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New Catalysts for Change

BRIDGING RESEARCH TO PRODUCTS ON THE SHELF: IDENTIFYING THE FINANCE TO MAKE IT HAPPEN

Panel

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Moderator:

Sergei Nedoroslev, Chairman of the Board of Directors, Kaskol Group of Companies

Panellists:

Serguei Beloussov, Senior Founding Partner, Runa Capital; Founder, Parallels, Acronis, Acumatica, Rolsen

Andrey Fursenko, Aide to the President of the Russian Federation

Denis Manturov, Minister of Industry and Trade of the Russian Federation

Satish Reddy, Vice Chairman and Managing Director, Dr Reddy's Laboratories Limited

Alexey Repik, Co-Chairman, Business Russia

René Svendsen-Tune, Head of Customer Operations, Europe and Latin America, Executive Board Member, Nokia Siemens Networks

S. Nedoroslev:

Good afternoon, colleagues. We are happy to have you here. Thank you very much for braving this late hour to take part in our session.

Today we wanted to have a discussion about the question of how to find financing for scientific research in these difficult times. Many countries today have lower levels of financing for fundamental research than they did forty or fifty years ago. The crises of the past 10–15 years have also taken away from some areas of funding. Nevertheless, private businesses around the world continue to expand aggressively, and today we would like to discuss the ways in which private business funds scientific research. Is it involved in financing fundamental research? What counts as fundamental research, and what falls under the category of applied research? Today, this is more a question of semantics than a real distinction. What should the boundary be between private and public financing of science?

We extend a warm welcome to all the participants, and we suggest we start with a few questions for Denis Manturov, the Minister of Industry and Trade of the Russian Federation.

Mr. Manturov, the government invests actively in various industries, and the Ministry's programmes are quite large. I would like to ask you how actively the public and private sectors in Russia are currently investing in science. What has been the nature of such investments in the past three to five years? How actively are innovations being implemented in industry, and to what extent are these innovations translating to real end-product results? How does the Ministry of Industry and Trade help channel investment into the world of research, and what is the role of private business in this? Will Russia see the rise of an effective infrastructure for innovation, and what plans are being drawn up to make this happen?

D. Manturov:

Sergei, that was not just one question. I think I counted six separate parts. So I will try to give a quick briefing, so to speak, about each of those elements, since this is truly a topic that we could go on all night about.

The general outlook for investment in science in our country is that we lag behind other developed countries. Our investment level is no more than 1% GDP, whereas others invest 2.5–3%. So we have something to strive for, and we in the government are very actively investing in both science and business. The private sector also has a fairly diversified portfolio of investment in this area. The companies that invest are those which understand that without a substructure of innovation and a scientific base it will be impossible to implement modern production techniques. Those companies that lack funds and are dependent on demand for their products coming from the public sector are the least active contributors to the scientific base. If we look at the growth rate of innovation input as a whole, we can see that it is fairly impressive: the annual rise is about 30%. You asked about what has been happening over the last three to five years. Total industrial output is seeing a 30% annual increase in innovation inputs.

If we look specifically at the industrial purview of the Ministry of Industry and Trade, we have a fairly large number of special programmes directed specifically towards financing R&D. These provide a valuable helping hand to the industrial firms that work with them and share in their financing. Last year we launched five basic government programmes: aviation, shipbuilding, pharmaceutical and medical technology, electronics, and radioelectronics. There is one large umbrella programme, the so-called sixteenth programme, which is devoted to developing industry and increasing its competitive ability. This covers other sectors that are less easily categorizable. As part of this targeted programme mechanism, we are going to gradually inject our investments into scientific research. We hope to have an increased stimulating effect on the manufacturing base without allowing our resources to become overly diffused, which can easily happen in today’s environment. This happens when companies, unfortunately, become a little bit spoiled, so to speak. They receive money that they are already used to

incorporating into their budgets, and they fail to bring the results of their research to fruition as a product. Let us take the past six years as an example, to keep the numbers low. In the past six years, we have created 7,000 pieces of intellectual property. Only 700 patents have been obtained out of this, with 500 applications pending, and the rest just sitting on the shelves. We are now engaged in a complex process of inventorying all the pieces of intellectual property that came out of government co-financed projects. We must work to motivate our companies to bring these to the level of industrial prototypes, so that they can be put to good use. Unfortunately this is not happening very quickly. My deputy, Viktor Evtukhov, who happens to be in the room with us, has been working on this for a long time. We have been working this project for the past year. I think in the next two to two and a half years at the most we will finish our task and be in a position to hand over the existing intellectual properties royalty-free to the business that took part in its development. Excluded from this will be things that fall under the aegis of national security.

