especially smart cities, bringing relevance to research on the subject.
Contributions/value: KBD brings together groups of people who share tangible and intangible resources. Ostrom's Common Theory, on the other hand, explains how a community of people can share a limited common resource subject to social conflict. This article brings together the two fields of knowledge seeking to contribute to the development of the KBD field.
Findings: For the authors, the research shows that open data as new commons are important to improve the economic development of knowledge as a raw material for the development of software and applications that contribute to the development of cities, generating entrepreneurship, and contributing to innovation ecosystem.

Keywords: Knowledge-based development. Commons theory. Urban commons. Knowledge commons. Smart cities.

Contribuições da teoria dos commons para o KBD, utilizando dados como um bem comum

Resumo

Objetivo: Desenvolvimento Baseado em Conhecimento (KBD) é um campo científico multidisciplinar baseado no processo endógeno de criação de valor de compartilhamento de conhecimento. A Teoria

[1]This article is an updated version of the paper "Contributions to Knowledge-Based Development from the Commons Theory" published in the 2020 e-book Economy for the Common Good: A Common Standard for a Pluralist World?.

Comum de Ostrom, por sua vez, explica como uma comunidade consegue compartilhar um recurso comum limitado sujeito a conflitos sociais. Este artigo revisa a literatura disponível em ambos os campos e pretende responder à questão de pesquisa sobre se e como a Teoria dos Commons pode contribuir para melhor compreensão do campo de KBD.
Metodologia: Análise qualitativa buscando semelhanças sobre as teorias, bem como estudos empíricos que pudessem trazer diferentes lentes para auxiliar na análise e identificar as contribuições da Teoria dos Commons para o campo do KBD.
Originalidade: A recente análise de artigos publicados em periódicos de alto impacto revela a falta de conexão entre commons e KBD.
Contribuições para a gestão: O KBD reúne grupos de pessoas que compartilham recursos tangíveis e intangíveis. A Teoria dos Commons de Ostrom, por outro lado, explica como uma comunidade de pessoas consegue compartilhar um recurso comum limitado sujeito a conflitos sociais. Este artigo aproxima os dois campos de conhecimento, buscando contribuir para o desenvolvimento do campo do KBD.
Resultados: Para os autores, a pesquisa mostra que os dados abertos como novos bens comuns são importantes para melhorar o desenvolvimento econômico do conhecimento como matéria-prima para o desenvolvimento de softwares e aplicativos que contribuem para o desenvolvimento das cidades, gerando empreendedorismo e contribuindo para o ecossistema de inovação.

Palavras-chave: Desenvolvimento baseado em conhecimento. Teoria dos bens comuns. Bens comuns urbanos. Bens comuns de conhecimento. Cidades inteligentes.

Contribuciones de la teoría de los comunes a KBD, utilizando los datos como bien común

Resumen
Objetivo: El desarrollo basado en el conocimiento (KBD) es un campo científico multidisciplinar basado en el proceso endógeno de crear valor de intercambio de conocimientos. La Teoría Común de Ostrom, a su vez, explica cómo una comunidad de personas puede compartir un recurso común limitado sujeto a conflictos sociales. Este artículo revisa la literatura disponible en ambos campos y tiene como objetivo responder a la pregunta de investigación sobre si y cómo la teoría de los comunes puede contribuir a una mejor comprensión del campo KBD.
Metodología: Un análisis cualitativo buscando similitudes y diferencias en ambos, así como otros estudios empíricos que pudieran traer diferentes lentes para ayudar en el análisis e identificar los aportes de la Teoría. of Commons para el campo KBD.
Originalidad: El análisis reciente de artículos publicados en revistas de alto impacto revela la falta de conexión entre commons y KBD.
Contribuciones a la gestión: KBD reúne a grupos de personas que comparten recursos tangibles e intangibles. La Teoría de los Comunes de Ostrom, por otro lado, explica cómo una comunidad de personas puede compartir un recurso común limitado sujeto al conflicto social. Este artículo aglutina los dos campos del conocimiento, buscando contribuir al desarrollo del campo KBD.
Resultados: Para los autores, la investigación muestra que los datos abiertos como nuevos bienes comunes son importantes para mejorar el desarrollo económico del conocimiento como materia prima para el desarrollo de software y aplicaciones que contribuyan al desarrollo de las ciudades, generando emprendimiento y contribuyendo al ecosistema. de innovación.

Palabras-clave: Desarrollo basado en el conocimiento. Teoría de los bienes comunes. Bienes comunes de conocimiento. Bienes comunes urbanos; ciudades inteligentes.

Introduction

This paper aims to address the convergence between the Knowledge-Based Development (KBD) field of knowledge and commons theory, understanding data production as a common good. Data as a common good has increasing relevance in society, leading to smart and connected cities where innovation ecosystems are promoted through applications that improve the lives of citizens.

Commons theory is based on principles that contribute to and support the social process, which refers to a form of community management or governance applied to a resource, and involves a group or community of people sharing access to use of that resource. Hence, the purpose of this paper is to answer the following questions: (i) How does Commons Theory contribute to the field of KBD? and (ii) What are the main points of convergence between the elements of knowledge-based development and Commons Theory? Thus, the objective of this article is to point out how the theory of the commons contributes to the KBD field, establishing the main points of convergence between the elements of knowledge-based development and the theory of the commons.

From a literature review of KBD and commons, especially two new commons (knowledge commons and urban commons), we seek to identify points of convergence and potential contributions, focusing on the eight principles of Ostrom (1990). The theory of commons is based on the process of co-production between heterogeneous actors from different institutions, subject to conflicts, which justifies its potential contribution to the scientific field of KBD, which is based on the social process of knowledge as endogenous value-creation. It explores a community's potential and its local resources to achieve sustainable development, and therefore has been adopted by several cities in the world as a sustainable development strategy (Carrillo, 2002, 2004; Yigitcanlar, 2010, 2011).

