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Communities of Practice of the Future in Russian Universities: FabLabs, CMITs, Kruzhoks

Original article
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Abstract. The purpose of this article is to determine the potential for constructive social change that can reach the communities of technology enthusiasts in Russian universities, and to identify possible directions for such changes. University communities of technology enthusiasts and the sites where they work are chosen as the object of research: fablabs, CMITs, circles[1]. The basic conceptual framework of the research is the theory of fields, which asserts that society is a system of embedded social fields. Social changes in this theory are referred to as the transformation of existing social fields or the emergence of new ones. The term "practice of the future" is first introduced, and understood as a group of people united by common interests in advanced technological and social solutions sharing common activities and knowledge (sharing), but not included in a sustainable social field. The hypothesis of the present study is that communities of practice of the future have the capacity for social change and the directions of such changes can be identified through the analysis of strategies that are consistently applied in these communities. The semi-structured in-depth interviews of leaders and participants of university student technological centers are used as the material for the study. The article concludes that the two most obvious social fields in which communities of technology enthusiasts of Russian universities are capable of producing changes are the field of technological entrepreneurship and the field of educational innovation. In the first of these fields, the strategies of technology enthusiasts (initiative, project orientation, diversity and meritocracy) give advantages over players who do not employ these strategies. In the second field (educational innovation) these strategies can give the direction of changes, bringing together enthusiasts of relevant educational technologies. Social changes of the techno-optimistic type generated by the university communities of technology enthusiasts is not yet directed to a specific social field. However, examples of large-scale country-wide projects show that such a field is beginning to form. It is quite possible that modern university communities of technology enthusiasts are able to generate a social field no less powerful than their predecessors – the movement of technological kruzhoks – at the begining of the 20th century.

Keywords: communities, communities of practice of the future, university management, social capital, makers, fablab, kruzhok

[1] CMITs – centers for youth innovative creativity, kruzhoks – technological student circles.

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Introduction

In 1908, professor Nikolai Zhukovsky, who will later be described as the father of Russian aviation, established the Aeronautical Kruzhok at the Moscow Technical School (today – Bauman Moscow State Technical University). In 1921, the Circle's alumni, Vladimir Vetchinkin, launched the glider circles movement which swept the country, with the first glider tests taking place in Koktebel[2] in 1923. In the same year, sixteen-year old Sergei Korolev joined the glider circle at the Odessa Seaport. In 1961, the chief designer S.P. Korolev launched the first man into space.

In 1998, professor Neil Gershenfeld began teaching his "How to Make (Almost) Anything" course at the Massachusetts Institute of Technology (MIT), with the course title later transforming into the fablab movement motto: "We can make anything from almost nothing". After the period of twenty-five, the global fablab movement (has) created free wireless Internet networks in Afghanistan and Kenya, and a global initiative for green urban transformation along with providing millions of doctors with personal protective equipment during the first wave of the COVID-19 pandemic. The Russian segment of the "Makers against COVID" movement delivered more than 170,000 pieces of equipment to doctors within six months, reaching 40% of the public hospitals and 6% of medical practitioners of Russia[3].

Most Russian universities declare the training the qualified professionals for the country's modern economy as their main mission. However, the examples mentioned above vividly show that university spaces can serve as an incubator for socio-economic phenomena. Under certain circumstances, a university can not only prepare qualified specialists, but also directly shape the future, by growing new industries, creating and exploiting social practices and institutions from small communities of enthusiasts.

In today's Russia, universities efforts to their social development mission are strongly required. One of the tasks of this development is directly addressed to university communities of technology enthusiasts, whose aim is to create innovative technological entrepreneurship across the country. Thus, the national program "The Platform of University Technological Entrepreneurship" sets out the ambitious goal of forming a mass of entrepreneurs capable of launching a vast scale of new businesses. The project's key performance indicator is to bring 30,000 technology entrepreneurs out of the universities and into the economy by 2030[4].

However, the above-mentioned examples of societal changes originating from universities have an essential similarity: the time between the emergence of a community and its transformation into a historically significant socio-economic phenomenon may take even decades rather than years. This poses considerable difficulties for researching the role of universities in social development. The purpose of this arti-

[2] Andruskov A.A. To the origins of the circle movement. The first glider circles, The NTI Journal of Circle Movement, Association of Technology Circle Participants, 2021. URL: https://journal.kruzhok.org/history/tpost/o1enbu5b01-k-istokam-kruzhkovogo-dvizheniya-pervie (accessed 26.11.2022).