It is actually something of a mystery. The companies that did this research are not very eager to have the final product in hand, along with the obligation to implement it immediately into production. One wonders what their aim was in embarking on this research in the first place. We have realized that things are not as simple as all that, and so we now make explicit contract obligations with our industrial partners to take upon themselves the task of putting the results of this research directly into production. Again, those sectors that touch on national security are excluded from this. In all the other areas, technology will be transferred royalty-free. Our first experience with this model was with the special federal programme on pharmaceutical and medical technology. It was a real source of motivation for our industrial partners, who continue to take part in the programme. They understand exactly what to do with the products, how to use them, and where to introduce them. I can say that we will continue to actively co-invest in science, but to do so in a way that moves away from direct financing and towards instruments of motivation, so that industry itself places the orders for new projects. We will increase our interest

rate subsidy, since rates right now are fairly high. This will allow industry to modernize its production capacity and to then order the R&D projects necessary to fulfil their production targets.

From the audience:
What is an ‘RIA’?

D. Manturov:
A Result of Intellectual Activity, or intellectual property.

S. Nedoroslev:
Thank you very much, Mr. Manturov. We have decided to have time for questions after each panellist has spoken, so that we can raise questions right away. We now open the floor for questions. Please raise your hand, introduce yourself, and ask your question.

L. Zilberburg:
I am Leonid Zilberburg, President of Bee Pitron.
How is the Ministry stimulating the integration of small and medium-sized business into the industrial supply chain? It seems to me that you give money to the giants and expect there to be a supply chain. Is this correct?

D. Manturov:
What do you mean by the supply chain?

L. Zilberburg:
In the automobile industry, there is Tier 1, Tier 2, and Tier 3. The first tier is assembly of automobiles, the second tier is manufacture of parts, and the third tier is making the parts of parts. Foreign companies set up their supply chains on each of the tiers, so that they can assemble products on the highest tier. We have the

ability to work with foreign companies, but Russian companies do it all themselves. Is this correct?

D. Manturov:

Let us take into account the difference between different industries, since in every field we have individualized tools for stimulating R&D. If we are talking about your example of the automotive sector, then we use subsidies for technical upgrades, as well as subsidies for credit interest rates up to two thirds of the cost of refinancing. We do this in order to encourage businesses to renew and modernize their basic resources so that they can produce quality goods. Our firms need to be able to produce at the level demanded by both Russian end-product manufacturers and those producers who have recently entered the Russian market and have struggled with the deficiency of the automotive components they found when they located production here. In the current cycle, lasting until 2018, one of the conditions under which we sign investment agreements is a maximum level of localization. So the first element is retooling and modernization, and the second is customs policy. We currently protect our market from imports of foreign components, thus stimulating the production of these components on our territory. We are also creating special economic zones and technology parks where new ventures are being formed. We might note that the new ventures are being built in regions where heavy industry is already in place: Togliatti, Tatarstan, Kaluga, and St. Petersburg. If you think that we have failed to create the right conditions for motivation, then please tell us, and we will be glad to take your suggestions and criticisms for developing our instruments going forward. And this is not just the work of the Ministry of Industry and Trade, but also of the Ministry of Economic Development, which also strives for a stimulating effect through subsidizing small and medium-sized business.

L. Zilberburg:

Thank you.

S. Nedoroslev:

By the way, we have opened our electronic interface. If you have the software installed, you can submit questions electronically. Please give it a try.

P. Plavnik:

I am Mr. Plavnik, and I am Chair of the Board of Directors of the Zvezda diesel engine plant.

Mr. Manturov, I would like to speak in support of the work that has been done as part of the special federal programmes. Perhaps for the first time in twenty-plus years, we have the incentives needed and a path towards implementing cutting-edge technologies that are already in place throughout the world. The mechanism that we are building under the special federal programme allows us to undertake the transfer of real technologies that become structural elements in our products. I think your message about the necessity of getting to the end product is absolutely on point, about the implementation and use of end products in domestic business. A diesel engine is not an end product in itself, but merely a component of mining tech, ships, railroads, or diesel generators. These are the four sectors in which we collaborate with the federal special programme run by the Ministry of Industry and Trade. Unfortunately, we do not see in the programme a clear, legible roadmap for creating a new diesel engine.

