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Sustainable professional career in science and technology: interdisciplinary perspective and the Russian context¹

We are faced with a contradiction in the approach to professional careers of scientists and engineers. On the one hand, we have an emerging environment, characterized by uncertainty, instability in regard to the status and the prospects of various groups employed in this sphere, growing mobility and diversity of career types, as well as bases for differentiation of their typology. On the other hand, the integrity and biography of a career as a process of accumulating knowledge, professional experience, resources of social networks and statuses remains an important requirement. And, from this viewpoint, it can only be long-term and consistent. Establishing a favorable professional environment remains the main task in resolving this contradiction.

The impact of various external factors on professional careers, including the science and technology sector, is becoming an urgent problem within the framework of various concepts and disciplines. Conceptual accuracy and thoroughness in the examination of external career factors distinguishes primarily the approaches to social psychology, sociology, management and organizational studies. This allows us to pose the question of infrastructure of professional careers in the field of science and technology. The conceptual framework from the viewpoint of various disciplines enriches our perceptions of it. This presentation offers an attempt to raise the problem of interdisciplinary interaction in relation to the study of the potential for regulating professional careers in the field of science and technology. In the Russian context, its various aspects may need to be emphasized. We must take into account the specifics of the Russian situation, which during the recent decades was differentiated by the radical disruption of continuity, as well as the erosion of previous models of the work force regeneration in the field of science and technology; substantiation and establishment of new ones for more effective organization of activities in this field. In general, the analysis helps identify three levels of such infrastructure: a macro level (state policy in regard to science); middle level (on the level of a particular institution and organizations) and family level. This report utilizes data based on research projects supported by The Russian Foundation for Humanities grant № 16–03–50220).

Keywords: professional career, science and technology, sustainable career, professional association.

From the perspective of the mechanisms of their regulation, Careers in the field of science and technology are susceptible to the impact of changes in the social context, primarily, in the state policy towards the research and development sector. To a large extent, its productivity (success, efficiency) depends on the external environment created and regulated at the level of public policy. In this research paper, the productivity of a scientific and

¹ This paper is based on the research project «Professional career in the field of science and technology» supported by the Russian Foundation for Humanities, grant № 16-03-50220.

engineering professional career is examined from the point of view of such a criterion as its sustainability. In attempting to fully grasp the factors of sustainability, it makes sense to address the approaches and concepts of various disciplines. Their diversity can be unified by our perception of the different levels and contexts of the structures that are supporting various types and models of career development trajectories — career infrastructures. We can distinguish three different levels of this complex: the macro-level, which is determined primarily by the national state scientific and technological policy; mid-level, where the conditions within the organization are taken into consideration; as well as the level of influence of the close surrounding environment and the family. The empirical part of this research deals with the analysis of the practice of interactions during the formation of scientific policy at the macro- and meso-levels of the career infrastructure — in the particular segment of the “middle” level, where the principles of professional autonomy and self-organization are implemented by means of scientific and engineering professional associations.

Perceptions regarding the stability of professional careers

In Russia, for almost three decades, there has been an ongoing shift in the models of a professional career in science and technology. During the Soviet period, this used to be a model of a stable, successive career, managed through the system of external control, including hierarchical structures of advancement in science (postgraduate studies, doctoral studies, academic degrees, administrative positions in scientific organizations); quality control of scientific work (attestation); job security (government orders, planning and funding of research, as well as scientific and teaching activities). In complex post-war conditions, this mechanism had successfully proven itself, especially in the development of fundamental research. However, at the turn of the 1990s, with the changing conditions of the organization of science, this model began to transform [Scientific staff ..., 1991; *Vinkler, Kelle*, 1998, p. 387]. Primarily, this was due to the crisis of fundamental science, the development of which depended on state support. At that time, the new models of science organization were being discussed, where the market played a decisive role, and, accordingly, new models of a professional career, pragmatically oriented towards the change in the conditions of activity, based more on the adaptive capabilities of the person himself rather than on the institutional capabilities of the environment. However, the regulators that would ensure the development of such career models were not created. Since the 2000s, state policy has turned to the search for the forms of scientific management, administration [*Arutjunov, Strekova*, 2003, p. 285] and the formation of long-term guides and investments in the scientific sphere [*Gohberg et al.*, 2011, p. 120–158]. Today we can denote a new stage in the search for substantiation of flexible career models, integrated tools of its regulation in the state scientific and technological policy².