[3] Makers against COVID. URL: https://boomstarter.ru/projects/999127/meykery_protiv_covid (accessed 26.11.2022).

The NTI circle movement launches the junior route of "Markers against COVID-19" initiative. URL: https://tass.ru/obschestvo/8255753 (accessed 26.11.2022).

[4] Decree of the Government of the Russian Federation dated to 13.05.2021 No. 729 "On measures for implementation of the programme for strategic academic leadership "Priority-2030"

cle is to determine the potential of technology enthusiast communities of Russian universities for constructive social change, and to identify possible course for such changes. The university communities of technology enthusiasts and the sites of their work were chosen as the object of this research: fablabs, CMITs, circles.

Literature Review

The publication in 2005 of Neil Gershenfeld's article on upcoming technological revolution "from personal computers to personal production" can be considered as the starting point of modern research on university communities of technology enthusiasts. In the article, the founder of the international fablab community proclaims the imminence of the revolution of "personal factories" which will allow to make the physical world as programmable as the digital one, along with turning the consumer economy into the economy of personal distributed fabrications.

Fablabs as a phenomenon appeared a few years earlier. The first fablab at MIT was opened in 2001 while the rapid growth of their popularity fell on 2009-2010. As of May 2023, there are 2.134[5] of functioning fablabs in the world. Nowadays, fablabs make a global network of laboratories promoting inventions and providing access to digital manufacturing tools.

The researchers, following in the footsteps of Gershenfeld's ideas, link the socio-transformative mission of the universities ("the third mission") with the ideas of transition to a new techno-economic order, in which distributed, economical and customized production will play the main role [2]. There are noticeable connections between the knowledge economy, in which the universities involved, and the future "economy of embodied knowledge", which due to new production opportunities becomes available to universities [3].

Another line for research of technology enthusiasts communities in universities proposes to analyze their work sites through the concept of a "third place", which came into scientific use in the 1980s [4]. The "third place" is simultaneously set against the "first place" (home) and the "second place" (work or study) and it is presented as a kind of social space where people display integrity, independence and engagement. Traditionally, the third places are understood as cafes, bars and shopping malls, but may also include university spaces for collaboration of technology enthusiasts – fablabs, makerspaces [6; 7].

The researchers in this line pay much attention to new principles of collaborative work based on the idea of community. Co-working becomes the central notion understood as a common environment where independent intellectual workers gather to "work alone together" [8]. In co-working spaces the workers can take advantage of communities (e.g. collaborate with colleagues), while remaining free of hierarchies [9]. The understanding of technology enthusiasts' working spaces as co-working allows for inclusion into a wider context of societal development: renewal of labor and economic relations, daily managerial and working practices, leading to predominance of "horizontal" or "turquoise" organizational forms [10].

Another line for research of technology enthusiast communities is focused on their ability for updating educational practices. The main streams for such changes, as authors identified, include:

transition to project-centric model of interdisciplinary education based on an engineering approach to mathematics and natural sciences, often identified as STEM education[6];

shift of educational technologies from translational and teacher-oriented to interactive

[5] URL: https://www.fablabs.io/labs (дата обращения: 26.11.2022).

[6] Bevan B. et al. Making as a strategy for afterschool STEM learning: Report from the Californian tinkering afterschool network research-practice partnership // The Exploratorium. 2016. URL: http://researchandpractice.org/wp-content/uploads/2016/04/Final_CTAN_Report_Jan2016_for_Bechtel.pdf

technologies geared towards the students and their proactivity in the educational space [11];

elevation of access to education for the youth from disadvantaged families by way of involving and organizing influence of the enthusiast community [12];

development of collective transformative agency in teams of technology enthusiasts [13].

A number of researchers draw attention to significant dissimilarities between the major streams of activity and culture of technology enthusiast communities in countries across the world. For instance, the researchers from Shenzhen University distinguish the peculiarities of "Chinese makers movement": the direct connection with the national strategy of "widespread entrepreneurship and innovations"; massive economic impact; and movement "from the city to the countryside" [14; 15]. Systematic literature reviews confirm this idea [16]. A comparative analysis of technology enthusiast communities in various countries shows that the main topics of their discourses differ: in Singapore, they concentrate on the preparation of the fourth technological revolution, in China – it is inclusion of the youth in national programs for economic renewal, and Ghana – they are focused on solving mutually ecological issues of the country [17].

