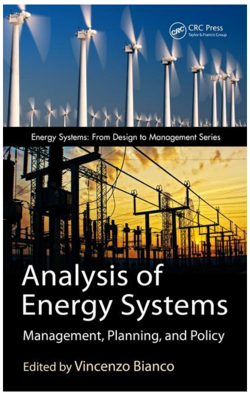

Analysis of Energy Systems
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Vincenzo Bianco

Energy Innovation Policy: Fostering Energy Service Companies

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Andrey Kovalev, Liliana Proskuryakova
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Energy Innovation Policy: Fostering Energy Service Companies

Andrey Kovalev and Liliana Proskuryakova

CONTENTS

3.1 Introduction 49
3.2 Research on Energy Service 50
3.3 Role of Oilfield Service Companies in Russia 52
3.4 Discussion 65
3.5 Conclusion 67
Acknowledgment 68
References 68

3.1 Introduction

There is a double interplay of the innovation potential of a company, its business model, and the structure of the market that is rarely caught in researchers' focus. This interrelation is of importance to companies working in various segments of the energy sector. In this chapter, we review multiple activities launched by the Russian authorities to foster innovation in technological sectors of the Russian economy. The activities centered on mergers and acquisitions are a major part of this framework in both public and private organizations.

This chapter shows that mergers and acquisitions per se have little influence on the organization's innovation potential. At the same time, a proper strategy based on the clear-cut competitive advantage and the related specialization is a more productive path to foster innovation in an energy company. Such a specialization may be later followed by a series of mergers and acquisitions. However, if the initial step was ignored or neglected, the subsequent mergers cannot trigger corporate innovation. This thesis is illustrated with three cases (Eurasia Drilling Company or EDC, TGT, and Rosgeologiya) described in the following text.

3.2 Research on Energy Service

Energy service companies (ESCos), including those operating in the energy sector, are known for increasing competitiveness (Hirst and Brown, 1990), productivity (Worrell et al., 2003), and innovation activity of their clients. They are also known for offering green, environment-friendly solutions (Dangelico and Pontrandolfo, 2013). However, smooth advancement of products and service provided by ESCos to the market is hampered by a number of barriers (Hirst and Brown, 1990; Jaffe and Stavins, 1994), including market imperfections and asymmetries, excessive transaction costs and institutional factors, as well as underdeveloped markets (Bertoldi et al., 2006; Painuly et al., 2003; Vine, 2005). Certain barriers are more common to developing countries and include institutional barriers, poor energy pricing policies, high transaction costs (Painuly et al., 2003), limited access to capital, and poor management of ESCos (Akman et al., 2013).

Analysis of ESCos and their business models is in the focus of several recently published studies (e.g., Mahapatra et al., 2013; Pätäri and Sinkkonen, 2014), in particular devoted to increasing energy efficiency of residence buildings (Hannon et al., 2013; Lombardi et al., 2016), residential heating (Suhonen and Okkonen, 2013), and the benefits of ESCos for deployment of renewable-based power and heat generation (Borge-Diez et al., 2015; Bustos et al., 2016). Some studies even go as far as analyzing the role of ESCos in advancing the capacity of local energy systems to address social needs (Hannon and Bolton, 2015). Kindström and Ottosson (2016) identified the requirements and barriers for the successful development of local and regional energy service companies. Based on a survey of a few companies, researchers identified essential business model elements. Among the success factors are early support from top managers or incremental approach to the service portfolio, clear targeting of existing customer base, and internally balancing two business models.

Oilfield service companies are not precisely ESCos in the traditional sense of this term. But there is a certain parallel between them, energy service companies provide energy technology and energy-efficient services to general profile companies whose activities related with energy technology, while oilfield service providers are outsourced a number of necessary exploration and production activities being an inherent part of the petroleum sector value added chain. Petroleum companies widely use oilfield services such as geological exploration, enhanced oil recovery, well intervention, and repair. It is interesting to analyze the activity of oilfield service providers as ESCos offering services to the oilfield operator as the owner of the rights. This view helps examine the role of the market structure in shaping the incentives for the petroleum industry to develop cost-efficient and environment-friendly technology and business processes.

Market structure is rarely considered to be one of the key factors determining the effectiveness of each segment of the energy sector and the scale of externalities created by those segments. Some research in this field is available (Azomahou et al., 2008; Lutzenhiser et al., 2001), but it does not concern the Russian petroleum industry that has a number of important distinguishing features such as the "high level of monopolization in domestic energy markets, lack of competition and prohibitively high entry barriers for any link in the value chain" (Proskuryakova and Filippov, 2015: 2800). Therefore, the Russian energy sector can be an illustrative example of the interlink between the structure of a market and its effectiveness.

Formulating precise quantitative criteria for measuring this interlink is a difficult task because of its complexity and due to lack of transparency in the Russian energy sector. For example, Eurasia Drilling Company Limited, one of the largest Russian service companies, was delisted from the London Stock Exchange (Eurasia Drilling Company Ltd., 2015a), and this limits the publicly available information about the company. At the level of smaller energy service companies, lack of transparency is an even more noticeable problem.

Yet the structure of the Russian market points to the differences of the country-specific trends and those in many developed countries. In countries that adhere to sustainable practices, it has become a rule of thumb that areas where competition without negative externalities is possible should be separated from those areas where the operation of a monopoly is natural and reasonable from the economic point of view. In the Russian energy sector, it has become a standard practice to merge organizations or business entities under various types of state control to achieve economy of scope or economy of scale effect.

