

Why Does Russia Have So Much Trouble Modernizing?

An STS Approach

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I do not have to remind a group like this that trying to modernize is one of the oldest, if not the oldest, theme in Russian history. Going back to Peter the Great the idea of borrowing technology from the West and transferring it to Russia in the hopes that it would take roots has been a perennial theme. Peter tried it, Catherine the Great tried it, Alexander I and II tried it, Nicholas I and Count Witte tried it, Lenin and Stalin tried it (Remember “dognat i peregnat” [catch up and surpass the West]?) and now in post-Soviet Russia Dmitri Medvedev and Vladimir Putin are trying it. Why is it so difficult for Russia? That is what I want to discuss today, basing myself on research I have done in recent years. This research will be presented soon in a book by me entitled “Lonely Ideas: Russia’s Trap.”

At the moment Russia’s leaders are making a major effort to modernize, emphasizing that high technology is the key. The Russian government has asked my university, MIT, to help it create a new “silicon valley,” Skolkovo, near Moscow. Major Western companies, including Intel, Cisco, Siemens, Boeing, and Nokia are investing in facilities in Skolkovo.

Unfortunately, Russia’s current leaders are making the same mistake that its past leaders have made, from Peter the Great onward: they have their eyes on the technology, not on the social and economic conditions that cause technology to flourish. Russia’s history reveals that getting one’s hands on technologies does not result by itself in economic growth and prosperity. Russia has often been good in developing new technologies, but abysmal in sustaining them and benefitting from them. If Russia produces novel technologies at Skolkovo, those innovations will almost certainly be commercialized elsewhere, in countries with more propitious social and economic conditions. The Western companies investing in Skolkovo know this, and that explains their enthusiasm. They are more likely to benefit than the Russians.

What I would like to do today is, first, take a look back in history to show that Russia's problem is not inability to create technology. Lack of technology **is not** the problem. A failure by Russia to take advantage of its talented scientists and engineers by creating an environment in which technology could flourish **is** the problem.

Many of you probably know that Russians, especially in Soviet times, claimed that they had invented many of the main technologies of modern civilization: the steam engine, the light bulb, the radio, the airplane, the computer, the laser, and many others. Westerners ridiculed these claims. I have recently gone back and studied each of these claims and a big surprise emerged: although Russians may not have been the "inventors" of all these technologies they were very active in the pioneering periods of their development and they have absolutely legitimate claims to great achievements. But if they were so good at these early moments, why are they so backward in commercial technology today? Little Switzerland today exports each year about three times more high technology, in dollar terms, than Russia. That is the paradox I want to explain.

Let us look at some examples, the first ones long ago, the last one rather recent. Russians built the first steam locomotives outside England and the first operational diesel-powered locomotives in the world.¹ The first Russian steam railway was opened to the public in 1837, the same year as the first steam railway in Austria and only five years after the first steam railway in France. In 1847 Russians had a railway factory in St. Petersburg that an American expert called the best in the world.² Russians connected the cities of St. Petersburg and Moscow by railway before Americans connected New York and Chicago. And yet – Russia's prominence in railways did not last long. The railway network in Russia grew much more slowly than in Britain, France, Germany, and the United States. Between 1844 and 1855, when railroad construction was booming in the US and Western Europe, no railroad construction

¹ M. I. Voronin, P. P. Mel'nikov: *Inzhener, uchenyi, gosudarstvennyi deiatel'*, Gumanistika, St. Petersburg, 2003; V. S. Virginskii, *Cherepanovy*, Sredne-Ural'skoe izdatel'stvo, Sverdlovsk, 1987; Anthony Heywood, *Engineer of Revolutionary Russia: Iuri V. Lomonosov (1876-1952) and the Railways*, Surrey, England and Burlington, Vermont, 2011.

² Merritt Roe Smith, "Becoming Engineers" (unpublished ms. of 31 August, 1987), based on papers of George Washington Whistler, who worked in Russia on constructing the St. Petersburg-Moscow railway.

occurred in Russia. By 1855 Russia possessed only 653 miles of railroads, compared to 17,398 in the United States and 8,054 in England. Why was Russia progressing so slowly in railroads despite its early promising start?

