

The Importance of Investments in Scientific Research in the Innovative Activity of Industrial Enterprises



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ABSTRACT: In the article, the importance of investments in scientific research in the implementation of digital transformation and automation in industrial enterprises is studied on the example of developed countries, such as USA, theoretical and practical proposals are made for directing investments in scientific research in digitization and automation of industrial enterprises of Uzbekistan. The innovative activity of industrial enterprises should be such that it creates innovations in all processes: from research and development to production, from production to management, from sales to delivery to consumers, to study of the post-consumer situation, introduction of new digital and automated technologies, management system evaluation of activities, improvement of the functionality of products and technologies, reduction of costs and increase of efficiency, organization and production of marketing and advertising activities, with coverage of consumers, convenient delivery to customers, packaging, clarification of product description and rules of use of the product, as well as benefits or advantages obtained as a result processes should be covered. In addition, having a certain share of the main products in the total volume of production, it is possible to create business models with the aim of achieving a large amount of income from the main products due to the increase in the volume of sales with new technologies of production. The use of investment funds by industrial enterprises in the direction of scientific research in their innovative activities has a great effect.

KEYWORDS: Investment, digital transformation, digital technology, automation, scientific research, fundamental research, applied research, experimental research, innovation

I. INTRODUCTION

Today, the industrial enterprises of Uzbekistan are directing the main part of investments to digital transformation and automation. Through this, all aspects of the industry, from research and development to production, from production to management, from sales of products to post-consumer situation studies, to customer relations, are being digitized and focused on evaluating management system performance, improving functionality in products and technologies, networks, reducing costs and increasing efficiency.

The fact that industrial enterprises of developed countries have been implementing modern digital technologies for several years and achieving high results is reflected in their economic indicators. That is, digital technologies are widely used in the circular economy to save resources and increase efficiency, to introduce innovations that allow to extend the life of products, to exchange information, to receive feedback on the quality of products and the wishes of customers, and to carry out benchmarking.

II. LITERATURE REVIEW

Regardless of the type and size of production activities of industrial enterprises, in today's 4th industrial revolution - the era of digital technologies, the use of innovative technologies is of great importance to gain a competitive advantage.

According to foreign scholars, Rachinger and others, the fourth industrial revolution forced companies to question their existing strategies and explore new business opportunities [1]. Soutto, Mat, Fitzgerald and others argue that "how companies use digital technologies is even more important for their innovation potential and growth" [2]-. Müller et al. believe that "Industry 4.0 can offer enormous opportunities for the creation of new products and services, better ways of serving customers, improved integration along the value chain, and the adoption of innovative business models" [3].

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According to Verhoef and Quintons, digital orientation has recently been added as a complement to digitizing the organizational functions of a firm [4], while Lucas and Bharadwaj have stated that digital transformation changes the way enterprises create and capture value [5]. As a result of Usaj and Gobbel's research, "...innovation is not an end in itself, firms innovate to become more profitable, efficient and competitive. Similarly, while digital transformation may lead to new products and processes, its ultimate goal is to meet new demand and explore market opportunities arising from digital technologies" [6]- concludes. In this study, we explore the importance of research-oriented investments in the implementation of digitalization innovations in production, sales, supply and management processes in industrial enterprises, with a special focus on the interconnections in production and logistics, digital value chains and big data analytics.

III. METHODS

The theoretical and methodological basis of the research was based on the scientific works of local and foreign scientists on digital innovative management models, digital management models used by enterprises of developed countries were studied, and the processes of applying digital technologies were used using scientific abstraction, evaluation, induction and deduction, comparison and analysis methods based on a systematic approach.

IV. RESULTS AND DISCUSSION

Innovation in the chemical industry of developed countries is directly related to science - it is carried out in the development of products and technologies that help to make life healthier, safer, more sustainable and more efficient, and to grow food products. If we analyze the funds spent on scientific research by developed countries, we can see that in 2019, 2 419 billion USA dollars were spent on scientific research in the world, among which the United States of America spent the most money on research and development (R&D), followed by the People's Republic of China. (Table 1). South Korea spent the largest share of GDP (4.64%) on scientific research. Over time, the United States' R&D spending - as a share of GDP - has been declining as other countries, particularly middle-income countries such as China and India, have increased R&D spending since the turn of the century.

Table 1. Countries that spent large amounts of money in 2019 for the development of new digital technologies

Countries	Amount spent (US\$ billion)	Share of GDP
USA	668.4	3.13%
China	525.7	2.23%
Japan	173.3	3.20%
Germany	148.1	3.19%
Korea	102.5	4.64%
India	58.7	0.65%
Great Britain	56.9	1.76%
Global total	2 419.1	2.48%

Source: OECD

U.S. R&D spending is divided into five sectors: chemical (including pharmaceuticals), computer and electronics, transportation equipment (including automotive and aerospace), professional services (including computer systems design), and information services (including software publishing).

Academic research shows that research productivity has declined over the past few decades. In other words, it takes more research and development resources to achieve a unit increase in productivity today than decades ago. This means that innovation-based R&D is becoming more expensive over time, and yet such investment is key to economic growth.

