FACTORS IN LOCAL GOVERNMENTS' DIGITALISATION IN THE NORTHWESTERN FEDERAL DISTRICT OF RUSSIA: SOCIAL MEDIA REVIEW

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With digital communication becoming a quotidian practice, social media has emerged as a common channel for personal and business communication, utilised by authorities among other actors. This article proposes an approach for measuring a territory's digitalisation by quantifying local governments' presence on social media. The work aims to identify digital underperformers among municipalities of Russia's Northwestern Federal District, drawing on data from the Vkontakte social network. The empirical part of the research utilised data gathered from 2011 to 2022 on the socioeconomic performance and municipal heads of 1,083 settlements and 199 districts. Significant factors influencing municipalities' presence on social media were determined using binary logistic regression, with two clustering results compared to identify the underperforming municipalities. It was concluded that population size, municipal revenues and expenditures, fiscal capacity and average salary are directly proportional to municipal social media presence, and the distance to the regional centre and the status of a district centre are inversely proportional to the study parameter. Age, place of residence and the method of nomination for elections affect the likelihood of a municipal head having a social media account. The findings show that a fourth of the study settlements, most of them located in the Pskov, Novgorod and Vologda regions, need to take measures to develop digital technologies and strengthen their social media presence.

Keywords:
social media, VKontakte, municipalities, settlements, local administrations, binary logistic regression, Northwestern Federal District

Introduction

Social media emerged less than two decades ago but have already become an integral part of our lives. A social media platform is an online software package designed for communication and social networking. Users themselves create

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its content, which consists of posted personal information, messages, comments, audiovisual content, and non-verbal responses to messages [1]. Nowadays, social media are used for both personal and business communication. Smartphone apps make people available 24/7, enabling a high rate of interaction in real time. Authorities are expected to adopt the communication tools that citizens habitually use for person-to-person interactions [2]. Government authorities cannot ignore social media, which have millions of users. According to the study "Digital 2023: The Russian Federation," 73.3 % of the Russian population have accounts on social media. Therefore, pages of governors and mayors, as well as official groups of various ministries, departments, and services, were created on social media to reach out to citizens. In 2020, Regional Management Centres were established nationwide to process citizens' messages and complaints on social media and provide feedback. Since December 1, 2022, maintaining official pages on social media under Russian jurisdiction (VKontakte, Odnoklassniki)[1] has become mandatory for state authorities, local administrations, subordinate agencies, and courts.[2]

The absence of initiative in utilising social media by local authorities in several municipalities before the legislative changes can be attributed to the low level of digitalization. We define the digitalization level of a municipality as the combination of the following factors: the availability of relevant infrastructure for stable internet connection throughout the territory, the possession of and access to necessary equipment among the population, and the financial affordability of internet access. This constraint applied more to rural areas,[3] where the process of adopting social media in the work of local administrations was slow and challenging.

In this article, we propose viewing social media as an indicator of the level of digitalization of a territory. The creation of official social media pages by conservative organisations such as municipal administrations suggests that a significant portion of the local population has access to and actively uses these platforms. This indicates that the territory likely has broadband and/or mobile internet coverage, and its citizens possess the necessary tools and devices to access these platforms.

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[1] Order № 2523-r dated September 2, 2022. *Government of the Russian Federation*. URL: http://government.ru/docs/46448/ (accessed 17.05.2023).

[2] Federal Law of July 14, 2022 № 270 FZ. *Official Internet portal of legal information*. URL: http://actual.pravo.gov.ru/content/content.html#pnum=0001202207140024 (accessed 17.05.2023).

[3] For example, in the annual report 2020, Head of the Krivetsky Rural Settlement (Pudozh District, Republic of Karelia) informs: "Residents of some settlements, namely Prirechny Village and Ust-Reka Village, often criticize the quality of telephone connection (Rostelecom), since there is no other type of communication available. In 2020, work on laying a fiber-optic Internet line to socially significant facilities (school, post office, and medical posts) was completed and the plan is to extend the connection to citizens. The application was submitted this year." Register of regulatory legal acts for the Krivetsky Rural Settlement, March 2021. URL: https://pudogadm.ru/poseleniya/krivetskoe_selskoe_poselenie/normativno-pravovye-akty/reestr-npa-po-kriveckomu-sel-skomu-poseleniju-mart-2021-goda (accessed 09.11.2023).

Our goal was to identify municipalities in the Northwestern Federal District of Russia that perform the worst in using Internet capabilities in the work of local administrations by analysing factors influencing the emergence of official groups on social media (a case study of VKontakte). It is reasonable to assume that if authorities struggle with using social media, they are likely to face difficulties with other applications of digital technologies as well. In the absence of official statistics on the development of information and communication technologies (ICT) at the municipal level in Russia, indirect methods for assessing the level of digitalization seem extremely important and relevant.

Literature review

In recent years, the digital economy has become one of the most popular topics among Russian economists. However, the study of territorial differentiation is mainly limited to the regional level [3—6]. This tendency is not exclusive to Russian researchers. In foreign academic literature, the municipal level is seldom represented due to the lack of publicly accessible specialized databases [7; 8]. The primary solution suggested has been to conduct sociological surveys with large sample sizes [9—11], although this is not always feasible. Another option is to use alternative data sources. Russian researchers use the maps of mobile network operators with Internet coverage areas [3; 12] and metrics that characterize online trading at pickup points [12]. These data are detailed enough to conduct research at the municipal scale. Another possible metric is the assessment of settlements' self-presentation on the Internet using official websites [13]. We could not find any Russian-authored studies that have used municipalities' official groups on social media for these purposes.

The topic of adopting social media to serve government needs came into the focus of scientific attention after the release of the Transparency and Open Government Memorandum on January 21, 2009, in the United States [14]. One of the main research lines is the investigation of the factors contributing to the integration of social media into the work of local administrations and the use of social media by the population for communication with authorities [15—23]. It should be noted that most of the factors studied so far turned out to be insignificant (for example, the level of education [20; 22]). The population size is the only factor that consistently proves significant. The larger the population, the more likely it is for the settlement to have an official page on social media [21] and the higher the administration's activity on social media is [15; 17; 18; 20]. Some of the identified significant factors exhibited opposite effects depending on the study area. Local administrations of financially better-off municipalities are more active on social media and the quality of this activity is higher [16; 18; 20]. At the same time, social media activity in European countries tends to be higher in areas that are less wealthy and less developed in terms of ICT [17]. For instance, in Canada, higher incomes and access to high-speed Internet are indicators that residents pre-

fer to contact local authorities using social media [22]. Conversely, in Spain and Italy, the poorer the population, the more active they are on the local authorities' social media pages [20].