The COVID-19 pandemic and the response to this problem of international fablab network indicated a new research area for technology enthusiast communities. The global movement of "Makers against COVID-19" was able to provide millions of doctors with personal protective equipment and their patients with indispensable parts for oxygen cylinders in the shortest time possible. This was done relying on the tools for distributed development and manufacturing along with filling the gaps in production chains of the traditional economy. The researchers focused on the ability of such communities for constructive large-scale social action that goes beyond established socio-economic practices [18].

Researchers of this phenomenon rely on abundant material collected from web forums and seminars, by means of which the community of makers organized digital model improvement, distribution of materials for 3D printers, and logistics of delivering end products to medical practitioners. One of the substantial research topics is the issue of the comparative role of government measures to support technology enthusiast communities and their self-organization ability based on new "horizontal" principles. Following Gershenfeld's ideas, the researchers discovered the first real example of testing out the new post-capitalist model of distributed jobbing in the actions of makers during the COVID-19 pandemic [19].

Two large blocks can be single out among Russian studies on university communities of technology enthusiasts: publications devoted to the development of the network of Centers for Youth Innovative Creativity (CMITs), created within the framework of the Fund for Facilitation of Innovation and allied to the international fab lab network ideology; and the materials developed by the Association of Technology Kruzhoks Participants (Kruzhok Association) within the framework of the grant from the infrastructure center of the Kruzhok Movement of the National Technological Initiative and the development of the National Technological Initiative Contest [20].

The major studies on CMITs refer to the period 2015 – 2017 and mainly present case studies [21; 22]. At the same time, references to the classic article by Gershenfeld and the core logic of narration allow for a conclusion that the authors perceive CMITs movement as a part of the global fab lab network. In some papers, researchers lay a stronger emphasis on changing the content of education, focusing on support issues for technology enthusiast community's initiatives and self-organization [23].

Summary studies covering the whole network of CMITs describe them from the two angles: as a part of the country's innovative economy, and as an educational project that broadens educational opportunities of its participants [24]. Moreover, many of the cited authors mention a direct connection among the culture of

contemporary technological enthusiasts and Soviet post-war movement "Do It Yourself", the movement of inventors and innovators, and the technology circles of the first half of the 20th century [25]. In other words, modern university communities are considered to be a part of a much larger historical process.

Studies on the Kruzhok Association have been conducted since 2018, they describe various communities of technological enthusiasts [26] along with a wide range of their work sites [27]. Altogether, more than 3 000 circles, organizations and communities were included in the Association's research database according to the results of the annual technology circles competition. In its research, the Association see a connection between practices of informal education realized by technology enthusiast communities and their potential for constructive social changes by introducing the concept of "practices of the future" and "testing grounds for the practices of the future"[7].

Using the term "practice of the future", the researchers mean the union of leading bearers of groundbreaking technologies or practices and pupils or students, with the aim of developing and implementing a new way of life [28; 29]. There are three main elements that much attention is drawn by researchers to personal self-determination of the technology enthusiast: the urge to develop own talent [30]; the involvement in historic destiny of the country, and the readiness to take on global challenges. The Association's methodological developments are geared towards resolving issues of combining informal educational practices and emerging elements of new socio-technological way of life, e.g. the practices of the future [31]. The sustainability of self-organized communities, in time of crises included, is studied by the researchers as a separate issue [32].

This literature review shows that various researchers mean differently the role of technology enthusiast communities in societal changes: these communities are perceived as prototypes of socio-economic structures of the future; as social setting for human self-actualization; as innovators of educational practices; and, finally, as direct participants of new large-scale social phenomena of the present days. At the same time, the role of technology enthusiast communities varies significantly from country to country whereas their potential for constructive social change in Russia is not fully assessed in the national scientific literature. Besides, international literary works show little, if almost no interest, in empirical studies on perceptions of such communities by their immediate participants, and there are no signs of such kind of research in Russia. This article is meant to fill the described gaps in research.

