Технічні науки

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VIRTUAL SCIENTIFIC AND TECHNICAL SUPPORT FOR STARTUPS

Startup Projects and Their Virtual Scientific and Technical Support for the Purpose of Accelerating the Development Process

Summary. *Even the boldest and most seemingly brilliant commercial and technological idea requires deep professional evaluation before it can become the foundation of an innovative project.*

Organizational issues, in virtually any new project, inevitably involve additional systemic coordination of knowledge levels and the technical-technological preparedness of the project team members.

As practice shows, even an ambiguous understanding of tasks and technical development requirements—caused by differing foundational knowledge and experience, as well as disparities in technical-technological culture among individuals from countries with uneven technological development—can significantly influence project outcomes.

Therefore, in the early decision-making stages, a clear and feasible methodology for deep and multidisciplinary search across available information arrays is required.

Typically, the search methodology—and most importantly, the methods of evaluating search results—demand much deeper knowledge in specific scientific and technical domains, and at the most advanced levels.

Project partners who previously had experience in real invention practices can certainly utilize their accumulated patent search experience, but such experience quickly becomes outdated. Every new direction in technological advancement instantly demands an adequate response in assessing the novelty potentially embedded in a declared idea for a new product.

To clearly formulate and assign tasks to the project team, it is necessary—considering the dynamics of the technology sector relevant to the new project—to develop a survey-based analytical matrix document. In this document, the primary search operations focus on analytically assessing distinctive features and positive effects precisely at the intersection of classical exact sciences.

Key words: *Commercial Idea, Technological Idea, Innovative Project, Ambiguous Understanding of Tasks, Technical Development Assignment, Methodology of Deep Multidisciplinary Search, Methods for Evaluating Search Results, Task Formulation for the Project Team, Accumulated Experience in Patent Search, Technology Sector Development Dynamics, Survey-Based Analytical Matrix Document, Analytical Assessment of Distinctive Features.*

Organizational aspects, in virtually any new project, inevitably include additional systemic coordination of knowledge levels and the technical-technological training of the project team members.

As practice shows, even an ambiguous understanding of the tasks and the technical specifications for development—stemming from differences in foundational knowledge and experience, as well as disparities in the technical-technological culture of individuals from countries with uneven technological development—can significantly impact the outcome of the project.

So-called "technological alignment" of team members in a group of developers working on a non-trivial technical task, if left to unfold spontaneously, may lead to unexpected and not always positive results.

Modern communication technologies open up many unusual channels and opportunities in this regard, but communication tools alone unfortunately do not define the content of the information being transmitted through these channels.

If, as is often the case today, the project team includes representatives of both developed and developing countries' technological cultures, even the varying levels of secondary school education—and, more importantly, differences in university-level training—demand a systemic leveling approach. Otherwise, there is a risk of disproportion in the design and functional principles of the various components and units of the future innovative, integrative startup product.

To define the key points and themes of a scientific and technological retraining program—and to standardize the starting level of specialized scientific and technical knowledge as well as technical and technological skills necessary for the consistent (yet fairly rapid) development of the project—a unique framework may be proposed. This framework includes a thematic selection process for such support training, along with a methodology of guided informational expansion and virtual influence aimed at transmitting essential knowledge and technical techniques to all team members involved in the project.

Innovative Problem Formulation

Even the boldest and most seemingly brilliant commercial and technological idea requires deep professional verification before it can become the subject of an innovative project.

Therefore, in the early stages of decision-making, a clear and feasible methodology for deep and multidisciplinary search across accessible information sources is essential.

As a rule, the search methodology—and more importantly, the methods for evaluating the results—require significantly deeper knowledge in specific fields of science and engineering, and at the most up-to-date level.

Future project partners who previously had experience and practice in real inventiveness may, of course, apply their accumulated expertise in patent search. However, this experience quickly becomes outdated, and every new direction in technological development instantly demands an adequate and current approach to assessing everything novel that might be embedded in a declared new product idea.

To clearly formulate and assign tasks to the project team, it is necessary—considering the development dynamics of the technology sector to which the new project belongs—to develop a survey-based analytical matrix document. Within this document, the core search operations should focus on the analytical evaluation of distinctive features and positive effects, particularly at the intersection of classical exact disciplines.

Heuristic brainstorming experience has shown that the most successful and practically implementable ideas typically arise at the junction of well-established disciplines and are characterized by multidimensional intellectual diffusion into the layers of classical science and technology.

The authors of this methodology plan to present clear analytical matrices in the following sections, enabling digital processing of the identified and selectively compiled information.

Only after such in-depth and comprehensive preparation can a foundational project model be formulated, followed by the consistent assignment of evolving project tasks.

The simulation and modeling of real-time feasibility and the practical conditions for completing the assigned task are also based on the same analytical matrices and evaluation principles.

