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*As a manuscript*

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# INNOVATION ECOSYSTEM MODELS IN POWER SECTOR

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# I. GENERAL CHARACTERISTICS OF THESIS RESEARCH

**The relevance of research.** Electric power sector plays a significant role in the Russian economy, is of strategic importance for the country, performs a role of basic infrastructure and serves as a big customer for many other industries. The development of electric power sector reflects the state of production forces in the society and its scientific and technological potential. At the same time, electric power sector is very important from societal perspective – electricity is crucial life-supporting resource.

Moreover, electric power sector drastically differs from other industries of Russian economy – it is based on the product that is very specific in its nature – its production and consumption have a set of distinctive characteristics. First, electricity is similar to the service – its production coincides with consumption. Second, electricity must be available for consumers immediately after the emergence of corresponding demand (including peak volumes) – it determines the existence of reserve capacities. Third, nowadays electric power sector is the only industry where continuous nature of production as accompanied with continuous nature of consumption. Therefore, there are very strict requirements towards every stage of technological cycle – production, transmission and consumption (including standardized frequency and voltage). Fourth, the customer can substantially influence the stability of the whole electric power system and is therefore an important member of interfirm collaboration.

Over the last 20 years a number of significant events have taken place in the industry. They led to its structural transformation, changes the industrial value chain and shifted focus towards innovative trajectory of development. Correspondingly, these changes necessitated the revision of interfirm collaborations. First, there was a transition from centralized and vertically integrated model with the corresponding planning system towards decentralized – based on the division of major activities into naturally-monopoly (transmission) and competitive ones (generation; sales). This transition created a solid foundation both for the development of domestic companies and entry of foreign ones. At the same time, transition triggered the development of various network-based interfirm collaborations. State, however, maintained its coordinating and regulatory role – regarding the strategic nature of the industry and its high economic and societal role for the country.

Second, the state implemented a set of initiatives aimed to boost competition on the wholesale and retail markets: day ahead market, balancing market, competitive power take-off. These initiatives fostered the role of efficiency in activities performed by companies as well and stimulated their innovative development.

Third, in order to tackle several major problems (low innovative activity of companies, high deterioration of their production assets, cross-subsidization, rise of network tariffs) the state initiated a shift towards innovative trajectory of industry development.

Fourth, over the last few years Russian electric power sector faces a substantial transformation of consumer requirements and their role – their focus is shifting from traditional supply of electricity and/or power towards additional services and flexibility. At the same time, due to cross-subsidization and rise of network tariffs, many industrial consumers switch from wholesale purchases of electricity towards development of their own generation facilities. This requires companies to seek for alternative ways to collaborate with consumers – either by providing them with more appealing propositions or by delivering additional products and/or services.

Fifth, for the last couple of years there is a rapid expansion of new technologies (e.g., smart grids, digital twins, virtual power plants, demand response) and business-models (demand aggregators, operators of an active energy complexes etc.) in the industry. At the same time, majority of "new" products and/or services are developed by innovative startups and/or SMEs – and not by incumbents. This necessitates collaboration between companies and requires for a revision of forms of such collaboration.

Sixth, due to liberalization of the industry (including the introduction of less directive state policy), changing consumer requirements, emergence of new participants and products / services, there is are changes in the nature of innovations – they transform from local projects executed by stand-alone companies into multicomponent systemic solutions that require inputs from various participants.

Abovementioned changes within Russian electric power sector have a twofold influence on the industry – on the one hand they increase a role of innovations, on the other – they require companies to reconsider forms of their collaboration. In current conditions companies must be flexible (able to adapt to the changes in the industry), open (ready to collaborate with external partners – including innovative startups and/or SMEs, which are "new" for the industry) and able to provide consumers with fundamentally new products and services (which are not common for incumbents) – including abovementioned multicomponent systemic solutions. Moreover, for the first time since liberalization regulatory environment favors the development of innovations and new forms of interfirm collaborations.

Current state of Russian electric power sector is unique. It triggered the development of new forms of interfirm collaborations during creating innovations – innovation ecosystems (IEs). Development of IEs in the industry is a natural reaction of the companies to the abovementioned changes and is determined by a number of factors. First, IEs allow firms to collaborate with wide variety of external partners (including innovative startups and/or SMEs). Second, IEs allow to avoid the problem of "imposed" innovations and help companies to develop those innovative areas, which are of interest for them. Third, changes in the nature of innovations (shift towards multicomponent systemic solutions) requires for combination of efforts from many companies (including those bearing specific and/or unique resources and/or capabilities). Fourth, specific nature of innovative projects in the industry (high capital

costs, duration and risks) facilitates the development of IEs where participants maintain tight collaboration over a long period of project execution.

However, creation and development of IEs is associated with substantial difficulties for the companies. First, they have a substantial experience of collaboration within more formalized forms and therefore do not always understand how to collaborate within innovation ecosystems. Second, there is a very fragmented empirical evidence on peculiarities of IEs in various conditions at the moment. Moreover, there is a lack of empirical evidence on IEs in traditional process industries with high capital intensity and longevity of innovative projects – which is exactly the case of electric power sector. This necessitated the identification of existing IE models within Russian electric power sector and in-depth analysis of their peculiarities. Third, regarding the abovementioned changes in the industry, companies face difficulties in decision-making – when do they need to develop innovation ecosystem and when to adopt alternative forms of interfirm collaborations during creating innovations.

Therefore, research on IEs in Russian electric power sector is relevant both from theoretical and practical perspectives. This research will help to deepen the understanding of IE phenomenon by conducting an empirical investigation of its peculiarities. In particular, identification of existing innovation ecosystem models in Russian electric power sector and their distinctive characteristics will help to understand the variations of the studied phenomenon in various settings. At the same time, the study will complement the existing body of knowledge on IE by investigating its peculiarities on the developing market and in capital-intensive industry.

Companies of Russian electric power sector may use findings of the study as a foundation for developing innovation strategies in terms of collaboration with external partners. In particular, it may help to create a basis for decision-making in terms of choosing an appropriate form of interfirm collaboration during creating innovations by companies of the studied industry – when should they develop innovation ecosystem and when it is better to adopt alternative forms.

**The degree of the scientific development of the problem.** Currently, IE phenomenon received a substantial attention among scholars. At the same time, considerable part of the research landscape is represented by conceptual works. In particular, works by Adner, R., Auto, E., Bek, N.N., Bilberg, A., Bogers, M., Cusumano, M., Etzkowitz, G., Gawer, A., Halinen, A., Jacobides, M., Ketonen-Oksi, S., Kleiner, G.B., Leydesdorff, L., Li, U., Moller, K., Park, D., Phillips, F., Radziwon, A., Sidorova, D.V., and Valkokari, K. are devoted to the investigation of conceptual nature of IE phenomenon and its distinctive characteristics. A lot of attention is devoted to the conceptualization of the phenomenon, development of corresponding terminology and descriptors.

A lot of studies analyze how to study innovation ecosystems. Among them are works by Allen, T., Altman, E., Holmstrom, Y., Leviakangas, P., Liu, J., Ojala, L., Podoynitsyna, K.S., Romm, J., Show, D., Stephens, B., Talmar, M., Tushman, M., and Walrave, B. In their studies scholars propose various

tools for conducting empirical investigation of innovation ecosystems. We can observe a dominance of approaches based on strategic leadership, those considering innovation ecosystem as complex multilevel structure, and studies of group dynamics of ecosystem participants.

There is also prominent stream of papers devoted to investigation of innovation ecosystems emergence and development. It is represented by works of Adner, R., Dedehayir, O., Dellerman, D., Gaidelys, V., Juceviciene, V., Jucevicius, P., Kalman, A., Kapoor, R., Kollock, M., Luo, J., Makinen, S., Ortt, R., Phillips, M., Seppanen, M., and Sra, D. Authors investigate triggers of ecosystem emergence, study the influence of external environment and peculiarities of innovation ecosystem development in various conditions.

