Virtual Temporary Collaboration Networks – A Case Study of the IT Industry

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New product development projects in the IT industry have introduced various new methods and techniques of team management. IT projects often use hybrid models of new product development, which combine agile team management methods with classic and waterfall project management methodologies. However, there is an alternative solution available that consists in creating a temporary network of experts in a virtual environment in order to develop a new product or service. The article presents the characteristics of ad-hoc temporary development team networks and specifies the conditions necessary for their creation in a virtual environment. Also, the analysis of a temporary virtual collaborative network used to develop new products in a Polish IT company have been presented as a case study research.

Keywords: NPD, temporary collaboration networks, virtual project teams, IT products.

Wirtualne tymczasowe sieci współpracy – studium przypadku branży IT

Projekty rozwoju nowych produktów, realizowane w branży IT, wprowadziły szereg nowych metod i technik zarządzania zespołem deweloperskim. Projekty informatyczne często wykorzystują hybrydowe modele rozwoju nowych produktów, które łączą zwinne metody zarządzania zespołem wykonawczym z klasycznymi i kaskadowo-liniowymi (Waterfall) metodykami zarządzania projektami. Istnieje jednak alternatywne rozwiązanie, polegające na utworzeniu tymczasowej sieci współpracy w wirtualnym środowisku roboczym, w którym grupa ekspertów opracowuje nowy produkt lub usługę. Niniejszy artykuł przedstawia istotę działania i funkcjonowania tymczasowych sieci współpracy złożonych z zespołów deweloperskich zajmujących się rozwojem oprogramowania. Omówione zostały również warunki tworzenia tego typu sieci w wirtualnych środowiskach. W części badawczej artykułu przeprowadzono analizę tymczasowych sieci współpracy (zajmujących się rozwojem nowego produktu) w wybranej firmie IT za pomocą metody studium przypadku.

Słowa kluczowe: rozwój nowego produktu, tymczasowe sieci współpracy, wirtualne zespoły projektowe, branże twórcze, produkty IT.

JEL: M540, M500, L240

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1. Introduction

Information Technology (IT) companies are searching for more effective methods and tools to develop innovative IT products in the form of software, services or computer hardware. IT products in the form of software must possess a series of characteristic attributes in order to be considered innovative and modern (Liebert, 2018). An innovative product is understood as a tangible or intangible solution with a certain degree of innovation in comparison to the already existing products on the market (Kahn, 2018). In the case of IT products, very often the element of innovation is extended by customer personalization, as well as expansion of the product's life cycle, that is, development of various add-ons, updates and expansion sets (Liebert, 2018). In order to achieve the highest level of quality and customer satisfaction, IT companies have gradually started to migrate from linear methods of manufacturing and project management towards agile approaches of product development (Highsmith, 2005; Schwaber & Beedle, 2001; Palmquist, 2013). Agile methods like: Dynamic Systems Development Method (DSDM), Scrum, Agile Modeling (AM), Extreme Programming (XP), and Crystal Clear enable small development teams to swiftly execute assigned tasks. Enterprises adapt their resources, organizational culture and internal systems to gradually implement new production methods – for this purpose, Scale Agile Framework concepts have been developed, which are a set of best practices in implementing agile solutions in the enterprise (Laanti, 2014). Despite this, new methods of product development are constantly being sought to match the available capabilities and resources of a given IT company. One of the modern approaches to the development of a new product or service is the establishment of temporary collaborative networks in the form of dynamic virtual teams.

Over the last decade, the advanced development of information technology (Bottazzi, 2008) enabled organizations and individual professionals to participate in virtual networks (Jackson, 2002), where communication, data transmission and knowledge exchange can occur anytime, anywhere in the world, with the use of IT equipment. Collaboration networks are being established in order to create a new product or to develop an existing solution (Bendkowski, 2017). This leads to the exchange of knowledge between organizations or groups of creative industry experts. Therefore, they are created in order to carry out and implement a certain project. Collaborative networks may be considered on a wider or smaller scale (Czakon, 2012). On a macro scale, we may perceive it as a strategy of cooperation between two competitive companies, which scientists define as a phenomenon of coopetition (Martins de Resende et al., 2018). Coopetition consists in creating a network of connections and mechanisms for the exchange of knowledge between at least two entities which compete with each other but maintain friendly relations. Both aim at joint implementa-

