# LIFE STRATEGY: 55 YEAR-LONG FASCINATING EXPERIMENT INSPIRED BY LEONARDO DA VINCI

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**Abstract:** 55 years ago, during my childhood, I set forth to get educated in most of the fields that Leonardo Da Vinci worked in, which I have been implementing all these years.

The origin of this plan was based on two important events happen in my childhood. The first was a present I received from parents for my 10th birthday, a collection of books, a copy of his diaries along with a replica of his bas-relief and coins dedicated to Leonardo Da Vinci, since my father favourite character was Da Vinci. That was the first turning point when I became acquainted with the works of da Vinci. The second event occurred when my father introduced me to TRIZ a new philosophy of system thinking, and later, he introduced me to Genrich Altshuller. These events inspired me to want to understanding the legacy of Leonardo Da Vinci from TRIZ perspective. Namely, to develop a system using TRIZ, understand the legacy of Leonardo da Vinci from a TRIZ perspectives and create inventions, projects in some of his fields.

Leonardo Da Vinci books were not easy to comprehend. I became so puzzled by and fascinated with his creative and scientific genius that decided to retrace his footsteps and learn his subjects.

Leonardo's Notebooks became my guide. I collected a list of Da Vinci's fields based on which I created my study path. This list propelled me to study in 19 different institutions and gain expert knowledge in various fields.

The 55 years experiment of fascinating journey approved that combination of diverse educations, gives unpredictable boost of synergy for creativity in different fields.

***Keywords:*** *Da Vinci, Genrich Altshuller, life strategy,500th anniversary, creativity, TRIZ, biomechanics, biotechnology, nanotechnology, biomechanics, optics, masterpieces, inconsistencies, blind spots, experiment.*

**Аннотация:**

55 лет назад, еще в детстве, я решил получить образование во многих областях, в которых работал Леонардо да Винчи. В этих областях я работал все эти годы.

Происхождение этого плана было основано на двух важных событиях, произошедших в моем детстве. Первым был подарок, который я получил от родителей на свой 10-тый день рождения: коллекция книг и копия дневников да Винчи, а также копия его барельефа и посвященные ему монеты, поскольку любимым персонажем отца был Да Винчи. Это был первый поворотный момент, когда я познакомился с произведениями да Винчи. Второе событие произошло, когда мой отец представил мне в ТРИЗ новую философию системного мышления, а позже он представил меня Генриху Альтшуллеру. Эти события вдохновили меня на желание понять наследие Леонардо да Винчи с точки зрения ТРИЗ. Я хотел понять наследие Леонардо да Винчи с точки зрения ТРИЗ и создавать изобретения, проекты в некоторых из его областей.

Книги Леонардо да Винчи было непросто понять. Я был настолько озадачен и очарован его творческим и научным гением, что решил повторить его шаги и

изучить его исследования в разных областях науки.

Записные книжки Леонардо стали моим гидом. Я собрал список полей Да Винчи, на основании которых я создал свой учебный путь. Этот список побудил меня учиться в 19 различных учреждениях и получить экспертные знания в различных областях.

55-летний эксперимент увлекательного путешествия подтвердил, что сочетание различных образований дает непредсказуемый импульс синергии для творчества в различных областях.

***Ключевые слова**: да Винчи, Генрих Альтшуллер, жизненная стратегия, 500 лет, творческий подход, ТРИЗ, биомеханики, биотехнология, нанотехнология, биомеханика, оптика, шедевры, несогласованности, слепые зоны, эксперимент.*

## Life Strategy: 55 year-long fascinating experiment inspired by Leonardo Da Vinci

This year, 2019, will mark the world's most important anniversary: 500 years since the death of Leonardo da Vinci.

55 years ago, during my childhood, I set forth to get educated in most of the fields that Leonardo da Vinci worked in, which I have been implementing all these years. I was interested why da Vinci chose his particular fields of knowledge and while perusing various publications, it was explained that he chose these fields at random, based on his diverse interests.

My hypothesis was and still is: all of Leonardo Da Vinci combinations of fields of knowledge, chosen by the genius himself were not random at all and these particular combinations of fields of knowledge and their order could have a unique synergetic effect to explain his creativity.

How did I come up with this hypothesis? What was the pivotal point which made me study da Vinci's legacy during all these years?

Well, there were two important events in my childhood. The first was a present I received from parents for my 10th birthday: a collection of books, diaries along with a replica of his bas-relief and coins dedicated to Leonardo Da Vinci, since my father's favourite character was Da Vinci. The second event occurred when I was 11. My father introduced me to TRIZ (Theory of Inventive Problem Solving)- a new philosophy of system thinking, and year later, he introduced me to Genrich Altshuller, the creator of TRIZ. These events inspired me to want to understand the legacy of Leonardo Da Vinci from another perspective. Namely, to develop a system using TRIZ to create inventions, projects and understand the legacy of Leonardo da Vinci from a different perspective, including TRIZ [1].

Some books about Leonardo were written in simple language and I became absolutely fascinated with his creative and scientific genius. However, "Leonardo Da Vinci's Notebooks" were not easy to comprehend at all, since he displayed top skills in an unfathomable number of diverse areas and were written in layman's terms.

In studying Da Vinci's scientific work, many facts stood out to me:

1. Da Vinci displayed top skills in an unbelievable number of diverse areas. Mankind has never seen such a prolific individual across such a vast array of fields.
2. Secondly Da Vinci, the greatest scientist and the greatest artist of masterpieces the world has ever known, admired the human foot. In fact, he once said that "The human foot is a masterpiece of engineering and a work of art."
3. Da Vinci's discovery of the wave nature of light: he studied interference and diffraction in optics many centuries before these were discovered by the broader scientific community and was officially accepted.
4. Leonardo had astonishing insights about nanotechnology, geology, hydraulics, revolving and self-supporting bridges, etc.
5. Leonardo da Vinci created the first robots, designed a self-propelled cart, multi-axed tank, and created many of the greatest inventions in various fields.