S. Nedoroslev:

What would your question be, then?

P. Plavnik:

Yes, I am going to ask a question.

I think we all know how to set up production. The question is always one of money. And there is a totally open question of figuring out real world applications and consumer marketing. All the government programmes that exist now are working in parallel: the development of rail transport, the development of river transport, a

programme for mining tech with BelAZ, and another separate programme for the energy sector. The end result is that there is no consolidated technical policy, and no pathway to realization for the intellectual property that is being created by these large private and public funds. From your point of view, do you see a need for the Ministry to provide organizational support for the realization of these products? Thank you.

D. Manturov:

Forgive me, I did not hear that: organization?

P. Plavnik:

Some kind of organizational activities that would allow end products to come to market in the economy at large by integrating the various programmes that we currently have in the country.

D. Manturov:

For the production of diesel engines there is only one programme in the country, and unfortunately, the Ministry of Energy does not have such a programme. With regard to Russian Railways, they are also dependent on the organizational activities that go on under the framework of our programme. It seems that you were alluding to the fact that they are developing new production ventures in conjunction with foreign manufacturers. We have a free market, and cannot hinder the participation of foreign partners. I remember hearing your presentation on Zvezda at a round table during The Ocean exhibition. You had just won a tender. So we obviously cannot hinder you. You won the tender, and of course you expect that the engine that comes out of it will be implemented in production and maximally sought after by customers in shipbuilding, transport industries, energy, and so on. Unfortunately, all of our projects are, at this time, being managed on an individual basis. We are often forced, in spite of motivation on the part of scientists, to babysit the development of the product from beginning to end, and to oversee the implementation of the product

for producers and purchasers. So when you are ready and the project is drawing to a close, at the stage of certification and testing, we will be there to organize an event in cooperation with your company at which we will present the product to potential buyers: shipbuilders, transport companies, and others. I cannot advise anything more at this point. Just make sure to bring it to our attention when you are entering the final stage.

S. Nedoroslev:

Thank you. Next question. Go ahead, please.

S. Makarov:

Sergei Makarov. I have a question for the Minister. Our topic today is ‘Bridging Research to Products on the Shelf.’ The way I see it, we have universities and institutes which are supposed to work on fundamental science. And we have industry, which is supposed to manufacture various products. And it is right here that we lack a bridge between the two. I am characterizing a whole sector: the scientific research institutes. They were meant to help industry solve practical problems. So here is my question. How do you see this process developing? Will it happen in the institutes of fundamental science, which will move towards applied science? Or will industry and its design ventures move more and more into fundamental science? Unfortunately, there does not seem to be a middle ground between the two. How are we going to create such a centre point, and what is the government prepared to do? Thank you.

D. Manturov:

I see you are segueing to the topic of engineering centres. We do in fact have a shortage of engineering firms in the country. We only have about 40 engineering firms, and most of them are large companies working for the energy sector. Just compare that to the USA, which has 140,000 small, medium-sized, and large companies. We are very eager to see engineering firms emerge and develop,

especially on the basis of technical universities. We are currently making a roadmap in conjunction with the Ministry of Education and Science which will establish a pilot group of roughly 10–15 technical institutes to start creating subsidiary companies. They have had the right to do this since 2009. Students will begin working at the company straight out of university. With our colleagues at the Ministry of Education and Science, we are ready to subsidize such ventures, and it is these ventures that will bridge the gap between research and implementation and see a product through its entire life cycle. Our concept of an engineering firm right now is limited to the notion of a company that produces technical equipment. Our goal is to expand to include every aspect of the process, from the idea and the prototype to implementation, production, market research, research on future utilization cycles, and implementation of logistics for delivery of the engineering company's products. We have investors who are ready to secure a stake but do not know where to put their money. Of course it is clear that it ought to be the heavy industrial sector. An engineering company should develop a product end-to-end, and the investor should see where his or her funds are going, what he or she is going to get out of it, and how long it will take to get a return. The government plans to stimulate the creation of structures for helping build a bridge between science and industry. Have I answered your question?