This story gets repeated again and again. Russians first illuminated the avenues of major cities with electric lights in 1887-1888, giving Paris the name “city of light” that it retains today.³ When the American industrialist and inventor George Westinghouse saw what Russians had achieved in electrical illumination he said “This is the start of a new industry.” He was right, but sadly for Russia the new industry was not in Russia but in the United States and Western Europe. The Russian pioneer in electric lights, Pavel Yablochkov, tried to establish a company in Russia to sell his electrical lights and failed miserably.

AND THE STORY GOES ON:

Russians transmitted radio waves before Guglielmo Marconi. They built the world’s first multi-engined passenger planes (just a few years after the Wright brothers first flew).⁴ They pioneered the development of transistors and diodes.⁵ And they built the first electronic computer in continental Europe.⁶

I could talk about each of these episodes in detail, but just let me choose the example of lasers. In April 1955 the American physicist Charles Townes journeyed to Cambridge, England, where he wanted to announce what wonderful work he had just done on stimulated microwave radiation.⁷ He called his new device a “maser,” later considered to be the ancestor

³ L. Zhukova, *Lodygin*, Moscow, 1989; L. D. Bel’kind, *Pavel Nikolaevich Iablochkov, 1847-1894*, Moscow, 1962; Moisei Radovsky, *Aleksandr Popov*, Moscow, 2009;

⁴ Scott W. Palmer, *Dictatorship of the Air; Aviation Culture and the Fate of Modern Russia*, Cambridge University Press, Cambridge, 2006. Also see State Archive of the Russian Federation, GARF f. 102 DPOO 1909, d. 310.

⁵⁵⁵ A. G. Ostroumov, A. A. Rogachev, “O. V. Losev – pioneer poluprovodnikovoi elektroniki,” in V. M. Tuchkevich (ed.), *Fizika: problem, istoriia, liudi*, Leningrad, 1986; M. A. Novikov, “Oleg Vladimirovich Losev – pioner poluprovodnikovoi elektroniki,” *Fizika tverdogo tela*, v. 46 (No. 1, 2004), pp. 5-9; O. V. Losev, “Über die Anwendung der Quantentheorie zur Leuchtenscheinungen am Karborundumdetektor,” *Physik. Zeitschrift*, 30 (1929), pp. 920-923; Nikolay Zheludev, “The Life and Times of the LED – a 100 year history,” *Nature Photonics* 1 (April, 2007);

⁶ Georg Trogemann, Alexander Y. Nitussov, Wolfgang Ernst (eds.), *Computing in Russia: the history of computer devices and information technology revealed*, Vieweg, Braunschweig, 2001.

⁷ Jeff Hecht, *Beam, The Race to Make the Laser*, Oxford University Press, Oxford and New York, 2005.

of the laser. Lasers are of course today the center of a vast multi-billion dollar industry. Everyone of us uses lasers today.

At the Cambridge conference Townes was not the first to speak. He was preceded by a Russian scientist named Alexander Prokhorov, who in excellent English presented a paper describing the theory of an ammonia maser, exactly the device that Townes had developed and which he wished to announce to the same audience.⁸ Townes was astounded. He had never met Prokhorov before and at that time did not dream that he would eventually share a Nobel Prize with him and his student Nikolai Basov for development of the laser.⁹ And even before Prokhorov, in fact a generation earlier, another Russian scientist, Valentin Fabrikant, had published the principles of the laser.¹⁰

When one considers what an important part Russian scientists played in the development of the laser a striking fact is how unimportant Russia is in the worldwide laser industry today. By the year 2000 approximately \$200 billion worth of lasers and laser systems had been sold¹¹. Yet the Russian share of the world laser market at this time, 36 years after two Russians and an American were awarded the Nobel Prize for the invention of the maser and laser, was merely 1% to 1.5%.¹² The largest laser manufacturers were American. No Russian manufacturer was a major player. It is the same story as that of steam railways and electrical lights: early brilliance, later commercial failure.

Russians failed to commercialize successfully a single one of the innovations I have studied: the steam engine, the railway, the electrical light, the radio, the airplane, diodes and transistors, the computer – although they were pioneers in the development of all of them. Russia has great difficulty taking advantage of the technologies it creates. The Russian

⁸ I. G. Bebikh (ed.), *Aleksandr Mikhailovich Prokhorov, 1916-2002*, Moscow, 2004; also, see I. A. Shcherbakov, "K istorii sozdaniia lazera," *Uspekhi fizicheskikh nauk*, Vol. 181, No. 1 (January 2011).