The ability to shape the structure that maximizes the wealth and matches restrictions on externalities is probably the key element of a consistent economic policy (Li and Yu, 2016). In energy sector and energy markets, understanding and modifying the market structure have an impact on firms' productivity, which is bound to a specific technology (Dai and Cheng, 2016). In some cases, the general principles of economic theories may not coincide with the technological architecture of the engineering systems. Third Party Access (TPA) to district heating water networks (Soderholm and Warell, 2011) is an example of a dilemma where general economic considerations may contradict a specific technology under consideration, and this complicates the theoretical analysis of this problem. Such dilemmas are aggravated by the fact that cross-case comparisons are not always possible. In the given example different heating utility systems work in different conditions, and isolating only one factor of efficiency is a tricky way to compare TPA and non-TPA systems.

It is presumed that small energy service companies face fundamentally different incentives depending on the structure of the markets and the structure of the adjacent markets (petroleum exploration for the case of oilfield services and production, industrial goods, and residential sector for the performance contractors). The energy sector covers only a part of activities related to energy transportation, conversion, and consumption. Negative environmental externalities resulting from these processes depend on organizations having no competence in energy technology and often attributing low priority to energy efficiency and conservation (Fais et al., 2016). Energy service companies are expected to bring professionalism, efficiency, and rigor to the field where energy efficiency would have been paid much less attention otherwise.

3.3 Role of Oilfield Service Companies in Russia

Since 2015, Russian oil and gas industry has been facing several major challenges. Drop of fossil fuel prices, oversupply and increasing competition at the market, gradual depletion of traditional major Russian oilfields, and economic and financial sanctions.

In 2015, the key problems pointed out by the oil and gas companies CEOs and specialists were limited access to capital, lack of qualified specialists, corruption and legislative inconsistencies, and rising costs of field development. According to the survey conducted by Deloitte (2016), among the response measures that companies introduce, the most prominent are effective management of asset portfolios (100% of respondents), attracting partners (38%), increasing management efficiency (38%), and introduction of technological and other innovations (38%). This survey covered energy companies working in extraction and refinery (54%), services (31%), and pure extraction (15%).

On average, 10.9% of Russian manufacturing and service companies in 2013 and 2014 performed innovation activities and companies involved in fossil fuel extraction have slightly lower values—8.6% and 8.5%, correspondingly (Gokhberg et al., 2016). Of all innovations introduced by fossil fuels extraction companies, the majority were of technological nature.

The response of the Russian petroleum companies was to lower research and development and other investments and to increase production. Indeed, in 2015 Russian petroleum companies produced about 10.7 mln barrels per day in average, a historic record since the times of the Soviet Union.

This growth is troubled by several persistent issues. For instance, monopolies are not suited for flexible development of small oilfields benefit from the outdated licensing in Russian petroleum industry while lagging behind leading international petroleum companies in efficiency benchmarks. Low oil recovery factor has been particularly noticeable in the last years, limited to 20%–27% only in 2015, which is unacceptably low.

There are three main categories of oil service companies operating at the Russian market: international service giants, Russian in-house service providers, and independent Russian service companies. All three differ from energy performance contractors in several important aspects. Oilfield service companies work generally in the same area as their clients, and the division of labor between petroleum companies and oilfield service companies depends on the competition between the independent service contractors and in-house service centers.

Oil and gas industry is the most significant sector of the Russian economy. It accounts for the largest share of the Russian budget and the income of the Russian economy in general. Therefore, it is of interest to investigate the mechanisms, problems, barriers, and opportunity windows within this field. Twenty-five years ago, the Russian oil and gas industry inherited a giant but outdated and inefficient Soviet petroleum industry that required restructuring and modernization, which proved to be a long and painful process. The Russian oilfield services inherited many features from the petroleum industry and its history. Just as the petroleum industry in general, the oilfield service market in Russia is highly monopolized. For instance, in Russia's onshore drilling three service companies dominate the market: EDC (22.3%), SurgutNG (21%), and RN-Burenie (17%).

The landscape of Russian oilfield services depends on the state of the Russian oil and gas business in general. As major oil and gas producing provinces have long entered into their maturity stage, the production has decline. Infill drilling aimed to sustain the production on the depleted fields results in similarly declining production per meter drilled in Russia. The currently popular technology of hydraulic fracturing cannot change this trend.

One could expect a gradual shift of field service activities toward greenfield regions, but the glut in the international oil market and the price gulp of 2014 and 2015 slowed down this trend. Until 2014, oilfield service market analysts expected that after a decade of growth, when the Russian onshore market had risen from 10 to more than 20 million m drilled, the growth would slow down but continue. However, the situation in 2016 is much more uncertain. The oil market glut persists, the price did not return to the level of 2013 (as the Russian service companies were expecting), and the major Russian oil and gas companies have cut down their investment programs. Finally, given the federal budget constraints, there is a persistent risk that tax load on the petroleum industry will increase. These factors affect the expectations of the oilfield service companies.

The characteristics of drilling operations in Russia show that onshore well construction and workover was at the level of 15.5 bln in 2015 and was expected to grow to 27.6 bln by 2020. Drilling volumes in Russia are also expected to grow from 22.6 mln m in 2015 to 30.6 mln m in 2020. The average depth of wells in Russia has increased from 2410 to 3185 m over a decade (2005–2014) (Eurasia Drilling Company Ltd., 2015b). These figures testify to the increasing complexity of oilfield services and the advanced competences required from service companies. The aging Russian fleet of drilling rigs will have to be modernized. Therefore, drilling companies will have to attract considerable investments in the short run.

