The Austrian Journal of Technical and Natural Sciences, 2026 No 3–4
ISSN 2310-5607

PREMIER Publishing
ppublishing.org

Section 5. Food processing industry

DOI:10.29013/AJT-26-3.4-140-146

ACTIVATING FOUNDATION FOR THE DEVELOPMENT OF COMBINED SOFTWARE PRODUCTS (Compositional integrated technical solutions as a necessary foundational framework for the development of combined software products equivalent to comprehensive system-level integrative inventions)

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Cite: *Skokova L. (2026). Activating Foundation for the Development of Combined Software Products. (Compositional integrated technical solutions as a necessary foundational framework for the development of combined software products equivalent to comprehensive system-level integrative inventions). Austrian Journal of Technical and Natural Sciences 2026, No 3–4.* https://doi.org/10.29013/AJT-26-3.4-140-146

Abstract

This article examines the growing integration of complex combined software products into modern industrial, commercial, and technological processes, where digital systems increasingly consist of numerous interrelated functional elements originally developed as independent or weakly connected components. The article emphasizes the need for fundamentally new approaches to the design and structuring of technical architectures capable of integrating such disparate elements into unified functional systems. Particular attention is devoted to substantiating the necessity of developing compositional and integrative technical solutions as the foundational basis for creating advanced combined software products. The study analyzes the technological, structural, and organizational prerequisites for such integration, including the increasing complexity of digital infrastructure, the development of multifunctional cyber-physical systems, and the growing demand for scalable and interoperable software architectures. It is demonstrated that the implementation of compositional integrative technical solutions enhances system interoperability, improves operational reliability, reduces structural redundancy, and enables the creation of scalable platforms for application in smart manufacturing, intelligent infrastructure, industrial automation, and other high-technology sectors. The article concludes that compositional integrative technical solutions constitute a key technological foundation for the development of the next generation of combined software products.

Keywords: *Combined software products, compositional integrated technical solutions,*

characteristics and properties of fundamentally new materials and their combinations with traditional materials. achievement of smart manufacturing level, presence of composite materials, particularly carbon – carbon composites. formation of positive perception of new products, real-time quality control capabilities at all stages of the production process

Introduction:

The near-complete transition of developed economies to innovative methods of planning and management establishes new qualification criteria for the technical solutions being applied. Under such conditions, any type of production must progressively transform and optimize its technological and commercial assets in order to maintain competitiveness and achieve the level of so-called smart manufacturing.

At the same time, establishing production solely for the sake of production, without a well-developed strategic framework – including effective informational tools for attracting partners and clients, such as dynamic web-based information systems – has limited practical value. Within the paradigm of smart manufacturing, increasing attention is being devoted to this aspect, including the parallel development of appropriate software tools and methods, as well as the integration of advanced visualization technologies, such as three-dimensional graphics, capable of conveying extensive information regarding applied innovative technologies, equipment, and materials.

Taking into account that, for example, new patent legislation has been adopted and implemented in the United States, it is advisable to consider in greater detail the inclusion of information about advanced developments used in marketed products. Such developments may be evaluated for compliance with the fundamental criteria of patentability, particularly the criterion of non-obviousness of the technical solution.

At the same time, from a commercial standpoint, it is essential to preserve all possible levels of intellectual property protection, even in cases where full legal protection has not yet been established and the product is already being introduced to the market.

A key question arises as to what type of information, and in what form, can effectively convey to stakeholders the necessary level of understanding to form a positive perception of a new product and its associated informational context. First and foremost, such information includes data on fundamentally new materials used in the innovative product, as well as their combinations with traditional materials that are well established in the market.

However, disclosure of detailed information regarding such materials and their applications must be approached with appropriate caution, as premature disclosure may compromise the criterion of novelty and limit the potential for patent protection of the product or its components.

Figure 1. *Example of a compositional integrated technical solution incorporating combined software products integrated with comprehensive system-level inventions in the field of environmentally friendly and fully automated dairy production*

A significant role in ensuring the required technical performance and consumer properties of modern products is played by the use of composite materials, particularly carbon-carbon composites. These innovative materials are typically integrated with advanced manufacturing technologies, and within the framework of smart manufacturing, one of the most valuable features is the ability to perform real-time quality control at all stages of the production process.

Finally, the manner in which information is presented – including on web platforms – is increasingly influenced by evolving consumer standards, as well as by emerging environmental requirements and

their perception across different segments of the global market.

Presence of Fundamentally New Materials

Fundamentally new materials today may exist in a wide variety of forms and serve diverse functions, and can be applied in innovative products for multiple technical and operational reasons.

One of the most significant aspects in the search for and utilization of such advanced structural materials is the requirement to manufacture components and elements of new products using technologically advanced equipment with digital numerical control.

