CONCEPTS CONCERNING DIGITAL ECOSYSTEMS- A REVIEW

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***Abstract**: Digital transformation is anticipated to be the fourth industrial revolution. Considering this phenomenon, some economic entities tend to group and collaborate using digital technologies, thus forming economic ecosystems. The notion of ecosystem is a relatively recent concept used in economic language, coming from biology. Because of this, the ecosystem and the specific types of ecosystems, such as business and digital, are not consistently defined in the literature. There are multiple conceptualizations of these concepts, which in practice leads to confusion and even misuse of the terminology. The main purpose of the paper is to revise the concepts related to the ecosystem construct, but also the most important types of ecosystems for the world economy, namely the business and digital ecosystems. The methodology used is the analysis of the main sources dealing with ecosystems, particularly digital and business. We have reviewed papers from the following journals: Technological Forecasting and Social Change, Journal of Business Research, Technovation, Digital Business, International Journal of Information Management, and Technology Innovation Management Review. It is important to note that the analysis of the articles was carried out from a managerial point of view, without adopting a technical perspective. Following this analysis, we made a comparison between the two types of ecosystems, highlighting their common features.*

Keywords: digital ecosystems, business ecosystem, digital transformation.

Jel Classification: M10

Introduction

Digital transformation represents a major change (Gong & Ribiere, 2021) manifested at the level of the entire economy, requiring all economic entities to adapt the specifics of their activities, including this digitization process. This process represents even for managers a major modification of their leadership style, as they are forced to make decisions at a faster pace (Fernandez-Vidal et al., 2022) in a society where speed is such a commonly used term that it has become normalcy.

With the increasingly profound implementation of digital transformation, economic entities have begun to cluster themselves according to the nature of their activities and the interests they pursue. Thus, the ecosystem concept has been adopted and adapted, evolving from its primary biological form—illustrating the first type of grouping that followed this pattern of association based on certain characteristics and common interests (Scaringella & Radziwon, 2017)—to encompass business, digital, knowledge and innovation ecosystems (Valkokari, 2015).

The economy has been influenced by the activity of numerous ecosystems created because of technological and societal development, but, specifically, business ecosystems and digital ecosystems are the ones that have deeply impacted the economic phenomenon.

Therefore, in this paper, we will analyze these two types of ecosystems, observing their main characteristics. We conducted this analysis with the aim of clarifying the concepts of digital

ecosystem and business ecosystem. These concepts are not well enough understood, as there is no universally accepted definition for them, which leads to ambiguity.
This article is structured as follows: the concept of an ecosystem is presented at the beginning, starting from the origin of the term, also mentioning the main types of ecosystems. Then, business and digital ecosystems are presented in detail, by analyzing the most relevant definitions for each of them, but also by mentioning their particular aspects. The article concludes by comparing the two types of ecosystems.

1. What is an ecosystem?

1.1. The origin of the word

Ecosystem, a concept already well-established in economic discourse, originates from a vastly different field, one might say almost unrelated to economics, namely, from the field of biology. In biology, it represented a community of living organisms interacting with various elements within their environments (Scaringella & Radziwon, 2018).
In a biological ecosystem, organisms are unique, each species having its own well-defined traits. This composition is also found in business ecosystems, where companies, despite major differences, interact, thus creating an ecosystem in which each entity will have its own role. Due to this similarity, the concept of an ecosystem has been adopted in the economic domain. In a business ecosystem, interactions between entities will determine the evolution of the ecosystem. Simultaneously, the ecosystem can influence the success or evolution of individual entities (Ianisiti & Levien, 2004).

1.2. Types of Ecosystems

Although business ecosystems are looking at a niche problem of the economy, the need to categorize these ecosystems has been observed, with a view to researching them in a deeper, more niche manner. So, Bejjani et al. (2023) in their work carried out a classification of business ecosystems, starting from the simultaneous analysis of the degree of interaction within the ecosystem and the degree of autonomy in governance. As a result of the analysis, there were identified four categories in which business ecosystems could be classified: the open-source ecosystem, the chat room ecosystem, the marketing ecosystem, the marketing ecosystem, the innovation platform ecosystem (Bejjani et al., 2023). The open-source ecosystem exhibits a high degree of autonomy in governance, but in terms of collaboration within the group, this type of ecosystem demonstrates a low level of collaboration ((Bejjani et al., 2023). The Marketplace Ecosystem, both in terms of governance autonomy and collaboration within it, displays a low degree, indicating the presence of a higher authority or entity managing power through various mechanisms. In contrast to The Marketplace Ecosystem, the Chat Room Ecosystem demonstrates a high degree of both governance autonomy and collaboration within the ecosystem, thus indicating an equal distribution of power, with all members engaging in decision-making ((Bejjani et al., 2023). The Innovation Platform Ecosystem shows a high level of collaboration within the ecosystem but a low one in terms of governance autonomy ((Bejjani et al., 2023).
Valkokari (2015), by analyzing the combination of various external and internal factors, diverse ideas, skills, and knowledge, identified three categories of economic ecosystems: the business ecosystem, the knowledge ecosystem, and the innovation ecosystem. The business ecosystem focuses on providing and enhancing satisfaction for end customers, i.e., consumers, as their purchases of products or use of services offered by the ecosystem generate profit for the entire group, with customer loyalty being the primary goal of any economic entity. The knowledge-based ecosystem, as the name suggests, concentrates its entire focus on generating new knowledge, through which the discovery of new technologies and techniques becomes possible. Within this type of ecosystem, research centers and technology-focused companies constitute the core of the group. The innovation ecosystem

