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Digital Platforms for Network Innovation-Intensive Industrial Clusters: Essence and Characteristics

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Abstract. The Fourth Industrial Revolution has largely contributed to the reorientation of the manufacturing industry (under the concept of Industry 4.0) towards the implementation and adaptation of such digital tools as big data, the Industrial Internet of Things, blockchain and many others to its own needs and the needs of the market. All the above technologies provide the basis for digital platforms, which are an essential activity component for network innovation-intensive industrial clusters; it follows that their essence and characteristics represent a relevant research area, which determines the novelty of this research. Thus, the research aims to establish the essence and identify the characteristics of digital platforms for network innovation-intensive industrial clusters as well as to develop a classification of digital platforms. The paper uses the following methods: general scientific methods (synthesis and analysis), methods of interpretation (including graphical ones) and comparison, the combination of which has made it possible to achieve the goals and objectives of the research, to reveal the essence and characteristics of digital platforms for network innovation-intensive industrial clusters. The results of the research are as follows: key concepts associated with the concept of a clustered economy have been revised, and the authors have developed their own definitions of "a network innovation-intensive industrial cluster" and "a digital platform for a network innovation-intensive industrial cluster"; the specifics of the innovative and digital potentials of such clusters have been considered in detail; the structure of digital platforms has been examined, the authors have suggested a classification of digital platforms based on the level and area of their utilization and on the scale of operations. The practical significance of the research results is determined by their applicability in the operations of innovation-intensive industrial clusters in terms of establishing the essence of their innovative and digital potentials and defining the role of and opportunities for using digital platforms in their day-to-day and strategic operations.

Keywords: Digital platform; Digital potential; Industrial enterprise; Network innovation-intensive industrial cluster; Smart manufacturing

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1. Introduction

Wide dissemination and use of information and communication technologies by integrated industrial clusters, including cluster formations, have substantially predetermined the emergence of new organization forms of industrial enterprises from a management perspective and a new level of innovative activity, i.e., network innovative-intensive industrial clusters, which, if viewed from the evolutionary standpoint, rank in between innovation-intensive and systemic innovation-intensive industrial clusters (Figure 1) (Babkin et al., 2021; Babkin et al., 2020a; Babkin & Novikov, 2014).

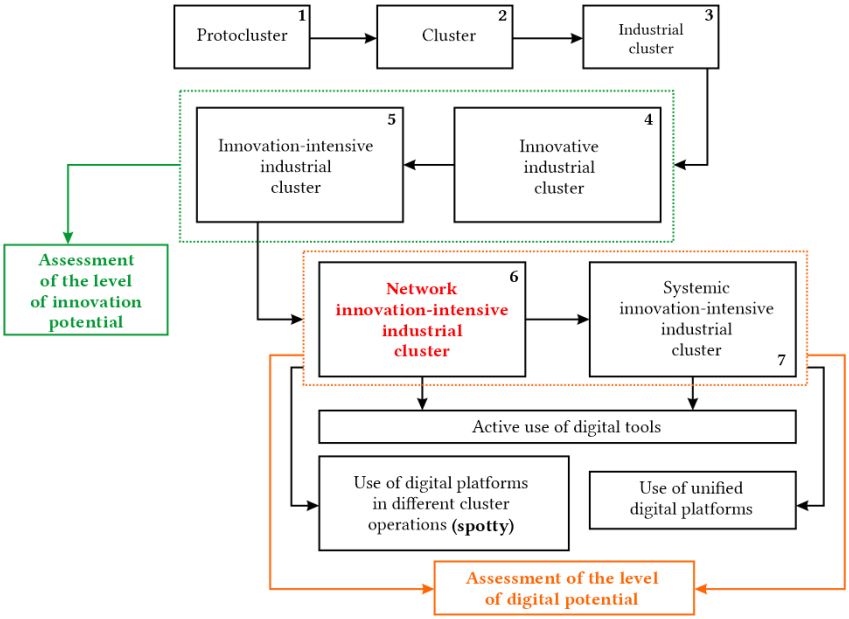

Figure 1 Position of the network innovation-intensive industrial cluster within the development structure of industrial clusters from the evolutionary standpoint

The key distinction between the network cluster and the systemic innovation-intensive industrial cluster (hereinafter referred to as the SIIIC) is that the former is heavily characterized by the use of digital technologies and digital platforms within particular activities: in the production cycle, in the processing of customer orders, in the financial spheres, etc., whereas the SIIIC is marked by a unified digital platform ensuring full connectivity among cluster participants and mediating production processes and cycles, issues in marketing and creating customized products, levels of smart manufacturing, financial and insurance cluster operations and many more (Babkin et al., 2020b).