At the same time, the operational efficiency of the leading Russian oilfield service companies lags behind the world leaders. Even though it is growing and companies adopt the best international practices, there is still significant potential for improvement. It is difficult to compare trends across companies and regions as available information is fragmented and somewhat anecdotal. At the same time, gradual growth of indicators such as meters drilled per day illustrates the increasing productivity of oilfield operations.

At present, the Russian petroleum industry seems to be approaching another bifurcation point. Multiple forecasts indicate that oil production in Russia will decline in forthcoming decades. Given the oil price decrease and constant fluctuations, Russian oil and gas companies with inflated costs and mediocre managerial efficiency will have to reconsider the basic principles of their activity.

Another challenge that Russian oilfield service companies face is competition with international companies. International providers of oilfield services have access to or directly develop the most advanced exploration and production technologies that are extensively tested and fine-tuned in international projects all over the world. These companies are larger than their Russian peers and can suggest the full range of oilfield services so that the operator may deal with a single contractor. Their leadership leaves little chance for Russian services in the high-cost market niches. As a result, international oilfield service giants control two-thirds of the Russian market, mostly large-scale high-value projects, so that their Russian competitors have to content themselves with the rest. It comes as no surprise because the choice of service contractors has a considerable influence on the entire project through a number of factors such as the quality of drilling-time log or mud log. Extensive experience may be an exclusive advantage, and if large investments are at stake, the operator prefers to work with a well-known contractor having a long reference list.

Many Russian service companies choose to consolidate in order to lower management costs and gain access to a larger and more stable share of the market. To achieve this goal, consolidation should be followed by a major fundamental restructuring, a long, painful trial-and-error process. Companies have to learn to be efficient. Moreover, even companies with established client base, technological, and management background do not necessarily benefit from a merger. The story of the Halliburton and Baker Hughes deal interrupted in the spring of 2016 is an illustration of this thesis.

From time to time, lobbyists of the Russian service operators call on the authorities to restrict the international service dominance. Such attempts are counterproductive for several reasons. First of all, the unfavorable economic situation has already made client companies switch to low-cost contractors. Second, some Russian oilfield service providers have a “success story.” These stories (see, e.g., Zirax Nefteservice, 2016) demonstrate that viable technological start-ups can survive and develop in a hostile business environment with the limited independent up-to-date research and development (R&D) potential. Just as in many other industries, protectionist regulatory policy will conserve inefficiency and undermine the stimuli to develop new technologies instead of seeking the government's protection. Moreover, Russian policy-makers put forward the policy of import substitution, particularly in the energy sector. Even though it is usually declared that import substitution should only be aimed at a small number of critical technologies, various sectoral and industrial lobbyists exploit this leverage to gain access to subsidies, tax reductions, and other state support. In reality, it is impossible to develop (in some cases from scratch) oilfield services similar to international on a tight schedule. The most realistic option to foster Russian oilfield service businesses is to help them achieve the level at which they could cooperate with international companies. International oilfield service leaders may readily outsource and localize some operations if Russian companies prove themselves able to guarantee quality and cost of their services and products. International cooperation also allows Russian oilfield services to get access to the international market.

So far, however, the share of Russian oilfield services had steadily declined. Now that the low oil price period seems to remain at least in the midterm, some small independent Russian oilfield services started to hover on the brink of bankruptcy. There might be several reasons why the glut hit them so hard. First, it is natural that petroleum companies decreased their investments in exploration and production, and the service market has shrunk. Then, there is a specifically Russian problem of monopolization: in-house service centers, subsidiaries, or departments of large energy companies are directly managed or supported by their parent companies of the three mentioned categories (international service giants, Russian in-house service providers, and independent Russian service companies). The small independent ones have the least bargaining power and they are the first to lose the market.

It is hard to predict the dynamics of Russian oilfield service market because of the fluctuating international oil market and unclear Russian economic situation. However, there are some indicative discrepancies. In the absence of comparable replacements of the depleted old deposits, the only way to sustain the overall production level is to intensify the production on the existing sites preferably using cheap and well-established technologies such as infill drilling in combination with different kinds of flooding (such as CO_2 flooding). According to the Russian Energy Minister, sustaining the total production requires increasing infill drilling by 5%–7% annually, given declining production per meter of a well drilled (Tretiyakov, 2014). Moreover, given the quality and average age of the Russian drilling rigs fleet, even maintaining the level of production requires significant investments.

The available data indicate that the market is shrinking. Before the glut, the volume of the Russian oilfield service market had risen to $20–$25 bln. Russian oilfield service market accounted for RUB 700 bln in 2013–2014

($22 bln). The subsequent devaluation of the Russian currency did not change its ruble volume but sharply cut the volume in U.S. dollars. It became a problem for the clients of international oilfield service providers, while petroleum companies could benefit from the ruble devaluation and only enjoyed 11% in ruble revenues (Deloitte, 2015). In 2015 it shrank by 10%, and in 2016 one can expect a further decline.

In the long run, the international oilfield service market is expected to grow because hydrocarbon motor fuels will be consumed in comparable quantities, but simply structured deposits will be largely depleted. Thus, oilfield services will generally become more and more in demand. In Russia, on the contrary, a reversal of the described market trends seems highly unlikely in the short run and, therefore, oilfield services may become a bottleneck hindering the development of the Russian petroleum industry. On the other hand, it is highly likely that the crisis will cause restructuring of the Russian oilfield service market. Generally, one can expect weakening the positions of small independent oilfield service providers, whose market share will be taken by the in-house service providers. The Russian petroleum giants will try to acquire international oilfield service assets, the takeover of which started approximately a year ago with Rosneft acquiring Weatherford subsidiaries. The number of such takeovers will be rather limited because of exhausted financial resources of the Russian petroleum companies.