tion of projects or research for innovative solutions. On the micro scale, collaborative networks may be perceived as small development teams, which are created by a group of a few to several people, where knowledge, experience and content are exchanged in order to develop a product or service. In the IT industry, this cooperation usually takes place in virtual working teams (Townsend et al., 1998). Collaborative networks can also be divided depending on the level of competition for resources – if this competition is high, we can speak about networks of projects based on cooperation or networks creating scale effects. Networks with a low level of resource competitiveness, on the other hand, may include networks of research projects or networks with complementary resources (Kozarkiewicz, 2015). One of the most important factors in the proper functioning of a network is the ability to identify and acquire knowledge by all network members (Najafi-Tavani et al., 2018). Similar results which relate to the knowledge sharing factor can be observed in studies on the functioning of networks and working groups in virtual environments (Alsharo et al., 2017).

A Virtual Project Team is defined as a group of people who interactively cooperate to achieve the same objective, where at least one of the team members works at a different geographical location, in a different time zone or at a different organization, and that communication and decision-making are based only on digital connection like e-mails, phones, video conferences, live streams and others (Gibson & Cohen, 2003; Dulebohn & Hoch, 2017). A few conditions have to be fulfilled in order to form a virtual network (Cantu, 1997), such as: appropriate infrastructure and technology that enables swift network connection, diversified geographical locations of virtual team members, a set of tasks or projects that have to be carried out, establishment of collaboration and proper preparation of the virtual team. Various key characteristics and factors have been researched in the area of virtual teams in recent years (Großer & Baumöl, 2017). Researchers indicate that social aspects like multidimensional trust are very important success factors of virtual teams (Clark et al., 2010; Ford et al., 2017). The awareness of tasks and disclosure have significant impact on virtual collaboration (Yong-Kwan, 2018). Structural support and leadership may influence the work-flow of online team cooperation (Hoch & Kozlowski, 2014). Other researchers (Ko, 2011) indicate that: a properly integrated management and technological platform, supportive IT tools with file-sharing capabilities, well-developed social skills of team leaders, and project control mechanisms all affect the functionality of virtual development teams, especially in the area of search for innovation. Another study (Choi & Cho, 2019) point out that proper cooperation and coordination enhance knowledge sharing in virtual teams.

In this scientific paper, the authors define what is a temporary collaborative virtual network in the form of connected virtual teams, and what are the main characteristics of such networks and development groups. This

description was supplemented by the results of a case study conducted within an IT company which provides a range of services related to the development of software, websites, and marketing-related content.

2. Definition of Temporary Collaboration Networks Operating in a Virtual Environment in the IT Industry

2.1. Attempt to Define Temporary Virtual Collaboration Networks

The main purpose of a temporary collaboration network is to develop a product of the highest quality within the constraints of time and cost. It is quite an effective method of using various external resources of the organization and the possibility of relieving other internal assets – human or technical. Bendkowski defines temporary collaboration networks[1] on the basis of co-configuration which is perceived as a "new, flexible and interactive form of work organization that enables the creation of adaptable and highly individualized products in the network of cooperating manufacturers, customers and suppliers" (Bendkowski, 2017). Networks, on the other hand, are often defined as a set of relations, interactions and links between organizational units, individuals or business entities whose mutual cooperation produces specific effects (Olechnicka & Płoszaj, 2010).