While research in the chemical industry was once conducted mainly in laboratories, modern research and development in the chemical industry today goes beyond the development of new chemical compounds and products through innovative digital technologies. Digital technologies include a wide range of activities, such as research into manufacturing improvements, new uses for existing products, the use of artificial intelligence, and digitization of processes. Investment in research and development is the investment of resources in the present in return for an expected flow of benefits in the future. It represents the distribution of resources and increasingly digital technologies to people, as opposed to simply increasing output. Companies are absorbing many ideas from outside, including open innovation thinking through customer collaboration and Big Data. As a result, there is a direct connection between research and development activities and their commercialization, and strategic business units of many companies are defining research and development programs that match their goals and objectives.

Research and development includes three types of activities: **basic** research, **applied** research and **experimental** research.

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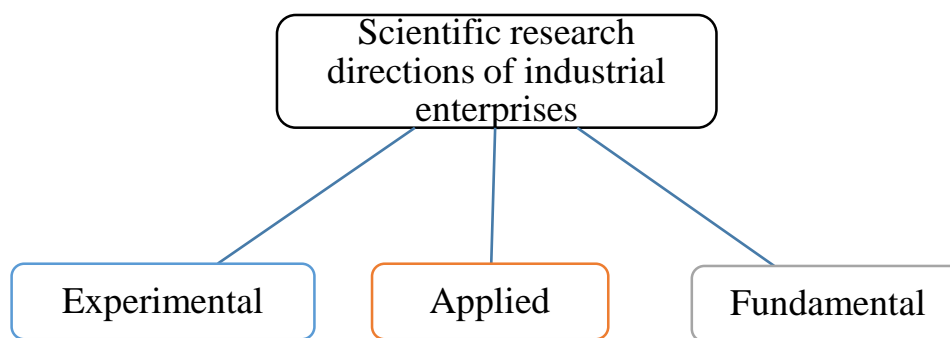


Figure 1. Scientific research directions of industrial enterprises

Basic research is **fundamental research**, regardless of commercial goals, and it includes work conducted in search of new knowledge based on the principles of general validity. **Applied research**, on the other hand, is outcome-based, designed to achieve a specific goal. **Experimental research** uses the results of research to produce new products or services.

Chemical industry companies allocate an average of 2-3% of annual sales to research and development, although some companies can allocate up to 8-9%. Unlike some other manufacturing industries, which receive government funding for research, the chemical business in the USA typically finances its own R&D. For example, in 2019, chemical companies funded 91% of their R&D, while 46% of R&D in aerospace products and spare parts was funded by the Federal budget. [8]

Over the past century, the R&D of the chemical business has continued to expand, and even in times of low profitability, chemical companies have continued R&D. In recent years, there has been a growing interest in data-driven R&D, which has become more and more accessible in the age of digitization. In addition to traditional researchers, companies are integrating technologies such as artificial intelligence and digital simulation into their R&D processes.

Table 2. Funds spent on scientific research by chemical industry enterprises in the United States

	2017	2018	2019	2020	2021	2022
Business of Chemistry (\$ billion)	10.9	11.3	10.5	10.1	12.8	13.4
As a % of it for logistics	2.1	2.1	2.1	2.2	2.2	2.1

Source: American Chemistry Council

As part of its annual economic survey, the ASS collects data on the percentage of revenue generated by new products and services. Analysis of this data shows that specialty chemical companies allocate a slightly higher proportion of revenues to new products and services than mainstream chemical companies. The data is not completely comparable from year to year.

Table 3. Investments in chemical industry activities

	2017	2018	2019	2020	2021	2022
Share of revenues from new products	12.7	17.8	14.2	14.1	14.7	11.4
An indicator of the ratio of research and development to products	6.1	8.7	6.9	6.5	6.7	5.4
New products profit share indicator	1.4	1.8	1.5	1.6	1.2	1

Source: American Chemistry Council

Innovation - the realization of ideas through knowledge to create new products and services to meet current and future customer needs - is a long-term driver of future financial performance and value creation. This provides business opportunities as well as a stable foundation for continued growth. Innovation can lead to changes in relative cost relationships and provide sustainable competitive advantages. In fact, it is at the heart of the chemical business and is critical to economic growth and improving the quality of life.

V. CONCLUSION & SUGGESTION

The enterprises of the chemical industry should introduce and constantly develop the use of innovative digital technologies in terms of the organization and simplification of product production, their delivery and after-sales services. For this purpose, it carries out constant updates to create reliable information technologies, new scientific and chemical developments, supply chain

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management, implementation of network processes, maintaining office efficiency, business and production management systems. As technology continues to advance, the chemical industry is required to expand its use of digital technologies to improve the way it does business.

By implementing digital technologies, industrial enterprises:

- improves product and process development;
- Supply chain integration promotes greater organizational flexibility to meet changing customer needs;
- Accelerates management decision-making;
- Companies collaborate with customers and suppliers to deliver greater value.

Investments directed to scientific research by industrial enterprises:

- introduction of modern information technologies and technological re-equipment in industrial enterprises;
- automation of all stages of enterprise supply and improvement of the management system;
- improving the quality of products and services, reducing their cost, production interruptions, increasing the transparency of financial and economic activities due to the development of modern information systems and software products;
- automation of workplaces and robotization of production processes, as well as creation of artificial intelligence technologies;
- creation and improvement of interaction mechanisms with customers (customers) in order to increase the volume of sales and improve customer service;
- creation of platforms for selling products and services produced by enterprises through the Internet global information network;
- it will be appropriate if it is directed to the establishment of departments conducting research in robotics and engineering specialties in large industrial enterprises.

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