S. Nedoroslev:

Thank you very much.

Let us move on to another subject. Extending human longevity and increasing the standard of living has always been a goal of both the fundamental and applied sciences, and they have always formed a single unbreakable chain. Satish Reddy, who comes to us from Dr. Reddy's Laboratories Ltd, is on the forefront of this branch of science. His pharmaceutical company has brought new, innovative products to market. We wanted to ask you what the balance was in your company between your own private funds and those contributed by the government. What

programmes are available to you, and how do they affect your company's competitive ability on the world market? Sir, the floor is yours.

S. Reddy:

My comments will be somewhat closer to what happens in the Indian pharmaceutical market, coming in from the private sector Dr. Reddy's Laboratories, as it was introduced, in terms of our experience in this whole thing.

We as a company were the first private sector company to get into discovery of original drugs sometime in the year 1992. Just to give you the background on when we started this, this was a time when India did not recognize product patents, which means there was no intellectual property protection when we were starting on our journey to discover drugs. It sounds a little bit contradictory, but discovering new drugs was the thing we as a company thought would be important if the country and the industry were to survive in the long term.

To the question that was asked: was there any government support? Unfortunately there was none at that point in time because, as I said, there was no intellectual property protection in the country. The government did not have any policies that encouraged basic research in the industry sector. That was the situation then. We funded our company out of our own earnings at that point in time in the field of analogue research, which means we were strong in chemistry skills, having brought a lot of new products, which were mostly generics, onto the market. Using those skills, we got into analogue research, and that is how we started our research. The model for us was to licence it out once we discovered a drug because we did not have the money; we did not have the support from the government, nor did we have the expertise to ultimately take it to the market, so we would licence it out to multinationals. That was the next step in terms of what we did. But along the way, sometime in the year of 2005, India also introduced intellectual property protection. They changed the patent laws. That encouraged a lot of research in the country. Now there are several companies that are working in it, but mostly large companies.

I think, in terms of what the role of the government should look like in this, especially coming from an Indian perspective, the first thing is to create the environment. The Minister just talked about the linkages with academic institutions. I think in India, this is still very basic. The institutions and the universities have a shortage of ongoing research, a shortage of research funding, at this point, and the result is that they churn out very few engineers or scientists. Why is that important? Because these are the people who would ultimately get into industry or work with the government institutions to get into research, so we have a basic problem with that.

Then comes the other point, which is linkages from the institutions into applying the research after that. We also have a situation there because the government-funded institutions are not strong enough, nor do they have enough intellectual property protection, or at least they did not in the past, to get to that stage. They started very late, so this leaves mainly pharmaceutical companies who can fund research on their own with obvious support from the government to create that environment. I am trying to say that if the government is able to provide the environment that supports institutions and universities, then it also incentivizes the industry to conduct research through funding or through soft loans. Only then will it make a big difference, but our experience so far has been to work without much government support. In the future, we do look forward to the government supporting and creating the environment. That is where we are coming from. Thank you.

S. Nedoroslev:

Thank you very much.

D. Manturov:

So it is not all so bad here, Sergei. We do take care of our scientific ventures.

S. Nedoroslev:

We hope that this will lead to an increase in the market viability of Russian companies on the world stage. I would now like to introduce a man who has

founded such companies: Serguei Beloussov. He is the founder of such well known companies as Parallels, which makes products that many of us have on our computers, and he has supported many other projects. Runa Capital has now become a large investment fund. Serguei is active on the world market and invests in fundamental scientific fields such as quantum mechanics, with an eye towards developing products on the basis of this type of research. Twenty or thirty years ago, there probably was not a single physicist who could imagine that his or her research into quantum mechanics could have some kind of practical application in his or her lifetime. But we are already seeing and discussing this. I have a question for you, Serguei. What help is coming from the government? What percentage of those funds are invested? And how does this contribute to the competitive ability of your company? Thank you.

