FROM RUSSIA WITH CODE

Programming Migrations
in Post-Soviet Times

edited by

MARIO
BIAGIOLI

and

VINCENT
ANTONIN
LÉPINAY

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CONTENTS

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ACM	Association for Computing Machinery
CIS	Commonwealth of Independent States
CS	computer science
EUSP	European University at Saint Petersburg
FSU	former Soviet Union
IBM	International Business Machines Corporation
ICPC	International Collegiate Programming Contest
ICT	information and communications technology
IT	information technology
KGB	Komitet gosudarstvennoy bezopasnosti (Committee for State Security)
MIT	Massachusetts Institute of Technology
MNC	multinational corporation
NASDAQ	National Association of Securities Dealers Automated Quotation
NATO	North Atlantic Treaty Organization
NGO	nongovernmental organization
OECD	Organisation for Economic Cooperation and Development
PC	personal computer
R&D	research and development
RCS	Russian computer scientists
RVC	Russian Venture Company
Skolkovo	Skolkovo Innovative City
Skoltech	Skolkovo Institute of Science and Technology
SEZ	special economic zone
STS	Science and Technology Studies
USSR	Union of Soviet Socialist Republics

This book is a collective effort in more ways than we can describe. From conceptualizing the project, securing the funding, assembling the team, all the way to developing the international network to support the research and conversations that we wanted to have, we have relied on colleagues and friends in Russia, the US, France, the UK, and the Netherlands, including several we made along the way. *From Russia with Code* is the product of a three-year effort by a team of scholars connected to the Science and Technology Studies (STS) Center at the European University at Saint Petersburg (EUSP), funded by a grant from the Ministry of Education and Science of the Russian Federation for the study of high-skill brain drain. This project would not have been possible without the EUSP's unique intellectual and interdisciplinary environment and the Ministry's support for the extensive and multisited research required by our research topic.

As in all collective enterprises, especially academic ones, the most important persons are not necessarily the most visible. In our case, they do not appear on the book cover nor in the list of contributors, and yet they have been present throughout the book, working next to it, and making it possible. Olga Dragan, EUSP's finance officer, has crucially supported the project from its inception in January 2013, when it was only a grant application, all the way through its slow metamorphosis into the book you are reading. With the help of Natalia Voinova, Olga steered the ship clear of all bureaucratic shoals, even when the political campaigns against the EUSP turned bureaucratic rules into something else.

A relatively recent arrival on the Russian academic landscape, the EUSP is at once a research center and the leading private higher-degree-granting social science institution in Russia, ranking every year in the

top five of all Russian universities. A project of this scale would not have been possible without the support that the sts Center was fortunate to receive from the other departments, especially Anthropology, History, Sociology, Political Science, and Economics. While enjoying their support, it has also been a pleasure to witness the "positive spillovers" that our project has enabled, inserting sts questions and approaches into conversations with colleagues across the social sciences and into the research that the graduate students have been conceptualizing and pursuing.

We were fortunate when Zinaida Vasilyeva accepted our invitation to become the executive director of the project. Since the project's inception, she skillfully negotiated the contrasting needs and desires of the academic scholars and of the multilayered bureaucratic world in which the project grew and operated. In this, she was helped throughout by Anastasia Karkacheva, who added to the job description of assistant director her precious and much-appreciated design skills. Diana Kurkovsky West joined the project as a researcher in 2014, quickly moving to direct the sts Center in 2016, with the support of Olga Sezneva who took leave from her faculty position in Amsterdam to help strengthen and broaden the academic agenda and programs of the Center while also connecting it to Saint Petersburg's broader cultural circles and networks. Liliia Zemnukhova was part of the research project from the beginning, always contributing much-appreciated problem-solving skills and contagious energy. Mélanie Feakins generously shared with us her knowledge and experience of Russian offshoring in the it business, providing crucial fieldwork contacts and suggestions.

In Paris, Sciences Po supported the completion of the book through its Scientific Advisory Board funding in 2014. Medialab was the perfect institution to conduct the project while in Paris. Michel Gardette and Bruno Latour were understanding enough to let Vincent Lépinay finish the project in Saint Petersburg while holding a teaching position in Paris. In Davis, California, the Center for Science and Innovation Studies and the faculty of the Science and Technology Studies Program supported and participated in the project, providing a welcoming intellectual and institutional home to some of our Russian visitors. Martin Kenney lent his expertise in innovation studies and regional development, making him one of our most helpful collaborators, brainstorming with our team both in Saint Petersburg and Davis.

Andrei Mogoutov provided invaluable guidance to the project participants pursuing quantitative analyses of the patterns of collaboration and publication of Russian computer scientists. Michael Gordin, Loren Graham, Alexei Grinbaum, David Kaiser, and Martin Kenney joined our summer

school in 2014, providing extensive and insightful comments on the team's work. Their generous presence and critical input were as useful as the inspiration that their work triggered. Harley Balzer, Slava Gerovich, Martin Giraudeau, and Ben Peters kindly discussed with us versions of this book and provided much-needed advice, as did Yuri Takhteyev on the earlier framing of the project. As EUSP's vice-rector, Boris Kolonitsky provided much-needed support and connections. Olga Sezneva, Diana Kurkovsky West, Mikhail Sokolov, Ilya Utekhin, Artemy Magun, Anatoly Pinsky, Stephanie Dick, and Jay West have all supervised and advised students at the STS Center. As the project was reaching its completion, Veljko Vujacic read the book manuscript and provided extensive and incisive comments that contributed to shaping it in its current form. Special thanks go to Beatrice Lewin Dumin whose editing skills turned an assemblage of stylistically unruly essays into a coherent volume.

Preliminary versions of this book's chapters were presented at a variety of conferences: "From Streets to Boardrooms: Internet Activism and Business Strategies," September 18–19, 2013, EUSP; "Crossbreeding STS and Innovation Studies," December 7–8, 2013, EUSP; "Innovating Russia: Computer Science and Entrepreneurship in Historical Perspective," December 9–10, 2013, EUSP; "Explorers and Pirates: Digital Creators and the Creation of Value," June 18–19, 2014, EUSP; "Summer School on Russian Computer Scientists," June 16, 17, and 20, 2014, EUSP; "Garage Innovation," September 26–27, 2014, EUSP; "Central and Eastern European Software Engineering Conference," October 23–25, 2014, Digital October Center, Moscow; "Scientific Diaspora," December 5–6, 2014, EUSP; "Summer School on Russian Computer Scientists," June 22–24, 2015, EUSP; "STS Winter School," January 8–13, 2016, Venice International University, Italy; Association for Slavic, East European and Eurasian Studies Conference, November 20, 2016, Washington, DC; "Soviet Computing Workshop," November 29, 2016, UC Davis; "History of Science Seminar," June 16, 2017, European Institute, Florence, Italy. We wish to thank all those who provided us with comments, criticism, and support during the many discussions we had at these conferences.

This book would not have seen the light of day were it not for the institutional energy and imagination of Oleg Kharkhordin, who served as EUSP's rector during most of the duration of the project. He first invited one of us (Vincent Lépinay) to take the lead of the STS Center he had recently launched at EUSP, and his work on Russian high-tech entrepreneurship has been a constant reference. This book extends those intellectual conversations and the institutional project that framed them. The team of Russian

and international scholars and networks that have grown around the "mega-grant" project have contributed to Oleg's goal of solidifying the EUSP Center's role as the premier STS hub in Russia—a country where our already inter-disciplinary field needs to add additional perspectives to make sense of the many different scenarios emerging at the intersection of dramatic historical changes, geographical specificities, and mobilities. While his name does not appear among the book's contributors, Oleg has been a full-fledged collabo-rator, from his early support of our "megagrant" application to innumerable discussions and brainstorming sessions throughout the project. The pleasure associated with the completion of this book is also tinged by the sadness of acknowledging the closure of the project, but we hope that the relations of intellectual kinship with Oleg and the faculty and students of the EUSP will spawn more initiatives and conversations, in Saint Petersburg and elsewhere.

RUSSIAN ECONOMIES OF CODES

Mario Biagioli and Vincent Antonin Lépinay

Three recent vignettes of Russian information technology (IT) education, migration, entrepreneurship, and activism mark the boundaries of this project, as well as some of its analytical foci.

1

"I tell you honestly and openly—if you want to harm the country, invest in training IT specialists in the Russian Federation. You couldn't harm Russia more."[1] With this stunning remark, Dmitry Marinichev, Russia's presidential internet ombudsman, addressed IT entrepreneurs, government officials, and academics in October 2015 at a meeting of the Russian Civic Chamber to discuss import substitution—the replacement (due to Western sanctions) of foreign-produced technologies with Russian ones. Accepting as a fact the isolationist tendencies of the Vladimir Putin government, the West's growing hostility toward Russia, and the lack of a Russian innovation ecosystem that could sustain the production of domestically and internationally competitive digital technologies, Marinichev argued that Russia was already cut off from global innovation networks and that, therefore, "we can give technology to other countries only when we have a military presence [there]. When other countries will not have an alternative option than to get it from us."

Considerable uproar ensued, but Marinichev held his line in a follow-up interview with *Gazeta*:

I am saying absolutely banal things, which have been well known since the time of the Roman Empire. First an army

comes on a territory, then merchants, and then there is state power and a market. It's only that way, and no other way. Therefore if at a government level we choose the regimen of "Russia against all," then we will have no chance to sell our products and technologies except by conducting geopolitical expansion in the world. (Evstifeyev 2015).

