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FEATURES OF THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES TO SUPPORT PROJECT PROCESSES IN DISTRIBUTED TEAMS

The study presents an in-depth analysis of the role of information and communication technologies (ICT) in the context of managing project processes in distributed teams. The main focus is on the classification and evaluation of the effectiveness of communication and information technologies as tools that significantly increase productivity and contribute to the optimization of work processes in such distributed teams. The main interpretations of the concept of distribution in project teams are given.

The methodological approach of the article is based on a comprehensive analysis of existing problems of communication and information exchange in distributed teams. A systematic approach was used to structure and define the main channels of communication, based on a hierarchical diagram developed on the basis of expert assessments and analysis of work processes.

The results of the study present a detailed comparative analysis of widely used platforms for project management, such as Trello, Asana, Jira, Microsoft Project, etc., with an emphasis on their functionality, areas of application, and project management models and assignments in terms of distribution in project teams.

The authors carried out a comprehensive comparison of communication and information systems, as a result, a number of main trends in the use of ICT in project management over the past four years were revealed. Special attention is paid to the most popular tools, the definition of their unique features and the potential of application in various projects. Innovative approaches to the automation of project processes in the context of project management platforms for distributed teams are also considered, with the proposal of a new algorithm for their implementation.

The conducted analysis makes an important contribution to the understanding of how information and communication technologies can be applied to improve the efficiency and productivity of distributed teams, in particular in the aspects of supporting project processes. The study contributes to a deep understanding of the key factors affecting the successful integration of the considered technologies into modern project practices.

Keywords: information technologies, communication technologies, distributed teams, platforms for project management, project management model, project management services, automation of project processes, tools for joint work, tools for documentation.

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ОСОБЛИВОСТІ ВИКОРИСТАННЯ ІНФОРМАЦІЙНИХ ТА КОМУНІКАЦІЙНИХ ТЕХНОЛОГІЙ ДЛЯ СУПРОВОДУ ПРОЄКТНИХ ПРОЦЕСІВ У РОЗПОДІЛЕНИХ КОМАНДАХ

У дослідженні представлено глибокий аналіз ролі інформаційних та комунікаційних технологій (ІКТ) у контексті управління проєктними процесами в розподілених командах. Основна увага приділена класифікації та оцінці ефективності комунікаційних та інформаційних технологій як інструментів, які значно підвищують продуктивність та сприяють оптимізації робочих процесів у таких розподілених командах. Наведено основні трактування поняття розподіленості в проєктних командах.

Методологічний підхід статті базується на комплексному аналізі існуючих проблем комунікації та інформаційного обміну в розподілених командах. Використано системний підхід для структурування і визначення головних каналів комунікації, заснованих на ієрархічній діаграмі, розробленій на основі експертних оцінок та аналізу робочих процесів.

У результатах дослідження представлено детальний порівняльний аналіз широко застосовуваних платформ для управління проєктами, таких як Trello, Asana, Jira, Microsoft Project, і ін., з акцентом на їх функціональні можливості, сфери застосування й моделі управління проєктами та призначення в розрізі розподіленості в проєктних командах.

Автори здійснили комплексне порівняння комунікаційних та інформаційних систем, в результаті виявлено ряд основних тенденцій використання ІКТ у проєктному менеджменті за останні чотири роки. Особливу увагу приділено найбільш популярним інструментам, визначенню їх унікальних особливостей та потенціалу застосування у різноманітних проєктах. Також розглянуто інноваційні підходи до автоматизації проєктних процесів в контексті платформ управління проєктами для розподілених команд, з пропозицією нового алгоритму їх імплементації.

Проведений аналіз у роботі вносить важливий вклад у розуміння того, як інформаційні та комунікаційні технології можуть бути застосовані для покращення ефективності та продуктивності розподілених команд, зокрема в аспектах супроводу проєктних процесів. Дослідження сприяє глибокому розумінню ключових факторів, що впливають на успішну інтеграцію розглянутих технологій в сучасні проєктні практики.

Ключові слова: інформаційні технології, комунікаційні технології, розподілені команди, платформи для управління проектами, модель управління проєктами, сервіси управління проєктами, автоматизації проєктних процесів, інструменти для спільної роботи, інструменти для документації.

