

TECHNOLOGICAL MANAGEMENT AND AUDIT WHEN IMPLEMENTING GREEN TECHNOLOGIES

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Abstract

At the present stage, the competitiveness of modern corporations depends not only on the demand and quality of products, but also on the level of environmental responsibility of the business. Reducing the negative impact on the environment and increasing labor productivity is achieved through the introduction of innovative green technologies. This article examines the essence of green technologies, features of technology management and technology audit during their implementation. Environmental safety is one of the most important aspects of sustainable development and ensuring the quality of human life. The concept of environmental safety is closely related to the use of green technologies in all sectors of economic activity - industrial production, agriculture, energy, construction and transport. Ensuring environmental safety contributes to the conservation of biodiversity, maintaining clean air, water resources and soils, as well as reducing the level of environmental pollution. This article analyzes the impact of green technological trends on ensuring environmental safety at the regional, national and global levels.

Keywords: global levels, reproductive health, environmental sustainability, public policy, partnership, environmental safety

I. Introduction

Green technologies (GreenTech) are a set of innovative technological developments aimed at reducing the environmental footprint of production and efficient use of resources. They play a key role in addressing many global challenges related to the environment, energy, climate and sustainable development. Modern researchers distinguish between green technologies aimed at reducing greenhouse gas emissions, pollutants and waste, technologies for increasing energy efficiency and innovative solutions aimed at saving water, land, forests and other natural resources.

Green technologies are used in various sectors of the economy. Thus, in the energy sector, green technologies involve the development and use of renewable energy sources such as solar, wind, geothermal and hydropower. In the transportation industry, these are represented by electric vehicles, hybrid and autonomous vehicles, and the development of low-emission public transport. In industry, green technologies include methods of recycling waste, introducing processes and technologies with minimal use of resources and reducing emissions of harmful substances. Precision and organic farming methods, smart irrigation and soil monitoring systems, as well as biological waste decomposition technologies are used in agriculture. In the construction sector, energy-efficient buildings are erected using environmentally friendly materials. In each of these industries, green technologies play a key role in the transition to a sustainable and environmentally responsible development model.

Green technologies play a key role in the formation of a green economy, which is focused on sustainable development and minimizing the negative impact on the environment. The green economy is a concept of economic development based on the principles of sustainable use of resources, protection of the environment and promotion of social well-being. Unlike traditional economics, which focuses on maximizing economic growth at the expense of the environment and resources, green economics strives to create economic structures and processes that promote the conservation of natural resources, the reduction of pollutant emissions, and the improvement of quality of life.

One example of the successful implementation of green technology is the use of solar energy systems to supply electricity to households and businesses. Thus, several years ago, the city authorities of Los Angeles invested in the installation of solar panels on the roofs of buildings and the introduction of solar farms throughout the city. This has significantly reduced dependence on fossil fuels, reduced greenhouse gas emissions and provided energy to a significant portion of domestic and industrial consumers. Additionally, government incentive programs have enabled many residents and businesses to benefit financially from installing solar panels.

II. Methods

The introduction of environmentally friendly materials, technologies and practices can be carried out at various stages of the production process - from the extraction of natural resources to the final product (Fig. 1).