The investigation of the factors promoting the use of social media by public authorities has been largely neglected in Russian research. Russian scientists tend to discuss general issues related to the use of social media in public administration [24; 25] and focus on the relationship between the practice of maintaining official pages of regional heads and the level of public trust in the authorities [26—29]. There seem to be no such studies at the level of districts (okrugs) or settlements, where social media accounts are maintained by the heads themselves rather than by media offices. Thus, the role of social media in liaising between local governance structures and citizens in Russia has remained unexplored in the scientific literature.

Foreign and Russian researchers pay little attention to the social media activities of administration representatives in sparsely populated municipalities, do not include them in population samples, and do not use cartographic methods. Thus, such studies do not view the territory as a single digital space, failing to provide a comprehensive understanding of the digitalization problems at the settlement level. Our approach, on the other hand, involves full coverage of official social media pages of municipal districts, urban and municipal okrugs, and urban and rural settlements in the Northwestern Federal District of Russia (hereinafter referred to as NWFD), thereby filling the gap in the scientific literature on the degree of digitalization at the municipality level and the use of Russian social media in the work of local governments. Furthermore, this approach reveals the factors influencing the creation of local administrations' official groups on social media in Russia.

Data and Methods

Official municipal groups on the social network VKontakte (VK) were selected as the object of the study. It is the most popular social media in Russia[1] and people in the NWFD historically prefer VK to Odnoklassniki.[2] Besides, Odnoklassniki is the least used social media among heads of the Russian Federa-

[1] Digital 2023: The Russian Federation. 2023, *Datareportal*, URL: https://indd.adobe.com/view/052e9750-217c-4b85-b533-c371ad746349 (accessed 11.04.2023).

[2] In 2023, a comparison of VK and Odnoklassniki audiences in the NWFD's regional capitals (10 cities with the largest population were chosen in the Leningrad Region) by the TargetHunter service showed there were, on average, 5.1 pages on VK per one page in Odnoklassniki (Kaliningrad — 9.7; Veliky Novgorod — 6.5; Vologda — 5.7; Arkhangelsk, Murmansk, Petrozavodsk — 5.4; Syktyvkar — 3.9; Pskov — 3.8; Naryan-Mar — 2.3; cities of the Leningrad Region — 2). In St. Petersburg, the number of VK users is 79-fold that of Odnoklassniki. Due to the limitations in the search queries of the TargetHunter service for Odnoklassniki, region-wise comparisons are not possible. Sources: Search. Users. Geolocation. 2024, *TargetHunter*, URL: https://vk.targethunter.ru/search/users/geo (accessed 15.01.2024), Search. Users. Geolocation. 2024, *TargetHunter*, URL: https://ok.targethunter.ru/search/users/geo (accessed 15.01.2024).

tion subjects (regions) [30], which local administrations consult for guidance.[1] Chronologically, the study covers the period from 2011 to 2022. The beginning of this period is characterized by the emergence of the first municipality groups on VK in the NWFD. The geography of the study covers all municipalities of the NWFD excluding St. Petersburg. These are 199 urban and municipal districts,[2] and 1,083 urban and rural settlements.[3] It should be noted that the enlargement of municipal entities was happening during the analysed period, primarily through the formal merging of settlements. Since 2019, it has become common to transform all municipalities within a district into one municipal okrug. In some regions, territorial administrations (Vologda Region) or territorial departments (Arkhangelsk and Novgorod Regions) appeared instead of settlements as entities. The above circumstances made data collection and processing more complicated. Firstly, official statistics for settlements that have become part of municipal okrugs is no longer published. Secondly, the original data had to be recalculated for the enlarged settlements to ensure comparability.

The search for official groups of local administrations on VK was carried out based on the list of municipalities as of the end of 2018.[4] A three-step algorithm was employed for retrieving groups. At the first step, the search was conducted directly on VK using the official name of the municipality. If no group was found, we proceeded to the second step, which involved making a search query in Yandex, for example, 'administration of settlement N on VK' or the official page of settlement N on VK'. Next, we looked for links to social media groups on the official websites of municipalities. If no group was detected after, it was concluded the group did not exist. The description in each group was checked for belonging to the specified region (for districts) and district (for settlements) to avoid errors associated with coincident municipality names.

A convenient feature of Russian social media is that government organisations are marked by a special flag. A vast majority of district groups were also supplied with a special 'tick' denoting an officially verified group. However, this practice was not typical of settlements. The information about VK official groups was collected in January 2023. The date of group creation was recorded as the date of the

[1] As part of our project, we searched for official groups on other social media and found that NWFD municipalities were less represented in Odnoklassniki than on VK. Only 10 official groups were found representing the settlement level.

[2] Some of them have changed their status to municipal okrug.

[3] The number of settlements in NWFD at the end of 2018.

[4] This ensures maximum possible coverage of official groups on VK. While some settlements have changed status to municipal okrugs, their previously created social media groups continue to function as groups of territorial departments.

first post on the wall, rather than the date indicated in the community description because a substantial amount of time could have passed after the page's creation before it started being used for outreach. Moreover, the group could have originally been a closed one and used only for communication between administration employees. The main challenge at this stage was to identify the settlements' official groups. Focusing solely on groups with a 'flag' would be a mistake in our research, since not all the detected groups managed to receive one.[1] Also, some settlements created new groups in 2023 to obtain the status of public organisation. This practice was observed in the Leningrad Region. In such cases, the old groups were considered to accurately determine the start date of social media communication with residents. Unverified groups were included in the study if they lacked advertisements and closely resembled groups with a 'flag' in terms of their group description and the topics of wall posts. Personal pages of municipality heads, groups of local parliament councils, and groups of self-governance entities were not taken into account.

Our approach involves studying the factors influencing digitalization at two levels of administrative-territorial division: districts (okrugs) and settlements.[2] Therefore, the selection of socio-economic indicators was limited by the availability of official statistics for both levels. The empirical basis of the study was the Rosstat database "Indicators of Municipalities". The following information was collected: population size; area of the municipality; number of municipal employees; budget expenses; budget revenues; non-repayable receipts of the budget; and average monthly salary of organisation employees. The latter has not been published for settlements since 2013, so its analogue was calculated based on data from 5-NDFL tax return forms [31]. The shortest road-travel distances from regional[3] and district centres to the settlements were obtained from the Yandex Maps service. There was a plan to use the virtual population (number of users registered on VK) [32] as a factor in addition to the population size, but it was not included in the study as the time series could not be obtained for the years in question.

In addition, an attempt was made to factor in the characteristics of local decision-makers. Information about candidates posted on the website of the Central Election Commission was used to collect facts about heads of municipalities: full name; date of birth; education; place of residence; place of work; job title; and party support for nomination. It should be noted that the choice of the head

[1] Later on, we discovered that groups without a "flag" in January have obtained it by July.

[2] In this group we include municipal districts, and municipal and urban okrugs.