Platforms of this level are quite a new phenomenon. As of yet, they are fairly uncommon due to a limited number of systemic innovation-intensive industrial clusters whose development, according to the modern viewpoint, constitutes the final stage in the evolutionary advancement of integrated structures.

Indeed, the new industrial revolutions development of fundamentally unique information and communication technologies in the future may contribute to the expanding this conceptual field. Therefore, it is of significant importance today to consider digital platforms in the structure of network innovation-intensive industrial clusters (Pisareva, 2019; Geliskhanov et al., 2018).

Thus, the *aim* of the given research is to establish the essence and to identify the characteristics of digital platforms for network innovation-intensive industrial clusters as well as to develop a classification of digital platforms. The *research objectives* are to provide the authors' definitions of "a network innovation-intensive industrial cluster" and "a digital

platform for a network innovation-intensive industrial cluster"; to determine the place and role of a digital platform within the structure of a network innovation-intensive industrial cluster; to identify the characteristics of a digital platform for a network innovation-intensive industrial cluster and to develop a classification of digital platforms.

A comprehensive understanding of how to build and develop industrial clusters from the evolutionary standpoint allows for defining "a network innovation-intensive industrial cluster" as a group of industrial enterprises with one system company as the parent organization, whose operations are coordinated using information and telecommunication network technologies and control digital platforms within different cluster operations: production, logistics marketing, etc.

It is important to note that monitoring the performance of both network and systemic clusters should involve the assessment of the levels of their innovative as well as digital potentials conducted based on an integral assessment (Burova et al., 2021; Tashenova et al., 2020a; 2020b). It is also critical to mention that the assessment of digital potential can make use of the parameters defining the innovative component.

It should be pointed out that a high level of the digital potential of network innovation-intensive industrial clusters can be indicative of a wide range of current options and capacities for the implementation and efficient use of digital tools and digital platforms (Babkin et al., 2019). The latter being understood as an assemblage of hardware and software built on the general and specific design principles and algorithms intended for coordinating activities of all its participants and essential to producing/developing mostly high-tech products, gathering and processing data on other production and management cycles.

It should be noted that over the last two or three years, the number of papers on the issues under consideration has increased significantly in such scientific databases as Scopus, Clarivate Analytics and the RSCI. For instance, a search query for "digital platforms" on webofknowledge.com (Clarivate Analytics) yields 40,150 results related to the query directly or indirectly. If the search is limited by date (2019-2021) and to only articles, the results amount to 9,447 articles in such fields of science as Communication, Business, Management, Environmental Science, Information Science, Telecommunication and many others. As the analysis indicates, however, it is this bulk of papers that account for the majority of publications. It should be mentioned that so many search results from diverse academic fields suggest multidimensionality, broad applicability and complexity of the research object. A number of the retrieved publications focus on developmental aspects of digital platforms in the age of digitalization, identifying their essential features and innovative developmental aspects of their ecosystems (Fedorov et al., 2021; Derave et al., 2020; Skotarenko et al., 2019; Constantinides et al., 2018; De-Reuver et al., 2018). Geliskhanov and Yudina define a digital platform as a new economic institution and remark on a lack of work in the relevant research area (Geliskhanov & Yudina, 2018). It seems obvious that issues associated with the creation and use of digital platforms, especially those in the structure of industrial clusters, should also be considered through the lens of understanding the essence of industrial enterprises/clusters and their sustainable development in the globalized world, developing efficient and innovative development programs (Kudryavtseva et al., 2020b; Nikolova et al., 2017a; Nikolova et al., 2017b; Rodionov & Rudskaya, 2017; Rodionov et al., 2015), Industry 4.0 (Tereshko & Rudskaya, 2021; Kudryavtseva et al., 2020a). Real-life experiences of using digital platforms are presented in Badran (Badran, 2021), Eferin, Hohlov and Rossotto (Eferin et al., 2019). Herein, Schreieck, Riasanow, Setzke, Wiesche, Bohm, Krcmar, Smirnov and Lukyanov consider issues related to digital platform ecosystems from the standpoint of platform

