«Science is at the base of all the progress that lightens the burden of life and lessens its suffering».

A Nobel Prize Laureate in Physics and Chemistry
Marie Sklodowska Curie

White Paper
gmp.im

GMP PROJECT

GMP is a global international project designed to create a network of metrology centers and innovative technology clusters.

CONTENTS

ABOUT THE PROJECT

GMP – THE GLOBAL METROLOGY PROJECT

GMP is an international project for creating a network of metrological centers and innovative technology clusters.

GMP is a prospective business project in the sphere of highly precise measurement, demanded in many branches of human activity, having no parallel at the current moment and for this reason possessing considerable economic potential.

GMP project was developed for addressing the needs of the Eurasian countries in the sphere of traceability of measurements in conformity with the quality management standard for the competence of testing and calibration laboratories ISO/IEC 17025:2005.

More than 200 GMP centers will be opened in 70 countries.

GMP centers will become a reliable strategic partner in the sphere of measurement unification, testing and standardization to meet the needs of:

- industry;
- agriculture;
- construction;
- transport;
- trade;
- medicine;
- science.

GMP was developed by the Russian specialists at the request of private companies and state organizations for the purpose of making different measurements and expert examinations, quality control of production, checking conformity of goods and services to the existing international standards, ensuring precision in research works, providing life safety of citizens.

In the first place GMP centers are aimed at providing metrology maintenance of measuring instruments applied to meet the needs of the military-industrial complex, industrial safety, environmental protection and conformity assessment of products.

Our centers are aimed at execution of works for the military-industrial complex for the purpose of production of reliable modern equipment that is highly appreciated by the leading experts and demanded all over the world.

Within the framework of cooperation with security agencies GMP centers will be able to make an expert examination of the items being at the disposal of the security agencies, to carry out laboratory analysis of samples, being seized within the scope of investigation work, to perform compulsory checks of measuring instruments in concern with conformity to their specified metrological characteristics.

In addition such works as identification of counterfeit and selection of the best manufacturers in fast-changing market conditions are being planned to be executed in GMP centers.

Due to the use of the newest technologies and efficient application of material and technical resources of the enterprise GMP centers will be able to become an authority in the sphere of condition monitoring and maintenance of medical equipment.

GMP centers will provide the necessary precision of measuring instruments in public and private hospitals, conduct an audit, organise training for medical staff in order to give detailed and informative understanding of legal metrology legislation.

GMP centers will become a reliable strategic partner in the sphere of unification of measurements, testing and standardization for industrial plants.

Giving the tasks of metrological support of production, incoming inspection of raw and other materials and quality accessment of released products to GMP centers, the customers of GMP can expect timely completion of the tasks being given, high efficacy and informative value of the diagnostics.

The data from the leading metrological centers of the world situated in the USA, the UK, Australia demonstrates that the return of investment into metrology in high-technology industries can reach up to 400%. In some of them which are the most advanced such as new material and nanotechnology the investment return can reach 1000 %.

THE OBJECTIVES OF THE PROJECT

Our ambitious plans include the achievement of the leading market positions in the sphere of metrology on the international scale, active cooperation with transnational companies and federal state institutions, development and implementation of the most innovative ideas in different branches of social activity.

One of the most important aims of the project is creating and developing a separate scientific platform - the innovative technology Clusters - on the foundation of GMP projects!

4 Clusters will open their doors in the countries of Asia and Europe.

The main objective of the Clusters lies in uniting the best specialists from different scientific areas in order to develop and implement the most prospective ideas and innovative inventions of the modern times.

In prospect we will be able to unite the leading scientists, the unique single-discipline experts, the commited volunteers and talents from all over the world due to creation of GMP centers on the territories of the Russian Federation, of the Commonwealth of Independent States and of different countries of Asia and Europe.

GMP clusters will help to combine efforts to implement such projects as renewable energy, medicine of the future, artificial intelligence, quantum computer, bioinformatics and other future issues which boggle the human mind.

In their turn over time the Clusters will start creating ever new projects that change and transform the world.

FROM IDEA TO SUCCESSFUL IMPLEMENTATION OF THE PROJECT

THE BIRTH OF IDEA

2014 – the start up of GMP project. Teambuilding and preparing for launch of pilot project on the basis of the Federal Law №102 from 26.06.2008 "On provision of measurement uniformity".

The idea of the project dates back to 2013 when a fateful meeting of the future project's co-founder Sergey Maltcev and a metrology scientist Aleksey Novikov occurred.

Aleksey told interestedly about the importance of metrology and existing metrological standards to modern society, the history of measurement and the impact of its methods on human history. He highlighted the role of high-precision metrology and measurement method development for our future.

He informed that metrology scientists stopped using steel calibration weights quite a long time ago. Applying the newest methods of measurement, testing and gauging to different kinds of devices they help to create the future technologies of communication, navigation and control which for example can allow to predict volcanic eruptions or operate unmanned vehicles in the city. Taking into consideration the high demand for metrological services in many spheres of societal activity, the lack of competition and the fact that the beginning scientists do not have enough resources to implement their innovative ideas there are clear prospects that the investment into metrology business can be extremely profitable.

That meeting resulted in making a mutual decision on cooperation, integrating efforts and material resources and building a team of like-minded individuals. These professional individuals would pursue the plan to establish a network of competent centers able to secure a leading position in metrology market in Russia and overseas. An outcome of that cooperation was the development of GMP project.

THE PROJECT CONCEPT

Creating the network of GMP metrology agencies in Russia and overseas.

Generation of financial flows as a result of GMP centers' activity.

Implementation of the most courageous, prospective and hi-tech ideas and developments of the future.

The common use of the innovative GMP products in the most diverse spheres of human activity.

THE IMPLEMENTATION STEPS OF THE PILOT PROJECT

The first step – teambuilding.
For the purpose of project implementation we have built a superteam of professionals These people possess a high level of inner motivation, an extraordinary fund of energy and a great striving for achievement. Having a high-potential team allows to say confidently that the goals of the project will be fulfilled.

The second step – breaking the barriers and establishment of the first GMP metrology center.
This step was crucial for approbation and formalization of organizational procedures in practice and team consolidation in the face of such difficulties as:

- The lack of true and fair view being the new entrants into the market.
- The long and complicated procedure of authorization for provision of metrology services (in line with specifications of the local legislation).
- The feasibility study of the juridical person's authorization for the execution of works.
- The necessity to provide additional training and skills for the verification officers.
- The necessity of considerable initial investment funding (by the beginning of works there should be the necessary standards of units of measurements, the appropriate technical equipment, the developed methods of verification, the necessary regulatory support and the corresponding measuring systems as well).
- Establishment of the first GMP metrology center in strict accordance with the quality management system standard used by testing and calibration laboratories ISO/IEC 17025:2005.

The third step – obtaining a certificate of authorization of a juridical person in the area of traceability and uniformity of measurement.

- In October of 2015 the Federal Service for Accreditation (Rosstandart) appointed the expert panel.
- In November the expert panel carried out an expert examination in two stages: the examination of documents and the field inspection according to the location of the first GMP metrology center.
- In December of 2015 the Federal Service for Accreditation issued a Certificate of authorization of a juridical person in the area of traceabilty.
- Obtaining the Certificate was a crucial stage in the implementation of the Project.

The fourth step – the launch of the first GMP metrology center.
In January of 2016 the first GMP center started its operating activity.
In the first month of its operation more than 500 customer orders were fulfilled. In general the verification services in the area of water, gas and electricity meters' accuracy checking were demanded by the people.

In the second and the third months the volume of testing and calibration of precision instruments increased because of a request from industrial plants. In this regard the volume of the provided services increased by more than three times and the list of the verified instruments significantly expanded. The staff of metrology specialists of the GMP correspondingly increased.

The main objective of the GMP center at this stage consisted in the increase of delivery of provided at services 80-100% per month and the expansion of the nomenclature of the verified instruments at 30-40% per month.

In July of 2016 the GMP center concluded long-term contracts for metrology maintenance with more than 60 companies.

A successful start-up kept growing, the technologies and procedures developed, the troubleshooting activities were executed in order to fix the defects and to prevent downtime, the skills of the staff improved.

The fifth step – the review of the first-year activities
The main objective of the GMP center's first year consisted in testing the Center's work "at full speed" in order to:

- To check the acceptance rate of the center.

- To detect errors and shortages, to introduce corresponding corrections into work procedures, to establish the quality evaluation system to check the quality of the provided works.
- To perform the metrology market analysis.
- To analyze the needs of the Center's customers for the measurement services, to make up a plan for improvement of the physical facilities.
- To detect the needs of the staff for training, upgrading human skills and getting new specialists on board.

The achievement s of the Center during its first year:

- The orders of more than 9000 private customers were fulfilled.
- The works for more than 200 companies were executed.
- Nomenclature of the verified instruments expanded up to 50 types.
- More than 60 long-term contracts for metrological provision at enterprises were concluded.
- The quantity of errors and correction was minimal in the operating activity of the Center.
- For a short period of time the GMP Center became the largest private regional metrology center.

Conclusions of the Center's first year:

- According to the results of the analysis of competitive environment in the area of metrology provision in the Russian Federation it is possible to make a conclusion that the studied market represents a market with underdeveloped competition.
- The demand for metrology services significantly exceeds the supply.
- The existing enterprises constitute not more than 20% of the services demanded at the market.

The sixth step – the confirmation of competence of the first GMP metrology center of the Federal Service for Accreditation.

According to the existing Russian legislation after a juridical person obtains a certificate of authorization in the area of traceability and the uniformity of measurements it must prove its competence after the first year of work, after the first three years of work and then be recertified every five years.

For this reason:

- In November of 2016 the Federal Service for Accreditation (Rosstandart) appointed the expert panel in order to perform a scheduled verification of the GMP center's activities.
- In December of 2016 the expert panel carried out the second field expertise of the Center.

- In January of 2017 according to the results of assessment the Federal Service for Accreditation issued its positive conclusion.

Obtaining this conclusion confirmed the adequacy of the implemented business plan and reinforced the intention to further develop the Project.

The seventh step – the additional testing of GMP
For the purpose of a more comprehensive market analysis in the sphere of metrology services the project team decided on an additional testing of the project in three new and disneighbouring regions of the Russian Federation.

The following prerequisites were provided for the testing:

- The field expert team from the number of the specialists and managers of the Center.
- The equipment collection points for the purpose of verification and calibration.
- The mobile laboratories for operational measurement.
- Advertising campaign in the specialized local media.

The eighth step – the analysis of the GMP project's activity in the region.
The test duration constituted just over three months.

According to the test results it was found that:

- As in the home region the analysis of the competitive environment at the metrology market showed the underdeveloped competition.
- The demand for metrology services significantly exceeded the supply.
- The metrology agencies operating on the territories of the regions under study constitute, on average, not more than 15% from the necessity of the services market.

The ninth step – summarizing the results of the pilot project.
In addition to testing in the home region and three other regions of the Russian Federation the team of the project carefully analyzed the global metrology services market.

The team members visited the metrology institutes, talked to scientists, got acquainted with the specialists of the relevant institutions and partook in the international metrology exhibitions and conferences.

Much attention in the process of research was focused on the communication with students and young scientists from different countries. We managed to collect and systematize the information on the following questions:

- What excites the young scientists?
- What kind of projects do they want to work on?
- What dreams and goals do they want to implement having the necessary resources?

These meetings resulted in the full understanding of the existing relevance between the objectives of the project and the desires, goals and dreams of the young talents and the beginning metrologists from different countries.