Within this equipment, there is substantial potential for the application of new structural and tool materials and alloys, particularly cutting materials characterized by increased hardness and durability. In recent years, metal-ceramic materials and their various modifications have gained particular prominence in this field. The use of such materials significantly enhances the reliability and precision of metal-cutting tools, as well as the overall productivity of manufacturing equipment. With the emergence of 3D printing technologies for structural materials, there is an increasing demand for a wide range of polymer materials and their ceramic equivalents. The variability in this area is extensive, encompassing a broad spectrum of end products that differ substantially in their technical characteristics, including mass and weight parameters, as well as their practical fields of application. As is known from patent law, the mere replacement of a previously used structural material with a new, or even fundamentally new, material does not in itself constitute an invention. At the same time, such a substitution is not always feasible without additional technical solutions. A complete replacement typically requires supplementary design, circuit-level, and component-level modifications.

As a rule, it is precisely the combination of material substitution with corresponding changes in product properties and performance characteristics that leads to the formation of a comprehensive technical solution. The distinguishing features of such a solution determine its compliance with the criteria of patentability, including the requirement of non-obviousness for a person having ordinary skill in the art.

Figure 2. *Example of the application of fundamentally new materials in fire protection, as demonstrated at an international exhibition of protective technologies and materials. This type of information does not disclose manufacturing, technological, design, or operational secrets, while still allowing potential customers to understand the key advantages and capabilities of new products*

In most cases, when a new product is developed, manufactured, and tested within a single working group or startup team, patent searches and qualification of the technical solution for compliance with patentability criteria can only be effectively conducted after the completion of all production testing cycles and final qualification tests confirming the actual technical performance of the product.

If the product incorporates a control and monitoring processor or a group of processors, the scope of the patent search expands, and both the structure of the invention and the search methodology evolve accordingly. In such cases, the invention typically assumes a multi-component form: device, system, program, and method.

Thus, the novelty of an innovative product is formed by a set of interdependent distinguishing features related to different aspects of its functional characteristics. Particular attention in this integrative identification process is given to the use of fundamentally new structural materials, as well as innovative technological media such as solutions, emulsions, and aerosols.

The methodology for presenting such innovations to potential users is largely determined by the level of informational content provided through the developer's and manufacturer's web platform. Since, under U.S. and other innovation-driven patent systems, simple material substitution does not qualify as an invention, the correct presentation of technological and design advantages – without disclosing critical details – makes it possible to preserve the novelty of the product while still providing sufficient information for informed decision-making by potential stakeholders.

The boundary between fundamentally new materials and composite materials may be relatively narrow; however, composite materials warrant separate consideration due to their distinct functional and structural characteristics.

Presence of Composite Materials

Figure 3 A. *Example of the use of innovative composite materials, specifically phosphors, in laser technology and fiber optics; red phosphor*

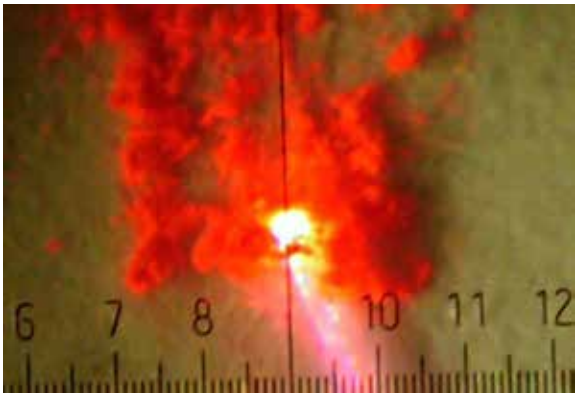
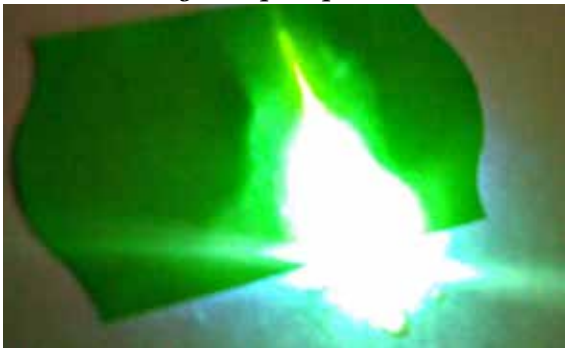


Figure 3 B. *Example of the use of innovative composite materials, specifically phosphors, in laser technology and fiber optics; green phosphor*



The phosphors shown in Figures 3A and 3B are intended for use in disposable surgical laser instruments.

Application of Composite Materials

The use of composite materials fundamentally transforms the principles of industrial design. Previously, the selection of structural materials was strictly determined by their inherent properties and parameters, such as strength, elasticity, resilience, chemical resistance, durability, specific weight, and electrical resistance. However, with the introduction of composite materials, it has become possible to actively control and tailor material properties and performance characteristics by adjusting the composition of their constituent components and the interactions between them.

This is particularly evident in the case of carbon-carbon composites. Such materials are typically produced through a multilayer pyrolysis process carried out in a vacuum environment on a viscose-based substrate. The number of pyrolysis layers can be varied depending on specific requirements, thereby allowing for precise pre-determination of the resulting material properties. As a result, using the same equipment – namely, tunnel-type vacuum furnaces – it is possible to manufacture both flexible and rigid electrodes for electrochemical cells, as well as flexible permeable contacts for electrochemical reactors.