Introduction

The use of information technologies is becoming a critical success factor in the management of project processes in today's world, which is rapidly developing and constantly changing, caused by globalization and technological progress. This is especially true for distributed teams, where coordination of efforts, parallel execution of project fragments, effective communication and integration of efforts of all participants, who may be located in different time zones and have diverse cultural and professional backgrounds, are vital.

During the COVID-19 pandemic, unpredictable military conflicts with cells in Ukraine, Israel, and other countries, it becomes clear that we are facing new challenges. The economic, business and human costs of the pandemic continue to unfold, and organizations that previously focused on office work have been forced to quickly shift to a distributed team model while trying to keep their businesses afloat during the global economic downturn. During military conflicts, the issue of relocation of offices, employees, effective communication, preservation of personnel and their potential, and effective management of project processes arises as well.

Features of the use of information and communication technologies in distributed teams gain even more weight in the light of these events. People who were previously used to office work and stability in the external environment suddenly found themselves in conditions of remote work or relocation without the appropriate training and base, many of them also faced with additional difficulties due to the closure of children's institutions and educational institutions, as well as direct threats to health or even life due to pandemics and military conflicts. Therefore, acquiring the skills to work effectively in distributed teams is more important than ever.

This problem can be traced not only in the software development industry, but also in many other industries and countries, where it is necessary to find common principles of success among a wide range of professions [1].

Information and communication technologies can contribute to the effective implementation of project processes in distributed teams, taking into account the geographical, functional and temporal distribution of their participants.

According to Maynard, distributed teams (or remote teams) are those whose members are geographically distributed, rely on ICT for communication, and face challenges in terms of reducing gaps, reducing the number of people involved, and inefficiency [2]. In Malhorta's work, a distributed team is defined as a decentralized group of people working from different geographical locations, often in different time zones and with daily schedules, interacting through technologies for communication and collaboration, with varying degrees of reliance on ICT to coordinate their activities, regardless of the team size [3].

Before considering the use of information and communication technologies for the implementation of project processes in distributed teams, it is worth highlighting the main problems that may arise in distributed teams and affect project processes (Fig. 1).

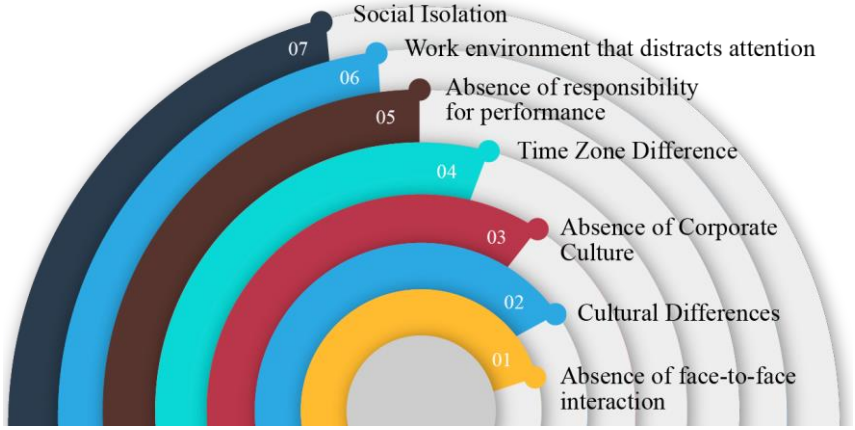

Fig. 1. Distinguishing problems that arise in distributed teams

A team is usually a group of members from different departments who work together temporarily to solve problems. The definition of distributed teams will be considered according to Margaret Boos. She defines distributed teams as groups of people who do their work in different locations and can interact primarily through communication tools such as e-mail, video conferencing, and other technological tools. This means that team members are physically dispersed, but remain connected through technology to achieve a common goal [4]. Another definition is given by Cramton. She believes that distributed teams are groups of people with a common goal who perform interdependent tasks in different locations and time zones, using technology to communicate much more than face-to-face meetings [5]. Solving problems by such teams has some advantages. First, it is possible to find the right person for almost every job. Especially if some special skills or expensive licenses are required, working in distributed teams helps to find solutions. In addition, different participants can have good knowledge and expertise in their market, so products can be adapted to the realities of the market represented by the members of the distributed team.