⁹ Nikolai Gennadievich Basov, Moscow, 1982.

¹⁰ L. Biberman, B. A. Veklenko, V. L. Ginzburg, et al, "Pamiati Valentina Aleksandrovicha Fabrikanta," *Uspekhi fizicheskikh nauk*, Vol. 161 (No. 6, 1991), pp. 215-218.

¹¹ Nick Taylor, *Laser: The Inventor, the Nobel Laureate, and the Thirty-Year Patent War*, Simon and Schuster, New York, 2000, p. 287.

¹² Laser Focus World, <http://www.optoiq.com/index/photronics-technologies-applications/lfw-display/lfw-article-display.articles.laser-focus-world.volume-32.issue-7.departments.marketwatch.laser-industry-in-russia-struggles-to-build-market.html>, accessed January 13, 2011.

economy today is largely dependent on oil and gas; it is very difficult to name one Russian high-technology manufacturer that is world-class, with the possible exceptions of one or two software companies and vestigial Soviet strengths in the weapons, nuclear, and space industries.

In order to solve this problem Russia's leaders, in my opinion, should stop merely trying to get their hands on the latest technologies by creating their own isolated "silicon valleys" and instead ask the following questions about their society as a whole, because it is Russian society that needs to change, not Russian science and technology.

¶ How does one change the mentality of Russians about "business," shifting to a view that a businessperson making money from an innovation is an admirable citizen, one of the major contributors to a country's prosperity, and not a person involved in dirty deals merely for self-benefit?

¶ How does one create a political order in which successful entrepreneurs are not feared by government leaders as rivals for power and influence but promoted? (remember Khodorkovsky)

¶ How does one create a society in which freedom of expression, geographic mobility, and economic independence are valued and protected?

¶ How does one establish a legal system in which judges are independent from political authority, intellectual property rights are protected, and people accused of a crime have a chance of being acquitted?

¶ How does one create an economic and political order in which investors are not only numerous, but willing to take risks on developing novel ideas?

¶ How does one overcome rampant corruption, an environment in which extortionists quickly focus on any business that looks profitable?

¶ How does one reform a research and education system so that it combines teaching together with research as a single operation, producing prominent scientists and students who

care about application and economic development rather than priding themselves on working in an ivory tower?

I could talk about each one of these questions in detail but because of time constraints let me just say a little more about two of them: the attitudinal problem and the problem of R&D organization.

First, the attitudinal problem:

In 2010 scholars at your university, the European University in St. Petersburg, published the results of their survey of Russian scientists and engineers asking them about their attitudes toward their work, and they also drew on a larger sociological study on professional attitudes conducted by the University of Magdeburg.¹³

One Russian scientist replied:

There are no models in the consciousness of [Russian] people of a successful scientist-entrepreneur. We look upon a scientist as a disinterested person who does everything for the good of humankind. An entrepreneur is a member of the bourgeoisie who takes advantage of other people. (respondent was 41 years of age in 2010, meaning he was 21 at the time of the collapse of the Soviet Union).

Another respondent said:

We must talk about our inability to commercialize our own products. This is not a misfortune of the Soviet Union, it is a misfortune of the Russian mentality in general. . . . To our regret, up to the present day society does not have a very positive attitude toward the commercialization of scientific ideas.

Yet another Russian scientist, one with more than 50 international patents, said:

¹³ I am grateful to Oleg Kharkhordin, one of the editors, for pointing me to: Istoriia tekhnicheskikh proryvov v rossiiskoi imperii v XVII-nachale XX vv.: uroki dlia XXI v. ?, European University in St. Petersburg, St. Petersburg, September 2010, and Ingrid Oswald, Eckhard Dittrich, Viktor Voronkov (eds.), Wandel alltäglicher Lebensführung in Russland: Besichtigungen des ersten Transformationsjahrzehts in Skt. Peterburg, LIT, Hamburg, 2002.

You know, I do not have a commercial bent! I have an idea and my goal is to realize it. And when I manage to do that, when I get a good result, that means I will publish it or maybe patent it. And then I am content. To go further is not my affair – to try to apply all that in business requires so much work of a sort that is not interesting to me. And as a result other people [in other countries] simply rob from us. Right now several of my innovations are being shamelessly used by companies in, for example, China and Israel.