S. Beloussov:

I would like to touch on two points. They both have wide-ranging effects on industry and manufacturing. The first point is quite straightforward. It is obvious that in 30 or 40 years nearly all of our devices will be hooked up to the web, have automatic features, and gather a huge amount of data from a huge number of things. A very large portion of world GDP will be somehow connected either directly or indirectly to information technology. I have seen various estimates, from 20% to 40%, which is a very large portion. This will have an impact not only on high-tech industries, but even on such basic industries as agriculture and resource extraction, as well as on sectors related to national security. When we talk about weapons of destruction, we think of something that happens in the physical world, since we have lived in the physical world alone for the last 50,000 years. Think about what can be destroyed: you can break a chair, blow up a building, sink a ship. But as the economy and information in general migrates to the electronic, virtual world, weapons will follow close behind. So information technologies are extremely meaningful for the future. Practically not a single industrial venture can do without them. For example, every aspect of the design and construction of a new hydroelectric plant must be done

with IT in mind. The theme of our discussion is ‘Bridging Research to Products on the Shelf’, so we have to think about where the bridge goes: what is point A and what is point B. We are not doing enough fundamental research, especially in the fields of computer science and software engineering. I see a deficit of commitment to science on the part of the Russian government. There are dozens of groups of excellent professors who are conducting computer science and software engineering research – that is, IT – on a world-class level. But there should be hundreds and thousands of these groups in order for the economy to function normally. Nearly every venture that involves industrial development requires hiring an expensive technical expert who has been trained abroad. In order for us to bridge science and industry, there must me somewhere to build the bridge from: there must be scientific research. And computer science is one of the most applied branches of science. There is not enough attention being paid to this field. It is incredible to me that computer science and software engineering, after being underfunded in the Soviet period, fell into some strange halfway point between the Ministry of Communications and the Ministry of Education and Science. Both ministries seem to lack either the resources or the interest in sufficiently promoting computer science development, despite the fact that without it virtually no other types of research are possible. This is a very important matter which for some reason has not been fully recognized in Russia.

Sergei has already mentioned the other vanguard field, where the possible breakthroughs may change the world even more profoundly than information technology has. Indeed, while quantum mechanics has been around for almost a century, it is only in the last 10 to 20 years that we have figured out how to manipulate materials at the level of quantum mechanics. This is giving rise to a huge number of different applications, and will have an impact on all industries. Some industries have already felt an impact. There are new materials, some with potentially supernatural properties, some more basic things like superconductors, and some complex phenomena like metamaterials. There are new generations of sensors, and impregnably secure lines of communication. But this industry is rarely

talked about either. For better or worse, I am a representative of industry, so forgive me if I speak on very narrow subjects.

Are there any specialized scientific research institutes in Russia currently capable of conducting research in this area? There are practically none. We would like to create a Russian quantum centre in the form of a very small institute. To bridge theoretical science and practice, we need specialists with very deep knowledge of a given subject area. The only training we have for such specialists is in the fundamental sciences. Even in America, where a large percentage of GDP goes to research funding, only 15–20% of students who get science degrees stay in the sciences. The rest of them go into industry and bring their expertise to companies, which allows the industry to remain a leading player.

Another serious issue right now is that Russian culture has developed an anti-elitist streak. The fact is that the best, most innovative discoveries are happening within a small number of elite scientific institutions. Perhaps it is best to think not about expansive programmes encompassing the whole industry, but instead to focus on a handful of world-class scientific centres located at some leading universities, which might then enable the whole industry to move forward. Generally in technology and especially in IT, companies that reach USD 100 million in the first ten years get to dictate the shape of the entire industry. To start these kinds of companies, you do not need many wide-ranging programmes. You need precise, focused programmes with the potential to create these kinds of companies. This is what I have concluded.

Most government programmes in Russia today are fairly broad. They reach every part of the country, in a large number of industries, in many areas of research. Creating new knowledge is a complicated, team-based game, and team play requires a focus on a small number of areas. It is impossible to do everything at once. The way of the world is that practically everything is put together with the cooperation of many countries. It would be useful to define in which innovative areas of research it would be most opportune for Russia to become a leader. There are still some areas for which Russia is well placed. These include mathematics and our strong aerospace sector, which is one of the world’s best. These sectors have

many benefits. I think there could be some other areas of focus, such as IT, computer science, and software engineering, which is a prerequisite for any industry, and there may also be some innovative work done in physics.

It may seem like I am telling you a tall tale about some spaceships that will conquer the expanse of space in the far off future, or something like that. But the fact is that most of the technologies I have mentioned are already in existence and are being sold on markets worth tens and hundreds of millions of dollars. Of course, that is a very low number compared to the world economy, but the IT industry, which did not even exist 40 years ago, is now on the order of 7% or 8% of the world economy, with 20% or 30% more dependent on it. The same thing can happen with new technologies that are emerging from physics research. Thank you.