The idea of a sustainable professional career can be utilized as one of the prospects in this process. Within its framework, career environment and factors are primarily associated with a set of ideas, concepts and policies of sustainable development. The normative and ideological aspect of this complex concept, which has been emerging in the practices of the

² See: Strategy of scientific and technological development of the Russian Federation, approved by presidential decree of December 1, 2016.

United Nations since the 1970s, is the best known³. The notion of the need for an integrated, balanced and successive development of modern societies, including through the improvement of institutional conditions of economy and employment, is at the center of this ideology. This type of advancement — both systemic and interrelated — is being developed in a wide range of theories and disciplines that include basic system theories [*Burns*, 2016]. In Russia, this concept has gained wide popularity — on the one hand, as a tool for measuring regional development, on the other — as a political perspective, while the scientific schools within its framework are associated with the philosophy of Russian cosmism, the possibilities of innovative development.

A useful prospect for career research is the interpretation of the development as integral, interrelated and coordinated, taking into account the factors of various levels (global, social, human), as well as the goals of continuity, based on a variety of balanced structures and influencing their formation. This is important, under the conditions where such career characteristics as integrity, from the view point of maintaining stability, coherence and consistency of the positions held, the ability to ensure continuity in professional development, the accumulation and utilization of the resources, are also in question in the face of changing employment conditions [*Collin, Young*, 2000]. This is important in the sphere of science and technology as well: it can be viewed as both a complex factor of an “unprecedented crisis of stability”, inability to provide solutions for overcoming the economic, environmental and social crises connected with it [*Dedeurwaerdere*, 2015], on the one hand, and as an instrument of a balanced scientific and technological progress, on the other [*Collin, Young*, 2000].

In Russia, for example, within the framework of this ideology, the importance of this sphere for long-term sustainable development of the country is recognized — the need for structural and technological progress and investments in human capital, including in science. The costs of research and development, their share in GDP are among the indicators of the of sustainable development index of Russia. Decrease in the indicators in the sphere of science, along with the drop in employment in this sphere are recognized as a negative trend for the sustainable development of the country as a whole [*Grigoriev, Bobylev*, 2015, p. 56]. The key to effectiveness of the development of this sphere lies in the quality of human capital and, accordingly, in the opportunities (both individual and determined by the external factors, its various levels) for professional development of those engaged in it. Thus, career research in the field of science and technology fits into certain normative ideological frameworks, which are outlined by the goals of effective development oriented towards the long-term and humanistic goals.

Interdisciplinary career studies: general discourse and specific trends

In various disciplines, several approaches to comprehending the potential, as well as the conditions for the formation of professional careers have been developed. At the same time, career research is generally considered as a separate interdisciplinary research area, including industrial, organizational, social psychology, counseling, sociological disciplines, research of organizations, etc.

³ See: Transforming our world: the 2030 Agenda for Sustainable Development: Resolution adopted by the General Assembly on 25 September 2015. New-York. URL: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&referer=/english/&Lang=R (accessed: 1.09.2017).

The relevance of this research field is reaffirmed by fairly long-standing discussions regarding the development of career theory as an interdisciplinary, trans-disciplinary methodology, which is centered around the concept of a career as an orderly sequence of work experiences of an individual in time [Arthur, Hall, Lawrence, 1989]. Career theory is the “new territory” where “theoretical transformations” [Sonnenfeld, Kotter, 1982] are unified. Interdisciplinarity should absorb and process various definitions of a career, along with contrasting methodological tools and broad research programs [Arthur, 2008, p. 163]. Presently, the interdisciplinarity in the studies of careers is further substantiated by fact that the need to incorporate the resources of various disciplines in these studies, along with the development of their holistic perspective, will enrich them, enhance their effectiveness in the interests of society and the clients, and, additionally, will facilitate the integration of social sciences as a whole (see introductory article to the special issue, dedicated to the interdisciplinary career research [Khapova, Arthur, 2011, p. 10–11]).