ownership, value-creating mechanisms, complementor autonomy and singling out common elements (Hein et al., 2020; Smirnov & Lukyanov, 2020). Kitsing dwells on potential future developments of digital platform ecosystems; identifies a number of political, social, economic and technological factors that will somewhat predetermine these processes (Kitsing, 2020). Kovacevic-Opacic and Marjanovic examine digital platform architecture from the evolutionary standpoint, whereas Saariko lays special emphasis on aspects related to identifying the core of a digital platform mediated by the potential of digital technologies (Saarikko, 2016). Sanchez-Cartas (Sanchez-Cartas, 2021), Thomas, Le Masson, Weil and Legrand (Thomas et al., 2021) study the specifics of taxation concerning intellectual property considered through the prism of digitalization, the role and nuances of creating platforms by means of blockchain technology and also common pathways for their potential development. Leong, Pan, Leidner, Huang (Leong et al., 2019), Van Dijck (Van-Dijck, 2020) reflect on aspects of business interactions and future developments involving the use of digital platforms. Srinivasan and Venkatraman focus on the development of entrepreneurship and business models of innovative start-up projects built on digital platforms (Srinivasan & Venkatraman, 2018).

Thus, the conducted analysis has shown that the majority of works focus on the essence, structure and peculiarities of utilizing digital platforms, whereas there have been found no comprehensive works reflective of and accounting for the specifics of digital platforms for network innovation-intensive industrial clusters, which is indicative of the relevance of the study and integral to its aim and objective.

This article includes four main sections: the first – "Introduction", which reflects the relevance of the research, as well as a literature review on the issues under research; the second – "Methods" shows the main stages of the research, and also briefly describes the methods used; the third – "Results and Discussion" reflects the main results of scientific research; the fourth – "Conclusion" is devoted to brief conclusions obtained in the frame of the analysis.

2. Methods

This study has employed the following methods: the *method of synthesis,* which was utilized to generalize current notions related to establishing the essence of network innovation-intensive industrial clusters; the *method of analysis,* which allowed for determining the role and position of digital platforms in the structure of this type of clusters; the *method of interpretation* which made it possible for the authors to introduce their own definitions of the terms "a network innovation-intensive industrial cluster" and "a digital platform for a network innovation-intensive industrial cluster"; the *graphical method* which was used to visualize the position of a network innovation-intensive industrial cluster in the system of industrial cluster development as well as digital platforms in its structure. Figure 2 shows the key stages of the research process concerned with achieving the established aim.

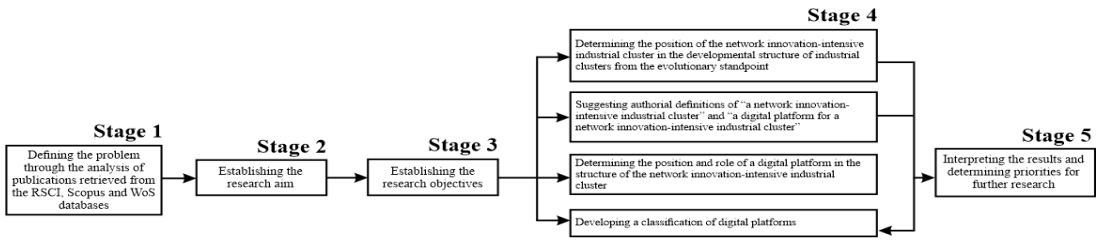

Figure 2 Research stages

So, according to Figure 2, the key stages include: defining the problem, establishing the research aim and objectives, interpreting the results and determining priorities for further study within the research area.

3. Results and Discussion

As is seen in Figure 3, understanding the essence of digital platforms for network innovation-intensive industrial clusters allows for determining their position and role in the system of integrated structures of this type.