6. Being not just a brilliant painter, but a Renaissance polymath and arguably one of the most talented human beings to have ever lived, he made some unexplained “mistakes and inconsistencies.
7. Leonardo had unexplained facts and white spots of his creativity.
I became so puzzled, that I decided to follow in his footsteps to learn all of his subjects. I created a plan to gain a well-rounded education in a number of subjects, which I have been following all these 55 years.
So, as my first step I decided to study Da Vinci fields of knowledge. At the beginning it was just a detailed list of disciplines, but later I applied Ishikawa (Cause and Effect) Diagram of Leonardo Da Vinci Fields of Knowledge Synergy (Fig.1).
At the same time, I created a plan of studying Da Vinci projects and inventions. At the beginning it was also just detailed list, but later I applied Ishikawa (Cause and Effect) Diagram of Da Vinci: Inventions, Projects and Blind Spots with "Mistakes and Inconsistencies" (Fig.2).

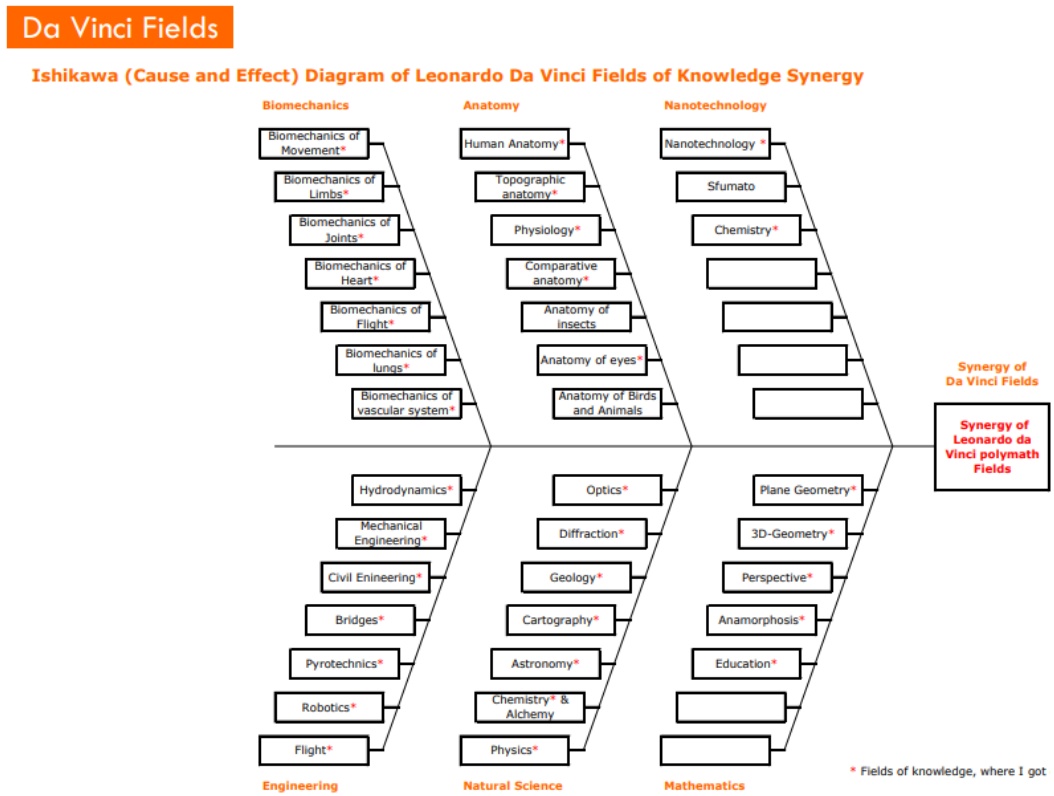



Fig. 1 Diagram of Leonardo Da Vinci Fields of Knowledge Synergy

*Fields where I got education
At the same time, I created a plan of studying Da Vinci projects and inventions. At the beginning it was also just detailed list, but later I applied Ishikawa (Cause and Effect) Diagram of Da Vinci: Inventions, Projects and Blind Spots with "Mistakes and Inconsistencies" (Fig.2).

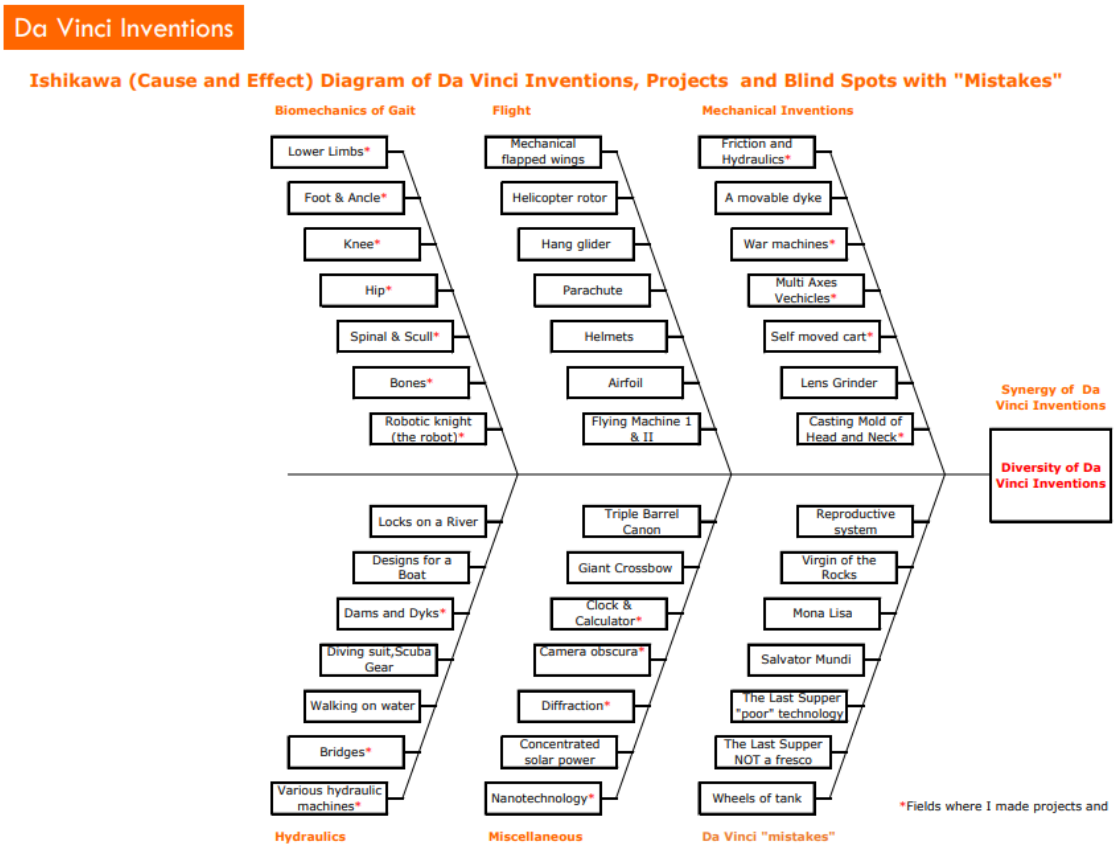



Fig.2 Diagram of Da Vinci: Inventions, Projects and Blind Spots with "Mistakes and Inconsistencies