He then continued:

A clearly-expressed confrontation is underway between the Western world and Russia. Whether Russia is guilty here or not is not important. What's important is the status quo, and it is impossible to discuss technological export and import substitution because we must produce everything ourselves totally and completely. In that context, preparing IT specialists for foreign-based technologies is essentially to undermine Russia's sovereignty. . . . I don't want to look at that option because it is unacceptable. We have all managed to live as citizens of the global world, freely moving about—a vacation in Italy, a merry-go-round ride in America. But it could happen that everything will change. And the question of what method of technology transfer to use lies on that plane—who we are and what we want and where. (Evstifeyev 2015)

2

Exploring his company's server in 2015, Dmitry Korobov, a programmer at the Russian company Yandex, found a folder containing the source code of its search engine, which he proceeded to download and then tried to sell. Yandex is not simply a Russian IT company, but more like *the* Russian IT company. Started in 1997, it quickly outperformed Google in Russia (controlling about 60 percent of the market), becoming one of the few darlings of foreign investors and opening its own research center in Silicon Valley. It is considered the fourth-largest search engine in the world.

At first, Korobov looked for buyers on the darknet, but he then openly approached NIX, an electronics retail company where he had acquaintances. Need, not greed, may have motivated Korobov, who claimed to sell the stolen software in order to launch his own startup, leave Yandex, and become an entrepreneur. He seems to have had poor business sense, though, asking $28,000 for software that may have been worth $14 million; apparently equally oblivious to the fact

that $28,000 would hardly have paid office rent in Moscow for a year, let alone launched a startup. With the Russian security services (FSB) scouring the darknet on a daily basis to locate signs of suspicious activities, Korobov was easily lured into meeting a prospective buyer who handcuffed him before he could sing the praises of the sophisticated system he was trying to sell. He received a suspended sentence of two years in jail—a lenient punishment that probably reflects the court's perception of Korobov's actions as naively, rather than professionally, criminal (Degeler 2015).

3

Virtual Rynda: The Atlas of Help is a platform "to support and facilitate mutual aid and crowdsourced solutions to different types of problems affecting Russian citizens" (Asmolov 2014). It emerged in the wake of the 2010 wildfires that ravaged the forested areas around Moscow. Help Map (Wildfires.ru) was set up on the model of Ushahidi, a crowdsourcing platform initially developed in Kenya in 2008 to help collect and report evidence of violence and fraud. Help Map succeeded beyond all expectations, leading its founders to consolidate their social experience of mutual help and collective data gathering into a platform that could be used in a variety of situations. As a response to the poor handling of the disaster by local authorities and as an active decision to equip citizens with new modes of coordination, Help Map both facilitated and managed a successful grassroots outpouring of aid and collaboration. In programming and design terms it effectively translated a massive and otherwise disorganized stream of compassion into human action, and in so doing it reenacted an old Soviet political philosophy. Nearly two decades after the collapse of the USSR, it proudly brought back the notion of the public good, this time in the form of a city threatened by smoke.

Interestingly, the people behind Help Map only met in person after the site had already achieved its collaborative goal. Its successor, Virtual Rynda, is one among many such projects harnessing the power of virtual connectedness to address issues that are both local and broadly shared across constituencies—information, needs, and agendas that political authorities would otherwise leave unseen. These citizen-produced digital platforms are, thus, not just tools for

emergency management or other forms of practical help but rather vectors of a new public sphere, their very existence a finger that points to a neglectful or willfully blind state.

< / >

Taken together, these three contemporary vignettes function as signposts of the techno-scientific and political field engaged in this book—a field that kept changing as we were studying it. When we started mapping the brain drain and global migrations of Russian computer scientists, software practitioners, and IT specialists to Finland, the UK, Israel, the US, and beyond we expected the diasporic process to be the primary agent of change and hybridization of people who otherwise shared comparable professional profiles, educational backgrounds, and technical skills. However, as soon as we went into the field—a field that was new to us and for which we had limited background literature to guide us—we were confronted with the heterogeneity and fluidity of our subjects *prior* to their diasporas.

One can recognize an academic computer scientist virtually anywhere in the world by reference to standardized forms of academic training, publication venues, professional roles, and disciplinary networks. The relatively stable profile of Russian academic computer scientists was, however, more the exception than the rule among the subjects of our study. Unlike "computer scientist," terms like "software practitioner," "IT entrepreneur," or "hacktivist" were remarkably difficult to specify in the Russian context, not just because they indexed new professions and roles, but because Russia— the sociocultural and political framework in which these changes were taking place—was itself a work in progress (Yurchak 2005). It quickly became apparent, therefore, that defining our subject was going to be an important and ongoing research question—more a heuristic window than a problem. (When we refer to them as "Russian computer scientists," or RCS, we use that term under erasure.)

What is commonly referred to as the collapse of the Soviet Union in the early 1990s was nothing short of a cultural revolution that triggered a rather unique kind of diaspora. Traditional revolutions often trigger migrations of members of the losing faction (people who had clear social identities like, say, aristocrats after the Bolshevik Revolution of 1917), but the transition to post-Soviet Russia spawned a diaspora of subjects that were in the process of refashioning themselves into something else. The "Russian software practitioners" we have been following around were not seeking refuge in other communist enclaves abroad to hold on to their previous identities, but were

instead technically skilled people who, while participating in some emergent post-Soviet subjecthood, often found themselves constrained by the post-Soviet context itself. Being a "tech entrepreneur" in post-Soviet Russia does not mean occupying a specific preestablished role, but rather constructing a new subject position—one that is as new as that of the hacktivist and the forms of political participation associated with that term.

After 1991, the country we now call the Russian Federation migrated toward a capitalist economy, enabled the mobility of its citizens both within and beyond its borders, renegotiated its relation with the former Soviet republics, and attempted to pivot from extractive industries to a "knowledge economy," as well as to reorient its famous and extensive techno-scientific apparatus from its traditional centralized, top-down, and military-oriented structure toward a more horizontal and entrepreneurial culture aimed at technologies and products for private industries and the consumer market. The people whose movements we sought to understand were participants and actors in many of these changes, as well as in the emergence of a new political sphere made possible by the internet and digital media. It became clear, then, that we needed to look both at those who opted to refashion themselves in situ, and those who instead engaged that refashioning process in diasporic settings. Rather than simply the opposite of "staying put," moving was a different facet of a process of emergent change that was affecting all post-Soviet subjects. This emphasis on emergence (whether geographically anchored in Russia or not) is reflected in the layout of our chapters, which map both the new post-Soviet configurations of software practitioners, entrepreneurs, and hacktivists from Saint Petersburg to Vladivostok, as well as some of the assemblages they have constructed abroad.

At the same time, while it became difficult or plainly impossible for us to describe exactly what "Russian" meant in the midst of all these changes, it was equally clear that the conditions, resources, constraints, and possible trajectories for all these developments were genealogically specific to "Russia." The global mobility of IT specialists,[2] software theft, and grassroots web-based initiatives is nothing new. Still, the remarkable mobility of IT specialists, especially highly skilled individuals such as those who have traditionally been produced by the Soviet and then Russian pedagogical system, is a particularly thorny issue for this country because it turns a pedagogical strength into an economic and possibly even political threat. In addition to the problems that brain drain poses to all countries, here it is feared to contribute, at least in Marinichev's neo–Cold War perspective, to "undermin[ing] Russian sovereignty." Unlike other countries that have been able to stem the loss of

academics and entrepreneurs, create opportunities for returnees, or benefit from networks developed through the back-and-forth mobility of their highly skilled workers, Russia continues to face a one-directional flow, the pace of which seems to be accelerating in response to an increasingly unsettled political environment at home (Balzer 2011; Kuznetsov 2006; Luo and Wang 2001; Saxenian 2007; Wang 2015). Recent surveys show that in 2014 the emigration of Russian scientists and entrepreneurs was by a wide margin the highest since 1999 (Dezhina 2015, 330). It is this trend that Marinichev was addressing in his radical 2015 speech before the Russian Civic Chamber: "All the programmers will instantly move abroad. That is the practice of the last two years" (quoted in Fitzpatrick 2015a).

METHODS FOR MOVING POPULATIONS

From Russia with Code analyzes changing populations of techno-scientific practitioners and entrepreneurs. As indicated by the three vignettes, these are heterogeneous populations without essential features or stable identities. They mutate as they move, in Russia and abroad, turning communist mathematicians into post-Soviet software entrepreneurs, political activists into civic hackers, academic theoreticians into entrepreneurs, Jews in Russia into Russians in Israel, used-car salesmen in Vladivostok into web designers, KGB technicians into US security specialists, nationalists into cosmopolitans, and back to nationalists, etc.