Active attempts at generalization are quite common today as well, they form both a general research agenda, and separate directions for a “big” career theory [Handbook of career, 2007; Cuzzocrea, Dawn, 2011; Baruch et al., 2015a] (for example, ideas regarding career fields and career capital generated from the theory of P. Bourdieu [Jellatchitch et al., 2003]).

At the same time, career studies in the field of science and technology are often separated into their own sphere. Academic careers related to the employment in universities are examined, less often — scientific careers in a broad techno-scientific context [Prpić, 2014; Duberley et al., 2006]. Both their specificity, as well as involvement in interdisciplinary career research should be noted.

Career researchers turn to the problems of (in)stability and (un)sustainability in different conceptual and disciplinary perspectives from the point of view of (them) being determined both by the social and historical context, as well as the internal dynamics of various elements of the career. In the 1980–1990’s scientists are discussing the difference between traditional models of career trajectories under the conditions of employment during industrial era from their new variations. The concepts of “new career” that, to a greater degree, examine its formation from the standpoint of action, primarily individual, rather than the structures, are emerging [Arthur et al., 1999]. A new direction in career research that incorporates the prospect of sustainability is emerging as well [De Vos, van der Heijden, 2015]. The conceptualization of a sustainable career is based on a variety of topics and approaches to its elements, primarily the basic ones (such as time, social space, action and meaning), factors, periods, organizational conditions, performance indicators [ibidem].

The influence of external conditions on the careers of modern day professionals, including careers in the sector of science and technology, is relevant in various concepts and disciplines, especially in social psychology, sociology, management and organizational studies.

In psychological studies, the problem of career environment, which is closely associated with personality is examined. Studies take into account a whole range of environmental factors that impact individual career, including macro-social (such as social movements), structural-organizational (socio-technical), socio-cultural, and socio-demographic (including those related to the family) [Arthur, Lawrence, 1984]. Within the interconnection between careers and the environment, the “fracture lines” resulting from major social changes are actualized: changes in organizational forms and structures, in the functioning of labor markets, demographic trends, as well as in the balance of work and life outside the labor sphere and increasing labor instability [Storey, 2000]. The question regarding the ca-

reer ecosystem is being raised: global and local factors (associated with external and internal labor markets) that affect career management at various levels, as well as the formation of its sustainability are identified [Baruch, 2015]. In research of the academic sector, creation of a positive, supportive ecosystem is recognized as not only an individual and organizational task, but also a goal at the national level, where the government has to support its competitive advantages through the educational structures and the creation of new knowledge [Baruch, 2013]. The question of influence on the conditions of social environment as possible resources for professional and career development is formulated as relevant due to the possibility of governing them on the state and organizational scale [Tolochek et al., 2015].

Career research in the sphere of *organizations and management* focuses on the career management of employees in organizations, their qualification and job growth, career management (see: [Chernyshev, 2010; Mangutov, Skvorcov, 2011; Sorokin, 2011; Shapiro, 2012]). Within this approach, the professional career development time frame is limited by the framework of its development inside the organization. If we take into account the conditions of market economy and the constant change of jobs, as well as places of employment that are characteristic of it (market economy), then this time frame has a very narrow range. In a conceptualization of a career as an integral organization of an individual in a profession, several levels of its development are identified from the perspective of compliance with the norms of basic components of its professional position [Chernyshev, 2010, p. 348].

In sociological studies, traditionally, a career is viewed as a sequence of labor transitions, and its research is related to both — the institutions and social structures, as well as individuals [Becker, Strauss, 1956, p. 253]. External factors of the formation of a career trajectories are the coordinates of the professional structure, strongly depending on the regulatory and institutional factors at the level of society as a whole (see: [Сорокин, 2005]). Career regulation factors are stronger associated with the macro-level. Thus, the factors of mobility in the sphere of science are primarily connected to the level of institutes of state scientific policy regulating the conditions of various types of mobility [Asheulova, Dushina, 2014; Dezhina, 2015].