*Fields where I made projects and inventions

**2. Leonardo da Vinci's legacy-guide for Life Strategy**

Leonardo's Notebooks became my guide. I set my goals based on the analysis of Da Vinci fields and inventions. My goals were as follows:

1. To analyse fields of Da Vinci's knowledge.
2. To analyse his projects and inventions.
3. Based on these analyses, to gain deep knowledge and education in all of Da Vinci's Main fields, especially:
3.1. Biomechanics and Bioengineering.
3.2. Nanotechnology.
4.To study entire Leonardo da Vinci's scientific legacy.
5. To study the relationship between various fields of da Vinci's science and his art.
6.To study supplementary fields, which could help to get Main fields, according to the level of knowledge of current modern science.
7.Try to understand "inconsistencies" and blind spots in Da Vinci's Legacy.

## PART 1. BIOENGENEERING

So, after studying in a few institutions, I got admitted to a post graduate school of Central Institute of Prosthesis-the largest institute in the World in this domain. My goal was to study a foot. I studied biomechanics, anatomy, and many supplementary subjects. Based on obtaining new knowledge, I started to design artificial foot for lower limb prosthetics. In order to deeper understand biomechanics of foot, I invented special static device [2] and later, according with law of TRIZ-dynamic [3]. Since a foot was of an irregular shape, we applied a photo elasticity

method and got entire stress distribution in a foot. I created a system operator for the artificial foot.

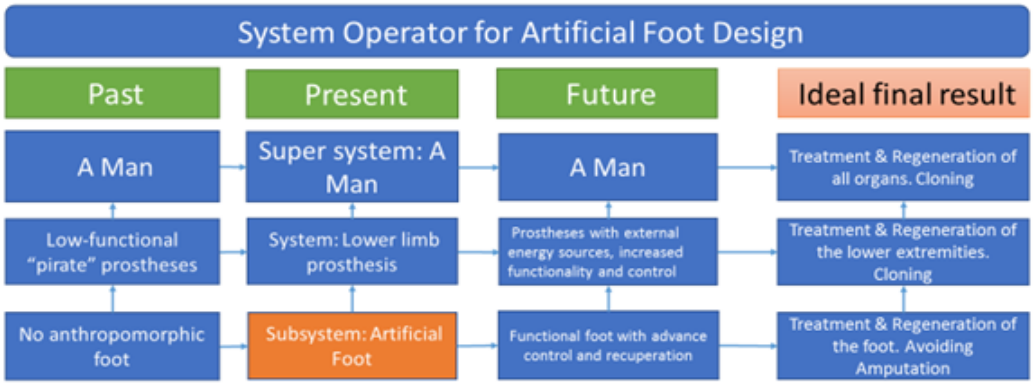



Fig.3 System operator for artificial foot design

## Example1. Based on our result we created and patented two artificial feet [4,5].


Fig.4 Artificial foot structure

So, originally my plan was to study a Subsystem (a Foot), but using System operator I decided to move to a System (Lower Limb Prosthesis), where another subsystem –Knee Unit, which was part of a huge system related to a Man, needed serious design.

## Example 2. Above knee prosthetics.

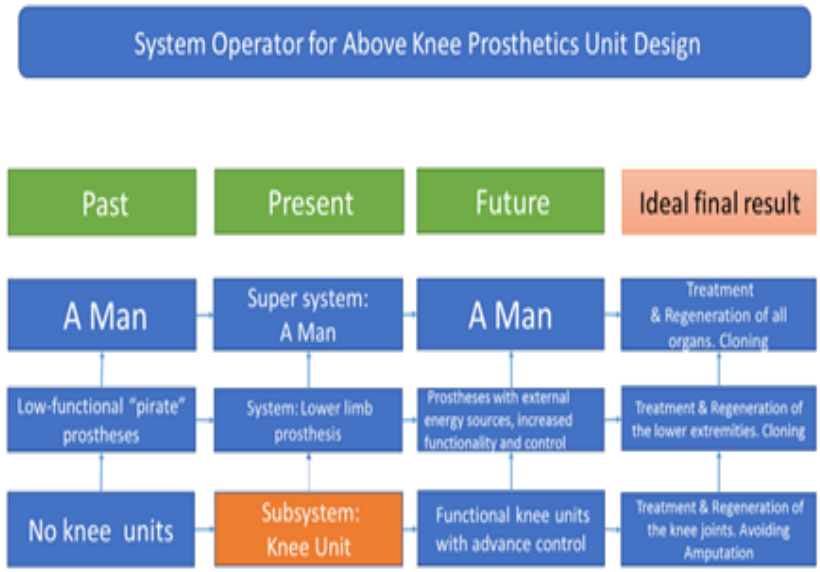



Fig.5 System operator for above knee prosthetics unit design

## Example 3. Method and device of imitation of walking and running for the rehabilitation of patients with various movement disorders (e.g. stroke)

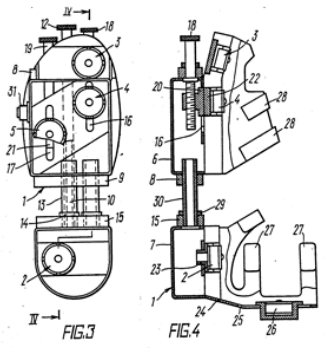
At the same time, I always kept in mind my goal to study Da Vinci legacy in depth. One issue especially attracted my attention: cause of physical death of Leonardo Da Vinci.