Theoretical Framework

The article explores the potential of technology enthusiasts' communities at Russian universities for constructive social change, and possible trends for such changes. The basic conceptual framework of the study is field theory [32–34], which asserts that society is a system of interactive and embedded social fields while its changes are the transformation of existing social fields and the emergence of the new ones. For instance, such changes include the emergence of open source community[8], which has radically shifted the balance of power and dominant players in the IT social field.

A social field is a sustainable system of rules of the game, in which players, having a "sense of the game", strive for a better position [35]. A social field consists of a variety of elements, including rules and possible stakes, dominant players, contenders for dominance, etc. The players in a particular social field adopt associated strat-

[7] Fedoseev A.I., Andruskov A.A., Molodykh Yu. O., Rachinskaia M.S., Konovalenko A.N. Circles 2.0. Scientific and technical circles in the ecosystem of practices of the future. Assembly instructions. Moscow: Association of Technology Kruzhoks Participants. 2018. https://kruzhok.org/storage/app/media/nauchno-tekhnologicheskie-kruzhki-v-ekosisteme-praktik-budushchego.pdf

[8] Open-source software. https://ru.wikipedia.org/wiki/Открытое_программное_обеспечение

egies giving the advantage to win in this social field.

The same social field can interact or become part of other social fields. Thus, the social field of a specific regional university can simultaneously become part of the social field of heavy engineering, for which the university is an institution for co-opting new players. In the social field of the regional intellectual elite, it can act as the dominant player; whilst in the field of national higher education in Russia, it becomes a candidate for a better role of a participant of the university support programmes.

However, the modern field theory does not pay much attention to the role of a particular individual in producing changes in social fields. The individual is assigned a role of a player in the social game, striving to maximize his/her social gain. However, in order to describe the of technology enthusiasts' communities united primarily around common interests and activities, such a conceptual framework is not sufficient. In this article, field theory is complemented by the term "community of practice" [36, 37][9]. A community of practice is a group of people united by a common interest, who exchange knowledge and expand it while being included in the common practice within a social field. One example of a university community of practice is a group of teachers-interns and their mentors who take part in a school-based internship discussing their experience at a university seminar and supporting one another during the internship.

Nonetheless, this modern concept seems rather unsuitable when describing university community of neuro-technology enthusiasts or underwater robot engineers, as it is impossible to trace a distinct connection with an existing social field. One can point out that such communities are united by their interest in the future. To describe such phenomena, this article introduces the term "communities of practice of the future", meaning a group of people united by a common interest in advanced technological and social solutions along with common activities and knowledge sharing, but not included in a sustainable social field.

The hypothesis of this study states that the future can not only be practiced in the present, but can also flow into adjacent social fields, changing them and creating new ones, due to interaction of social fields within each other as well as players' strategies in communities of practice of the future. An example of this process is the translation of strategies from the open source community into the wider IT social field: the "show me your code" strategy allows those who put in more effort into improving the code of common projects to receive greater recognition. By joining companies with other dominant strategies and gradually occupying leadership positions, open-source supporters attract like-minded professionals to their teams through social capital networks. Companies, along with new people, receive the flow of strategies from the open source community, including the practices of the future making them the rules of the game in the social field of the present.

The design of this study is based on two goals resulting from the hypothesis: 1) identify and describe the strategies implemented by members of university communities of technology enthusiasts (who are a variation of the communities of practice of the future); 2) determine with which adjacent social fields the technology enthusiasts' communities have the closest connection. On the basis of this information, conclusions will be drawn on the potential for constructive social change that the technology enthusiasts' communities at Russian universities possess, and the potential trends of such changes.

Research Methods

The material for the study was semi-structured in-depth interviews of leaders and participants of university student technology centers (the names of such centers differ in each case), including Higher School of Economics, St. Pe-

[9] Also check Étienne Wenger's website for relevant data. https://wenger-trayner.com/introduction-to-communities-of-practice/

tersburg Polytechnic University, ITMO University, Moscow Polytechnic University, Russian University of Transport (MIIT), Far Eastern Federal University. Overall, 26 interviews lasting from 45 to 90 minutes were conducted, within the timeframe of June-November 2022. The studied communities include 100-500 members and implement 10-50 technological projects. Based at universities and running workshops with equipment for individual and small-scale production, their activities are included into the university educational process from extracurricular classes to compulsory project courses. The interview guide includes the following series of questions: a) the community origin, its scale, major activities and themes; b) organizational and communication culture of the community; principles of knowledge management; c) community's mission and its connection with social change movements; d) interactions with other social fields, e.g. university, urban entrepreneur community, other professional communities. For data analysis, the method of thematic coding was employed, with the codes determined by the theoretical framework.