In one year and seven months while the pilot project was being run our Team succeded:

- To implement the business plan of arrangement of a metrology center's work in a single region of the Russian Federation,
- To gather the relevant information about the state of metrology market in Russia and overseas,
- To define the prospects of participation in innovation efforts in the sphere of high-technology measurements.

These results confirm the significance of the Project, the adequacy of the chosen way of development, give more confidence and inspire to implement the GMP project at full scale.

> The successful results of all the stages of the pilot project allow speaking confidently about the global potential of the GMP project.

THE BASE OF THE PROJECT

METROLOGY

At the base of the project lies metrology – the science of measurements embracing the means and methods for ensuring their uniformity and the ways to provide the required accuracy. The subject of metrology is the extraction of the quantitative information about the qualities of objects with the determined degree of precision.

The metrological standards including ISO/IEC 17025 and the identical ones GOST ISO/IEC 17025 (the Russian Federation), DSTU ISO/IEC 17025 (Ukraine) and STB ISO/IEC 17025-2007 (the Republic of Belarus) serve as the regulatory basis. They set the requirements to testing and calibration laboratories and adherence to these requirements guarantees their technical competence and ability to provide technically proven results. The application of the standard, in particular, facilitates the simplification of the procedure for the acknowledgment of the testing and calibration results in different countries.

Today measurement and metrology penetrate all spheres of life. A new-born baby having no name yet immediately becomes an object of measurement. In the very first minutes of life the measuring instruments for length, mass, and temperature are applied to it. In everyday life we also constantly face quantitative assessments. We estimate the temperature of the air in the street, watch the time, and decide how profitable and rational almost any of our actions can be. Human professional activity is related to measurements in any industry. The engineers of industrial enterprises that carry out metrological support of production should have full information about the possibilities of measuring equipment for the purpose of solving the problems of interchangeability of units and details and controlling production at all its life cycles.

Metrology occupies a special place among technical sciences, since metrology absorbs the latest scientific achievements and this is expressed in the perfection of its standard base and methods for processing the results of measurements.

Metrology has become a science without which no specialist can work in any industry.

Our GMP project consolidates the experience of Russian specialists in the field of metrology in order to provide the requirements for conducting high-precision measurements in various branches of industry in accordance with the existing standards. And this trend, of course, has tremendous economic potential.

TESTING AND CERTIFICATION IN GMP CENTERS

Testing and certification are an integral part of the activities of the GMP Centers. The main task of the tests is to evaluate how much the product is able to perform the expected or required functions in certain specific conditions by obtaining the qualitative and quantitative characteristics of the products with the help of research methods.

Without product testing in the laboratory it is not possible to obtain a certificate of conformity, a fire safety certificate, or other permissive documents that are the basis for putting the products into circulation.

The list of the services rendered by the GMP centers in the sphere of testing:

- Testing of medical devices.
- Testing of household appliances and electronics.
- Testing of low-voltage equipment.
- Testing and product research.
- Testing of oil and refined products.
- Electromagnetic compatibility tests of technical means.
- Testing of light industry products.
- Testing of personal protective equipment.
- Testing of food industry products.
- Testing of measuring instruments for type approval.
- Testing of heat networks to determine the actual loss of thermal energy.

The list of certification services rendered by the GMP centers:

- Certification of integrated management systems.
- Certification of occupational safety and health management systems.
- Certification of systems. Certification of products.
- HACCP certification.
- Certification of environmental management systems.

Along with testing and certification the GMP centers provide the following services:

- Certification of test equipment.
- Certification of measurement techniques.
- Certification of standards.
- Graduation of tanks and reservoirs.

- Diagnostics of energy metering units.
- Measurement of radio interference.
- Instrumental control of technical condition of medical devices.
- Investigating the parameters of electrical energy.
- Calibration of research, test and measurement tools.
- Quality control and production control.
- Metrological examination of documentation.
- Interlaboratory comparison (ILC)
- Nanometrology.
- Registration of the Energy Passport.
- Verification of measuring instruments.
- Design, installation and commissioning of energy metering units.

This is not the whole list of services provided by the metrological GMP centers.

THE MARKET VOLUME

METROLOGY SERVICES MARKET SIZE

In Russia about 200 billion measurements are made every day, more than 4 million people consider measurements to be a part of their profession.

The share of expenses for measurement is 10-15% of the costs of social labor, and in industries that produce sophisticated equipment (electrical engineering, machine tools, etc.), it reaches up to 50-70%.

The scale of costs for obtaining reliable measurement results is evidenced by the following figures: in 1998 the cost of these works in Russia was 3.8% of the gross national product (GNP).

In developed countries this figure reaches up to 9-12% of GDP. It is estimated that the number of measuring instruments grows in direct proportion to the square of the increase in industrial output. This means that with an increase in the volume of industrial output by 2 times, the number of measuring instruments can grow by 4 times.

At present, there are more than 1.5 billion measuring instruments in Russia.

The effect obtained in the national economy due to the use of measuring instruments is approximately 8-10 rubles for 1 ruble costs (International scientific journal "Symbol of science" No. 8/2016).

> The GMP project is aimed at the Russian and international market in the amount of $ 1,500,000,000,000 + growth of 10% per year.

What contributes to the growth of the market of metrological services?

- In many measurement areas, particularly in the field of time and frequency measurements, linear-angular measurements, mechanical measurements, and electrical and optical measurements, the level of accuracy being required increases from three to ten times over a decade. In some areas, the current level of accuracy does not practically meet the requirements for trade or security and the limit values established by legislative acts.
- The general trend towards miniaturization of products and introduction of submicron technologies, such as "lab-on-a-chip", predetermines the emergence

of completely new measurement principles. Nanometrology is a new direction, providing for development of new methods and measuring instruments, including the development of primary and secondary standards and standard samples intended for measuring objects in the nanometer range or for measuring new parameters.

- International trade in gas and oil products, pharmaceuticals, chemical and food products continues to grow, necessitating the revision of metrological requirements in the field of chemistry and biotechnology. At the same time, reliable and comparable measurements in the field of food testing are becoming increasingly important not only because of the large volume and its significant cost, but also because of the need to control the safety of these products (for example, testing genetically modified products).
- The list of legislative acts in the field of safety and environmental protection is constantly expanding, which in all cases requires internationally recognized traceable and comparable measurements.
- Further development and application of new types of lasers and interferometric methods of measurement are of great importance for precision linear-angular measurements and measurements of the surface roughness, and, in particular, for measuring nanostructures used in electronics, optics and medicine.
- The implementation of the International Temperature Scale of 1990 (ITS - 90) should improve the accuracy of thermodynamic measurements, heat capacity and thermal conductivity measurements and create insulating materials necessary for energy-saving technologies.
- The use of absolute radiometers and the expansion of the measurement range for far infrared and far ultraviolet spectral regions are particularly important, for example, for remote measurements, for the production of microchips and lithography.
- More accurate traceable measurements are in high demand in the field of ionizing radiation. Increased attention to nuclear power engineering and wide application of ionizing radiation in the field of diagnostics, therapy and radiation protection require the creation of precision dosimetric equipment.

This is a far from complete list of examples that characterize the increased need for high-precision measurements.

Year after year, the requirements for accuracy increase more and more rapidly. By the way, if before the average life cycle of the standard was 10-15 years, today the needs of advanced industrial technologies, defense, economic development require these terms to be cut by half - up to 5-7 years. And this process – the man's race to accuracy – is endless!

THE VOLUME OF INNOVATIVE TECHNOLOGY CLUSTERS

In parallel with the development of the metrological direction, a separate scientific platform – innovative and technological Clusters will be formed. The main goal of the Clusters will be to unite the best specialists from various scientific fields for the purpose of generation and implementation of the most promising ideas and innovative developments of our time.

The solutions of such problems as renewable energy, future medicine, artificial intelligence, quantum computer, bioinformatics and other topics of concern to humanity, will contribute to the consolidation of hundreds of scientists within the Cluster walls. Over time clusters will become a scientific platform for generation and implementation of 1000 stunning projects.

The emergence of new technologies will make it possible to turn latent demand into the actual one as soon not only demand creates supply, but a new supply creates a new demand. Exactly the new supply creates new markets and determines the image of the future.

Clusters are a successful, effective and profitable business strategy.

With 100% certainty we can say that this strategy has shown its effectiveness 100 years ago, shows it now and will show it in 200 years which is why the investment into this strategy is the most reasonable decision. Investments will pay off in multiple amounts, because the creation of a new market brings thousands of profit percents. Creating a new market is the most attractive business strategy. When there is a market, when there are customers, there is someone to sell the goods and services to.

OPENING OF THE MARKET

OPENING OF THE MARKET IN RUSSIA

In January 2009 the new Federal Law "On ensuring the uniformity of measurements" No. 102-FZ of June 26, 2008 came into force.

Since that time the previous law – No. 4871-1 of April 27, 1993 – has lost its force. The adoption of the new law was caused primarily by the need to bring the legislation of the Russian Federation in the field of metrology in line with modern international requirements.

Significant innovations of the Federal Law on ensuring the uniformity of measurements represent some narrowing of the scope of the state regulation and removal of certain devices from its influence, for example, of gambling machines, abolition of licensing for manufacturing and repairing of measuring instruments, abolition of certification of verification officers and other important changes.

Thus, the new law permitted to delegate the authority for verification and testing of measuring instruments for the purpose of pattern (type) approval to juridical persons that passed proper accreditation. Thus, the legislative foundation for real competition between state and commercial organizations in the market of metrological services was laid.

It became possible to pass proper accreditation in the Federal Service for Accreditation (Rosaccreditation)

Rosaccreditation was created in 2011 in accordance with the Decree of the President of the Russian Federation of January 24, 2011, No. 86 "On the unified national accreditation system" and operates on the basis of the Regulations on the Federal Service for Accreditation approved by Resolution of the Government of the Russian Federation No. 845 of October 17, 2011.

Now the doors to the metrological market of Russia are open for accredited commercial organizations!

THERE IS NO COMPETITION SO FAR

Based on the analysis of the state of the competitive environment in the market of metrological services in the Russian Federation, it can be concluded that the market under study is a market with underveloped competition.

At the moment, the federal state-funded institutions – state regional centers for standardization, metrology and testing (FSFI CSM) have a share of more than 87% in the market of metrological services.

The high concentration of the presence of one player is due to the following factors:

- Only in 2009 the legislative basis for real competition between state and commercial organizations in the market of metrological services was laid.
- Lack of complete and reliable information for the newcomers to the market.
- Complicated and long accreditation procedure for gaining the right to conduct work.
- Feasibility study of the accreditation of a juridical person for the right to carry out works.
- The need for training experts - verifiers.
- The need for the initial investment of significant financial resources (by the beginning of works there should be the necessary standards of units of measurements, the appropriate technical equipment, the developed verification methods, the necessary regulatory support and the corresponding measuring systems as well).

However, it is the presence of obstacles for a new player in the market combined with a high level of concentration of the industry's monopoly that opens up great prospects for the "newcomer".

After overcoming the initial barriers that were outlined above the new participant must actively take market share, using the advantages and weaknesses of the main competitor.

The main advantages of the new market participant are the following:

- The complete absence of aspirations to take market share from the state regional centers of standardization, metrology and testing in FSFI CSM.
- The tendency of FSFI CSM to delegate part of the services to the authorized third-parties.

- The inability of FSFI CSM to meet the increasing demand for services.
- The absence of any competitive experience and flexibility in decision-making in FSFI CSM (for example, volume, terms and costs of services are strictly regulated by the state).
- A new market participant has the opportunity to take a significant market share without being impeded by the main player.

A similar picture of the metrology services market shaped up in the post-Soviet space.