And another young scientist said:

We do not have an innovation culture – no experience, no traditions. Our scientists, they are all still Soviet in their attitudes, for them business is something dirty. Our scientific culture is practically untouched by the business entrepreneurial spirit¹⁴

I could go on to try to explain this curious attitude – it has historical roots – but instead I will go on with a discussion of a major problem for Russia in developing an innovative society: the organization of R&D.

We have learned in the last half-century that the most productive locus for research and development in the world is in large research universities. As Jonathan Cole recently wrote in his study of research universities “tens of thousands of . . . inventions, devices, medical miracles, and ideas” have come out of research universities, including magnetic resonance imaging, the algorithm for Google searches, Global Positioning Systems, DNA fingerprinting, fetal monitoring, scientific cattle breeding, advanced methods of surveying public opinion, and even Viagra.¹⁵

¹⁴ All above quotations taken from Istoriia tekhnicheskikh proryvov v rossiiskoi imperii v XVII-nachale XX vv., cited above.

¹⁵ Jonathan R. Cole, The Great American University: Its Rise to Preeminence, Its Indispensable National Role, Why It Must be Protected, Public Affairs, 2009, New York.

Yet Russia does not have a single leading research university in world rankings. According to the major ranking systems, Moscow and St. Petersburg Universities, the best research universities in Russia, do not even rank in the top 100 internationally.

This unfortunate phenomenon is the result, in my opinion, of the decision that was made in the early Soviet period to assign a primarily pedagogical function to the universities and a primarily research function to the institutes of the Academy of Sciences. This division between teaching and research, seen in retrospect, was a tragic mistake. Evidence is mounting that teaching helps research and that research helps teaching. Separating them harms both.

EXPAND ON THIS ORALLY, POINTING OUT THAT EVEN UNDERGRADUATES CAN MAKE IMPORTANT CONTRIBUTIONS TO COMMERCIALIZING TECHNOLOGY SUCCESSFULLY; AFTER ALL THE ONE CHARACTERISTIC THAT BILL GATES, STEVEN JOBS, AND MARK ZUCKERBERG ALL SHARE IS THAT THEY STARTED THEIR COMPANIES WHEN THEY WERE UNDERGRADUATES (MICROSOFT, APPLE COMPUTER, FACEBOOK).

CONCLUSIONS

The greatest flaw, in my opinion, of the Skolkovo Project is that it is an attempt to improve technology without basically changing the society in which technology must develop. This is the same defect that has plagued modernization efforts in Russia for three hundred years. Russia's leaders concentrate on developing new technologies, not on reforming society in such a way that advanced technologies become self-developing and self-sustaining. What we have learned from Russia's repeated attempts to modernize technically is that successful modernization depends on the characteristics of the society in which it is attempted much more than it does on individual technologies, however modern these technologies may be at the moment of introduction. Without thorough social reforms making Russia a more open,

receptive, free, and stimulating society individual technologies will have only very partial modernizing effects. They will work for awhile, then become obsolescent. Russian society as presently organized is not likely to rejuvenate those technologies on its own. Once again, the Russian government will have to save the situation by direct action from above. Russia has not yet escaped from its age-old trap of repeated cycles of modernization followed by obsolescence. I call this the “fits and starts” of the history of technology in Russia

Thus, Russia faces a tall order if it truly wishes to modernize. But in principle progress is possible. After all, South Korea made the transition in about forty years, reforming its society, creating a democracy, at the same time it modernized technologically. That is the ticket. The present Russian government does not want to buy that ticket because of its dislike of competition and political democracy. It is sad, because in an interconnected world of knowledge economies we would all benefit if Russia truly modernized.

Concluding quotation from Daniel Treisman:

“What matters most for growth is not where new ideas first appear but where they are developed. And this depends less on the brainpower of scientists or the extent of state research funding than on the quality of the business environment A simple conclusion follows: even if Russian scientists have brilliant ideas, unless the country undergoes major reforms of its economy and state those brilliant ideas will be exploited first *somewhere else*.”¹⁶

¹⁶ Daniel Treisman, “Russia’s Tom Sawyer Strategy,” IWM post, No. 106 (January-March 2011), p. 14.