serves as a link between the previous ecosystems, integrating new technologies and techniques resulting from research conducted within the knowledge-based ecosystem into the practical side of the business ecosystem. Thus, this group continually tests new techniques for company development.
Bejjani et al. (2023) grouped ecosystems by analyzing their governance autonomy and intra-group collaboration, whereas (Valkokari, 2015) categorized ecosystems based on the combination of various external and internal factors, diverse ideas, skills, and knowledge.

2. Business ecosystems

2.1. Definitions

Understanding the origin of this term, numerous researchers have provided definitions for the notion of business ecosystem; however, there is no universally accepted definition.
Milinkovich, (2008) explains the business ecosystem as a group of entities that interact with each other by combining various resources, thus creating value both individually and for the entire ecosystem. This definition paints a very clear picture of what happens within a business ecosystem, with the author highlighting how value is created for the members of the ecosystem and for the ecosystem. The method emphasized by the author is represented by the combination of different resources from equally different entities, as the most complex outcomes can be achieved only by combining multiple types of resources.
Another definition is provided by (Moore, 1998), who explains the ecosystem as a community composed of a wide variety of economic agents that interact with each other, thereby providing vitality and support to the entire ecosystem. In Moore's conception, economic agents are viewed as "organisms of the business world" (Moore, 1998).
This definition provides us with an overview of what a business ecosystem represents, with the basic idea being summarized as a group of organizations or individual economic agents interacting with each other.
Peltoniemi & Vuori, (2004) explained the concept of the business ecosystem as a structure formed by the interaction of individuals representing various economic entities, with a focus on human resources. Peltoniemi & Vuori, (2004) provide details regarding the types of organizations that can be part of a business ecosystem, including both small and large companies, as well as universities or research centers.
Milinkovich, (2008) emphasized the concept of a business ecosystem by focusing on the idea of a group and the interaction within that group. He provided further details about the group, specifying it as being comprised of various firms and organizations. Through the interaction among these members, he refers to the commercial relations that take place between them, with the exchange of resources aiding in the development of both individual organizations/companies and the ecosystem.
Moore, (1998) explains the concept of the business ecosystem by characterizing it as a group of organizations that mutually assist each other. The author provides details about the composition of this group, which includes representatives of customers, producers, governmental institutions, and various financial institutions. The connections within this group are strong, even though the formation of the group is not entirely intentional, with the author specifying that it has formed somewhat accidentally. Additionally, according to (Moore, 1998), the business ecosystem is an independent group, in which all members are involved in organization, thus emphasizing the collective nature of the group's organization.
Garnsey & Leong, (2008) provides a concise definition of the business ecosystem, presenting it as an open system where companies interact freely. This definition emphasizes the essence of an ecosystem, which is illustrated by freedom.
Analyzing all these definitions reveals a common element, represented by the idea that business ecosystems are characterized by the concept of a group, particularly the interaction among ecosystem members. Within the analyzed definitions, it is mentioned that this type of communal relationship among members adds significant value to the entire ecosystem,

representing an advantage for both the group and individual companies. In contrast to the other definitions, (Moore, 1998) pays special attention to analyzing the nature of relationships within business ecosystems, mentioning a trait not encountered in the rest of the analyses, namely that certain relationships among members have been formed unintentionally, even accidentally (Moore, 1998).

2.2. Attributes of an ecosystem

Any form of existence or organization requires certain characteristics in order to be able to develop in a harmonious way. There is also the premise that any entity wants to achieve a certain success, and to achieve this goal, certain specific traits are needed again, consistent with that positive result. So business ecosystems too, to be success-oriented, require the inclusion of certain features.

In his vision (Bejjani et al., 2023) a business ecosystem will be successful if it meets certain conditions and if it owns certain resources. One of the most important criteria that, once respected, will bring good development of the business ecosystem is governance. This feature refers to the fact that the ecosystem is organized in its own way, there is no entity to control it, the power being divided between its members. This equal distribution of power determines certain behaviors among group members, one of which is illustrated by the fact that although the member entities are mutually dependent on each other, they are hierarchically equal, autonomous, as there is no hierarchical structure of the ecosystem. This feature of the business ecosystem is also mentioned by (Senyo et al., 2019).