At the same time, despite a wide variety of papers devoted to the studied phenomenon, there is still no common ground on what innovation ecosystem is. Therefore, there are numerous papers aimed to investigate this research area – works by Bifulco, F., Dedehayir, O., Facin, A., Ferasso, M., Gomes, L., Ikenami, P., Radziwon, A., Russo-Spena, T., Salerno, M., Scaringella, L., Seppanen, M., Suominen, A., and Tregua, M. Authors study the evolution, existing gaps and major trends within the innovation ecosystem studies.

Empirical studies on innovation ecosystem may be divided into three major streams. First includes works by Autio, E., Ding, L., Hu, G., Levelin, D., Mindshall, T., Surie, G., Thomas, D., West, D., Wood, D., Wu, J., Wu, Y., Ye, R., and Yu, U. They are devoted to separate cases of the emergence and development of innovation ecosystems. Through in-depth case studies authors aim to outline peculiarities and possible variations in the mechanisms of emergence and development of innovation ecosystems. At the same time, majority of papers in the stream investigates innovation ecosystem phenomenon in client-centric and hi-tech industries.

Second stream is represented by papers of Helfat, K., Laurell, K., Raubitschek, P., Sick, N., and Suseno, Y. These authors investigate potential benefits from participating in innovation ecosystems. Regarding the economic nature of firms' behavior, such participation (which implies high level of openness and interdependence) should provide them with certain benefits, which may not always be obvious – which is of particular interest for scholars.

Third stream of empirical studies on innovation ecosystem is aimed to investigate particular mechanisms of IEs – dynamics and peculiarities of collaboration among members (works by Adner, R., Davis, D., and Kapoor, R.), as well as the processes of sharing results of collective intellectual activity (works by Agoridas, V., Assimakopoulos, D., Bogers, M., Grandsrand, O., Gies, O., Holgersson, M., and Ritala, P.).

Therefore, it can be argued that innovation ecosystems are widely studied nowadays. However, existing body of knowledge lacks empirical research on internal mechanisms of IEs – specifics of their organizational structure, development processes and coordination mechanisms in particular. Moreover,

regarding the observed differences in IE behavior in various contexts, discovery of typical innovation ecosystem models in such context seems to be a very promising area of research. At the same time, majority of studies on IE is based on empirical data from developed markets (Europe, USA) and hi-tech industries (mostly IT). Russian studies of the phenomenon are also mostly of conceptual nature, investigate IEs in hi-tech industries and approach the concept from regional perspective. Thereby, study on innovation ecosystems in capital-intensive industry (electric power sector) and on the developing Russian market is of particular relevance.

Taking the abovementioned into account, we can argue that study on innovation ecosystem phenomena is very relevant both from theoretical and practical perspectives. There are certain gaps in empirical evidence on IE peculiarities in various contexts – including capital-intensive industries and developing markets. Insufficient degree of elaboration of typical IE models in various contexts as well as the relevance of the issue for the companies of Russian electric power sector determined the choice of the topic for the study while also specifying its goal and objectives.

**Research goal and objectives.** This study aims to reveal peculiarities of innovation ecosystem models within Russian electric power sector and their role in the process of interfirm collaboration during creating innovations.

This goal is achieved by the virtue of the following objectives:

1. Analyze the antecedents of innovation ecosystem emergence as a standalone managerial concept.
2. Discover the specifics of innovation in Russian electric power sector and prerequisites for innovation ecosystems development.
3. Uncover the key innovation ecosystem models and their distinctive characteristics within Russian electric power sector in regard to industry-specific issues.
4. Contextualize the discovered forms of interfirm collaboration among companies of Russian electric power sector during creating innovations, identify factors that determine the choice of a particular form, indicate the role of innovation ecosystem.
5. Develop an approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector.

**Object of the research:** innovation ecosystems in Russian electric power sector.

**Subject of the research:** innovation ecosystem models in Russian electric power sector.

**Empirical object of the research:** companies which perform innovation activity within Russian electric power sector.

**Theoretical and methodological basis of the research.** The study is based on conceptual and empirical papers by leading Russian and foreign scholars in the following knowledge domains: innovations, strategic management, innovation strategies and organization theory. Theoretical results of

the study are obtained by analyzing papers, monographs and dissertations retrieved from specialized scientific periodical sources, as well as materials of various scientific conferences. Methodology of the study is based on the following general scientific methods: analysis, synthesis, induction, deduction, systematization, classification, comparison, formalization. In order to justify the results of the study the following methods were applied: classification, comparative analysis, sociological methods, bibliometric analysis. Secondary data was processed by applying meta-analysis, open and axial coding as well as comparative analysis. Data of the theoretical study was processed and analyzed in graphical add-on "biblioshiny" for the bibliometric package "bibliometrix" for the R.Studio software v. 1.2.5033. Primary data was collected via qualitative methods (in-depth interviews). Results of the analyses are represented with tabular and graphical methods. Data obtained during the empirical study was processed and analyzed in Microsoft Excel v. 16.38.

**Information and empirical base of the research.** The study is based on the following data sources: published academic studies, research of consulting firms (McKinsey, PwC, EY), statistical data from various analytical centers. Empirical base of the study includes data obtained through mixed empirical study of Russian companies. It includes qualitative (semi-structured interviews with representatives of the companies performing innovative activities in the industry) methods, as well as analysis of secondary data on the topic in the corporate resources of the studied companies and major profile information sources.

**Scientific novelty of the research.** This study aims to develop an innovation ecosystem concept by identifying its key models within electric power sector and investigating their role within interfirm collaborations aimed to created innovations.

The most significant results of the research characterizing scientific novelty can be formulated as follows:

1. This study revealed peculiarities of innovations in Russian electric power sector as well as antecedents of innovation ecosystems development.
2. Revealed innovation ecosystem models in Russian electric power sector and analysis of their distinctive characteristics deepened the understanding of specifics of innovation ecosystem phenomenon in various settings.
3. The study also outlined key forms of interfirm collaboration among companies of Russian electric power sector during creating innovations, identified factors that determine the choice of a particular form, and indicates the role of innovation ecosystem.
4. The research allowed to develop an approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector. This approach includes criteria system as well as the choice mechanism. It provides companies with the conceptual framework for the development of innovation strategies in terms of collaboration with external partners

**Arguments of the research to be defended.**

1. Ecosystem concept represents a development of interfirm network phenomenon and is based on organizational ecology findings (this determines the adoption of biological terminology). In parallel with biological systems firm do create partnerships and construct "systems of mutually beneficial relations". At the same time, the ultimate goal of the ecosystem lies in the creation and development of symbiotic community of collaborating members, who strive to reach the common goal, use resources in a circular way and increase the "ecosystem productivity". Ecosystem encompasses the development of network relations of a specific type – those which allow for utilizing the potential of its members, coordinating their activities and development in a coherent way. Moreover, the study shows that innovation ecosystem term is mostly focused on the mechanisms of collective value creation (in a form of various innovative offerings) incorporating joint use of common resources and knowledge base. Such collaboration results in a form of innovative technologies / products / services portfolio, which could not be developed by the virtue of a single firm. Complementors and consumers are of paramount importance in this case as they provide valuable inputs – resources and knowledge. At the same time, the ultimate goal of collaboration among innovations ecosystem participants lies within achieving access to the existing pool of resources and capabilities.

2. The study revealed two major innovation ecosystem models in Russian electric power sector – namely, "closed" and "open". These models are similar in terms of their structure, coordination mechanisms, criteria for selecting participants as well as major issues faced by members. At the same time, "closed" model incorporates more conservative behavior of focal firm and complementors in terms of utilizing the potential of the ecosystem. "Open" model incorporates more ecosystem-focused behavior – it is considered to be the source of flexibility and adaptability within dynamically changing environment.

3. There are four major forms of interfirm collaboration within Russian electric power sector during creating innovations: contracts, in-house R&D, open and closed innovation ecosystems. At the same time, the choice of a particular form is determined by the following factors: strategic focus of a company, and its innovation focus. In those cases when a company is focused on the development within its existing markets and on the innovations supporting such development, it will rely on contracts as a way to create innovations. If a company is planning to do business within its existing market but is aimed to create additional value for its clients, it will develop innovations in-house. When a company is aimed to support its business by entering new (related) markets it will collaborate with external partners within "closed" innovation ecosystem. And if a firm simultaneously pursues the goal to enter new markets and create value for its customers, it will develop innovations by the virtue of "open" innovation ecosystem.