S. Nedoroslev:

Thank you, Serguei.

We all know that humans have been engaged in fundamental scientific research for millennia. But only with the advent of infrastructure 100 to 150 years ago (I mean earthly infrastructure, rather than the virtual one), of roads and railroads, did we see the massive rise in economic activity and in the large scale investment of capital into fundamental research. This has lead to a boom in the fundamental knowledge on which we now rely. I expect that the massive influx of money that is now washing over the telecommunications sector and funding the new generation of infrastructure in space and on Earth will be the source of the next boost to the economy. Perhaps it will lead to major new investments in fundamental research, and we will find answers to questions we have been asking for a long time.

Our next guest is René Svendsen-Tune, of Nokia Siemens Networks, who probably knows more than anyone here about telecommunications infrastructure, how it is built, how it is funded, and whether or not the government is helping.

The floor is yours.

R. Svendsen-Tune:

Thank you very much. I represent the telecommunication infrastructure business, and therefore the technology sector. Obviously, in the technology sector, basic science and scientific research play strong roles, but so does the commercialization phase, as we have mentioned in this session.

A lot has been said already. I wanted to address two points that I think are relevant for the discussion we have had in this room here. One is the speed at which this process happens, from basic research results to when we have to have commercial results out there in the field. The second is the globalization of this kind of industry. The cycle times of technology are shortening, as we all know, by the month, by the year, and from the time we put in place a result or a research programme to when we take that through some technology development and forward into a product. The product development cycle is decreasing all the time. TSM8 was about 15 years. The UNT8 was about five years, and now we see the LT8 is even shorter than that, so things are happening faster and faster.

Typically also, what we are seeing is that the number of people involved as we go from basic research to technology development to product development is going up, which of course means that the economic implication of research, technology development and product development is of a different nature. This is a global business, and obviously to participate in this business, the decision has to be made on what part of the journey you want to participate in.

We carry out basic research in various places in Europe, including Russia. We are carrying out basic research in North America, but we are doing technology development and product development all over the world. Sometimes we make products or technology based on research from one site; sometimes we make it based on multiple sites. Sometimes we make products based on technology from one place; sometimes we make products based on technology from multiple places. Therefore, again, the end-to-end journey has a lot of bearing on the outcome in terms of the economic impact that we are discussing here today. There is a choice to be made on where you want to participate and how you would engage yourself in that end-to-end process.

The second part is globalization. There is strong competition in this space. Many regions, cities, and universities are trying to make themselves attractive in this space. For a company like us, it is really about quality and depth of science, it is about the scale and access to engineering capacity, it is about the cost, and it is about the impact: where can we get it done? Where can we have the deepest research and deliver results as fast as possible? How can we turn that into sustainable technology development, meaning not once, but again and again and again? How can we turn that into products that can be sold and distributed across the world?

When you talk about these matters, I think the funding as such may not be the prime issue, but rather issues like ability to transfer technology across borders, regulations, international agreements, and IPR regimes. For instance, can you produce IPRs in one place and take that forward? Are you aligned with IPRs? This is a mine field, we know, but are you aligned with IPR settings where these products will be taken to market? For example, it would be something like connectivity of networking in scientific institutions.

There are all these pieces where, on one hand, you can create scale, and on the second hand, you can network globally, and also where you can drive depth in terms of quality and cost efficiency. These are the pieces we would be looking at as a global company when we go to countries and we try to drive impact on technology through technology research, technology R&D, and technology product development. Thank you.

S. Nedoroslev:

Let us return once more to pharmaceuticals. Alexey Repik, our next presenter, built a company from the ground up, and now does over USD 1 billion in sales annually. He is an investor in research and manufacturing in the very complex pharmaceutical sector.

Alexey, the floor is yours.

A. Repik:

Thank you for inviting me to speak and to give my perspective on the question of whether private business can and should be responsible for funding both fundamental and applied science, or whether it should be involved in commercialization only.

The demand for fundamental science almost always comes from society. Most often this goes through government, or sometimes social institutions and non-profit funds. It is only by founding itself on top of this base that business can develop the applied know-how it needs to develop. In fact, the main challenge of business is to create a qualified consumer who is able to recognize a daring new idea and be ambitious enough to try it out in the practical realm.