A glance at the social context: practices of interaction between professional associations with the state in the implementation of scientific and technological policy

The interconnection between different levels in the creation of structures regulating the career conditions can be examined from the viewpoint of the inclusion of professional control mechanisms into these structures. They are aimed at regulating the conditions for certain career models through the creation of opportunities and norms of “negotiation processes” with the state and the market in regards to the spheres of competence, as well as interrelations with society. This concerns the potential for ensuring professional autonomy, which is important for functioning of the professional groups of scientists and engineers. Organizing negotiating interactions with the state is considered an important function of professional associations in the field of science and technology. Its implementation can be viewed from the perspective of maintaining the balance between the requirements (demands) of various subjects at the macro- and meso-levels: the authorities / bureaucratic structures and organizations of various types. In turn, this affects the formation of scientific

policies, including structures and practices that support the sustainability of professional development and career paths in various types of organizations.

Professional associations (PAs) are examined as structural elements that influence the creation of the context for the development of a professional group that they represent: its status, the ways of impacting the relations with other actors in this regard, the implementation of the policy of harmonizing interests in education, interaction with employers. This notion of the role and activity of professional associations is methodologically based on the conceptualization of sociology of professions; approaches and attitudes in it also change — toward the types of professional associations, their goals and functions, among others. Those of them that interact with the state regarding such issues as guarantees and methods of social protection from nonprofessionals, professional control, achieving the objective of raising the status of the professional group and protection from competition, maintaining the professional culture, self-regulation and the code of professional ethics, continue to remain traditional. Their role is linked to the functioning of such institutions as licensing, vocational training, collegial decision-making, autonomy, ethical code, expertise, etc. (see: [Abbot, 1988 (1992), p. 5; Larson, 1977 (2013), p. 208]). The new ones that emerge, promote socialization and professional development under the new conditions, such as specialized professional education, encompassing the issues of production efficiency, planning, financial systems, risks, management, leadership, steering the behavior of the professionals toward engagement in the market relations, entrepreneurship [Noordegraaf, 2011, p. 466, 468]. Accordingly, they contribute to the creation of the new models of professional careers.

In Russian practice, professional associations are increasingly becoming the subject of scientific studies⁴. They are regarded as important institutions of professional control that can influence society in confronting the “failures” in economy and public life [Moskovskaya, 2009, p. 115]. Russian researchers focus on the influence of legal, political and socio-economic system on the established practices of interaction with state bodies, administration of institutions and enterprises, as well as professional community [Chirikova, 2014]. Studies of the interaction between professional associations in the sphere of science and technology and the state lead to the conclusions regarding the “replacement” of certain functions of the state by the professional associations, in the context of adaptation to the new market conditions [Kirdina, Popova, 2014], and the resources of professional associations of various types [Popova, 2017].

Examining the role of the PAs as a subject of state policy in the field of science and technology (research and development) is of particular interest. The data of semi-structured expert interviews with the heads of professional scientific and engineering organizations (associations) served as the empirical basis of this analysis. The interviews were conducted in the course of two studies — in 2013 (National Research University Higher School of Economics project, A. Moscovskaya, see: [Moskovskaya et al., 2013]), and in 2015–2016 (the “Engineering dynasties in Russia” project, with support of the The Russian Humanitarian Scientific Foundation, headed by V. A. Mansurov). These studies focused on a variety of issues, but relevant questions regarding the characteristics, functions and features of the practical activities of associations, as well as their role in the integration of professional community comprised the core of the research toolkit. Organizations that were included into the sample are diverse in functions and spheres of activity. 15 interviews with the heads of professional associations in the field of science and technology are analyzed. These interviews

⁴The results of one of the first studies can be found in: [Moskovskaya et al., 2013].

represent a variety of cases of organization and representation of the interests of professional groups in scientific-technological and engineering activities. In order to take this diversity into consideration, the following criteria can be applied to identify PA types:

- *based on the nature of their activities*: 1) associations representing the interests of engineers in general (defending and maintaining the status of a professional group); 2) associations representing the functions of education in the field of science and technology in general; 3) associations representing the interests of engineers in a specific industry: scientific or industrial;
- *based on the duration of the activity*, which determines the *continuity* in its principles: 1) “old” professional organizations created in the Soviet and even pre-Soviet period, which proclaim the continuity of their activities during different time periods; 2) “new” professional organizations, created during the newly emerged, changed conditions, that are setting adaptation to new requirements (primarily to the free market) as one of the goals.

