UDC 004.942
DOI: 10.15587/2312-8372.2020.198536

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DEVELOPMENT OF ARCHITECTURAL MODELS OF INTERACTION OF VIRTUAL COMMUNITIES FOR ORGANIZING THE COLLECTIVE DOCUMENTATION PROCESS

Об'єктом даного дослідження є методи організації віртуальних спільнот у веб-середовищі. Проведено дослідження існуючих рішень щодо типів комунікативних особливостей, інформаційної поведінки, розподілу можливих ролей між учасниками веб-спільнот, методів їх організації та управління. На основі проведеного дослідження було виявлено переваги та недоліки організації кожного з типів віртуальних спільнот, а також можливостей їх функціонування в Інтернет-просторі. Досліджено принципи комунікативних особливостей між учасниками однієї віртуальної спільноти, а також вплив взаємодії між учасниками різних віртуальних спільнот на процес колаборативного інформаційного наповнення веб-ресурсів. Основні проблемні моменти пов'язані з можливістю взаємодії учасників певних віртуальних спільнот. Це може призвести до неконтрольованих інформаційних потоків, які можуть впливати на процес генерування кінцевого контенту. В ході дослідження використовувалися тематичні наукові праці, а також проводився аналіз позиціонування віртуальних спільнот різного типу. В результаті було виявлено можливі варіанти інтеграцій між різними віртуальними спільнотами, в залежності від принципу позиціонування різних веб-спільнот у веб-середовищі. В залежності від необхідності керування інформаційними потоками різного характеру для покращення якості взаємодії учасників віртуальної спільноти та генерації контенту було запропоновано три основні архітектурні рішення щодо проектування веб-спільноти. Кожен із запропонованих архітектурних підходів має свої особливості. Для забезпечення максимальної інформаційної безпеки найкраще підходить використання власної інформаційної системи, де відсутні зв'язки з іншими онлайн-спільнотами. Загальнодоступні веб-сервіси мають багато веб-спільнот різного характеру. Такі спільноти є складовими однієї глобальної спільноти конкретного веб-сервісу у цілому. Взаємодія між віртуальними спільнотами може призвести до небажаних інформаційних дій між учасниками з різних віртуальних спільнот. Доволі цікавим варіантом може стати поєднання даних парадигм. Завдяки отриманим результатам дослідження пропонуються ситуативні методи, кожен з яких має свої переваги та недоліки.

Ключові слова: *віртуальна спільнота, колективне документування, інформаційна поведінка, інформаційні потоки, архітектура віртуальної спільноти.*

Received date: 14.11.2019
Accepted date: 18.12.2019
Published date: 28.02.2020

1. Introduction

The process of electronic collaborative documentation involves the interaction of its participants, the main purpose of which is the generation and distribution of information content among themselves. Modern web technologies allow to use their functionality to implement this process.

The use of modern web tools encourages users to unite within certain online communities. These web tools form their own virtual communities as part of their resource. Since each web service is designed according to specific requirements for the specifics of its operation, the quality and productivity of the existence and functioning of various virtual communities on many services can vary significantly.

The use of one or more means of the web environment for organizing a collaborative process leads to a certain type of interaction between participants in various virtual communities.

Given the possibility of using one or many web services for organizing the process of collective documentation, the formation of information flows that need to be regulated becomes possible. Therefore, it is relevant to study existing approaches to the architectural organization of virtual communities in a web environment.

2. The object of research and its technological audit

The object of research is the methods of organizing virtual communities in a web environment.

An important factor is that each virtual community uses certain online services that have their own specific functionality [1]. The informational behavior of participants

in collaborative documentation, as well as the quality of the content of the web service, depends on this. This can cause unauthorized information flows both between participants in the process of collective documentation, and between participants in various online communities. Since each web service contains its own global community [1], when using a complex of various web services, some communities nest in other communities. This can lead to uncontrollability of information flows. Also, various functionalities and information bases of various services can cause a lack of automation of regulation of rights and permissions for participants in the process.

3. The aim and objectives of research

The aim of research is to identify the most relevant principles of the architectural organization of virtual communities to ensure the process of electronic collaborative documentation. To achieve this aim, it is necessary to:

1. Analyze the types of virtual communities.
2. Identify the possibilities of positioning various web communities in the Internet space.
3. Identify the main advantages and disadvantages of the informational behavior of participants in virtual communities in various conditions of positioning of their virtual communities.
4. Identify possible applications of various architectural paradigms and the possibility of preventing the influence of their weaknesses on the process of color documentation.