Apart from these advantages, there are also several disadvantages. The critical point is the participants themselves. They should be suitable for working in distributed teams. Otherwise, they jeopardize the success of the project. Another problem that can negatively affect projects is personal conflicts. To avoid this, a good identification with the team and the project is necessary. This can be ensured through personal meetings. However, such meetings are often avoided when working in distributed teams due to the associated costs. This leads to the predominance of digital communication forms that filter some important communication channels [6].

Kumar Goel believes that information and communication technology (ICT) is essential for working in distributed teams, but there are both advantages and disadvantages. As for the first, these technologies facilitate the rapid exchange of information, the sharing of files, and the clarification of doubts and the exchange of opinions [7].

M. O'Leary, J. Wilson and A. Metiu found increased communication in remote work due to the proximity effect provided by ICT, regardless of whether team members have daily contact or not. From this perspective, a cultural view of information technology (IT) that supports interpersonal dynamics can be seen as a way of enriching interactions among members, adding even more value in terms of increased productivity, enhanced communication, and the process of identification. The authors investigated that perceived proximity (i.e., cognitive and affective feelings of relational closeness) rather than physical proximity (i.e., geographic proximity measured in miles or kilometers) influences relationship quality in distributed teams. The results prove that people can form strong bonds despite great distances, and continue to shift the emphasis from information systems as "pipes" or channels to information systems as means of conveying shared meaning and symbolic value [8].

According to research by A. Reed and L. Knight, there are three factors that can lead to communication risks such as communication loss or poor communication, technical connectivity issues that hinder communication, and insufficient knowledge transfer. Some of the risks associated with perception can also lead to problems in communication. Despite the increased reliance of distributed teams on ICT, there was no evidence of significantly greater project risk due to technology failures. However, there was noticeably more risk precisely because of insufficient transfer of knowledge in the projects of distributed teams. A likely explanation is the reduction of implicit or informal knowledge transfer in virtual environments [9].

A review of communication technologies to ensure the effectiveness of distributed teams

Communication channels used by distributed teams are tools that promote effective interaction and coordination in project processes. Expert evaluations were conducted regarding the importance of each channel according to a scale from 1 to 5, where 1 indicates the minimum importance, and 5 – the maximum one, evaluations were made on the basis of the methodology of expert evaluations. Face-to-face meetings, including environment, verbal exchange, dialogue, voice communication and sign language, receive the highest score of 5, given their high effectiveness for deep understanding and complex communication in the context of project teams, but this communication channel in its classical form is extremely difficult to use for distributed teams.

Video conferences. Video conferencing with ratings of 4 for verbal and dialogue communication, and 3 for sign language, demonstrate almost the same benefits as in-person meetings, but may be limited by connection quality and technical parameters. Popular communication systems for this type of communication are Zoom, Microsoft Teams, Google Meet, etc.

Phone connection. Phone communication is rated 3 for words and dialogue and 4 for voice, identifying it as a means of direct voice communication without the possibility of visual contact. Tools for this type of communication can be standard telephone lines, VoIP services such as Skype.

Chats. Communication through chats takes an important position in interaction in distributed teams, rated at 3 points for verbal communication and dialogue. Chats allow you to conduct an immediate text exchange of information, contributing to prompt solution of issues. This is especially valuable in situations where rapid interaction between project participants is required. Despite the convenience and speed, chats can limit the possibilities of deep dialogue due to the difficulty of conveying emotional coloring and nuances in text form. Information and communication systems such as Slack or Microsoft Teams provide platforms for effective organization of chat communications.

E-mail. Email is a traditional and widely used channel for professional communication, scoring 3 for verbal communication and 2 for dialogue. E-mail is effective for documenting information exchange and provides the convenience of having organized and structured discussions. However, it may not be ideal for situations that require an immediate response, and often results in delays in communication. In addition, an excessive number of emails can cause information overload. Tools like Gmail or Outlook help you organize and manage your e-mail correspondence.