Additionally, the author of this article directly supported the work of university technology centers of particular universities on the national scale during 2014-2022, while now he leads the implementation of the roadmap for the National Technological Initiative on the "circle movement"[10]. The initiative was developed to coordinate the government, businesses, academia and individual technology enthusiasts in fostering the new generation of young engineers and entrepreneurs. Today, the circle movement is the union of more than 500, 000 pupils, students and mentors, including university communities of technology enthusiasts. This made it possible to rely on the author's personal involvement in the issue of study when coding and analyzing the interview data.

[10] Decree of the Government of the Russian Federation dated to 18.04.2016 No. 317 "On implementation of the National Technological Initiative".

Results

The results of the interview analysis mentioned below showcase, that university communities of technology enthusiasts demonstrate traits of communities of practice of the future: they unite around a common interest for advanced technologies and common activities; their members implement strategies that differ from practices of their social environment; they have an intent to spread these strategies to external social fields; they accumulate social capital necessary for successful action in other social fields and social changes; they have certain pronounced trends for such social changes. The results of the empirical research are separated in two sections: 1) the description of member strategies of university communities of technology enthusiasts; and 2) the description of trends of social changes that such communities have an intention for.

Strategies at the Technology Enthusiasts' Communities

This section provides a description of the four most common strategies that are upheld and rewarded by communities, allowing to achieve higher social status and recognition. According to the research hypothesis, these strategies can flow into adjacent social fields and produce changes in them or create new ones. As will be shown below, the technology enthusiasts' communities are not united into any structure or meta-community, meanwhile their participants implement similar strategies that lead to success, recognition and social capital growth. Success in these communities can be achieved through a display of enthusiasm and initiative, the ability to act on a project basis, the capacity to be result oriented, the skill of not limiting oneself to narrow topics, support the various ideas of other community members, and following the meritocratic approach in the choice of leadership and "horizontal" principles of work organization.

1. "Come to the Garage" Strategy: Community Supports Initiative

The main way to join a technology enthusiasts' community is to take the initiative and to

show that one has come not for the sake of formally passing a milestone in one's educational program and is ready to invest personal time and energy. Many communities have specific formats for taking such initiative, from project fairs inviting those who want to join, to project courses within the program, after which the persons interested in joining the community may stay on for optional events and showcase their readiness. In cases when the community is built into the formal mandatory educational process, there exists a clear boundary for community inclusion that runs along the line of proactive participation in extracurricular activities.

The head of the project center at Far Eastern Federal University (FEFU) describes the role of initiative in the community in the following way: "*The teams of enthusiasts who are, so to say, ready to work for the food, are the core of our community. The members are driven not to receive some benefit for themselves but to create something new and teach others to do the same. For instance, we have a guy who is a technology enthusiast, and so he traveled with our flag throughout Russia from Vladivostok to St. Petersburg, organizing workshops at every university and sending us photos*". The founder of the technology enthusiast site at ITMO clarifies: "*We have a series of events to involving people in workshops, create their own workshops and teams, and projects on how to draw them into the organizational activities and lead the labs or similar platforms. The goal of all these events is to provide everyone with an opportunity to reveal their talents and find themselves*".

Some respondents suggested that the technology enthusiast sites should not be a mandatory part of mass technology education. In their opinion, the critical condition for the success of such sites is freedom: an individual should join a community voluntarily and find their calling there. The founder of the technology enthusiast site at Moscow Polytechnic University puts it this way: "*A good project is not created for university credits but rather to follow an interest. The project center does not make you do a project. It fulfils your need in a garage, where you could take your creative initiative*".

Thus, players who can display personal initiative, their own interest in a topic, and a readiness to do more than is required, gain recognition and a higher status in the community of technology enthusiasts.