4. Research of existing solutions of the problem

The problem and classification of the concept of virtual or online communities has been dealt with by a number of scientists. Taking into account some of their scientific works [1, 2], it is possible to conclude that virtual community is a fundamental concept that is directly related to the emergence of various types of web services. The online community is based on shaping the content of web services.

Virtual communities can be classified according to certain categories: open, closed; global, local, in the thematic area [1].

The concept of «electronic document» is quite multifaceted. Therefore, in the framework of this study, it should be understood as a text file that can be distributed by means of online communication. And also this, directly, the content of the online resource, which is obtained as a result of collaborative interaction of participants in certain virtual communities.

It is also necessary to take into account the communicative activity of all types that are inherent in a particular virtual community, based on the use of specific types of online environments, including posts, messages, comments, etc. [1, 2].

The activity of users of web services has a different context, in connection with which it is necessary to take into account the classification of participants in virtual communities within a single web service [2, 3]. Since the content itself is formed as a result of the information behavior of users [4, 5]. An important factor is ensuring the correctness of information flows within the web community [6]. According to the information activity of users, they can be divided into certain hierarchies, depending on the context of their assessment.

When designing the architecture, the study also took into account:

– approaches to modeling social networks and communities, development of design and management methods [7];
– issue of information retrieval in social media [8];
– algorithms and methods for identifying and processing subjectively created information [9, 10]. In particular, indicators of social leadership in information systems [11];
– system of integration of public and state institutions, social media of the Internet [12];
– communication processes, the formation of web communities and content [13].

A study of the planning process for the provision of educational services is based on the experience of universities in different countries [14, 15]. The experience of Japanese universities in providing general access to education is also taken into account [16].

Summing up the above analysis of literary sources, it should be noted that there are no developed architectural solutions for the interaction of virtual communities for organizing the process of collective documentation. This emphasizes the promise of the research.

5. Methods of research

Various scientific methods are used:
– analysis of existing solutions in the study of scientific papers;
– monitoring the functioning of various types of web resources;
– comparison of the functionality of all the analyzed web resources and the functioning properties of their virtual communities;
– abstracting from specific objects of research in order to transfer the acquired knowledge to a unified form;
– synthesis of the obtained research results in order to identify the most successful options for architectural solutions for creating and positioning virtual communities;
– generalization of the results.

6. Research results

According to studies, all virtual communities are based on the use of a web service and are a group of participants who produce certain content. Organization of the process of collaborative documentation in a modern Internet environment can use various means to achieve the most productive interaction between its participants. Therefore, the concept of a virtual community can be somewhat different for the same people within different types of web resources [3, 4].

The organization of the collaborative electronic documenting process provides for the possibility of using a number of services, which can vary significantly both functionally and in the quality of the formation of information content [1]. The differences in the positioning of virtual communities on various web services are due to the rules for their use, which are designed by the owners of these services.

Users of information systems using a web resource of one type or another, in fact, are participants in the general virtual community of this particular web resource. The scheme of this phenomenon is shown in Fig. 1.

ISSN 2664-9969

Attracting one web resource that is designed specifically for a specific group of people is the most effective. This is because the virtual community (possibly of a closed type) will consist only of authorized participants, make up a single virtual community within a single web resource. This approach can solve all the necessary needs in regulating the information behavior of users. The implementation of such an approach may prove financially unjustified for organizing collaborative documentation if the organizers are limited in resources or the amount of work is not worth the cost. Therefore, an affordable solution may be to use existing publicly available information systems in an online environment.

First of all, the process of interaction between participants who produce content using the means of web environments provides for their integration into one common virtual community. If one web tool is used in the collaboration process, it is publicly available, a number of features of its functioning should be taken into account. Thus, when using a publicly available web based tool, all users can be divided into certain dedicated online communities, which are united in one global one. An example of this situation is shown in Fig. 2.