Therefore, temporary collaboration networks operating in a virtual environment (in the form of virtual working teams) can be defined as temporary network systems (between customers, network moderator, employees and subcontractors) that use various supportive IT tools and are composed of geographically remote and specialized participants, set up to develop or create a certain high quality solution while maintaining optimal values of cost and time. In other words, in contrast to project management, where the individual stages sequentially follow one another, temporary and virtual development teams are created dynamically in an ad-hoc mode without the time-consuming phase of project initiation and planning. In such forms of cooperation, the main key to success is to simply determine the major objective and effects of a given task. Moreover, the main advantage of this type of network may be a significant reduction of risk – if a selected professional skips his or her duties, he or she might be replaced at any time. In such a situation, the company may recruit another expert to amend the scope of work in case of problems. Virtual working teams operating in such networks are very often characterized by self-management and self-organization (Carte et al., 2006) – network members do not have a clearly declared leader, but cooperate in a manner that is appropriate to the tasks they carry out and bear personal responsibility for the progress of their work. It can therefore be concluded that the main reason for the existence of such a network is the temporary use of knowledge of a given expert or professional. In other words, a specialist who has many years of

experience and knowledge in a given field lends it to a company for the duration of the project, which is a kind of outsourcing. For example, in the studied company, during the production of a promotional video about a well-known series of computer games, a game producer commissioned an episodic series of commercials with a large number of HDR special effects. A small collaborative network was set up for this purpose, consisting of 5 specialists with the required expertise, where only one member of the network was a full-time employee of the company. The remaining members were freelancers who had significant experience in the field of HDR effects. Thanks to this, the promotional films were produced in a fast and professional way. The experience and skills of temporary subcontractors in the field of post-processing effects greatly exceeded the competencies of other editors of the company.

The differences between a virtual temporary collaborative network and a virtual development team require some discussion. Although it is possible to identify a virtual development team (consisting of different individuals and business entities) as a temporary collaboration network, there are some differences in these terms. First of all, networks can consist of many virtual working groups and are a much broader concept. Furthermore, as a rule, virtual working teams in IT companies are often identified as development groups consisting of employees from different branches or locations of the same company. They can also be employees of several different companies that work in a strategic alliance or coopetition. It should be noted, however, that virtual temporary collaboration networks are more oriented towards the use of professionals and specialists operating individually, i.e. who do not have permanent relations with any company. A great example of this type of phenomenon occurs at TOFU Media (Japan, Poland) enterprise, which develops, assembles and processes audio-video marketing content in social media. This company often employs professionals or outstanding talents in a given field for its temporary projects. Therefore, development teams operating in virtual collaborative networks can be even more dynamic and flexible than virtual working teams established within a given corporation.

2.2. Procedure for Setting Up Temporary Collaboration Networks and Virtual Development Teams

Each virtual development team that operates within a temporary collaborative network is formed when a new order is received from the customer. These contracts usually concern the development of a new product or the expansion of an existing service. Usually, such virtual teams and development teams are formed in two alternative ways (Figure 1).

The first variant occurs when a company already has a strong collaboration network between internal and external employees, which results in the phenomenon of a self-organizing network. In other words, each employee

or co-worker knows his or her skills so well that they individually choose the best possible role in the development team. This approach is somewhat reminiscent of holacracy (Robertson, 2015), where members choose their roles and perform specific activities. Also, there is no hierarchy in the team structure. In this case, the person acting as a moderator of the network has fewer responsibilities, because he or she concentrates mainly on controlling and monitoring the work schedule of the project. Specialists can determine their responsibilities, the scope of their activities and the level of their skills. As a rule, such networks consist of (depending on the size of the enterprise) from 3 to 9 people. There are cases when a given project exceeds 9 people, then the network can be divided into smaller subnetworks or specialist circles, where issues and solutions in a given field are being developed (graphics quality team, sound quality team, database management team, etc.). Many elements of a virtual collaboration network resemble the Scrum method used in agile development. According to the Scrum Guide, the optimal size of the development team should be from 3 to 9 developers or around 6 team members.
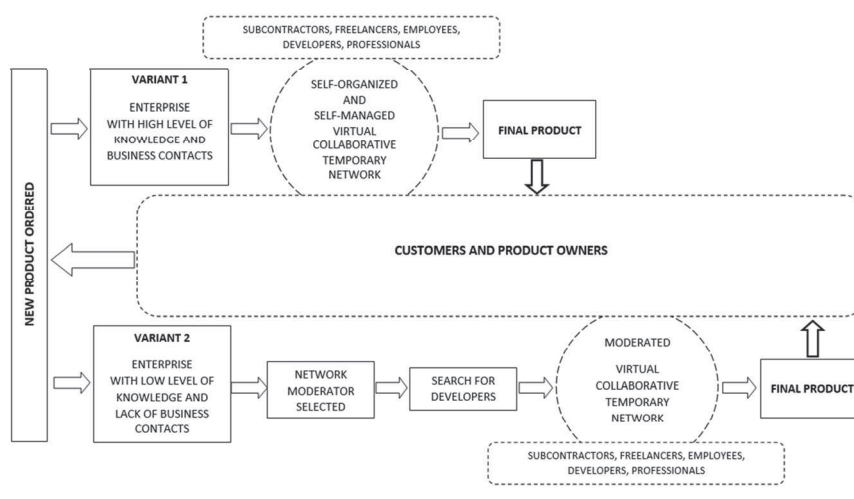