70 COUNTRIES OF THE WORLD

More than 200 GMP centers will be established in 70 countries in the process of project implementation.

Most of the GMP centers will be opened in the countries of the Asia-Pacific region.

The interest in this region is explained by a number of important circumstances. First of all, this is an advantageous geopolitical and geostrategic position. In addition, more than 40% of the world's population lives on the territory of the region, more than half of the world's gross product is produced, more than 50% of the total world trade volume is sold. The countries of the Asia-Pacific region are characterized by the highest rates of economic growth.

And also an important aspect is the recent (June 27, 2017) accession of the Federal Service for Accreditation (Rosaccreditation) to the Mutual Recognition Arrangement of the Asian-Pacific Laboratory Accreditation Cooperation (APLAC MRA). The corresponding document was signed by the head of Rosaccreditation Alexey Hersontsev, the APLAC MRA Chairman Dr. Llewellyn Richard and the APLAC Chairman Wong Wang Wah at the annual joint meeting of the Asia-Pacific Laboratory Accreditation Cooperation and the Pacific Accreditation Organization held in June 16-24, 2017 in Bangkok, Thailand.

Accession to the adopted agreements guarantees that the results of accreditation of Russian laboratories will be acknowledged abroad.

The signing ceremony was preceded by a meeting of the APLAC MRA Council which reviewed the report of the Vice-President of APLAC the head of the National Association of Testing Authorities, Australia, Jennifer Evans who led the APLAC team of experts that evaluated the activities of the Rosaccreditation regarding verification of testing and calibration laboratories' compliance with international standards and regulating documents of specialized international organizations.

Within the framework of the on-site assessment stage, which took place on the territory of the Russian Federation from 9 to 19 November, 2016, the six APLAC experts from Australia, Canada, Mongolia, Singapore and the USA monitored the work of Russian accreditation experts in 9 laboratories in Moscow, St. Petersburg, the Republic of Tatarstan, Orel and Tula regions, visited the central office of Rosaccreditation, as well as the territorial administration of the Service in the Volga (Privolshsky) Federal District in Kazan.

The assessment resulted in the recommendation of the APLAC expert group to grant Rosaccreditation the status of the APLAC MRA’s signatory in regarding testing and calibration laboratories, which was supported by the participants of the APLAC MRA Council meeting.

The Rosaccreditation became the 38th participant of the APLAC MRA, an agreement that unites 39 accreditation bodies from 26 economies of the Asia-Pacific region, which provides for mutual recognition between the signatories concerning accreditation within the declared area on the basis of equivalence of the conformity assessment bodies used in the accreditation. In practice, such recognition is an important tool used by international trade participants to ensure favorable conditions for the promotion of their goods to foreign markets.

Each country has its own accreditation rules and requirements for laboratories and certification bodies that issue proof documents for products. In order to relate these requirements to each other there are international organizations for accreditation. Membership in them and joining to the accepted agreements guarantees that the results of Russian laboratories’ accreditation will be acknowledged abroad.

In order to further develop and implement all project plans globally GMP centers will be established in Europe. Working in different parts of the world, GMP offices will accumulate the efforts of the young, ambitious, talented people seeking opportunities for self-fulfillment.

THE WORLD NEEDS THE GMP PROJECT

“I want to present to your attention a very important article that details the problems of modern science. In this article the representatives of world-famous universities talk about the obstacles faced by scientific projects and the scientists themselves and discuss the measures that must be taken to avoid such situations for the purpose of successful implementation of innovative ideas.

This article made a deep impression on all the participants of our team and inspired us to create innovative technology Clusters, which are of the utmost importance to us and represent an integral part of the GMP project. We firmly believe that the advanced innovations of the talented scientists, who created the newest measuring instruments and measurement technologies, that are super-demanded in modern production facilities, being based on full-scale research and proven to consistently deliver high-quality results, contribute to the production of high-quality products and generally move progress, make our life better, safer, more comfortable and more interesting.”

- The Founder of the GMP Project
Sergey Maltcev

THE 7 BIGGEST PROBLEMS FACING SCIENCE, ACCORDING TO SCIENTISTS

"Science, I had come to learn, is as political, competitive, and fierce a career as you can find, full of the temptation to find easy paths."
– Paul Kalanithi, neurosurgeon and writer (1977–2015)

Science is in big trouble. Or so we’re told.

In the past several years, many scientists have become afflicted with a serious case of doubt - doubt in the very institution of science.

As reporters covering medicine, psychology, climate change, and other areas of research, we wanted to understand this epidemic of doubt. So we sent scientists a survey asking this simple question: If you could change one thing about how science works today, what would it be and why?

We heard back from 270 scientists all over the world, including graduate students, senior professors, laboratory heads, and Fields Medalists. They told us that, in a variety of ways, their careers are being hijacked by perverse incentives. The result is bad science.

The scientific process, in its ideal form, is elegant: Ask a question, set up an objective test, and get an answer. Repeat. Science is rarely practiced to that ideal. But Copernicus believed in that ideal. So did the rocket scientists behind the moon landing.

But nowadays, our respondents told us, the process is riddled with conflict. Scientists say they’re forced to prioritize self-preservation over pursuing the best questions and uncovering meaningful truths.

"I feel torn between asking questions that I know will lead to statistical significance and asking questions that matter," says Kathryn Bradshaw, a 27-year-old graduate student of counseling at the University of North Dakota.

Today, scientists' success often isn't measured by the quality of their questions or the rigor of their methods. It's instead measured by how much grant money they win, the number of studies they publish, and how they spin their findings to appeal to the public.

"Is the point of research to make other professional academics happy, or is it to learn more about the world?"
– Noah Grand, former lecturer in sociology, UCLA

Scientists often learn more from studies that fail. But failed studies can mean career death. So instead, they’re incentivized to generate positive results they can publish. And the phrase "publish or perish" hangs over nearly every decision. It’s a nagging whisper, like a Jedi’s path to the dark side.

"Over time the most successful people will be those who can best exploit the system," Paul Smaldino, a cognitive science professor at University of California Merced, says.

To Smaldino, the selection pressures in science have favored less-than-ideal research: "As long as things like publication quantity, and publishing flashy results in fancy journals are incentivized, and people who can do that are rewarded … they’ll be successful, and pass on their successful methods to others."

Many scientists have had enough. They want to break this cycle of perverse incentives and rewards. They are going through a period of introspection, hopeful that the end result will yield stronger scientific institutions. In our survey and interviews, they offered a wide variety of ideas for improving the scientific process and bringing it closer to its ideal form.

Before we jump in, some caveats to keep in mind: Our survey was not a scientific poll. For one, the respondents disproportionately hailed from the biomedical and social sciences and English-speaking communities.

Many of the responses did, however, vividly illustrate the challenges and perverse incentives that scientists across fields face. And they are a valuable starting point for a deeper look at dysfunction in science today.

The place to begin is right where the perverse incentives first start to creep in: the money.

1**. Academia has a huge money problem.**

To do most any kind of research, scientists need money: to run studies, to subsidize lab equipment, to pay their assistants and even their own salaries. Our respondents told us that getting — and sustaining — that funding is a perennial obstacle.

Their gripe isn't just with the quantity, which, in many fields, is shrinking. It's the way money is handed out that puts pressure on labs to publish a lot of papers, breeds conflicts of interest, and encourages scientists to overhype their work.

In the United States, academic researchers in the sciences generally cannot rely on university funding alone to pay for their salaries, assistants, and lab costs. Instead, they have to seek outside grants. "In many cases the expectations were and often still are that faculty should cover at least 75 percent of the salary on grants," writes John Chatham, a professor of medicine studying cardiovascular disease at University of Alabama at Birmingham.

Grants also usually expire after three or so years, which pushes scientists away from long-term projects. Yet as John Pooley, a neurobiology postdoc at the University of Bristol, points out, the biggest discoveries usually take decades to uncover and are unlikely to occur under short-term funding schemes.

Outside grants are also in increasingly short supply. In the US, the largest source of funding is the federal government, and that pool of money has been plateauing for years, while young scientists enter the workforce at a faster rate than older scientists retire.

Take the National Institutes of Health, a major funding source. Its budget rose at a fast clip through the 1990s, stalled in the 2000s, and then dipped with sequestration budget cuts in 2013. All the while, rising costs for conducting science meant that each NIH dollar purchased less and less. Last year, Congress approved the biggest NIH spending hike in a decade. But it won't erase the shortfall.

The consequences are striking: In 2000, more than 30 percent of NIH grant applications got approved. Today, it's closer to 17 percent. "It's because of what's happened in the last 12 years that young scientists in particular are feeling such a squeeze," NIH Director Francis Collins said at the Milken Global Conference in May.

Some of our respondents said that this vicious competition for funds can influence their work. Funding "affects what we study, what we publish, the risks we (frequently don't) take," explains Gary Bennett a neuroscientist at Duke University. It "nudges us to emphasize safe, predictable (read: fundable) science."

Truly novel research takes longer to produce, and it doesn't always pay off. A National Bureau of Economic Research working paper found that, on the whole, truly unconventional papers tend to be less consistently cited in the literature. So scientists and funders increasingly shy away from them, preferring short-turnaround, safer papers. But everyone suffers from that: the NBER report found that novel papers also occasionally lead to big hits that inspire high-impact, follow-up studies.

"I think because you have to publish to keep your job and keep funding agencies happy, there are a lot of (mediocre) scientific papers out there ... with not much new science presented," writes Kaitlyn Suski, a chemistry and atmospheric science postdoc at Colorado State University.

Another worry: When independent, government, or university funding sources dry up, scientists may feel compelled to turn to industry or interest groups eager to generate studies to support their agendas.

"With funding from NIH, USDA, and foundations so limited ... researchers feel obligated - or willingly seek - food industry support. The frequent result? Conflicts of interest."
– Marion Nestle, food politics professor, New York University.

Already, much of nutrition science, for instance, is funded by the food industry — an inherent conflict of interest. And the vast majority of drug clinical trials are funded by drugmakers. Studies have found that private industry–funded research tends to yield conclusions that are more favorable to the sponsors.

Finally, all of this grant writing is a huge time suck, taking resources away from the actual scientific work. Tyler Josephson, an engineering graduate student at the University of Delaware, writes that many professors he knows spend 50 percent of their time writing grant proposals. "Imagine," he asks, "what they could do with more time to devote to teaching and research?"

It's easy to see how these problems in funding kick off a vicious cycle. To be more competitive for grants, scientists have to have published work. To have published work, they need positive (i.e., statistically significant) results. That puts pressure on scientists to pick "safe" topics that will yield a publishable conclusion — or, worse, may bias their research toward significant results.

"When funding and pay structures are stacked against academic scientists," writes Alison Bernstein, a neuroscience postdoc at Emory University, "these problems are all exacerbated."

Fixes for science's funding woes

Right now there are arguably too many researchers chasing too few grants. Or, as a 2014 piece in the *Proceedings of the National Academy of Sciences* put it: "The current system is in perpetual disequilibrium, because it will inevitably generate an ever-increasing supply of scientists vying for a finite set of research resources and employment opportunities."

"As it stands, too much of the research funding is going to too few of the researchers," writes Gordon Pennycook, a PhD candidate in cognitive psychology at the University of Waterloo. "This creates a culture that rewards fast, sexy (and probably wrong) results."

One straightforward way to ameliorate these problems would be for governments to simply increase the amount of money available for science. (Or, more controversially, decrease the number of PhDs, but we'll get to that later.) If Congress boosted funding for the NIH and National Science Foundation, that would take some of the competitive pressure off researchers.