From several studies published in the field of KBD, one can observe its composite perspective, starting from the individual and the organizational to the social, from the physical dimensions of proximity to social dimensions such as culture and trust, from geography to anthropology (Carrillo, Metaxiotis & Yigitcanlar, 2010). KBD is a multidisciplinary field of study that derives and uses the convergence of several disciplines such as economics, urbanism, geography, psychology, computer science, sociology, anthropology, and political science (Carrillo & Batra, 2012).

The concept of KBD came to urban planning and development during the 20th century with the goal of supporting the transformation of cities into knowledge cities and societies into knowledge societies, which require conditions and environments distinct from those based on industrial economics (Knight, 1995). However, the redefinition of the concept has become a necessity during the first decade of the 21st century, especially in regards to the economy, society, management, and technology, along with severe climate change (Yigitcanlar, 2011 p.63).

For Carrillo (2014), despite the wide use of concepts such as knowledge economy, knowledge societies and knowledge cities, there is still a need for solid KBD definitions. Even in specialized circles, the central concept of knowledge-based development has a series of interpretations (Carrillo, 2014). In this sense, the author presents three objectives for KBD: two main ones – (i) knowledge for economic prosperity and (ii) knowledge for human development;

as well as (iii) contributing to a sustainable society (socially and environmentally) where knowledge is the facilitator of an evolutionary future, putting sustainability in focus and giving direction and meaning to related knowledge strategies.

By including this third objective, the author notes that it is necessary to consider that those living in a knowledge economy are knowledge citizens, which means a population that is better educated (formally or informally), critical and informed – ready to participate in civic life, politically active, appreciative of artistic expression and cultural activities, more competent in human relations, and interested in a better quality of life for themselves and for the next generation, including concerns for health and less dependence on consumption, (Carrillo, 2014).

From a social point of view, knowledge citizens play a role in the "capacity to act" (incremental view of KBD), influencing the change from society to knowledge society (Carrillo, 2014). But it is in the disruptive perspective of KBD, where knowledge is the main element in the dynamics of social value, that "new functional realities emerge and radically transform the space of possibilities" (Carrillo, 2014, p. 408). In this sense, it can be said that it directly influences the knowledge co-production process.

The co-production of knowledge can be an effective factor for the sustainable evolution of cities and urban spaces, as it occurs when the interactions between actors minimize the differences in their cultural origins and emphasize the collective nature of the object (Schuttenberg and Guth, 2015). It is an "iterative and collaborative process that involves several types of specialization, knowledge and actors to produce knowledge and context-specific paths towards a sustainable future" (Norström et al., 2020, p. 183).

Understanding and transforming the way cities "think" is a decisive part of the development of effective knowledge infrastructures oriented towards the human being. Muñoz-Erickson et al. (2017), for example, present a conceptual and empirical framework that views existing co-production processes as preconditions for the design of new knowledge infrastructures in cities.

When analyzing the co-production of existing knowledge governance dynamics and conditions, as defined by Jasanoff (2004), Muñoz-Erickson et al. (2017) state that it is possible to help cities understand and improve their ability to create and implement new knowledge effectively in the service of sustainability and resilience. They conclude that knowledge co-production is promising for the construction of knowledge systems for cities, since it recognizes the diversity of actors, knowledge systems, social relationships and networks involved in the creation and application of knowledge relevant to sustainability.

Thus, Ostrom's theory of commons supports the process of co-production and knowledge co-production, essential in environments such as cities, with emphasis on urban commons. According to Ostrom (2009), data are considered common goods, since they are

used collectively and bring benefits to society. With this, digital and intellectual resources (data, knowledge) are applied in the generation of innovations aimed at the wellbeing of the city's population.

The view of the commons as a driver of the innovation ecosystem is strengthened through innovative entrepreneurs who use data as a raw material to develop innovative solutions to society's problems as a whole. The government has a fundamental role in the development of this ecosystem, making data available in order to foster the kind of innovative entrepreneurship that allows citizens to bring solutions for improving the quality of life in cities, as local residents are the ones who know the pains of each location and may bring proposals for improvements (Sabatini-Marques, 2020). Thus, in the face of this new era, data is of great value and should be made available to society as a common good, as it strengthens the innovation ecosystem (Sabatini-Marques 2020).

Schumpeter (1911) had already pointed out that fostering the innovative entrepreneur creates new markets and job opportunities, which promotes economic development. Errichiello & Marasco (2014) bring to discussion the importance of open service innovation in smart cities with a framework for exploring innovation networks in the development of new city services. Open data is a way to develop and create knowledge-based development. Similarly, Zhuang et al. (2019) demonstrate the importance of opening data so that collective knowledge contributes to the co-creation of sustainable solutions for cities.

1 KBD and smart cities

Repette et al. (2021) provide evidence that it is necessary to design, develop and implement technologies that positively affect the behavior of citizens in relation to common goods and also claim that open data should be available with effective guarantees o transparency, security and privacy. In this sense, the concept of smart cities is a contemporary approach that demonstrates the importance of the common good for knowledge-based development.

