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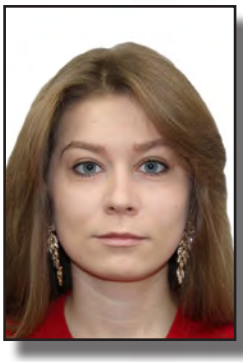
Comprehensive Analysis of Forms of Innovative Activity of Foreign Railway Companies



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ABSTRACT

The current stage of economic development is characterized by a structural crisis that manifests itself in many areas and sectors of the economy. This situation is explained, among other things, by the transitional state of the world economic system, caused by the process of rooting of a new technological order, development of Industry 4.0. The changes resulted from implementation of the process will play a key role in determining trends and directions of world economic development in the coming decades and will characterize the new technological structure and vectors of further development and introduction of technologies.

The speed of development and introduction of new technologies and products is the main distinctive feature of the new technological paradigm. The most important indicators of the success of the new economic model will be thus speed, volume, and quality. Those companies that can adapt faster and better to the new realities of economic development will be the leaders of the new system of market economy. Speed and quality will be among key criteria that determine the success of a company in modern conditions: in the competition for leading positions, companies will have to do everything faster and better than others. The relevance of such a paradigm is confirmed by the reduction of research, technological and innovation cycles as for the time from emergence of an idea to its implementation and transfer to industrial operations.

Mass digitalization of all aspects of activities and a reduction in duration of cycles of updating equipment and technologies determine the tendency for companies to reorient from an exclusively internal type of organization of innovation activities to, mainly, external ones. This article analyzes forms and tools for organizing innovative activities, including through building specific relationships with external participants in the innovation ecosystem. The research is focused on the practices of selected world railway companies.

The objective of this article is to review the tools and methods of organizing innovation in selected leading railway companies and to identify its most common forms. A comprehensive analysis of functioning of forms of innovation was carried out using methods of structural and comprehensive comparative analysis, generalization, and deductive methods.

Keywords: innovation activity, railway industry, R&D center, innovation laboratory, intracorporate entrepreneurship, innovation management, RID, hackathon, business accelerator, business incubator, captive venture funds.

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Background. The active process of digital transformation of priority sectors of the economy, including railway transportation, predetermines the need for companies to structurally change the existing management system in the field of research and technical activities.

In Russian Federation in accordance with the passport of the federal project «Digital Technologies» of the national program «Digital Economy of the Russian Federation», companies with state participation are required to develop and implement digital transformation strategies. The specified program document predetermines, among other things, the need to develop management approaches and coordination of research and development processes, and formation of an innovation ecosystem. Special attention is paid to the issues of complex intersectoral interaction of companies on development of «end-to-end» digital technologies and, in general, to implementation of initiatives aimed at joint implementation of breakthrough scientific, technological, and socio-economic development of the Russian Federation.

Most of the railway companies have historically included a highly developed scientific and technological unit into their organizational structure, consisting of and/or cooperating with specialized universities, research institutes and laboratories. The main task of such an innovative cluster is to fully control, manage and organize the innovative activity of railway companies.

Within the framework of this article, a review of features and forms of organization of innovation activities in selected leading foreign railway companies is carried out, the main *objective* of which was to identify and describe the most common and relevant ways of conducting innovation activities, resulting in competitive effects of innovation activities aimed at improving quality and efficiency of the overall organization. To achieve this objective, structural and comprehensive comparative analysis methods, generalization and deductive methods were applied.

Results.

Traditionally, the internal initiation of the process of innovation and of innovative projects is associated with functioning of a corporate R&D center or innovation laboratory. The main functionality of innovation laboratories and R&D centers is to independently conduct research and development within the priority areas of technological development [1]. A company assumes all possible risks associated with development and implementation of technologies and solutions within the framework of innovation laboratories and R&D centers.