Project management platforms. Project management services play a decisive role in the coordination of distributed project teams, it should be noted that they combine the tools of both information systems and integrated elements of communication systems. Having received ratings of 4 for verbal interaction and dialogues and a maximum rating of 5 for the ability to track statuses, these services are becoming a necessary tool in modern project management. These systems simplify the process of planning, allocation of tasks, control of deadlines, and also enable careful monitoring of project progress and resources. Thanks to integrated communication tools, they allow team members to quickly exchange information and effectively manage projects regardless of geographic location. Platforms such as Jira, Asana, Microsoft Project or Trello are examples of such information systems that integrate with a wide range of tools and services, providing a high level of interaction and visualization of project processes.

Professional social networks. Professional social networks, rated 3 for verbal communication and dialogue, act as platforms for sharing knowledge, experience and creating professional connections. These networks, such as LinkedIn, allow users to post professional updates, share content, and discuss industry trends, which helps develop professional relationships and support corporate culture, especially in distributed work environments. They create a

virtual space for networking, which can contribute to career growth, recruiting and increasing the company's visibility in the market.

Tools for brainstorming. Collaborative brainstorming tools play a crucial role in the phase of idea generation and creative project planning by distributed teams. With a score of 4 for visualization, such tools allow you to visually organize thoughts and ideas, facilitating deeper analysis and discussion. The dialogue component is also rated at 4 points, which emphasizes their effectiveness in supporting interaction between team members. Tools like Miro and MindMeister are examples of platforms that provide powerful real-time brainstorming capabilities, regardless of the location of participants.

Instant messaging systems. Instant messaging systems are indispensable for ensuring operational communication within distributed teams. Rated 3, they support instant text messaging, allowing participants to quickly share information and receive responses. Platforms like Slack, Telegram, Messenger or WhatsApp provide intuitive interfaces and various functions for group chats, direct messages, as well as integration with other services, which facilitates interaction within project groups.

Code version control platforms. Collaborative coding tools are the foundation for synchronous and asynchronous development in distributed teams of programmers. Rated 4 for verbal communication and dialogue, they provide effective coordination and code sharing, facilitating collective problem solving. GitHub and Bitbucket are important tools in this category, offering version control, code review, and change tracking functionality that is critical to ensuring a high-quality software product. This toolkit allows you to improve the efficiency of the communication component and synchronize work during software development, ensuring integrity and a single ecosystem.

Video and audio recording tools, rated 4 for voice and video, are essential for creating documentation, training materials, and demo presentations. They make it possible to record detailed instructions and procedures, which greatly facilitates the knowledge transmission within the team. Platforms like Zoom for video conferencing, Vimeo and Loom for recording video presentations provide powerful tools for creating and sharing multimedia content.

The different forms of communication and communication channels used in distributed teams is presented in the form of a hierarchical diagram, which is built on the basis of the expert judgments that are mentioned above (Fig. 2).