But that only goes so far. Funding will always be finite, and researchers will never get blank checks to fund the risky science projects of their dreams. So other reforms will also prove necessary.

One suggestion: Bring more stability and predictability into the funding process. "The NIH and NSF budgets are subject to changing congressional whims that make it impossible for agencies (and researchers) to make long term plans and commitments,"

M. Paul Murphy, a neurobiology professor at the University of Kentucky, writes. "The obvious solution is to simply make [scientific funding] a stable program, with an annual rate of increase tied in some manner to inflation."

"Bitter competition leads to group leaders working desperately to get any money just to avoid closing their labs, submitting more proposals, overwhelming the grant system further. It's all kinds of vicious circles on top of each other."
– Maximilian Press, graduate student in genome science, University of Washington

Another idea would be to change *how* grants are awarded: Foundations and agencies could fund specific people and labs for a period of time rather than individual project proposals. (The Howard Hughes Medical Institute already does this.) A system like this would give scientists greater freedom to take risks with their work.

Alternatively, researchers in the journal *mBio* recently called for a lottery-style system. Proposals would be measured on their merits, but then a computer would randomly choose which get funded.

"Although we recognize that some scientists will cringe at the thought of allocating funds by lottery," the authors of the *mBio* piece write, "the available evidence suggests that the system is already in essence a lottery without the benefits of being random." Pure randomness would at least reduce some of the perverse incentives at play in jockeying for money.

There are also some ideas out there to minimize conflicts of interest from industry funding. Recently, in *PLOS Medicine*, Stanford epidemiologist John Ioannidis suggested that pharmaceutical companies ought to pool the money they use to fund drug research, to be allocated to scientists who then have no exchange with industry during study design and execution. This way, scientists could still get funding for work crucial for drug approvals - but without the pressures that can skew results.

These solutions are by no means complete, and they may not make sense for every scientific discipline. The daily incentives facing biomedical scientists to bring new drugs to market are different from the incentives facing geologists trying to map out new rock layers. But based on our survey, funding appears to be at the root of many of the problems facing scientists, and it’s one that deserves more careful discussion.

2**. Too many studies are poorly designed. Blame bad incentives.**

Scientists are ultimately judged by the research they publish. And the pressure to publish pushes scientists to come up with splashy results, of the sort that get them into prestigious journals. "Exciting, novel results are more publishable than other kinds," says Brian Nosek, who co-founded the Center for Open Science at the University of Virginia.

The problem here is that truly groundbreaking findings simply don't occur very often, which means scientists face pressure to game their studies so they turn out to be a little more "revolutionary." (Caveat: Many of the respondents who focused on this particular issue hailed from the biomedical and social sciences.)

Some of this bias can creep into decisions that are made early on: choosing whether or not to randomize participants, including a control group for comparison, or controlling for certain confounding factors but not others. (Read more on study design particulars here.)

Many of our survey respondents noted that perverse incentives can also push scientists to cut corners in how they analyze their data.

"I have incredible amounts of stress that maybe once I finish analyzing the data, it will not look significant enough for me to defend," writes Jess Kautz, a PhD student at the University of Arizona. "And if I get back mediocre results, there's going to be incredible pressure to present it as a good result so they can get me out the door. At this moment, with all this in my mind, it is making me wonder whether I could give an intellectually honest assessment of my own work."

"Novel information trumps stronger evidence which sets the parameters for working scientists."
– Jon-Patrick Allem, postdoctoral social scientist, USC Keck School of Medicine

Increasingly, meta-researchers (who conduct research on research) are realizing that scientists often do find little ways to hype up their own results — and they're not always doing it consciously. Among the most famous examples is a technique called "p-hacking," in which researchers test their data against many hypotheses and only report those that have statistically significant results.

In a recent study, which tracked the misuse of p-values in biomedical journals, meta-researchers found "an epidemic" of statistical significance: 96 percent of the papers that included a p-value in their abstracts boasted statistically significant results.

That seems awfully suspicious. It suggests the biomedical community has been chasing statistical significance, potentially giving dubious results the appearance of validity through techniques like p-hacking — or simply suppressing important results that don't look significant enough. Fewer studies share effect sizes (which arguably gives a better indication of how meaningful a result might be) or discuss measures of uncertainty.

"The current system has done too much to reward results," says Joseph Hilgard, a postdoctoral research fellow at the Annenberg Public Policy Center. "This causes a conflict of interest: The scientist is in charge of evaluating the hypothesis, but the scientist also desperately wants the hypothesis to be true."

The consequences are staggering. An estimated $200 billion — or the equivalent of 85 percent of global spending on research — is routinely wasted on poorly designed and redundant studies, according to meta-researchers who have analyzed inefficiencies in research. We know that as much as 30 percent of the most influential original medical research papers later turn out to be wrong or exaggerated.

Fixes for poor study design

Our respondents suggested that the two key ways to encourage stronger study design — and discourage positive results chasing — would involve rethinking the rewards system and building more transparency into the research process.

"I would make rewards based on the rigor of the research methods, rather than the outcome of the research," writes Simine Vazire, a journal editor and a social psychology professor at UC Davis. "Grants, publications, jobs, awards, and even media coverage should be based more on how good the study design and methods were, rather than whether the result was significant or surprising."

Likewise, Cambridge mathematician Tim Gowers argues that researchers should get recognition for advancing science broadly through informal idea sharing - rather than only getting credit for what they publish.

"We've gotten used to working away in private and then producing a sort of polished document in the form of a journal article," Gowers said. "This tends to hide a lot of the thought process that went into making the discoveries. I'd like attitudes to change so people focus less on the race to be first to prove a particular theorem, or in science to make a particular discovery, and more on other ways of contributing to the furthering of the subject."

When it comes to published results, meanwhile, many of our respondents wanted to see more journals put a greater emphasis on rigorous methods and processes rather than splashy results.

"Science is a human activity and is therefore prone to the same biases that infect almost every sphere of human decision-making."

– Jay Van Bavel, psychology professor, New York University

"I think the one thing that would have the biggest impact is removing publication bias: judging papers by the quality of questions, quality of method, and soundness of analyses, but not on the results themselves," - writes Michael Inzlicht, a University of Toronto psychology and neuroscience professor.

Some journals are already embracing this sort of research. *PLOS One*, for example, makes a point of accepting negative studies (in which a scientist conducts a careful experiment and finds nothing) for publication, as does the aptly named *Journal of Negative Results in Biomedicine*.

More transparency would also help, writes Daniel Simons, a professor of psychology at the University of Illinois. Here’s one example: ClinicalTrials.gov, a site run by the NIH, allows researchers to register their study design and methods ahead of time and then publicly record their progress. That makes it more difficult for scientists to hide experiments that didn’t produce the results they wanted. (The site now holds information for more than 180,000 studies in 180 countries.)

Similarly, the AllTrials campaign is pushing for every clinical trial (past, present, and future) around the world to be registered, with the full methods and results reported. Some drug companies and universities have created portals that allow researchers to access raw data from their trials.

The key is for this sort of transparency to become the norm rather than a laudable outlier.

3. Replicating results is crucial. But scientists rarely do it.

Replication is another foundational concept in science. Researchers take an older study that they want to test and then try to reproduce it to see if the findings hold up.

Testing, validating, retesting — it's all part of a slow and grinding process to arrive at some semblance of scientific truth. But this doesn't happen as often as it should, our respondents said. Scientists face few incentives to engage in the slog of replication. And even when they attempt to replicate a study, they often find they can’t do so. Increasingly it’s being called a "crisis of irreproducibility."

The stats bear this out: A 2015 study looked at 83 highly cited studies that claimed to feature effective psychiatric treatments. Only 16 had ever been successfully replicated. Another 16 were contradicted by follow-up attempts, and 11 were found to have substantially smaller effects the second time around. Meanwhile, nearly half of the studies (40) had never been subject to replication at all.

More recently, a landmark study published in the journal *Science* demonstrated that only a fraction of recent findings in top psychology journals could be replicated. This is happening in other fields too, says Ivan Oransky, one of the founders of the blog Retraction Watch, which tracks scientific retractions.

As for the underlying causes, our survey respondents pointed to a couple of problems. First, scientists have very few incentives to even *try* replication. Jon-Patrick Allem, a social scientist at the Keck School of Medicine of USC, noted that funding agencies prefer to support projects that find new information instead of confirming old results.

Journals are also reluctant to publish replication studies unless "they contradict earlier findings or conclusions," Allem writes. The result is to discourage scientists from checking each other's work. "Novel information trumps stronger evidence, which sets the parameters for working scientists."

The second problem is that many studies can be difficult to replicate. Sometimes their methods are too opaque. Sometimes the original studies had too few participants to produce a replicable answer. And sometimes, as we saw in the previous section, the study is simply poorly designed or outright wrong.

Again, this goes back to incentives: When researchers have to publish frequently and chase positive results, there’s less time to conduct high-quality studies with well-articulated methods.

Fixes for underreplication

Scientists need more carrots to entice them to pursue replication in the first place. As it stands, researchers are encouraged to publish new and positive results and to allow negative results to linger in their laptops or file drawers.

This has plagued science with a problem called "publication bias" — not all studies that are conducted actually get published in journals, and the ones that do tend to have positive and dramatic conclusions.

If institutions started to reward tenure positions or make hires based on the quality of a researcher’s body of work, instead of quantity, this might encourage more replication and discourage positive results chasing.

"The key that needs to change is performance review," writes Christopher Wynder, a former assistant professor at McMaster University. "It affects reproducibility because there is little value in confirming another lab's results and trying to publish the findings."

"Replication studies should be incentivized somehow, and journals should be incentivized to publish ‘negative’ studies. All results matter, not just the flashy, paradigm-shifting results."
– Stephanie Thurmond, biology graduate student, University of California Riverside

The next step would be to make replication of studies easier. This could include more robust sharing of methods in published research papers. "It would be great to have stronger norms about being more detailed with the methods," says University of Virginia’s Brian Nosek.

He also suggested more regularly adding supplements at the end of papers that get into the procedural nitty-gritty, to help anyone wanting to repeat an experiment. "If I can rapidly get up to speed, I have a much better chance of approximating the results," he said.

Nosek has detailed other potential fixes that might help with replication — all part of his work at the Center for Open Science.

A greater degree of transparency and data sharing would enable replications, said Stanford’s John Ioannidis. Too often, anyone trying to replicate a study must chase down the original investigators for details about how the experiment was conducted.

"It is better to do this in an organized fashion with buy-in from all leading investigators in a scientific discipline," he explained, "rather than have to try to find the investigator in each case and ask him or her in detective-work fashion about details, data, and methods that are otherwise unavailable."

Researchers could also make use of new tools, such as open source software that tracks every version of a data set, so that they can share their data more easily and have transparency built into their workflow.

Some of our respondents suggested that scientists engage in replication *prior to* publication. "Before you put an exploratory idea out in the literature and have people take the time to read it, you owe it to the field to try to replicate your own findings," says John Sakaluk, a social psychologist at the University of Victoria.

For example, he has argued, psychologists could conduct small experiments with a handful of participants to form ideas and generate hypotheses. But they would then need to conduct bigger experiments, with more participants, to replicate and confirm those hypotheses before releasing them into the world. "In doing so," Sakaluk says, "the rest of us can have more confidence that this is something we might want to [incorporate] into our own research."

4. Peer review is broken

Peer review is meant to weed out junk science before it reaches publication. Yet over and over again in our survey, respondents told us this process fails. It was one of the parts of the scientific machinery to elicit the most rage among the researchers we heard from.