[3] The capital status in the Leningrad Region belonged to different cities over the study period, so St. Petersburg was regarded as the centre.

of a municipality as the decision-maker is suboptimal. A more suitable option to represent executive authorities would be the head of the municipal administration. On the other hand, Russian legislation allows combining these positions in municipalities with a population of less than 1,000 people, which accounts for 38 % of our sample. The absence of a uniform management model across municipalities in the studied area, along with the necessity to consider municipal acts alongside regional legislation, significantly complicates the task of identifying these individuals. A crucial challenge in collecting data on heads of administration stemmed from the lack of a reliable information source. Even compiling retrospective data on heads of municipalities proved to be challenging, as not all municipalities conduct direct elections for this position. In this case, most of the people and the time they served in the office were identified by studying the archive of official municipal websites (service web.archive.org) and local media posts. Still, only information on the current heads could be collected for settlements of the Leningrad Region even using this method.

The significance of the factors was assessed using binary logistic regression, with the dependent variable focusing on the creation of a municipality group on VK rather than its mere existence in the current year. The VK variable is 1 if the group was created in the current year, and 0 in all other cases. This setup implies that when moving to the next year, municipalities that created VK groups in the previous period are excluded from the spatio-temporal data panel. The factor variable 'Region' was introduced to reflect regional characteristics. The 'Year' variable is also a factorial one: it accumulates all institutional changes and events (for example, COVID-19) that changed the attitude towards social media. At the settlement level, the calculations included an additional binary variable *VKd* which accounted for whether the municipal district to which the settlement belonged had a VK group (1 — the group exists, 0 — the group does not exist). If both groups were created within the same year, then the value of *VKd* depended on which group appeared first.

$$\mathrm{VK} = \left\{ \begin{matrix} \text{Socio} - \\ \text{economic} \\ \text{indicators} \end{matrix} \right\} + \left\{ \begin{matrix} \text{Information} \\ \text{about the Head} \end{matrix} \right\} + \text{Year} + \text{Region}$$

The datasets prepared for the calculations for municipal districts and settlements contain a total of 1,373 and 11,562 entries, respectively. For some indicators, not all values could be collected, particularly at the settlement level (Tables 1 and 2). Data on some socio-economic indicators for 2021 and 2022 have not yet been published. Values for some municipalities were missing from the published data. All indicators were converted into comparable values (in 2021 prices) us-

ing regional consumer price indices. The fiscal capacity percentage in Table 1 is defined as the ratio of budget revenues minus non-repayable revenues to budget expenditures. All variables in Table 1, except the distance variables *(Dist, Dist_d, Dist_r),* are anticipated to have a positive effect.

Table 1

Description of socio-economic variables

Variable	Variable description	Time, years	Number of observations	
			Districts	Settlements
Pop	Population size, persons	2011—2021	1.344	10.816
Den	Population density, people per hectare	2011—2021	1.344	8.796
Dist	Distance from the district to the regional centre by road, km	2011—2022	1.352	—
Cent	The settlement is the district centre: 0 — no; 1 — yes	2011—2022	—	11.562
Dist_d	Distance from the settlement to the district centre by road, km	2011—2022	—	11.331
Dist_r	Distance from the settlement to the regional centre by road, km	2011—2022	—	11.331
Sal	Average monthly salary of employees, RUR	2013—2021	1.086	—
Sal_t	Average monthly salary of organization employees based on individual income tax return (5-NDFL), RUR	2015—2021[1]	—	6.362
Rev	Local budget revenues incurred, thousand RUR	2011—2020	1.286	10.077
Exp	Local budget expenses incurred, thousand RUR	2011—2020	1.287	10.073
Ind	Fiscal capacity percentage	2011—2020	1.286	9.978
Civ	Number of municipal employees, persons	2011—2021	1.333	9.549

Data sources: the Rosstat "Indicators of municipalities" database,[2] the Federal Tax Service[3] and Yandex Maps.[4]

[1] It was not possible to collect data for the Pskov region for the year 2021 since the Federal Tax Service website duplicates the individual income tax returns (5-NDFL) for 2020 instead.

[2] Database "Indicators of municipalities". 2023, *Rosstat*. URL: https://rosstat.gov.ru/storage/mediabank/munst.htm (accessed 11.02.2023).

[3] Regional tax reports. 2023, *Federal Tax Service*. URL: https://www.nalog.gov.ru/rn10/related_activities/statistics_and_analytics/forms/ (accessed 15.01.2023).

[4] Yandex maps. 2023, *Yandex*. URL: https://yandex.ru/maps (accessed 05.03.2023).

Table 2

Description of variables by heads of municipalities

Variable	Variable description	Number of observations	
		Districts	Settlements
Age	Age,	1.373	9.941
Gender	Sex: male — 0; female — 1	1.373	9.993
Location	Place of residence before appointment to the office: local — 0; newcomer — 1	1.363	9.941
Education	Level of education: higher; vocational; secondary	1.372	9.993
Experience	Previous work experience at the Administration: no — 0; yes — 1	1.373	9.993
Novice	First-time head of municipality: no — 0; yes — 1	1.373	9.993
Party	Party support provided in the direct election for the Head or elections of the local parliament council: United Russia; Communist Party of the Russian Federation; LDPR; Patriots of Russia; A Just Russia; Yabloko; Self-nomination	1.343	9.887
Self-promotion	Ran for office as a self-nominated candidate: no — 0; yes — 1	1.343	9.887

Data source: Central Election Commission of the Russian Federation.[1]

Table 2 presents the variables related to the personal details of the municipality heads. The *Age* variable is expected to have a negative correlation: the younger the head, the higher the chances of a group emergence on VK. Higher education would increase the chances of using social media. Although 61 % of the VK audience are women, the ratio of male and female profiles in regions of the NWFD is currently 49 % versus 51 %,[2] and in 2015 it was 53 % versus 47 %.[3] Therefore, we do not expect the *Gender* variable to have any effect. In addition

[1] Elections' calendar. 2023, *Central Election Commission of the Russian Federation*, URL: http://www.vybory.izbirkom.ru/region/izbirkom (accessed 02.02.2023).

[2] According to the TargetHunter service at the end of 2023.

[3] Male regions. Virtual population of Russia. URL: http://webcensus.ru/vmap/sex-and-age (accessed 01.16.2024).

to the standard characteristics used in such studies (gender, age, party support) [19; 21], an attempt was made to test the 'novice' effect, which could change the established management practices. In a generalized form, the *Novice* variable was used to characterize the change of leadership in the municipality and the first year of the new head in the office. The initial idea was to assess the impact of the duration of the head's holding the office. However, the information available on the website of the Central Election Commission is bound by 2006, which is not enough for this task. The *Experience* and *Location* variables reveal other possible factors that increase the likelihood of using social media when heads are changed. The first one represents the experience of working in the administration of any municipal entity. Not only the place of work but also the position was taken into account.[1] The assumption was that people without such experience were more likely to use social media more actively since they do not have the habit of strictly following the protocol. The second variable was based on the place of residence, with the heads divided into local residents registered in the municipality[2] and newcomers from elsewhere. The newcomer head might bring over the methods of communication that were common where he/she came from but novel for the given municipality. In addition, social media could be a quick and easy way for the new head to present oneself to the entire population and inform about the first results of the work.