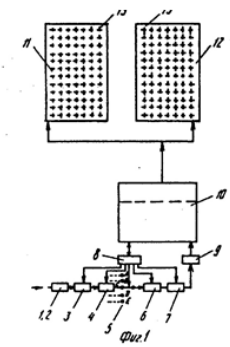
In his 1550 book "Lives of the Artists," Vasari described Leonardo as a sick and bedridden man, unable to stand up without being “supported by the arms of his servants and his friends. He was ill for many months”. There were many publications about these. I would provide one of numerous publications. The study, carried out by two Italian medical doctors, examined ancient sources to reconstruct Da Vinci's health from 1517 until his death in 1519 aged 67.

According to Dr.Antonio Perciaccante from Gorizia hospital: "The diary of Louis d'Aragona's journey, written by Antonio de Beatis, tells us that Leonardo had the first stroke which caused right hand's paralysis when he was 65 years old. Other stroke events then followed, deteriorating Da Vinci's health and motor activity." So, in addition to my projects, related to a foot biomechanics I studied ways to cure a stroke. According to modern medicine recommendation, Exercise if You Have Limited Mobility

**Contradiction:** ***In order to recover faster, a patient should do mild exercises, including walking, but he can’t walk. How to walk without walking?***

We pay attention to vibro receptors which everybody has. Pacinian capsules are located under the skin, especially on surfaces of feet and hands. According to biomechanics of gait, during our stance phase they send signals to our brain. Together with my colleague, Dr. Mirkin we researched Vater-Pacinian bodies. As a result, we created patented and produced a Method and device of imitation of walking and running for the rehabilitation of patients with various movement disorders.



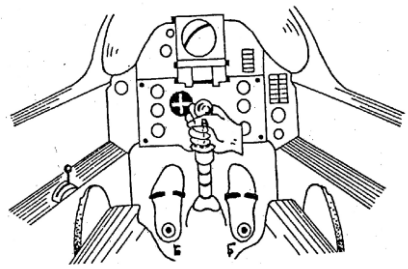



Fig.6 Pacinian capsules are located under the skin, especially on surfaces of feet and hands
Fig.7 Method and device of imitation of walking and running for the rehabilitation of patients with various movement disorders

In this technology we solved a contradiction: a patient could “walk and run” without walking-just by sitting on a chair or laying in a bed.

This technology was used many years in government clinics for treating patients after a stroke and heart attack. In addition, this technology was used in space for spacemen, for plane pilots, for operators of nuclear stations, etc. The method has been using for treating patients in combination of hyperbaric oxygenation. Sometimes I think about a miraculous scenario: if we had a time machine and could travel 500 years ago, using our technology and contemporary means of medicine, we could have treated Leonardo Da Vinci’s stroke.

## Example 4. General approach for designing biotechnical system

In order to develop biotechnical systems, I designed functional biomechanical method, which helped to solve hundreds of problems in this field.

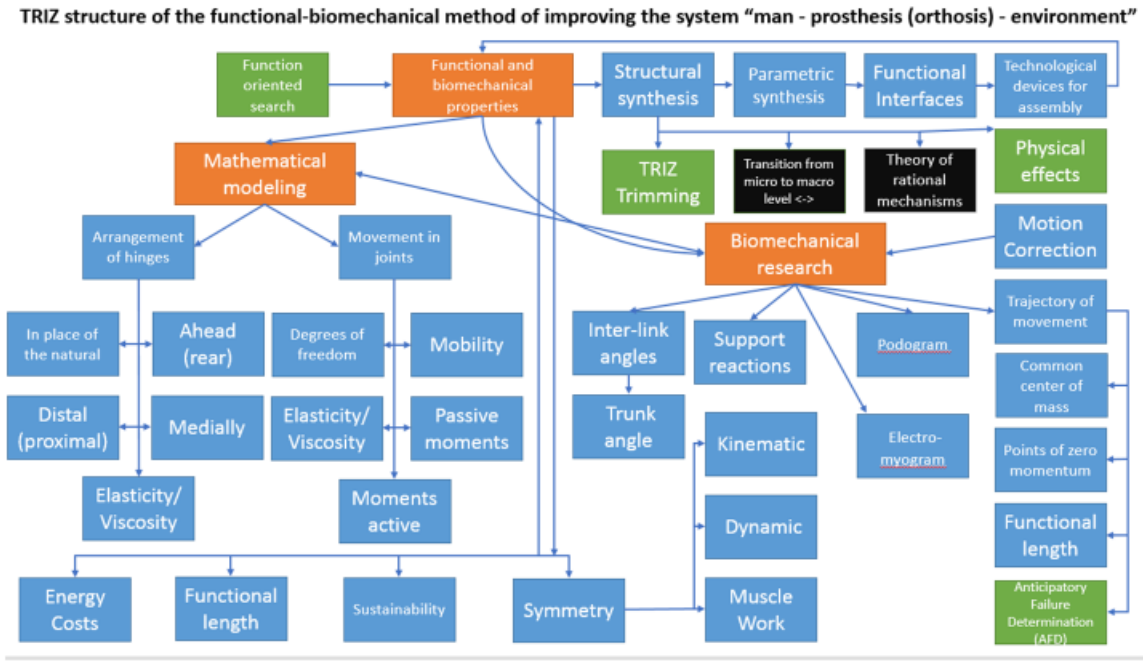



Fig.8 TRIZ structure of the functional – biomechanical method of improving the system "man-prosthesis (orthosis) – environment"

## Example 5. Multi axes vehicles

I will provide just a few more examples about how Leonardo da Vinci's legacy impact my work. Meanwhile, always keeping in mind my goals, I studied multi axed vehicles. As a result, we created and patented a new multiaxial dynamic vehicle [6]. This vehicle used wave nature of mechanical stresses in pavement and has advantage to carry much heavier loads, compared to regular vehicles with static position of axes.

## Example 6,7. Studying bones, we created a new type of self-adjusted compression-distraction apparatus for osteosynthesis [7] and neck support [8].