The problem of externalities is another substantial difference between energy performance contractors and oilfield service companies. The former generally increase energy efficiency and promote energy saving, while the latter only intensify extraction of hydrocarbons that are later processed and used with certain degree of efficiency. In some cases, extraction may become more energy efficient. For example, a steam for SAGD (steam-assisted gravity drainage) (Banerjee, 2012) may be produced using a heat recovery steam generator of a local combined heat and power source. But generally speaking, extraction of hydrocarbons affects the environment. Thus, while energy service is aimed at developing energy conversion and transport processes that generally benefits the environment, oilfield operations may be performed more effectively, but it does not necessarily make them less harmful. This interference has been acknowledged in research (Reis, 1996).

Case 3.1 Eurasia Drilling Company

Being the largest Russian drilling company (in terms of the meters drilled as a measure of the market share), Eurasia Drilling Company Limited (EDC) can serve as an illustration of the entire Russian oilfield service market. The history of the company goes back to 1995 when the company Lukoil-Burenie (Lukoil-Drilling) was founded as the drilling subsidiary of Lukoil, one of the Russian petroleum majors.

As a business entity, EDC was established in 2002 by several Russian and foreign investors, and 2 years later, this company acquired the drilling subsidiary of Lukoil that had become a steadily operating oil-field service subsidiary with established management structure. The company name was changed to Burovaya Companya Eurasia (the Russian Eurasia Drilling Company). The sale of drilling subsidiaries was logical for Lukoil (in 2004 it represented the entire Lukoil's drilling fleet). The company de-invested from a noncore asset, which could make the market more competitive and cut the costs borne by Lukoil. Then, by concentrating on its core business Lukoil increased the efficiency of its operation. This move fits the modern business concept in which oilfield service and petroleum E&P projects are different areas and require different specializations and strategies. Management of daily engineering activity implies that an E&P project operator has to collect and integrate available information about the project, which is a highly innovative technological area including decision support models based on genetic programing, fuzzy logic and neuro-fuzzy models, multi-scenario intelligent optimization, and evolutionary algorithms (Pacheco and Vellasco, 2009). These processes represent a higher level of abstraction from concrete engineering processes in business models and data aggregation as compared with core E&P processes including specific engineering operations and specific models in reservoir simulation, processing data for seismic imaging systems, etc.

The traditional way of dealing with increasingly more complex technology is through a greater specialization* and deeper competence assisted by distribution of risks at every stage of a decision-making process by means of outsourcing operations to a specialized contractor.

Based on the prior development of Burovaya Companya Eurasia, the new management continued the expansion strategy: in the year following the acquisition, the company's share of the Russian drilling market grew to 17%. Two years after the acquisition, the company had roughly 20% of the drilling market and entered the offshore drilling niche. It should be mentioned that the company's offshore interests lie in the region of the Caspian Sea, a more or less traditional area for Russian petroleum companies. Thus, the offshore development did not include deepwater projects, which would have been overly challenging to the Russian petroleum industry.

In the following years, the company continued its merger and acquisition strategy and integrated other Lukoil's service subsidiaries (LUKOIL Shelf Ltd., LUKOIL Overseas Orient Ltd., two West Siberia subsidiaries of Lukoil holding 163 workover rigs, and other Lukoil services). In 2009, the company had more than one quarter of the Russian drilling market,

* The growth of service companies may be explained not by increasing specialization, but by the rise of national oil companies. National oil companies possess petroleum reserves but lack access to modern E&P Technologies and, therefore, have demand for oilfield service free from property rights. Oilfield service companies met this demand.

and the merger and acquisition activity continued. After the 2-year-long slump of 2008 and 2009 caused by the economic crisis, the growth continued: the company's share of the market neared one-third, while the total annual length drilled exceeded 6,000,000 m.

Given its close business relations with Lukoil, it was a challenge for the company to diversify its clients in order to avoid a large bargaining power of Lukoil as the major consumer of oilfield services provided by the company. In 2008, EDC started to work with Rosneft in Vankor field, which was followed by a deal with TNK-BP (in 2010) and GazpromNeft (in 2014). Despite its long-term efforts aimed at the diversification of the client pool, Lukoil still remains EDC's major client. In 2015, Lukoil accounted for 56% of the total length drilled by EDC, and a year earlier its share was close to two-thirds of the total length drilled. In fact, it is only recently that the diversification strategy has yielded noticeable results, as GazpromNeft's share has risen to one-third, and it has become EDC's second largest client. At the same time, Rosneft's share even decreased slightly, so the general trend is still mixed. As a result, a drop in drilling activity of Lukoil in 2015, as compared with 2014, still influenced the total length drilled of EDC, which also dropped by 13% (first half of 2015 to first half of 2014). Therefore, the diversification was a forced move and is far from being achieved.

There are several conclusions concerning the growth strategy of EDC. First, the oilfield service market in Russia has been stagnating recently, and given the present oil price trends it will likely stagnate in the near future or longer. There are also high chances that the oilfield market in Russia will shrink, and this decline will hit small oilfield companies in the first place. EDC's growth strategy will also likely be affected by the harsh market conditions.