The above variables were entered one by one into the binary logistic regression formula containing the year factor. Some socio-economic variables were used in the models in both raw and logarithmic form. The significant variables were selected and new models were built based on their combination. The main task in that stage was to test the stability of the selected factors' impact. The separate district (okrug) and settlement subsets were clustered based on selected socio-economic variables using the k-means clustering method in the R software environment. Before clustering, a multicollinearity test was conducted to exclude some variables from the clustering criteria. The number of clusters was determined using the elbow method, which is implemented in the R factorextra package. Municipalities that underutilize Internet opportunities in municipal government were identified by comparing district and settlement clusters.

[1] Categories of administration employees such as drivers or cleaners were marked as having no work experience.

[2] Settlement heads were regarded to be local if they lived in the municipal district the settlement belonged to.

Results

By 1st February 2023, all municipal districts (okrugs) and urban okrugs in the NWFD except Novaya Zemlya have created official groups on VK. Primacy belongs to ZATO Mirny of the Arkhangelsk Region.[1] Their group appeared on 30th June 2011. Two more municipalities created their groups by the end of 2011. More than a half of the official communities in this category were created between 2017 and 2018 (Fig. 1).

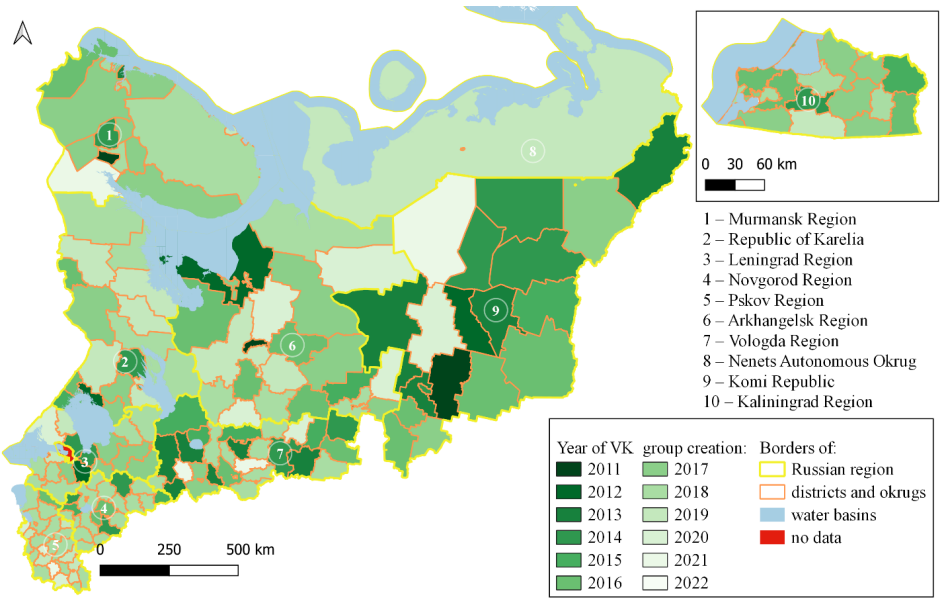

Fig. 1. A retrospective map of district-level VK group creation in the NWFD, 2011—2021

Prepared by authors using VK data.[2]

It is worth noting that the capitals were not pioneers in this process in any of the NWFD regions. The regional centres created their official VK groups two to seven years later than the first municipality from their territory did. At the settlement level, only 65 % of the entities were represented on VK. This percentage varied among regions: from 44.9 % in the Republic of Karelia to 100 % in the Nenets Autonomous Okrug (Table 3).

[1] Based on the date of the first post on the wall, according to our chosen method.

[2] Search of groups, 2023, *Vkontakte*, URL: https://vk.com/groups?act=catalog (accessed 05.01.2023).

Table 3

Settlements on VK in NWFD regions as of 01.02.2023[1]

Region	Number of settlements	Percentage of settlements with VK groups
Nenets Autonomous Okrug	19	100
Komi Republic	159	91.2
Leningrad Region	187	89.8
Murmansk Region	23	69.6
Arkhangelsk Region	178	55.6
Vologda Region	179	55.3
Novgorod Region	120	52.5
Pskov Region	111	45.9
Republic of Karelia	107	44.9

Prepared by authors using VK data[2] and Rosstat.[3]

In this category of municipalities, the process of creating their official groups also started in 2011 and until 2016 less than two dozen of them appeared annually. The average annual number of new groups appearing in the period from 2018 to 2020 was 76. In 2021 and 2022, the number of settlements' official groups on VK increased 2.2-fold. The most significant increase was observed in 2022, with the creation of pages for 248 settlements on VK. Specifically, the Pskov region saw a notable rise, with 43 new settlement groups emerging compared to only nine previously. Another feature of this category of municipal entities was that some district centres had no pages of their own. They were supposed to have acted as a foothold and role model for 'connecting' other settlements in the district to social media, since they have greater resources, including the possibility to delegate this function to a specialist. However, the current practice of merging the administrations of the district and the district centre into one has led to a situation where the joint administration would usually maintain only the district's official page. It is the most vivid in the Leningrad Region (Fig. 2), where only one district centre has a VK group. Meanwhile, almost all non-central settlements in the region have official groups.

[1] At present, the Kaliningrad Region administratively consists entirely of municipal and urban okrugs with no settlements as administrative entities.

[2] Search of groups, 2023, *Vkontakte*, URL: https://vk.com/groups?act=catalog (accessed 05.01.2023).

[3] Number of municipalities by constituent entities of the Russian Federation by 1st January 2023. 2023, *Rosstat*, URL: https://rosstat.gov.ru/storage/mediabank/1-adm-2023.xlsx (accessed 23.04.2023)

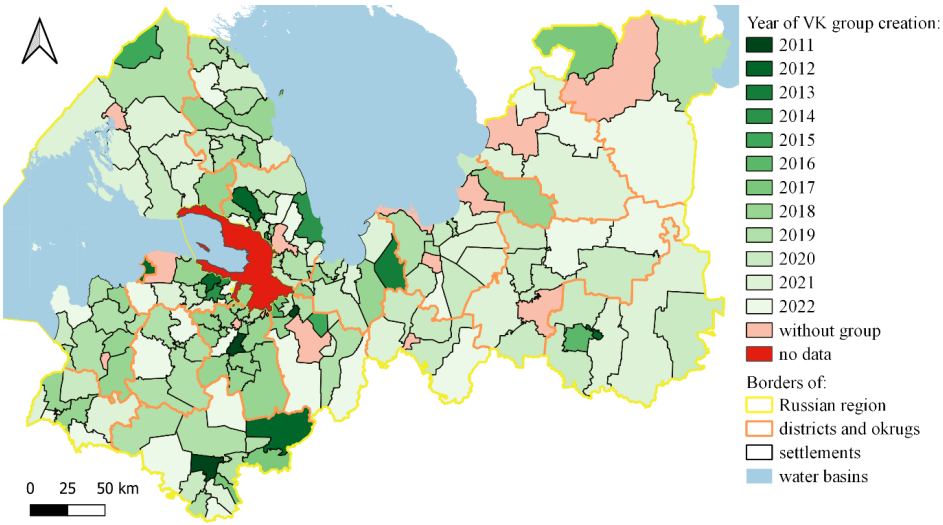

Fig. 2. A retrospective map of VK group creation in the Leningrad Region, 2011—2022