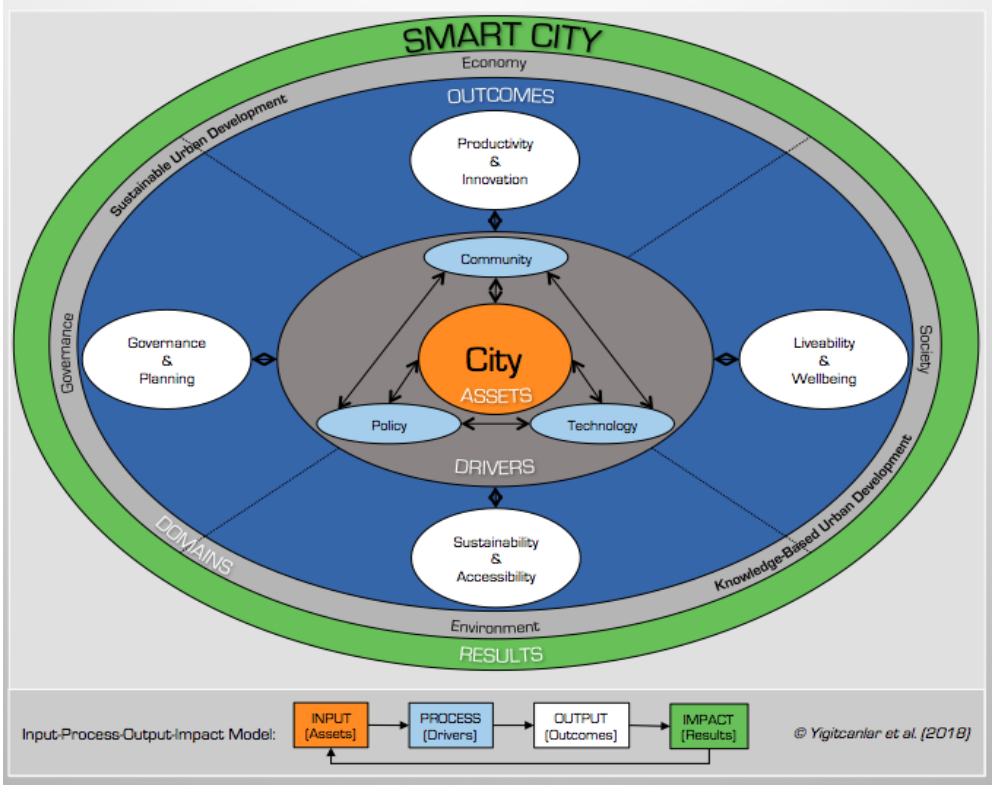
Yigitcanlar et al. (2018) consider as a desired outcome in terms of economic development in smart cities that they should have the capability of developing their own unique technologies to meet their developmental needs. This can contribute to creating a local innovation economy and prosperity that is a central element of smart cities. This outcome connects with open data as a commons that not only generates prosperity in a city, but also creates new ways of consumption and wellbeing.

Considering the objectives of KBD and the concept of smart cities, it was proposed by Lara et al. (2016, p. 9) that a Smart City is “A community that systematically promotes the overall wellbeing for all of its members, and flexible enough to proactively and sustainably

become an increasingly better place to live, work and play."

Another perspective of Knowledge-Based Urban Development (KBUD) and Smart Cities is the concept of Smart City 4.0 (figure 1). It is an urban locality functioning as a healthy system of systems with sustainable and balanced practices of economic, societal, environmental and governance activities generating desired outcomes for all humans and non-humans (Yigitcanlar et al., 2018). It has, as inputs, community, policy and technology as part of the process and drivers to generate outputs in four domains: (i) economy: productivity and innovation; (ii) environment: sustainability and accessibility; (iii) governance: governance and planning; and (iv) society: livability and wellbeing. For a city to be smart, it is important that the four domains should be balanced and work together.

Figure 1 – KBUD - Framework proposed by Yigitcanlar et al. (2018)



Source: Yigitcanlar, T., Han, H., Kamruzzaman, M., Ioppolo, G., & Sabatini-Marques, J. (2019).

Sustainability requires collaboration between governments, businesses, and civil society at all levels and scopes, whether local, national or international, for the joint creation of meaningful and sustainable futures. Carrillo (as cited in Gonzalez et al., 2005) also considers that committed leadership is fundamental to achieving the sustainable well-being of a community.

Interconnectivity, through the technologies of information processing and communication, transcending the geopolitical limits. is crucial for the necessary commitment

to successful KBD initiatives. From the point of view of cities, we are dealing with groups of people making choices (beginning by establishing themselves in the same territory) as well as the sharing between people (largely intangible). These two aspects have profound economic implications and are at the heart of KBD (Carrillo, 2015). This means that individuals in their various groups in society are the subject of social transformations, or agents of change in the social process, and this is reflected in the sustainable well-being of the planetary community (Laszlo & Laszlo, 2007)

The socioeconomic and cultural transformations so necessary for the well-being of our society begin with a global commitment to the cause of justice, because there will be no renewed society without men and women dedicated to the principles of the common good, and it is the social process knowledge of the context that contributes to generating this commitment (Marques et al., 2020).

2 Methodology

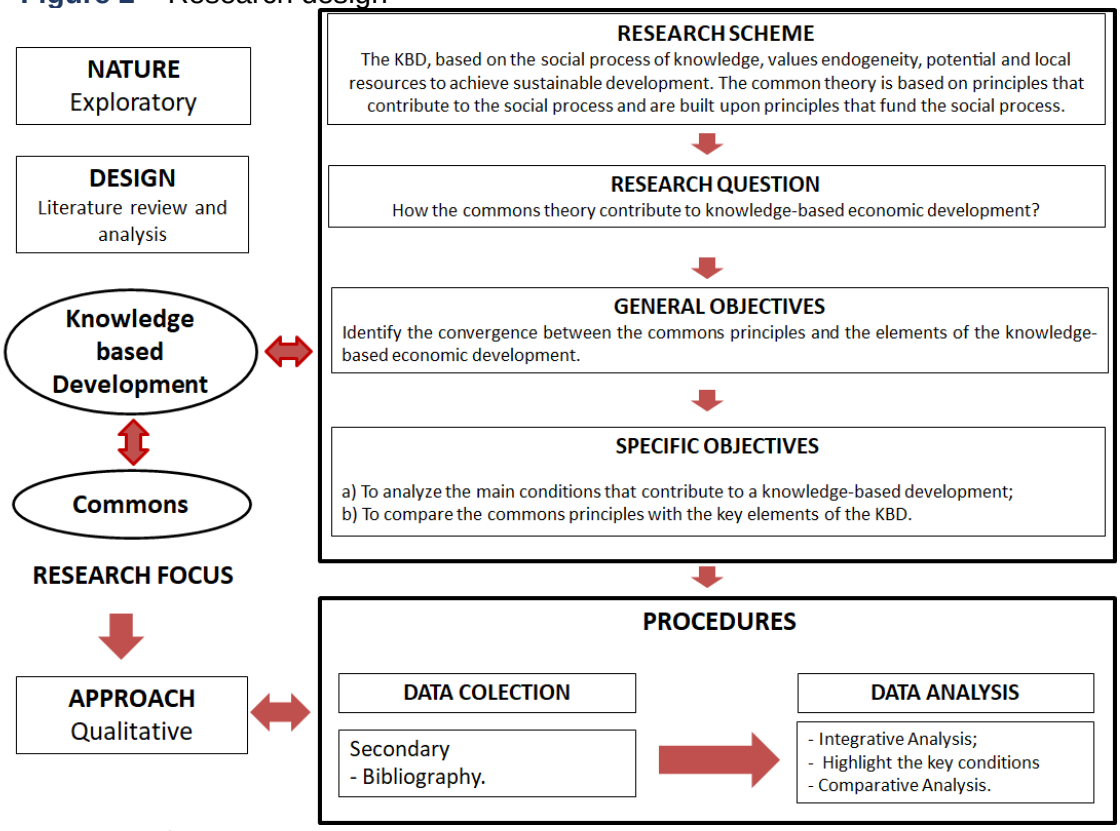
This study was based on the integrative review method proposed by Torraco (2005) and privileged a qualitative analysis of the available literature. This sought to obtain an overview of KBD and Commons Theory, as the research design in Figure 2 shows.