Analysis of the documents published by such associations, primarily on the Internet, reveals a fairly wide range of activities (see: [Popova, 2013, p. 69; Kirdina, Popova, 2014]):

Function	Types of activities of professional association
<i>Lobbying for the interests of professional group/ professional activity</i>	Participation in the development of federal laws, socio-economic programs and investment projects on a national scale; legal protection of the interests of professional communities; participation in the work of public authorities of various levels; preparation of materials and proposals for public authorities in the sphere of professional activity, etc.
<i>Professional development</i>	Participation in the organization and conducting of further education (CDP); participation in the public accreditation; participation in professional competitions among students at universities; development of ethical standards (norms, laws), etc.
<i>Quality control and licensing of organizations / experts and specialists</i>	Participation in the development and revisions of regulatory, as well as guidance documents in the professional field; development of reference materials, methodological guidelines for professional standards; assistance in obtaining research and development patents; etc.
<i>Information and integration of the professional community</i>	Updating the website and mailing of the information for the professional activities; releasing printed materials aimed at informing the professional community of new developments and trends; organizing competitions, exhibits, conferences, meetings, seminars and other events in the area of professional activity, etc.
<i>The development of international cooperation in professional activities</i>	Membership in international professional associations; cooperation with international professional organizations; establishment of temporary international creative teams, etc.

Analysis of the interviews with the heads of the PAs allows us to concentrate in more detail on several key issues of their participation in the shaping of the scientific and technological policy: strengthening of the status of a professional group, including cooperation with the government authorities of various levels regarding lobbying for the interests of a professional group; efforts toward the professional development, encompassing participation in the advancement of engineering education, public and socio-professional accreditation of educational programs; “mediation” aimed at harmonization of the interests of society with the interest of the market.

While analyzing the results of our interviews, a number of comprehensive notable statements on the following issues stood out: the status of a professional group (mainly engineers), higher professional education, postgraduate professional training. Within these major categories, specific topics that were raised and elaborated by the leaders of professional associations, were highlighted (policy regarding the status of professional groups in science and technology, accreditation, information, etc.).

Legislative activity of professional associations in regard to the status of professional groups

In all of the interviews, strengthening the position of scientists and engineers in one way or another, was associated with the creation of favorable external conditions, policies and ideology of the state. “We need to cure the social conditions for our engineers...” (“Engineering education”⁵, [Popova, Pohlkov, 2016b, p. 8]). An important element of this policy, which was often discussed in the interviews, *is the propagation of the importance of engineering profession* at the level of society. The lack thereof, or even its negative character in relation to scientists and engineers, is considered as a significant inhibitory factor. The problem of *professional autonomy* — one of the essential conditions for creative activity, along with broader outlook and independence of the specialists are among the other important policy issues discussed in the interviews. Limiting professional autonomy is considered to be a significant impediment to the scientific and technological initiative. An important task of the state policy is the creation and reproduction of the conditions for scientific and technological business. Creation of the new types of career advancements based on the entrepreneurial initiative is the way of overcoming the obstacles to its development.

This kind of *an engineering-entrepreneurial career type* suggests some possibilities of creating engineering companies that would enable the realization of the potential and ambitions of young engineers outside of traditionally defined hierarchical structures. Professional associations (organizations) can perform the function of supporting such initiatives based on the evaluation of professional experience. “... *the new graduate is career-oriented in a positive sense of the word, working energetically, moving ahead ...And there are certain mechanisms in place that help to determine whether you can trust this experience or not — these are the professional associations...*” (“Engineering Chamber”).

Discussions of the main issues of social standing of engineers leads to the recognition of the lack of social protection of the status of this professional group and the necessity of self-organization for its protection. Development of the legislation on engineers that would strengthen and reinforce their status in society, lobbying various government bodies, becomes a goal of some professional associations representing the interests of the professional group of engineers in general. One of them focuses on defining the scope of professional engineering activities, as well as establishing the certification system for professional qualifications. (“Engineering education” [Popova, Pohlkov, 2016b p. 6]). Competing approaches to the legislative initiative concerning such basic professional development issue as the status of engineers in society, demonstrates the heterogeneity of the environment for

⁵ Hereinafter: the sphere of activity of the professional association or their conditional name.

self-organization in engineering profession, the importance of diversifying the mechanisms of professional control.