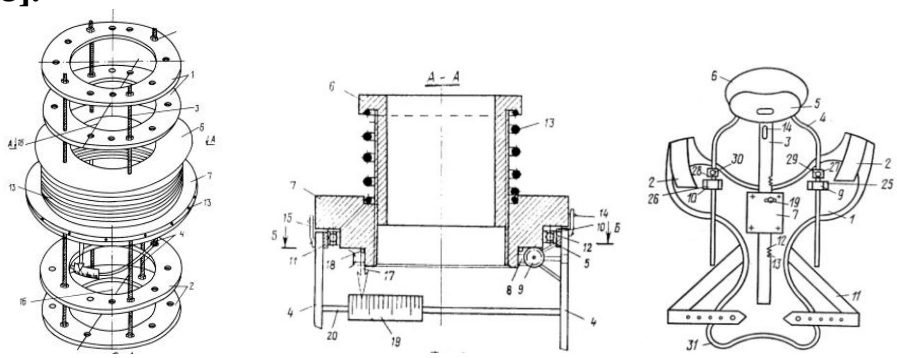


Fig.9,10 Compression-distraction apparatus for osteosynthesis
Fig.11 Orthosis

## Example 8. Studying light, we designed a new Diffraction Approach in Surgery to Obtain the Average Centre of Centroids Rotation on Knee Joints

In medicine, it is important to determine the centre of rotation of the knee joint, which is a complex polycentric hinge.

To speed up the process of obtaining the averaged centre of rotation of the centroids of the knee joint, instead of using complex mathematical models and speeding up the calculation process (an important factor in the treatment process), we propose a method based on diffraction.

To do this, both sides of the knee joint on the thigh and lower leg strengthen point sources of light. Then the lower leg is turned relative to the thigh. At the same time, point sources of light describe the curves that are photographed. The image is reduced to fit on film. This film is illuminated with a flat wave of coherent light. On the screen, diffraction bands appear. The point of intersection of the diffraction rays is a projection of the instantaneous centres of rotation of the knee joint.

The technology relates to medicine, to biomechanical research, and is intended, for example, to determine the centroid of rotation of the knee joint in traumatology and prosthetic engineering, by directly projecting an image from a positive film on the screen in coherent light.

To do this, on both sides of the knee joint on the thigh and lower leg strengthen point sources of light. Then the lower leg is turned relative to the thigh. At the same time point sources of light describe in space some curves that are photographed on film. The image is reduced several times on a positive film, resulting in arcuate slits. Positive film with slits is illuminated by a flat wave of coherent light. Diffraction bands are obtained on the screen, the point of intersection of the diffraction rays is a projection of the instantaneous centres of rotation of the knee joint. In order to obtain a high-quality image of the intersection of the rays after diffraction, and in order to calculate the reduction ratio of the image, the slit is taken into consideration: the width of the path of the point source on the film to decrease; the radius of curvature of the path of the point source to decrease; the distance from the positive film to the screen; and the wavelength of coherent radiation.

The position of the instantaneous centre of rotation of the joint with a fixed thigh is determined. Filming the movement of light sources produced in the dark and opening the shutter of the camera at the time of flexion of the joint, allows for a positive image to be obtained in two stages with a gradual reduction on the camera and photo stamp using high resolution photographic plates.

## PART 2 NANO AND BIOTECHNOLOGY: CREATION OF NEW MEDICAL DRUGS BASED ON TRIZ AND COMPUTER MATHEMATICAL MODELING

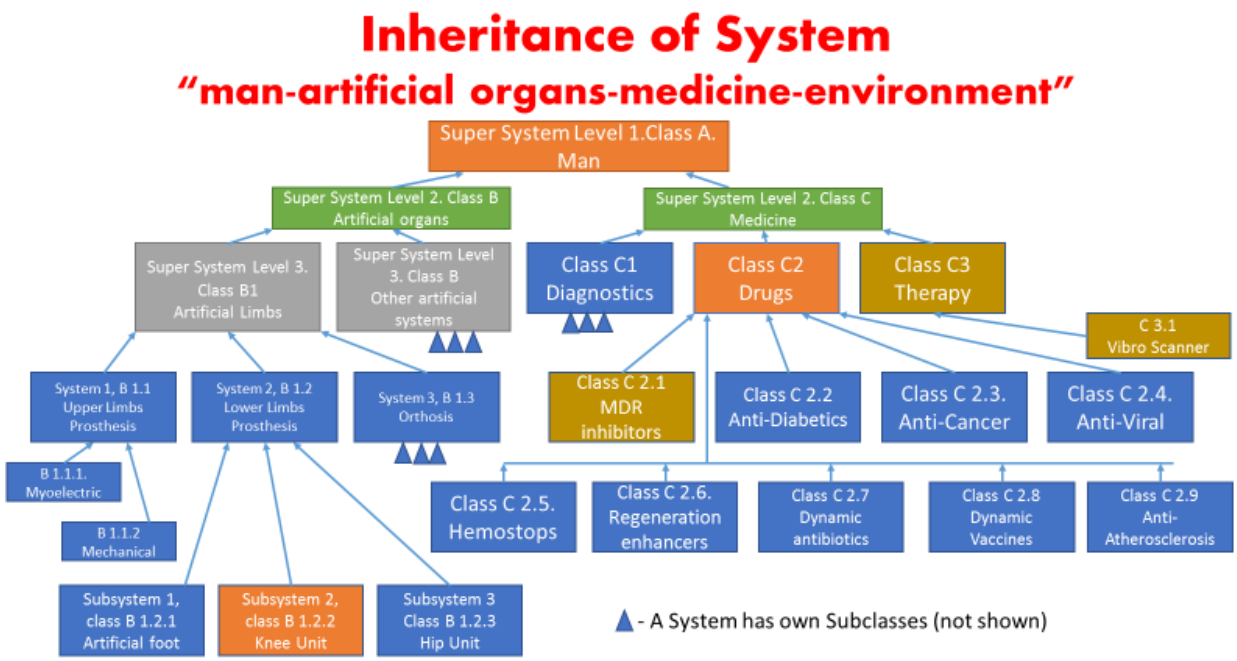



Fig 12. Inheritance of system "man-artificial organ-medicine-environment"

I built an inheritance relationship where, in addition to designing an artificial foot, it was a path for supersystem "Artificial Limbs" and from supersystem to any element system and subsystem.

Moreover, “Inheritance of Systems” showed another Super System Level 2. Class C “Medicine.” Health issue such are diabetes, vascular disease, infections are one of the main reasons of amputation. Such it follows form our Inheritance diagram in in parallel with creating new prosthetics devices, it would be great if we concentrated on medicine by preventing or at least decrease amputations. Even when amputation is unavoidable, we face antibiotics problem based on Multidrug Resistant Bacteria.