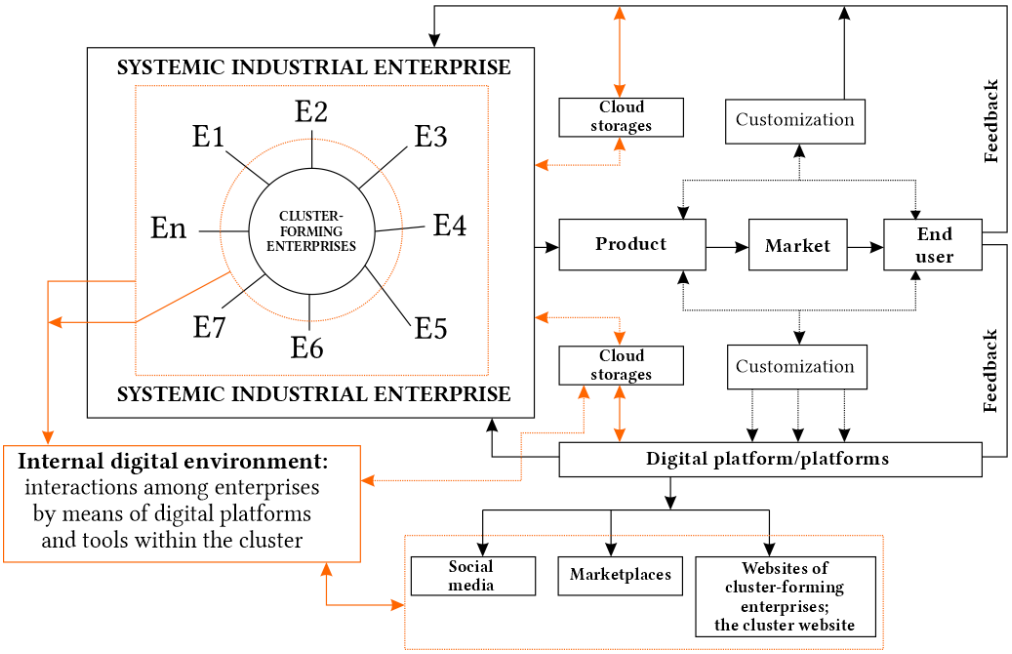

Figure 3 A digital platform in the structure of the network innovation-intensive industrial cluster

It can be seen from the figure that connectivity of systemic and cluster-forming enterprises is provided by the internal digital environment represented by digital platforms and tools; the external environment mediates interactions between the cluster and the end user by introducing a product to the market particularly but not exclusively through official websites, marketplaces and social media that can also constitute part of the internal digital environment of the cluster. It should be noted that a wide range of digital opportunities allows for creating customized products that cater for user needs and requirements as early as at the stage of product/service development as well as during the feedback process.

Processing of data from customers and market participants can be effected via one of the digital platform components, that is, cloud storages tightly integrated with the internal digital environment of the cluster itself.

As for the types of digital platforms for network innovation-intensive industrial clusters, researchers have yet to develop a consensual understanding of those and establish a unified approach to their taxonomy. In our view, however, it is critical to distinguish two levels of digital platforms: the *first* one includes digital platforms and tools that constitute the internal digital environment of the cluster and provide for efficient interactions among its participants, whereas the *second* one encompasses platforms represented by marketplaces, social media pages, and official websites that allow for maintaining communication with the end user and marketing various products/services, including those that have been customized.

Given the overall diversity and broad applicability of digital platforms, it is possible to identify three taxonomic features:

- Level of utilization: digital platforms used within the framework of single processes (De-Falco et al., 2017; O'Farrell & Montagnier, 2020); employed to streamline and expedite operations; coordinating e-government activities (Styrin et al., 2019; Mikhaylov et al., 2020; Chen et al., 2021).
- Area of utilization: manufacturing industry (Okano et al., 2021; Adamenko et al., 2020; Gerrikagoitia et al., 2019) service industry (Kazan et al., 2018; Rolland et al., 2018), sharing systems (Sutherland & Jarrahi, 2018; Mamrayeva & Tashenova, 2017), tourism (Mamraeva & Tashenova, 2020; Genzorova et al., 2018), social media marketing (Rangaswamy et al., 2020; Plantin & Punathambekar, 2019; Kuchta & Miklosik, 2016), education, transportation (Chiappini, 2020; Grabher & Tuijl, 2020); platforms for designing and developing digital products (Drewel et al., 2021; Hevner & Malgonde, 2019).

Scale of operations: global/international, national (regional) and local (used only within the internal digital environment of enterprises).

The analysis has shown that in the research area concerned with the specifics of digital platforms, particularly regarding network innovation-intensive industrial clusters, determining their role and structural components in relation to their utilization still remains a debatable issue.

4. Conclusions

The research presented in this paper yielded the following findings and conclusions: - network innovation-intensive industrial clusters are akin to a connecting link in the evolutionary chain of cluster structures: they have already surpassed innovation-intensive industrial clusters as they actively engage in employing information and communication technologies but have not yet reached a level of "systemic innovation-intensive industrial clusters" operating on unified digital platforms; a digital platform is an essential component of network innovation-intensive industrial clusters which allow for gaining significant competitive advantages in terms of effective IT infrastructure development, cutting the time participants spend on communication, etc. The authors of this paper plan to further pursue research on the specifics of unified digital platforms for systemic innovation-intensive industrial clusters as a new and complex form of organizing cooperation among industrial enterprises.

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