Reliability of Modern Multifunctional Systems and the Potential of TRIZ and ARIZ to Enhance It

The reliability of a technical system—especially that of a complex hierarchy of localized technical segments, some of which are software-based and closely integrated with higher-level system elements—now carries numerous definitions and interpretations. Integrating these into a clear understanding of the situation is extremely difficult, and in most cases, nearly impossible.

Recently, some developments have emerged that propose identifying specific elements within the integrated reliability structure of a system—elements that determine the reliability of the most critical and potentially hazardous components—sometimes even at the expense of the system's overall complex reliability.

For example, engineers designing airplanes proposed treating malfunctions as inevitable and developed a new design approach for aircraft. Their work was accepted for publication in a scientific journal.

The distinguishing feature of this new approach is that, instead of optimizing an aircraft solely for its intended function, the engineers first focused on the potential malfunctions that could occur.

They analyzed statistics on various specific malfunctions and estimated the probabilities of their occurrence.

Each malfunction—from something as minor as a blown lightbulb to as serious as engine failure—was simulated to evaluate its impact on the overall aircraft, its controllability, and its aerodynamics.

As a result, the engineers built a failure interaction tree, which allowed them to identify exactly which components needed to be redesigned.

For instance, they analyzed failures in a small 12-seat military aircraft for which detailed failure statistics were available.

It turned out that in some failure scenarios, altering the aircraft’s geometry could significantly improve its safety. For example, if the rudder failed or one engine shut down, a design with a larger tail would behave more stably.

Such geometry changes might reduce aerodynamic efficiency, but they would drastically improve reliability.

This proposed approach could prove useful in the development of unmanned aerial vehicles, which cannot land for repairs and must continue operating at all costs.

Such is the case for aircraft conducting research in Antarctica, where there are no runways or maintenance personnel.

Now, let’s return to the tools of TRIZ and ARIZ, which were specifically designed to overcome exactly these types of complex contradictions.

In the **Theory of Inventive Problem Solving** (TRIZ), there is a special program for solving difficult problems. This program breaks the problem-solving process into about 50 sequential steps. It includes specific steps to help overcome psychological inertia and is supported by a rich informational foundation. This program is known as ARIZ—the **Algorithm for Inventive Problem Solving**.

Initially, the "inventive methodology" was imagined as a set of rules like: "solving a problem means identifying and overcoming a technical contradiction," or "a solution is stronger when it uses less material, energy, space, and time." It also included some typical techniques: segmentation, merging, inversion, changing aggregate state, replacing mechanical with chemical systems, and so on.

The main sources for identifying these rules and techniques were the work of great inventors, personal experience, and historical materials on technology development.

By the mid-1950s, it became evident that even the best inventors relied on inefficient trial-and-error methods. Therefore, relying on "secrets of creativity" was seen as unpromising.

A fundamentally new "methodology of inventiveness" was needed—one based on the objective laws of technical system evolution, which could be identified through systematic analysis of large arrays of patent data.

By the late 1950s, it was clear that this methodology had to include not only ARIZ but also a section on the laws of technological evolution and a constantly updated information base. The term "methodology" was expected to give way to a "science of inventiveness." This idea met with strong resistance. While a methodology was seen as a useful set of tips based on inventor experience, the science of inventiveness challenged the sanctity of "creative genius" and questioned the mystique of the creative process. It rejected the notion of natural-born talent and was considered heretical at the time.

Over the years, ARIZ became more rigid and structured. The analysis process now includes defining the operational zone and contradictory requirements (a prototype of the Ideal Final Result). The PBC (substance-field analysis) operator was introduced. The table for eliminating technical contradictions was refined, and the list of techniques expanded (first 40, later 50). Prescriptions, comments, and examples were added to guide each step. A strong interconnection between the steps was formed, and a new part was added—preliminary evaluation of the solution idea.

However, the emergence of processor-based technology fundamentally changed the concept of reliability. The rigid mechanical interpretation of reliability was replaced with a more flexible one—enabled by precise control over processes and operating cycles through analytical and monitoring capabilities of modern processors.

The following key directions can be identified in the evolutionary development of TRIZ and ARIZ in terms of synthesizing and modifying complex technical solutions, where integrated system reliability serves as one of the fundamental base indicators:

1. A traditional increase in algorithmization within ARIZ, based on deeper application of the objective laws of technical system evolution, including processor-based systems.
2. Strengthening the "bridge" between physical contradictions and their solutions, including those using composite materials and cutting-edge digital technologies.
3. Enhancing the informational foundation and strengthening the connection between ARIZ and technical standards, including blending operational manufacturing standards with environmental standards, even when these conflict with traditional economic norms.
4. Separating the second half of ARIZ (developing and applying the found idea) into a standalone algorithm—structured like a program, system, and method.
5. Developing a new initial component (or a separate algorithm) for identifying new compositional and integrative tasks.
6. Reinforcing ARIZ's general educational function—it should more actively develop strong, integrative thinking skills.
7. Gradually increasing universality in creating compositional models of devices or processes closely linked with software and processor technologies.