Fig. 1. Two variants of creating a virtual temporary collaboration network in the IT industry. Source: Own work.

The second variant (Figure 1) occurs when the company does not yet have a wide range of contacts in the market and lacks extensive network connections between internal staff and external specialists. Then the employee of a company with significant experience in a given area of operation is promoted to "project and network manager", but might be called a moderator or network admin from the point of view of his or her role. The

network moderator looks for and establishes contacts to form the team needed to complete a specific task. Experts are searched by various ways and methods: from personal acquaintances, through business contacts, to social media, trade fairs and exhibitions, or best practices meetings in a given area of management (e.g. Agile Silesia – meetings with agile project team management).

Therefore, the following question emerges: How do employees or experts learn about a new product or service development project? The goal of the project is often communicated using virtual communicators (which often take the form of popular social media messengers), where everyone can submit and express their willingness to participate in the project. An alternative way of establishing cooperation is the classic e-mail contact. It should be noted that everything is in a sense based on the virtual environment chosen by the company. Regardless of whether it is a Slack communication environment or an internet forum, network participants must meet on a virtual platform.

The structure of a temporary collaborative network in a virtual environment is set up by a network moderator or a self-organizing team, but it should be noted that in the latter case the organizational culture of the company is of great importance. Depending on the industry, the organizational culture can be very different and have distinct values. In the case of the computer video games market, for example, a more informal, member-friendly culture is preferable, which is rooted in social media and virtual communication. Therefore, an autonomous team might be formed only if specific factors are taken into account, such as: synergy, tolerance, and trust among all team members (Zakaria & Yusof Mohd, 2018). Also, members have to know their skills and even the abilities of their co-workers. Due to the very short-term nature of temporary networks, their structure is formed even within a few hours. When the task is clearly defined, full cooperation of participants begins immediately after joining a given work environment on a virtual disk (or in a virtual working space).

3. Virtual Temporary Collaboration Networks in Practice – A Case Study of an IT Company

3.1. Description of Research Method and Characteristics of the Analyzed Company

The company provides services in the field of video games industry, as well as computer hardware. The surveyed IT company has been operating on the Polish market since 2000. Its activity is based on production and maintenance of internet portals, production of marketing materials (including video/audio and social media-related content), provision of ready-made outsourcing solutions, as well as creation of new technologies for the needs

of the internet. The company employs 53 full-time employees and over 120 outsourced employees. Among external collaborators there are also experts with vast knowledge in a specific area of expertise, who regularly participate in temporary virtual working groups. The company maintains constant contact with computer game developers, famous YouTubers, publicists, journalists and other entities or professionals in the field of computer games and hardware. The company uses virtual temporary collaboration networks to carry out various software development, marketing-related and journalistic IT projects.

To find as much valuable information as possible on the work-flow of virtual temporary collaboration networks, case study research has been conducted in the aforementioned IT company. The research was conducted in the time period of March-May 2019. After studying articles and scientific papers related with the phenomena of virtual temporary collaboration networks (desk research), the following research questions emerged:

1. How are the members of virtual temporary collaboration networks recruited in the IT industry?
2. What does the work-flow of virtual temporary collaboration networks look like in practice?
3. What types of tools are used to enhance or support the work-flow in such virtual temporary collaboration networks in IT companies?
4. What are the key characteristics of virtual teams operating in temporary networks in the IT industry?
5. What are the main problems that may occur while working in such virtual temporary networks?
6. What are the main benefits of using virtual temporary development teams in comparison to waterfall and agile product development practices?