Prepared by authors using VK data.[1]

The binary logistic regression calculations based on the data from districts and okrugs (Table 4) revealed the significance of the population factor, the fiscal capacity, the budget revenues and expenditures: the higher the values of these factors, the higher the rate of official page creation on VK. In addition, the influence of the municipality head on the process was confirmed. If the elected head of the municipality was a non-local or self-nominee as a candidate, the probability of an official VK group being created increased. In the models, the year variable almost always had a significant effect, except in 2012. The likelihood of the VK group being created increased towards 2023. The peak in 2018 is due to the targeted efforts of regional authorities in the Pskov and Novgorod Regions, where VK groups were created almost simultaneously throughout the region. The high values in 2020 and 2021 can be interpreted as a response to the COVID-19 pandemic, as well as an outcome of the activities of the Regional Management Centres and their aspiration to fill in all the 'blank spots'. The combined analysis of these factors proved their impact to be stable (models 7 and 8 from Table 4). Belonging to a specific region and other factors from Tables 1 and 2 turned out to be insignificant.

At the settlement level, analysis confirmed the significance of the factors of population size, average monthly salary of organization employees according to individual income tax returns (5-NDFL), budget revenues and expenditures, the number of municipal employees, distance to the regional centre, district centre status, and the head's age (Table 5).

[1] Search of groups, 2023, *Vkontakte*, URL: https://vk.com/groups?act=catalog (accessed 05.01.2023).

Table 4

Binary logistic regression calculation results for municipal districts (okrugs) and urban districts in the NWFD, 2011—2021[1]

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept term	−6.541***	−4.719***	−8.250***	−8.141***	−4.250***	−4.688***	−4.785***	−7.449***
Year 2012	1.133	1.128	1.142	1.140	0.724	1.116	1.129	1.806’
Year 2013	1.809*	1.773*	1.782*	1.775*	1.486*	1.817*	1.775*	2.435*
Year 2014	2.136**	2.095**	2.125**	2.120*	1.616*	2.149**	1.987*	2.769**
Year 2015	1.977*	1.915*	2.044**	2.044**	1.514*	1.979*	1.875*	2.682*
Year 2016	2.660***	2.570***	2.706***	2.698***	2.186***	2.587***	2.522***	3.290**
Year 2017	3.475***	3.405***	3.544***	3.537***	3.034***	3.499***	3.369***	4.190***
Year 2018	5.267***	5.164***	5.354***	5.347***	4.816***	5.289***	5.160***	6.060***
Year 2019	4.819***	4.729***	4.885***	4.878***	4.363***	4.736***	4.734***	5.543***
Year 2020	5.174***	5.243***	5.416***	5.411***	4.761***	5.093***	5.308***	5.978***
Year 2021	6.303***	—	—	—	5.859***	6.297***	—	7.218***
Log Pop	0.194*	—	—	—	—	—	—	0.193*
Ind	—	0.006*	—	—	—	—	0.006*	—
Log Rev	—	—	0.261**	—	—	—	—	—
Log Exp	—	—	—	0.254**	—	—	—	—
Location	—	—	—	—	0.535*	—	0.516*	0.535*
Self-promotion	—	—	—	—	—	0.427’	—	0.619*
AIC	824.39	782.12	778.01	778.87	836.15	802.94	774.21	769.69
Number of observations	1344	1286	1286	1287	1362	1342	1276	1304
Significance level: ’ p<0.1; * p < 0.05; ** p < 0.01; *** p < 0.001.								

Data source: Tables 1 and 2.

[1] 2022 not included since only the Novaya Zemlya Urban District still had no group on VK.

Table 5

Results of binary logistic regression calculations for settlements in NWFD, 2011—2022

Variables	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18	Model 19
Intercept term	−4.586***	−5.630***	−7.568***	−9.192***	−9.228***	−4.549***	−9.288***	−6.204***	−5.426***	−4.490***	−5.057***
Year 2012	0.411	0.411	0.416	0.452	0.459	—	—	0.237***	0.412	0.412	−0.061
Year 2013	−0.685	−0.685	−0.677	−0.652	−0.643	—	***	−0.582	−0.685	−0.684	−0.759
Year 2014	1.410*	1.344*	1.357*	1.341*	1.342*	—	—	1.652**	1.275*	1.275*	1.667*
Year 2015	1.289*	1.287*	1.306*	1.398*	1.388*	—	—	1.669**	1.288*	1.290*	1.762*
Year 2016	1.665**	1.665**	1.690**	1.817**	1.809**	0.377	0.374	1.891**	1.613**	1.616**	2.247**
Year 2017	2.102***	2.100***	2.130***	2.249***	2.249***	0.812*	0.810*	2.389***	2.100***	2.105***	2.593***
Year 2018	3.156***	3.147***	3.195***	3.310***	3.314***	1.848***	1.830***	3.466***	3.140***	3.151***	3.302***
Year 2019	3.101***	3.098***	3.157***	3.257***	3.255***	1.820***	1.801***	3.463***	3.099***	3.113***	3.213***
Year 2020	3.353***	3.397***	3.476***	3.520***	3.519***	2.070***	2.036***	3.804***	3.338***	3.355***	3.794***
Year 2021	4.146***	4.170***	4.262***	—	—	3.009***	2.971***	4.689***	4.130***	4.154***	4.585***
Year 2022	5.243***	—	—	—	—	—	—	—	5.120***	5.147***	5.707***
Cent	−0.932***	—	—	—	—	—	—	—	—	—	—
Pop	—	0.000008’	—	—	—	—	—	—	—	—	—
Log Pop	—	—	0.255***	—	—	—	—	—	—	—	—
Log Rev	—	—	—	0.345***	—	—	—	—	—	—	—
Log Exp	—	—	—	—	0.349***	—	—	—	—	—	—
Sal_t	—	—	—	—	—	0.00001*	-	—	—	—	—
Log Sal_t	—	—	—	—	—	—	0.496**	—	—	—	—
Civ	—	—	—	—	—	—	—	0.069***	—	—	—
Dist_r	—	—	—	—	—	—	—	—	−0.0007**	—	—
Log Dist_r	—	—	—	—	—	—	—	—	—	-0.218***	—
Age	—	—	—	—	—	—	—	—	—	—	−0.020***
AIC	4049	3198.4	3161.3	2442.7	2441.3	2808.5	2801.9	2721.7	4011.7	3997.3	3530.5
Number of observations	11 538	10 816	10 816	10 070	10 073	6362	6362	9549	11 331	11 331	9941
Significance level: ’ p < 0.1; * p < 0.05; ** p < 0.01; *** p < 0.001.											

