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TECHNOLOGY INCUBATOR AS AN ELEMENT OF THE INNOVATION ECOSYSTEM. (The Role of a Technology Incubator in the Innovation Ecosystem of Industrial and Agricultural Production Development)

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Abstract

This article examines the role of technology incubators as essential components of the innovation ecosystem, facilitating the effective transformation of scientific ideas, engineering developments, and promising technological solutions into commercially viable products and services. Particular attention is given to the organizational, technological, and economic mechanisms involved in creating a favorable innovation environment that promotes the accelerated development of startups and the implementation of new technologies in industrial and agro-industrial production.

The publication provides an analysis of the formation and development of technology incubators as specialized structures supporting innovation activities. The study explores the fundamental principles governing their operation, including expert project support, the integration of scientific potential with industrial resources, the attraction of investment capital, and the creation of conditions necessary for the commercialization of advanced developments.

Special emphasis is placed on the significance of technology incubators for the development of industrial and agricultural production, the enhancement of enterprise competitiveness, the implementation of modern digital technologies, and the formation of sustainable innovation ecosystems. The article also analyzes opportunities for cooperation between technology incubators, research institutions, industrial enterprises, investment organizations, and governmental development agencies.

The study highlights that technology incubators represent an effective instrument for supporting innovative entrepreneurship and fostering the emergence of new high-technology sectors. By accelerating the transfer of scientific and technological achievements into practical applications, technology incubators contribute to the long-term innovative development of industrial and agro-industrial complexes and promote sustainable economic growth.

Keywords: *Technology incubator; Innovation ecosystem; Effective implementation; Innovative development model of industrial and agricultural production; Ecosystem infrastructure*

framework; Quantum computing; Augmented reality visualization; Testing laboratories; Laws of technical system evolution; Standardization; Technology transfer

Introduction

The laws and practices governing the comprehensive development of integrated technical systems and supersystems under conditions involving the application of quantum computers and their simplified modifications, combined with embedded elements of artificial intelligence and artificial neural networks, represent an increasingly important area of scientific and technological research.

Due to the critical role played by analytical efficiency in determining the success of innovative initiatives and the appropriateness of patent and licensing strategies for projects incorporating highly novel technical and software solutions, investors and managers of new, pioneering projects frequently encounter a shortage of computational performance and analytical depth required for the real-time processing and modeling of complex innovation-related processes using conventional computing systems.

Information regarding the successful testing of a quantum computer developed by Google Corporation has provided a well-founded basis for optimism concerning progress in this field.

According to the generally accepted definition, a quantum computer is a computational device that utilizes the phenomena of quantum mechanics for data transmission and processing.

Unlike conventional computers, which operate using bits capable of assuming either a value of 0 or 1, quantum computers operate using qubits, which can simultaneously represent both 0 and 1. Theoretically, this capability enables the simultaneous processing of all possible states of systems at various hierarchical levels, including both subsystems and supersystems, thereby providing substantial advantages over traditional computing architectures.

Furthermore, the absence of analytical tools of this type significantly increases the cost structure of innovative projects, as extensive computational modeling, high-speed iteration of alternative solutions, and comprehensive analytical evaluation of their feasibility and effectiveness become necessary.

At the same time, the laws governing the evolution of technical systems formulated within TRIZ (Theory of Inventive Problem Solving) are no longer capable of fully reflecting the diversity of functions, tasks, and characteristics associated with modern multifunctional innovation objects. Considering the emergence of numerous new factors influencing innovative systems, these laws require reformulation and integration with the principles governing the development of commercial organizations and the commercialization of innovative ideas.

Such formulations should be based on empirical data and the results obtained from quantum-computing research while taking into account the nature of the fundamental contradictions identified within innovative systems and technologies.

The dialectical approach based on contradiction analysis, which formed the foundation of ARIZ (Algorithm for Inventive Problem Solving), was subsequently modified through the introduction of concepts such as “technical contradiction” and “physical contradiction.” These concepts were originally intended to facilitate modeling under conditions where existing computer systems lacked sufficient computational power and processing speed to support real-time simulation of complex innovation processes.

However, the introduction of these additional concepts partially distorted the original meaning of dialectical contradiction as defined within dialectical logic. As a result, significant difficulties emerged when attempting to identify and resolve contradictions within real-world inventive and innovation-oriented tasks using ARIZ methodologies, primarily due to limitations in computational resources and the inability to perform sufficiently deep and comprehensive process modeling.