The Scopus and Web of Science databases were searched from January 1960 to June 2018. In the Scopus database, 119 papers were found and 47 were selected on Commons Theory, and 196 papers were found and 51 were selected on KBD. In the Web of Science, 300 papers were found and 77 were selected on Commons Theory, and 140 papers were found and 30 were selected on KBD. Searches on Scopus and Web of Science databases with the words "Knowledge Based Development" plus "Commons Theory" did not result in articles or reviews.

Repeated articles, articles not accessible in full text, reviews, conference proceedings, opinion articles, reflection articles, and editorials were excluded.

Thereafter, new articles were also incorporated, provided they met the inclusion criteria.

Figure 2 – Research design



Source: Authors.

The three KBD objectives – as already mentioned: (i) knowledge for economic prosperity; (ii) knowledge for human development, and (iii) the contribution to a sustainable society (socially and environmentally) where knowledge is the facilitator of an evolutionary future or futures – bring with them some basic assumptions. These assumptions include the need to develop collective planning and management actions for development, using knowledge to do so; solving complex and interdisciplinary problems; and the need to manage conflicts and interests of various parts of society.

From these assumptions, an analysis was made of the similarities and differences between KBD and the Commons theories, looking at the existing literature on both, as well as other empirical studies that could bring different lenses to aid in the analysis. In the particular case of Commons Theory, the literature on knowledge commons and urban commons was searched for its closest focus on the challenges of city development, and to limit the scope of this study.

Analyzing recent articles of relevance published in high-impact journals reveals a clear lack of connection between the commons and smart cities and also knowledge-based development, highlighting the relevance of research on the subject. The review “Can cities become smart without being sustainable? A systematic review of the literature,” published in *Sustainable Cities and Society* by Yigitcanlar et al. (2018), mentions only one article about

commons. The article (“Introducing a taxonomy of the “smart city”: towards a commons-oriented approach?”) shows the importance of the commons-oriented smart city that can provide the capacity for open participation and democratic problem-solving procedures. Society's engagement in the decision-making processes is essential to create a direct link between technology and the needs of city-dwellers (Niaros, 2016).

Another article, “Understanding ‘smart cities’: Intertwining development drivers with desired outcomes in a multidimensional framework,” published in *Cities Journal* by Yigitcanlar et al. (2018), does not mention commons connected to smart cities. This is an important paper that brings literature reviews of smart cities in the aspects of smart city frameworks, smart city and community, smart city and technology, and smart city and policy.

There is a dearth of research that connects the themes of knowledge-based development and smart cities with Commons Theory. This paper outlines a look at the commons in the area of urban knowledge. After a comparative analysis, a discussion of the findings and recommendations for other studies is made in the discussion and conclusion section.

3 The commons good theory and the tragedy of the commons

Elinor Ostrom, a Nobel laureate in economics in 2009, began exploring common pool resource management in the 1970s as an extension of her dissertation and subsequent research on institutional arrangements for public water management in Southern California. Her 1977 publication, co-authored with her husband Vincent Ostrom, "A Theory for Institutional Analysis of Common Pool Resources," argued that the articulation of institutions is the critical factor in effective management of common resources.

Throughout the 1980s, from a large volume of empirical research, Ostrom highlighted international case studies of successfully managed commons, which were then analyzed to allow the identification of shared governance characteristics that seemed to form generalizable principles (Kaunekis, 2014). The results inspired the eight commons principles reported by Ostrom in *Governing the Commons* (Ostrom, 1990), from a model in which a group organizes, sets rules, applies systems, and monitors compliance. The principles established by Ostrom are a set of conditions existing in self-organized and self-governing groups with success in collective action.

The key in establishing institutions to effectively manage commons is the consideration of equity, efficiency, and sustainability (Hess & Ostrom, 2007). Equity concerns fair ownership and contribution to the maintenance of the resource or common good. Efficiency refers to the optimal production, management, and use of the common good. Sustainability focuses on long-term results and is concerned with the well-being of the common good users in the future.

Commoners, which Ostrom has also called appropriators, need to create rules of appropriation restricted to time, place, technology, and quantity of resources that are clearly related to local conditions, as well as rules of supply that demand work, material, and money. In successful examples, Ostrom found that most individuals affected by operational rules could participate in modifying them, which meant that there were collective choice agreements. Ostrom concluded that monitoring the conditions of the common resource and more common behavior is a critical function for the success of collective action together with the need to monitor action.

Successfully managed common land studied by Ostrom generally had penalties for offenders. Such common goods had clearly-defined and low-cost conflict resolution mechanisms. In addition, the rights of citizens to design their own institutions have not been challenged by government authorities in successful common goods. Overall, Ostrom concluded that effectiveness for commons management requires "successful collective action and self-governing behavior; trust and reciprocity; and the continuous design and/or evolution of appropriate rules" (Hess & Ostrom, 2007, p.43).