Development of a Patent and Licensing Strategy for a New Technology or Product or Their Combination in Modern Commercial Conditions

TRIZ originally declared its rejection of the methodology of variant enumeration (trial-and-error), yet the majority of tools within TRIZ were, in fact, methods that facilitated such variant generation—like the method of "little people," the STC Operator (Size–Time–Cost Operator) — a mental modeling tool in TRIZ for overcoming cognitive inertia, and substance-field analysis.

Substance-field analysis was positioned in TRIZ as a scientific approach based on the analysis of structural development laws of technical systems. However, its reliance on hypothetical physical fields and the possibility of ambiguous interpretations of constructs and transformation rules suggests that this method is better categorized as a tool for activating variant generation—rather than true scientific analysis.

The most promising effort toward formalizing the inventive problem-solving process in TRIZ was the creation of the contradiction matrix and the accompanying set of techniques for resolving technical contradictions. This approach was based on statistical analysis of invention descriptions available at the time. However, despite its potential, the method did not progress further within TRIZ. A range of weaknesses and the obsolescence of statistical data led to its loss of practical value.

There is a widespread illusion that TRIZ can be integrated into real-world manufacturing. In essence, TRIZ is an individual method for solving problems—its application depends on personal initiative. For this reason, embedding TRIZ directly into production processes is not feasible. At best, a company can offer TRIZ training to its employees to help enhance their creative problem-solving capabilities.

Identification of the Most Competitive Technical Parameters of the Product on the Market and Development of a Methodology for Demonstrating the Advantages of the New Technology and the Product Based on It

The recent surge in cross-patent lawsuits among high-tech companies prompts a fresh look at how inventions are created within large corporations—and what kind of innovations are being patented.

So, who is actually inventing today within these companies—whether out of production necessity or as part of their direct, formal job responsibilities?

Typically, most manufacturing operations are outsourced to partner companies or, as has become quite common today, based in China.

In other words, within these companies, the responsibility for innovation mainly falls on programmers, analysts at various levels, and other knowledge workers—but not on mechanical or electromechanical engineers, since such specialists are no longer part of the in-house staff. Due to the organizational structure of these companies, they simply don't need them internally; those experts are needed where the production itself takes place.

That means new product ideas are indeed being generated, but not in the form of classic technical solutions. Rather, they emerge as abstract algorithms, mathematical models, or software—concepts often far removed from the kinds of technical solutions that traditionally serve as the foundation for patentable inventions.

Commercial pressure drives the filing of thousands of patent applications that are not truly inventive in nature. These applications often lack both explicit and implied elements of a fully formed technical solution.

The vague nature of definitions, the absence of clear cause-and-effect logic, and the overall incompleteness of such "solutions" leads to their perception as abstract constructs.

Moreover, since most of these patents pertain to methods and tools related to mobile communications and tablet devices, distinguishing one from another becomes extremely difficult—if not impossible.

In this context, we believe the most critical role should be played by clear and impartial patent legislation—legislation that allows no room for compromise.

In practice, legal loopholes and ambiguities in current patent laws—especially those accommodating inventions with non-mechanical or non-electromechanical foundations—must be eliminated entirely through legislative reform.

Brainstorming Systems for Reviving the Process of Optimizing and Modifying a Core Product That’s Hit a Stagnation Point

Our experience in multiple projects—where the authors of this methodology played active roles—shows that the most effective brainstorming sessions are those prepared in such a way that all participants are at least somewhat familiar with the 40 inventive principles from the Theory of Inventive Problem Solving (TRIZ) used to generate effective technical solutions.

As is well known, numerous variations of these principles have emerged in recent years—some more successful than others. Ultimately, this has led to the addition of 10 extra principles, expanding the arsenal of TRIZ-based tools.

It’s important to note that the emergence of engineering-oriented professional design software—not just visual modeling tools—has made it possible to conduct brainstorming not only in real-time group settings but also in virtual environments. In such environments, any idea introduced into the brainstorming session can be immediately simulated and modeled in real time.

In upcoming sections of this methodology, the authors will propose software tools specifically designed to optimize the preparation and execution of brainstorming stages and sessions.

The Algorithmic Component in Complex Innovation Projects, Illustrated Through the Development of Fuel Mixture Modification Technologies (Including Biofuel Compositions)

Statistics on innovation projects increasingly show that their commercial value and effectiveness are strongly influenced by the algorithmic component — including the logistics of the entire innovation process, from the formulation and synthesis of the idea to its integration into a concrete production and commercial structure.

Given our experience and our technological and commercial groundwork in one of today's most in-demand areas—fuel mixture modification—we offer this field as an example for illustrating how innovation projects can be algorithmized.