The book is the outcome of over three hundred in-depth interviews conducted over a three-year period (from 2013 through 2015) in Russia and around the world by a team of Russian, US, French, and Dutch scholars.[3] While the practitioners we have studied are regularly covered by popular media (Bowles 2017; Shane, Sanger, and Perlroth 2017), discussed in business publications, and reported upon in foreign-policy think tanks, they have as a whole received scant scholarly attention, and almost none in academic Anglophone literature (Bardham and Kroll 2006; Borjas and Doran 2012; Feakins 2009; Freinkman, Gonchar, and Kuznetsov 2013; Ganguli 2015; Lonkila 2011). The Russian IT sphere is one of successful private enterprises, greatly varying in size. Despite the limited availability of venture capital in Russia, Yandex and Kaspersky have grown into large companies on par with some of their Silicon Valley competitors. At the other end of the spectrum, thousands of self-employed programmers work on projects without formal labor contracts. Despite the efforts of IT trade associations like Russoft to understand market morphology and the population of programmers actu-

ally working in Russia, the actual lay of the land for both companies and individual practitioners has been highly speculative. *From Russia with Code* offers a much more granular picture of the specific, often daily practices of these actors than can be provided by statistical aggregations or high-level policy papers. It provides a unique window onto a Russia that lies beyond the headlines of political and economic media reports—a Russia of technicians, but also of civic hackers who are trying to reshape Russian politics from the bottom up, strongly committed to avoiding both old Soviet and neoliberal Western political templates.

Methodologically heterogeneous, our project is inspired by multisited ethnography, though in this case different sites are analyzed by different chapters authored by different scholars. The chapters sample different practices, goals, and sites of Russian computer scientists, software specialists, hackers, and IT entrepreneurs, but are not aimed at constructing a holistic comparative global picture. Rather,

> comparison emerges from putting questions to an emergent object of study whose contours, sites, and relationships are not known beforehand, but are themselves a contribution of making an account that has different, complexly connected real-world sites of investigation. The object of study is ultimately mobile and multiply situated, so any ethnography of such an object will have a comparative dimension that is integral to it, in the form of juxtapositions of phenomena that conventionally have appeared to be (or conceptually have been kept) "worlds apart." Comparison re-enters the very act of ethnographic specification by a research design of juxtapositions in which the global is collapsed into and made an integral of parallel, related local situations rather than something monolithic or external to them. (Marcus 1995, 102)

In particular, we believe that George Marcus's critique of the conception of the global as something monolithic or external to local situations may be usefully applied to Russia itself. The local materials and analyses put forward by the chapters are not framed by a preset relationship with "Russia" as a stable framework that contextualizes these local studies and organizes their comparisons, but are presented as sites in which post-Soviet Russia is constructed through and in relation with those local situations.

The perspectives that we have borrowed both from multisited ethnographies and from science and technology studies turn *From Russia with Code* into a study of mobilities that does not easily fit the template of diaspora studies. A focus on the movement (domestic and global) and on the constantly

outward gaze of highly skilled practitioners is central to the book, but it is articulated primarily through an attention to the technological specificity of this population—code, coding skills and practices, and the social assemblages that are sometimes built through and around code—and how that frames both their migration options and their sense of being "Russian" (which often collides with the professional identity that comes with being a programmer, a computer scientist, or an IT person). This is a population in movement and whose movements—as shown by Marinichev's remarks about the challenges that IT brain drain poses to Russian sovereignty—have created issues for a state that has long assigned populations to their specific cities.

While there may seem to be some family resemblance between our chapters and the genre of diaspora studies, the research object is quite different. Our questions do not concern the transformative effects of distance on memories of and connection to the motherland, or on the organization of diasporic communities. That is not only because the Russian motherland is an openly unstable construct, but especially because "distance" is not the right concept to capture the inherently tense relation between two very different modalities of identity formation that we find in our material. One is tied to the specific skills of the migrant practitioners of a technical discipline with inherently fuzzy boundaries and a deterritorialized ethos—skills that are conducive to the formation of distinctly nondiasporic communities and publics, like those associated with the free software and open source movements. The other modality of identity formation is, instead, virtually antithetical to the first one, developed by a state with a long tradition of population control. At the same time, the technical skills that these practitioners are internationally appreciated for and identified with—the same skills that make them highly moveable and put them on a centrifugal trajectory away from the pull of the Russian state—are skills they have developed through the very specific Russian (and formerly Soviet) educational system.

This unavoidable tension questions the meaning of both "diasporic population" and "motherland," but it also complicates in interesting ways the multisited stories told in this volume. Multisited studies have treated seriously the territories of activities that used to be described without attention to their spatiality—hence the typical study of local and distributed deployments of one object, like a drug tracked from the labs of the pharmaceutical company designing it in Cambridge to the offices of the medical doctors prescribing it in Argentina and the websites where patients comment on the effects of its consumption on their health. But despite this grounding and spatialization of the object and its movements and transformations, multi-

sited analyses have tended to treat territories as *relative* coordinates of objects, which are often as emergent as their trajectories.

But while Russian computer scientists and IT specialists are as dispersed across the world as pharmaceutical drugs are, their movements also make visible, and make sense from, a specific coordinate system. These subjects are Russian (in the specifically constructed sense discussed above), looking with either frustration or nostalgia to their motherland (often perceived through the polarized "Russia v. The World" narrative), while simultaneously exploiting and reinforcing the "Russian software specialists" brand that gives them an edge in the global labor market. In this sense, Russia is not just a departure point but a point of reference for their movements, including the decision to stay put. Their Russianness is constructed and ever changing, but it is also the proverbial elephant in the room, large enough to inflect the otherwise uniform coordinate system of multisited ethnographies.

SETTING THE STAGE

Dmitry Marinichev's frustration is somewhat understandable because coding, unlike most other high-tech disciplines, is predominantly labor intensive—a fact that greatly reduces the government's possible policy levers. Software production's low capital requirements are what made Russia one of the most successful countries for the offshoring of high-end coding projects immediately after the collapse of the Soviet Union; all that foreign companies needed to do was send over some laptops and a bit of cash and that might be enough for a Russian techie to start a company.[4] For example, in 1992 you could hire a good programmer for $100 a month. But the other side of this same coin is that the Russian government finds it very difficult to retain IT specialists, as compared to retaining or attracting back physicists, chemists, or biologists. While the latter require sophisticated and generally expensive facilities—and are thus likely to respond to policies that would provide them with these resources[5]—most IT specialists seek jobs rather than laboratories or companies. Because they travel light (and thus easily) the Russian government can do little to control their movement short of restricting emigration, thus effectively treating them as potential defectors. This is most likely what Marinichev had in mind when claiming that "preparing IT specialists for foreign-base technologies is essentially to undermine Russia's sovereignty."

Dmitry Korobov's story also contains specifically Russian elements: while he is certainly not the first software thief we have heard of, his remarks (if we are to believe them) point to a dramatic lack of funding opportunities
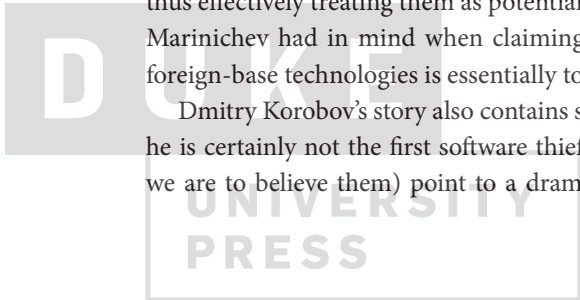
for tech startups. Coders like Korobov are allegedly reduced to theft in order to become entrepreneurs, pushing the figurative link between pirates and entrepreneurs to a new level (Clay and Phillip 2015; Durant and Vergne 2012; Ramadan et al. 2016). But, setting his piratico-entrepreneurial visions aside, Korobov (if we are to believe the way he has been represented in the media) seemed to have had extraordinarily little sense of the market value of the goods he was selling, or of how to go about planning or executing such a heist. Of course, one may be tempted to discount this vignette as a mere reflection of Korobov's limited skill set, but the presence of a significant gap between technical ability and entrepreneurial skill has emerged in several of our interviews of Russian IT specialists, suggesting a pattern that moves beyond individual specificities.

There are several true success stories in the Russian IT industry—Yandex being a globally prominent one—but they are the results of extraordinarily steep learning curves in business culture, not just technical innovation. In the mid-1990s, for instance, budding Russian IT entrepreneurs lacked not only MBAs but familiarity with basic business practices. Arkadiy Khotin, the founder of Arcadia—one of Saint Petersburg's earliest software companies that is still going strong today—recalls that in 1994, when he began working on projects for foreign clients, "I had no idea about how to speak of the terms of payment. I had no idea of the concept of things like retainers. My Soviet mentality did not allow me to ask. I was waiting for them to offer. . . . [That] was not very good because when someone asked me how much I wanted to be paid for this activity, I had no idea how to arrive at an appropriate figure. . . . In trying to price a small project I had no idea how to say it would be about $500 or it would be in the lower hundreds of dollars" (quoted in Lonkila 2011, 28).