Data source: Tables 1 and 2.

Contrary to expectations, the district centre status reduced the likelihood of the settlement creating a VK group. The reason for that is the above-mentioned practice of merging district and settlement administrations. Other factors behaved as predicted: higher budget revenues and expenditures, population size, number of municipal employees and average wages increased the likelihood of a group being created on VK. The probability of a settlement creating its official VK group decreased with the distance to the regional centre. Unlike the case of district heads, the only significant characteristic of settlement heads was age. The chance of an official page being created was higher in settlements with younger leaders. The year variable had a significant effect in most cases. Since 2014, a clear trend has emerged towards an increase in settlement page emergence on VK. The most powerful incentive during the study period however was the change in Russian legislation in 2022. Settlements in the Leningrad Region, Komi Republic and the Nenets Autonomous Okrug were more likely to appear on VK compared to settlements in the Pskov Region. The effect of belonging to the rest of the regions proved to be insignificant. For settlements, the fiscal capacity level turned out to be insignificant since it can vary greatly over the years. The fact that the attributes 'distance to the district centre' and 'district's group on VK in place' (*VKd*) had no effect indicates a lack of smooth interaction on social media issues between district and settlement authorities.

Additional models were constructed to combine the significant variables, excluding those that were highly correlated (such as budget revenues, budget expenditures, population size, and number of municipal employees). These models demonstrated both the stability of the impact vector of the selected factors and their significance (Table 6).

For municipal districts (okrugs) and urban districts, clustering was carried out by population size for 2021 and the average fiscal capacity level for 2015—2020. Eleven municipalities were excluded from the clustering due to data gaps. The remaining ones formed four groups (Fig. 3).

The smallest cluster was D4, which included the Nenets Autonomous Okrug and Novaya Zemlya. They are the most hard-to-access and sparsely populated territories with the highest levels of fiscal capacity (Table 7). The next cluster in the order of increasing number of members is D2. It includes all the most populated municipalities: regional centres (except Naryan-Mar); Cherepovets and Severodvinsk urban okrugs; and three municipal districts of the Leningrad Region. The remaining municipalities form two large groups. When comparing the clustering features between them, cluster D3 completely outranks D1. In fact, cluster D1 consists of the economically weakest municipalities. It would be incorrect to say that official pages on VK were being created at a faster rate in any specific cluster. Members of cluster D2 were the first to complete this task, with the last group registered in 2020. In clusters D1 and D3, this process was completed a year later. Before 2018, when the federal government started paying much attention to this matter, the process of creating groups had been more active in cluster D3 than in D1.

Table 6

Results of binary logistic regression calculations for settlements in the NWFD: several variables and the year factor, 2011—22022.

Variables	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28	Model 29	Model 30
Intercept term	−5.092***	−8.740***	−10.705***	−10.662***	−3.826***	−3.799***	−8.845***	−8.643***	−10.974***	−5.538***	−4.054***
Year 2012	−0.060	−0.039	0.062	0.073	—	—	—	—	—	−0.161	−0.054
Year 2013	−0.756	−0.731	−0.658	−0.645	—	—	—	—	—	−0.786	−0.752
Year 2014	1.669*	1.708*	1.666*	1.671*	—	—	—	—	—	1.803*	1.577*
Year 2015	1.764*	1.813*	2.020**	2.003**	—	—	—	—	—	2.006**	1.767*
Year 2016	2.248**	2.312**	2.596***	2.576***	0.478*	0.479	0.473	0.475	0.491	2.348**	2.197**
Year 2017	2.596***	2.672***	2.939***	2.942***	0.824***	0.826*	0.818*	0.821*	0.852*	2.696***	2.602***
Year 2018	3.287***	3.415***	3.634***	3.642***	1.510***	1.496***	1.485***	1.472***	1.568***	3.408***	3.296***
Year 2019	3.201***	3.272***	3.362***	3.359***	1.433***	1.427***	1.402***	1.397***	1.432***	3.270***	3.216***
Year 2020	3.841***	3.955***	3.972***	3.970***	2.024***	2.026***	1.978***	1.981***	2.074***	3.987***	3.795***
Year 2021	4.626***	4.775***	—	—	2.964***	2.967***	2.914***	2.919***	3.080***	4.832***	4.612***
Year 2022	—	—	—	—	—	—	—	—	—	—	5.695***
Cent	−0.989***	−1.749***	−1.524***	−1.525***	−0.683***	−0.992***	−0.727**	−1.024***	−1.857***	−0.758**	−0.844***
Pop	0.000024**	—	—	—	—	0.000021*	—	0.00002*	—	—	—
Log Pop	—	0.525***	—	—	—	—	—	—	0.533***	—	—
Log Rev	—	—	0.560***	—	—	—	—	—	—	—	—
Log Exp	—	—	—	0.561***	—	—	—	—	—	—	—
Sal_t	—	—	—	—	0.000010*	0.000010’	—	—	—	—	—
Log Sal_t	—	—	—	—	—	—	0.524**	0.505**	0.374*	—	—
Civ	—	—	—	—	—	—	—	—	—	0.114***	—
Log Dist_r	—	—	—	—	—	—	—	—	—	—	−0.176***
Age	−0.019**	−0.022***	−0.017*	−0.017*	−0.013*	−0.014*	−0.012*	−0.0134*	−0.017**	−0.0194**	−0.020***
AIC	2629.6	2566.5	1906.2	1905.4	2381	2370.9	2374.7	2364.9	2301.9	2209.5	3417.9
Number of observations	9203	9203	8478	8480	5596	5591	5596	5591	5591	8060	9713
Significance level: ’ p < 0.1; * p < 0.05; ** p < 0.01; *** p < 0.001.											

Data source: Tables 1 and 2.