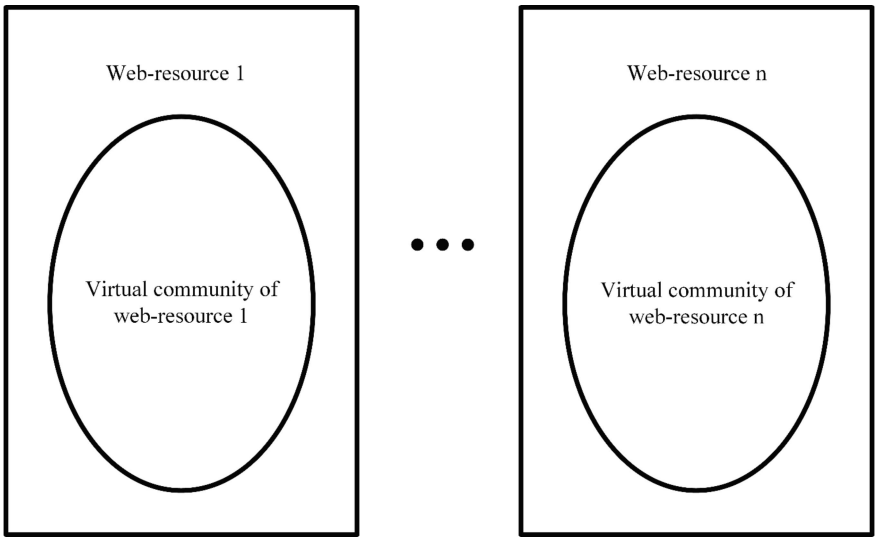

Fig. 1. Positioning scheme of a virtual community within a specific web resource

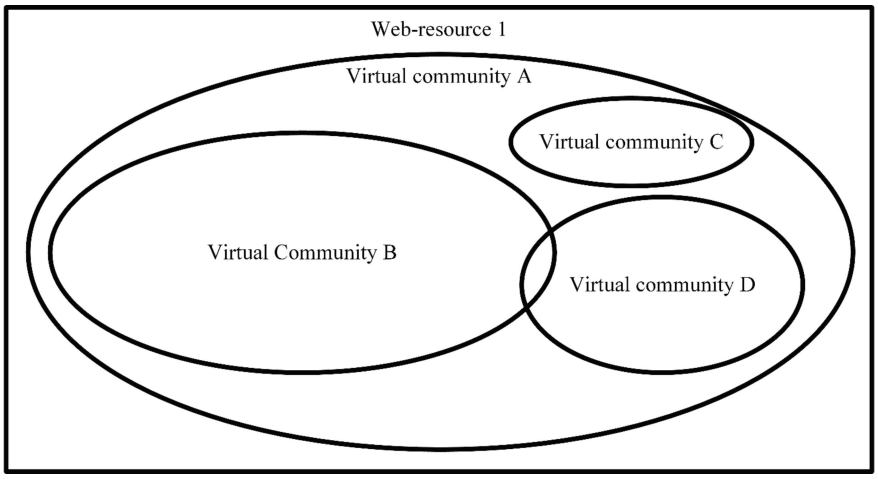

Fig. 2. The scheme for positioning virtual communities within one public web resource

As can be seen from Fig. 2 users of various web communities can be in close communication. For example, one and the same user can be a member of several groups of users that are independent of each other. It is also possible that there are no comprehensive tools for establishing access rights to links within the activity of a specific virtual community. Situations of this type can lead to undesirable information flows as part of the collaboration process itself, as an irrelevant information impact, and vice versa – loss of quality information content. The organization of the privacy of the process of generating content and user access rights, in this case, depends on the means provided by the developers of the target service.

Using a specific web resource is provided for by its functionality. Web resources of various types have slightly different features of the regulation of control over users, or their groups. Regulation of the information behavior of users, as well as the establishment of rights for them, occurs within the limits provided by the developers when implementing a particular web service. A detailed analysis of the features of each of the basic types of web resources is carried out in the study [1]. According to this study, it is found that the regulation of user groups within the same web resource is the easiest to implement and automate the regulation of user rights, from the point of view of organizers of collaborative interactions of participants in web communities. In this case, users use a single shared web resource without using third-party web services. This option is the most transparent in the regulation of rights and privileges, as well as for analyzing the information behavior of each of the users of the virtual community. The principle of using one web service, with the goal of creating a web community to produce content, is shown in Fig. 3.