Things were not much different in 1996: "I definitely had raised some interest but I had a [*sic*] zero marketing skills including a lack of understanding of how to follow-up. I even went [to a meeting in Finland] without business cards. They said we will send you something but they did not even know my e-mail address" (Khotin, quoted in Lonkila 2011, 29).[6] This was clearly not the result of a Soviet-style rejection of bourgeois business mentality. On the contrary, what we see in Russia from the 1990s all the way up to the present is a genuine appreciation—often bordering on mythification—of the discourse of innovation and entrepreneurship, though not one that is always coupled with competence in Western entrepreneurial practices and expectations. Since the early 1990s, however, things have dramatically changed. Still, despite a craze for business workshops, online training mate-

rials, and translations of Western textbooks, there remains a noticeable gap between the level of available mathematical, technical, and coding skills and the familiarity with entrepreneurial practices and culture, especially at the periphery of the Russian Federation.[7]

This may help to explain why Russian programmers tend to do very well when they move abroad or are hired by the Russian branches of foreign companies, that is, in contexts where their technical skills are put to work in environments that already have their business organization and infrastructure in place.[8] While coding is a skill young Russians can learn at school, in afterschool computer clubs, in coding competitions, or even on the web, business culture is another matter altogether.[9] Those IT entrepreneurs who went into business just after the collapse of the Soviet Union typically credit their business training not to workshops and classes but to interactions with their Western foreign customers—often initiated by informal or simply out-of-the-blue email contacts whose rate of success was only slightly better than spam. It was through early offshoring work that the first post-Soviet generation of coders slowly turned into entrepreneurs, learning their foreign clients' practices and cultures while also learning how to talk to them and understand what their expectations were so as to build trust and, in some cases, long-term business relations.

It goes without saying that given the virtual absence of domestic training resources, neither the informal but remarkably rapid learning process nor business opportunities would have been possible without access first to FidoNet (from the late 1980s on) and then to Relcom, Free-Net, and the internet, which became available in the early 1990s (for those with some affiliation to a university or academic institute, as several first-wave Russian entrepreneurs had) (Peters 2016). In a literal sense, the Russian IT industry was itself a product of IT. One must also credit the cyberinfrastructure for much of the English-language training—however approximate it may have been—that Russian coders were able to access early on.[10] Despite the increased demand for English-language education in Russian schools (where high schoolers are now required to learn two foreign languages) and plans to introduce a nationwide mandatory English test by 2020 (*Moscow Times* 2005), there remains a substantial gap between the English-language proficiency of Russian IT specialists and those from competitor countries such as India, Ireland, Korea, and Israel.

Arcadia's Khotin (who did not seem to know about business cards in 1994 and was taught how to write proper English business letters by a US acquaintance around 1998)[11] was proud to report in 2009 that his company (which

now employs close to five hundred people) is "a top notch specialist in major technologies on the Microsoft platform. *But overall our strongest point is people management, project management and business process organization because this is the most important part*. We call it PPP—People, Processes, Projects" (Cook Report 2009, 22; emphasis in the original). The dramatic shift that Arcadia experienced between 1996 and 2009—moving from an emphasis on superior coding and low cost to superior people-management skills, down to the American-style use of acronyms like "PPP"—was the result of many interactions with important clients (like Johnson and Johnson) that lasted over years, turning into quasi-partnerships (Cook Report 2009, 20–21). However, companies doing offshoring work are not uniformly distributed across the Russian Federation, but tend to cluster in cities with major international airports. The opportunity for informal business training through interactions with foreign customers is therefore rarer in the provinces, or for the many IT specialists working for the domestic market.[12]

The widespread imbalance between technical skills and entrepreneurial competence, however, ceases to be a problem when we look at the third vignette about the Virtual Rynda project. There, substantial IT skills are not directed toward the commercial sphere, and platforms and applications are not being developed with an eye to selling or licensing; rather, they are seen as contributions to the establishment of a new body politic. In these cases, business competence becomes relatively irrelevant compared to technical skills and an eye for identifying spaces and windows of opportunity for political intervention.

The connection between IT and democratic movements is quite direct in Russia, going back to the undoing of the August 1991 attempted coup d'état against Mikhail Gorbachev and his reform program. On that occasion, according to Rafal Rohozinski:

> The programmers at one of Russia's private Net providers—Relcom/Demos—were among the first to testify to the coup from their offices near the Kremlin. Within a few minutes of tanks appearing in Red Square, they began broadcasting information to network nodes across the USSR. . . . Within hours, they had established a temporary network node at the White House and were e-mailing Yeltsin's defiant declaration, rejecting the legitimacy of the coup committee, to Russia's regions and abroad. . . . By evening, the Relcom network was acting as a major channel of information between Moscow and the regions. . . . The information vacuum, a key factor in the coup plotters' game plan, was filled. (Rohozinski 1999, 1–2)[13]

"Civic hackers" remain key players in Russia today, less dramatically but much more pervasively than in 1991. For them, IT innovation and practice is not just a way to develop better and cheaper products or profitable companies, but also a technically sophisticated attempt to develop new forms of politics and democratic participation. From monitoring elections to filing complaints about failing urban infrastructure with the appropriate authorities, their goal is not to achieve "efficiencies" but to change politics. Their projects are simultaneously mundane and utopian, directed at local problems in the present but aimed at rethinking future politics at the national level. One could say, perhaps, that Russian hackers (of both the civic and dark variety) are particularly effective because their practices require virtually no business skills.

This may also explain the specific kind of attraction that young Russian IT specialists have for the free software movement, for hacker culture, and for informal collaborative worksites like hackerspaces (Davies 2017). In most developed countries, these sympathies often index a commitment to alternative business cultures (or plainly antibusiness attitudes), but the Russian love for free software and hackerism may reflect the values of a community that, for better or for worse, has never been part of a traditional business culture. Is the Russian hacker a business idiot savant?

AMBIVALENT EXCELLENCE

Russian computer scientists are globally sought after by major IT firms, their desirability enhanced by the success of teenage Russian "prodigies" who regularly win the IBM-sponsored Association for Computing Machinery's International Collegiate Programming Contest (ACM ICPC) and other computer science competitions organized by major players in the IT global scene, such as Facebook, Microsoft, and Google. (Students from Saint Petersburg State University won the 2016 ICPC, ahead of Harvard [third] and MIT [sixth], with five Russian universities in the top ten finishers. Between 2000 and 2016, Russian universities won the ICPC eleven times.)

The appreciation of the Russians' coding skills is neither new nor limited to academic circles. Back in 2001, the "Whitepaper on Offshore Software Development" by the American Chamber of Commerce in Russia described the "special characteristics" of Russian coders, and their roots: "Russia's major advantage over other common offshore software development locales is the technical skills and education of its workforce. Russia has more personnel working in R&D [research and development] than any other

country, and ranks 3rd in the world for per capita number of scientists and engineers. . . . Initially trained for research careers in physics, engineering, or mathematics, they switched to IT instead, having 'mastered' new programming languages and other skills for which there was demand" (American Chamber 2001, 4; quoted in Gapova 2006). Jason Horowitz, Sun Microsystems' Russian project team manager, is more categorical. In his view the coders whom Sun employs in Ireland, Israel, India, and the Czech Republic "don't have anywhere near the talent [of] the Russians," who are specifically "stronger at tasks that require deeper mathematical backgrounds" (quoted in Peterson 2005).[14]

But RCS are also followed, at times foreshadowed, by a very different kind of reputation: "After the fall of the Soviet Union, most Russian specialists lost their jobs, some went abroad, others turned to criminal activities. Everyone knows that the best viruses are written in Russia."[15] Hackers originating from ex-communist countries—people who might belong to the same communities as those of the international computer science competitions—have been accused of carrying out cyberattacks on various Western targets, most recently against the US Democratic National Committee (DNC). Cold War memories are thus reactivated by the narratives that Europe and the US have recently developed about Russian hackers, narratives that simultaneously celebrate and fear the technical excellence passed down from the Soviet period. The same applies to the other side in the trenches of cyberwarfare. One of the most globally respected cybersecurity firms—the Moscow-based Kaspersky Labs—was founded by a graduate of the Institute of Cryptography, Telecommunications, and Computer Science at the Federal Security Service of Russia—a school that was previously part of the Technical Faculty of the KGB Higher School.

Russian hackers are perceived as a worrisome mix of Soviet rigor and new Cold cyber-War operatives. At the same time, they can also be seen as epitomizing the ultimate non-Soviet subject, not just as embodiments of neoliberal ideology but also as self-trained anarchists with little allegiance to institutions, authorities, and nations. And while that mentality may worry the ruling classes, it could also be a rather valuable business skill. According to the American Chamber of Commerce in Russia (2001, 11; quoted in Gapova 2006, 5), "many Russian software programmers are self-taught, partially explaining their reputation as hackers who can think outside the box."

These polarized narratives about the different figures of the Russian computer scientist are not accidental but rather index the tense political and ideological environment of technological innovation in post-Soviet Russia.

Because of its nature, IT sits exactly at the intersection between technology, business, and politics. At the economic level, it may be the Russians' best option to end what former President (and now Prime Minister) Dmitry Medvedev (2009) called "our country's humiliating dependence on raw materials." At the same time, being so closely connected to communication and to the development of new platforms for political participation, IT is a prime tool for political criticism, activism, and whistleblowing. Russian computer scientists develop software, computational media, and communication networks and do so while inhabiting them at the same time. They are the vectors of information in the Russian Federation not only because they work on information technologies but because they are the sector of the population that is most exposed to the information disseminated by those technologies, much of it coming from outside the Russian Federation. They are techies but, precisely as a result of being techies, they are also carriers and disseminators of new information and modes of thinking.

DREAMS OF INNOVATION ECOLOGIES

During his presidential tenure, Medvedev vowed to return Russian science and technology to their due rank among the most developed nations of the world by making major investments in areas that had been left to their own devices as public funding virtually vanished with the collapse of the Soviet Union in the early 1990s. The restoration of Russian techno-scientific pride, however, was not aimed at recreating the old Russia but at modernizing and democratizing the present one—"modernization" being mobilized as something between a keyword and a magic incantation.