4. The study allowed to develop an approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector. It is based on multi-parametric process and implies the choice of a particular form of collaboration basing on the following criteria: Type of resource and/or capability required for innovation; Focus of an innovative project; Potential for scaling-up the results of collective development outside the boundaries of the project / focal firm; Strategic priority of focal firm; Limitations on innovative activity; Formalization of procedures in when collaborating with external partners; Relation to resources and/or capabilities underlying the innovative project; Stability of the segment where the innovative project is executed. Depending on the combination of the indicated factors firms do rely on a particular form of collaboration, which is congruent with their strategic goals, specifics of an innovative project and existing limitations.

**Theoretical significance of the research.** The study fosters the understanding of an innovation ecosystem concept by determining its peculiarities within Russian electric power sector, indicating its key models and role within interfirm collaboration during creating innovations. This study complements theoretical and methodological foundations of innovation ecosystem phenomenon. Its results may be adopted within the following academic courses: “Strategic management”, “Strategy implementation”.

**Practical significance of the research.** This study provides companies of Russian electric power sector with the conceptual framework for the development of innovation strategies in terms of collaboration with external partners. It provides companies with the methodological basis for choosing an appropriate form of interfirm collaboration during creating innovations. The study shows when companies should develop innovation ecosystems and when it is better to adopt alternative forms of collaboration during creating innovations.

**Approbation of the research results.** Results of the study were discussed at the meetings of general and strategic management department (currently – department of strategic and international management of Graduate school of business) and HSE. They were also presented at various Russian and international scientific conferences, including:

2020 – GSOM Emerging Markets Conference 2020 (St. Petersburg, Russia, November 2020). Report: “Exploring Internal Mechanisms of Innovation Ecosystem: A Case of Russian Electric Power Sector”;

– DRUID PhD 2020 Academy Conference (Odense, Denmark, January 2020). Report: “Innovation Ecosystem Models in Russian Electric Power Sector”;

2019 – GSOM Emerging Markets Conference 2019 (St. Petersburg, Russia, September 2019). Report: “Institutional Factors of the Innovation Ecosystem Model in Russian Power Sector”;

2018 – Academy of International Business South-East (Nashville, USA, November 2018). Report: “Role of SMEs in Innovative Ecosystem Development: The Case of Transitional Economy”;

– 11th Annual scientific conference “Business. Research. Education” (Moscow, Russia, November 2018). Report: “Model for assessing the maturity of innovation ecosystem of Russian power sector” (in Russ.);

– International youth conference in knowledge management KMCONF`18 “Knowledge management in digital economy” (Moscow, Russia, April 2018). Report: “The concept of knowledge platform for innovation ecosystem of Russian electric power sector” (in Russ.);

2017 – Bavarian-Russian conference in economic science (Nuremberg, Germany, November 2017). Report: «Knowledge Platform for Russian Power Industry»;

– 10th annual international scientific conference “Modern management: problems, hypotheses, research” (Moscow, Russia, November 2017). Report: “The concept of knowledge platform for innovation ecosystem of Russian electric power sector” (in Russ.);

– International BRICS global business and innovation conference (St. Petersburg, Russia, September 2017). Report: «Development of the target model for the power industry innovation ecosystem»;

**Logic and structure of the thesis.** Dissertation includes introduction, four chapters, conclusion, references and seven annexes. The total volume of the thesis is 273 pages. It includes 15 tables and 54 figures. The list of references includes 322 items (274 in English).

Introductory chapter of the thesis includes justification of the relevance of the selected topic, indicates the degree of scientific development of the problem, outlines the goal and objectives of the study, and highlights major points of the scientific novelty as well as theoretical and practical significance.

First chapter of the thesis includes industry analysis and outlines specificity of innovations in Russian electric power sector. It highlights current structure of the industry, its regulatory environment and infrastructure, major markets. First chapter also includes the analysis of the ongoing structural transformation of the studied industry, peculiarities of innovations at its current state of development as well as changes in the industrial value chain. It concludes with the inquiry into new innovation practices and forms of interfirm collaborations during creating innovations.

Second chapter of the thesis includes the analysis of innovation ecosystem theoretical foundations including its antecedents and distinctive characteristics. It also incorporates the analysis of three tightly related terms widely used in modern studies on ecosystems: “innovation ecosystem”, “business

ecosystem" and "entrepreneurial ecosystem". Second chapter also provides a detailed view on innovation ecosystem model – including a set of components allowing for empirical research on the studied phenomenon.

Third chapter of the thesis provides an overview of the research design and methods of empirical study. It also presents the comparative analysis of major case-study approaches, methodology of the empirical study considering specifics of the industry and innovations within. The chapter follows with the description of data collection and analysis, characteristics and justification of companies selected for the purpose of the study.

Fourth chapter of the thesis includes results of the empirical study: description of the indicated innovation ecosystem models in Russian electric power sector and their peculiarities; major forms of interfirm collaboration during creating innovations, their contextualization and role of innovations ecosystems; criteria system for selecting a form of interfirm collaboration during creating innovations.

The thesis concludes with the summary of the study.

## II. ARGUMENTS OF THE RESEARCH TO BE DEFENDED

**1. Innovation ecosystem concept represents a development of interfirm network phenomenon, is based on organizational ecology findings, and is focused on the mechanisms of collective value creation with the corresponding collective use of common resources and knowledge base.**

Due to the multiplicity of business forms and interfirm collaborations there is no common understanding of the ecosystem concept (and innovation ecosystem in particular) among scholars. At the same time there are challenges in relating this concept to interfirm network phenomenon as they share a few similar attributes. They are also similar in terms of the following organizational principles distinctive for network organizations: (1) common goal, mindset, values and concentration on achieving results among participants; (2) independence of participants (they are able to function independently while simultaneously achieving benefits from their position within the network); (3) voluntary coupling (members unite their resources voluntarily); (4) plural leadership (each member owns something unique); (5) multi-level nature of networks (cooperating participants have different organizational structures).

At the same time, provided description of ecosystem and interfirm network concepts supports the argument of their similarity (Table 1). This is not surprising as both received development within organizational theory domain while ecosystem represents a development of interfirm network concept within modern evolutionary theory.

Regarding the abovementioned ambiguity on the essence of ecosystem and interfirm network concepts among scholars, there is a need for a comparative analysis. It will allow to clarify the existing research field on the topic and develop an integrative understanding of the existing points of view on the concepts which will ultimately benefit the theory development.

Therefore, ecosystem concept inherits a number of attributes from interfirm network – in terms of focus of analysis and fundamental assumptions. Ecosystem point of view on interfirm network represents the development of an organizational theory approach – which also explains the adoption of biological terminology. In a similar fashion to biological systems firms create partnerships and develop "systems of mutually beneficial relations". At the same time, ecosystem is ultimately aimed to develop symbiotic community of collaborating participants[1], who strive to reach common goal, use resources in cyclical manner and increase the "productiveness of the ecosystem".

[1] Such multilateral nature of collaboration among ecosystem participants ("many to many") differentiates it from the "relations portfolio" ("one to many") and dualistic collaborations ("one to one").

Table 1 – Comparative analysis of an "ecosystem" and "interfirm network"

| # | Indicator | Ecosystem | Interfirm network |
|---|---|---|---|
| 1 | *Definition* | *"Set of actors with varying degree of multilateral non-generic complementarities, which are not fully hierarchically controlled"* [2] | *"Contracts system among formally independent economic agents…"* [3] |
| 2 | *Features of the research stream* | The stream is developed by scholars studying platforms, innovations and issues of establishing standards[4,5,6,7,8,9,10] | The stream is developed by organizational theorists, studying social inclusion of economic activities[11,12,13,14] |
| 3 | *Maturity of the knowledge field* | Developing[15] | Mature[16] |
| 4 | *Peak of popularity and underlying reasons* | 2010 – to the present day (due to wide spread of such practices)[17] | 1990-2000 (research followed business shifts). This stream of studies received major attention during the period due to fast internationalization of companies[18] |
| 5 | *Activities coordination* | Coordination of non-generic complementarities[19] | Coordination of non-generic complementarities (formal and informal mechanisms) [20] |

[2] Jacobides, M. Towards a theory of ecosystems / M. Jacobides, C. Cennamo, A. Gawer // Strategic Management Journal. – 2018. – Vol. 38. – P. 2255-2276.