The life cycle of an innovation, from the original idea to its implementation, can be described as an octahedron standing on one of its vertices. At the bottom are the fundamental scientific discoveries, which are few in number but responsible for a much larger quantity of applied research. Research is not always successful, and we must remember to be ready for failure and for the waste of time and manpower. But it is this applied research that eventually turns into products and technologies.

It seems to me that government and business are slowly trading roles in this regard. That is, government is still funding fundamental science, while applied science may be co-financed by government and business. Mr. Manturov already talked about the way this works in our pharmaceutical industry. And it is, in fact, working, or at least starting to work. We will be able to see results in four or five years. This is a good tempo, in league with global standards. When it comes to implementing production and bringing products to the consumer market, these are the tasks of private capital.

It is important to understand that this octahedron is unstable, because it stands on only one of its vertices. When the fundamental sciences are neglected, the whole thing tends to tip over. Without fundamental research, after a while there will be no more ideas for us to implement.

The relationship between the tiers of investment is not always linear, since we can effectively import technologies for our use that were developed abroad. The playing

field is transnational. Nevertheless, we should strive to develop an ecosystem that produces the knowledge, will, and capability needed to create something completely new.

And one last thing, quickly: why is private business afraid or hesitant to step into the fundamental sciences? Because the state has a much different time scale for planning than any company. I know of no companies that have a shareholder mandate to give a return on investment after 50–70 years. But we all know that the applications which are currently coming out of my field, in the life sciences, are based on fundamental research that was done in the late sixties and seventies.

Therefore, if industry has good common sense and wants to be competitive on a global level, it will continue to invest in R&D. Moreover, I see this as potentially paving the way for companies to achieve a healthy level of capitalization and bigger profits for investors all around. The next step in the direction of good common sense would be philanthropy; science is a basic human value. I think it would be quite reasonable for us to create funds and endowments, as has been done in the USA. I hope that we will see this happen in Russia within the next few decades, and that we will all live long and happy lives.

S. Nedoroslev:

Thank you very much, Alexei. That is a very optimistic note to take us on to the next speaker. Andrey Fursenko is Aide to the President of the Russian Federation and a former Minister of Education and Science, and a scholar. Mr. Fursenko, please give us your opinion, and comment on what the previous speakers have said. We will thus draw the discussion to a close.

A. Fursenko:

Thank you, Sergei, and thanks to all who have come.

I will say a few words to sketch an outline of the bridge between research and industry, and fundamental and applied science, in Russia and in the world.

The situation we face is this. Mr. Manturov mentioned that in other countries – let us take the OECD countries as an example – the average amount of domestic expenditure devoted to research and development is around 2.5%. The OECD number is 2.4%. There are countries – Japan, for example – where this number is more than 3%. In the USA, it is about 3%, and in Germany, it is just under 3%. There are places it is lower, such as in Great Britain, where it is less than 2%. But in Russia, it is 1.12%; that is, just above 1% of GDP. If we look at the percentage of the budget that is involved, we get a different picture. We invest 0.9% of the budget into research and development. Comparing that, Japan spends 0.7%; the United States spend just a little more than we do – about 1% – and Germany also comes in at about 0.9%.

So it is clear that the government is investing money in applied and fundamental science on a level with the most developed countries. The problem is that business is not investing its money. I would support Mr. Manturov and the previous speaker once again in saying that this is the correct situation for fundamental science. It should be financed by the government. With the applied sciences, the situation should be completely different. That does not mean that the state should not give assistance. As Denis has pointed out, the state needs to help, but in a guiding role, and it should also provide incentives for businesses to invest. The Ministry of Education and Science works with the Ministry of Industry and Trade, and the two agencies had a competition – some of you may remember this – in which money was awarded for applied research not to universities and research institutes, but to businesses. This was Order No. 218, which dictated that the companies would be obligated to take responsibility for the final result and contribute their own funds to the implementation of the product.

Now I will turn to the second issue. We should understand that when the scientific community in universities and academia at large asks for money, those who give the money expect there to be some conditions that some expectations of theirs will be fulfilled. This is perfectly fair. What kinds of expectations do I mean? In the case of fundamental research, there should be some kind of comparative data. In what

regard is our science held around the world? How often is it cited and how widely is it published? What innovations have been taken up by industries around the world?