Normally, peer review works like this: A researcher submits an article for publication in a journal. If the journal accepts the article for review, it's sent off to peers in the same field for constructive criticism and eventual publication — or rejection. (The level of anonymity varies; some journals have double-blind reviews, while others have moved to triple-blind review, where the authors, editors, and reviewers don't know who one another are.)

It sounds like a reasonable system. But numerous studies and systematic reviews haveshown that peer review doesn't reliably prevent poor-quality science from being published.

"I think peer review is, like democracy, bad, but better than anything else."
—Timothy Bates, psychology professor, University of Edinburgh

The process frequently fails to detect fraud or other problems with manuscripts, which isn't all that surprising when you consider researchers aren't paid or otherwise rewarded for the time they spend reviewing manuscripts. They do it out of a sense of duty — to contribute to their area of research and help advance science.

But this means it's not always easy to find the best people to peer-review manuscripts in their field, that harried researchers delay doing the work (leading to publication delays of up to two years), and that when they finally do sit down to peer-review an article they might be rushed and miss errors in studies.

"The issue is that most referees simply don't review papers carefully enough, which results in the publishing of incorrect papers, papers with gaps, and simply unreadable papers," says Joel Fish, an assistant professor of mathematics at the University of Massachusetts Boston. "This ends up being a large problem for younger researchers to enter the field, since that means they have to ask around to figure out which papers are solid and which are not."

"Science is fluid; publishing isn't. It takes forever for research to make it to print, there is little benefit to try [to] replicate studies or publish insignificant results, and it is expensive to access the research."
– Amanda Caskenette, aquatic science biologist, Fisheries and Oceans Canada

That's not to mention the problem of peer review bullying. Since the default in the process is that editors and peer reviewers know who the authors are (but authors don't know who the reviews are), biases against researchers or institutions can creep in, opening the opportunity for rude, rushed, and otherwise unhelpful comments. (Just check out the popular #SixWordPeerReview hashtag on Twitter).

These issues were not lost on our survey respondents, who said peer review amounts to a broken system, which punishes scientists and diminishes the quality of publications. They want to not only overhaul the peer review process but also change how it's conceptualized.

Fixes for peer review

On the question of editorial bias and transparency, our respondents were surprisingly divided. Several suggested that all journals should move toward double-blinded peer review, whereby reviewers can't see the names or affiliations of the person they're reviewing and publication authors don't know who reviewed them. The main goal here was to reduce bias.

"We know that scientists make biased decisions based on unconscious stereotyping," writes Pacific Northwest National Lab postdoc Timothy Duignan. "So rather than judging a paper by the gender, ethnicity, country, or institutional status of an author — which I believe happens a lot at the moment — it should be judged by its quality independent of those things."

Yet others thought that *more* transparency, rather than less, was the answer: "While we correctly advocate for the highest level of transparency in publishing, we still have most reviews that are blinded, and I cannot know who is reviewing me," writes Lamberto Manzoli, a professor of epidemiology and public health at the University of Chieti, in Italy. "Too many times we see very low quality reviews, and we cannot understand whether it is a problem of scarce knowledge or conflict of interest."

"We need to recognize academic journals for what they are: shop windows for incomplete descriptions of research, that make semi-arbitrary editorial [judgments]

about what to publish and often have harmful policies that restrict access to important post-publication critical appraisal of published research."
– Ben Goldacre, epidemiology researcher, physician, and author

Perhaps there is a middle ground. For example, *eLife*, a new open access journal that is rapidly rising in impact factor, runs a collaborative peer review process. Editors and peer reviewers work together on each submission to create a consolidated list of comments about a paper. The author can then reply to what the group saw as the most important issues, rather than facing the biases and whims of individual reviewers. (Oddly, this process is faster — *eLife* takes less time to accept papers than *Nature* or *Cell.)*

Still, those are mostly incremental fixes. Other respondents argued that we might need to radically rethink the entire process of peer review from the ground up.

"The current peer review process embraces a concept that a paper is final," says Nosek. "The review process is [a form of] certification, and that a paper is done." But science doesn't work that way. Science is an evolving process, and truth is provisional. So, Nosek said, science must "move away from the embrace of definitiveness of publication."

Some respondents wanted to think of peer review as more of a continuous process, in which studies are repeatedly and transparently updated and republished as new feedback changes them — much like Wikipedia entries. This would require some sort of expert crowdsourcing.

"The scientific publishing field — particularly in the biological sciences — acts like there is no internet," says Lakshmi Jayashankar, a senior scientific reviewer with the federal government. "The paper peer review takes forever, and this hurts the scientists who are trying to put their results quickly into the public domain."

One possible model already exists in mathematics and physics, where there is a long tradition of "pre-printing" articles. Studies are posted on an open website called arXiv.org, often before being peer-reviewed and published in journals. There, the articles are sorted and commented on by a community of moderators, providing another chance to filter problems before they make it to peer review.

"Posting preprints would allow scientific crowdsourcing to increase the number of errors that are caught, since traditional peer-reviewers cannot be expected to be experts in every sub-discipline," writes Scott Hartman, a paleobiology PhD student at the University of Wisconsin.

And even after an article is published, researchers think the peer review process shouldn't stop. They want to see more "post-publication" peer review on the web, so that academics can critique and comment on articles after they've been published. Sites like PubPeer and F1000Research have already popped up to facilitate that kind of post-publication feedback.

"We do this a couple of times a year at conferences," writes Becky Clarkson, a geriatric medicine researcher at the University of Pittsburgh. "We could do this every day on the internet."

The bottom line is that traditional peer review has never worked as well as we imagine it to — and it’s ripe for serious disruption.

5. Too much science is locked behind paywalls

After a study has been funded, conducted, and peer-reviewed, there's still the question of getting it out so that others can read and understand its results.

Over and over, our respondents expressed dissatisfaction with how scientific research gets disseminated. Too much is locked away in paywalled journals, difficult and costly to access, they said. Some respondents also criticized the publication process itself for being too slow, bogging down the pace of research.

On the access question, a number of scientists argued that academic research should be free for all to read. They chafed against the current model, in which for-profit publishers put journals behind pricey paywalls.

A single article in *Science* will set you back $30; a year-long subscription to *Cell* will cost $279. Elsevier publishes 2,000 journals that can cost up to $10,000 or $20,000 a yearfor a subscription.

"My problem is one that many scientists have: It's overly simplistic to count up someone's papers as a measure of their worth."
— Lex Kravitz, investigator, neuroscience of obesity, National Institutes of Health

Many US institutions pay those journal fees for their employees, but not all scientists (or other curious readers) are so lucky. In a recent issue of *Science*, journalist John Bohannon described the plight of a PhD candidate at a top university in Iran. He calculated that the student would have to spend $1,000 a week just to read the papers he needed.
As Michael Eisen, a biologist at UC Berkeley and co-founder of the *Public Library of Science* (or *PLOS*), put it, scientific journals are trying to hold on to the profits of the print era in the age of the internet. Subscription prices have continued to climb, as a

handful of big publishers (like Elsevier) have bought up more and more journals, creating mini knowledge fiefdoms.

"Large, publicly owned publishing companies make huge profits off of scientists by publishing our science and then selling it back to the university libraries at a massive profit (which primarily benefits stockholders)," Corina Logan, an animal behavior researcher at the University of Cambridge, noted. "It is not in the best interest of the society, the scientists, the public, or the research." (In 2014, Elsevier reported a profit margin of nearly 40 percent and revenues close to $3 billion.)

"It seems wrong to me that taxpayers pay for research at government labs and universities but do not usually have access to the results of these studies, since they are behind paywalls of peer-reviewed journals," added Melinda Simon, a postdoc microfluidics researcher at Lawrence Livermore National Lab.

Fixes for closed science

Many of our respondents urged their peers to publish in open access journals (along the lines of *PeerJ* or *PLOS Biology*). But there's an inherent tension here. Career advancement can often depend on publishing in the most prestigious journals, like *Science* or *Nature*, which still have paywalls.

There's also the question of how best to finance a wholesale transition to open access. After all, journals can never be entirely free. Someone has to pay for the editorial staff, maintaining the website, and so on. Right now, open access journals typically charge fees to those submitting papers, putting the burden on scientists who are already struggling for funding.

One radical step would be to abolish for-profit publishers altogether and move toward a nonprofit model. "For journals I could imagine that scientific associations run those themselves," suggested Johannes Breuer, a postdoctoral researcher in media psychology at the University of Cologne. "If they go for online only, the costs for web hosting, copy-editing, and advertising (if needed) can be easily paid out of membership fees."

As a model, Cambridge's Tim Gowers has launched an online mathematics journal called *Discrete Analysis.* The nonprofit venture is owned and published by a team of scholars, it has no publisher middlemen, and access will be completely free for all.

"I personally spend a lot of time writing scientific Wikipedia articles because I believe that advances the cause of science far more than my professional academic articles."
—Ted Sanders, magnetic materials PhD student, Stanford University

Until wholesale reform happens, however, many scientists are going a much simpler route: illegally pirating papers.

Bohannon reported that millions of researchers around the world now use Sci-Hub, a site set up by Alexandra Elbakyan, a Russia-based neuroscientist, that illegally hosts more than 50 million academic papers. "As a devout pirate," Elbakyan told us, "I think that copyright should be abolished."

One respondent had an even more radical suggestion: that we abolish the existing peer-reviewed journal system altogether and simply publish everything online as soon as it’s done.

"Research should be made available online immediately, and be judged by peers online rather than having to go through the whole formatting, submitting, reviewing, rewriting, reformatting, resubmitting, etc etc etc that can takes years," writes Bruno Dagnino, formerly of the Netherlands Institute for Neuroscience. "One format, one platform. Judge by the whole community, with no delays."

A few scientists have been taking steps in this direction. Rachel Harding, a genetic researcher at the University of Toronto, has set up a website called Lab Scribbles, where she publishes her lab notes on the structure of huntingtin proteins in real time, posting data as well as summaries of her breakthroughs and failures. The idea is to help share information with other researchers working on similar issues, so that labs can avoid needless overlap and learn from each other's mistakes.

Not everyone might agree with approaches this radical; critics worry that too much sharing might encourage scientific free riding. Still, the common theme in our survey was transparency. Science is currently too opaque, research too difficult to share. That needs to change.

6. Science is poorly communicated to the public

"If I could change one thing about science, I would change the way it is communicated to the public by scientists, by journalists, and by celebrities," writes Clare Malone, a postdoctoral researcher in a cancer genetics lab at Brigham and Women's Hospital.

She wasn't alone. Quite a few respondents in our survey expressed frustration at how science gets relayed to the public. They were distressed by the fact that so many laypeople hold on to completely unscientific ideas or have a crude view of how science works.

They griped that misinformed celebrities like Gwyneth Paltrow have an outsize influence over public perceptions about health and nutrition. (As the University of

Alberta's Timothy Caulfield once told us, "It's incredible how much she is wrong about.")

They have a point. Science journalism is often full of exaggerated, conflicting, or outright misleading claims. If you ever want to see a perfect example of this, check out "Kill or Cure," a site where Paul Battley meticulously documents all the times the Daily Mail reported that various items — from antacids to yogurt — either cause cancer, prevent cancer, or sometimes do both.

"Far too often, there are less than 10 people on this planet who can fully comprehend a single scientist's research."
—Michael Burel, PhD student, stem cell biology, New York University School of Medicine

Sometimes bad stories are peddled by university press shops. In 2015, the University of Maryland issued a press release claiming that a single brand of chocolate milk could improve concussion recovery. It was an absurd case of science hype.

Indeed, one review in *BMJ* found that one-third of university press releases contained either exaggerated claims of causation (when the study itself only suggested correlation), unwarranted implications about animal studies for people, or unfounded health advice.