It is also possible to use several information resources that are not directly dependent on each other. An example would be the use of a single information environment as a data warehouse. To establish communication between participants – the use of email or chat. In addition, the use of a web forum to organize a more centralized discussion process, the creation of qualified electronic information sources. In addition, it is possible to attract other specific services in the presence of specific requirements for the activity of process participants. In this case, the participants in the collaboration represent a certain common virtual community. Each of the public web services is also its own users, which make up the overall virtual service community. But each service can contain different groupings of participants, which also make up virtual communities that are part of the general service

community (Fig. 2). Since it is possible to use several such services, this can lead to the integration of various web communities at the level of interaction of their participants within the framework of specific services (Fig. 4).

Fig. 4 depicts a situation where publicly available Internet tools are used. This approach may not be exhaustive if it is necessary to establish specific rules for regulating information flows and automating user administration processes.

A case of using a complex of generally accessible integrated information systems among themselves is also possible. In this case, the integration of services can contribute to both better automation in regulating the process of user interaction, and in regulating information flows in general.

This method involves the use of both related services, and completely independent of each other. In any case, this allows to significantly expand the efficiency and quality of the process of filling a certain web resource, but this can cause problems in the regulation of rights and in the analysis of information activity of users as a whole. The general principle of using many web services in the form of means of organizing one web community, in the framework of which color-coded documentation occurs, is shown in Fig. 5.

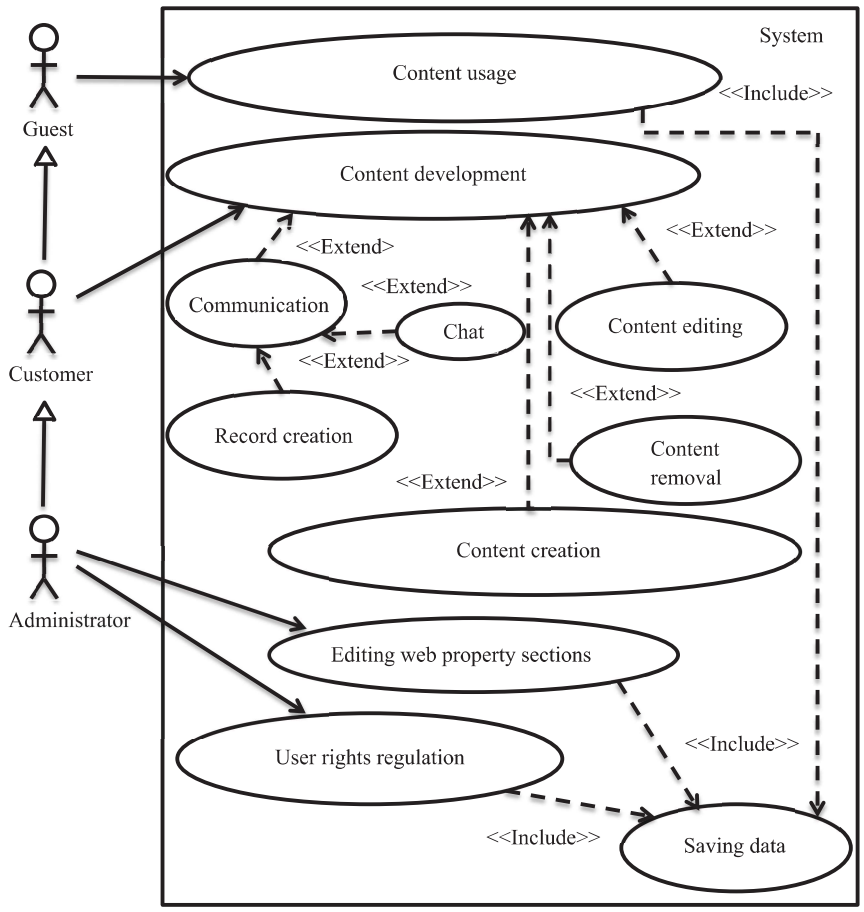

Fig. 3. Diagram of the use of an information system for collaborative documentation using a single web service