The answers to all the questions presented above were obtained in case study research. The research was divided into three different stages. The first stage consisted in collecting archival data (including lessons learned and outputs) of the last 5 projects carried out by the enterprise – all data provided by the company was analyzed. During the second stage, a series of meetings and interviews with the company employees were conducted, where various issues were discussed with particular emphasis on the proper functioning of virtual temporary collaboration network teams. The third stage consisted of participation in the currently ongoing project (as a spectator), which was carried out in a virtual temporary collaboration network. The latter allowed to witness how the supportive tools are being used in practice.

3.2. Running Temporary Collaborative Networks in a Virtual Environment

In the case of researched enterprise, the temporary virtual collaborative networks are deployed in four areas of activity:

1) Production of marketing and media content in the form of video materials related with computer games or hardware.
2) Production of diversified press releases, guides and benchmarks, especially about computer hardware.
3) Production of internet portals and websites (software development).
4) Development of user-friendly mobile apps.

These networks are formed in order to produce as much material and content as possible, of the highest quality and in collaboration with external experts. On the other hand, the project objectives quite often have a very general character, and the direction of development and specific objectives emerge with time and further production cycles. Therefore, it is a rather unusual and creative approach in comparison to e.g. traditional project management methods. The following list contains examples of the main objectives (or names) of temporary collaboration network projects:

1) Production of promotional video game films of very high quality using 4K resolution.
2) Development of a promotional campaign for video games.
3) Establishment of an e-sport tournament for players.
4) Development of a game guide in the form of video series and a text publication of a specific character.
5) Development of an online store platform with a subject matter selected by the customer.

Members of temporary collaboration networks were recruited in various ways. Each project required the participation of experts with professional skills. Very often, experts were recruited on the basis of knowledge gathered at trade fairs and conferences (such as the annual industry conference on video games and IT – Digital Dragons, Kraków). Personal acquaintances or business contacts from the industry were also a big part of gaining contacts and experts. Moreover, cooperation proposals were sent to individual specialists (known on the market in a given field) or the specialists themselves asked on their own if they might participate, e.g. by noticing project announcements shared in social media. The last form of contact used by the company is the classic job or cooperation offers, stored on the company's website. Administrative matters were handled electronically, using the internet and e-mails, as well as software such as Slack, Skype and Discord.

3.3. Description of Work-Flow and Tools Used in the Temporary Collaboration Network

In the case of the analyzed IT company, the participants of the cooperation network create a virtual project team. First, customers order a new

product or service (e.g. a web portal or video material), then one of the company's employees initiates the formation of a network, informs the subcontractors about the order and configures the virtual working environment, namely: Google Sheets (comments, preliminary project plans), Dropbox (a virtual disk for data storage), Slack (a communicator with file transfer functions), Trello (a list of tasks and product functions, the ability to assign tasks). This employee can be considered as a configurator or a moderator of the whole virtual cooperation network. Then, the virtual work team is joined by other subcontractors and experts in the field. The product is produced in a dynamic and incremental way in a group of several or more people.

An important element is the fact that subcontractors use their own hardware and software to develop a given product. Therefore, it is not only a lease of expert knowledge by a company, but also a lease of equipment and technical resources. The cooperation is largely based on continuous communication on Slack and social media such as Facebook's Messenger. The formal style of communication is abandoned. All problems are discussed in a virtual environment. Each participant in the network should have emergency communication channels available at his/her disposal – e.g. two e-mails to each other member (such as work-related and private e-mails – saved in a public Google Sheet list with all team contacts), plus phone numbers in the case of any unusual failure of the internet connection. The network moderator informs about the objectives and schedule – each member deals with his or her own task in which he or she specializes and makes comments to other participants on an ongoing basis to share and exchange knowledge about the product. Any uncertainties or potential improvements of the developed product or service are discussed together with the network moderator by means of a forum – a virtual communication board such as a communication channel on Slack or a video conference (Discord/Skype). Working in virtual networks is characterized by quite intensive concentration on specific tasks, but at the same time the implementation of changes in certain product functions can be sudden and purely creative. All work is done in a virtual environment only, unless, in extreme situations, the customer wishes to gather the entire temporary team in a real environment. In addition, the final user of the product (also referred to as product owner or customer) can interact at any time with all participants of the network.