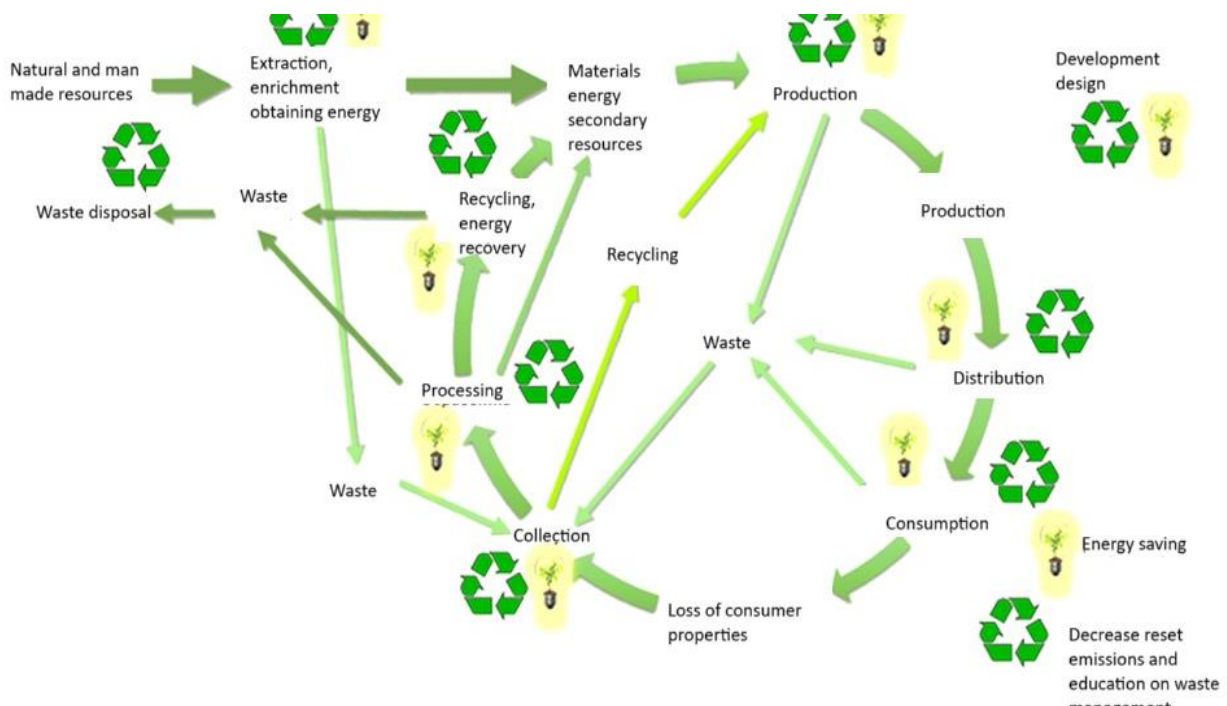


Figure 1 – Application of green technologies at various stages of the economic cycle

The introduction of green technologies requires a comprehensive restructuring of the production system and can be associated with a number of difficulties. Thus, modern innovative technologies require significant investments at the implementation stage due to the high cost of technological equipment, the need to modify infrastructure and train personnel. Many green technologies have not undergone extensive testing and may demonstrate unreasonably low economic efficiency, which will have a negative impact on the financial stability of the corporation implementing them.

The lack of government regulatory mechanisms and economic incentives also slows down the implementation of green technologies. Companies may also face resistance from stakeholders who are unwilling to transform established practices and processes. In addition, the field of innovative

technologies is always associated with a high level of uncertainty and risk, which can become an obstacle to making a decision on implementation.

Overcoming these difficulties requires an integrated approach implemented within a separate management sphere - technology management, which focuses on the effective management of technological resources, processes and innovations in the organization. The main goal of technology management when introducing green technologies is to effectively manage the process of integrating environmentally sustainable and energy-efficient technologies into the organization's activities. Local goals set for the technology management system may include optimizing the use of resources, introducing innovations, ensuring compliance with environmental standards, increasing competitiveness, improving reputation and relations with stakeholders [1].

The subjects of technological management in the context of the introduction of green technologies in corporations are:

- top management of the corporation – develops a strategy for the introduction of green technologies, makes management decisions on financing, creates incentives for innovation and changes in corporate culture;
- technological development department - is responsible for the development and testing of new green technologies, as well as for their integration into the corporation's current business processes;
- technical control department – carries out independent control of product quality, ensures compliance with standards in the field of sustainable development;
- Risk Management Department – ensures assessment of risks associated with the introduction of green technologies, develops measures to minimize them;
- Supply and Purchasing Department - responsible for sourcing suppliers of environmentally sustainable materials, equipment and services, as well as for establishing long-term relationships with suppliers that comply with environmental standards;
- personnel training and development department – prepares employees to work with new green technologies, ensures their understanding of the goals and tools of sustainable development.
- Suppliers, customers, investors, non-governmental organizations and other external stakeholders can also be involved in the corporation's technology management to exchange information, resources and experience, and to implement joint sustainability initiatives.

The objects of technological management are the technological aspects of the corporation's activities, which are subject to transformation to achieve specific strategic and operational goals. In the context of the introduction of green technologies, the objects of technological management are innovative technologies, production processes, equipment and infrastructure, manufactured products, as well as local regulations of the organization.

Within the framework of technology management, a project approach is most often used, taking into account the life cycle of implemented innovations. The life cycle of any (including green technologies) is presented in Fig. 2.