Currently, open-source information reveals a trend toward the modification and modernization of internal combustion engines, particularly through the enhancement of systems that automatically monitor fuel delivery and combustion processes.

In research related to alternative fuels like ethanol and methanol, a clear challenge emerges: mixing ethanol or methanol with gasoline or diesel fuel.

A long-standing issue—over a century old—is rarely addressed head-on: the traditional mechanical system of converting linear to rotational motion. It's often considered only in isolated technical contexts that don't significantly impact the broader problem. Yet, this very mechanical inefficiency consumes up to 50% of an internal combustion engine's potential.

Within our creative consortium, we've submitted invention applications addressing a suite of such interrelated problems.

It is widely known that both ethanol and methanol introduce water into the fuel mixture—ethanol more so, methanol to a lesser extent. Ignoring this is unacceptable, which makes emulsion formation a critical part of the process.

For example, the issue of ethanol-gasoline mixing at fueling stations is entirely solved by an invention we've prototyped—originally a device designed for churning cream into butter. This very prototype effectively demonstrates how to solve the problem of mixing and stabilizing emulsions when combining diesel fuel with different technical alcohols, including glycerin, and other components of both organic and inorganic origin. (An application for this invention was submitted in March of last year.)

In addition to the well-known systems and methods of automatic fuel monitoring, we propose a non-contact monitoring system to evaluate the real-time condition of the fuel mixture—including its air saturation level and foaming behavior just before injection or high-pressure pump delivery (as seen in diesel engines).

(An invention application for this solution was also submitted last year.)

Moreover, our team has proposed a solution to the mechanical inefficiencies in all types of internal combustion engines, by redesigning the mechanism that converts linear motion into rotational motion—without making any changes to the fuel system. (This application was filed in April of last year.)

All of these technologies can be implemented, provided that several key principles and conditions are met.

References, Patent, and Licensing Information

Appendix 1

United States Patent Application	**20110069579**
Kind Code	**A1**
	March 24, 2011

FLUID MIXER WITH INTERNAL VORTEX

Abstract

The present disclosure generally relates to a fluid mixer, a system for mixing fluids utilizing the fluid mixer, and a method of mixing fluids using the fluid mixer or the system for mixing fluids, and more specifically, to a compact static mixing device with no moving parts and capable of mixing any fluid, such as air, nitrogen gas, water, oil, polluted water, and the like. A first pressurized, incoming fluid is accelerated locally by a section reduction, is split into streams, and then is released into a second fluid found in a closed volume or an open volume after a period of stabilization. The directed and controlled first fluid slides along an insert up to

directional and angled fins at a vortex creator where suction forces from a self-initiating vortex in an internal cavity draws in at least part of the first fluid to fuel the vortex. The compactness and simplicity of the fluid mixer with internal vortex can be used alone within a closed volume in a conduit, in a sprayer, or within a fixed geometry to direct the mixing vortex to specific dimensions. One or more fluid mixers can also be used in an open volume such as a reservoir, a tank, a pool, or any other fluid body to conduct mixing. The technology alone, as part of a multi-mixer system, or as a method of mixing using the fluid mixer with internal vortex is contemplated to be used in any field where mixing occurs.

Appendix 2

United States Patent Application	**20100243953**
Kind Code	**A1**
	September 30, 2010

Method of Dynamic Mixing of Fluids

Abstract

Methods are provided for achieving dynamic mixing of two or more fluid streams using a mixing device. The methods include providing at least two integrated concentric contours that are configured to simultaneously direct fluid flow and transform the kinetic energy level of the first and second fluid streams, and directing fluid flow through the at least two integrated concentric contours such that, in two adjacent contours, the first and second fluid streams are input in opposite directions. As a result, the physical effects acting on each stream of each contour are combined, increasing the kinetic energy of the mix and transforming the mix from a first kinetic energy level to a second kinetic energy level, where the second kinetic energy level is greater than the first kinetic energy level.

Appendix 3

United States Patent Application	**20100281766**
Kind Code	**A1**
	November 11, 2010

Dynamic Mixing of Fluids

Abstract

Methods, systems, and devices for preparation and activation of liquids and gaseous fuels are disclosed. Method of vortex cooling of compressed gas stream and water removing from air are disclosed.

Appendix 4

United States Patent Application	**20120102736**
Kind Code	**A1**
	May 3, 2012

MICRO-INJECTOR AND METHOD OF ASSEMBLY AND MOUNTING THEREOF

Abstract

The invention relates to a compact device for producing a composite mixture made of two or more fluids, and for aerating and energizing the composite and injecting it into a volume, and more specifically a micro-fuel injector mixing water, air, or any other types of fluid before it is injected into a volume such as a combustion chamber of an engine made of stackable mechanical elements, and the method of assembly and mounting thereof.