The company uses a variety of tools to support and maintain proper work-flow in the virtual environment. The Slack virtual working environment, e-mails with Google Hangouts (in case of a Slack failure) and Messenger (Facebook) are used for basic communication over the internet. The list of product functions based on user stories and requirements (so-called Backlog) is usually compiled using Google Drive with interactive Google Sheets (available to all members of the temporary network). In addition, Dropbox virtual disk services are also used to transfer large files

with data and required content. For more complex projects, the Trello online platform is often used to manage tasks. The Trello software allows project teams to create a work schedule and allocate human resources to specific tasks through a special billboards system (very similar to Kanban billboards/signboards). A characteristic feature of all these applications is their universal accessibility, as they work on personal computers, tablets and mobile devices. An important element of any development team operating in a virtual network is the ability to transfer, share and exchange knowledge. Experts often share their knowledge or experience from various fields in search of best solutions. Furthermore, there have been situations where professionals have equipped each other with various types of specialized software (e.g. additional Adobe Premiere packages for editing video materials) to exchange experiences and develop their skills. The characteristics and work-flow of a temporary collaboration network in a virtual environment are presented in Figure 2.
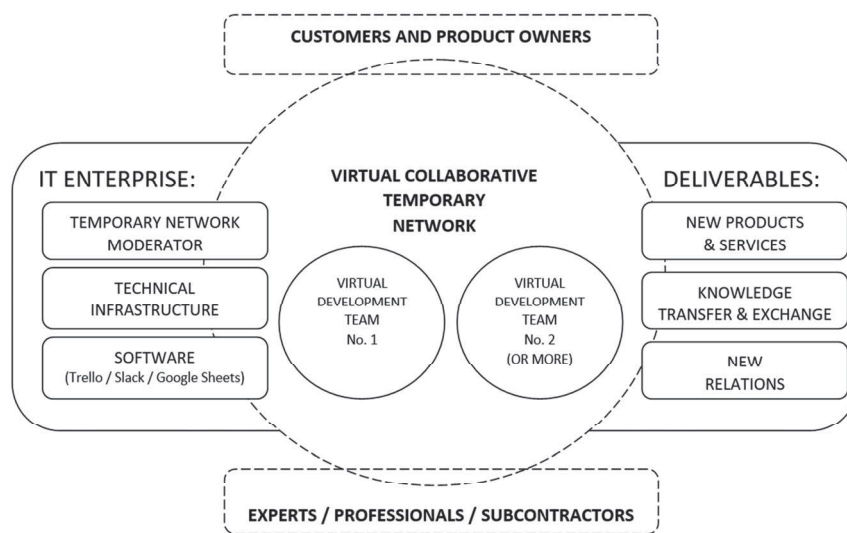
Fig. 2. Work-flow of a virtual collaborative temporary network in the analyzed IT company. Source: Own work.

Decisions on product development in each situation are made collectively, that is, in a democratic manner. However, it can be noticed that there are cases where key decisions are supervised to a large extent by a network moderator or chief engineer with the greatest experience in a given field. In the creative industries, important decisions are often left to the experts creating the solutions, because they are aware of the requirement to maintain the highest quality of the product.

Developed software is controlled and monitored bilaterally, from the side of both the network moderator and the network participants. All network members verify whether their part of the product is compatible with the rest of the solution (customer or product user is also one of the participants as he or she controls the definition of done aspects). In all projects, the client or product owner has access to the network to supervise the work-flow and consult on any new ideas. Nevertheless, after analyzing the last 5 projects implemented in the company, not all customers were interested in participating in the network. Many customers ordered a product in advance and provided key guidelines for it, after which the concept of a new product or original solution was developed by the development team without significant customer participation. If the trial version of the product does not meet the customer's requirements, modifications are made. The product is completed only once the customer has accepted it, so the whole development process may be repeated. There was no case in which a project had to be carried out completely from scratch.