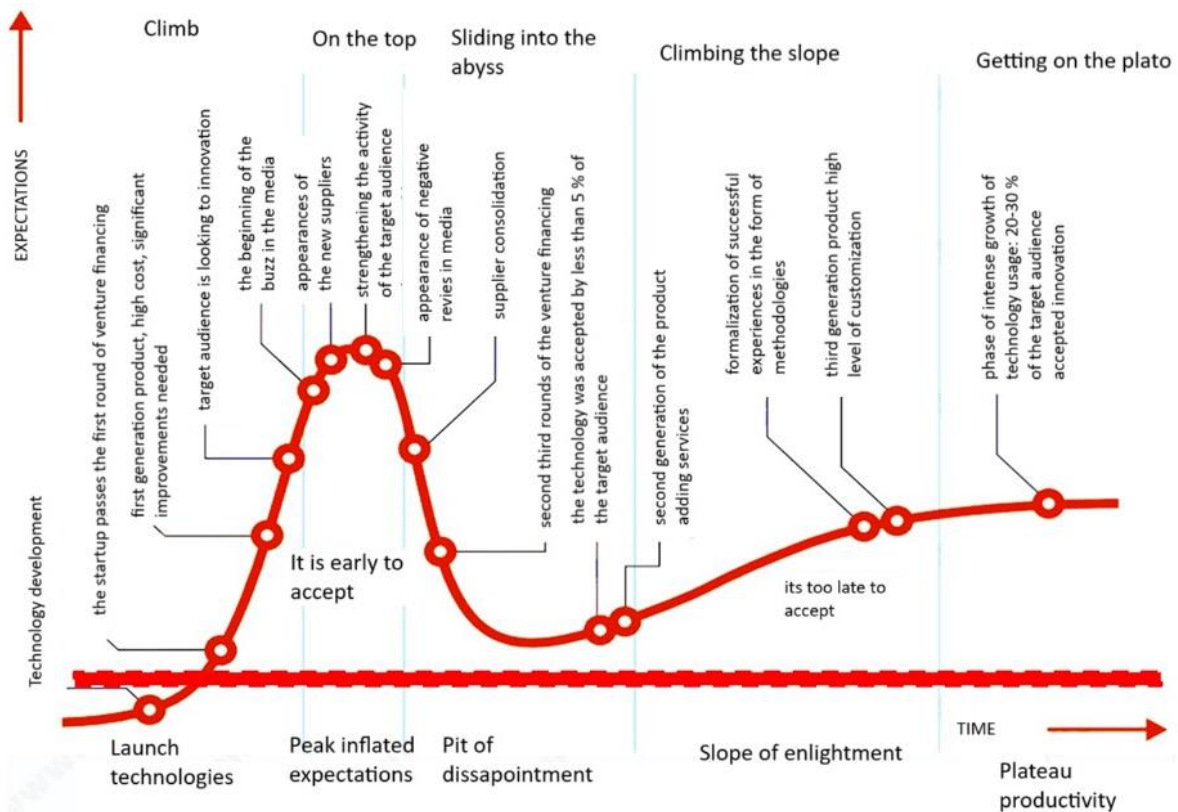


Figure 2 – Life cycle of green technologies [3]

The life cycle of green technologies is the sequence of development stages that a technology goes through from its development to the end of its use. The initial stages of the life cycle involve research and development of green technologies, involving the creation of prototypes and testing of their effectiveness. Next, the technology is gradually introduced, including preparation of infrastructure, personnel training and commissioning. During the period of operation of the technology, its active use and monitoring of effectiveness occur. As a corporation's requirements and capabilities change, technology may be updated and upgraded. At the end of the technology's life cycle, disposal procedures for associated objects are carried out to minimize the negative impact on the environment and increase the efficiency of resource use.

Thus, technology management in the field of green technologies plays an important role in the development, implementation and management of environmentally sustainable innovations that help reduce negative environmental impacts, improve energy efficiency and increase the competitiveness of the organization. It represents a key tool for achieving sustainable development and ensuring long-term success in the modern world.

The effectiveness of the implementation and use of green technologies is tested as part of the organization's technology audit. In accordance with the provisions of the National Standard GOST R 57194.3-2016 "Technology Transfer. Technological audit" technological audit is a set of works to assess the state and capabilities of the production and technological base of the organization, the results of intellectual activity in accordance with the terms of reference for the audit, including the development of proposals for the modernization of the production and technological base. The main purpose of a technology audit is to identify opportunities to improve the efficiency of technology use, optimize the use of resources, improve the quality of products or services, and reduce costs and risks.

