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Unification of Digital Tools in the Process of Technology Transfer Implementation

Mariia F. Chesheva [a], Valentin A. Dzedik [b]
Volgograd State University, Volgograd, Russian Federation
chesheva@volsu.ru

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Abstract : In the context of globalization and digitalization of the country's economy, technology transfer is becoming a key mechanism for the dissemination of innovations. Due to the existence of a large number of types of digital platforms, standards and protocols, this significantly complicates the effective exchange of technologies between organizations. This article examines the role of the unification of digital tools in the process of technology transfer, analyzes the benefits of standardization, and considers the best international practices for the application of the unification of digital technologies. Particular attention is paid to issues of compatibility, data security and process automation.

1 INTRODUCTION

Technology transfer (TT) is an important process for the implementation of scientific developments in industry and the commercialization of innovations. However, the use of traditional methods of technology transfer encounters a number of problems such as data fragmentation between organizations (research centers and enterprises in the real sector of the economy); long approval periods; and the risk of leakage of information on intellectual property.

The use of digital technologies in the implementation of the technology transfer process helps to solve many serious problems by offering the use of the following tools:
- unification of processes using standardized platforms;
- automation of processes using artificial intelligence and big data.

The transition to digital transformation of industry, the introduction of advanced technologies, and the creation of smart production are inextricably linked with the expansion of the role of standardization in the development of the digital economy. At the same time, standards have a decisive influence on the dissemination of technologies and their use and are a mechanism for the structural transformation of industry.

This article examines best practices for the application of standardization and unification of digital technologies (including AI technologies) in the management of organizations and the implementation of design and technological developments.

2 MATERIALS AND METHODS

In determining the feasibility of using international or national practices for standardization and unification of digital technologies in organizations implementing technology transfer, approaches to system analysis were used, which considered scientific publications, international and national standards and practices. Application of comparative analysis in the analysis of digital platforms used in the process of technology transfer.

Big data analysis was conducted to assess trends that are used in technology transfer, as well as modeling of some processes to visualize work processes.

[a] https://orcid.org/0000-0002-2695-1213
[b] https://orcid.org/0000-0002-6061-7964

3 RESULTS

By analyzing the best domestic and foreign practices of unification of digital technologies, it is possible to identify key successfully developing areas:

- application of digital technologies in product life cycle management;
- creation and application of digital twins of enterprises and technological processes;
- creation of digital roadmaps (TRM);

and also create a recommended model for the application of digital technologies at the stages of the knowledge transfer process (Figure 1):

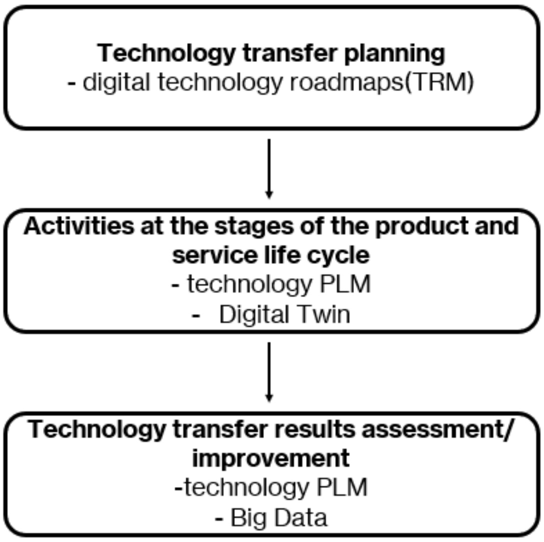

Figure 1: Application of digital tools in the technology transfer process.

Let's conduct a detailed analysis of the key areas of application of digital tools:

3.1 Product Life Cycle Management

The PLM system (product lifecycle management) is actively being introduced into global practice as an important digitalization tool , which is specialized software . PLM technologies combine methods and means of information support for products throughout all stages of their life cycle.

The key function of PLM is to organize the joint work of automated systems from different manufacturers, as well as to ensure interaction between the IT infrastructures of different companies. PLM system ensures an increase in the following production parameters: increased employee productivity; reduced time for preparing the production process; compliance of the enterprise with the requirements of the international standard ISO 9000.

PLM technologies serve as the foundation for creating a single information space that unites automated systems of many enterprises. This ensures end-to-end digitalization of processes - from design to production, which opens up opportunities for the implementation of artificial intelligence technologies and increased efficiency of product lifecycle management.

3.2 Standardization of development, creation and application of digital twins of enterprises and technological processes

A digital twin is a virtual model of any objects, systems, processes or people that can accurately reproduce the form and actions of the original and is synchronized with it. A digital twin is needed to simulate processes in the original under given and other changing conditions. As a result - saving resources, preventing accidents, optimizing technological processes.

According to the general concept of a digital twin, which was described by Michael Greaves , "under ideal conditions, all the information that can be obtained from a product can be obtained from its digital twin."

The term "Digital Twin" was coined by NASA in 2010 in the context of space systems modeling. The agency's report emphasized the idea of creating a detailed digital copy of a spacecraft that could accurately reproduce all stages of its existence – assembly, testing, and operation in space.

Digital twins make it possible to reliably recreate not only physical objects, but also their entire existence cycle – from the construction stage to operation in real operating conditions.