3.4. Problems and Threats of Temporary Collaborative Networks in a Virtual Environment

During the case study research process in the company, members of temporary cooperation networks pointed out three dangerous aspects in the implementation of such virtual working groups.

Unclear risk management is seen as the first threat. In practice, it depends on all members of the network and, on the other hand, on the moderator of the network. In other words, the risk identification and analysis procedure often boils down to a simple checklist, where the moderator of the temporary network simply assumes that: "If the appointed collaborator (subcontractor) is an expert and a professional, there will be no problems with the work progress". The risk of infrastructure failure seems to be equally problematic. There may occur some unpredictable virtual disk failures or limited cloud accessibility, which may result in reduced availability of data. Then the project can be postponed for a certain period of time if emergency tools are not set and running.

The second problem is the issue of cyber-security, also in the context of cooperation ethics. This problem concerns the issue of trust, i.e. the possibility of sharing important or sensitive data with temporary employees of the company. There is a risk that valuable data may be stolen. Specific projects may require important or secret data to be shared within team members. This causes a risk of loss of sensitive files or even theft of shared software licenses.

The third problem is the diversity of organizational and personal culture. Each external employee, expert or freelancer may have advanced within different culture, a specific organizational culture and has an individual approach or habits to specific behaviors during communication in a virtual

team. Nevertheless, these problems are usually solved by an initial interview initiated by the network moderator, who explains which forms of communication are preferable and which working culture is recommended in the temporary network team. This issue also concerns the definition of values.

3.5. Comparison of a Collaborative Network With Different Approaches to Product Development in the IT Industry

To support the research presented in the previous chapters, it seems reasonable to discuss and determine the overall benefits of using a virtual development team in a temporary collaborative network from the perspective of NPD projects. Table 1 provides a comparative analysis of the different elements and stages of the project in relation to the used product development methods and the overall organization of the development team.

Element of the new product development project	Methods and approach to product development and development teams		
	Traditional project management (waterfall)	Agile project management (APM, Scrum)	Virtual team in a temporary collaborative network
Conditions for implementing product innovations	Low or very constrained	High	Very high
Project goal	Fixed (permanent)	Fixed or dynamic	Dynamic
Planning time	Long	Short	Very short
Resource cost	High	Medium	Optimal
Product quality	Medium	High	Very high
Project scope	Fixed (permanent)	Variable and adjusted to user requirements	Variable and adjusted to user requirements
Duration of the project	Medium or long	Medium or short	Short or very short

Tab. 1. Comparison of different approaches in NPD project and team management in the IT industry. Source: Own work.

As shown in the table above, projects carried out by virtual teams operating in temporary network conditions have a much shorter duration compared to the classical linear approach (waterfall). In addition, they ensure the optimal use of resources in relation to costs. Virtual teams in temporary networks are strongly related to the features of agile project management; however, they deliver faster results due to their simplicity and short establishment time. A high level of expertise and no requirement to use formalized procedures or structures significantly accelerates the development process in temporary networks. Despite that, not every company has sufficient resources to form and use such networks. Also, large projects

have to be well-organized and may require the use of other methods than temporary networks due to their scale and a wide range of objectives.

4. Key Characteristics of Virtual Teams Operating in Temporary Networks in the IT Industry

Virtual networking and temporary collaboration require trust and a well-developed working culture. Virtual teams operating in temporary collaborative networks have a set of characteristics which at the same time can be considered as the main rules and requirements for their proper functioning. After conducting interviews with 21 employees of the analyzed IT company who work in virtual collaboration networks, it was possible to identify and characterize key features of this type of development teams (Table 2). In-depth interviews were conducted in March 2019. The enterprise uses virtual temporary collaboration networks to carry out various software development and marketing projects. The interviewed employees had at least 3 years of work experience in the company and took part in the last 5 projects executed by the company during which virtual temporary collaboration networks were used. All the interviewed employees were software programmers and designers of marketing content, including video producers and editors. To determine all features and key characteristics presented below, a two-stage brainstorming process was conducted which allowed to determine all factors that have an impact on the work-flow and proper functioning of virtual teams operating in temporary networks. Then, 21 employees were individually interviewed and gave scores to each of these factors with an explanation regarding their decision. The research results presented in Table 2 require further investigation and empirical study in the future as virtual networks are evolving and their attributes may vary across project types or industry types.