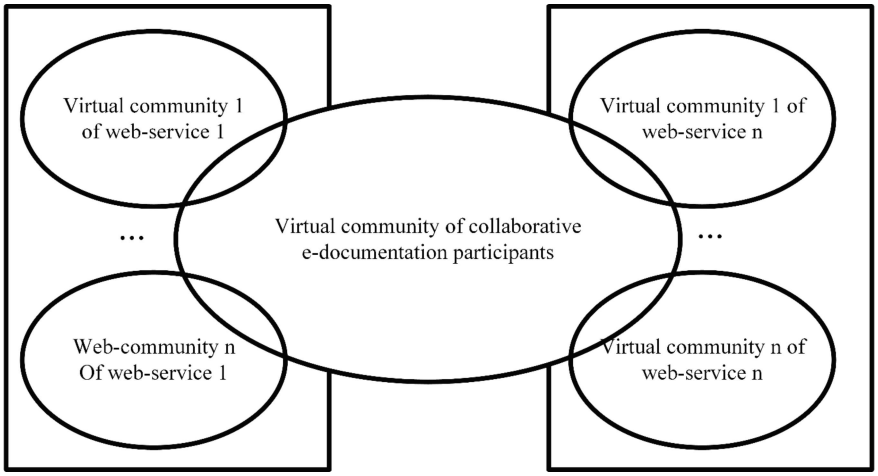

Fig. 4. Scheme of possible interaction of virtual communities when using various web services

ISSN 2664-9969

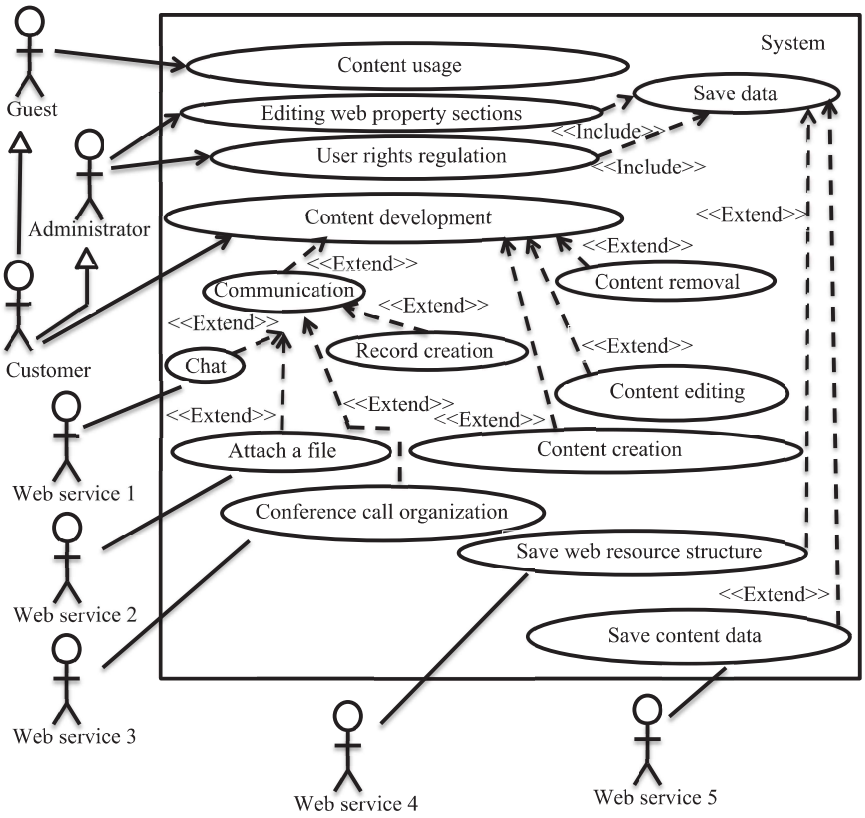

Fig. 5. Diagram of the use of many web services to organize the process of collaborative documentation

As can be seen from Fig. 5, each individual service provides for the maintenance of a particular user need. Thus, the regulation of the information behavior of users can be significantly difficult, because in this case one online community is based on the use of non-directly related web resources.

The principle of interaction between users and the information flows of various online communities may differ, depending on the specific implementation of certain services. The simplest scheme of the principle of implementation of integrated environments in general is shown in Fig. 6.

According to the principle indicated schematically in Fig. 6 it is possible to conclude that when using the same identification data, each individual service has its own database in which the results of information activities of users should be stored. Since the virtual community is a combination of its participants and the information that they produce, it is therefore possible that fuzzy characteristics may arise in the process of determinism of the very concept of «virtual community» in this particular case. In this case, the general scheme for detecting virtual communities is shown in Fig. 7.