So there is another kind of bridging here, not between science and industry but between a global body of fundamental, basic knowledge and a more specific, applied type of science. By building this bridge, by the way, we not only make use of fundamental research in the applied fields, but also simply attract good people into science professions. If there is talk about powerful, innovative new discoveries in the fundamental sciences, then young people begin to take interest. They go into the sciences and begin to do work in both fundamental and applied science. There can be a strong synergy effect.

If this does not happen, then the state has a right to question what it is getting as a return on its investment. After all, that is taxpayer money. The government has to explain why it gave those funds to the development of fundamental science instead of giving it to preschools or retirees.

All of the speakers have commented in some way on the need to push more strongly towards achieving results. The notion of results, of course, is not the same for all of us. We have to identify what kinds of results we should expect from both fundamental and applied research.

There are two key aspects to this. The first is the issue of the application of technologies. Not a single country can afford to give money for everything and not need to ask what kinds of results it can expect to have. Government must keep in mind some basic, fundamental priorities: for example, life expectancy. How can we raise our standard of living? In some areas, this should perhaps be the main priority. Another of the government’s basic priorities is the need for defence.

The second issue is this: we have to look at the latest tools that are being developed. We have just mentioned one such tool, which the Ministry of Industry and Trade is already using as well. What kinds of tools do we have at our disposal? I have already mentioned Order No. 218. It is likely that we will need to make targeted investments in infrastructure. We have already talked about that as well. Without infrastructure, neither fundamental nor applied research can be developed

effectively, and that probably falls well within the purview of government. For example, we could create a primary engineering centre. In the past, we created design institutes around different tech sectors, and they continue to pursue that which is interesting to them. Academia continues to do what it finds interesting, and industry tries to acquire that which it finds lucrative. All three of these excellent social institutions have very little contact with one another and are not able to muster very much cooperation. The Ministry and the government as a whole must take the lead in making sure this chain is well wrought.

It will likely need to expand our grant-based programmes. There are several ways to fund fundamental science. One is to give money to a researcher, another is to give it to a group of researchers, and third is to give grants for interesting, well-founded proposals. This is exactly the issue Serguei Beloussov was raising. The proposals, of course, must come from people and institutions with a track record of success in realizing such ventures. Unfortunately, there seems to be a global outbreak of daydreaming, with many a tale being spun by people who plan to save the world if they could only get a little bit of money, like RUB 1 billion, for starters. Of course, the world-saving will commence 15 years down the road, but the money is needed immediately.

When we discuss new kinds of instruments, we need to have a strict system of accountability in place. To use the metaphor of the bridge, we must make sure that at every stage in the bridge's construction the bridge itself is structurally sound and does not sway or wobble. If it is not structurally sound, the traffic from research to industry cannot cross over it. The octahedron of which I spoke earlier may not be a very stable structure, but we know that as long as it is moving forward at all times, stability increases with momentum. For this to happen, the rules and regulations that make up the rails on which everything is rolling along must be known to all, from taxpayers to government employees.

To bookend today's discussion, I would like to give a big thanks to our colleague from India. We can see that not a single researcher out there is living on easy street. You will not find a perfectly funded researcher in any country on Earth.

Everywhere you go, there are requirements and conditions. And a final point is that businesses that have saved up cash are ready to invest it, so long as they are able to be aware of what kind of partners they are working with, and what kind of conditions are attached. If these conditions are met, they will invest further and further.

Thank you, Sergei. I have tried to keep my comments brief.

S. Nedoroslev:

Thank you very much, Mr. Fursenko.

To conclude, I would say that the bridge is holding strong on both sides. Government will continue, as it has always done, to fund fundamental research and to stimulate the implementation of the results in the economy.

But we should also note the changes that have taken place within the last century. The private sector today is very powerful. We see the huge reduction in the time lag after fundamental discoveries or some seemingly futuristic ideas like graphene film or heterostructures, invented by our esteemed physicist, Academician Alferov. We never imagined we would be listening to music with the help of LEDs, but today all of this is already present in our lives. This is incentivizing private companies to begin investing in areas of science that were once considered abstract. So the bridge is strong, and stands on two powerful pillars. We see a very bright future ahead.

Thank you all for coming, and a special thanks to the speakers for their forthright and impassioned comments. The formal part of our session has now come to a close. Thank you.