To implement technological projects that require specific competencies, experience and knowledge that lie outside the boundaries of the company, there is a practice of organizing innovation laboratories operating on the principle of «open innovation». This principle implies active interaction with third parties (for example, universities, competitors, or customers) [2], which opens access to complementary knowledge, markets, and networks [3].

Among leading railway companies outside Russia, having innovation laboratories or R&D centers among their organization structures, one can single out Deutsche Bahn (hereinafter – DB) (Germany), SNCF (France), China Railway (hereinafter CR) (China).

DB's main research laboratory is DB MobilityLab[1], headquartered in Frankfurt. Within the framework of this research laboratory, employees of the company independently develop and test various prototypes in order to assess their effectiveness. Based on the results of assessment, a program for completion and implementation of prototypes in production activities of the company is formed. The priority areas of research at DB MobilityLab are:

- development of automated control systems for locomotives;
- additive technologies;
- technologies of virtual and augmented reality.

In 2017, an internal entrepreneurship program was launched on the basis of DB MobilityLab, giving employees of the German Railway Company an opportunity to implement their own ideas. The main mechanism for initiating and supporting technological projects within the framework of this program is initial review of projects by experts and, if they are promising and in demand from DB, subsequent

[1] [Electronic resource]: https://karriere.deutschebahn.com/karriere-de/ueber-uns/it-projekte/DBmobilitylab-3673300. Last accessed 19.03.2020.

transfer to the project team formed around the initiator of the idea for their implementation.

Another independently functioning innovation laboratory of the German Railway Company is DBmindbox[2], whose main goal is to select, assess and support the most promising startups during the implementation process. The pool of applications under consideration by DBmindbox includes projects in the fields of construction and operation of infrastructure facilities, increasing efficiency of customer operations through implementation of digital solutions; automation of transport systems, and development of software solutions.

SCNF management has identified the need to move from R&D to RID (Research, Innovation & Development), which means adoption of new innovation management processes. The application of RID principles is carried out by leading innovative companies [4], which occupy a leading position in the market in terms of technological development.

Innovation Management is the core mission of SNCF Innovation & Research[3]. The area of responsibility of this structural unit comprises management of innovation laboratories and minilabs focused on study and development of priority areas in the field of energy, public transport, mobility of the elderly, eco-design, etc. These innovation laboratories are made up of SNCF employees, who work in working teams during implementation of projects aimed at development of disruptive and incremental innovations. Laboratories regularly conduct training workshops involving third-party specialists, including those from related industries.

For example, the activities of the innovative public transport laboratory, PublicTransportLab are focused on developing transport opportunities and improving convenience of passengers in urban transit. PublicTransportLab is based on the principle of «open innovation». Bringing together SNCF employees from different departments (marketing, infrastructure, strategic management, etc.) within a single laboratory increases creativity required to generate innovative ideas.

The practice of the Chinese Railway exemplifies organization of an R&D center, which is managed jointly with a partner company: CR signed a strategic agreement with Huawei, one of the largest Chinese telecommunications companies, to create a joint innovation center. In accordance with this agreement, the joint center is organized on the principles of cooperation in the following priority areas of technological development: logistics network, cloud technologies, big data, wireless network, emergency communications, etc.

The priority goal of the functioning of this center is to develop solutions aimed at development of a single intelligent transport system through deep integration of information and communication technologies into the activities of railway companies, including through development of a single geoinformation space of railways [5–7].

Innovation laboratories and R&D centers are basic corporate institutions involved in innovation development. The most developed companies are moving from R&D to RID, shifting focus from traditional research and development to integrated innovation management at all stages of the life cycle. Nevertheless, modern realities and speed of the technological cycle predetermine the need for interaction between railway companies and third organizations, including those from related sectors of the economy. Companies express a high level of interest in building technology transfer systems, with a special role for external transfer and commercialization mechanisms.

Conducting innovation-oriented events, including hackathons, is one of the ways companies interact with external actors in the innovation environment in the framework of building their own innovation policy. Hackathons are events lasting from 12 to 72 hours, during which various participants interact intensively with each other developing samples of innovative solutions/products, mainly of an informational nature [8].