## Two pathways of future drugs development

To improve treatment of patients, according our Inheritance diagram, Supersystem Level2, Class C, together with Dr. Arthur Martynov and our teams, we developed New Paradigms in pharmaceutical industry based on TRIZ, mathematical modeling, nanotechnology and modern technologies.

Over the last 100 years the pharmaceutical sciences and industry have changed significantly. The approach to drug development has changed from banal screening (out of thousands of synthesized compounds, only one showed biological activity) to those obtained as a result of molecular modeling. The approach using molecular modeling led to the intensification of research - to the synthesis of drugs based on simulated inhibitor profiles. This increased the yield of drugs - out of every hundreds of the synthesized substances, one showed the expected activity. The cost of pharmaceutical development software is currently quite high and can reach tens of millions of dollars. However, this is a reasonable amount, which makes it possible to obtain the required pharmaceutical preparations, at least for known target proteins. However, for the design of drugs of new generations at all stages of development - from building a model of a target protein to creating a drug profile and its synthesis, TRIZ has not been used systematically [9]. Pharmaceutical industry and pharmacology are huge niche for TRIZ [10,11].

TRIZ Biopharma International and Noigel LLC are the only companies in the World which applied TRIZ method in pharmaceuticals. Based on TRIZ system evolution, the next logical step was applying this approach of self-adjusted and self-organized dynamical system for developing different aspects in the medical field including medical drugs. Research in self-adjusted and self-organized dynamical drugs started in 1993 with my college Dr. Artur Martynov. As a result, a new group of 23 medical drugs and methods of diagnostics were discovered, including the first dynamic drugs in the World. These drugs are quasi-living, self-adjusted, self-organizing dynamic medicinal and diagnostic medicines, which represent a revolutionary jump from static medicines to dynamic drugs with variable structure and synergy [12,13,14]

These drugs system have the ability to adjust to the body of each individual, and to adapt to its system of receptors. As a result, the effectiveness of such drugs increases and the action spectrum extends substantially. The implementation of this approach has shown tremendous results. For instance: a dynamic antiviral veterinary drug was produced showing wide action spectrum and efficacy. Another example is haemostatic "Gemma" successfully applied in practice on the battlefield and saved hundreds of lives. We continue to research dynamic anti-cancer drugs, antiviral drugs, synergistic quasi-living antibiotics, and antiatherosclerosis drugs, quasi-living medicines for diabetes, insulin, vaccines, and wound healing, a method of reducing polymyxin nephrotoxicity.

Example of our solution fighting against multi-drug resistant (MDR) nosocomial microorganisms, which has become increasingly important in recent years.

Multi-drug resistant strains have arisen over the years due to overuse of antibiotics in hospitals and in the veterinary space. Recent studies on the mechanism of bacterial resistance was found to be associated with biofilm formation and their ability to be in non-growing state.

Currently available antibiotic fight against planktonic forms of microorganisms. These antibiotics are no longer effective against highly susceptible microbial strains, due to bacteria generating high degree biofilm protection. It is important to change the paradigm to combat multi-drug resistance of microorganisms.

Bacterial production of toxins is observed only in starving nutrient media (not rich in

carbohydrates) containing aggressive factors such as, serum, red blood cells, and extracts of brain or heart tissue. This process applies to bacteria such as *Corynebacterium diphtheriae, Pseudomonas aeruginosa, Clostridium tetani* and *Bordetella pertussis*. If these bacteria were transferred to the rich, non-starvation medium without the aforementioned aggressive factors, they would begin to grow rapidly and without releasing toxins. They would also stop synthesizing biofilm and other resistance factors

To solve this problem we face a classic TRIZ contradiction [15,16,17]. In order to stop the production of virulence factors we should stop killing the microorganisms, however if they are not killed then the bacteria will harm patients. This contradiction was resolved by us using the principles of TRIZ studied bacterial growth and found commonalities with curve of development cycle of technical system (Fig 13) We found commonalities between two curves.