The situation is that each individual web service has its own target functional characteristics. This allows to use it in accordance with its intended purpose, within the framework provided by its developers. But the identification information of users of each service, in this case, is common.

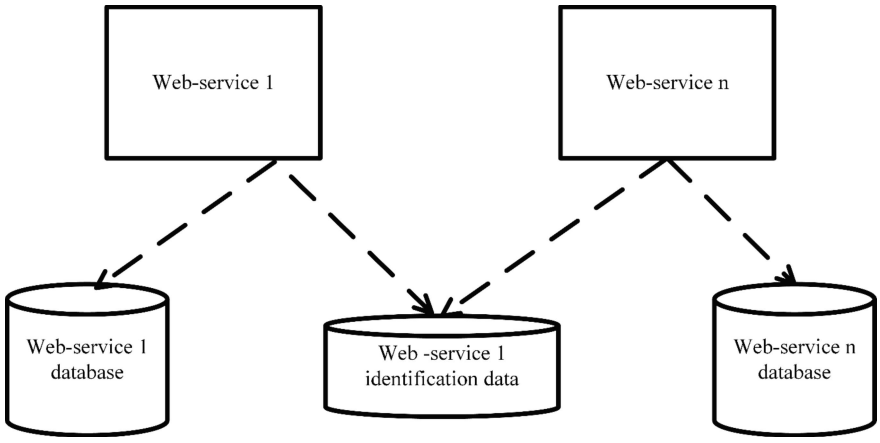

Fig. 6. The implementation scheme of simple integrated environments

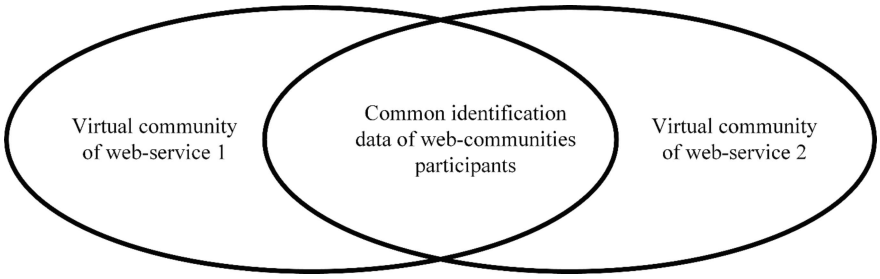

Fig. 7. Virtual community diagram with different content and shared identification data

One example of such integration may be a website that does not have direct registration, but provides login using the identity of one of the supported services (for example, log in via Facebook). Thus, the generation of content on each of these services can occur and be stored in independent data warehouses. This will indicate the distribution of the same participants to two different, albeit related, online communities, in fact. According to the analyzed works of scientists, this can be described as the existence of two local online communities within one global [1]. It should also be noted that in the case of such a simple implementation of the integration of web services, it becomes possible to automate the behavior and roles of all participants in collaborative documentation as much as possible. This is due to the use of common identification information on both services simultaneously.

There are also many other, more complex, options for implementing integrated web services.

The web environment also includes services, the use of which is possible during the sequential registration of accounts, which, to a certain extent, may be interconnected. The basic principle for implementing this kind of information systems is shown in Fig. 8.

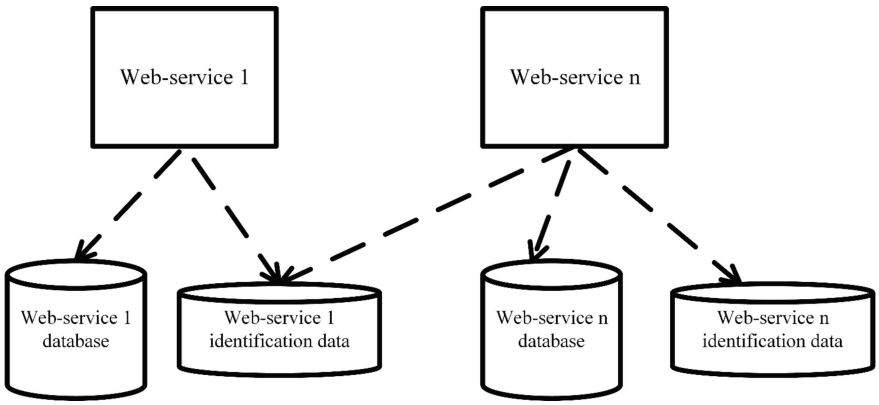

Fig. 8. The principle of implementing related web services that require the registration of additional accounts