Another important feature in his vision (Bejjani et al., 2023) is considered the removal of geographical barriers, as proof in certain ecosystems the entities that are part of them, even if the physical is at a great distance, the collaboration is not affected. Also, the concept of a barrier can be extended, respectively within a business ecosystem, one can observe a connection of several areas of activity, and this gives the ecosystem added value and utility.

Senyo et al., (2019) considers platformization an important feature in the proper development of a business ecosystem. It refers to a set of software and hardware tools and programs that facilitate both interaction between ecosystem members and innovation. This feature is somewhat of a cornerstone for any digital ecosystem, as without it it would be practically impossible to achieve remote collaboration in such an efficient way. Bejjani et al., (2023) indirectly mentions this trait by assessing the removal of geographical barriers within business ecosystems.

Another important feature in his vision (Senyo et al., 2019) is illustrated by symbiosis. This refers to the close connection between the subjects of the business ecosystem: members, information, and technology. A good collaboration between them will lead the entire group to accelerated development, while the individual development of the member entities. Also, a symbiosis within the ecosystem will generate an increase in creativity, the whole group being driven to generate a higher value, this process benefiting the entire society.

Co-evolution is another trait that (Bejjani et al., 2023) noted when it comes to the business ecosystem. This refers to its ability to transform collectively, meaning change is adopted on an individual level by all entities that are part of the ecosystem, when external or internal factors demand this. This feature is easy to highlight when considering in antithesis the reaction of solitary companies, when a stimulus occurs that causes certain changes within them.

Another feature of the business ecosystems observed by (Bejjani et al., 2023) is illustrated by its own independent organization. The authors refer by this feature to the fact that this type of ecosystem applies a style of its own organization, materialized by its ability to learn to react to changes in its environment. Bejjani et al., (2023) emphasized the same feature of business ecosystems, appreciating the fact that there is no entity that fully holds the power, it is divided in a balanced way between all members of the ecosystem.

Iansiti & Levien, (2004) conducted a deep analysis of business ecosystems and highlighted certain features that determine their evolution. A first feature observed by the authors is illustrated by productivity. It retains its classic meaning, emphasizing its importance for absolutely any type of ecosystem, and even more, for any type of business. Productivity in its general sense illustrates the efficiency of various processes from production to organization, it is recommended to apply to any economic entity as one of its objectives is to quantify the results obtained from the various activities performed, and for a manager the lack of them could be synonymous with failure.
Following the research carried out, (Iansiti & Levien, 2004) appreciated the robustness of a business ecosystem as another characteristic specific to a successful one. It refers to the ability of an ecosystem to successfully manage potential threats or problems that arise either from within it or from the outside environment, so that the ecosystem is not affected by the negative stimuli that have arisen, and more so, it transforms the danger into opportunity. This ability also allows an ecosystem to succeed in changing the environment in which it operates, regardless of the moment or the global situation, in order to maximize the interests pursued.
Another feature of business ecosystems that in his opinion (Iansiti & Levien, 2004) Fails to lead to a good development of them and even to achieve success is illustrated by the creation of niches and certain opportunities for new entities. This ability gives any ecosystem great value, especially when referred to as a whole, because any economic entity aims to produce certain products or services to address to certain customers. One of the most difficult issues for an economic entity, especially at the beginning of the road is considered to be the correct identification of niches and opportunities. In practice it is noted that opportunities are difficult to identify not only for companies in the initial phase, but even for large companies, for managers with a lot of experience behind them. Thus, if an ecosystem manages to acquire this feature, it will surely attract a large number of entities that will want to be part of the group, and on the other hand, it will attract, it will certainly provide a climate conducive to the harmonious development of firms, guiding them towards success.

Attribute	Source
Self-organization	Bejjani et al., 2023, Senyo et al., 2019
Platformization	Senyo et al., 2019
Governance	Bejjani et al., 2023
Robustness	Iansiti and Levien, 2004
Productivity	Iansiti and Levien, 2004

3. Digital ecosystems

Although, on the one hand, it is digital ecosystems that have changed many operating principles of the world economy, and on the other hand, it is digital ecosystems that have changed many operating principles of the world economy, many researchers with remarkable results were involved in the process of defining them, a unanimously accepted definition has not been established. This misunderstanding about the clear meaning of the concept of digital ecosystem causes a general confusion, so the use of this concept must be carried out with increased attention (Koch et al., 2022).