Information technologies were among the "five strategic vectors for the economic modernisation of our country" that Medvedev identified in his famous "Go Russia!" article of September 2009, a manifesto-like text that was perhaps more representative of his own personal views and desires than those of the Russian government as a whole. Brain drain was flagged as a key problem—"Our best specialists are headhunted by the world's largest companies and universities"—and Russian scientists of all stripes were subsequently courted to return to the motherland and participate in a full-fledged national modernization effort. This time, however, the modernization process was cast as neither imperial nor communist but democratic: "Today is the first time in our history that we have a chance to prove to ourselves and the world that Russia can develop in a democratic way." In that grand plan, information technology was part of both a new economic vision and
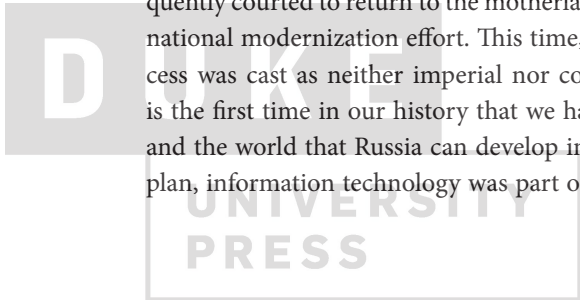
a new political project: "The growth of modern information technologies, something we will do our best to facilitate, gives us unprecedented opportunities for the realisation of fundamental political freedoms, such as freedom of speech and assembly. It allows us to identify and eliminate hotbeds of corruption. . . . It facilitates the direct exchange of views and knowledge between people all around the world. Society is becoming more open and transparent than ever—even if the ruling class does not necessarily like this" (Medvedev 2009).

His frequent references to the "intelligent economy" suggest that Medvedev saw information technologies as paving the way toward both new forms of democratic politics and new forms of economic value production. Rather than the traditional Chicago-style privatization dogma of the young economists who had set Russia on a wild ride to liberalization in the early 1990s, Medvedev and his advisors seemed to model their vision of the new Russian economy after the innovation ecologies of MIT and greater Boston, or Stanford and Silicon Valley. Information technology was thus key to growing the new Russia, both economically and politically and, in Medvedev's view, the state (rather than the market alone) was best situated to propel that transformation, while simultaneously regulating it.

Despite the political rivalry that characterizes American-Russian relations, key figures of the Russian government like Medvedev and other presidential advisors are enamored of Silicon Valley and, more generally, of the US system of science and technology R&D supported by federal agencies and by technology transfer policies from the university to the private sector. During his highly visible 2010 visit to Palo Alto, Medvedev gave a talk at Stanford in which, reading from his iPad, he told his audience: "It is not by chance that I came here. I wanted to see with my own eyes the origins of success" (quoted in Joseph 2010). His goal was to create relations and partnerships to replicate that success at a new Russian "innopolis," which was to be built at Skolkovo, on the outskirts of Moscow. His plans for a new high-tech city that would also include Skoltech, a new university modeled after and developed in partnership with MIT, testified to these hopes for the future and techno-scientific aspirations. Skolkovo's goal was to develop an innovation ecology able to prevent brain drain not just by providing generous funding but by creating the conditions of possibility for making scientists and entrepreneurs *want* to remain in Russia (Braunerhjelm and Feldman 2007; Kenney and Mowery 2014; Lecuyer 2005; Saxenian 2000).

Medvedev's vision, however, has not materialized, not even by a long shot.[16] Skolkovo never took off the way it had been imagined, its relation-

ship with MIT souring after a promising but brief honeymoon. And while the Russian IT sector has kept growing, it has not had the transformative effect the former president hoped for. In particular, the conspicuous, capital-intensive, and forward-looking innovation policies behind the establishment of Skolkovo seem ineffectual at harnessing the potential of the RCS community that, more often than not, continues to opt for emigration. Then, following the 2011–12 mobilization of students and liberal groups demanding transparency during the presidential election and the accountability of political leaders, the government began to exercise growing control on traditional media. The ecosystem of information has changed quite dramatically, to the point that the rare, but thriving, sources of critical information in the Russian Federation (e.g., the TV channel Dozhd' [Russian for "rain"] and the news platform Slon) have nearly all disappeared, thus leaving the web as the sole source of alternative information for people who, by and large, no longer believe in the new democratic modernizing alliance between government, scientists, technologists, and IT specialists articulated in "Go Russia!"

HISTORICAL PRIDE OR PRESENT CURSE?

The RCS provide interesting food for thought because of the technical and emergent entrepreneurial dimensions of their work but also because of the multiple ways in which they embody both the imaginaries about a future Russia and the tense connections between present Russia and its Soviet past.

Russian computer scientists are hailed for ushering modernity into post-Soviet Russia by exemplifying new forms of e-citizenry—the "bright" side of hackerism—and offering some hope for the emergence of a strong IT industry that will help wean the Russian economy off its dominant extractive industries. At the same time, the RCS are firmly connected to the Soviet past through the school system and its curriculum, which formed generations of formidable Soviet mathematicians and physicists and even now continues to provide the foundation of this community's distinctive technical skills—skills that, based on both the results of international coding contests and the opinions of experts, are widely recognized as outstanding.

The Soviet genealogy of today's RCS, however, is unusually specific. Unlike disciplines whose present identity is still framed by their Soviet past through substantial continuities in their institutional and sociopolitical "hardware"—from the Soviet Academy of Sciences, to engineers' factories, biologists' laboratories and agricultural research stations, and physicists' accelerators and weapons labs—the Russian computer scientists' link to the
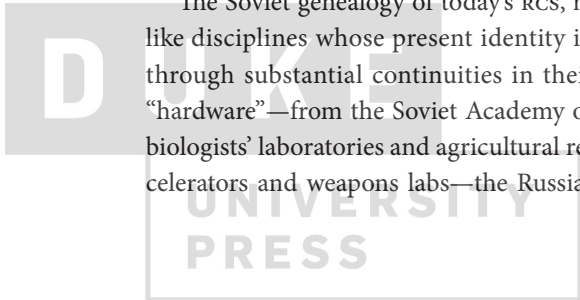
Soviet period is through "disciplinary software."[17] The RCS are connected to the past much more through pedagogical traditions than brick-and-mortar laboratories, factories, and professional organizations (which, in the case of the software industry, were established only in 1999).[18] We could say, perhaps, that while most disciplines had and still have extensive links to many parts of the state and government apparatus, the only elements of the Soviet system that are still directly traceable to today's RCS are the schools they frequented (especially the *fizmat* high schools that specialized in math and physics), the curriculum they followed, the teachers they had, and the Math Olympiads they went to with their fellow math students.

Nonetheless, as some of our chapters show, while the connection between modern Russian computer scientists and the old Soviet system may be limited in institutional terms—often confined to the students' relationship to their schools—it is also quite tight; it may be a small umbilical cord, but it is a strong one. Several of our interviewees indicate that it was those personal and pedagogical experiences that made them who they are professionally, shaping what they perceive as a uniquely Russian coding style. This is a mark of identity, not just of professional competence, though the two halves often merge, turning "Russian programmer" into a brand that signifies both origin and quality.

Somewhat paradoxically, the RCS who join the flows of the global brain drain do so precisely because they are Russians, because of the distinctive skills they have acquired as Russians. In this sense, the brain drain could be read as both a source of pride and a curse, or as hope for a future of technological and industrial innovation that is simultaneously possibly within reach and possibly already foreclosed. Because of their reputation (and because of their inherent mobility and relatively low need for institutional support) these specialists often flow away like oil and gas—precisely the resources that Russia hopes to wean itself away from by developing a strong IT industry. From the Russian point of view, brain drain may look like a tragic tale of technology transfer.

## THE PROJECT

From Russia with Code is a contribution to science, technology, and innovation studies, focusing simultaneously on technological matters like software and IT development and on the difficult emergence of the new Russian public sphere, which is closely tied to the development of an entrepreneurial economy and a new set of related values.[19] Entrepreneurship is about competition

(rather than government plans and policies) but it also requires some notion of trust that is not tied to one's place in a rigid social configuration like a Soviet *kollektiv*, or collective (Kharkhordin 1999).[20] As direct proponents of the digital economy, RCS are thus involved in developing new tools and products while also articulating new (and distinctly non-Soviet) forms of collaboration and accountability. Paraphrasing the famous Russian saying that "a poet in Russia is more than a poet," we believe that in the current political Russian context, software is about a lot more than software.

Recent anthropological studies of populations of software developers, hackers, and hacktivists have shown how their ethos is rooted in technical expertise but also in the appreciation of the unique transparency of computer language and the collaborations enabled by that transparency (Coleman 2012; Kelty 2008; Levy 2010; Takhteyev 2012). The traditional Mertonian divide between the openness of scientific knowledge and proprietary views of industrial expertise and secrets ruled out the cultivation of hybrid professional identities and ethos. Whether or not Merton's divide ever existed in the past, it seems to have disappeared today, as demonstrated by the university/industry partnerships that are now the norm in the US and Europe. At the same time, we also find a growing presence of free and open source software in for-profit environments, suggesting that the shareability of code is not seen as antithetical to business and entrepreneurial logic.