Technology audits in green technology adoption play a key role in assessing the current state of technology infrastructure and identifying opportunities for implementing environmentally sustainable solutions. As part of a technology audit, the environmental efficiency of existing technologies is analyzed and the potential for their improvement is identified. When conducting a technology audit,

such areas as strategic, current and operational planning, product quality, level of personnel training, sufficiency of technological resources, the use of in-house or third-party innovative developments, and experience in introducing innovations in the technological process are also assessed. Based on the audit results, specific areas are identified where the implementation of environmentally sustainable technologies can bring the greatest benefit - this could be the introduction of renewable energy sources, improving energy saving systems, optimizing the use of resources, recycling production waste and much more.

Technological management in modern corporations is divided into three levels: strategic, functional and linear, on the basis of which, in turn, three levels of audit are distinguished. At the strategic level, a technology audit includes interviewing people filling key positions in the corporation, studying strategic plans for the functioning of technological systems, and analyzing the dynamics of change. At the functional level, a technological audit is designed to identify the efficiency of departments and identify problem areas in ensuring the environmental safety of production processes. Auditors determine the compliance of the results with the goals set, analyze costs and the possibility of increasing the efficiency of the management procedure.

At the linear level, a technology audit is designed to determine the effectiveness of using specific technologies within an organization or within a specific project. It aims to identify problem areas, bottlenecks and opportunities to improve production processes, reduce costs and increase competitiveness. Also, the purpose of a technology audit at the line level may be to assess the compliance of technologies with standards and regulations, including environmental and safety requirements. The audit may identify potential areas for introducing green technologies, upgrading existing systems, or training staff to make optimal use of available resources.

The technology audit was carried out by a special working group, which can be formed both within the corporation itself and within parent organizations. The working group should include personnel management specialists, labor law experts, auditors and sociologists.

There are three methods of conducting a technology audit, depending on its goals, timing and parameters: operational, situational and comprehensive [2]. The operational methodology is used if it is urgently necessary to obtain information about the technological state of the organization. The main characteristic of this technique is the speed of obtaining results, which are provided in an abbreviated form. Audit data relates to key production positions, and this data should be sufficient to make operational management decisions. A technological audit using operational methods is carried out in an extremely short time frame – no more than 15 days.

Conclusion

A situational audit methodology is necessary to obtain information about the state of the organization when introducing new technologies and diagnosing technological management. The volume of data in this case is much more extensive compared to the operational technique. The duration varies from 15 to 30 days. An integrated methodology involves obtaining the most complete information about the current state of a technological system, analyzing its effectiveness and influencing decision-making that is strategically important for the relevant economic entity. A comprehensive technology audit methodology is used in cases of radical changes in the profile of a company's activities and in the event of other global transformations.

A technological audit is carried out in accordance with a plan, which must contain a sequence of measures to achieve the goals and objectives of the audit, indicating the timing of their implementation and specific performers from among auditors and technical experts. The technology audit plan is also a means of monitoring and verifying the quality of work performed by the technology audit team. During the technological audit, a list of key issues approved by GOST R 57194.3-2016 is used. These include problems in the field of strategic planning, the use of innovations in the technological process, the provision of material and human resources, the organization of the production process, as well as other issues at the discretion of the auditors.

The SWOT analysis method and the decision tree method used based on the results of the audit allow us to structure problems and make informed management decisions on the implementation of green technologies. Also, in the process of technology audit, the benchmarking technique can be used - comparative analysis based on benchmark indicators. Benchmarking allows you to identify the best green practices and transfer them to a specific organization. The choice of technology audit methodology depends on the goals, specifics and needs of a particular organization, as well as on the nature and scope of the audit. A combination of different techniques may be most effective for a complete and comprehensive analysis of the technological aspects of an organization.

Thus, as part of a technology audit, data is systematically collected on production policies, processes and practices in the activities of the corporation under study using methods of monitoring the production process, questionnaires, interviews, analysis of documentation and statistical data. It is of great importance to conduct a thorough analysis of the compliance of production practices with current standards, regulations and standards, including those related to ensuring environmentally friendly production. Based on the results of the technology audit, specific recommendations are developed to optimize production activities, introduce green technologies and ensure sustainable development of the organization.

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