At present, the potential for any further extension has been largely exhausted. Unlike many smaller companies, EDC has the capacity to increase its efficiency, including efficiency of engineering operations and management efficiency. One of the problems the company is facing is the age of the rig fleet: EDC accumulated a considerable amount of old rigs as a result of its acquisition strategy. The dip in the distribution at the range of middle-age rigs shows that only a few dozen rigs were added to the fleet during the "Lukoil period" of the company's history, which may be explained by the unfavorable market situation (Figure 3.1).

According to the corporate strategy, EDC has lately been paying considerable attention to the development of its offshore division specializing in shallow water drilling. Shallow water reserves account for about 15% of the world oil production. Their average CAPEX per barrel is equal to the CAPEX of expensive traditional onshore reserves, which presently makes these deposits more attractive than deepwater and especially tight oilfields. The cost of tight oil and deepwater projects is a strong incentive

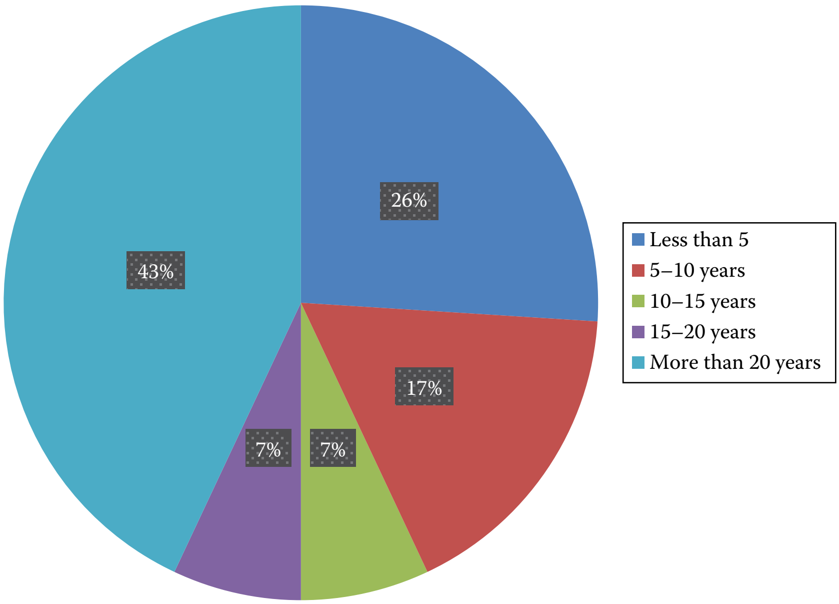

FIGURE 3.1
Age of EDC's rig fleet. (From Eurasia Drilling Company Ltd., EDC land drilling fleet, 2014, available at: http://www.eurasiadrilling.com/operations/rig-fleet/edc-land-drilling-fleet/, last accessed June 7, 2016.)

to intensify the development of technology that could potentially drive the cost down, but Russian companies have not been involved in deepwater projects, and extraction of nonconventional reserves in Russia has been of marginal importance so far. Thus, not only the corresponding technologies are an engineering challenge to Russian developers, but also the demand for such technologies in Russia is marginal. The decision of EDC to focus on shallow water drilling appears logical. On the other hand, maintaining production in old fields gradually becomes more expensive and Russian petroleum companies could benefit from a lower cost-per-barrel ratio that requires cost-efficient drilling technology, such as sidetrack drilling.

This goal may also be a challenge. The situation in Russian drilling is somewhat similar to the middle-income trap known in economics (Agénor and Canuto, 2015). In 2014, the three leading petroleum producers demonstrated the total global drilling volumes shown in Figure 3.2.

While the volumes are almost identical, the trends differ. Both the number of wells drilled and length drilled point to the same fact: the Saudi Arabia producers have access to easy-to-extract resources, for which the necessary amount of oilfield service per extracted barrel is low. The U.S.

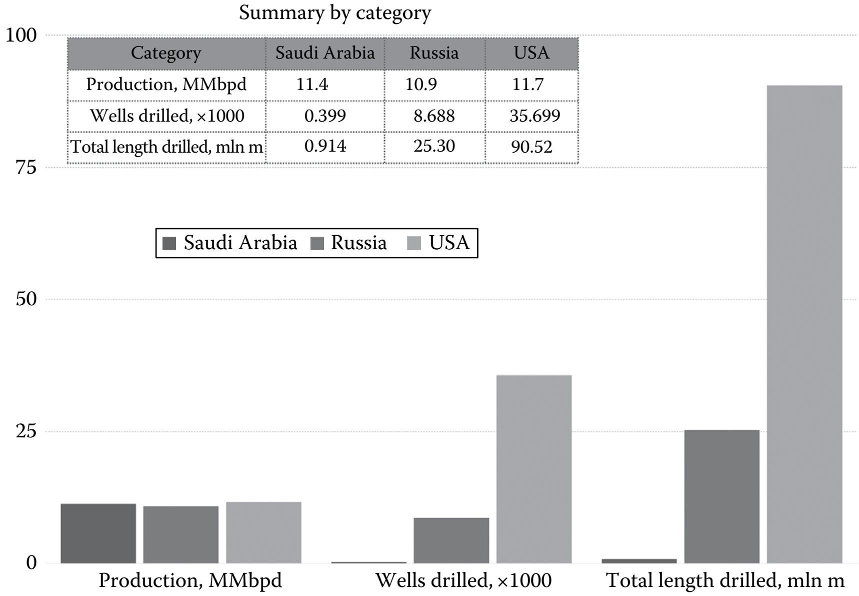

FIGURE 3.2
Drilling volumes that provided the market share of hydrocarbons in 2014 (the number of wells includes sidetracks). (From Kibsgaard, P., *Scotia Howard Weil 2015 Energy Conference*, New Orleans, LA, Schlumberger, March 23, 2015, available at: http://www.slb.com/news/presentations/2015/~/media/Files/news/presentations/2015/Kibsgaard_Scotia_Weil_03232015.ashx, last accessed June 7, 2016).

producers benefit from access to cost-efficient oilfield service operations that assure the same production volumes by means of a larger oilfield service use. The Russian petroleum industry has both disadvantages: it does not have reserves like in Saudi Arabia, and it has no access to equally cost-efficient local oilfield service industry.