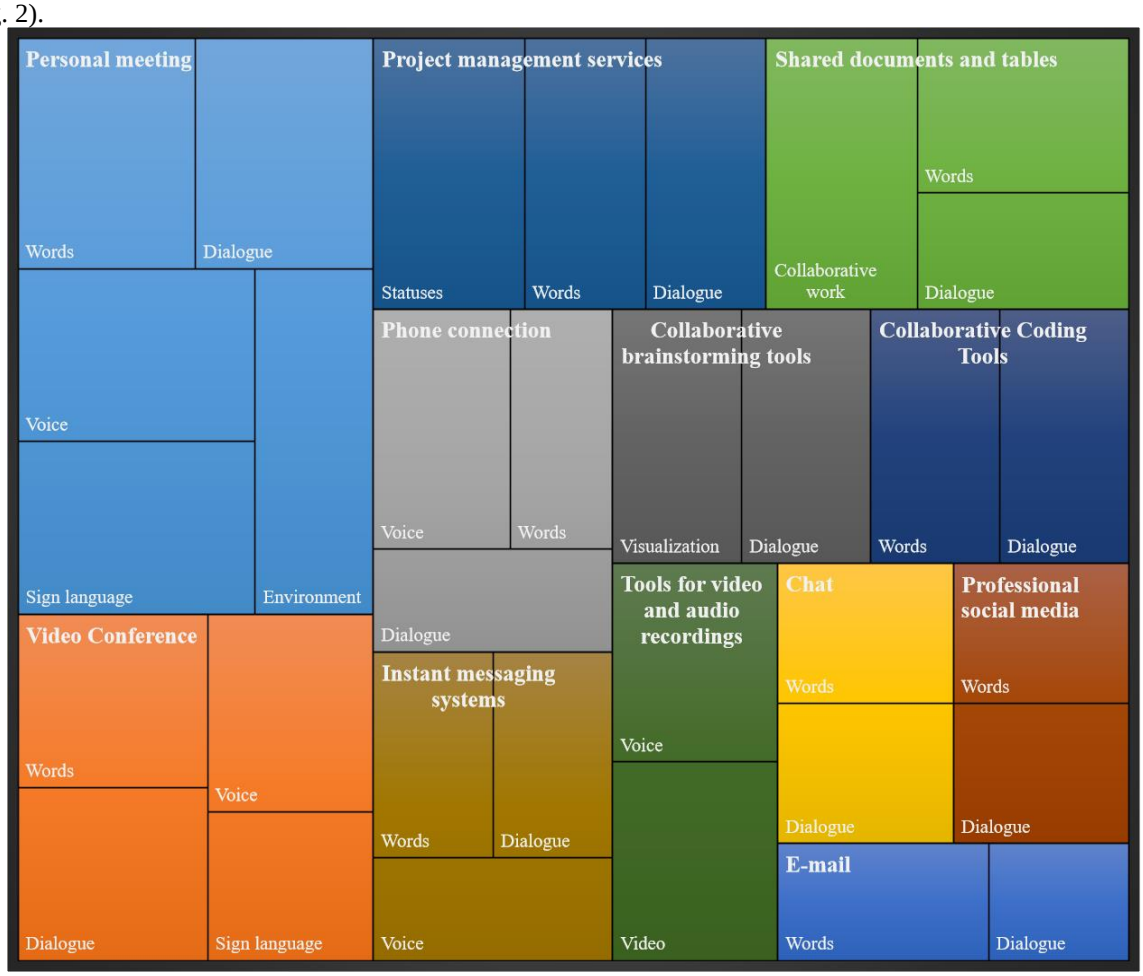

Fig. 2. A hierarchical diagram of the main communication channels used in distributed teams

In today's world of remote work and distributed teams, collaborative brainstorming tools, instant messaging systems, collaborative coding tools, and video and audio recording tools are vital to support effective interaction and collaboration. Each of these communication channels has its own specificity and a level of importance, but together they form a complex ecosystem of tools that provide successful project management in distributed teams, ensuring flexibility, responsiveness and efficiency in work processes.

The absence of one or more communication channels leads to generally limited communication. Moreover, due to the lack of communication, the project manager tends to collect most of the information about the project. This leads to the information monopoly of the project manager and supports a more hierarchical project management. Thus, the success of the project mainly depends on the skills of the manager, which may include a high risk of failure. A lean thinking approach to product development can improve teamwork [10]. The success of this approach is based on the reduction of design errors and shortening of the execution time. Since there is a timely delivery and an engineering budget that is regularly reported and visualized, the lean approach also allows you to set countermeasures in case of problems [11]. Because of the required face-to-face meetings, the approach is usually limited to local projects, but with information technology in mind, it can be adapted for distributed teams. In addition, in the future, development projects will be increasingly distributed around the world, so such project teams will have to face new challenges.

In today's world, where geographical boundaries are gradually disappearing thanks to digital technologies, the management of distributed project teams becomes especially relevant. Effective communication and coordination of the activities of such teams are critical factors for the success of projects. As a result of the analysis of the forms of communication and communication channels used in distributed teams, both traditional methods, such as e-mail and video conferencing, and modern approaches, including specialized tools for project management, which are indispensable for the collaborative work of distributed teams, were considered. The following studies will consider the formation of platforms for the integration of communication and information technologies to ensure the effectiveness of project processes in distributed teams.

To support project processes in distributed teams, various information and communication technologies are used, which are presented in Table 1. Such tools help teams to effectively manage project processes, ensure constant communication and coordination, and serve to increase productivity as well.