But not everyone blamed the media and publicists alone. Other respondents pointed out that scientists themselves often oversell their work, even if it's preliminary, because funding is competitive and everyone wants to portray their work as big and important and game-changing.

"You have this toxic dynamic where journalists and scientists enable each other in a way that massively inflates the certainty and generality of how scientific findings are communicated and the promises that are made to the public," writes Daniel Molden, an associate professor of psychology at Northwestern University. "When these findings prove to be less certain and the promises are not realized, this just further erodes the respect that scientists get and further fuels scientists desire for appreciation."

Fixes for better science communication

Opinions differed on how to improve this sorry state of affairs — some pointed to the media, some to press offices, others to scientists themselves.

Plenty of our respondents wished that more science journalists would move away from hyping single studies. Instead, they said, reporters ought to put new research findings in context, and pay more attention to the rigor of a study's methodology than to the splashiness of the end results.

"On a given subject, there are often dozens of studies that examine the issue," writes Brian Stacy of the US Department of Agriculture. "It is very rare for a single study to conclusively resolve an important research question, but many times the results of a study are reported as if they do."

"Being able to explain your work to a non-scientific audience is just as important as publishing in a peer-reviewed journal, in my opinion, but currently the incentive structure has no place for engaging the public."
– Crystal Steltenpohl, PhD student, community psychology, DePaul University

But it’s not just reporters who will need to shape up. The "toxic dynamic" of journalists,academic press offices, and scientists enabling one another to hype research can be tough to change, and many of our respondents pointed out that there were no easy fixes — though recognition was an important first step.

Some suggested the creation of credible referees that could rigorously distill the strengths and weaknesses of research. (Some variations of this are starting to pop up: The Genetic Expert News Service solicits outside experts to weigh in on big new studies in genetics and biotechnology.) Other respondents suggested that making research free to all might help tamp down media misrepresentations.

Still other respondents noted that scientists themselves should spend more time learning how to communicate with the public — a skill that tends to be under-rewarded in the current system.

"Being able to explain your work to a non-scientific audience is just as important as publishing in a peer-reviewed journal, in my opinion, but currently the incentive structure has no place for engaging the public," writes Crystal Steltenpohl, a graduate assistant at DePaul University.

Reducing the perverse incentives around scientific research itself could also help reduce overhype. "If we reward research based on how noteworthy the results are, this will create pressure to exaggerate the results (through exploiting flexibility in data analysis, misrepresenting results, or outright fraud)," writes UC Davis's Simine Vazire. "We should reward research based on how rigorous the methods and design are."

Or perhaps we should focus on improving science literacy. Jeremy Johnson, a project coordinator at the Broad Institute, argued that bolstering science education could help ameliorate a lot of these problems. "Science literacy should be a top priority for our educational policy," he said, "not an elective."

7. Life as a young academic is incredibly stressful

When we asked researchers what they'd fix about science, many talked about the scientific process itself, about study design or peer review. These responses often came from tenured scientists who loved their jobs but wanted to make the broader scientific project even better.

But on the flip side, we heard from a number of researchers — many of them graduate students or postdocs — who were genuinely passionate about research but found the day-to-day experience of being a scientist grueling and unrewarding. Their comments deserve a section of their own.

Today, many tenured scientists and research labs depend on small armies of graduate students and postdoctoral researchers to perform their experiments and conduct data analysis.

These grad students and postdocs are often the primary authors on many studies. In a number of fields, such as the biomedical sciences, a postdoc position is a prerequisite before a researcher can get a faculty-level position at a university.

This entire system sits at the heart of modern-day science. (A new card game called Lab Wars pokes fun at these dynamics.)

But these low-level research jobs can be a grind. Postdocs typically work long hours and are relatively low-paid for their level of education — salaries are frequently pegged tostipends set by NIH National Research Service Award grants, which start at $43,692 and rise to $47,268 in year three.

Postdocs tend to be hired on for one to three years at a time, and in many institutions they are considered contractors, limiting their workplace protections. We heard repeatedly about extremely long hours and limited family leave benefits.

"End the PhD or drastically change it. There is a high level of depression among PhD students. Long hours, limited career prospects, and low wages contribute to this emotion."
– Don Gibson, PhD student in plant genetics, UC Davis

"Oftentimes this is problematic for individuals in their late 20s and early to mid-30s who have PhDs and who may be starting families while also balancing a demanding job that pays poorly," wrote one postdoc, who asked for anonymity.

This lack of flexibility tends to disproportionately affect women — especially women planning to have families — which helps contribute to gender inequalities in research. (A 2012 paper found that female job applicants in academia are judged more harshly and are offered less money than males.) "There is very little support for female scientists and early-career scientists," noted another postdoc.

"There is very little long-term financial security in today's climate, very little assurance where the next paycheck will come from," wrote William Kenkel, a postdoctoral researcher in neuroendocrinology at Indiana University. "Since receiving my PhD in 2012, I left Chicago and moved to Boston for a post-doc, then in 2015 I left Boston for a second post-doc in Indiana. In a year or two, I will move again for a faculty job, and that's if I'm lucky. Imagine trying to build a life like that."

This strain can also adversely affect the research that young scientists do. "Contracts are too short term," noted another researcher. "It discourages rigorous research as it is difficult to obtain enough results for a paper (and hence progress) in two to three years. The constant stress drives otherwise talented and intelligent people out of science also."

Because universities produce so many PhDs but have way fewer faculty jobs available, many of these postdoc researchers have limited career prospects. Some of them end up staying stuck in postdoc positions for five or 10 years or more.

"In the biomedical sciences," wrote the first postdoc quoted above, "each available faculty position receives applications from hundreds or thousands of applicants, putting immense pressure on postdocs to publish frequently and in high impact journals to be competitive enough to attain those positions."

Many young researchers pointed out that PhD programs do fairly little to train people for careers outside of academia. "Too many [PhD] students are graduating for a limited number of professor positions with minimal training for careers outside of academic research," noted Don Gibson, a PhD candidate studying plant genetics at UC Davis.

Laura Weingartner, a graduate researcher in evolutionary ecology at Indiana University, agreed: "Few universities (specifically the faculty advisors) know how to train students for anything other than academia, which leaves many students hopeless when, inevitably, there are no jobs in academia for them."

Add it up and it's not surprising that we heard plenty of comments about anxiety and depression among both graduate students and postdocs. "There is a high level of depression among PhD students," writes Gibson. "Long hours, limited career prospects, and low wages contribute to this emotion."

A 2015 study at the University of California Berkeley found that 47 percent of PhD students surveyed could be considered depressed. The reasons for this are complex and can't be solved overnight. Pursuing academic research is already an arduous, anxiety-ridden task that's bound to take a toll on mental health.

But as Jennifer Walker explored recently at Quartz, many PhD students also feel isolated and unsupported, exacerbating those issues.

Fixes to keep young scientists in science

We heard plenty of concrete suggestions. Graduate schools could offer more generous family leave policies and child care for graduate students. They could also increase the number of female applicants they accept in order to balance out the gender disparity.

But some respondents also noted that workplace issues for grad students and postdocs were inseparable from some of the fundamental issues facing science that we discussed earlier. The fact that university faculty and research labs face immense pressure to publish — but have limited funding — makes it highly attractive to rely on low-paid postdocs.

"There is little incentive for universities to create jobs for their graduates or to cap the number of PhDs that are produced," writes Weingartner. "Young researchers are highly trained but relatively inexpensive sources of labor for faculty."

"There is substantial bias against women and ethnic minorities, and blind experiments have shown that removing names and institutional affiliations can radically change important decisions that shape the careers of scientists."
—Terry McGlynn, professor of biology, California State University Dominguez Hills

Some respondents also pointed to the mismatch between the number of PhDs produced each year and the number of academic jobs available.

A recent feature by Julie Gould in *Nature* explored a number of ideas for revamping the PhD system. One idea is to split the PhD into two programs: one for vocational careers and one for academic careers. The former would better train and equip graduates to find jobs outside academia.

This is hardly an exhaustive list. The core point underlying all these suggestions, however, was that universities and research labs need to do a better job of supporting the next generation of researchers. Indeed, that's arguably just as important as addressing problems with the scientific process itself. Young scientists, after all, are by definition the future of science.

Weingartner concluded with a sentiment we saw all too frequently: "Many creative, hard-working, and/or underrepresented scientists are edged out of science because of these issues. Not every student or university will have all of these unfortunate experiences, but they're pretty common. There are a lot of young, disillusioned scientists out there now who are expecting to leave research."

Science needs to correct its greatest weaknesses

Science is not doomed.

For better or worse, it still works. Look no further than the novel vaccines to prevent Ebola, the discovery of gravitational waves, or new treatments for stubborn diseases. And it's getting better in many ways. See the work of meta-researchers who study and evaluate research — a field that has gained prominence over the past 20 years.

But science is conducted by fallible humans, and it hasn't been human-proofed to protect against all our foibles. The scientific revolution began just 500 years ago. Only over the past 100 has science become professionalized. There is still room to figure out how best to remove biases and align incentives.

To that end, here are some broad suggestions:

One: Science has to acknowledge and address its money problem. Science is enormously valuable and deserves ample funding. But the way incentives are set up can distort research.

Right now, small studies with bold results that can be quickly turned around and published in journals are disproportionately rewarded. By contrast, there are fewer incentives to conduct research that tackles important questions with robustly designed studies over long periods of time. Solving this won't be easy, but it is at the root of many of the issues discussed above.

Two: Science needs to celebrate and reward failure. Accepting that we can learn more from dead ends in research and studies that failed would alleviate the "publish or perish" cycle. It would make scientists more confident in designing robust tests and not just convenient ones, in sharing their data and explaining their failed tests to peers, and in using those null results to form the basis of a career (instead of chasing those all-too-rare breakthroughs).

Three: Science has to be more transparent. Scientists need to publish the methods and findings more fully, and share their raw data in ways that are easily accessible and digestible for those who may want to reanalyze or replicate their findings.

There will always be waste and mediocre research, but as Stanford's Ioannidis explains in a recent paper, a lack of transparency creates excess waste and diminishes the usefulness of too much research.

Again and again, we also heard from researchers, particularly in social sciences, who felt that their cognitive biases in their own work, influenced by pressures to publish and advance their careers, caused science to go off the rails. If more human-proofing and de-biasing were built into the process — through stronger peer review, cleaner and more consistent funding, and more transparency and data sharing — some of these biases could be mitigated.

These fixes will take time, grinding along incrementally — much like the scientific process itself. But the gains humans have made so far using even imperfect scientific methods would have been unimaginable 500 years ago. The gains from improving the process could prove just as staggering, if not more so.

The article by Julia Belluz, Brad Plumer, and Brian Resnick on September 7, 2016

THE ROADMAP

THE LONG-TERM PROJECT GOALS

2014
The start-up of the the Project, teambuilding and preparation for a pilot project.

2015
Procurement of laboratory equipment and obtainig the certificate of accreditation (licensing).

2016
The successful results of the pilot phase allow to start scaling up the project.

2017 – 2018
ITO: investment attraction, expansion of the project team.

2018 – 2020
The establishment of 86 GMP centers in the Russian Federation and creation of the first Cluster (Moscow).

2020 – 2021
The beginning of testing and certification of production for the military-industrial complex.

2021 – 2022
The establishment of 18 GMP centers in the countries of the CIS (the Commonwealth of Independent Countries), the creation of Cluster (Astana).

2022 - 2024
Obtaining the international certificates, the preparation for creating the Clusters in the countries of Europe and Asia.