The main goals of such events are:

- selection of the most promising projects on the market for their subsequent implementation in production activities;
- generation of new ideas;
- attracting talented employees and project teams;

[2] [Electronic resource]: https://dbmindbox.com/de/. Last accessed 19.03.2020.

[3] [Electronic resource]: https://www.sncf.com/en/innovation-development/innovation-research. Last accessed 19.03.2020.

• improving perception of the company's image and brand.

In accordance with the classification of G. Briscoe [8, p. 5] the following categories of hackathons should be distinguished:

• technology-oriented hackathons organized to develop technology or information platforms;

• focus-oriented hackathons aimed at collective solution of pre-formulated problems (tasks).

For example, in 2018 Tyumen Industrial University located in in the city of Tyumen held 2nd All-Russian Smart City & IoT Hackathon. The main goal of the event was to develop smart city's technologies and, in particular, an intelligent transportation system.

DB and SNCF are strong advocates of these forms of innovation in the railway industry. For example, the German Railway regularly organizes hackathons in Berlin, the main goal of which is development of open data technologies[4].

Based on the results of hackathons, DB selects the most promising and competitive projects, which are provided with various kinds of support and expertise (financial, technological, marketing, etc.). Such interaction results in a modernized product to be introduced into production activities of the company.

SNCF hosts hackathons as part of EcoMotion, an annual forum dedicated to innovations regarding passenger transportation. In 2017, winners of the event comprised, e.g., Selentium, which developed QuiteBubble soundproofing system for passenger transport[5].

Another similar SNCF event is Traindroid, aimed at developing technologies in the field of robotics[6]. The most important results of this hackathon are:

• optimized mechanism for opening/closing train doors;

• systems of interaction «man-machine»;

• application of additive technologies for quality management purposes.

[4] Deutsche Bahn Open data. [Electronic resource]: https://dbmindbox.com/de/db-opendata-hackathons/. Last accessed 19.03.2020.

[5] EcoMotion hackaton. [Electronic resource]: https://www.silentium.com/ecomotion-hackathon-2017/. Last accessed 01.03.2020.

[6] Plant of the future SNCF. [Electronic resource]. https://www.sncf.com/fr/groupe/newsroom/innovations-materiel. Last accessed 15.03.2020.

Active interaction with startups and other small and medium-sized businesses (hereinafter referred to as SME) allows companies to keep abreast of key technological trends in the railway industry and related sectors of the economy, for example, of bus transportation. Understanding the vectors of development of the nearest adjacent areas of the transport industry in the context of development of a single transport network and organization of multimodal transportation using various categories of transport is today one of the most significant criteria for successful development of transport companies.

Interaction with startups and SME is carried out by the following types of structures:

• corporate business accelerators and business incubators;

• partner business accelerators and business incubators;

• captive (corporate) venture funds.

The fundamental tasks of functioning of the selected tools of interaction with external subjects of the innovation environment are:

• selection and financing of the most competitive projects (companies) for subsequent purchase of their products at competitive prices (acting as an anchor customer);

• support of projects for subsequent implementation of their results in production activities;

• selection of the most competent and promising project teams for the purpose of cooperation with them as with an independent or subsidiary organization (or attracting personnel);

• improving perception of the company's image and brand.

The organizational structure of the DB includes all the above formats of interaction with startups and SME. Together with Plug and Play, DB initiated development of BEYOND1435 business accelerator. The key partners of the accelerator are leading international companies: Alba Group; Siemens AG; Swiss Federal Railways; TUI Group; Bombardier Transportation[7].

DB also maintains its own business incubator Startup Xpress, on the basis of which startups and young companies focused on

[7] Business accelerator Beyond 1435 [Biznes-akselerator Beyond 1435]. [Electronic resource]: https://beyond1435.com/. Last accessed 01.03.2020.

creating innovations in the field of services receive various expertise. The end result of the startups' participation in Startup Xpress is provision of funding and space in Berlin coworking area during the prototyping period. DB actively implements the results of the most successful projects into production activities[8].