Digital twins are divided into several types:

- a prototype, which is a digital copy of a physical object, including a full set of parameters and characteristics necessary for the exact reproduction of a material prototype;
- an instance is a virtual copy that stores all the data about the object (including the 3D model) and works simultaneously with it, constantly updating.

The permissible error in modeling is a 5% deviation of the digital twin from the physical original.

Tasks that are solved using digital twin technology:

– conducting a test run of a technological process or production chain;

– identify potential problems before launching large-scale production;
– increasing the efficiency of processes;
– reduction of risks arising during the technological process.

Currently, several types of classifications of digital twin systems have been developed in world practice. In particular, one of the widespread ones is the classification by the level of development (the term is used - the level of maturity of the digital twin): the predecessor of the digital twin, the classic digital twin, the adaptive digital twin, the intelligent digital twin.

According to the level of detail and volume of description, the CD can be used at the following levels:
-CD of a component. If the operation of a mechanism seriously depends on the condition of one part, you can create a virtual copy only for it. For example, for a bearing on a rotating part of equipment,
- The asset's central control system provides control over the state of specific equipment, such as an engine or a pump. If necessary, the mechanism's twins can exchange information with virtual copies of components,
-The system's digital control system allows you to control several assets that work together or perform the same function. For example, you can create a digital copy of a plant or a single production line,
- The process control center is a top-level twin that provides insight into the entire production process. It can receive information from asset or system twins, but it focuses more on the process as a whole rather than on the operation of specific equipment.

Digital twins are successfully used in the aerospace industry, education, medicine, agriculture, etc. Here are some examples of companies that have already implemented digital twins in production:
- Tesla creates a digital twin for every car it sells. Sensors embedded in it transmit data to the factory, where artificial intelligence decides whether the car is working properly or needs maintenance;
- Chevron Corporations use the technology in oil fields and refineries to predict potential technical problems;
- Singapore has a digital twin - a dynamic 3D model of the city with everything from buildings and bridges to curbs and trees.

The Russian Federation has also moved towards implementing digital twin technology in production processes. This is evidenced by the national standard GOST R 57700.37–2021 "Computer models and modeling. Digital twins of products. General provisions" created in 2021. The standard establishes uniform requirements and terminology for the development of digital twins of products, and not just the digitalization of production processes or logistics.

3.3 Digital Technology Roadmaps (TRM), including using AI

The use of digital technologies for technology roadmapping has the advantage of significantly expanding the range of information sources used to create the roadmap. This provides a more robust, evidence-based foundation for the comprehensive roadmap, and the risk of biased individual judgments is limited. The main challenge in expanding the information base is processing the information and integrating it into summary indicators for the final roadmap. The digital roadmap is used to optimize strategic and investment decision-making in project management, including determining investment priorities, identifying technology forks and strategic alternatives, identifying areas of presence and lack of competence, assessing risks, identifying potential consortia and potential tasks for them, project appraisal and active project search.

Technology Roadmap (TRM) is a tool not only for manufacturing, transportation and other companies, but is equally suitable for research institutes and government agencies for various decision-making purposes.

One of the main challenges facing organizations is to prioritize technology development. Given the complexity of economic activity and technology as such, developing the right framework and developing appropriate support measures will help to develop promising technologies and their further implementation. As stated in Park et al . (2020), there are several established schools of thought regarding TRM. They appear to complement each other in providing a framework for technology management.

recent special issue looked at "smart roadmaps". The issue presented applications of smart roadmaps in sectors such as pharmaceuticals and toys in countries such as Germany and Russia. The issue also presented frameworks such as a focus on assessing the impact of changes to the roadmap and integrating corporate foresight into the process. The trend is to research and apply smart technologies to develop smarter and fairer roadmaps . This research continues the tradition of developing digital roadmaps at the Moscow School of Integrated Technologies, which combines research in terms of further developing the roadmap approach and practical testing on examples of large companies.

At present, it is clear that the following issues need to be considered and unified:

1) the use of digital technology in the TRM development process to limit the possibility of obtaining biased estimates,

2) improvement in the processes of identifying and selecting experts using digital technologies to achieve better and more objective results.

Digital Technology Roadmaps (TRMs) integrate aspects of technology promotion and market attraction into a single roadmap that includes multiple layers to provide a comprehensive and systematic view of the development of a technology area. TRMs are applicable to a wide range of technologies and can be used for a variety of purposes, including strategic planning, investment and portfolio management, etc.

TRMs play several roles in companies, including strategic forecasting and planning, supporting strategic and investment decisions, and project management. Strategic forecasting and planning functions include providing a forecast of the future of the industry, market and technology development, identifying promising products and services, markets and niches, and technological forks and strategic alternatives.

The methodology for building technology roadmaps for digital technologies was tested during a project aimed at developing a TRM for transforming artificial intelligence for a large Russian technology company. The creation of the TRM is aimed at supporting analytics and developing management tools when transforming the organization's internal processes using AI technologies. During the development process, it is necessary to identify potential technological breakthroughs in the field of artificial intelligence applications.

4. CONCLUSIONS

As a result of statistical and descriptive analysis, it can be concluded that the unification of digital tools in the process of technology transfer is an important factor in accelerating innovation processes, reducing transaction costs and increasing the efficiency of commercialization of developments. The integration of standardized digital developments contributes to the transparency, security and automation of transfer processes.

The proposed model of using digital tools in the process of technology transfer is an assistant to the participants in the process, and also helps to reduce the time and improve the quality of production development.

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