In 2008, in response to the diverse definitions and understanding of new insights about commons, Charlotte Hess elaborated on a number of questions about how people come to the commons and what motivations lead to the naming of resources as a common good (Hess, 2008). In her review of works on new common goods meanings and uses different from the "Commons" as a descriptor of a resource, movement or phenomenon, the author realizes that all have a sense of sharing and joint ownership such as: (i) the need to protect a shared resource from enclosure, privatization or commodification; (ii) the observation or production in pairs and mass collaboration mainly in electronic media; (iii) evidence of new types of commons tragedies; (iv) the desire to build civic education and common thinking; (v) identification of new or developing types of common goods within traditional common goods; and (vi) rediscovery of the commons goods (Hess, 2008).

Examining the wide variety of new commons, Hess (2008, p.39) makes the following set of observations:

- Collaboration and cooperation are particularly vibrant in knowledge and in the common community;
- Many new common goods are on a much larger scale, usually global; at the same time, there is an increasing sense of commons at the local level;
- There is often a broader view of responsibility - "beyond our own backyard." It is the positive side of globalization that there is greater awareness of geographically remote communities. Even the common goods of the neighborhood, which can be focused only on local issues, are often mindful of the impact of current decisions on future generations;
- Sustainability is a ubiquitous issue. Often there is an effective management vision for the preservation and sustainability of a resource;
- Equity is often an important consideration in new commons;
- The "Gift Economy" concept is becoming more familiar;
- Users of commons resources are often aware of their interdependence;
- Unlike public goods, commons are vulnerable to failure through invasion, privatization, commercialization, congestion, scarcity, degradation;
- Appropriate rules are needed to govern the resource.

This paper discusses the knowledge and urban commons concepts that, given their nature and breadth, may have a greater correlation with the KBD approach, but other new commons definitions can contribute as well.

3.1 Knowledge commons

In the early 2000s, Ostrom and Hess recognized the emerging importance of knowledge commons as a research area and began applying the Institutional Analysis and Development (IAD) framework to commons analysis (Ostrom & Hess, 2007). For the authors, knowledge commons refers to common arrangements to overcome various social dilemmas associated with sharing and producing information, innovation, and creative work (Ostrom & Hess, 2006).

Madison, Frischmann, & Strandburg (2010) developed a research structure specifically adapted to the properties that distinguish knowledge and information from natural resources (Madison et al., 2010). These authors consider that resources in the knowledge commons result from human intervention constructs, rather than being found in some way in nature. They consider it a broad term, including cultural commons as cultural heritage, for example. Madison et al. (2010) adapt successful methods for the natural environment to develop a systematic and detailed study of commons arrangements, proposing a framework for the study of knowledge commons that initially uses the Institutional Analysis and Development (IAD)

structure developed and used by Elinor Ostrom and others and adapt it to unique attributes of knowledge and information.

The framework of knowledge commons governance (Madison et al., 2010; Frischmann, Madison, & Strandburg, 2014) is based on three basic propositions: (i) the traditional "free rider" theory of intellectual property does not explain cooperative institutions to create and share knowledge that are increasingly predominant in society, consequently a policy based exclusively on this traditional view is incapable of promoting the creative work of social value that is best governed by a commons approach and may in fact prevent such work; (ii) the widespread recognition of certain known commons successes, such as open source software, can be problematic when it ignores the significant governance challenges that often arise from these institutions, (iii) the development of a more sophisticated approach to knowledge commons governance will require a systematic empirical study of the governance of common knowledge "in nature."

Frischmann and his colleagues (2014) make an analogy between the cultural environment and the natural environment to explore the proposition that, just as natural resources are usually governed by common goods, rather than being managed as public or private property, knowledge production and sharing are often underpinned by common governance. The book *Governing Knowledge Commons* (2014), explores how the knowledge commons work, the place they occupy in the cultural environment, the specific benefits they offer, the costs and risks they create and their relationships with other institutional structures. The authors identify knowledge commons as an independent and affirmative way to produce innovation and creativity and as an important research domain, understanding that the commons are not totally independent, nor are they opposed to markets based on exclusive (formal or informal) rights, nor are they subordinated to them (Frischmann et al., 2014).

Knowledge commons cannot be physically limited; nor are they marked by the subtractability that defines the commons of natural resources. On the contrary, when one uses knowledge, not only is there nothing withdrawn from ordinary knowledge, but something is in fact added to it (Hess & Ostrom, 2007).

3.2 Urban commons

The notion of urban commons refers to shared resources in the urban context; resources that are accessed and used by different participants and whose long-term sustainability depends on how these different uses come into action and interact with each other (Foster, 2013). However, there is still little empirical research that explicitly theorizes the urban commons, despite the growing interest in cities as places of social struggle, as well as the contemporary concern for urban justice (Harvey, 2008). Most commons research does not

explicitly address the urban, although Ostrom (2007), and law scholars like Foster (2011), have drawn attention to the urban commons.

However, the city is a good place to test the theory of commons, because it is an environment that brings complexities by being more densely populated; containing eminently social spaces, and therefore with more potential for conflict; and being more subject to rapid change than less populated areas. As Harvey argues, the urban commons "represents all the commons political contradictions in a highly concentrated way" (Harvey, 2012, p. 80).

Foster (2011) addresses some challenges for urban commons, noting that in traditional commons, public authorities are generally not involved in collaborative management, but when it comes to urban commons, such involvement seems inevitable. The author exemplifies how the explosion of urban agriculture has opened channels for more collaborative forms of green space management in cities, and, as in this case resources are often publicly known, management is "open" to more collaborative and inclusive forms.

Foster also highlights that there are cases where public authorities are directly involved in the commons by having public officials cooperating with citizens, NGOs, and companies in managing a specific resource (e.g. business innovation districts, which entail the creation of a cooperation between city, landowners, and real estate developers for neighborhood improvement). She argues that there is a need to articulate even more the role of public authorities as facilitators and participants in urban commons (Foster, 2011). However, the actors involved may have different interests, so involvement of the public sector, citizens, private sector actors and the third sector means gathering different values and preferences as to what uses the common goods can support and thus how they can be managed (Foster, 2011), and making rational arrangements where collective interest is understood by users as a way to increase their individual long-term gain. The traditional way in which collaborative management is understood in the commons field does not allow articulation and understanding of these different values (Nightingale, 2011).