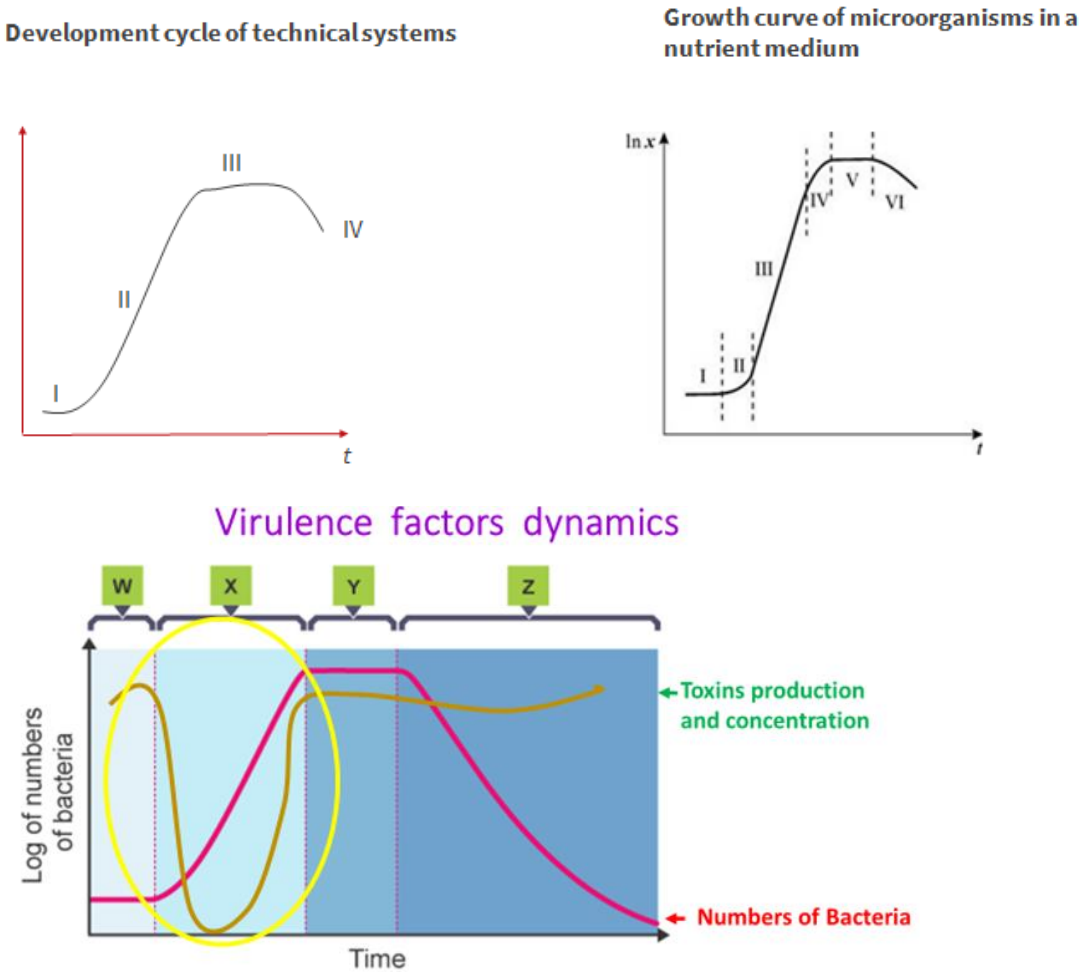



Fig 13 Similarity of curves "Development cycle of technical system" and "Growth curve of microorganisms in a nutrient medium"

1. TRIZ principle [18,19] of "Inversion" (#13, belongs to the group of methods for resolving contradictions due to structural changes within the system.) This principle is based on "doing the opposite" of what has been done and also known in TRIZ as "The other way around." Instead of the action dictated by the conditions of the task, we should carry out the reverse action. For example, a burn can be attained not only from extreme heat, but also from extreme cold, and expansion process can occur not only by heating, but also by freezing water. Overcoming psychological inertia allowing you to use the opposite action sometimes allows you to find novel solutions. In our case this would mean that instead of killing bacteria we should enhance them.

2. TRIZ principle of "Preliminary anti-action." (#9). This means that when you know that an undesirable situation is going to happen, you may be able to take action ahead of time.

This action could either prevent the undesirable situation from happening or to reduce its' impact if it does occur. We were able to come up with solution how to synchronize bacteria to the log state of bacterial growth, which makes them sensitive and they get destroyed by antibiotic, to which bacteria were resistant.

3. TRIZ principle of "Skipping "(#21). This principle tells us to conduct a process, or certain stages (e.g. destructible, harmful or hazardous operations) at high speed.

4. TRIZ principle of "Phase transitions" (#36). This important dictum tells us that substances often go through changes, such as expanding, evaporating, cooling or changing shape. This facilitated the importance of synchronizing the bacteria from the lag to the log phase.

5. TRIZ principle of "Local quality" (#3). This principle leads to the greatest local effect, specific only for log phase.

6. TRIZ principle of "Self-service" (#25) is very close to an Ideal Final Result. When bacteria stop producing virulent factors it is reduced and at some point, eliminates resistance to antibiotics.

7. TRIZ Principle of "Parameter changes" (#35). Based on the TRIZ approach we can decrease the antibiotics therapeutic dose to kill bacteria, which will be as effective as the original higher antibiotic dose. The benefit of this approach will eliminate side effects of higher dose of antibiotics and achieve same antibacterial therapeutic results.

8. TRIZ Principle of "Dynamics." (#15) Dynamicity means creating systems which are able to cope with change and intrusions from the outside. In our case by dynamically changing the bacteria, which is going through phase transitions, to help cope with the environment and inhibit toxin production.

It should be noted that, even if the application of TRIZ principles does present a solution, it will help you better understand the system. In our case we asked, what would happen if the bacteria are not killed, but on the contrary, we stimulate their growth? How will it change bacterial aggressiveness? How will it change virulence factor production and toxins release? It is well known that bacteria secrete aggressive factors into the external environment to "clear out" the place of residence, to destroy other microbes and tissues with toxins. If nothing needs to be "cleared out" the bacteria "feels" comfortable and it ceases toxins and virulence factors release and begins bacterial growth process.

Through TRIZ and our research we can offer a new paradigm that instead of focusing on killing bacteria, rather than focusing on synchronizing bacterial growth.

Based on our paradigm will be decreased and suppressed future selection of resistant bacterial strains. The mechanism of action of the enhancers is caused by the activation of the cAMP high doses accumulation process in the microbial cells. cAMP itself is a substrate for phosphorylation including DNA polymerases. Applying synergetic set of TRIZ Principles from matrix of contradictions, we created pioneer new paradigm to fight multi drug resistant bacteria, which could be not only treated generally, killing "unkillable" bacteria by also it could be done by low dosage antibiotics, which is extremely important for treating patients.

**Example Dynamic drugs: Dynamic insulin [20].**

All modern medical products are unchanging static chemical structures. In this regard, the real efficacy of these static drugs in comparison with placebos has only shown slight statistical difference. These current static substances are not working efficiently. Nearly 40% of people are not responding to these static substances. There are more than 40% of people currently taking classic insulin, which is completely ineffective.

This is due to the fact that human receptor sites are slightly different from person to person, but a static (classic) drug always has the same fixed structure. Therefore, it will be effective only in some people, those people, whose receptor sites will be most suitable to this drug (analogous to a hand and glove). If the "glove" is smaller than the "hand", the drug will not match and will not work.

In this regard, take for example the current standard treatments of hypertension. To treat hypertension, we need a selection of a combination of complex drugs: antihypertensive, diuretic and antiarrhythmic drugs. Furthermore, a hypotensive agent that works successfully for some people is absolutely ineffective for others. This process is extensive and not always successful.

The same approach is observed in the treatment of diabetes.

Many patients with type 2 diabetes mellitus develop insulin resistance (even when a normal amount of insulin is in the blood, the tissues receptors are not sensitive to it). This insulin resistance is also partly due to the static nature of insulin: the insulin structure always remains the same, but receptor sites on the cells change over time. Insulin ceases to "fit in" to the insulin receptor, because the receptor size becomes smaller and insulin effects on the receptor are not achieved.