Table 1

Division of tools for supporting project processes into information and communication technologies

Information technologies	Communication technologies
Project Management Systems: Asana, Trello, JIRA, Microsoft Project	Tools for video conferencing: Zoom, Microsoft Teams, Google Meet, Skype та ін.
Collaboration Tools: Slack, Microsoft Teams, Discord, Miro, MindMaster	Email: Gmail, Outlook, Yahoo та ін.
Documentation Tools: Confluence, Microsoft365, Google Docs, Notion, Vimeo, Loom та ін.	Instant messages, Chats: Slack, Telegram, Viber, WhatsApp, Skype
Version Control Systems: Github, Gitlab, Bitbucket та ін.	Social networks for professional communication: LinkedIn, Facebook, Twitter та ін.
Monitoring and Reporting Systems: Datalog, New Relic, Google Analytics та ін.	Phone communication: standard telephone lines, VoIP services (Skype)
Testing Tools: Selenium, Junit, TestRail та ін.	

Research and analysis of information systems for managing project processes

It will be considered and analyzed project management platforms that are especially important when working in distributed project teams. A project management platform is an integrated information system that includes a variety of tools and techniques to facilitate the planning, execution, monitoring and completion of projects. It often includes capabilities for task management, collaboration, documentation, and resource allocation, with the goal of improving efficiency and communication within project teams. We will single out platforms for project management and list their main features.

Table 2

Comparative analysis of project management tools

Platform Name	Key Features	Project Management Model	Purpose
1	2	3	4
Trello	Different project display formats, automation, templates, integrations	Flexible, Kanban	Flexible task management for small and medium teams
Asana	AI for business solutions, workflow designer, timeline, boards, calendar, reporting	Flexible, Agile	Collaboration and task management for different team sizes
Jira	Scrum and Kanban boards, roadmaps, timelines, reports	Agile, Scrum, Kanban	Complex project management, in particular for software development
Microsoft Project	Different project display formats, resource management, integration with Microsoft 365	Traditional, Agile	Complex project management for large teams and enterprises
Basecamp	One-page dashboard, communication, task lists, file storage	Flexible	An easy-to-use tool for small teams and startups

1	2	3	4
Monday.com	File storage, boards, communication, integration, automation	Flexible, Agile	Universal project management, suitable for remote teams
Notion	API (Application Programming Interface), activity dashboards, budget management, templates, document management	Flexible	Organization and storage of project information, suitable for creative projects
ClickUp	AI (artificial intelligence), task management, boards, communication, automation	Agile, Scrum, Kanban	Project management using Agile methodology, suitable for different types of teams
Wrike	Dashboards, automation, kanban boards, resource planning, Gantt charts	Agile, Scrum, Kanban	Flexible project management, with an emphasis on collaboration and automation
Zoho Projects	Advanced task management, time management, charts, reports, teamwork, automation	Flexible, Agile	Multi-project management, effective planning and collaboration

A detailed analysis of the popularity of various project management services was conducted using data from Google Trends for the period from December 2019 to October 2023. The research covers platforms such as Trello, Asana, Jira, Microsoft Project, Basecamp, Monday.com, Notion, ClickUp, Wrike, and Zoho Projects. Trends in their use by project teams over recent years were analyzed and their popularity around the world was determined.