It is also important to consider the "irrational" elements of the commons, which implies observing how subjectivity is at stake in collective action, considering the different understandings that are present and how they are negotiated, as well as looking at power in the relationships between users (Nightingale, 2011). Recently, Harvey (2012) theorized widely about urban commons, considering the concept promising; however, the author is concerned with elucidating how commons could "scale" and work at macro levels (Harvey, 2012).

For Harvey (2008, p.103) it is even possible to see "the metropolis as a factory for commons production". The human qualities of the city emerge from our practices in the its various spaces, even when these spaces are subject to enclosure by both private and public state ownership, as well as by social control, appropriation and countermeasures, to affirm what Henri Lefebvre (2008) called "the right to the city" by the inhabitants. Through their daily

activities and struggles, individuals and social groups create the social world of the city and in doing so, create something common as a framework within which all of us can inhabit. Although this culturally creative common cannot be destroyed by use, it can be degraded and undervalued through excessive abuse.

To have the right to the city, as Harvey argues, is beyond the needs of individuals and their communities to have certain access to the resources of this existential medium. The law is not only a guarantee of public benefits, or fullness of salutary living conditions for all citizens, as it prospects the ideology of the democratization of urban spaces. The right to the city must also allow the right to change and reinvent the urban environment itself. In this sense, the subject of the law is not only the citizen who is the beneficiary of political guarantees, but an interacting actor who must have his transforming biophysical spaces, infrastructures, and politicians of the city understood, recognized and protected by the formal value of his or her citizenship (Harvey 2012).

In a review of the literature on the theme of urban commons, Cruz (2019) states that, more recently, the notion of urban common has gained more prominence in academic production, mainly in its theoretical scope and in urban geography. More recent studies in urban commons have also addressed the collective practice of food production networks in cities, with a focus on the collective care of livelihoods and the creation of practical solutions for the needs of social groups or urban communities.

Guided by principles of solidarity, these initiatives have represented new contexts for research on urban common goods (Moreira & Fuster, 2020; Ng, 2020; Sardeshpande, Rupprecht & Russo, 2021). In addition to improvements in food, health, and environment systems, these urban commons are in synergy with other measures to improve the well-being of urban environments (Sardeshpande, Rupprecht & Russo, 2021).

Even in relation to the COVID 19 pandemic, Sardeshpande, Rupprecht & Russo (2021) consider that the use of urban food production goods can alleviate the impacts of the pandemic and build more resilience in food systems (Ng, 2020).

4 The commons contribution to knowledge-based development

Cities are places of relatively intense competition for land because they have relatively high densities of human population. A large number of people in a relatively small amount of space means that these people are more forced to share or compete for resources. As cities are densely populated and co-created by a diversity of people, with different ideas about commons – ideas about who should manage what common goods and how – there is always conflict. Cities are places where a wide variety of people coexist, in contrast to a village or small isolated communities in which people share more in terms of values and intentions.

Harvey insists commons are always contested. “A common good,” he writes, “may need to be protected at the expense of another" (Harvey, 2011, p.102). For example, in the Lower East Side of New York in the 1980s, community gardens were occupying lands that could be used for a different form of common goods: accessible housing (Schmelzkopf, 1995).

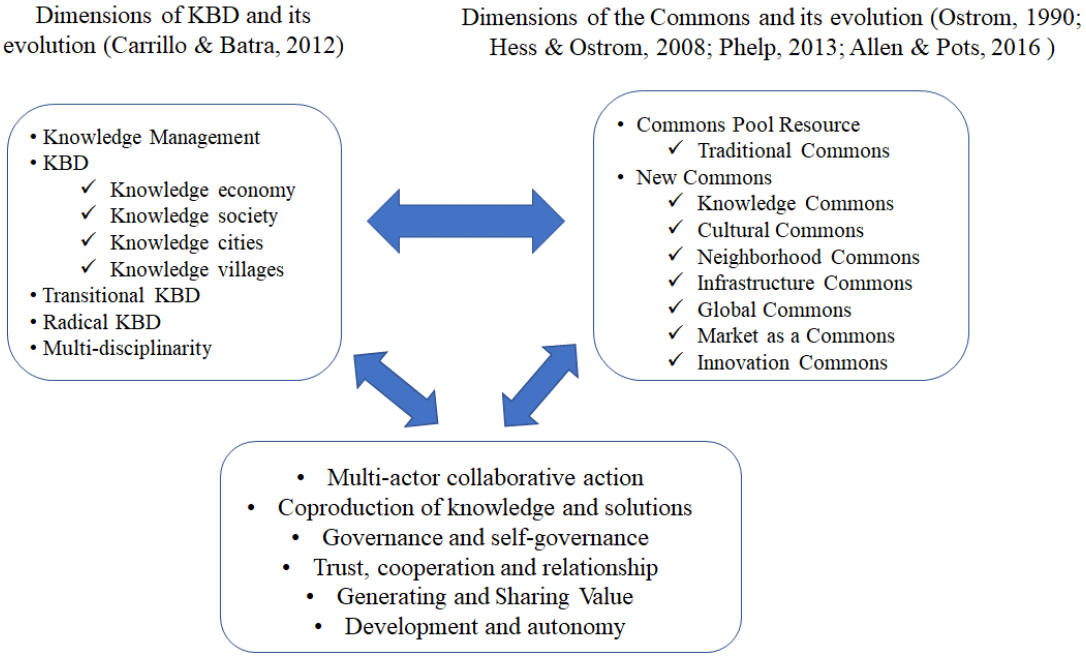
Finally, the city itself is the locus of the commons designed more broadly. In essence, the city is the physical manifestation of a positive balance generated collectively; cities have emerged as places to store the wealth of a society (Harvey, 2008). For Hardt and Negri, the metropolis is what generates the commons. The metropolis is where people come together and meet each other in unexpected ways, working together to create culture. The city, they write, "is the source of the common and the receptacle to which it flows" (Hardt & Negri 2009, p.154).