Case 3.2 TGT Oilfield Services

Getting into the international oilfield service market is an important measure of success for any oilfield service company. The key is the ability to compete with experienced and cost-efficient international oilfield service companies and local contractors that have a better understanding of their own home market including experience in local supply chain and procurement management to the knowledge of typical local geological formations. A company needs a clear-cut competitive advantage based on managerial experience or technological efficiency giving a competitive edge over the local analogs to come into steady operation abroad.

This logic may not work for Russian technological start-ups. In the generally hostile Russian business environment, where start-ups have to break through multiple financial, administrative, and market barriers, establishing a totally new technological company working for foreign clients may be as difficult as establishing business relationships with residents. At the same time, a company can benefit from the devaluated national currency and lower HR costs.

TGT is an example of such a company. It offers services based on the proprietary logging solutions. The company was founded in 1998, and thus, unlike many other Russian oilfield services and petroleum companies, it did not inherit shabby assets of the Soviet petroleum industry. The company did not have to invest in the renovation or modernization of old equipment and instead can build its organizational structure and technological processes based on best available solutions. Afterward, having established business abroad, such start-ups may shift their focus back to the Russian market and leverage their operational practices based on the acquired understanding of both modern technology and Russian specifics.

The strategy of TGT (predetermined by its specialization) was successful for several reasons: its area did not involve considerable investments in industrial production and depended more on R&D-intensive analysis and computer modeling. This specialization could leverage the high qualification of R&D engineers in Kazan (the hometown) and avoid the problems related to industrial production and operation of heavy E&P machinery, such as drilling rigs. The logging-based business model of the company somewhat resembles a highly mobile IT business: it is not attached to capital-intensive infrastructure (pipelines and refineries) or equipment (rigs), and a significant part of its capitalization is associated with the accumulated engineering background and know-how of the staff. The fact that the company could relocate to United Arab Emirates (UAE) demonstrates this trait.

Having established the core logging service, the company continued R&D activity and presented advanced logging tools, such as high-precision temperature logging, and a number of adjacent services (leak detection, corrosion assessment, etc.); the company started to develop reservoir simulation tools relying on the validation methods based on the well data acquisition tools offered by the company earlier. It is the classical expansion strategy of a company leveraging its core competences to diversify its business.

Having once invested in research, IT infrastructure, and software design, the company does not have to bear those costs fully in the future (except for some maintenance and modernization expenditures): with fully functional software and trained personnel, the marginal cost of working out an additional hydrodynamic model is close to zero. This does not entirely protect the company from unpredictable fluctuations of the oilfield service market inflicted by the unstable trends in the oil business, but it creates a much safer business environment than the one faced by many drilling contractors of similar size in present Russia.

Despite seeming straightforwardness, mathematical modeling underlying numerical simulations of petroleum reservoirs is a complicated process that requires both hard and soft skills. The R&D team ought to have sufficient mathematical and computer qualifications necessary to work with mathematical models, but the set of equations itself is by no means special. It is the specific relevant properties of a reservoir (physical properties, initial and boundary conditions, etc.) that make a model unique. The quality of a computer model, automatic control system, or database resulting from the mathematical model depend a lot on the skills and competences in retaining required phenomena (formation damage, fissuring, wetting for the chemicals used, etc.) while still complying with limited computational complexity and reasonable validations procedure. Such R&D skills, once acquired, create an entry barrier protecting the developer from potential competition. Although the quality of Russian education in natural sciences has declined over the past decades, the history of TGT shows that there are still educated and experienced professionals that are able to support the development of a newly established engineering start-up.

Case 3.3 Rosgeologiya

The third case analyses a company at the geological survey market. This area was a priority in the Soviet times. The dissolution of the Soviet Union and the subsequent decline of the Soviet economy had a negative impact on geological activity. This impact has not been fully bridged so far. There already are petroleum companies that conduct multiple exploration projects, but most experts agree that geological exploration should be intensified in Russia. Insufficiency in this respect may entail considerable risks to the Russian gross petroleum production. Basin geological modeling (Wangen, 2010), as exemplified with the activity of the corporation Rosgeologiya, is an indication of this insufficiency.

Rosgeologiya is a diversified Russian holding that provides geological services. According to the declared priorities and mission statement, Rosgeologiya is similar to the U.S. Geological Survey (USGS). Both organizations were founded in the late nineteenth century: the history of USGS started in 1879, and the history of Rosgeologiya may be traced back through multiple reorganizations to the Geological Committee established in 1882 in the Russian Empire. However, there is a difference between these agencies: USGS is a scientific organization. Geological research is impossible without extensive acquisition of basic geological field data, and USGS activity implies outsourcing to external contractors activities such as observation of well drilling or cooperation with an extensive network of national and international organizations of 564 partners in 2016.