2024 - 2026
Asian market entry, the creation of Asian Cluster (China).

2026 - 2028
European market entry, the creation of European Cluster (Germany).

By 2032 – The common use of the innovative GMP products in the most diverse spheres of human activity.

THE SHORT-TERM PROJECT GOALS

The short-term project goals for a period from 9 to 12 months under the condition of the successful implementation of the GMP Project:

- Search for premises for GMP Centers.
- Preparation of premises under a single standard (for all GMP Centers a single standard for premises and technical equipment requirements has been developed).
- Conclusion of contracts with energy supply and service organizations.
- Ordering equipment from suppliers.
- Material and technical equipment of the Centers.
- Creation of vehicle fleets of mobile laboratories.
- Organizational arrangements for passing examinations of documents and on-site examinations at the location of the metrological centers of GMP.
- Staff recruitment and training.
- Recruitment and training of metrologists.
- Organization control groups.
- Final testing of the Centers.
- Connection of all Centers to a unified system of control and data processing.
- Start of the advertising company and the beginning of the operation of the Centers.
- Testing and analysis of each GMP Center.
- Broad coverage of the Centers' activities in the media to attract the attention of the scientific community.
- Organization of the Team for contacts with scientists, single-discipline experts, talented people and volunteers for participation in the future activity of clusters.

Pre-planned short-term goals for12 months (regardless of ITO Project):

October - November 2017.
Expansion of the field of accreditation (expansion of the list of services provided by the GMP Center). Passing an on-site expert assessment commissioned by the Federal Service for Accreditation.

November 2017.
Search and purchase of new premises (3000 - 3500 square meters) for expansion of the GMP Center.

November - December 2017.
Preparation of a new premises and organization of relocation.

January - March 2018
Modernization and increasing the number of mobile laboratories.

April - May 2018
Purchase of equipment to expand the scope of accreditation.

May - July 2018
Preparation and submission of documents to expand the scope of accreditation.

August - September 2018
Expansion of the field of accreditation. Passing an on-site expert assessment commissioned by the Federal Service for Accreditation.

September - October 2018
Search and purchase of premises in the neighboring region for the new GMP Center.

MEET THE TEAM

THE PROJECT TEAM

To implement GMP project we have built the team of professionals having years of successful experience under their belt - in the sphere of metrology and standardization, hi-tech manufacturing and service provision with application of laboratory studies, resource mobilization and project management. These people are really involved in their mission and capable of working with great commitment and diligence.

1. CO-FOUNDER OF GMP
The ideological inspirer and founder of the project
Sergey Maltcev
Businessman, investor, and philanthropist.

“We are witnesses and participants of not just a new historical era, but also of a new step in human evolution.We have a real chance to become involved in the given processes.”

2. CO-FOUNDER OF GMP
The Project Director
Igor Vasilyev

Specialist in project development and hi-tech project implemenation from zero. Technology and technical complex design engineer. Investor. Entrepreneur since 2008 and the co-founder of several successful business projects.

3. TOP MANAGER
The Head of the Department of Execution Processes
Olga Guseva

Lawyer, an experienced manager, the expert in consolidation of human and other resources for the purpose of the project plan implementation. She has a successful experience in establishment and management of a construction firm and several trading companies. She is an entrepreneur with 16 years of experience.

4. TOP MANAGER
The Head of Planning and Development Department, financial consultant
Alexander Voronin

Economist, financial expert , an experienced manager with many years of service in the positions of manager in three banking institutions and director of major divisions of Russian military-industrial complex. Having a degree of candidate in economics he fulfills the tasks of goal setting, organization of development process , efficient planning of working processes. He consults on project financing. He has an experience over 30 years in the sphere of management.

5. TOP MANAGER

The Head of Department of Business Management and Analytics
Nikolay Golub

Deputy Academician of Irkutsk Scientific Center of Siberian Branch of the RAS (the Russian Academy of Sciences). He is in charge of scientific and technical issues in the department of biomedical research and technology in ISC SB RAS, and is a member of the ISC SB RAS Presidium Council of Irkutsk Academic Town. He has an experience of technical supervisor of all structural subdivisions of CJSC "Ilim Pulp Enterprise" (Bratsk) in which he managed a staff of 5000 people. He is an expert who evaluates the project progress regularly and implements monitoring in order to detect deviation from the project management plan and if necessary to take corrective actions in order to accomplish the project's objectives.

6. TOP MANAGER

The Head of Quality Management Department
Elena Sholomitzkaya

Economist, a co-organizer of the first metrological GMP center. She is an expert in creating and implementing quality management system (QMS) according to ISO 9001:2008. She certifies QMS in such international certification organizations as *TÜV* in Germany, Bureau Veritas in France and in Russian certification agencies as well. She is in charge of further development and enhancement of QMS. She trains the heads of structural subdivisions according to all parts regarding creation of QMS in accordance with the requirements of ISO 9001:2008 and recommendations from international certification agencies.

7. TOP MANAGER

The Head of the Department of Innovation and Technology, the chief metrologist
Aleksey Novikov

The chief metrologist with many years of service in government and private centers of standardization and metrology. He is a director of the first certified laboratory of GMP project and the expert who is responsible for scientific and metrological maintenance and monitoring of the Project. Being a scientist and science popularizer of metrology he deeply believes in the mission of the project.

8. TOP MANAGER
The Sales Manager
Alexander Pryanichnikov

Economist, an experienced manager. He has an experience of working as a sales manager at two large business enterprises in Russia. He performs integrated management tasks and manages purchases and project logistics. Being in charge of commercial strategy development he optimizes logistic business processes in order to enhance the operational efficiency of the Project. He manages commercial activities. Being responsible for budget management he is in charge of activity analysis too, sales prognosis and profit stability of the Project as well.

9. TOP MANAGER
The Head of PR and GR Department
Yuri Kuzmin

Market expert, a specialist in linguistics and cross-cultural communication. Specialist in Asian and African studies. He speaks English, German, Chinese, Arabic and Russian. He does market research, develops and implements marketing policy of the company. He plans and organizes marketing and advertising events, different conferences. He defines problems in promotion of service and formulates their solutions. He is in charge of interaction concerning cooperation with state institutions in the Russian Federation and abroad.

10. TOP MANAGER
The Head of Purchasing and Localization Management Departmen
Denis Matveev
Economist, an experienced manager, a supply specialist with 15 years of experience. He is responsible for coordination of operational and strategic purchasing, for execution of regional and multi-country tenders (RFQ). He is also in charge of localization process management and development of long-term strategies for supplying material resources.

THE TEAM OF THE PROJECT OF THE FUTURE

The creation of the international network of metrology Centers and arrangement of innovative technology Clusters is not an easy task. It requires not just enormous material and time expenses, but first of all involving into the team the competent labour resources – the professionals in their field, the commited, talented people, really fascinated by their work and striving to demonstrate their capabilities within the framework of international project implementation.

We expect that at every stage of the Project's development the quantity of its participants will multiply in accordance with the volume of the executed works and the level of the problems being solved. Special attention will be focused on the issue of searching and recruiting the employees in the period of intense work on establishment of the innovative-technology clusters.

At the current moment we are creating the personnel reserve for implementation of the further stages of the Project. Now we are inviting the metrology specialists both those having work experience and the ones beginning their career, the experts on international standardization, both the young and experienced sciences, specializing in different directions of scientific research, the software developers, the project management specialists including the supervisors and coordinators of the project groups), the experts in international communications to our team.

We are waiting for responsible, active, goal-oriented, ambitious and positive people who are able to share their work experience and come up with new ideas for successful project implementation.

For all the questions about participation in the Project do not hesitate to contact the personnel specialists in our Centers.

THE INSTRUMENT OF THE PROJECT IMPLEMENTATION

TOKENS AS THE INSTRUMENT OF IMPLEMENTATION

At the initial stages of the GMP Project the excellent results were achieved (partly through the rational use of venture capital and working capital). This indicates that the Project fully meets the requirements of the market, and therefore has tremendous potential for its further development even without attracting outside investments. However, in order to significantly accelerate the processes of scaling up and implementation of the Project at the international level, as well as the observance of the terms outlined in the Roadmap, it is more expedient to initiate the attraction of additional funds from investors in the international community. For this purpose in the middle of 2017 the Project management decided to conduct an ITO and release the GMP Project tokens.

ITO of the GMP project will be held in 4 stages and will last for 8-9 months. The division of the project funding into stages is justified by the desire of the Project team to demonstrate to the investors the implementation of intentions, as well as to provide reports on the progress of the Project towards the intended goals.

The planned amount of investments required for the successful implementation of the Project is equivalent to 450,000,000 USD according to the preliminary assessment. Otherwise, the Project team will take action to adjust the development strategy and choose the most optimal option from those described below.

THE THREE WAYS OF DEVELOPMENT

Regardless of the amount of the attracted investments the Project team will strive to implement all the planned stages in full. The time needed to achieve the objectives of the project directly depends on the amount of investment. There can be either slow (gradual) development or powerful (impetuous) progress.

The powerful way of development (receiving investments in the amount of 70-100%)
The given way presupposes prompt development of the GMP Project which means implementation of all stages of the Roadmap with observance of terms. This will allow starting immediately the implementation of the main objectives of the Project. They are generation and implementation of the new promising projects within the walls of clusters.

The average path of development (receiving investments in the amount of 40-70%)
It presupposes an insignificant increase in the time needed for implementation of certain stages of the Project and reduction in the number of projects on which the clusters will work.

The slow path of development (receiving investments up to 40%)
It presupposes a significant increase in the time needed for the implementation of all phases of the Project (the preliminary calculations show the increase at least by 3 times).This is primarily due to harnessing all the resources of the Project to create and develop the necessary material and technical base. And only after finishing this stage it will become possible to move onto the main objectives of the Project.

USE OF THE TOKENS IN MUTUAL SETTLEMENTS

VOLATILITY CONTROL

GMP centers will become a reliable strategic partner in the sphere of measurement unification, testing and standardization to meet the needs of:

- industry;
- agriculture;
- construction;
- transport;
- trade;
- medicine;
- science.

According to approximate calculations, the metrological centers of GMP, on an ongoing basis, will interact with more than 200,000 organizations. The average annual turnover of the network at the initial stage will be about 500 - 600 million dollars. This means not just high profit margins, but also good opportunities to switch most of the mutual settlements between counterparties to the operations with the GMP tokens. This switch to the GMP tokens will allow to stimulate the counterparties with more favorable and preferential terms for mutual settlements.

Thus, the GMP Project will also become an exchange regulator, controlling the volatility of its tokens by creating demand and supply.

Control over high volatility gives a number of advantages for counterparties and investors:

- Minimizing the risks (falling value of a token);
- Controlling the growth of the tokens (a very significant increase in the value of a token will be unfavorable for our counterparties);
- Possibility of forecasting and planning.

We will not only create new fabulous products, but also multiply investments with minimal risks!

WHAT ARE THE INVESTORS TO GET?

THE GROWTH OT TOKEN COST

The growth is conditioned by the following factors:

- The GMP project has a strong foundation, expressed primarily by the volume of the market at $ 1.5 trillion with annual and constant growth.
- The GMP project is a scientific platform for generation and implementation of 1000 projects.
- The GMP project is a really existing Project having great potential for global scaling up.
- Using GMP tokens in mutual settlements between GMP Centers and a very large number of counterparties (more than 200,000 organizations).
- Regular news releases in the media in relation to the GMP Project (with reference to establishing new centers, purchasing the unique equipment, signing significant contracts, meetings with scientists and then some).
- And the most important is releasing innovative products and receiving new patents.