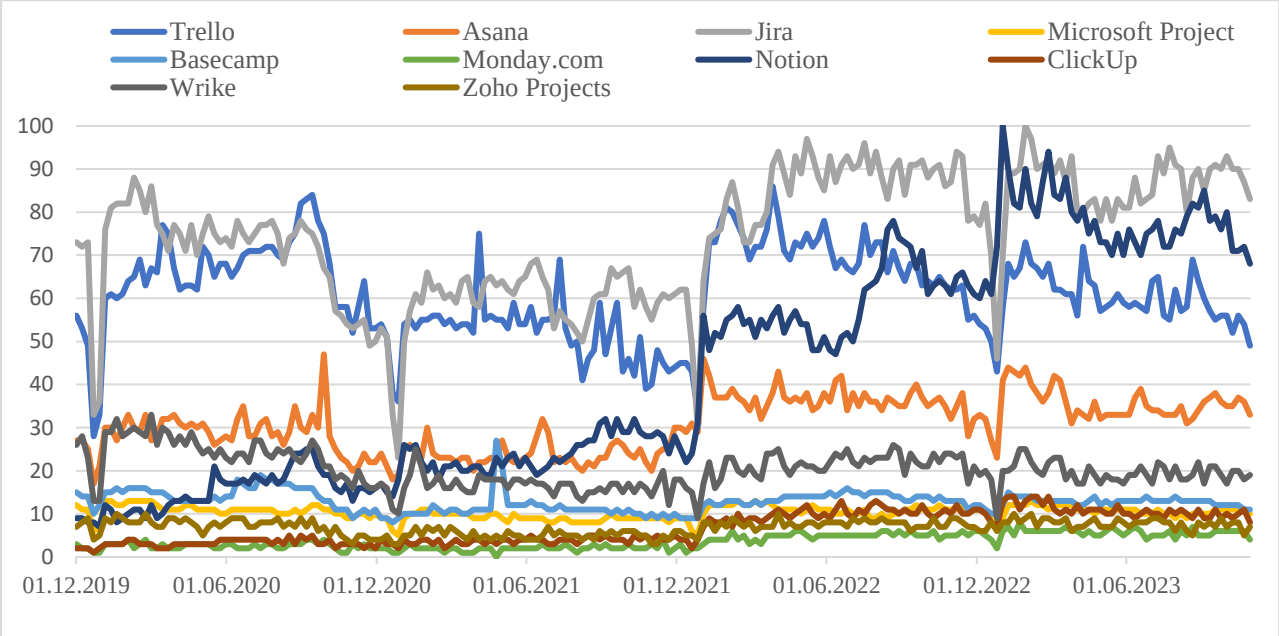

Fig. 3. Dynamics of popularity and interest in selected project management services from December 1, 2019 to October 31, 2023

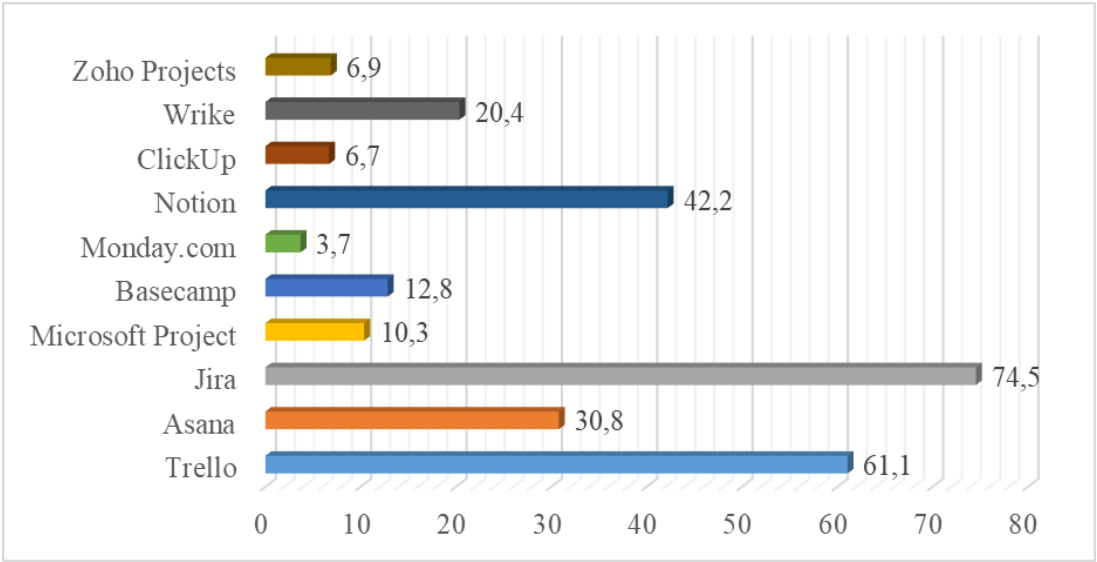

Fig. 4. Average values of the dynamics of popularity and interest of the analyzed project management services

Figures 3 and 4 present the dynamics regarding the popularity and interest in selected project management services from December 1, 2019 to October 31, 2023, based on Google Trends data [12]. The chart tracks relative search interest over time for various project management tools such as Trello, Asana, Basecamp, Monday.com, Jira, Notion, Microsoft Project, Wrike, Zoho Projects, and ClickUp.