In a development context, knowledge flows or even "leaks" from those who have created it to a broader spectrum of society, who are the beneficiaries of KBD. In this sense, knowledge tends to become a public good, despite the existence of several linguistic, social, and cognitive barriers against its diffusion (Ferreira & Neto, 2005).

The multidisciplinary nature of KBD is complex, and some of its source disciplines are undergoing revolutionary transformations, impacting the conceptual foundations of this new field, as is the case in all dynamic scientific fields that provide continuous reinterpretations of contributing theoretical substrates (Carrillo & Batra, 2012). The authors note that the apparent subversion of major social and economic constructs (e.g. development, democracy, government, market, price, money, business, property), as well as the emergence of new ones (e.g. social networks, crowdsourcing, open systems, collective intelligence, uniqueness) add a significant level of difficulty to the understanding and management of KBD realities, and it is increasingly apparent that the formal configuration of the field somehow depends on a systemic perspective.

At the same time, discussions about commons and their understanding and application have also evolved over time. The emphasis on the commons' social nature allows an understanding of the commons that are explicitly created by humans, including the intangible world of ideas and the built environment of cities. In this sense, some points of convergence between the elements of knowledge-based development and its evolution and commons principles can be highlighted (figure 3).

Figure 3 – The convergence between the elements of knowledge-based development and its evolution and commons principles



Source: Authors (2018).

The evolution to a knowledge society is still quite challenging and has some characteristics such as: promotion of collaboration rather than competition between economies; promotion of sharing rather than protection of knowledge; acting in the collective well-being of society as a whole and not only in generating economic results; understanding that educational achievement is not only a means of economic production, but also a result in itself; enhancement of self-realization as well as the ability of individuals to make their own choices based on informed decisions(Batra, 2007; Carrillo & Batra, 2012).

If we (i) consider the principles of commons applied to KBD, whose social cohesion is a fundamental element for their reach, and, (ii) understand KBD as a social process of knowledge that generates endogenous value, local potentialities and resources, considering the social, economic and environmental dimensions, in the pursuit of sustainable development (Fachinelli et al., 2014), an analogy can be made between them, as highlighted in table 1.

Table 1 – Analogy between the principles of Commons (Ostrom, 1990) and the social process of KBD (Fachinelli et al., 2014; Carrillo & Batra, 2012)

Principles of Commons (Ostrom, 1990)	The social process of KBD (Fachinelli et al., 2014; Carrillo& Batra, 2012)
1. Clearly defined limits	It considers the unique analysis of a city and cannot be extrapolated to another, concentrates on the strengths and opportunities and on the distinctive aspects of each city.
2. Congruence between appropriation and provision rules and local conditions	Action approaches reflection; establishes a relational and holistic system that combines development, identity, emotional and economic, individual and rational.
3. Collective choice arrangements	It analyzes what citizens want to be; part of the existing information and seeks the interpretation that citizens make of it considering their history, personality, and emotions. KBD focuses on several collective development alternatives, in which knowledge capital is the strategic medium.
4. Monitoring	Follow up the development based on the Capital System.
5. Mechanisms for sanctions	It provides guidelines for action to citizens.
6. Mechanisms for conflict resolution	It considers what citizens want to carry forward and only what they can carry forward.
7. Recognition of organizational rights	KBD belongs to the citizens and not to the municipal government and therefore transcends the vicissitudes of political changes.
8. Self-governance	The formulation of policies and strategies towards the knowledge cities underlying KBD are complex procedures that require leadership committed to the sustainable well-being of their community to be successful. It also needs a critical mass of change agents with sufficient understanding of qualitative differences in KBD and with the technical capacity to articulate and develop social capital systems.

Source: Authors (2018).

Although the knowledge economy and the knowledge society are increasingly present, the transition from the analysis of the phenomenon to a work structure for the understanding and development of a knowledge city is still at an early stage (Carrillo & Flores, 2012; Fachinelli et al., 2014). KBD has a method for evaluating and monitoring the capitals of a city: the so-called generic capital system (Carrillo, 2002), presented as a model of knowledge-generation based on value.

Although this work does not intend to approach the capital system, it is important to emphasize that its objective is to capture all relevant dimensions of value for a social group from a unified system of categories (Carrillo, 2002), and to understand that KBD concentrates on a series of alternatives for development, in which knowledge capital is the strategic medium (Fachinelli et al., 2014). In this way, Carrillo, Metaxiotis, & Yigitcanlar (2010) propose a perspective of KBD in which the accounts of the capital system become an instrument for a

balanced, equitable and sustainable development. This view focuses on the equilibrium of collective capital, both intellectual and material (Fachinelli et al., 2014).

Carrillo points out that an epistemological, axiological, and political platform that justifies KBD is necessary to allow the mapping and management of its impacts not only in economic terms, but also in all the main dimensions of social value (Carrillo, Metaxiotis, & Yigitcanlar, 2010).

The evolution of the concept of city over time, compared to the evolution of commons, demonstrates the underlying need to seek a more just, balanced, and sustainable society. There are several definitions of cities. For example, Lara et al. (2016) present a framework with domains, with the key issues in smart cities (adapted from Nam & Pardo 2011). For intelligent city, the conceptions focus on infrastructure and ICTs with key issues including smart, mobile, virtual and digital technologies; for the knowledge city the conception is for a creative economy and knowledge-based society with the key issues of entrepreneurship, innovation, competition, and knowledge society.

The understanding that commons is the "shared heritage of all of us" is central to the new commons literature (Hess, 2008). Threats of enclosure have awakened many people to protect common assets beyond the assumption that resources that were once safe as public goods do not require vigilance and even participatory management to safeguard them for the future. For some, commons are a birthright, while others recognize the role of personal responsibility in the sustainability of common goods, but, in any case, the definition of common goods varies with the type of resource available (Hess, 2008).

On the other hand, the knowledge city is a place where new knowledge is constantly created, through excellence in research, support for a flow of new knowledge, constant investmentss in the development of human capital and attraction of qualified immigrants, in addition to being prone to several types of innovation: technological, organizational, and institutional. Therefore, the knowledge city provides an environment of incentives to the generation, dissemination, and use of knowledge in an environmentally sustainable, socially fair, economically secure and well-integrated human capital system (Ergazakis, Metaxiotis, & Psarras, 2006; Yigitcanlar, O'Connor, & Westerman, 2008; Fachinelli et al., 2014).