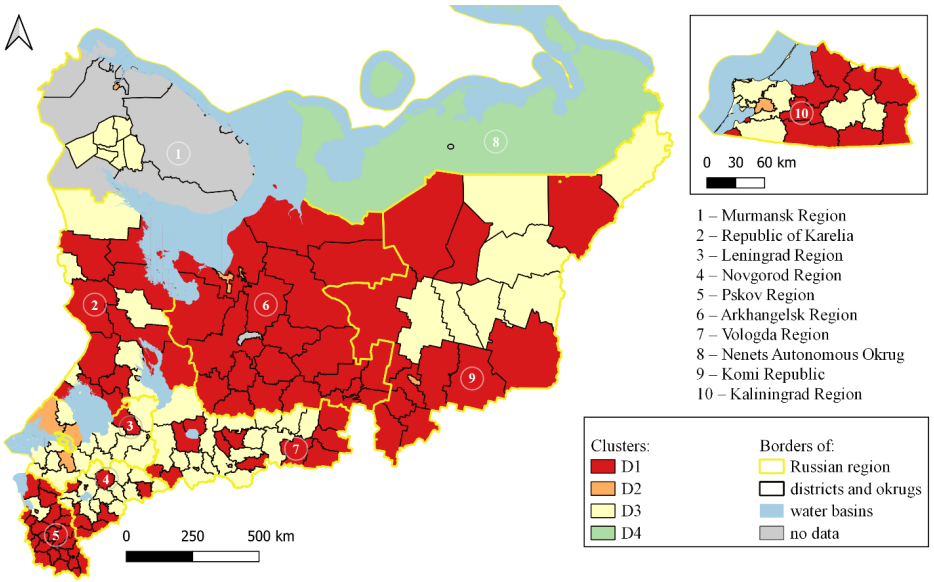

Fig. 3. Clusters of municipal and urban districts (okrugs), 2021

Calculated by the authors using Table 1.

Table 7

Descriptive statistics of cluster groups by municipal and urban districts (okrugs)

Cluster	Number of municipal entities	Indicators	Average	Median	Minimum	Maximum
D1	96	Population size, persons	1,4631.1	1,2970.5	3,551.0	52,192.0
		Budgetary independence, %	23.0	23.7	11.3	31.8
D2	13	Population size, persons	29,4905.4	279,064.0	180,668.0	506,289.0
		Budgetary independence, %	42.9	39.3	31.5	58.5
D3	76	Population size, persons	38,763.2	33,966.5	6,636.0	120,734.0
		Budgetary independence, %	37.6	36.5	26.2	55.6
D4	3	Population size, persons	16,070.7	18,745.0	3,672.0	25,795.0
		Budgetary independence, %	81.7	79.7	74.2	91.1

Calculated by authors using Table 1.

At the settlement level, the population size, average salary, distance to the regional centre, and the district centre status were selected as the clustering criteria. To conduct the cluster analysis, 96 settlements had to be excluded due to missing data. The Kaliningrad Region was also excluded because in 2018 it consisted entirely of urban okrugs and data about settlements was missing. Here, too, four clusters were formed (Fig. 4).

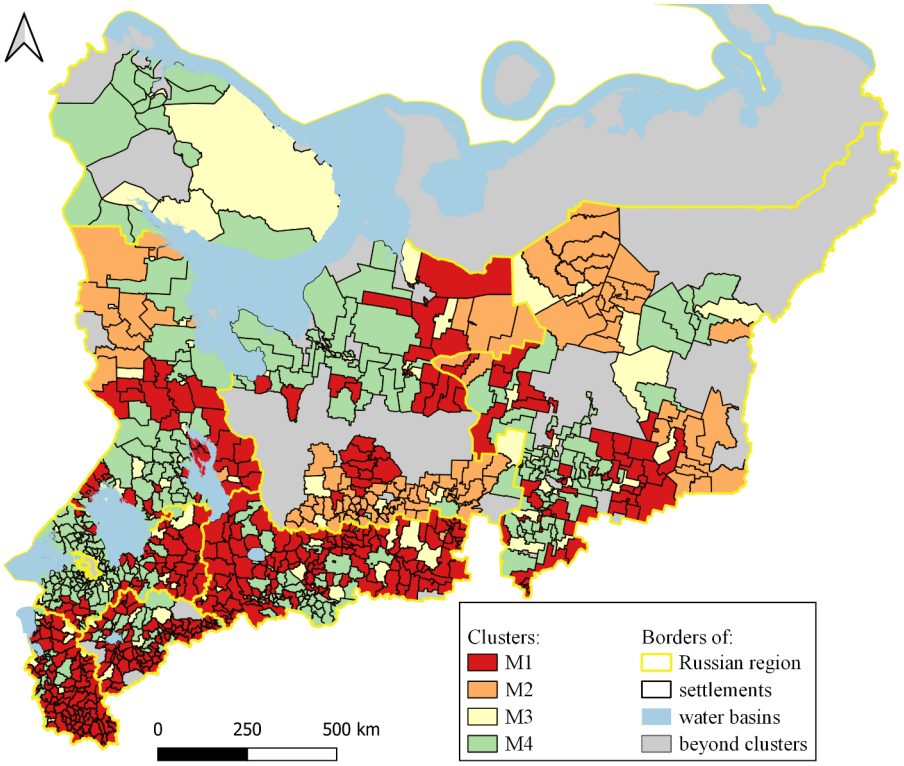

Fig. 4. Clusters of settlements, 2021

Calculated by authors using Table 1.

The settlement cluster with the smallest proportion of VK groups is M3 (Table 8). It includes all district centres of the NWFD and several settlements in the Vsevolozhsk District (Leningrad Region) falling under the strong agglomeration impact of St. Petersburg. A distinctive feature of this cluster is its high population size. It is obvious that had local government optimisation not happened, an overwhelming majority of the cluster's members would have been represented on VK. Cluster M4 has the largest percentage of settlements with official pages on VK. Its members have the highest average salaries and the largest population among non-district-cents. Settlements of the M4 cluster are located in relative proximity to the regional centre — the distance by road from half of them is less

than 100 km. In the M2 cluster, more than 70 % of settlements have VK groups. An average member of this cluster is a settlement located the farthest from the regional centre, sparsely populated, with medium-level incomes. The largest cluster is M1, where 63 % of settlements are represented on VK, and a significant part of them created an official page in 2021 or 2022. This cluster contains sparsely populated settlements with low salaries and a medium distance from the regional centre. Based on our calculations, this combination of factors did not favour the emergence of the settlement's group on VK.

Table 8

Descriptive statistics of settlement clusters

Cluster	Number of settlements	% of settlements with a VK group	Indicator	Average	Median	Minimum	Maximum
M1			Population size, people	1294.2	992.5	80	6198
			Distance to the regional centre, km	221.2	211	9	580
	404	63.4	Average monthly salary of employees of organisations based on income tax returns (5-NDFL), RUR	19 254.0	18 995.8	9327.6	30 006.5
M2			Population size, people	1084.8	703.5	75	4550
			Distance to the regional centre, km	588.6	585	390	890
	98	71.4	Average monthly salary of employees of organisations based on income tax returns (5-NDFL), RUR	27 561.7	26 815.8	20 524.9	38 826.4
M3			Population size, people	15 051.1	8009	1973	90 571
			Distance to the regional centre, km	215.9	178	8	808
	127	41.7	Average monthly salary of employees of organisations based on income tax returns (5-NDFL), RUR	28 586.9	28 379.8	16 268.5	49 773.9
M4			Population size, people	3941.3	2116	85	31127
			Distance to the regional centre, km	127.2	96.5	6	740
	358	79.3	Average monthly salary of employees of organisations based on income tax returns (5-NDFL), RUR	30 701.8	28 246.9	19 232.6	72 463.3

Calculated by authors using Table 1.