2. "Candles Before the Control Board" Strategy: Those with Project Thinking Win

The implementation of an engineering idea or an IT project is not only the major form of activity in a technology enthusiasts' community, but also a kind of the social and anthropological ideal. All of the respondents to the interview paid attention to the educational aspect of the work of the community, pointing out that, for them, the familiarization with and transfer of the project culture is a value in itself. Some technology enthusiast sites directly position themselves as centers for project activity.

One of the respondents used a metaphor of "candles before the control board", borrowed from the story by A. and B. Strugatsky "Noon, 22nd Century": "*There, a group of scientists has worked on digitizing brain signals of the dying academician Okado for several days without sleep and rest, in the hope of someday reviving his digital copy; in order to exclude distractions, they work by candlelight: all electric equipment is turned off apart from the coding computers; this image of a candle before the control board is an accurate description of the project culture of our community: one needs to do the job at all costs while meeting the deadline*". Another respondent describes the results-based culture of working within tight timeframes more succinctly: "*We have always lived within the value system of spurts. A project must involve a spurt*".

The majority of the studied communities see a point of their work not only in implementing technological projects, but also in spreading their culture. They put to practice, in one form or another, educational courses on projects, oftentimes embedded into the university study programs. At the same time, the respondents highlight that project culture is transferred not solely

in the classroom, and one should get directly involved with a project team: "*Until you fell asleep on an ottoman at the workshop on the morning before the deadline, you do not know what project work is*", one of the respondent notices.

In other words, the social recognition is awarded to those community members who demonstrate the ability to finish work on time, no matter the cost.

3. "Blooming Complexity" Strategy: Communities Support Diversity

The lack of a narrow thematic focus is an important difference between the sites that host the technology enthusiasts' communities and more traditional university laboratories and workshops. As a rule, such sites are equipped with a wide array of tools for prototyping: laser cutters, 3D printers, equipment for working with electronics. The teams which are a particular community are also not limited by a narrow topic: groups on satellite technology, neurotechnology and underwater robotics can work next to each other.

The multidisciplinary nature of the sites allows them to support enthusiasts' projects in different areas and at various stages of the project lifecycle. The community leader at MSTU describes it this way: "*We do not limit ourselves to narrow topics because we are a kind of techno-entrepreneurial hub, we can help almost any team of tech enthusiasts in its development*". A community leader at ITMO explains his role in a similar way: "*When you have a full project lifecycle across disciplines, you can find the right team, equipment and support measures for any individual*".

An important characteristic of the studied sites is the availability of a wide range of equipment and consumables for all of the community members. One of the respondents observes that the main sign of a functioning site for tech enthusiasts is a cupboard or a warehouse with an electronic component base. If there is an abundance of LEDs and transistors, it means that the site owner understands the importance of access to the means of quick prototyping and supports the spirit of free exploration.

The studied communities value the diversity of interests, the readiness to show a collaborative approach with other projects and take on a task within a new or unusual field.

4. "Invisible Leadership" Strategy: Horizontal Organization and Meritocracy

While speaking about managerial practices, the respondents exhibit varying combinations of two informal organizational principles: a) horizonal communication, mutual learning and knowledge exchange based on the idea of "peer to peer"; b) meritocratic leadership, when the authority and power go to the community member who, by all accounts, is the most suitable candidate for the position of leadership. Interestingly, the majority of the studied sites outwardly demonstrate a type of leadership in which there is little to no competition for the leader's position, possibly, because of its unattractiveness for most members of the community.

In the respondents' answers, the ideas of horizontal communication and non-directive management are often connected with pedagogical principles. One of the respondents expresses it this way: "*Our community began with projects on involving pupils in engineering. From the start, we decided to communicate with them based on the "adult to adult" principle and call them colleagues rather than kids or something like that. And we felt that because of this approach, the schoolchildren found a space for development here, they want to come back. When we started expanding the scope, we preserved this "horizontal spirit" in our community, because it was a value in itself*".

The respondents perceive the principles of horizontal communication and meritocracy as not only the favorable way of working in a community, but also as the basis for forming social capital that can be used in the future. This is how the community leader at ITMO describes it: "*Why is it good that we are here? We have the time to get to know each other and make friends, and understand that we can rely on one another. I see you work, you see me work. Everything is transparent, in plain sight. If you*

think, you need a leader like me, you will invite me to work. And if you need help, for example, with promotion, I will tell potential clients about you".