[3] Sheresheva, M.U. Methodology of research on network forms of business organization / M.U. Sheresheba, M.A. Beck, N.I. Beck, E.V. Buzulukova, N.A. Kolesnik, N.M. Lyubakova, M. Mariani, P.I. Popov, V.A. Rebyazina, A.N. Sterligova, O.A. Tretyak – Moscow, Russia: Higher school of economics, 2014. – 270 p. (in Russian).

[4] Gawer, A. Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation / A. Gawer, M. Cusumano / Boston, MA: Harvard Business Press, 2002. – 336 p.

[5] Gawer, A. How companies become platform leaders / A. Gawer, M. Cusumano // MIT Sloan Management Review. – 2008. – Vol. 49. – No. 2. – P. 28-35.

[6] Iansiti, M. Strategy as ecology / M. Iansiti, R. Levien // Harvard Business Review. – 2004. – Vol. 82. – No. 3. – P. 68-78.

[7] Adner, R. Match your innovation strategy to your innovation ecosystem / R. Adner // Harvard Business Review. – 2006. – Vol. 84. – No. 4. – P. 98-107.

[8] Adner, R. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations / R. Adner, R. Kapoor // Strategic Management Journal. – 2010. – Vol. 31. – P. 306-333.

[9] Baldwin, C. Organization Design for Business Ecosystems / C. Baldwin // Journal of Organization Design. – 2012. – Vol. 1. – P. 2-23.

[10] Gawer, A. Bridging differing perspectives on technological platforms: toward an integrative framework / A. Gawer // Research Policy – 2014. – Vol. 43. – No. 7. – P. 1239-1249.

[11] Granovetter, M.S. Economic action and social structure: The problem of embeddedness / M.S. Granovetter // American Journal of Sociology. – 1985. – Vol. 91. – P. 481-510.

[12] Powell, W. Neither market nor hierarchy: network forms of organization / W. Powell // Research in Organizational Behavior. – 1990. – Vol. 12. – P. 295-336.

[13] Gulati, R. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances / R. Gulati // Academy of Management Journal. – 1995. – Vol. 38. – P. 85-112.

[14] Shipilov, A. Can you have your cake and eat it too? Structural holes' influence on status accumulation and market performance in collaborative networks / A. Shipilov, S.X. Li // Administrative Science Quarterly. – 2008. – Vol. 53. – No. 1. – P. 73-108.

[15] Shipilov, A. Integrating research on interorganizational networks and ecosystems / A. Shipilov, A. Gawer // The Academy of Management Annals. – 2020. – Vol. 14. – P. 92-121.

[16] The same.

[17] The same.

[18] The same.

[19] The same.

[20] The same.

Table 1 – continued

| # | Indicator | Ecosystem | Interfirm network |
|---|---|---|---|
| 6 | *Unit of analysis* | Ecosystem as a whole / focal value proposition[21,22,23] | Firm / network as a whole[24] |
| 7 | *Interdependence of participants* | Relations among two separate members depend on the success of collaboration among others[25,26,27] | Importance of sustaining connection among hub and nearest spokes[28] |
| 8 | *Focus of analysis* | Transition outside the firm boundaries – management of interdependence with other organizations[29,30] | |
| 9 | *Basic assumptions* | – Organizations are open systems that depend on the external environment[31]<br>– Organizations tend to collectively navigate within economic and technological landscape. These landscapes include interdependences among various sets of resources, markets and technologies that are at least partially controlled by other organizations[32]<br>– Organizations are able to increase their effectiveness by collaborating with those having complementary resources, technologies or access to markets[33] | |

Source: developed by author.

However, ecosystem should be considered as a specific "local environment", where interfirm networks are created and developed. Basing on the research by D. Teece, we can argue that firm's external environment represents a dynamic surrounding, which consists of various economic agents (including its clients, suppliers, suppliers of complementary products, etc.). Ecosystem is considered to be a network of companies who develop, produce and/or use products and technologies within a common value chain. Ecosystem encompasses the development of specific type of relationships – those that allow for utilizing the potential of its members, coordinating their activities and coherent development.

Regarding the specificity of modern business (and Russian electric power sector in particular), which incorporates the module nature of value propositions and corresponding importance of creating

[21] The same.
[22] Adner, R. Innovation ecosystems and the pace of substitution: Re-examining technology s-curves / R. Adner, R. Kapoor // Strategic Management Journal. – 2016. – Vol. 37. – P. 625-648.
[23] Adner, R. Ecosystem as structure: An actionable construct for strategy / R. Adner // Journal of Management. – 2017. – Vol. 43. – No. 1. – P. 39-58.
[24] Shipilov, A. Integrating research on interorganizational networks and ecosystems / A. Shipilov, A. Gawer // The Academy of Management Annals. – 2020. – Vol. 14. – P. 92-121.
[25] Davis, J. The Group Dynamics of Interorganizational Relationships: Collaborating with Multiple Partners in Innovation Ecosystems / J. Davis // Administrative Science Quarterly. – 2016. – Vol. 61. – P. 433-468.
[26] Adner, R. Ecosystem as structure: An actionable construct for strategy / R. Adner // Journal of Management. – 2017. – Vol. 43. – No. 1. – P. 39-58.
[27] Walrave, B. A multi-level perspective on innovation ecosystems for path-breaking innovation / B. Walrave, M. Talmar, K. Podoynitsyna, G. Verbong // Technological Forecasting and Social Change. – 2018. – Vol. 136. – P. 103-113.
[28] Shipilov, A. Integrating research on interorganizational networks and ecosystems / A. Shipilov, A. Gawer // The Academy of Management Annals. – 2020. – Vol. 14. – P. 92-121.
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components and/or complements, leading role within the ecosystem (focal actor) is attributed to a particular company (systemic integrator / technological leader). Therefore, it can be argued that ecosystem relates to the focal type of interfirm networks.

At the same time, modern academic literature widely adopts the following three terms: innovation, business and entrepreneurial ecosystem. And sometimes these terms are synonymized. This leads to the incoherent theory development and fragmentation of terminology in the studied knowledge field. Therefore, through bibliometric and in-depth analysis of publications this study revealed that innovation ecosystem term is mostly focused on the mechanisms of joint value creation (in a form of various innovative offerings) with the corresponding collective use of resources and knowledge base. In this regard such collaborations result in a portfolio of innovative technologies / products / services, which are impossible to create by the virtue of a single firm. Complementors and consumers are of paramount importance – they provide important inputs in a form of resources and knowledge. At the same time, the ultimate goal of collaboration among innovation ecosystem participants is associated with achieving benefits in a form of access to the existing pool of resources and capabilities.

**2. Two innovation ecosystem models are dominant in Russian electric power sector: "closed", implying a more conservative behavior of members in terms of utilizing ecosystem potential; and "open", implying more ecosystem-focused behavior and considering it as a source of flexibility and adaptability in the dynamic environment.**

In order to detect major innovation ecosystem models in Russian electric power sector the study adopts multiple holistic case-study. It includes field-studies, in-depth interviews with experts and representatives of the 11 studied companies of various size and ownership which correspond to all three major industrial segments, and analysis of wide array of secondary data sources with the consequent open and axial coding of data. This allowed to outline two major innovation ecosystem models currently dominating in Russian electric power sector (Table 2).