Rosgeologiya, on the contrary, itself conducts 75% of stratigraphic drilling (called parametric drilling in Russia), which is covered by the JSC Nedra being a part of Rosgeologiya. Forty years ago, it was Nedra that drilled the 12,345 m long Kola Superdeep borehole. Kola Superdeep became the deepest well, surpassing Bertha Rogers* drilled in Washita (Oklahoma) by Lone Star Producing Co. while exploring oil and gas (Oklahoma Corporation Commission, 2014). Another representative project of Nedra is Jen-Yakhinskaya superdeep, a sedimentary wellbore (8250 m). At present, this wellbore is rivaled by Rosneft "Sakhalin-1" project with its 13,500 m deep well with horizontal part 12,033 m at Chaivo oilfield (Rosneft, 2015). Such projects demonstrate that present-day oilfield operators can work under demanding geological conditions and cope decently well with this level of complexity. In other words, the most complicated exploration or stratigraphic wells should not be managed as a new Manhattan project. State support may be helpful, but establishing another inflated and sluggish state corporation is not necessary.

USGS acts as a scientific organization that acquires and collects information by exchanging and purchasing data as well as operational activities via an extensive cooperation network. Its Russian analog works in a different way. Russian authorities chose to merge and centralize geological exploration organizations and keep them under state control. In 2011, the state-owned corporation Rosgeologiya gained control over 38 specialized public enterprises. The resulting holding provides a wide range of geological services including mapping and geodetic surveying, geophysical investigations, marine geology, parametric drilling, and more.

Unlike parametric drilling, basin geological modeling is an area that may require an active participation of a systemic moderator.

Basin modeling, as a mathematical description of the geological evolution of a sedimentary basin over a geological period, can be traced back to the late 1970s. Since then the research in this field has been driven by the petroleum industry that considered basin modeling to be a promising tool for exploration. As a result, basin modeling has developed into a sophisticated method. It absorbed geology, geomechanics (and geophysics in general), and chemistry. No wonder modern basin modeling relies on computer simulation, which adds numerical mathematics to the pool of necessary disciplines but allows to reduce investment risks in petroleum E&P projects. Thus, the use of such software can measure the leadership (or the lag) of national geological services.

There are a number of software products designed and continuously developed, such as Beicip Franlab TEMIS (Beicip Franlab, 2016) and PetroMod Petroleum Systems Modeling by Schlumberger (2016). Despite a declared priority of import substitution and self-sufficiency,

* Bertha Rogers went through sedimentary formations, while Kola Superdeep cut through the Baltic shield.

Russian developers have not demonstrated similar level products, although up-to-date basin modeling is an important element of replenishing Russian petroleum reserves. There are only a few groups working in this field (Ismail-Zadeh et al., 2016; Malysheva, 2015).

The tools available in Rosgeologiya seem outdated. For example, the corporation announced in April 2016 that one of its subsidiaries (a research institute) will perform basin 1D and 2D modeling for the region of Udmurtiya (Rosgeologiya, 2016). The use of 1D and 2D models is indicative of the development rate. Hantschel and Kauerauf asserted that even though "most models under study were first performed in 2D <…> they were rarely used in practical exploration studies as horizontal petroleum migration in the third dimension cannot be neglected" (Hantschel and Kauerauf, 2009: 16). As a result, a new generation of programs released in the late 1990s included 3D modeling functionality, which has been widely used since then. Simpler models still can be used for describing structurally simple basins. The current world trend is the opposite: the emphasis is shifted toward modeling increasingly more complex structures in 3D and 4D as well as the integration of the corresponding software with other petroleum.

Petroleum exploration in Russia is haunted by a number of technological problems that need to be resolved, but petroleum exploration activities in Russia are under crossfire. On the one hand, most Russian petroleum companies cut costs that do not generate short-term cash flows. On the other hand, the government cannot afford a larger financial support either.

For Russian authors, it is traditional to oppose company-based exploration activities with exploration activities organized and funded by state agencies. But the activity of the U.S. Geological Survey demonstrates that the government agency can outsource survey projects to private companies. There appears to be a more productive approach though. Just as projects in petroleum exploration, design and development of new materials is both complex and systemic activity of strategic importance which requires government intervention. The intervention may intend to intensify R&D and the commercialization of its result. The Materials Genome Program is an emblematic example of an inter-organizational collaborative strategic initiative intended to foster the development of new materials (U.S. National Science and Technology Council, 2011). In this case, the open innovation approach is promoted as the basic framework for achieving a synergetic result.

Merging former Soviet scientific institutions and geological exploration organizations under the state control does not produce a similar change. Inability to implement this or the alternative model productively combining the strengths of corporate and state-controlled exploration activities is an indicative symptom of the inefficient organization of R&D.

3.4 Discussion

The three cases described in this chapter (EDC, TGT, and Rosgeologiya) demonstrate three possible strategies of Russian energy companies:

1. Merger and acquisitions (Rosgeologiya).
2. Specialization followed by expansion (TGT).
3. A combination of (1) and (2): EDC as LUKOIL spin-off was an example of specialization followed by a series of acquisitions.

Of the three mentioned cases, the TGT case seems the most successful from the point of view of innovation potential. The company developed a number of high-tech products and services that are currently offered to Russian and other customers abroad. These products and services are based on the proprietary technology that is undoubtedly innovative.

Merger and acquisition is a popular strategy in Russia, and the energy sector is not an exception. It has been already shown that it may not be successful in some cases (Kovalev and Proskuryakova, 2014). The case of Rosgeologiya testifies to the same thesis. Merging organizations lagging behind in technological development may streamline business processes and eliminate some inefficiencies in management or procurement, but merger is not equivalent to coming up to the modern of technological development. The evidence from the history of EDC shows that mergers and acquisitions work better if it starts with a company that has already been optimized and follows modern standards of efficiency.