The renegotiation of traditional business culture assumptions that often goes under the name of "open innovation"—however hyped and vague that notion may be—is central to the kind of economy associated with the IT industry (Chesbrough 2005). Because of historical contingencies, however, the emergent Russian IT community engages that "renegotiation" from a distinctly different direction. The question is not how to modify the assumptions of a liberal economy and its understanding of how, as Yochai Benkler (2006) has argued, wealth can be produced by networks, but rather to articulate new notions and practices of collective endeavor that bypass the hierarchical and top-down modus operandi of the Marxist Leninist tradition.

A team at the European University at Saint Petersburg (EUSP) has studied at length the organizational forms mobilized by different groups of contemporary Russian technology entrepreneurs (not limited to IT), and the ways they narrativize their goals and values to themselves and others (Gladarev et al. 2013).[21] One of the project's key findings matched the observation shared by many historians of Russian science and technology;[22] namely, that Russian engineers claim to be "taken by their creation" and are driven by the "love of their work-in-progress (*razrabotka*)" (Kharkhordin
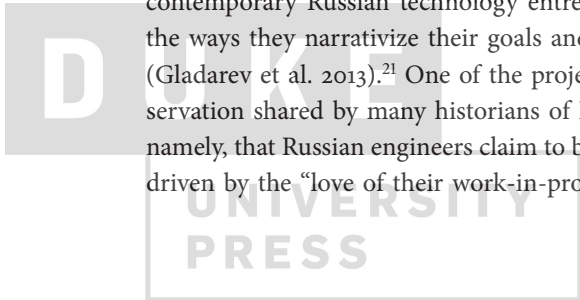
2014, 36). Interestingly, this is not a feeling they found expressed in their interviews of tech entrepreneurs from Finland, South Korea, and Taiwan (Kharkhordin 2014, 27–35). Russian tech entrepreneurs (like the earlier Russian scientists and engineers studied by historians) claimed that both the technical work of innovation and the building of a tech startup are labors of love and dedication, quasi-spiritual calls toward the articulation of the new and still embryonic technological system or device.

The emphasis and value, however, is placed on the working prototype or on the launching of a company rather than on the allegedly less creative labor of bringing the product to market, or growing one's company. Or, to reuse the parental metaphors deployed by several interviewees, their narratives emphasize the "delivery" of their children—the "prototypes"—rather than their growing up into mature products or technologies. As "Olga," an academic chemist and entrepreneur, put it:

> [As for] all those people who really swarm into business, especially the high-tech business, you really need to be crazy to decide on doing it. Often, I think, they are driven more by, say, a love of their work-in-progress. . . . So when they start working on something, at first they are driven, naturally, by all kinds of scientific [impulses]—I want to try this, I want to do this. Then, when [they] have done it, [they wonder] what it would be like in manufactured form. And when someone suddenly asks what it would be like in manufactured form, they are stuck. Because then they also have to be involved in commercialization. (Kharkhordin 2014, 37)

The phase between the prototype and the successfully marketed product is where things often come to a halt for aspiring Russian entrepreneurs. Unlike those in business cultures where product development traverses a path that goes all the way to the market phase with considerations of pricing and distribution, Russian technological entrepreneurs tend to insulate their ideas from such business imperatives. The result of this general posture is a long series of failures, from the nineteenth century onward, which Loren Graham compiles in a depressingly long list that would make any venture capitalist think thrice before investing money in Russia (Graham 2013).

Olga's narrative, however, shows an interesting new spin on the "love-for-the-prototype" model. For her, commercialization is part of the same "work-in-progress aesthetics" that motivated her creative work to begin with: "I was more involved in [the] realm of innovation, but I did not give chemistry up . . . perhaps they are now on an equal footing. . . . That is, I both work on my own work-in-progress—I have a research group and various grad

students—and there is the commercial part, where as an entrepreneur, I manage this work-in-progress myself and put science into practice. I realize no one else but me is as keen on implementing it" (Kharkhordin 2014, 37).

The many interviews collected by the EUSP team show that today's Russian tech entrepreneurs still represent themselves as different from (and superior to) "normal" business people in that they are not motivated by money but by the "love of the work in progress"—something that has been desired rather than needed, and whose completion is not as compelling as its conception. Of course money is not at all disparaged, and in fact some "fully liberalized" entrepreneurs present money making as their prime incentive. However, other techno-entrepreneurs, perhaps those more connected to their Soviet backgrounds, present money not just as revenue but as a "symbolic reward": "An IPO is when shares are put up for sale. My desire is to get a high valuation from someone for every share. . . . The goal is not to sell . . . [but] more to achieve a certain recognition, that yes, B****'s shares are worth so much today. . . . For a businessman, an IPO is this pure *selfeksperiens* [self-experience]" (Kharkhordin 2014, 10). It is not difficult to see in these narratives the reflection of Soviet notions of personhood and work as separate from individual economic success—traditional notions that are now being merged (largely through the translations of Anglophone business studies literature) with bourgeois concepts of self-realization through creative work (Kharkhordin 2014, 23).

Western liberals or neoliberals may argue that this element of the Soviet heritage—the dismissal or de-emphasizing of monetary incentives—is an obstacle on the path to entrepreneurial culture and should thus be dispensed with, the sooner the better. But if we go back to Olga's remarks we see that there is something else, something more striking than just the emphasis on the "creative purity" of the tech entrepreneur (as opposed to the tech businessperson). Like many of the other Russian interviewees, Olga expresses a clearly individualistic view of innovation—"No one else but me is keen to . . ." This does not seem identical to the "rugged individualism" of Western entrepreneurs, but more like an emphasis on the agency of the individual as distinct from or even opposed to the collectivism of the Soviet period. It may be an extension of her ethos as a scientist who, even in the USSR, cultivated a notion of the individual through creative work (though that work was done in the interest of the collective).

We believe, then, that the much-documented entrepreneurial failures of Russian scientists and engineers throughout history may not be the tragic outcome of the technological creators' absolute commitment to the integrity of

their creations, taking them to their grave to make them die pure rather than grow corrupted. In our view this attachment to an uncompromising model of invention may not stem from a chimeric infatuation with purity, but rather signal a mundane lack of trust in collective modes of organization—the kind of collaborative activities necessary to turn an invention into an innovation. Unlike the operations of the inventor's mind, bringing an invention to market requires a collaborative and adaptable ethos able to encompass the love for the inventive process, the love for profit, and the ability to engage and sustain collaborations involving both openness and the production of commercial value.

This was not something that was cultivated in the USSR, when both science and technology were predominantly managed by the state in a centralized fashion, premised on a scientific division of labor and a hierarchical mode of operations. The Soviet system did embody a collective mode of action, but not one of collaboration, at least of the kind that seems to animate the so-called knowledge economy. But even if not flexible enough to foster innovation, it was nonetheless a collective mode of action, and its collapse (coupled with the generally negative feelings that Russians had left for this particular model or experience) seemed to make the very idea of a collective mode of action unpalatable to the post-Soviet generation.

Studying the RCS communities, both in Russia and abroad, has thus allowed us to analyze the processes (and the remarkable challenges) through which a new entrepreneurial culture emerges—not just a technology or "commercial mentality" but the entire skill set required to work with others by developing grassroots norms of both trust and accountability. Comparing RCS operating in Russia with those who migrate abroad or collaborate with foreign colleagues provides additional evidence on the role that the possibility of geographic mobility plays on their decision to bridge science and collective enterprises, and how and where that tends to happen.

TOPICAL CLUSTERS

The volume includes thirteen chapters grouped into four sections: "Coding Collectives"; "Outward-Looking Enclaves"; "Russian Maps"; and "Bridges and Mismatches."

"Coding Collectives" focuses on the relation one finds in today's Russia between certain kinds of coding and certain kinds of professional and political identities, as new social formations are coming into being through a shared concern with the development of computer languages, software,

and apps. The relation between code and identity (in this case disciplinary identity) goes all the way back to the establishment of Soviet computer science and its differentiation from both mathematics and cybernetics, but identity issues take very different forms among contemporary Russian civic hackers (for whom code is both a means and a form of politics), as well as among the employees of Yandex, for whom reading and writing code functions as a rite of initiation into the professional culture and coding style of that corporation.

Scholars of computer codes, especially Friedrich Kittler (2008, 40–47), have long pointed to their duality. Computer codes are written in languages that need to be executed by machines, thus leaving no space for semantic ambiguities. At the same time, and for the same reason, there is a specific sociality to code in the sense that it sets specific conditions of possibility for the ways in which people can collaborate with and through it. Programs instructing a computer to perform a certain task may be written in a wide variety of languages, with different individual coding styles. But this remarkable diversity does not imply semantic ambiguity. Any language that is compilable and executable by a computer needs to be ambiguity free, which also means that those humans who collaborate and create new publics through codes and coding are facilitated in doing so by the fact that their codes are unambiguous not only to the computer but to their human partners too. The formal linguistic nonambiguity of code offers a political vector of community formation by providing a platform for collaboration among humans from different places and cultures, and with different values. Of course, ambiguities and negotiations do not disappear but are rather relocated from the site of coding to other moments of the collaboration, like discussions about its design, goal, structure, maintenance, membership, etc. But the nimbleness and collaboration-enabling features of code were not always there.