One example would be the implementation of the relationship of Google services. The foundation is the creation of Gmail email. After that, it becomes possible to register with subsidiary services, for example, YouTube, Google Drive, and others. In this case, it becomes possible to link the registration of subsidiary accounts to the main one, but it is really difficult to automate both the administration of user information behavior and the organization of their roles in general. From another point of view, such an implementation will maximize the isolation of the information behavior of online community participants within each of them.

Automation problems, with such an organization of the process of collaborative documentation, can be canceled if to create your own integrated information systems. Since all infobases should belong to the owners of these resources, therefore, an important factor is the creation of a software tool for administrators. With the help of this tool, they should be able to automatically regulate the powers and capabilities of information activities of users. This is done based on the general identity of user accounts. The use of proprietary systems is the most promising, since it is possible to take into account all possible variants of the functional characteristics of each of the systems. However, as practice shows, this is financially unjustified. In most cases, for the organization of joint electronic documentation, it is enough to attract publicly available online tools. In this case, a situation is possible where this may not be exhaustive.

According to the studies analyzed, virtual communities can be classified into open and closed.

The use of public services, the functionality of which provides for the formation of open virtual communities, is not always exhaustive. This is due to the fact that openness of the community can lead to an undesirable informational impact on the process of co-corporate content filling of electronic documentation by unauthorized users of the web resource. For example, hostile page visitors can use high-quality information, or vice versa – create certain obstacles in the formation of new content.

The solution to this phenomenon could be the use of closed web communities. Since only authorized users can see all the content, this makes the process of filling an electronic document with information filling more secure. But it should be noted that if such a community is created on the basis of publicly available web services (for example, a closed group on a social network), such a community will be local and must obey the general rules of the web service. Thus, authorized users of a higher rank in the hierarchy of roles in the web service itself will be able to adjust the actions of this community according to the authority assigned to them. In most cases, this is an insignificant factor when choosing a platform for organizing a virtual community for collaborative documentation, but in some cases this can be an important factor. It should also be noted that the use of publicly available web services does not guarantee the invariability of the policy for their use and the long-term support of their functionality.

These problems can be resolved by regularly archiving electronic documentation, but user credentials will not be available. In this case, if the accounts of the virtual community participants have not been previously registered by an authorized person. The person responsible for organizing the process of electronic collaborative documentation.

7. SWOT analysis of research results

Strengths. The strengths of research are to identify important architectural decisions for the organization of a virtual community, which take into account the necessary informational behavior between participants in the process of collective electronic documentation.

Closed virtual communities provide for the lack of information interaction with participants in other communities as part of the internal collaborative process. This makes it possible for all participants in the collaboration to concentrate as much as possible on the development of content without external destructive impact.

Open virtual communities – on the contrary, allow certain types of interactions with participants in other

ISSN 2664-9969

virtual communities, in some situations it can contribute to the addition of content generation.

By the way, the solution is also the creation of a «hybrid» virtual network, in which there should be a delimitation of access levels to information interaction between participants in various web communities. The combination of such features, for example, on different forum branches, can allow both the regulation of information flows within the created web community, and the possibility of cultivating information interaction with other virtual communities, if necessary.

Weaknesses. Weaknesses are also present for each of the detected architectural types of virtual communities.

To ensure complete closure of the virtual community, it is desirable to use a web service that will contain only one specific virtual community. This decision provides for the creation of its own web resource with all the necessary functionality, according to the requirements for the process of collective electronic documentation by its organizers. This requires financial costs as well as time.

The weakness of open virtual communities lies in their relative insecurity from informational influences from outside, compared with closed communities. This can significantly affect the quality of content generation by participants in the process of collaborative documentation, therefore, the organization of open-type virtual communities should only be necessary if there is a need for active integration of information flows with other web communities.

The organization of a virtual community, which could combine the properties of open and closed communities at different levels, completely depends on the functionality provided by the developers of the services, as well as the level of their information integration among themselves. In this case, the functioning of the virtual community of this type may not be exhaustive.