Advisory activities for government bodies are quite often mentioned in the interviews. They differ in both forms and subjects between the “old” and “new” professional organizations, especially those representing manufacturing and various branches of the economy. Among the first (the “old”), to a larger degree, these activities have a general nature. Negotiating with the state is not so specifically defined — within the framework of generalized statements regarding participation in the development of the state (as well as local self-government bodies’) resolutions, plans for socio-economic development and technological progress; development of proposals and assistance with the fair resolution of issues related to the legal and social protection of scientists and engineers (“Scientific and Engineering Associations”, see: [Popova, 2016a]).

Participation in the development of state programs appears to be very weak (ineffectual) and mediated among the “old” PAs representing industry branches (“... *no one asked [for our help with the preparation of programs within the framework of state policy]. Our State policy... is derived from what we have available*” (“Nuclear-geophysics”). At the same time, the development of legislative initiatives is declared as a fundamentally important area of activity, even if the conditions are insufficient and unfavorable. “... *our legislative initiatives are aimed at creating regulatory and management mechanisms, mechanisms of fairness, mechanisms of information, so that every common oilman, engineer, scientist would know how the oil and gas industry and its enterprises function, in order for justice to prevail and, so that on its basis, people would realize that they can increase their own productivity... Scientific and Technical Organization exists for this purpose. Its task is to be engaged in propaganda and doing something productive, regardless of the state of society*” (“Oil and gas industry”).

With the “new” industry PAs, this can be the first-hand development of government programs: “*operational work on normative documents that are being developed by the Ministry, working with the Duma, with the council of the Federation, where continuous movement can also be observed: holding of the roundtables, parliamentary hearings. And, it means that it is necessary to inform everyone, send out the materials, gather remarks, all the proposals on these materials... all of this has to be forwarded to the organizers of this event; afterwards, based on that, some recommendations are being put together — all of which we also have to coordinate*” (“Science”, see: [Popova, Gorskaya, 2014]). Conferences, as well as the structures within the government bodies, created with the participation of PAs can also become quite effective forms of lobbying for the interests of the industry: “The resolutions that are adopted at the conferences of the automotive engineers association are usually formulated as some sort of an appeal to the government... we have a fairly close relationship with the public council for the development of the automobile industry in the State Duma <...> we have simply established very close working contacts” (Association of Automotive Engineers). “We put together proposals for the Government programs, <...> based on the decisions of the Government, on Government bills, as well as legislative acts. Department of the Automotive Industry of the Ministry of Industry and Trade has basically been established based on our feedback... Expert Council of the State Duma on Automotive Manufacturing ... we are the members of the Russian Union of Industrialists and Entrepreneurs <...> We participate in technical regulation, as well as economic regulation — in general, we take part in all of those structures that are created there” (“Automotive industry 2”).

Practices in the sphere of vocational education: directions and forms of participation

Specific forms of participation in the development of vocational education, primarily engineering is one of the important functions of professional associations. These forms differ depending on their types. Professional associations in the sphere of engineering education, along with associations, representing engineering groups in general, are particularly active in this field. The differences were mostly associated with approaches, directions of participation in it, as well as the forms of interaction with other actors. They depended primarily on the scope of activities of the association, as well as its resources. Orientation toward acquiring actual practical knowledge and skills, as well as higher requirements and standards for obtaining the title of an engineer in the process of post-graduate professional activity, are considered as the most important trends in the sphere of scientific and technical vocational education.

Public accreditation of the programs in engineering education is carried out parallel with the state accreditation of educational programs, establishing their compliance with professional requirements. Currently, characteristics and functions of public and professional-public accreditation are legislated in the “Law on Education of the Russian Federation” (Article 96: Public Accreditation of Organizations that Implement Educational Activities. Professional-Public accreditation of educational programs)⁶. This is one of the most influential forms of professional control, which is being actively discussed by researchers and specialists-practitioners in engineering education. Professional associations of the educational type, consider the essence of this work to be centered around modification and supplementation of the state accreditation in accordance with professional requirements. “Our accreditation, taking the requirements of the state standard into account, also establishes the compliance of their quality with professional requirements, which are more flexible and less conservative. Our efforts in this direction supplement the work of the state structures toward improving the quality of engineering education” (“Engineering education” [Popova, Poholkov, 2016b, p. 4–5]).