Table 2 – Comparative analysis of innovation ecosystem models in Russian electric power sector

| # | Element of IE model | (1) "Closed" | (2) "Open" |
|---|---|---|---|
| 1 | *IE structure* | Focal firm + wide array of complementors | |
| 2 | *Focal participant(s)* | Focal firm | |
| 3 | *Goal(s)* | *Focal firm:* (moderate interest) Search for external support and expertise | *Focal firm:* (high interest) Search for external support and expertise; Search for flexibility; Becoming integrator |
| | | *Complementors:* Access to wide market; Focus on developing core competencies | *Complementors:* Scaling-up R&D results; Focus on developing core competencies |
| 4 | *IE emergence* | Result of a historical process; Result of interpersonal connections | Result of dedicated efforts; Result of interpersonal connections |

Table 2 – continued

| # | Element of IE model | (1) "Closed" | (2) "Open" |
|---|---|---|---|
| 5 | *Participants and their selection* | *Set of participants:* determined by value proposition | |
| | | *Selection process:* Own efforts– Consumer recommendations – Open search | |
| | | *Selection criteria:* Expertise in the given field and past experience; Competitiveness of technology; Competencies requires for commercializing the technology | |
| 6 | *Coordination mechanisms* | *Static:* Establishing mutually beneficial conditions; (Technical) requirements of the value proposition | |
| | | *Dynamic:* Periodic coordination; Support provision | |
| 7 | *Common resources* | (Limitation): Project specific (physical, expertise, etc.) | (Greater openness): Project specific (physical, expertise, etc.) |
| 8 | *Major issues* | PID-determined limitations; Human factor; Lack of required complementors; Low level of technological development of complementors; Lack of required managerial competencies among complementors | |

Source: developed by author.

Notes – PID (program of innovative development) – long-term program, ratified by profile ministry, which determines the scope of innovative projects that state-owned company is able to execute during a given time period

Revealed innovation ecosystem models are similar in terms of structure (represented by focal firm at the core and wide array of complementors at the periphery) and central role of value proposition, which determines the set of participants. Coordination mechanisms adopted by focal firms could be divided into static (establishing mutually beneficial conditions; requirements of the value proposition) and dynamic (periodic coordination of activities; provision complementors with the required support). This allows to establish and maintain long-term relations with external partners, which result in new innovative products and/or services therefore securing the competitiveness of ecosystem participants. When selecting partners focal firms rely on several factors related to technical and managerial potential of partners – availability of competitive technologies and abilities for commercializing them. At the same time, there are several issues faced by members of innovation ecosystems in Russian electric power sector: PID-determined limitations for state-owned companies; human factor – common issue in interfirm collaborations; lack of complementors in certain technological domains (due to specifics of the industry and its high capital intensity); lack of managerial competencies among complementors, which complicated collaboration.

At the same time, there are several important differences among models. "Closed" model represents a situation when focal firm behaves more conservative in terms of utilizing potential of its ecosystem. In particular, it is less interested in external expertise and support from complementors and reaches for external support only in non-essential areas of its business. Resources are source of competitive advantage for such companies which are therefore limited in terms of access for complementors. While developing innovative solutions companies within "closed" model initially assess the potential of existing resources and only then reach for external partners. Correspondingly, complementors treat such ecosystem as a way to get access to a wider market.

On the contrary, “open” model implies more ecosystem-focused behavior. Focal firms treat their innovation ecosystems as a source of flexibility (way to adapt to constantly changing requirement through support from external partners, whose expertise exceeds current business needs) and speed (utilizing existing developments of external partners in order to decrease time-to-market for innovations), while also pursuing the goal of coordination and in certain situations becoming integrator of various solutions provided by complementors. Therefore, focal firms treat their ecosystems – not resources and/or capabilities, which only provide competitive parity – as a source of competitiveness. Such firms initially build their activities on collaboration with external partners and demonstrate greater openness in terms of access to common resources. Considering this complementors treat such ecosystems as a possibility for scaling-up the results of their R&Ds.

**3. Four forms of interfirm collaboration during creating innovations are dominant in Russian electric power sector (contracts, in-house developments, open and closed innovation ecosystems). Choice of a particular form is determined by strategic and innovative focuses of the company.**

The form of interfirm collaboration during creating innovations is determined by two major factors that correspond to modern developments in strategy field and represent a combined approach to strategy. The first factor relates to the overall strategic focus of the company’s development – it represents its intended behavior and determines the source of its actions. This factor may be represented in a form of continuum between: (1) focus on the development within the existing market; and (2) focus on the development outside its boundaries. The second factor is related to innovative focus of the studied companies, which could be aimed either on (1) sustaining the existing business or on (2) creating an additional value for customers. These factors and their possible values allow to construct a 2x2 matrix representing possible forms of interfirm collaborations during creating innovations (Figure 1).

These alternatives (interfirm collaboration forms) during creating innovations correspond to a certain extent to traditional dichotomy “exploration – exploitation” and reveal the readiness of an economic agent to deviate from its development trajectory.

In-depth analysis of firms’ behavior in terms of creating innovations revealed that they do not always adopt innovation ecosystem approach for collaboration. Therefore, the first quadrant represents a case when interfirm collaborations rely on contracts and “client-contractor” type of relations (the most traditional and formalized type). Companies that adopt this form of collaboration are mostly focused on the development within their current market and innovations aimed to support such development. Second quadrant represents the case when firms rely on in-house developments. Firms are mostly focused on the development within their current market but have an external focus of innovations – their developments are aimed to create an additional value for customers. Third quadrant represents a case when companies adopt “closed” innovation ecosystem model and therefore aim to sustain their existing

business by entering new (related) markets. Fourth quadrant represents a case when firms develop an "open" innovation ecosystem and are therefore aiming to enter new markets while also creating additional value for their customers.

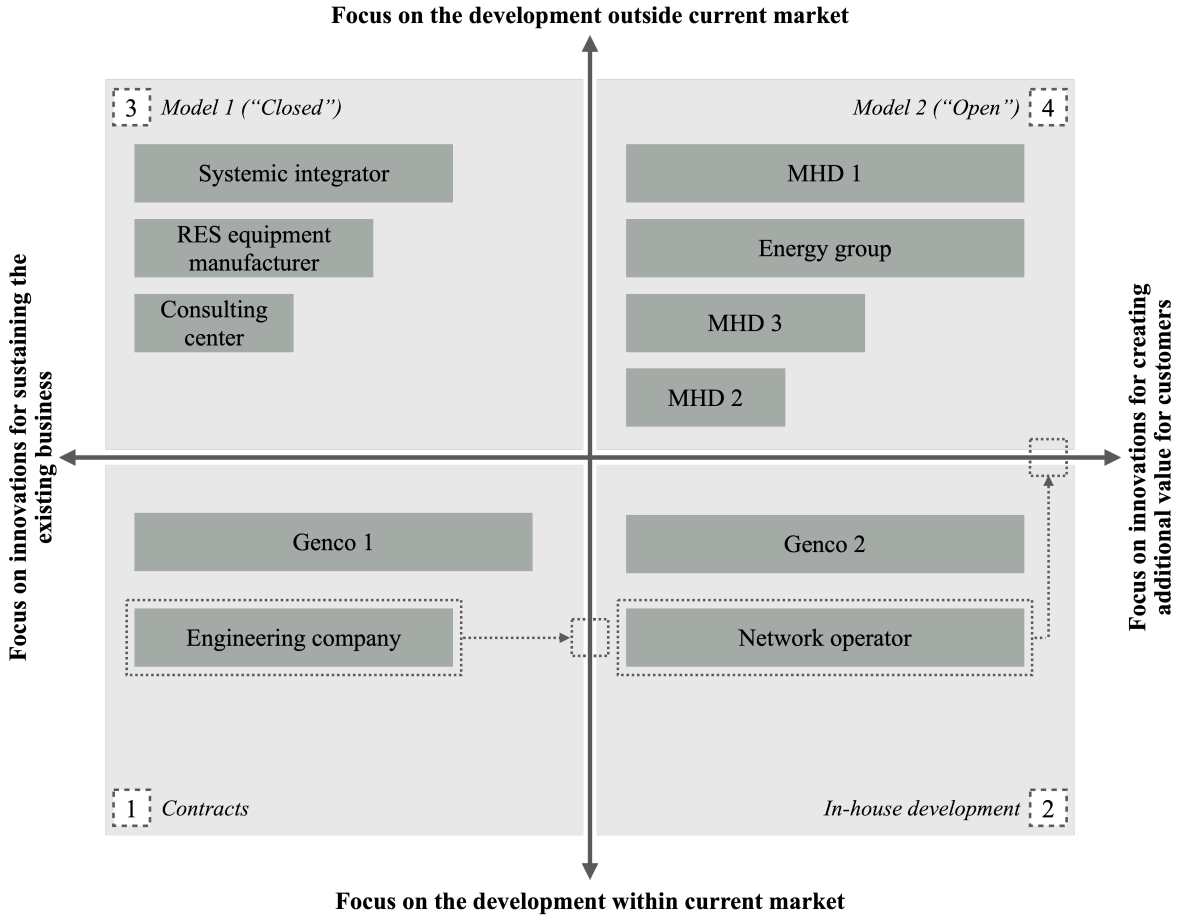


Figure 1 – Contextualized view on interfirm collaboration forms during creating innovation among the studied companies

Source: developed by author[34].