The history of TGT points to the importance of specialization, as in the case of EDC. It is difficult to build a modern industry from scratch and enter a market that had already been divided by internationally recognized service providers. This barrier becomes less demanding in the case of a specific market niche where a start-up may have a definitive competitive (or comparative) advantage. The need of a specific competitive advantage leads to further specialization within a market niche where capitalizing on a unique technological advantage opens access to foreign markets and, therefore, an extended client base.

The filter of competitive market, once passed, guarantees that the company's core competence can become a basis for an expansion (if the company chooses the expansion strategy). Energy performance contracting in Russia is another example of a competitive market where companies constantly have to go through reality check.

The history of energy performance contracts in Russia is rather short. The regulatory environment for these services was established with the adoption of the Federal Law No. 261 dated November 23, 2009, "On Energy Saving and Development of Energy Efficiency and Amendments to the Russian

Federation Federal Laws" that triggered the development of performance contracts. This process was rather slow and came over several barriers including monopolization (Russian monopolies are often reluctant to deal with independent contractors especially small newly founded technological service providers) and devaluation of the Russian currency (the cost of new imported equipment, such as high-power energy efficient fluid pumps, has risen). The economic decline that the Russian Federation has been going through since 2014 should have made investments in energy efficiency more attractive, but EPC services themselves require investments, and more importantly companies may go bankrupt and default on their EPC during an economic decline. Turbulent economic conditions may cause unpredictable changes in tariffs and regulations that also contribute to the EPC risks (Garbuzova-Schlifter and Madlener, 2015).

Yet, there is a significant energy efficiency growth potential that is explained by the low base effect: researchers and government agencies confirm that Russian industry, commercial, and real estate sectors have considerable potential for energy efficiency enhancements (IFC, the World Bank, 2014; Zhang, 2011). It is equally often found that much of this potential has not been realized so far (Ministry of Energy of the Russian Federation, 2013). Many Russian energy systems, especially built during the Soviet era, were not meant to be energy efficient. The Soviet command economy provided no incentives for state R&D institutes to adhere to energy efficiency to the extent that some large-scale hydroelectric power plants may have been built without a proper engineering economic feasibility study (Kirillin, 1990).

Not all engineering or economic inefficiencies of Soviet industrial or energy systems can be eliminated within the frameworks of energy performance contracts that are supposed to make incremental modifications of an energy system, nor radical change of the system. For example, the economic feasibility study of district heating systems included the concept of a district heating radius* as a spatial extension at which the centralization of district heating still demonstrates a positive economy of scale when compared with distributed heat sources.

Despite such problems, EPC business slowly develops in Russia. The reason for that lies in its nature: EPC projects are analogous to financial arbitrage at the fundamental level in the sense that such projects capitalize on inefficiency. Then, the EPC market in Russia is open. Any organization specializing in repair, civil engineering, maintenance, or similar fields can become an EPC market agent. And there are many organizations whose machinery, technological processes, and buildings still have room for energy efficiency improvements. Thus, there is a potentially large demand. The entry barrier for EPC contractors is low. The average scale of a typical EPC project is rather small, such as installing LED lighting instead of old filament lamps. This combination can potentially make this market very competitive in the

* These can be described as a geographic measure of monopoly extension.

future, but at present the EPC market in Russia is still underdeveloped and competition is limited. The participation of foreign companies in the EPC market (so important in oilfield services, as shown in the following text) is moderate. There are Russian branches of international service companies, such as EDF Fenice, but their presence does not create intense competition. As a result, energy performance contracting is slowly taking off in Russia.*

3.5 Conclusion

It was shown that mergers and acquisitions work differently depending on the maturity and efficiency of companies. A merger or acquisition can potentially provide significant benefits for a cost-efficient business, but it may also result in a significant decrease of efficiency if the basic level was suboptimal.

In the Russian oilfield service sector and petroleum exploration, the situation is far from serene, but companies demonstrate contrasting trends. Those having chosen to specialize within the sphere of their competitive advantage naturally become innovative. Companies or organizations that have been merged instead of optimization get stuck with accumulated inefficiency. In some cases, uniting patchy assets in a larger company could potentially lead to an advantageous position (at least in the local market), but it does not spur innovation. More often the resulting corporations try to create an entry barrier for other companies or call for state support (quotas, tax cuts, etc.).

The reality check of competitive advantage implies that the company faces competition. The TGT case shows that companies surviving in the competition tend to prioritize innovation. This testifies to the pressing need to restructure the Russian oil and gas industry. Ideally, the reform should bring more competition into the industry and incentivize companies to develop new efficient technologies. This restructuring should ideally have been conducted during a more favorable period when soaring petroleum prices could attract investors. That opportunity was lost. It is also obvious that various types of subsidies to the industry do not work toward this cause because without restructuring they compensate for management inefficiency of Russian energy companies.

Basic energy research in the interest of the entire sector is necessary and some of it has been planned by several Russian Technology Platforms (Proskuryakova et al., 2016), but as in the case with subsidies the effect may be moderate. Restructuring is a painful process, especially when it is conducted

* Official estimates and forecasts are not always accurate: in 2011 the official forecasts of the EPC market were RUB 500 bln (Voskresensky, 2011), but the actual volume in 2015 was around 1% of this amount (RBC, 2015).

in harsh market conditions that do not seem to change soon, but it appears more and more necessary for the Russian energy sector.

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