Just a few decades ago computer science was associated with large vertically managed facilities, with strict access rules, that could be found only in a few countries in the world. In chapter 1, Ksenia Tatarchenko recounts the Soviet history of that trajectory, looking at Andrey Ershov's commitment to fashion computer science as a discipline with an open and collaborative ethos that was rather unusual during the Cold War, possibly foreshadowing later associations between code-based practices, collaboration, and emergent communities and publics. Contrary to today's popular image of Russian programmers as the heirs to the Soviet Union's KGB, Ershov worked hard to promote a distinctly Soviet version of computers, languages, and their programmers that were meant to function as the new pillars of a peaceful
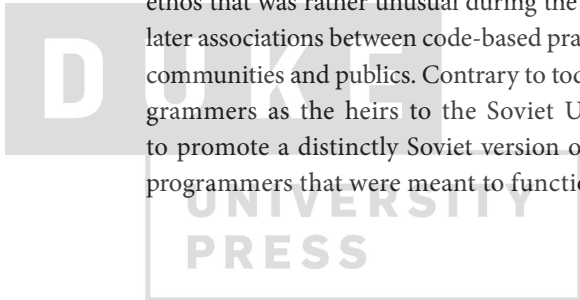
civilization uniting the East and the West. Such porous geopolitics are now resurfacing in many new experimental coding practices, like the hackathons that Ksenia Ermoshina discusses in this volume.

Ermoshina's chapter on contemporary Russian hacktivists offers a window on the sharp tension between the libertarian values of the Silicon Valley ethos and long-held principles of communal help that hark back to an idealized Soviet past. Codes and protocols of information gathering, formatting, and sharing have become central to the conversation animating these emergent collectives, providing not just a means but a form for the new modes of political participation they are developing. Codes also enable quick and efficient collaborations by allowing partners to come together around nothing more than a computer screen—a strikingly minimalist scenario compared to the facilities-intensive collaborations one finds in contemporary physics or biology.

In the age of laptops and tablets, the new Russian excellence in coding is no longer tied to large infrastructures or to the strict organizational and planned structure of Soviet science. But the natural experiment that we describe in these chapters goes beyond the immediate effects of this new looser format of practice. The commerce of codes and coders has created economic value that did not and could not exist in the Soviet system, when intangible goods were not recognized sources of national wealth. In her chapter, Marina Fedorova looks at Yandex—the darling of Russian IT companies—and the role of its source codes in the socialization of its employees. Unlike the old Soviet rules and disciplinary practices that charted the coming into being of good communist subjects, the new code is designed not only to instruct machines but also to foster communication between employees—a kind of communication that has disciplining effects but not preset ones. Also, familiarity with code gives employees skills that, far from being exclusively of local use, become assets that are readily fungible in the labor market. Reading and writing a company's code fashions one into a corporate subject, but also makes one easily and quickly movable beyond that company and its geographical location. Computing codes thus have two intriguing features: they are said to be computationally universal (when they can simulate any Turing machine), but such mechanico-algorithmic universality immediately translates into commercial universality. They are inherently mobile in the conceptual, technical, and commercial sense of the term, and for the same reason. Taken together, the chapters of "Coding Collectives" show some of the different ways in which this duality of code plays out in specific Soviet and post-Soviet Russian situations.

"Outward-Looking Enclaves" considers domestic professional IT enclaves that look abroad for business opportunities, modes of collaboration, or just lines of professional escape. These communities are also the direct heirs to the "science cities" that epitomized Soviet science (Josephson 1997).[23] Populated through massive post–World War II internal migrations like those that brought more than fifty thousand scientists and their families to Siberia's Akademgorodok or to smaller communities like Pushchino and Dubna, these cities were usually shielded from some of the hardships of the Soviet system and developed their own cultures as techno-scientific communes, at times transgressive of Soviet dogma (Tatarchenko 2013). Before the actual physical movement of scientists and young entrepreneurs away from Russia, some Soviet science and high-tech communities were already "moving" not only by relocating and concentrating in other parts of the country but also by developing outward-looking perspectives.

Since the collapse of the USSR, Akademgorodok has been dubbed the "Silicon Forest," due to the many IT startups that have emerged around and on the ashes of this former Soviet academic city (Wainwright 2016). These entrepreneurial developments have held on, albeit in mutated form, to their older ethos of autonomy and outward-looking perspectives, developing models that, as Andrey Indukaev argues in chapter 7, are significantly independent of the Russian state while also distinct from the forms of university-industry collaboration one finds in the US.

Aleksandra Simonova's analysis of Skolkovo—the large technopark recently built at the outskirts of Moscow in a collaboration between the Russian government and MIT—summons the image of the Soviet science city, though one that is not just outward looking but actually developed with foreigners to mimic as closely as possible emblematic high-tech sites like the Cambridge-Boston area or Silicon Valley. At the same time, both Skolkovo and the much smaller and more informal hackerspaces also discussed by Simonova are inward and outward looking at the same time. Skolkovo blends the traditional Soviet model of the science city with Western ecologies like Silicon Valley and its many global reproductions. Similarly, the Moscow hackerspaces borrow and exemplify a kind of collaborative space that has become emblematic of the global innovation scene. Still, despite their obvious outward orientation, their goals are distinctly inward: to create suitable environments for Russian IT innovators to occupy at home. They try to bring the West into Russia so that Russian innovators do not feel they have to leave for the West.

In Vladivostok, at Russia's eastern edge, the gaze of the IT community turned outward not as a byproduct of the Soviet government's centralized

planning of the military-scientific complex or of the more recent but equally centralized attempts by the Russian government to develop domestic Silicon Valleys. On the shores of the Pacific, looking outward came with the territory, from being at the periphery of the empire, much closer to China, Japan, Korea, and Pacific networks of exchange than to Moscow. As Aleksandra Masalskaya and Zinaida Vasilyeva show in chapter 4, the IT community there emerged from the computing needs of the local burgeoning Japanese car import business, to then grow into a broader Siberian network of practitioners for whom Moscow often remained effectively beyond the horizon. A different genealogy is found in a different periphery, around Kazan—the capital of the largely Muslim Republic of Tatarstan in the Russian Federation's southern Volga region. There, as Kontareva describes, a strong governmental investment in building a Western-style IT innovation ecology (involving technoparks, university incubators, etc.) is part of an attempt to "brand" the Republic of Tatarstan and its capital as an up-and-coming region, connected to Moscow but inspired by the West—a West that is not merely imitated but Russianized, mobilized as part of a branding narrative to turn Tatarstan into an emblem of the new "tech" Russia.

In other places, however, the West is no longer what it used to be, thus confusing in interesting ways what "inward-" and "outward-looking" may mean. Following the collapse of the Soviet Union and the exit of several former republics from the reconstituted Russian Federation, recently independent nations like Estonia have reinvented themselves as essentially Western, in opposition to Russia. Surprisingly, IT has become a crucial element of Estonia's re-invention as a nation, whose figurative birth date is pinned on a series of distributed denial-of-service (DDoS) attacks in 2007 by Russian hackers, who had blocked many of the country's servers, returning Estonians to pre-internet life. This episode was central to the articulation of the figure of the "new Estonia"—a small but strong new country that had to be defended from similar attacks by developing fine computing skills, starting with the code training of elementary school children. Unlike Tatarstan, which borrows Western images of digital innovation ecologies to brand itself as the epitome of the new Russia, Estonia relies on the menacing figure of Russian government hackers to brand itself as e-Estonia, which *Wired* has termed the "the most advanced digital society in the world."[24] In doing so, however, it relies on the skills and pedagogical tradition left behind by the Soviet computer scientists.

The short interlude "Russian Maps" marks the book's transition from domestic post-Soviet scenarios to properly diasporic ones, offering a com-

prehensive map of the Russian IT industry, its short history and markets, its major players, and its place in the context of the general Russian industrial and policy landscape. Because the previous sections have aimed at specific questions and regions, they have, as a whole, tended to describe some trees or important branches, but not necessarily the forest. Dmitrii Zhikharevich's interlude operates on a different scale, providing a grid on which the previous chapters can be placed, enabling the visibility of their possible mutual connections, as well as those with other areas of the Russian IT territory.

After surveying the ongoing policy debates and initiatives to wean Russia from its dependence on extractive industries (and the perception of IT as a viable alternative or strong complement to oil and gas), Zhikharevich maps the clustering of Russian computer scientists' activities around a few major centers in the Russian Federation. Presenting both the natural economic impulse for the concentration of IT activities in the Moscow area and recent efforts to create centers of academic excellence and technoparks in various more "provincial" cities, he addresses the main strengths, weaknesses, and paradoxes of today's Russian IT industry.

The book's final section is entitled "Bridges and Mismatches." It documents how the Anglo-Saxon way of life and work is central among the models animating the conversations of Russian computer scientists and software practitioners. It can be invoked in different ways, for different purposes. It can be a foil to belittle the US techno-scientific education compared to the pedagogical excellence that Russia claims to have inherited from the Soviet system; but it can also be mobilized in the opposite direction, to point to limitations in the Russian innovation ecosystem, like its relative lack of support for prospective entrepreneurs, its lax attitude toward intellectual property, or the general absence of trust among young professionals that often forces emergent Russian entrepreneurs to pick their business partners from among close friends or people they already know. The aspiration to identify oneself as American or British (or at least aligned with those lifestyles and business cultures that, while virtually global, are effectively Anglophone) is thus not necessarily the manifestation of frustrations about being Russian but rather about trying to operate in today's Russia.