Notes:
1 Genco –generating company
2 MHD – manufacturer of hi-tech equipment and software developed

At the same time, it must be noted that significant connection between the form of interfirm collaboration during creating innovation among the studied firms and the effectiveness of such collaboration have not been found. Effectiveness is rather related to the quality of collaboration and firms' ability to solve issues emerging in the process. Therefore, it can be argued that the choice of a particular form of collaboration is based on parameters that are related to the overall focus of the company, its priorities and existing limitations for innovative activity.

[34] Based on: Burda, Y. Innovation Strategies within the Transforming Russian Electric Power Sector / Y. Burda // Journal of Siberian Federal University. Humanities & Social Sciences. – 2021. – Vol. 14. – No. 7. – P. 1092-1102.

**4. Choice collaboration form during creating innovations by companies of Russian electric power sector is based on multi-parameter process, which includes two major and six additional criteria. Depending on the combination of criteria firms select one of the indicated forms of collaboration during creating innovations, which corresponds to their strategic goals, specificity of the innovative projects and existing limitations.**

The approach is based on the synthesis of results from empirical study, specificity of Russian electric power sector and peculiarities of innovations within. Choice of collaboration form is based on a multi-parameter process, which considers the multicomponent nature of innovative projects in the industry, embeddedness of companies in technological and economical context as well as their individual characteristics. At the same time, this approach considers both peculiarities of the studied companies and several issues related to their environment.

The approach is based on the abovementioned matrix and implies the choice of collaboration form in accordance with the set of criteria (two major and six additional) – Figure 2.

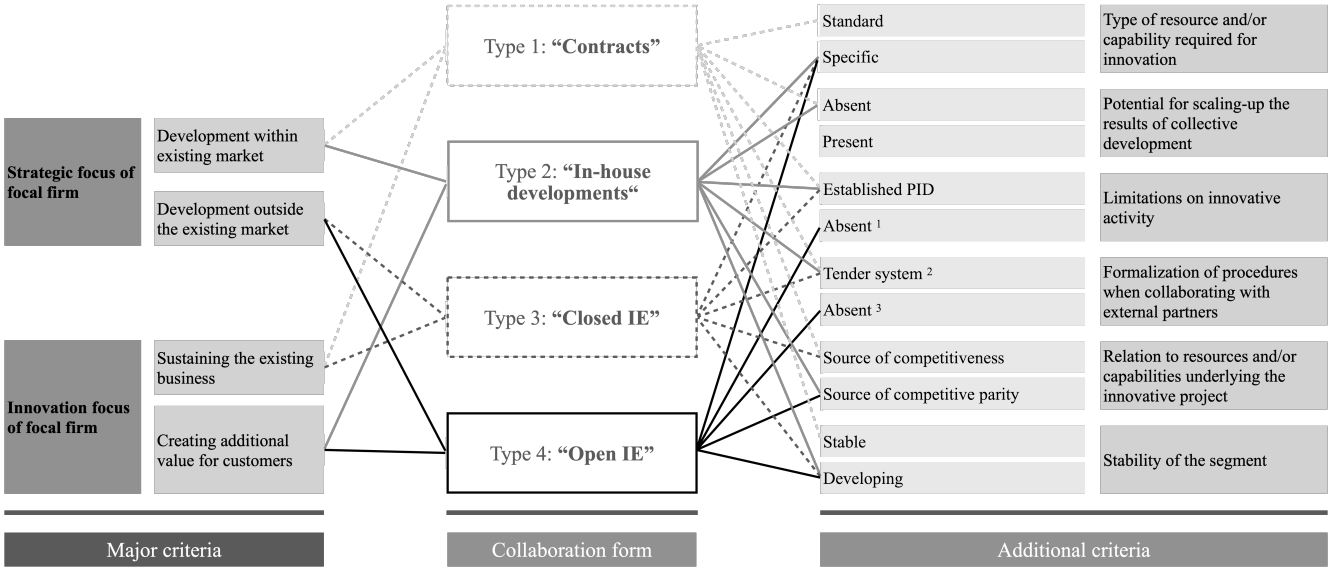


Figure 2 – Approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector

Source: developed by author.

Notes:
1 – Colors are used to ease the navigation
2 – PID – program of innovative development
3 – (1) lack of limitations does not mean a full freedom in actions in terms of creating innovations (non-state-owned companies have strategic innovative documents as well); it rather means independence from external partners in terms of changing the innovative agenda
4 – (2) several companies use informal collaboration with external partners; however, when considerable resources are mobilized, they have to use tender procedures
5 – (3) means that collaboration can be organized without the means of tender

Major criteria include:

- *(1.1) Strategic focus of focal firm*. It characterizes the corporate priorities in terms of development within existing market or outside its boundaries.

- *(1.2) Innovation focus of focal firm*. It implies the choice of innovation priority – either to sustain the existing business or to create additional value for customers.

Additional criteria include:

- *(2.1) Type of resource and/or capability required for innovation*. It can be either standard (available on the market) or specific (which requires adaptation and/or development in order to satisfy the need of a particular value proposition).
- *(2.2) Potential for scaling-up the results of collective development* (outside the project / ecosystem).
- *(2.3) Limitations on innovative activity* imply the existence / absence of established program of innovative development with the corresponding target areas for innovative development.
- *(2.4) Formalization of procedures when collaborating with external partners* implies the existence / absence of tender systems that presents a set of formalized requirements towards external partners.
- *(2.5) Relation to resources and/or capabilities underlying the innovative project*. They can be treated either as a source of competitive advantage or a source of competitive parity.
- *(2.6) Stability of the segment* where the innovative project is executed.

Therefore, an approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector can be described in disaggregated manner – starting with the major criteria (Figure 3).

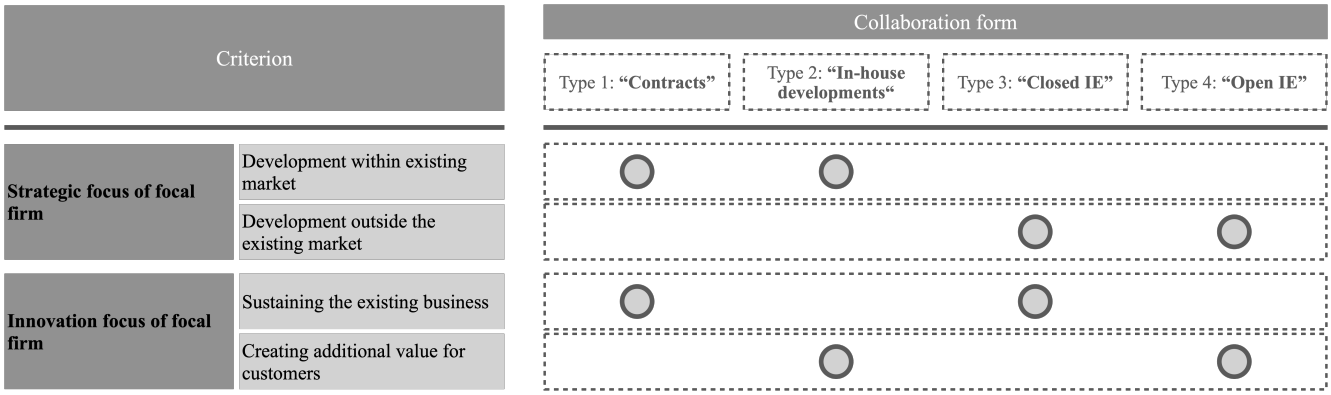


Figure 3 – Selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector (major criteria)
Source: developed by author.