A comparison between clusters D1 and M1 revealed the settlements that are less active in using the Internet in municipal government (Fig. 5). Among the 404 settlements in cluster M1, 242 are part of municipal districts from cluster D1. The greatest numbers of such settlements are found in the Komi Republic (47), Pskov (68) and Vologda (51) Regions.

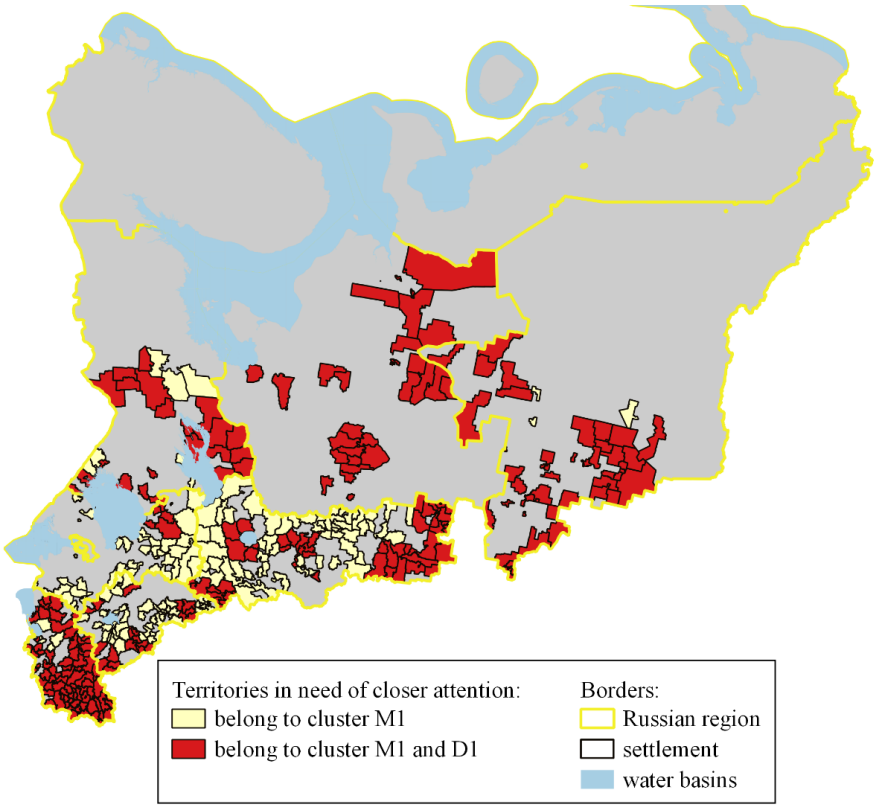

Fig. 5. Potentially hard-to-digitalize settlements

Calculated by authors using Figures 3 and 4.

Discussion and conclusions

Our results show that the engagement of social media in the work of local administrations proceeded at different rates at the administrative division levels in question. The district level is four years ahead of the settlement level. This is largely due to the regional authorities paying greater attention to districts (okrugs). Despite the legislative requirements, more than 30 % of settlements are not represented on VK.[1] One must not ignore the heterogeneity of the 'lag-

[1] 74 out of 124 district centres fall in cluster M3.

gards' group. Firstly, there are the district centres, in which the joint administration maintains only the official page of the municipal district. We believe it is a serious mistake, since the problems, events and matters of concern for residents of the district and the district centre may differ significantly. Thus, rural residents of the district can hardly benefit from the information about the dates on which the town will have no hot water in summer, whereas residents of the district centre are not interested in the information about the mobile dentist's route and schedule for small communities. Furthermore, the district centre can generate many news hooks, so some central messages may not be published on the common page for the sake of balance between centre and district messages. As a result, the interests of the district centre residents get dissolved in the district's current agenda, affecting the communication between the local authorities and citizens[1]. Secondly, this group comprises settlements merged into municipal okrugs. Formally, the legal requirements regarding presence on social media do not apply to them. There, official pages of territorial departments or directorates are maintained instead of settlement groups, depending on the region. This practice can only be welcomed. However, in the absence of uniform standards and rules, this practice is not universal and there is a tendency to minimize the number of groups.

The group of factors with positive effects on the creation of official VK groups includes the population size, income size, and budget expenditures. The population density, however, was insignificant at both levels. The fiscal capacity proved to be significant for districts and okrugs, whereas the average salary level was significant for settlements. Both indicators are metrics of the activity of the local economy. Thus, there is a direct correlation between the successful economic development of the territory and the presence of an official page on social media in the Northwestern Federal District. The distance factor appeared to be significant only at the settlement level. Settlements farther from the regional centre were less likely to create a group on VK. The distance to the district centre had no effect on the settlement's presence on social media, and neither was it influenced by whether the district had its official VK group. The above facts suggest that district authorities are not actively involved in managing the process of introducing social media into the work of settlement administrations.

[1] For example, the City of Vyborg with a population of more than 71 thousand people (36.7 % of the entire district) does not have an official group on VK. The official group of the Vyborg Region has more than 7000 subscribers, while the unofficial groups about events in Vyborg ("Vyborg VKontakte" and "Interesting events in Vyborg") have 64 and 82 thousand subscribers, respectively.

As a result, the regional centre has to orchestrate the process. Local officials from remote places have fewer opportunities to go to the regional centre for training, since the trips are more expensive for them and take more time. A good solution for this problem could be on-site workshops organized by Regional Management Centres.

Our model calculations show that in addition to the effect of socio-economic characteristics, the emergence of VK groups is also influenced by the municipality head's personalia. The effects are different for districts (okrugs) and settlements. Age turned out to be a significant factor at the settlement level: younger leaders were more willing to introduce social media into their work. It appears likely that because of the settlement administration's small staff, its head will keep the social media groups personally. The 'newcomer' effect of the head coming from elsewhere turned out to be significant at the district level. The new head's urge to get acquainted with the local population and demonstrate one's performance could be a motivation to create a page on VK. Another significant characteristic of the district (okrug) head was winning the municipal elections as a self-nominated candidate, which requires arranging streamlined communication with citizens.

Clustering based on significant socio-economic factors revealed the territories in need of closer attention in the matters of digital technology promotion. They constitute a quarter of all settlements in the Northwestern Federal District. The region that most notably lagging behind the rest in terms of the use of social media in the work of local administrations is the Pskov Region. Attention should also be paid to the Novgorod and Vologda Regions. The Arkhangelsk Region, the Republics of Karelia and Komi have local aggregations of vulnerable settlements. The analysis has thus identified territories in regions of the Northwestern Federal District that require informational, consulting, educational and infrastructural support from the Regional Management Centres, as well as measures to augment digital presence on social media.

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[1] Соцсеть *Facebook* принадлежит Meta— организации, деятельность которой признана экстремистской и запрещена на территории РФ.

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