Based on this analysis, the following patterns can be traced:

- Trello and Jira have high and variable interest levels throughout, with peaks and troughs that can indicate significant events or releases affecting user engagement.
- Asana, Basecamp, and Microsoft Project show a moderate but relatively stable level of interest, indicating an ongoing user base or market presence.
- Notion shows an increasing trend in popularity, especially in the second half of the analysis period, which may indicate a successful expansion or increase in its penetration and number of users.
- Wrike, Monday.com, Zoho Projects, and ClickUp show lower levels of search interest compared to the others, however, ClickUp has a slight upward trend over time..

For distributed teams, these trends indicate that they are more likely to consider Trello and Jira because of their high visibility and likely extensive capabilities, which may be well-suited for collaboration across geographic locations. Notion's growing popularity also points to it becoming a more popular choice, perhaps due to its flexible note-taking and organization capabilities that can be valuable to remote teams.

Variation in interest in some tools may reflect changes in market positioning, feature updates or changes in the competitive environment. Additionally, the stability of others like Asana and Basecamp indicates that they are solid options with large user bases and developed communities.

However, to make an informed decision about which service is best suited for project management of distributed teams, it is necessary to take into account not only Google Trends data [10]. Factors such as specific feature set, user experience, integration capabilities, pricing and customer support are critical to the evaluation. In further studies, a more extensive set of factors will be considered for choosing the optimal toolkit depending on the types of projects.

The results of this study highlight the importance of choosing the right project management service that meets the unique needs and workflows of each team. The results also highlight the changing demand and preferences in this area, indicating the continuous evolution of the digital project management environment.

Tools for automating project processes on project management platforms for distributed teams

To automate project processes in distributed teams and improve interaction and efficiency, it should be considered creating chatbots in popular messengers such as WhatsApp, Telegram, Viber and Messenger, etc. to integrate with project management tools such as Trello, Asana, Jira, Microsoft Project, Basecamp, Monday.com, Notion, ClickUp, Wrike, and Zoho Projects, as well as Github, Gitlab, and Bitbucket repositories, which can be an effective way to simplify workflow in distributed teams.

There are the key aspects of this process:

- Integration with project tools and repositories: Chatbots can be configured to interact with various project management tools and code repositories. Using the API of these services, chatbots can receive updates about changes in tasks, commits, pool requests and other important events.
- Customized notifications: Users can configure chatbots to receive notifications about specific events, which minimizes information noise and allows you to focus on important updates. These notifications are instant, which is an advantage over email or Slack, where delays can occur.
- Convenience and accessibility: Since most people use messengers regularly, receiving notifications through them is convenient and efficient. This is especially useful for distributed teams that work in different time zones and are geographically dispersed.
- Search functionality and autocomplete: modernized chatbots can include search and autocomplete functionality for convenient access to information about projects, tasks and documentation.
- Interactive interface: development of an intuitive interface for interaction with the chatbot ensures effective use of it, regardless of the technical experience of all team members.

Chatbots enable remote teams to quickly respond to changes in projects, improving communication and efficiency. They are also useful for various professional groups, including developers, testers, project managers, and HR professionals.

Project managers can first test chatbot solutions on small groups of users and then expand their use to the entire team, ensuring effective implementation and adoption.

Using chatbots in such scenarios significantly improves workflow, allowing teams to respond quickly to changes, manage tasks efficiently, and maintain high productivity.

Conclusions

The integration of advanced communication and information technologies becomes key in the strategy of managing project processes in distributed teams, ensuring high communication efficiency and optimization of work procedures.

In the course of the study, popular communication technologies used in distributed teams have been singled out, their advantages and bottlenecks in application have been presented, which should be taken into account when the project stakeholders select a set of tools to ensure effective communication and its success.

An analysis of project management platforms is carried out, the features of their use, popularity and interest of users in recent years are given. The basic capabilities for task management, collaboration, documentation, and resource allocation capabilities to improve efficiency and communication within project teams are covered. Options for integrating chatbots into project management platforms for automating project processes in distributed teams are offered.

Further research will focus on the comparative analysis of the effectiveness of different information platforms, developing new integration tools, adapting these platforms to unique project requirements, and evaluating their impact on team member productivity and satisfaction.

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