TRIZ contradiction: insulin, which is produced by drug manufacturers ideally should be the same to allow for mass production for all patients, but from another side each formulation must be different and adaptable to every patient and correspond to their receptor sites. Currently on the pharmacy shelves there is only insulin with a standard fixed structure, and it only work optimally for some people. What needs to be done to ensure that the same insulin fits the entire patient population? Insulin must become a dynamic structure, it must “be able” to adjust. Its structure should be able to “adjust” to the receptor of a particular patient.

According to the TRIZ Laws of technical systems evolution and increasing dynamism, systems are developed from being static to dynamic. This allows flexibility and maximum adaptability of the systems. In addition, to solve this contradiction, we utilized the principle of TRIZ known as “create dynamical” or increased dynamism, this facilitates transition from macro to micro level. When developing this composition, the TRIZ crushing principle of segmentation was also used.

To solve this we utilized the principle of TRIZ called “create dynamical” or increased dynamism. In addition, when developing this composition, the TRIZ crushing principle was also used. The crushing principle includes the following techniques: a) Divide the object into independent parts. b) Make the object collapsible. c) Increase the degree of fragmentation of the object. We suggested to split insulin in to fragments with proteolytic enzymes and partially replace the charges of amino group acid residues by carboxyl groups in these fragments.

Using these principles, we formed a mixture of thousands of insulin fragments, thereby causing only fragments that match the receptor to “settle” on that receptor in a particular patient. In addition, these types of fragments can be easily absorbed by oral administration in the form of tablets. This is all possible because the insulin was divided in to fragments by proteolytic enzymes and these fragments were protected from further destruction by acylation due to alterations of charges on them. Chimeric insulin was chosen for this project. Using the oral administration normally used in rats with alloxan-induced diabetes. The results were quite impressive. The level of blood glucose in the rats was reduced from an average of 40 mmol / l to 9 mmol / l. A single dose of such insulin maintained the glucose level in rats at the level of 9-11 mmol / l for 24 hours. By comparison in the control group the glucose level in rats was at the level of 38-42 mmol / l. Based on our research, it would be possible to create insulin tablets that can be taken once a day for patients with type 1 diabetes and patients with insulin resistance type 2 diabetes.

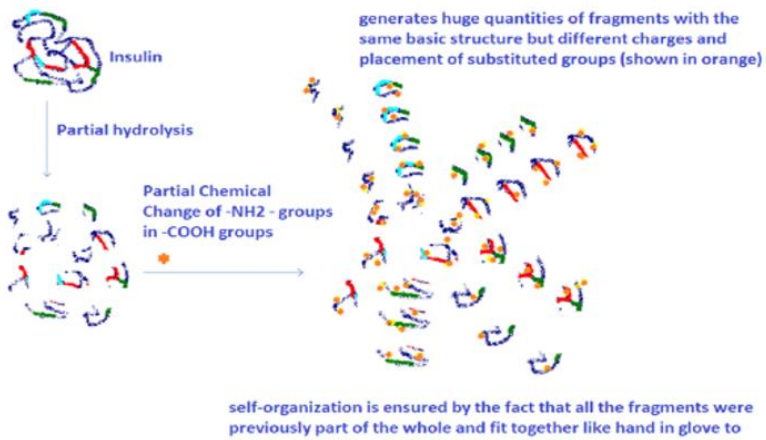



Fig 14. Principle of TRIZ-dynamization for proteinous drugs (for example – insulin)

**Looking back**

Looking back, attributes of success was based on choosing the strongest goal in a childhood as an Ideal Final Result, to understand Da Vinci's work. Beginning scientific career 55 years ago, when a plan had been created to understand Leonardo da Vinci's legacy, related to connections among his painting and scientific fields, including foot biomechanics and diffraction optics. As a result, after pursuing a diverse education, inventions were created not only new artificial feet, lower and upper prosthetics limbs extremities, and applied optics (new diffraction systems for knee surgery in biomechanics, photoinactivation in biotechnology), but also more than 700 technologies and hundreds of books and articles.

Scientific career planning was implementing Da Vinci's model of diverse education which served as an inspiration for 55 years of a fascinating journey. The hypothesis was that Da Vinci's expert knowledge of particular combinations of various subjects proved to be great for creativity. The experiment successfully proved the hypothesis and showed that Da Vinci's model combining his well-roundedness in diverse fields helps to better understand the legacy of a great genius.

Additionally, while studying Da Vinci's legacy for many years, were found explanations for his "inconsistencies" and "mistakes" in various areas. In fact, the graveness of Da Vinci's mistakes did not match to his genius. TRIZ and Anticipatory Failure Determination to further understanding the discrepancies. This approach has been successfully used for hundreds of my projects and inventions and I was able to apply it as a tool for historical analysis to understand Da Vinci legacy from different perspectives. A concept was developed that sheds light on Da Vinci's "mistakes" and helps to understand blind spots in his work. This is especially important now, when the world celebrated on May 2nd 2019 the 500th anniversary of his death.

So, in addition to R&D and education projects, a book and script for a science-fiction movie written devoted to blind spots of Leonardo da Vinci's legacy, including science and painting, from scientific point of view, based on diverse expertise and Anticipatory Failure Determination.

I began scientific career planning to understand Leonardo da Vinci's legacy, which was as a landmark for my 55 years experiment of fascinating journey. The experiment approved that combination of da Vinci's diverse educations with TRIZ, gives unpredictable boost of synergy for creativity in different fields.

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Vadim Kaner and many others. .

Fig 16.Together with Teacher Genrich Altshuller

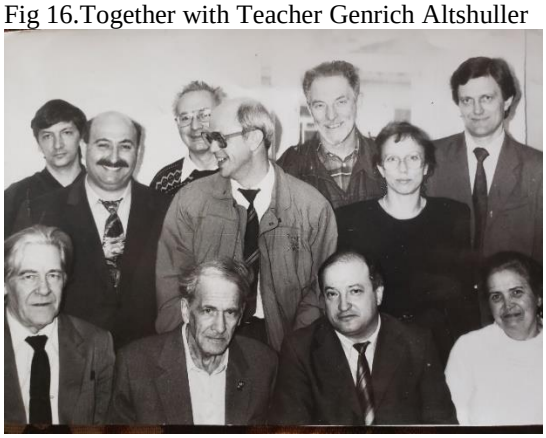

Fig 16. Together with Genrich Altshuller colleagues
Fig 17. Together with Boris Zlotin and Alla Zusman

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