An example of venture capital organization at DB is Digital Ventures, a captive venture fund. The fund finances activities of projects for development of digital technologies and their subsequent implementation in the railway industry. The priority area is development of artificial intelligence technologies and the industrial Internet[9].

Similar tools for interaction with startups and SME are actively used in other leading railway companies: JR East (Japan); SBB-CFF-FFS (Switzerland), NS (Netherlands), etc.

Business accelerators, business incubators and captive (corporate) venture funds provide companies with the opportunity to effectively organize their long-term innovation and investment activities. Interaction with external representatives of the innovation ecosystem contributes to development of external technology transfer processes, aimed at optimizing innovation management processes.

Effective innovation management (RID) presupposes a wide range of competencies [9], critical and creative thinking of the company's employees which is a conscious understanding of the need for and of sequence of implementation of advanced innovative developments. An important component of the process aimed at improving qualifications of employees and effectiveness of their activities in the field of project management is automation, including:

• provision of personal gadgets with special software that facilitates interaction of company employees with each other;

• application of advanced knowledge management systems.

The South Korean Railway Corporation Korail organizes interactive group sessions on

creativity, critical thinking and time management as part of its employees' training process. The main goal of such classes is to teach skills of self-adapting to continuous change and accelerating innovation management processes. A feature of interactive classes is the possibility of face-to-face meeting with mentors in order to systematize and refine the knowledge gained.

SNCF, in partnership with the Mines-Télécom Institute, has developed an Identity–Knowledge–Concept–Proposal Innovation Management and Product Innovation Management concept based on four key elements:

• clear definition of the purpose of the project;

• consolidation of existing knowledge;

• application of trigger and open concepts;

• transforming concepts and knowledge into strategically important proposals.

A separate significant area of development of the innovative potential of companies is introduction of intracorporate entrepreneurship tools. The purpose of this approach is to form a system that provides the company's employees with an opportunity to bring their

[8] Deutsche Bahn StartupXpress. [Electronic resource]: https://dbmindbox.com/dbstartupxpress/. Last accessed 12.03.2020.

[9] Deutsche Bahn Digital Ventures. [Electronic resource]: https://www.deutschebahn.com/de/Digitalisierung/startups/digitalventures-3242722. Last accessed 16.03.2020.

own ideas to life by implementing innovative projects within the perimeter of the company's innovation ecosystem.

A typical example of this practice is DB Intrapreneurs program[10], which consists of four stages:

• *involvement stage*: formation of project teams consisting of company's employees and their consecutive intensive training in the field of building business models in a digital environment, transfer of potentially useful contacts into the market;

• *design stage*: evaluation of proposals in the context of «problem–available solutions» within the paradigm of the formed business model;

• *construction stage*: direct development of the minimum viable product;

• *growth stage*: providing funding for projects that demonstrate the most competitive results, followed by development of the relevant project team as a department of the company or as an independent company.

An example of a real project that has gone through all stages of DB Intrapreneurs program is WeColli, an information platform for logistics companies that provide door-to-door parcel delivery services.

Conclusions. These examples indicate that leading foreign railway companies are actively using various tools for interacting with the external innovation environment in their activities. This enables support for a high level of competitiveness in the context of accelerating industry technological development, in which it is difficult to ensure development of advanced solutions solely by the company itself.

An important trend is joining of efforts of companies from related sectors of the economy to obtain a synergistic effect in the field of innovation management and of introduction of innovations into production activities. At the same time, the intracorporate scientific and technical unit retains its key role as an integrator of various technological solutions.

[10] Deutsche Bahn Intrapreneuers. [Electronic resource]: https://intrapreneurs.deutschebahn.com/. Last accessed 18.03.2020.

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