*(1.1) Strategic focus of focal firm*. When a company strives to develop and secure its position within the existing market is relies on a set of long-term contracts with trusted partners who are familiar with its requirements, business specifics and needs. When a company is focused on creating an additional value for its customers within the existing market, it will rather rely on in-house developments which

are based on its existing expertise and understanding of consumer requirements. If a company is trying to sustain its current business by entering new markets, it will adopt "closed" IE, which can help to decrease associated risks and/or investments by sharing them with external partners while also "testing" new market through utilizing the existing expertise and ultimately decrease "time to market" for the product. In those cases when a focal firm is aiming to create an additional value for its customers on the new market it will rely on the "open" IE and corresponding tight collaboration with external partners who own the required complementary resources and/or capabilities (in certain specific areas) therefore increasing speed and flexibility in perspective but competitive areas.

*(1.2) Innovation focus of focal firm.* It can be focused either on sustaining the existing business or creating an additional value for customers. In the first case firms tend to choose contracts or "closed" IEs that allow for achieving access to the requires resources and/or capabilities from external partners, control the process and boost the development of their core business – either by increasing its efficiency or by entering related markets and developing complementary products and/or services that increase its value. In the second case firms rely on in-house developments or "open" IEs that allow them to move beyond their current business and create additional value for customers (both existing and potential ones). In-house developments are used when there are no partners on the market and/or when the results of an innovative project cannot be scaled-up outside the boundaries of a given project (which is opposite for IEs).

The choice of collaboration form during creating innovations is also determined by a set of an additional criteria (Figure 4).

*(2.1) Type of resource and/or capability required for innovation*. When a resource / capability required to develop an innovation is standard (available on the market), collaboration with its supplier will be executed via contract – even if there are multiple suppliers and the project is multi-component in its nature. The reason for that is the rationality of firms' behavior who always seek for the most simple and transparent form of collaboration – if there is a choice. At the same time, if such resource / capability is specific (requires additional development and/or investments) firms will rely on in-house developments (if there are no solutions available on the market or they do not fit business needs) or IE of a certain type – when external partners have stimuli for developing such resource / capability (ability to gain access to a wider market or ability to scale-up their R&D results).

*(2.2) Potential for scaling-up the results of collective development*. If there is no potential for such scaling and external partners cannot benefit from collective developments, the firm will rely on contracts (will purchase products / services of rather standard type from trusted suppliers for the purpose of sustaining / developing the existing busines) or in-house developments. In other cases, firms will develop innovation ecosystem with the corresponding tight collaboration with external partners.

*(2.3) Limitations on innovative activity* heavily influence the choice of collaboration form – especially in case of state-owned companies. Established PID limits the company's ability to develop emerging technological domains – full-scale development requires interventions to the PID and corresponding ratification from the regulating bodies. Therefore, innovative activity of state-owned companies is heavily related to their core business – they develop those areas, which are already included to the PID. Such problem does not exist for privately-owned companies. Despite having established programs of long-term innovative development, it is easier for private companies to make interventions – there is no need to achieve ratification from regulatory bodies. It drastically decreases transactional costs and makes it easier to perform such actions.

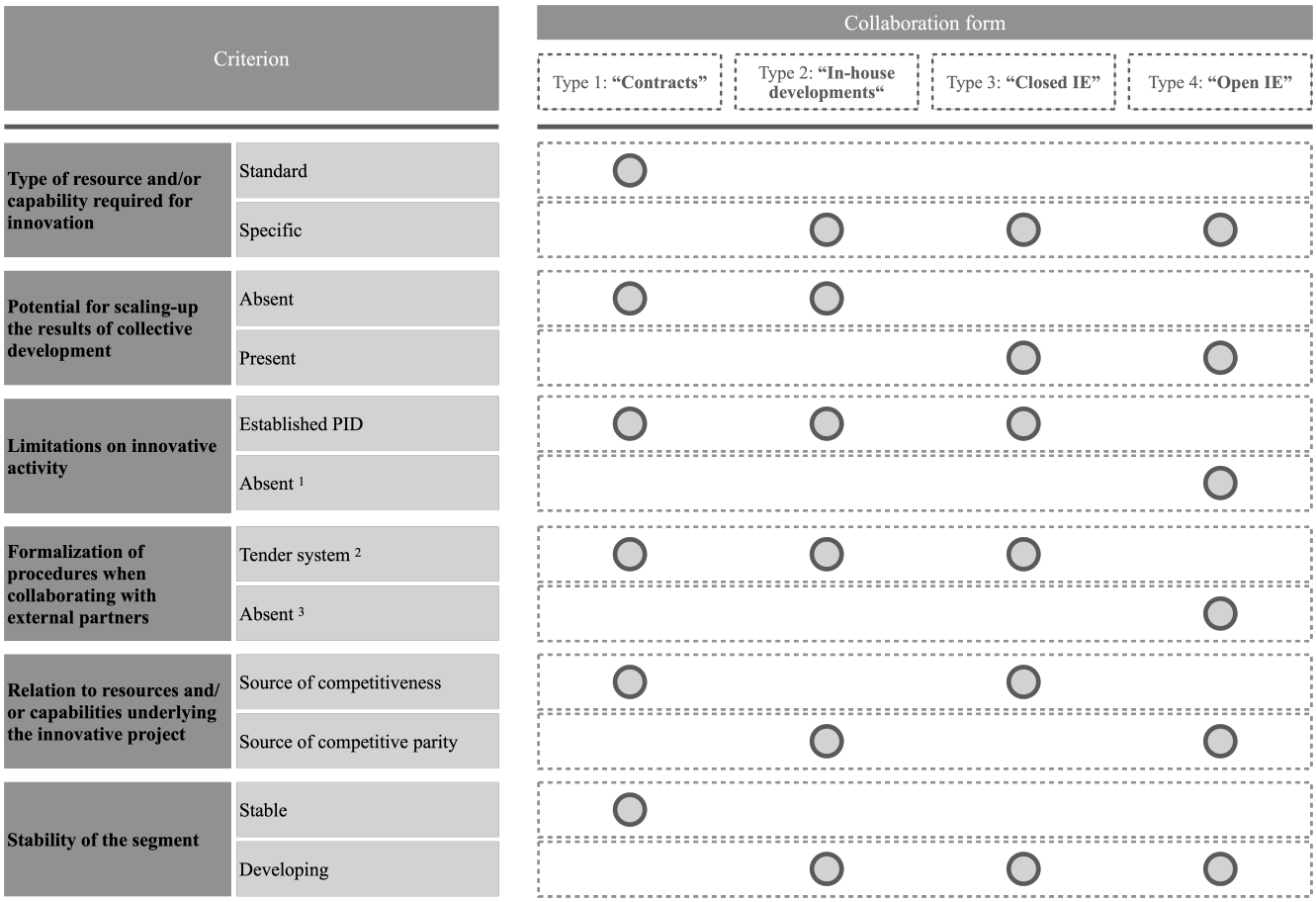


Figure 4 – Selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector (additional criteria)

Source: developed by author.

Notes:

1 – PID – program of innovative development

2 – (1) lack of limitations does not mean a full freedom in actions in terms of creating innovations (non-state-owned companies have strategic innovative documents as well); it rather means independence from external partners in terms of changing the innovative agenda

3 – (2) several companies use informal collaboration with external partners; however, when considerable resources are mobilized, they have to use tender procedures

4 – (3) means that collaboration can be organized without the means of tender

*(2.4) Formalization of procedures when collaborating with external partners* has a similar effect. State-owned companies tend to collaborate through tender procedures with the corresponding set of requirements for their partners (which many innovative startups and/or SMEs are not eligible to). This substantially limits a scope of partners for the focal firm as well as the degree of their collaboration (in terms of resource liabilities). At the same time, privately-owned companies are more flexible in this regard and are able to adapt their collaboration practices – however, maintaining general principles in ethical, ecological and other areas.