Opportunities. The use of one or another architectural paradigm for organizing a virtual community provides for various types of regulation of information flows, both between participants in a particular virtual community, and between participants in various virtual communities. Thanks to the regulation of information flows as part of the collaborative documentation process, it is probably better to plan analytics for generating content in the middle of a virtual community.

Threats. When using open information systems, financial costs are not mandatory. But in this case, the organizers of the process of joint documentation should take into account all the functional features of certain resources. Not every web service is available, or their complex, can satisfy all the ultimate needs for the correct functioning of the virtual community that is being created.

The use of our own information systems involves financial costs for the development of our own web service and the conditions for its positioning in the Internet environment.

In addition, the creation of the proposed system for synchronizing user data that use various web resources as part of a single process of collective documentation, also requires financial costs.

All possible costs for the implementation of the systems proposed in the research should be determined upon the fact, in accordance with the requirements for the organization of a specific process of collaborative documentation.

8. Conclusions

1. The main types of virtual communities are analyzed: global, local, open, closed. Based on the analysis, the specifics of the functioning of each type of community are revealed. Possible features of their functioning and implementation were depicted on the models reflected in the research. In particular, in the model of positioning a virtual community within a specific web resource, each web service has its own virtual community, which consists of users of one particular service. In the case of a model for positioning virtual communities within one public web resource, it is possible to form new virtual communities within such a web resource that become components of the global service community. In the model of interaction of virtual communities when using various web services, several services are used within the framework of a single organized process of collaborative electronic documentation. In this model, participants in the process are also participants in the web communities of each of the services used. Closed virtual communities are characterized by maximum isolation of information flows and connections with other virtual communities. Open – on the contrary, allow participants in various communities to influence, or use the results of content.

2. The possibilities of positioning various web communities in the Internet space are analyzed. An important observation is that when using several web services, «several» virtual communities can appear at once. These communities become local and, in fact, become an integral global community for each individual service. In this case, all local virtual communities are completely dependent on the administration of a particular web service, which at any time can change both the rules for using the service and its functionality available to users. The means of functioning of individual web services can vary significantly, which can lead to irrelevant automation of regulation of user rights. The solution proposed in the study indicates the possibility of avoiding this problem.

3. Based on the above results, possible options for interactions between participants in virtual communities are analyzed. The use of various types of web services affects the positioning and activity of virtual community members. In the case of the functioning of a closed-type community, all its members have the opportunity to conduct information provided for by the organizers of the collective documentation process. Participants from other virtual communities should not be able to conduct informational behavior in the middle of a closed-type web community. It is possible that the administrators of the process of collective documentation can provide special links to the site where there is a valid information interaction of participants from different virtual communities. Thus, it is possible to ensure the involvement of external information behavior in a limited space specially designated for this. Fully open virtual communities provide for the active integration of information flows between participants from different virtual communities.

4. For organizing a collaborative process of electronic documentation, as safe and controlled as possible, the most interesting option may be to develop your own web service. In this case, the site owners will be able to coordinate the actions of the virtual community. Setting up a web service for your own needs provides the opportunity to

maximize isolation of information flows, as well as create integrative capabilities with other services, if necessary. The main disadvantage of this approach may be the large expenditure of resources and time for its implementation and further support.

The use of public services implies a situation where web communities are embedded in one global one, within a specific web resource. The emergence of many subordinate local web communities that have the ability to exchange information flows, in some situations, the integration of part of the participants in one another, can lead to unpredictable situations in the regulation of information flows between its participants. In this case, it all depends on the functionality provided by the web resource itself, as well as on the ability of the organizer of the process of collaborative documentation to use them successfully.

The use of integrated environments can bring maximum productivity in achieving the quality of organization of the process itself. But this implementation assumes the presence of participants in the electronic documentation process in different, in fact, virtual communities. In addition, each of the services has its own global virtual community, if it is publicly available. This can lead to the ambiguity of the distribution of information flows between other virtual communities, if they are publicly available.

The disadvantages of available web based tools as a permanent platform include the ability to change their functional characteristics, the policy of using the service, as well as the cancellation of its further support. Each change can affect the functioning of virtual communities within a particular service as a whole. Solving the shortcomings associated with the use of publicly available Internet tools allows the user account management system of the collaborative electronic documenting process by an authorized user administrator who organizes the site process.

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