In the opinion, shared by some PAs of educational orientation, one of the most significant functions of the public accreditation, is that it takes into account the requirements and criteria of the reputable and competent international organizations while developing educational programs. The scope of such activities on international scale is still limited.

The leaders of professional associations regard creation of the certification system for engineers as a continuation of this work, and are making efforts in this sphere, which are limited in their scale as well. “This is a very slow process. Thus, we have two instruments at our disposal — accreditation and certification: if they work, the quality of training of our specialists will be fairly high” (Engineering education [Popova, Poholkov, 2016b, p. 6]).

Additionally, this accreditation takes into account the requirements and criteria of authoritative international organizations, and thereby “contributes to the competitiveness of Russian engineering programs” (“Engineering education”, see: [Popova, Poholkov, 2016, p. 5]). The accreditation efforts are recognized as important by the “old” professional associations that represent the status of engineers in general as well. However, the scope of such activities is limited: “there is an accreditation council, the criteria has been established, accreditation procedure, we have the experts and the access to international organizations. Randomly, in cer-

⁶See: On Education in the Russian Federation: Federal Law 29.12.2012 № 273 (ed. 29.07.2017) = Об образовании в Российской Федерации: Федеральный закон от 29.12.2012 № 273 (ред. от 29.07.2017) // URL: www.consultant.ru (data accessed: 27.12.2017).

tain spots this is already being done. The question now, is how to make it wide-spread” (“Scientific and Engineering Associations”, see: [Popova, Sitcev, Zhurakovskii, 2016, p. 219]). The PAs view the creation of certification system for engineers as continuation of this work and are making efforts in this regard, which are also limited in their scope. Some of the industry PAs offer assistance (to) and practice cooperation with universities.

The forms of this cooperation are diverse — for example, through the involvement of universities in associations, or work with the students. “Many universities in our field are members of our association. ... Presently, we hold competitions, within the framework of our association in order to support the best graduate student projects” (“Automotive industry 1”).

Coordination and harmonization of professional and educational standards for the new emerging professions that are required in manufacturing can also be included in the tasks of the PAs. “So, we have a new profession here <...> But, we don’t have an educational standard. It has to be created” (“Automotive industry 2”).

Educational, scientific and technological activities in society — is a direction that is characteristic primarily of scientific and technological professional organizations continuing the traditions of their direct predecessors. This activity also implies an indirect impact on the formation of the state’s policy towards the research and development sector. However, the overall sentiment, as far as its (government’s) active role in it, is often very skeptical. This skepticism is demonstrated in our sampling of associations involved in the development of mineral resources. At the same time, interaction with the state is recognized as one of the few instruments of influence: “...having realized that it is impossible to reach an agreement with the top management of... oil and gas companies... we were able to find a platform for expressing our ideas, taking care, first of all, of common workers — oil and gas workers, engineers and scientists. We have found such a platform — the State Duma of the Russian Federation...” (“Oil and gas industry”).

Conferences, lectures are often identified as one of the main forms of such activities “Conferences, publications <...> It’s not just information <...> It’s school, learning, it’s progress. Each publication, if you think about it, is an advancement in this process” (“Nuclear-geophysics”).

In the “old” PAs they are considered mainly as a source of information and a form of professional development. “New” PAs view such conferences as a form of lobbying for the interests of the industry. In any case, such conferences are used as platforms for establishing network professional communications. “We are a scientific and technological society, we are ready and able to pull together the entire intellectual potential of oil and gas institutes, universities and enterprises for any project. We are the unifiers of sorts” (“Oil and gas industry”).