3.1. Definitions

Koch et al., (2022) conducted a deep analysis on the concept of digital ecosystem, mentioning the existence of two important tools of the digital service and the digital platform. The authors provide an overview of the concept of the digital ecosystem, explaining it in a relatively simplistic manner as being such a social system, as well as technically aiming to

link supply and demand, between customers and suppliers, in order to meet the needs of both parties involved.
Following the sketch of this general image of the digital ecosystem, (Koch et al., 2022) specifies the special importance of its tools, represented by digital services and the digital platform, on which any digital ecosystem relies to optimise the expected effects, while providing a brief explanation for each instrument. Thus, the digital service was presented as an asset exchange activity between providers and users/clients. It is also specified that this exchange process takes place exclusively through the other instrument of the digital ecosystem, namely through the digital platform. This is defined as a software system that represents the engine of the entire digital ecosystem, the latter being unable to exist without the use of a digital platform. Its main role is to create and concretize a link between the customer and the supplier, in terms of acquiring a certain asset.
Briscoe et al., (2011) presented digital ecosystems as closely related to biological ecosystems, even suggesting that they appropriated the characteristics of biological ecosystems with certain peculiarities. Following the overlapping of the two types of ecosystems, in terms of features, the authors have customized digital ecosystems as robust, scalable, but at the same time self-organized. This definition emphasizes the link between ecosystems over time, the digital one, according to the authors coming from the biological one, which, from a temporal point of view, is much older, one of the first appeared. On the other hand, the digital ecosystem is considered to be one of the most recent emerging ecosystems.

3.2. The specificity of digital ecosystems in the world of ecosystems

Digital ecosystems are some of the newest types of ecosystems that were created with the accelerated evolution of technology, illustrating practically an effect of society's need to use digital services.
Digital ecosystems are extremely complex, unique in their functioning and reaction to the environment, with features that distinguish them from other ecosystems.
Boley & Chang, (2007) observed some of the most important features of a digital ecosystem, defining it as an open system whose organizing power is not a central one, a single entity in control, but none classically distributed among their constituent entities, this aspect offering uniqueness to digital ecosystems.
The way of distributing power is done in a unique way, according to the authors, it is constantly dependent on the variation of market demand. This policy in relation to the power within the ecosystem generates certain effects, such as the fact that within digital ecosystems, fixed roles are waived for entities that are part of the ecosystem as well, it goes without saying that by following this type of policy, there will be no centralized control structure, all these effects, distinguishing digital from traditional ecosystems where there are many clear provisions regarding power policy.
Briscoe & De Wilde, (2009) highlighted certain defining features of digital ecosystems, including self-organization, scalability and viability. These traits, although they are also found within the biological ecosystem, the way they manifest within digital ecosystems gives the digital ecosystem uniqueness in relation to other ecosystems.
Darking et al., (2007) emphasised transparency in decision-making within digital ecosystems as a feature that, together with the inclusion of member entities, distinguishes it from other ecosystems. Another feature observed by the author is illustrated by good organization and timing as proof, the basic code infrastructure is in constant development.
Analyzing the characteristics of digital ecosystems suggested by the cited authors, a common element is represented by the way power is divided. Boley & Chang (2007)considered this to be a differentiating factor compared to other types of ecosystems.

In contrast, Darking et al. (2007) regarded transparency in the decision-making process as what sets digital ecosystems apart from the rest.

3.3. Impact

Digital ecosystems have a major impact on all economic entities because, through their dynamics, they have changed the flow of the entire economy. One of the most quantifiable effects is the expansion of the level of activity of economic entities. Numerous companies operating locally have managed to expand their business to a higher level, with some agents managing to globalize their activity. Digital ecosystems have facilitated this opportunity for many companies by improving the speed of information transmission, but also by eliminating any type of boundaries between economic agents (Nachira et al., 2007).

4. In conclusion

The main traits of digital ecosystems and business ecosystems are in full accordance with the current trend of the economy, shaping its evolution.
Upon analysis, certain common characteristics are observed between the two ecosystems. One of the main common features is illustrated by the fact that both ecosystems practice a different policy compared to other types of ecosystems regarding power management within them. This difference lies in the fact that power is distributed equally among all component entities, with no central entity holding all the power (Bejjani et al., 2023; Boley & Chang, 2007). An effect of this approach to power within ecosystems is represented by a higher level of transparency (Darking et al., 2007) both in the decision-making process and in informing the component entities about the activities carried out.
Platformization is another common feature of the two ecosystems that facilitate the rapid transfer of information between the component entities, but also the innovation process (Senyo et al., 2019).
Thanks to the platforming use of various software and hardware equipment, it is possible to eliminate the physical boundaries between the entities that are components of the two types of ecosystems, business and digital, in order to collaborate, to, thus, the interaction is easy, regardless of the geographical position of the members.

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