In other words, the ostentatious desire for leadership and formal authority receives a negative assessment in communities of technology enthusiasts, while the leader who "reluctantly" accepts the power can count on community support.

The Fields of Potential Social Change

To answer the question of which social fields can be changed by communities of technology enthusiasts or which new fields they can create, two types of data were used: a) direct questions to community members, covering the trends of social changes; b) questions on social fields where community graduates fulfil their potential and ways they utilize their social capital. When answering the first question, the absolute majority of the respondents did not identify with any grand international community or movement. In some interviews, the communities of open source, fablabs and environmental movement were mentioned, but they were not recognized as the main activity of the respondents. In the meantime, answers to both questions have three distinct types of external (in relation to the community) social fields which are influenced by the communities: the field of technology entrepreneurship, the field of educational innovation, and the emerging field of technological philanthropy and techno-optimistic humanitarian transformations aimed at enhancing the quality of life and social justice.

1. The Field of Technology Entrepreneurship

The majority of the respondents, when asked about social changes that can result from the work of their community, mentioned the development of technology entrepreneurship. All of the sites have experience in interacting with prominent accelerator programs and grant competitions for entrepreneurial teams, most identify as participants of the National Technological Initiative. Oftentimes, the number of startups "grown" from the community is a formal or informal indicator for the quality of the site's work.

However, most respondents noted that their communities cannot be characterized by the ideology of market competition. "*Here, we value mutual pollination. The teams are young and inexperienced, they regard mutual support higher than rivalry. Competition is possible if you are already strong and present in the market, as it allows you to become better. But when I have nothing and you have nothing, we need to stick together and help one another*". Besides, the communities themselves do not act as market players and do not set a goal of doing business or joining the cadre of successful graduate startups as they pay more attention to social impact.

At the same time, both leaders of the studied communities and the representatives of tech entrepreneurial teams found the first entrepreneurial experience to be an important effect of community membership. "*One can take as many "create a business" courses as they like, but you feel like an entrepreneur only when you receive the first order, complete it in time and get paid. I had such an experience when, in a month's time, we created a demonstration board for a renown forum*", – says one of the young entrepreneurs. Other members of the community also pinpoint the role of technology enthusiast sites as an efficient team accelerator, able to produce highly-demanded product or service.

2. The Field of Educational Innovation

The respondents cite the renewal of university and school education as one of the main missions of technology enthusiast communities. The founder of the fablab at the Moscow Polytechnic University describes it this way: "*We were driven by a dream of a university with much freedom and many opportunities, where the studies are vibrant and engaging, not sad and rusty*". The studied communities implement activity-based educational formats, including hackathons, engineering competitions, project intensive courses, and mostly refer to

the ideas of kruzhok movement of the National Technological Initiative or directly identify with its membership.

As the examples of success, the respondents repeatedly mention the spread of their practices in the education system, calling themselves the testing grounds for new educational approaches. For example, the community leader at ITMO points out: "*In St. Petersburg, we have around seventeen amicable sites which generically resemble us a lot. And now I have a separate task, I am trying to organize the leaders of these sites to exchange information more actively. That is, until they are autonomous*". Another respondent notices that their community was the first to conduct a hackathon for schoolchildren in Russia, and it served as a start for the dissemination of this technology in the regions.

Speaking about the content of new educational practices, the respondents highlight the project approach, the ability to solve complex tech tasks, taking on leadership role while preserving mutual respect in the team, and the capacity to correctly understand whose life is going to improve as a result of the project. One of the respondents talks about it this way: "*Our ideal individual is someone with experience in changing the world, and not at a volunteer community cleanup, but something more complex*". While comparing respondent answers on the practices of their communities and their educational ideal, one can notice a direct similarity: the communities of technology enthusiasts aim to reproduce and disseminate their practices through educational formats.

3. The Field of Technological Philanthropy

The third type of respondent answers to the question on preferred trends of social change can be described as techno optimism. Community leaders mostly single out their graduates who implement technological projects with high social impact. In addition, unlike in the two previous sections, here it is challenging to define the specific social field where community graduates engage in technological philanthropy projects.