There are few venues through which people can learn how to perform the roles they aspire to except by connecting to the English-based professional communications networks of IT and computer scientists, or by doing contract work for foreign companies offshoring to Russia, which is often a training in the "ways of the West." There, RCs pick up the concepts and tricks of the trade, learning to walk the walk and talk the talk. These newly acquired

skills may be deployed at home, to develop new entrepreneurial trajectories that draw from Western models, but they can also function as "professional passports" for those who wish to move abroad.

Compared to the few migration options that occasionally opened up during the Soviet period (which were ethnicity-based, complicated, costly, and possibly dangerous), the path of today's Russian high-skill brain drain may appear to be as easy as crossing a bridge. But there are very many different bridges, depending on the specific professional niche, country, lifestyle expectations, and political inclinations of the émigrés, and on the time of the crossing. And there are also surprises about what one may find at the other end of those bridges. Rather than producing case studies of scenarios that are often covered in the popular media—young, smart, and aggressive Russian hackers flying straight to Silicon Valley or Seattle to join Google or Microsoft, or to London or Berlin to work for Goldman Sachs or Deutsche Bank—this section looks at more complicated, and not necessarily more successful, scenarios, places where the émigrés' "Anglo-Saxon dreams" may not fully match what they find at the other end of the bridge, or where the brain drain, far from being near instantaneous as the image suggests, is a long and complicated affair, as in Irina Antoschyuk's window on the various stages of migration of RCS to British academia in chapter 10.

Differences in professional and institutional culture do not seem to be particularly salient in that specific kind of migration—the journals are the same and, good or bad, a department is a department. What makes a significant difference in the migration process and its aftermath is, instead, the timeline and steps of the migration decision, which typically spreads over a few years, growing through conferences, visits, and short-term fellowships. The specific steps, and their timing, change the conditions under which the move takes (or does not take) place, as well as the émigré's ability to move alone, with a team, or with the possibility to function as a bridgehead for subsequent brain drain waves. More than travel, migration looks like alliance making, both in the UK and back in Russia.

And then there are cases where, because of the time and circumstances of the migration, the "Anglo-Saxon dream" was not part of the equation. Its absence, however, was consequential nevertheless. In chapter 11, Diana Kurkovsky West looks at predominantly Jewish IT practitioners who migrated to Boston during the Soviet period and, while having many of the same technical skills as more recent Russian emigrants, were not familiar with, and thus did not embrace, the Anglo-Saxon vision of the daring high-tech entrepreneur. Uncomfortable with or unskilled in the entrepreneurial

and managerial culture they encountered in Boston, they opted for "upper-middle tech" jobs. These careers led to upper-middle-class status and life-style, but not to startup entrepreneurial glory. This earlier population may have had research-grade skills, and in fact often obtained positions in corporate labs, but did not associate startup culture with the "good life," either materially or morally.

In chapter 12, Marina Fedorova analyzes another mismatch involving Russian immigrants' and native Israelis' cultural and professional values. Like the native Israelis, the immigrants prize education, but, reflecting Russian cultural values and expectations, they identify education almost exclusively with university training. Israeli-born teenagers, instead, understand the key role that military tech training plays in the career of future IT engineers, as well as its function as a networking site from which many startups emerge. One of the more manageable migration trajectories for Soviet Jews from the 1970s onward, Israel has paradoxically not been a destination where their technical skills and training have shone, as has instead been the case in virtually all other countries.

After having spanned several countries and continents, the volume comes to an end by almost coming back "home" to look at the shortest and most accessible brain drain path—that between Russia and Finland. But while geographically diminutive, this distance captures specific cultural and political choices. In the final chapter, Lyubava Shatokhina shows that here too migration choices are guided by views of the Anglo-Saxon way of life and work, and how the prospective émigré values them. For instance, a key factor that Russian software specialists consider in relocating to Finland is the appealing combination of professional autonomy and the country's socially liberal context. Autonomy means that scientists and engineers can pursue their work away from the intense pace they associate (based on evidence or imagined scenarios) with Silicon Valley and its privileging of competition over a commitment to the welfare state. What they identify as the desirable social context of their activities is described in terms that resonate with the ideals of Northern European social democracy, as opposed to the cut-throat competition typical both of the Anglo-Saxon models and of the wild "everything-goes" Russia of the 1990s. The ideals of professional and social life espoused by these immigrants are not far removed from those of Soviet society, and the Finnish lifestyle and political culture allow them to feel that they live in a place where at least some of the old Soviet commitment to the collective and to the respect of one's work is preserved, while being articulated in a much more appealing democratic framework.

1. Partial English translations of Marinichev's speech and critical responses are reproduced in Fitzpatrick 2015a and 2015b.

2. Among the vast literature about high-tech and academic migrations and mobility, see Agrawal 2006; Azoulay, Zivin, and Wang 2010; Breschi and Lissoni 2009; Kuznetsov 2006; and Saxenian 1999.

3. The questionnaire used for the interviews was designed to help understand the practice of computer science or information technology in the context of the migration strategies of our informants. One of the questions that we pursued looked at the exchanges between Russians who moved abroad and those who stayed in the Federation. Several of these interviews were transcribed, and some were translated into English. They are accessible at Rcs.eu.spb.ru, after registration.

4. This is effectively identical to what Loren Graham (1994, 127) has called the "blackboard principle," that is, that a discipline that could be effectively pursued with just a blackboard and a piece of chalk could thrive in the Soviet Union. The important difference, however, is that in the case of software, the "blackboard rule" applies to any country, not just the former USSR or modern Russia. For a contrasting account stressing the peculiar "Sovietness" of applied math, see Dalmedico 2004.

5. These policies were not always in place. For example, in the immediate aftermath of the collapse of the USSR the Russian government was unable to provide research funding (or even salaries) within the system that connected techno-scientific research to the military, causing much of the better part of the scientific community to depart for greener pastures (see Gokhberg and Nekipelova 2001).

6. Years later, after the business relation had developed and grown strong, Khotin realized that, in comparable circumstances, he should have received some equity in the Finnish business he had helped to develop rather than simply being paid as a contractor, but "I did not understand that I needed to ask. This is my Russian mentality. I have learned now that you need to ask. But at that time I would look for them to offer and if they did not offer I would not ask. And of course why would they be crazy enough to offer me stock for which I had never asked?" (Khotin, interviewed in Cook Report 2009, 11).

7. Kharkhordin 2014, 21; citing a 2011 interview with "Timur," a techno-entrepreneur from Tatarstan: "I studied, read a lot, and listened to lots of audiobooks."

8. Similarly, Russian businesses that have become successful doing offshore software development for foreign clients have often done so by "becoming local onshore," that is, by hiring local professionals (say, in the US) to inform and align the Russian company with local business practices and legal arrangements (Feakins 2009).

9. There are still only a few business schools in Russia and it is unclear whether a formal training toward an MBA—a degree predicated on the assumption that

graduates will go to work in business contexts that are comparable to those modeled by the curriculum—is needed, or even useful, given the fluidity and emergent quality of Russian business scenarios post-1991.

10. Unlike other countries that have recently emerged as software powerhouses (e.g., India, Ireland, Israel, and China), Russians had very low English proficiency.

11. "But I also came to understand that I needed to establish Arcadia on a proper professional level. I was getting useful feedback . . . from a guy named Ted McMahon from Boston University. Ted came to Russia to teach English and I was using him to teach my programmers English. I hired him to teach me how to write better business letters in English and I took him with me once on a trip to Helsinki to help in my negotiations" (Cook Report 2009, 11).

12. This is a large, if poorly quantified, population. Many Russian software developers work in-house for Russian companies, writing the software products needed by their employers. Because of a combination of low wages and the specificity of Russian legal, business, and accounting practices (and their frequent changes), it is often both cheaper and better to develop one's own software than to purchase off-the-shelf products from European and US software providers (Peterson 2005).

13. For later developments, see Soldatov and Borogan 2015.

14. On the global spread of the software industry, see Aneesh 2006; Arora and Gambardella 2005; Biao 2006; McFarlan, Jia, and Wong 2012; Popkin and Iyengar 2007; Takhteyev 2012.

15. Aleksey Andreyev, chief editor of Webplanet.ru; quoted in RT 2016.

16. The contrast between hopes and realities can be easily grasped by comparing SPIEF 2012 with Appell 2015. See also Balzer 2016.

17. A succinct but comprehensive institutional map of USSR science and technology is in Berry 1988.

18. Russoft (http://russoft.org/), originally named "FortRoss," after a nineteenth-century Russian settlement in Northern California.

19. On the last Soviet generation (or the first generation of Russian entrepreneurs) and how their entrepreneurial skills started to develop during the late 1980s, see Yurchak 2002.

20. On the distrust of collective action in post-1991 Russia, see also Howard 2003.

21. Additional material can be found at https://eu.spb.ru/sts/projects/item/4417 -technological-entrepreneurship. The detailed results of this project are in Bychkova, forthcoming.

22. The most recent statement of this position is Graham 2013.

23. In parallel to the science cities, the Soviets also developed closed cities where techno-scientific work was done, mostly for military application, in secrecy, or at least isolation (Brown 2013).

24. https://e-estonia.com/.

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