Professional associations as intermediaries in the matters of interests coordination between the state, the market and the professionals

One of the most prominent functions of professional associations is the mediation between the interests of the state, the market, the society and the professionals. The “new” industrial PAs most commonly declare this principle as their goal. Some of their leaders also point out that the interests of society are observed and respected when this harmonization, coordination is successful. “... The most important thing is trying to explain to the government that without industry there is no economy” (“Automotive industry 2”). “The Association, yes — it means to gather and examine all of the viewpoints, and arrive at a consolidated decision,

which would suit, on the one hand, the authorities, and, on the other hand — the businesses as generators of material value” (“Automotive industry 1”).

The theme of the influence of industry professional associations’ mediation between the market and society on the formation of the state’s economic policy, which has repeatedly been mentioned in the interviews with their leaders, requires special attention. Practices that can be attributed to this direction can be interpreted broadly.

These can include the previously described types of activities and methods of influence of the PAs, which have various aspects of meaning. This can be: lobbying for the interests of the industry in cooperation with government officials during the development of normative documents; conferences, forums and interaction (cooperation) with universities. One should particularly emphasize such method of influence as professional expert evaluations in the field of legislative norms, which is organized by the industry PAs. This could be state oversight of environmentally sound technical regulations in the public interest, or limiting the market’s desire for profit: “... in order to issue this regulation and, incidentally, a fairly successful regulation, it had to be tied in with the industry, and society, and with the state ... the process of such ... benevolent alignment of all positions, since for the business — all of this is a burden” (“Automotive industry 1”). This could be the question of developing federal rules in the production sphere: “... in order to write the rules that would be viable. But, these rules are being discussed. Here, during the discussion of these rules, various businesses express their opinions, and we are deliberating, considering these opinions, consolidating and informing” (Aviation industry). “It is in our interest that they do not come up with some official document that we will have to execute, and which would be impossible to fulfill. They have identical interests as well, to hear us out and comprehend what the industry needs and requirements are” (“Automotive industry 1”).

Conclusion

The establishment of effective careers models in the field of science and technology is based on the formation of a favorable, nurturing external environment, or infrastructure that includes methods of regulating careers at various levels. At the same time, conceptualizations of a sustainable professional career, which are based, inter alia, on a compilation of ideas regarding sustainable development as integral, interrelated, consistent and coherent, taking into account the factors of different levels and objectives of continuity, based on a variety of balanced structures, remain relevant as well.

The potential of interdisciplinary career research is also remains an important source. Various disciplines substantiate conceptual and practical approaches at different levels. We can identify a macro-level, which is primarily determined by the national scientific and technological policy; meso-level, where the conditions inside an organization are examined, and the micro-level — the level of an individual and the influence of a close surrounding environment.

In the scope of our work, we focus on an approach that addresses the issues of professional control and the development of public policy instruments through professional associations. A favorable environment for professional development and careers in the field of science and technology is created primarily at the level of state policy. Scientific and engineering professional associations that mainly perform “intermediary” function are one

of the subjects of science and technology policy. They create (or are supposed to create) a mechanism of reconciling and coordinating the interests of the state, society, business and professional communities. The set of their functions includes legislative and advisory/expert activities (development of laws and legislative initiatives, state programs, professional expertise); organizing conferences; participation in the development of professional education (accreditation of educational programs, certification, development or harmonization of professional and educational standards, cooperation with universities). The degree of interaction with government structures, as well as the effects of this interaction depend on a combination of various characteristics of the PAs. The very professional associations that declare the strongest pro-government positions, in reality, demonstrate the weakest positions in this interaction. These are primarily the “old” PAs, adhering to the former principles of activity, more often — scientific and technological societies. The “new” PAs, created under the changed conditions of professional activity and representing the interests of different branches of industrial sphere, in which the professionals are employed, have a more effective set of methods of influencing public policy. This allows us to assume, that relevant tools of interaction and cooperation in the development of scientific and technological policy are shaped in line with the market principles, which can determine limitations and contradictions in the formation of professional career infrastructure. Close attention to the approaches that correspond to a wider variety of interests and trends, which are advocated by, among others, the “old” professional associations, remains relevant.

We have to emphasize the legislative activity of professional associations, which is aimed at changing the status of engineers and the formation of a new type of professional career, mostly entrepreneurial (in our case studies, these are “new” associations representing the interests of the professional group as a whole).

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