The project center leader at FEFU distinguished a socially impactful project in his interview: "*Bogdan has a dream of helping people. The project center provided him with an opportunity to make this dream come true and work on prosthetics. There already are prosthetic arms but the situation with legs is more complex, and he has decided that this is a great story to work on*". Another university community leader gives the following example: "*The real problem that can be solved is that people who work with chemicals do not live long. We need to spray from drones*".

The founder of Moscow Polytechnic University's fablab identifies the anthropological ideal of his graduates in the following way: "*A young individual, who looks at Russia in the same way the Strugatsky characters looked at Space*". The leaders of technological philanthropy projects are not a sustainable social field just yet. Nevertheless, they have a network and are ready to support each other, and this is quite substantive social capital that can become the foundational resource for the formation of a new social field.

Conclusions and Discussion

Russian technology enthusiasts are comparatively little included in the global maker and other technological communities (e.g. open source, environmental, etc.). For them, the membership in international movements is secondary to the basic principles of community life (the source of which the respondents struggle to identify clearly), namely support for initiative, project thinking, creative diversity of topics and meritocratic management. A higher status and more developed social capital are awarded to community members who implement strategies based on these principles. Meanwhile, the studied communities are rooted in Russian history: their leaders mention the experience of the Soviet kruzhoks of young technicians, the "do it yourself" movement and the "garage" culture as reference practices along with the writings of Strugatsky brothers as a cultural model.

The detected strategies have similarities with the declared principles of technology enthusiast communities in different countries, but there exist crucial differences from foreign practice. For instance, the idea of countering the culture of consumption, which is characteristic of the international fablab community [17], is not in the focus of attention of Russian technology enthusiasts, potentially because it is displaced by the idea of a project that makes the world better (the "candles before the control board" strategy). The internationally popular declaration of the openness of technology enthusiast work sites, while in Russia, manifests as the idea of support to initiative, where the emphasis is on the characteristics of an individual rather than a community. Overall, Russian communities of technology enthusiasts pay much attention to an anthropological ideal: "*Our ideal individual is someone with experience in changing the world, and not at a volunteer community cleanup, but something more complex*". In the future, it seems interesting to conduct comparative research on the strategies of technology enthusiasts in different countries.

One of the two most obvious social fields, changes in which can produce communities of technology enthusiasts at Russian universities, is the field of technological entrepreneurship. It is interesting that such communities are paid little attention within the framework of modern Russian research on university-based entrepreneurial ecosystems while there are studies on the impact of entrepreneurial courses [38], the role of national programs for entrepreneurship development [39], the ways to evaluate students' entrepreneurial projects [40], and the role of universities in entrepreneurial ecosystems [41]. Furthermore, it is impossible to miss the product orientation of the identified strategies of technology enthusiasts, as such communities value the ability to create a product that people need and in due time. Such strategies can serve as a good foundation for the development of technological entrepreneurship in Russia. Additionally, the research shows that now the technology enthusiasts communities are relatively little integrated into the entrepreneurial ecosystem, and this opens up prospects for exploring the causes of this phenomenon along with working out managerial solutions to broaden the integration.

Another field where the communities of technology enthusiasts can produce constructive changes is the field of higher education organizations and the field of informal technology education. As was shown above, the technology enthusiasts oftentimes declare the educational development as their mission: "*We were driven by a dream of a university with much freedom and many opportunities, where the studies are vibrant and engaging, not sad and rusty*". Moreover, the connection between the studied communities and educational organizations is much more pronounced than that with the field of technological entrepreneurship, as community members occupy academic and administrative positions at universities and launch education startups while communities support their education projects. The potential for changing the social field of education is more distinct in Russian communities of technology enthusiasts than in foreign practice [12; 13]. It seems promising to continue in-depth research on the potential of technology enthusiast communities for developing education both in Russia and abroad.

The techno-optimistic direction of social change generated by university communities of technology enthusiasts is not yet aimed at a specific social field. Nevertheless, the examples of large-scale national projects, e.g. "Makers against COVID-19" to assist medical professionals during the pandemic in 2020, "Technical Support" to help residents of the regions affected by the special military operation in 2022, showcase that such a field is emerging. It is quite possible that modern university communities of technological enthusiasts are capable of giving rise to a social field no less powerful than their predecessors (the movement of technology kruzhoks) at the start of the 20th century.

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