*(2.5) Relation to resources and/or capabilities underlying the innovative project.* If they are considered to be a source of competitive advantage and are secured correspondingly (through intellectual property rights and/or limited access for external partners) firms will tend to adopt more closed forms of collaboration – contracts (treating partners as suppliers) or "closed" IEs with the limited access to common resources. In those cases when firms demonstrate opposite behavior and treat resources and/or capabilities as a source of competitive parity that guarantees competitive advantage for a limited period of time, they are more inclined to develop dedicated systems of their renewal and/or replacement – either though in-house development or through opening an access for external partners with an access within "open" IEs who are able to bring complementary resources and/or capabilities and therefore create additional synergy.

*(2.6) Stability of the segment.* In stable segments firms tend to adopt contracts that guarantee stability, predictability and control. If the segment is a subject to rapid changes, firms rely on more flexible forms of collaboration in creating innovations – in-house developments or collaboration with external partners (whose complementary resources and/or capabilities increase reaction time and the overall flexibility of focal firms).

Depending on the combinations of these criteria, studied firms develop a particular form of collaboration during creating innovations – appropriate in terms of their strategic goals, specificity of the project and existing limitations.

## III. THE MAIN CONCLUSIONS OF THE RESEARCH

The outcomes of the study are twofold. On the one hand they allowed to make an input to the existing body of knowledge on innovation ecosystems. On the other – they create a methodological basis for the choice of collaboration form among companies of Russian electric power sector during creating innovations under the circumstances of transforming industry.

Conclusions of the research are as follows:

1. Russian electric power sector drastically differs from other industries by the nature of its underlying product. Electricity is similar to service in its nature – in most cases its production is accompanies by the simultaneous consumption. At the same time, nowadays electric power sector is the only sector with continuous nature of production and consumption, while consumers are able to influence the stability of the overall system. This fact necessitates constant collaboration with consumers. Moreover, ongoing changes in the industry increase the role of innovations and transform their nature – we can observe a transition from individual to collective creation (development of complex multicomponent solutions) requiring collaboration of many companies. The very nature of innovative projects in the industry (their duration, capital intensity and associated risks) require for a collaboration among players. All these changes create a fruitful foundation for innovation ecosystems development.

2. Literature review revealed the fact that ecosystem concept represents a development of interfirm network phenomenon and is based on works from organizational ecology domain. Companies create partnerships and "systems of mutually beneficial relations" aimed to develop symbiotic community of collaborating participants, who strive to reach common goal, use resources in cyclical manner and increase the "productiveness of the ecosystem". At the same time, ecosystem should be considered as a network of companies who develop, produce and/or use products and services within a common value chain. Ecosystems incorporates network relations of a specific kind – those that allow for utilizing the potential of its members, coordinating their activities and coherent development.

3. Empirical study revealed two major innovation ecosystem models in Russian electric power sector. "Closed" model represents a situation when focal firm behaves more conservative in terms of utilizing potential of its ecosystem. In particular, it is less interested in external expertise and support from complementors and reaches for external support only in non-essential areas of its business. Resources are source of competitive advantage for such companies which are therefore limited in terms of access for complementors. While developing innovative solutions companies within "closed" model initially assess the potential of existing resources and only then reach for external partners. Correspondingly, complementors treat such ecosystem as a way to get access to a wider market.

On the contrary, "open" model implies more ecosystem-focused behavior. Focal firms treat their innovation ecosystems as a source of flexibility (way to adapt to constantly changing requirement

through support from external partners, whose expertise exceeds current business needs) and speed (utilizing existing developments of external partners in order to decrease time-to-market for innovations), while also pursuing the goal of coordination and in certain situations becoming integrator of various solutions provided by complementors. Therefore, focal firms treat their ecosystems – not resources and/or capabilities, which only provide competitive parity – as a source of competitiveness. Such firms initially build their activities on collaboration with external partners and demonstrate greater openness in terms of access to common resources. Considering this complementors treat such ecosystems as a possibility for scaling-up the results of their R&Ds.

4. Interfirm collaboration in Russian electric power sector during creating innovations is executed via four major forms: (1) contracts; (2) in-house developments; (3) open; and (4) closed innovation ecosystems. Choice of a particular form is determined by two major factors: (1) strategic focus of the company (development within or outside its current market); and (2) innovation focus of the company (sustaining the existing business or creating an additional value for its customers).

5. The study allowed to develop an approach for selecting a form of interfirm collaboration during creating innovations by companies of Russian electric power sector. It is based on multi-parametric process and implies the choice of a particular form of collaboration basing on the following criteria: (1) Type of resource and/or capability required for innovation; (2) Innovation focus of focal firm; (3) Potential for scaling-up the results of collective development outside the boundaries of the project / focal firm; (4) Strategic focus of focal firm; (5) Limitations on innovative activity; (6) Formalization of procedures when collaborating with external partners; (7) Relation to resources and/or capabilities underlying the innovative project; (8) Stability of the segment where the innovative project is executed. Depending on the combination of the indicated factors firms do rely on a particular form of collaboration, which is congruent with their strategic goals, specifics of an innovative project and existing limitations. This approach provides companies of Russian electric power sector with a conceptual framework for a better-grounded decision making in terms of choosing an appropriate form of interfirm collaboration during creating innovations. It also serves as a foundation for the development of innovation strategies execution mechanisms by companies of the studied industry.

## IV. PUBLISHED PAPERS

Major results of the dissertational study are published in three works, including two papers published in Scopus-indexed scientific journals and one paper published in scientific journal, included to the high-level journals list, developed in NRU HSE. Total volume of major publications is 3,95 p.s. Author's personal contribution is 1,83 p.s.

*Papers published by the author in Scopus-indexed scientific journals:*

1. Burda, Y. Innovation Strategies within the Transforming Russian Electric Power Sector / Y. Burda // Journal of Siberian Federal University. Humanities & Social Sciences. – 2021. – Vol. 14. – No. 7. – P. 1092-1102. – 0,91 p.s. (Q2, 2020, SJR[35]).
2. Burda, Y. Digitalization and Ways for the Development of the Electric Energy Industry with the Participation of Consumers: New Challenges for Shaping the Investment Climate / Y. Burda, I. Volkova, E. Gavrikova, A. Kosygina // Journal of Siberian Federal University. Humanities & Social Sciences. – 2019. – Vol. 12. – No. 4. – P. 545-564. – 1,08 p.s. (Q3, 2019, SJR[36]).

*Papers published by the author in scientific journals, included to the high-level journals list, developed in NRU HSE:*

1. Burda Y. Meaningful analysis of innovation, business and entrepreneurial ecosystem concepts / Y. Burda, I. Volkova, E. Gavrikova // Russian Management Journal. – 2020. – Vol. 18. – No. 1. – P. 73-102. – 1,96 p.s.

*Other works published by the author on the topic of dissertational research:*

Other works published by the author on the topic of dissertational research include six publications of the total volume of 20,49 p.s. Author's personal contribution is 4,05 p.s.

1. Burda, Y. Development of electric power systems based on the use of intelligent technologies / Y. Burda, A. Kosygina, I. Volkova, M. Gorgisheli, A. Yakovleva, K. Suslov / in: IOP Conference Series: Materials Science and Engineering Vol. 1064: International Conference on Mechanical Engineering, Automation and Control Systems (MEACS) 2020. – Novosibirsk, Russia: IOP Publishing, 2021. – P. 1-12. – 0,76 p.s.
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6. Burda, Y.D. Comparative analysis of the state of development of technological platforms in EU and Russia / Y.D. Burda, I.O. Volkova // Bulletin of South-Ural state university. Series “Economics and management”. – 2016. – Vol. 10. – No. 4. – P. 66-75. – 0,70 p.s. (in Russian).