ONE PROJECT EQUALS A THOUSAND OF PROJECTS

The GMP project will regularly generate ever new projects, conduct ITOs and distribute new tokens among the holders of GMP tokens. The tokens will be charged and distributed at a rate of 1 to 1 after confirming the availability of GMP tokens from holders by temporarily blocking them with the help of the main Project’s platform.

This strategy will be very beneficial for the holders of GMP tokens, and the ITO of a new IT project will be a good example of its benefits (February 2018). After the ITO part of the tokens will be distributed among the holders of GMP tokens as a reward.

Our best projects will be selected for ITO after passing various tests and achieving a working prototype.

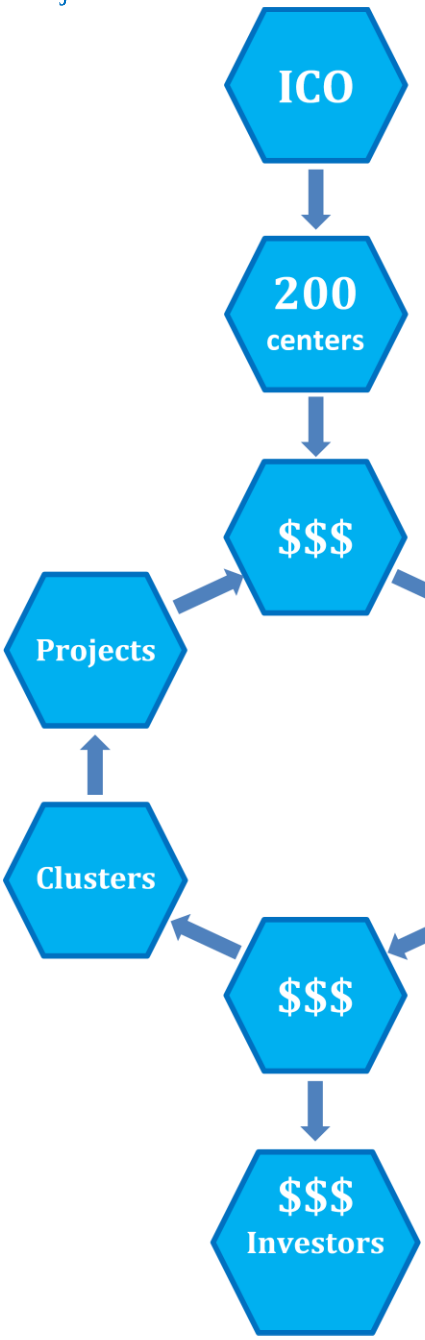
There will be a lot of new projects and new ITO, so you can safely say that "ONE PROJECT IS LIKE A THOUSAND OF DIVERSE PROJECTS".

ONE PROJECT MEANS PERMANENT PROFIT

The GMP project will become the owner of intellectual property products, copyrights and patents.

60% of the financial revenues from copyrights and research patents will be distributed pro rata among the holders of GMP tokens annually.

"GMP Project Continuation Plan and Capital Flow Program"



TOKEN RELEASE

A total amount of 500 million GMP tokens (ERC20 compatible tokens) will be issued, of which 400 million tokens will be distributed among the Project's investors. The remaining 100 million (20%) will be reserved for the project team and directed to the needs arising in the process of crowdsale (concerning advertising, marketing, accessing stock exchanges, partnerships, promoting staff to achieve the stages of project development, etc.) and after it.

THE STAGES OF ITO

The first round
From October, 30th, 2017 10:00 GMT (until November 27, 2017 10:00 GMT).

- Distribution of not less than 220 million GMP tokens.
- The price of one token is equivalent to the value $ 0.45 in Ethereum (ETH) on the day of the start of the 1st round of ITO.
- Unrealized tokens can be redirected for distribution in the 2nd round of ITO.
- Goal: implementation of the Project’s milestones according to the Roadmap.

The second round
From February 12, 2018 10:00 GMT (until March 12, 2018 10:00 GMT).

- Distribution of not less than100 million GMP tokens.
- The price of one token is equal to the price of one GMP token at the exchanges on the day of the start of the 2nd round of ITO, but not lower than the value of $ 1.35 per 1 GMP token in Ethereum (ETH) on the day of the start of the 2nd round of ITO.
- Information on the price of one token on the day of the start of the 2nd round of ITO can be taken from the website http://coinmarketcap.com.
- Unrealized tokens can be redirected for distribution in the 3rd round of ITO.
- Goal: implementation of the Project’s milestones according to the Roadmap.

The third round
From May 7, 2018 10:00 GMT (until June 4, 2018 10:00 GMT).

- Distribution of not less than 50 million GMP tokens.
- The price of one token is equal to the price of one GMP token at the exchanges on the day of the start of the 3rd round of ITO, but not lower than the value of $

4.05 per 1 GMP token in Ethereum (ETH) on the day of the start of the 3rd round of ITO.

- Information on the price of one token on the day of the start of the 3rd round of ITO can be taken from the site http: http://coinmarketcap.com.
- Unrealized tokens can be destroyed after the 3rd round of ITO, also for the purpose of increasing investment attractiveness and accelerating the growth of the value of GMP tokens.
- Goal: implementation of the Project’s milestones according to the Roadmap.

TO BECOME AN INVESTOR

VERY IMPORTANT! THE TIPS FOR THE ITO

In order to get GMP tokens you need:

- Send ETH (Ethereum) to the address of the GMP Project's smart contract, which will be listed on the site: **gmp.im**.
- GMP tokens will be sent to you automatically right after receiving ETH at the smart contract address.
- The minimum transfer amount is 0.01 ETH, and the maximum transfer amount will be determined on September 28, 2017. It will be equivalent to the value of $ 250,000.

To be sure contributions are sent and received correctly, we recommend to use the configuration as follows:
Browser: Google Chrome
Wallet: My Ether Wallet

The Ethereum address with built-in smart contract for the purchase of tokens will be available on September 28, 2017 at 09:00 GMT and is listed on the website: gmp.im.

Do not send ETH to the address of the smart contract until September 28, 2017 10:00 GMT.

Any compatible wallet can be used to partake in the purchase of tokens.

To be compatible, a wallet must be:

- Ethereum (ETH) and ERC20 compatible
- A web wallet.

If you send ETH to a smart contract of GMP tokens from an exchange account or an e-currency exchange site, your GMP tokens will appear on the exchange account or ETH e-currency exchange site and you can lose GMP tokens for good.

To send ETH to a smart contract you must use your personal ETH account that belongs to you.

There are a lot of incompatible wallets, please make sure that your wallet meets the requirements mentioned above before sending ETH.

The following wallets are not compatible:

This is not a complete list! **Do not use** any of the following wallets for participation in the purchase of GMP tokens:

- Any exchange or e-currency exchange site of Bitcoin.
- Any exchange or e-currency exchange site of Ethereum
- Do not use: Poloniex, Coinbase, Kraken, Bitfinex, Bittrex, Bitstamp, Cex, Exodus, Jaxx and many others.

THE TECHNICAL RISK

A smart contract for distribution of GMP tokens is processed on the Ethereum blockchain network and hence you should know the following:

1. **Do not send ETH to the address of the smart contract for distribution of GMP tokens from an account that you do not control.**

GMP tokens will appear on the ETH account from which ETH was sent. If you send ETH from the exchange, from the e-currency exchange site or from an account that you do not control, you can fail to get GMP tokens.

2. **Building of blocks happens at random time intervals**.

In the Ethereum blockchain network the time of creation of the block is determined by a cryptographic proof-of-work protocol (PoW), so the creation of the block can occur in random temporary intervals. For example, ETH sent to the address of a smart contract for distribution of GMP tokens in the last seconds of the distribution period may fail to catch up with the period of token distribution. You should know and understand that the Ethereum blockchain network may not include your transaction at the time that you expect and you may not get GMP tokens on the same day you sent ETH.

3. **Network congestion**

Please be also aware of possible periodic congestion that might happen in the Ethereum network when transactions can be delayed or lost. Some individuals can spam the Ethereum network in attempt to gain an advantage in cryptographic tokens purchasing. You should be aware that Ethereum miners may not include your transaction into the processing block when you expect or your transaction may not be included at all. This is Ethereum blockchain network restriction and not the restriction of the contract for distribution of GMP tokens.

THE TERMS AND CONDITIONS OF THE GMP PROJECT

BEFORE PURCHASING GMP TOKENS MAKE SURE THAT:

- GMP tokens are the ERC20 compatible tokens in the Etherium blockchain network.
- Purchasing GMP tokens is irrevocable and the purchase cannot be canceled.
- GMP tokens may have zero value and you can lose all of your funds.
- There are no guarantees that the process of purchasing or obtaining GMP tokens will not be interrupted. There are no guarantees that there will not be any errors or that the GMP tokens are reliable and bug-free.

THE BASIC RULES, TERMS AND CONDITIONS OF THE GMP PROJECT

This document is for informational purposes only and should not be considered as an offer to sell shares or securities of the GMP Project or any other related or associated company.

GMP Tokens do not grant the right of control.
Owning GMP tokens does not give their holder the right of ownership or the right to property in GMP. While the community's opinion and feedback can be taken into account, GMP tokens do not give their holders any right to participate in decision-making or in any line of business development related to the GMP Project.

No Guarantee of Income or Profit
Any examples of income and profits calculation used in this document are given for demonstrative purposes only or for showing industry averages and do not constitute a guarantee that these results will be obtained according to the marketing plan.

Regulatory Uncertainty
Blockchain-related technologies are subject to supervision and control by different regulatory bodies around the world. GMP tokens may fall under one or more inquiries or actions on their part, including but not limited to imposing restrictions on the use or possession of digital tokens such as GMP tokens, which may slow or limit the functionality of the system or the process of purchasing GMP tokens in the future.

GMP tokens are Not an Investment
GMP tokens are not an official or legally binding investment of any kind. Due to unforeseen circumstances, the objectives set forth in this document may be amended. Despite the fact that we intend to reach all the goals described in this document, all persons and parties involved in the purchase of GMP tokens do so at their own risk.

Quantum Computers
Technical innovations, such as the development of quantum computers, may pose a danger to cryptocurrencies, including GMP tokens.

Insufficient Use
Despite the fact that GMP tokens should not be considered as an investment, they can gain in value in the course of time. They may also fall in value for various reasons.

Risk of Loss of Funds

Funds collected during the ITO procedure are not insured. In the event of loss of value, there is no private or public insurance representative whom the buyer could address.

Risk of Failure

It is possible that for various reasons, including but not limited to the failure of business arrangements or marketing strategies, that the GMP Project and all subsequent marketing activities related to the funds collected during the ITO procedure may be unsuccessful.

The Risk of Using New Technologies

Crypto-tokens, such as GMP, are a fairly new and relatively untested technology. In addition to the risks mentioned in this document, there are additional risks that the GMP team cannot predict. These risks may emerge in other forms rather than those indicated here.

Integration

This Agreement constitutes the entire agreement of the parties with respect to the subject matter hereof. All previous agreements, discussions, presentations, warranties, and conditions are combined in this document. There are no warranties, conditions or agreements, express or implied, between the parties, except as expressly provided in this Agreement. This Agreement may be amended only by a written document duly executed by the parties.

Disclaimer of Warranties

You agree that your use or inability to use GMP tokens is solely at your own risk and you remove all responsibility from GMP. Since the date of issue, GMP tokens will be sent to you without warranty of any kind, either express or implied, including all implied warranties of commercial value for a particular purpose without violating anyone’s intellectual property rights. As some jurisdictions do not allow the exclusion of implied warranties, the above exclusion of implied warranties may not apply to you.