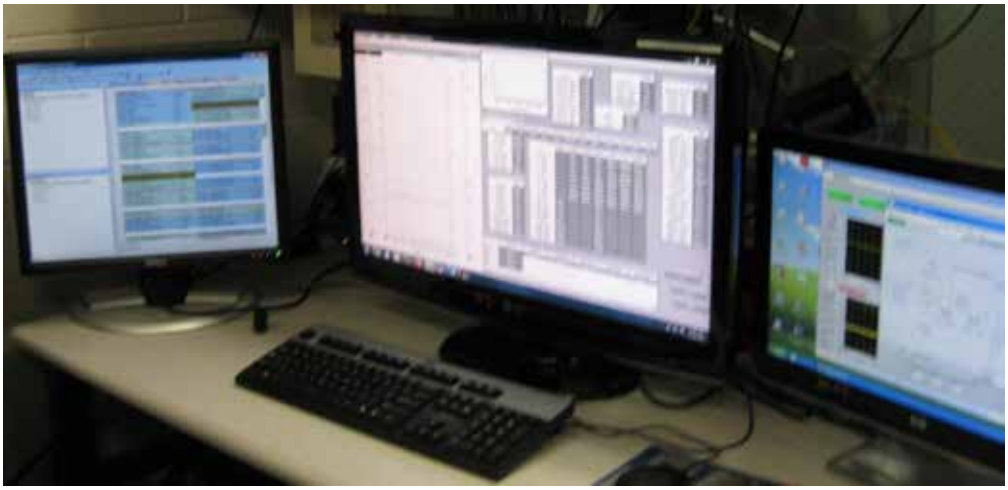
Particular attention should be devoted to a fundamentally important question: what should be considered a genuine inventive innovation problem?

From the perspective of investors and project managers, effective analytical assessment of project development requires a clear

understanding of the relationship between the formulation of an inventive problem and its impact on the commercialization of the resulting invention. An accurate or inaccurate formulation of project objectives and inventive tasks, especially in the absence of step-by-step analytical modeling, may lead to uncertainty regarding a fundamental issue: whether the resulting technical solution can be reliably protected against unauthorized copying and imitation.

The search for answers to these and many other related questions has become an essential component of the modern methodology for developing innovation strategies, establishing effective commercialization pathways, and ensuring reliable patent protection and licensing of inventions created throughout all stages of innovation project development.

Figure 1.



The following provides a brief overview of the organizational structure, activities, scientific collaborations, and industrial partnerships of existing technology incubators.

Government Structures Supporting Innovation Development

Technology incubators are government-supported organizations established to facilitate the development, financing, and commercialization of innovative projects, helping them successfully transition into independent participants within competitive markets.

Technology incubators operate under the supervision of the Ministry of Industry and Trade and, to a certain extent, the Ministry of Agriculture.

Both ministries maintain dedicated budgets for supporting the activities of technology incubators. Separate funding mechanisms are allocated for direct investment in innovative projects and for financing project management and administrative activities.

Chief Scientist of the Ministry of Industry and Trade

The position of Chief Scientist, together with the corresponding department, has been established to provide methodological support to technology incubators and to oversee the selection, evaluation, and monitoring of projects conducted within the incubator system.

The Office of the Chief Scientist includes divisions and groups of highly qualified experts, both permanent and external, who carry primary responsibility for evaluating innovative projects and recommending them for inclusion in the thematic development programs of technology incubators.

Each expert supervises several projects located in different incubators and serves as a key participant in the monitoring, evaluation, and financing of these projects.

Export Institute

The Export Institute provides projects within technology incubators with comprehensive methodological, informational, and consulting support.

In addition, the Export Institute offers substantial competitive grants, often reaching approximately USD120,000, for projects demonstrating significant export potential.

The Institute also assists in the preparation of promotional materials, prospectuses, technical documentation, and marketing publications, while actively supporting the introduction of newly developed innovative products into international markets.

National Standards Institute

Compliance with international standards is one of the fundamental prerequisites for successful commercialization and market entry of innovative products. Consequently, a well-established practice of continuous cooperation has developed between technology incubators and the National Standards Institute.

An equally important factor is the exceptionally high quality of technical evaluation, certification, testing, and performance verification conducted within the Institute's laboratories. These assessments are performed using advanced testing and measurement equipment, ensuring objective and reliable validation of the technical characteristics of innovative products before their commercialization and market deployment.

Figure 2.

Commercial Testing Laboratories

In addition to the National Standards Institute, there also exists an extensive network of commercial testing laboratories capable of conducting testing and certification of innovative products in accordance with regulatory standards and technical requirements that may not be recognized or adopted in certain jurisdictions, including European countries.

Furthermore, standards corresponding to internationally accepted measurements, technical specifications, weight systems, dimensional requirements, and other regulatory parameters are not always uniformly implemented in the countries to which innovative products are intended to be exported.

To address this challenge and to obtain reliable information regarding compliance with local regulatory requirements during the product development stage, technology incubators actively utilize the advantages

provided by cooperation with commercial testing laboratories.

Such cooperation enables developers and project managers to identify potential compliance issues at an early stage, optimize product specifications for target markets, reduce certification risks, accelerate market entry procedures, and improve the overall competitiveness of innovative products in international markets.

As a result, commercial testing laboratories serve as an important component of the innovation ecosystem, complementing the activities of governmental standardization institutions and contributing to the successful commercialization and international expansion of innovative technologies and products.

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