However, the formulation of policies and strategies towards knowledge cities underlying the KBD are still complex procedures that require leadership committed to the sustainable well-being of their community in order to be successful (Carrillo & Batra, 2012). In addition, there is also a need for a critical mass of change agents with enough understanding of the qualitative differences in KBD and with the technical capacity to articulate and develop social capital systems.

Open data has also transformed the Smart Cities model. With open data, citizens can develop applications that will provide new services to the city. However, there are still few

tangible examples of companies that have successfully transformed the city's open data platform to generate profitable apps or related services (Lee, Almirall, & Wareham, 2012).

For Cohen, Almirall, & Chesbrough (2016), there is still a need for new business models to drive the effective use of open data within cities. Open data is an excellent example of using a platform to convey third-party capability through common data. They consider that smart cities are a place of opportunity for creating new value for people within the city, and at the same time, can be the locus of serious breaches of trust where information can be shared to provide value to others, while simultaneously harming the city's residents.

However, we can find examples of physical asset, rather than virtual asset, mobilization. A good example is fab labs and public co-working spaces that allow the involvement of third parties such as developers, artists, manufacturers, and universities. In this case, physical infrastructures operating as commons permit and trigger the participation of an entire ecosystem (Cohen, Almirall, & Chesbrough, 2016).

Beckwith, Sherry, & Prendergast (2019) believe that a city should manage its data as a common good, and to this end one must try to understand the potential data flows and values of communities within the city, while respecting legitimate property claims and rules of stewardship. "If cities do this, they can expect that the citizens of the intelligent city will be better served by the intelligent city itself and will be more heavily invested in its success" (Beckwith, Sherry, & Prendergast, 2019, p. 219).

5. Discussion and conclusion

Study of the commons and the new commons is a recent, rich, and challenging area of research. Some new commons, among them the urban commons, are created, as there are threats of privatization and enclosure in detriment of the social welfare of a particular community. The commons, in this sense, can be understood as a key element to create new economic forms of life, which in turn are increasingly demanded by the challenges of modern life, especially in cities. Commons elements such as self-governance, coproduction of knowledge through collective action, value generation, and sharing require a dynamic and dialectical process that KBD has demonstrated to pursue, a process that demands leadership committed above all to the sustainable well-being of their community (Gonzalez et al., 2005).

How can Commons Theory contribute to KBD without exhausting the potential contributions of commons? Although the literature on KBD is still recent, it is constructed through social technologies that use the participation and engagement of social actors in a given territory or city, as a social process involving various strategies of economic, societal, spatial, and institutional development – to promote, attract, and retain investment and talent to form places of life, work, study, and visit (Yigitcanlar & Bulu, 2015).

In order to answer our research question, as open data is considered the new commons, it is crucial to improve knowledge economic development as a raw material for the development of software and applications that contribute to the development of cities, generating entrepreneurship and contributing to the innovation ecosystem. O'Reilly (2010) demonstrates the importance of the government positioning itself as a facilitator and manager of its interactions with society, acting as the provider of an open platform; while citizens would be co-producers of innovative solutions for the government resulting from their experience, knowledge, and collective intelligence.

Niaros (2016) demonstrates that a commons-oriented smart city is one that allows for open participation and has mechanisms for resolving democratic problems. To this end, the active participation of society in decision-making processes is essential to create a direct link between technology and community needs.

One of the conceptual challenges of considering open data as a commons is the 'ownership' of data. Beckwith, Sherry, & Prendergast (2019) consider that data are often created at points of interaction between multiple actors, each of whom has the potential to claim ownership. The data, therefore, usually have property claims distributed by various parties, and Beckwith, Sherry, & Prendergast (2019) consider dealing with this one of the roles of an intelligent city. For the authors, the great challenge lies in the use of open data as a commons, respecting ownership issues and generating a climate of trust in the community.

The evolution of the field of Knowledge Management (KM) led to the expansion of focus and the application of the principles of knowledge management to promote knowledge-based development (KBD), the third generation of KM. KBD has three interdependent purposes necessary for sustainable and successful development strategies: economic prosperity, human development, and social and environmental sustainability (Lazlo & Lazlo, 2007; Carrillo, 2014). It has a multidisciplinary nature, uses social and economic constructs and its success depends on a committed leadership, especially with the sustainable well-being of its community (Laszlo & Laszlo, 2007; Carrillo, 2015).

Considering the complexity of the social and economic constructs used by KBD such as development, democracy, government, market, property, sustainability, knowledge, among others, and the emergence of new commons, tangible in social networks, crowdsourcing, open systems, intelligence collective, innovation, entrepreneurship, etc., it becomes apparent that the creation of real or virtual collective spaces from Commons Theory contributes to KBD as a knowledge field.

The main contributions of the commons are in the processes of value creation and coproduction of knowledge with management of social conflicts; in the vision of sustainability from mechanisms of monitoring and self-governance; in the sharing of content, experiences and skills of individuals, organizations, networks, and informal groups, in matters of interest to

the city, neighborhoods or regions, dedicated to the creation of a sustainable society. Considering that a commons is a resource that the community has to take care of, the community needs to be concerned with sustainability and equity and should, also in the case of data resources, implement data governance procedures to ensure this.

It is of course necessary to broaden the discussion about and studies on the contribution of commons and new commons to KBD, addressing the impact of scientific, educational, tourism, and legal commons, among others. It is also important to develop new approaches based on commons to aggregate participation and collective action mechanisms into the KBD field of study, as in the development of common projects and the analysis of complex problems in planning (e.g. development of frameworks such as Institutional Analysis and Development).

The authors suggest future research that may characterize commons as drivers of knowledge-based development. Considering, therefore, that open data promotes innovation, entrepreneurship, and contributes to an innovation ecosystem, commons, through open data, can benefit society in the face of the needs of its people.

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