The above demonstrates that, based on identical technological processes, a wide range of innovative products can be produced using essentially the same production equipment.

One of the key objectives of combined software products is to provide targeted presentation – such as through web platforms – of all aspects of the innovative capabilities associated with composite materials. This includes the ability to adjust the output parameters of final products by modifying the properties of the composites used in their manufacturing.

New Directions in Manufacturing Technologies

Production lines at modern industrial enterprises represent complex and capital-intensive systems. Any modification of production conditions or requirements

inevitably leads to significant adjustments and reconfiguration of these technological lines.

Figure 4. *Example of the experimental integration of an innovative system for regeneration of process water without the use of chemical reagents into a typical modern food production facility*

As the primary tool for electrochemical treatment of contaminated water, the system employs an electrochemical reactor, which constitutes an integrative invention. In this context, the key objective is not to replace the core production equipment, but rather to modernize it by integrating new components into the existing technological workflow wherever possible.

Such an approach – enabling significant modernization with minimal modifications and, consequently, minimal costs – largely determines the feasibility of implementing new products and technologies at operating industrial facilities.

New Consumer Standards

Figure 5. *Example of developers' response to increased consumer requirements for the level of cybersecurity, including for web resources*

Compositional Commercial Solutions in an Innovation-Driven Economy

Compositional commercial solutions in an innovation-driven economy require an appropriate approach from developers at all levels, particularly from developers of combined software products, including web platform developers.

Today, consumers place primary emphasis on ensuring comprehensive information security, while simultaneously expecting maximum transparency and clarity in the presentation of content.

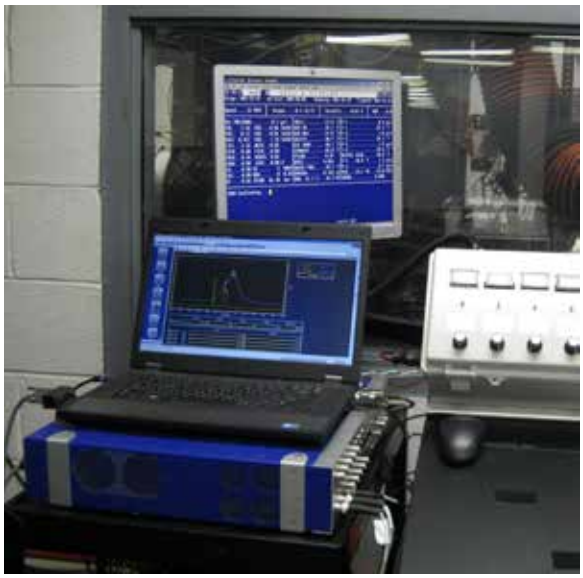
In turn, developers of relevant software solutions are equally interested in achieving the highest possible level of protection for their developments, while also maintaining the ability to provide users with a complete and informative representation of their products and technologies.

New Environmental Standards

Figure 6. *Example of an ultra-clean and environmentally friendly technological module at a high-quality food production facility. Readers are invited to assess the level of cleanliness and compliance with the most stringent environmental standards*

Despite the presence of ongoing ambiguities in the interpretation of environmental standards and regulatory constraints, the technologies used for monitoring are continuously improving, and the software ensuring the consistency and accuracy of control is being optimized and refined in parallel with the development of new measurement techniques and technologies.

Figure 7. *Example of a control system for monitoring the toxicity level of exhaust gases from a diesel engine using medium-viscosity diesel fuel*



In countries with advanced innovation-driven economies, significant attention is given to ensuring that environmental standards adequately reflect real operating conditions

Therefore, when presenting information – such as on web platforms – regarding the compliance of new products' technical characteristics and capabilities with environmental standards at the commercialization stage, it is also necessary to conduct a preliminary analysis and, to some extent, a forecast of potential future tightening of these requirements and threshold values. In cases where direct comparisons between product performance indicators at the commercialization stage and the tabulated regulatory limits of applicable environmental standards are not available, it is advisable to perform a systematic review through specialized laboratories and research institutes engaged in the development of relevant standards, guidelines, and regulatory documentation.

Criteria for assessing levels of environmental safety

Figure 8. *Example of a laboratory complex for analytical verification of compliance of exhaust gas toxicity levels with the requirements and limits of applicable environmental standards*

Since, for many categories of products, environmental performance indicators are inherently complex and may require – such as in the case of internal combustion engine emissions – the simultaneous monitoring of thousands of parameters, a systematic assessment and comparison of the environmental safety level with actual product performance necessitates specially developed comparison tables. These tables are based on mathematical models for analytical comparative evaluation of equivalent environmental safety levels, as defined in relevant official regulatory documents.

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submitted 15.04.2026;
accepted for publication 29.04.2026;
published 30.04.2026

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