Id	Key characteristics of a virtual team	Description
1.	Lack of formalized procedures and structures	Approach similar to holacracy and teal management. The hierarchy and multiplication of decision-making levels is avoided and instead democratic group collaboration is used, where decisions are made jointly and each member of the team has certain productive roles (related to his or her skills).
2.	Dynamic and transparent scope of implemented projects	It can take the form of a backlog like in the Scrum method/frameworks. It can take the form of a list of tasks on Trello or other tabular forms such as Google Sheets. Everyone has the right to view and make changes to the scope if necessary.

Id	Key characteristics of a virtual team	Description
3.	Shared project data	Each participant of the network has access to business order documentation, including backlog, project objectives, and schedule. Adequate file sharing and a sharing platform must also be provided.
4.	Individual responsibility	Each member of the network is assigned his or her own responsibility and is aware of the consequences of not performing his or her duties (because he or she understands the concept of a product/service).
5.	High transparency and communicativeness	Requirement to have fast and effective communication channels. Usually it is software such as: Slack, Skype, Google Hangouts, Messenger, WhatsApp, Messenger (Facebook). These tools are designed to ensure free communication within the team.
6.	Use of virtual environment and professional IT tools	Virtual environment in the form of virtual disks is a basic, fundamental tool on which activities will be carried out. Virtual teams can use applications like: Google Drive, DropBox, GitHub and many other tools. Also popular are such platforms as JIRA and Wrike, which are optimized for creating new software in a virtual environment.
7.	Democratic style of change implementation	All changes are discussed collectively and everyone has the right to implement a reasonable change in the project where additive production takes place.
8.	Daily monitoring	Depending on the duration of the network – in short networks any monitoring or controlling does not even have to occur if a solution can be implemented in 3 days. However, in the case of more complex projects, every day there is an exchange of information, data, feedback between all participants of the network. Monitoring is carried out by all network users, with particular emphasis on the network moderator, who also must take care of the network security.
9.	Highly developed mechanisms of knowledge sharing	The mechanisms of knowledge exchange are not only related to the transfer of experience and acquisition of skills between network participants, but above all to the company's capabilities in this area. The existing knowledge and know-how of the company in organizing contacts with various professionals are also very important.

Tab. 2. Key characteristics and features of virtual temporary collaboration network teams in the IT industry. Source: Own work.

5. Conclusions

Virtual temporary collaboration networks provide a fast and effective solution for the implementation of new, innovative products. This article presents the features of development teams operating in temporary collaboration networks set in a virtual environment. The main attributes and

key characteristics of such temporary virtual teams have been identified, namely: lack of formalized procedures and structures, dynamic and transparent scope of implemented projects, shared project data, individual responsibility, high transparency and communicativeness, use of virtual environment and professional it tools, democratic style of implementing changes, daily monitoring, highly developed mechanisms of knowledge sharing. Virtual workgroups can effectively perform a number of tasks within a given product, while optimizing cost and maintaining the highest quality of production. They require a proper working culture, contacts and business relations, an efficient knowledge management system, as well as properly adjusted technical infrastructure. The discussion presented in this article may be a starting point for further research. Further empirical verification of this phenomenon raises many questions. First of all, how many enterprises use this type of collaboration networks and are they used in a similar way? In which industries and on what scale are such product development methods being used? Particularly interesting seems to be the subject of virtual temporary network work-flow which consists of many virtual development teams. Additionally, it should be analyzed whether the future of IT will be based on dynamic and fast services, which will result in a complete departure from the currently used design approaches and formalized methods of production (waterfall or agile). Due to the dynamic aspects of the IT industry and constant search for new and better solutions of managing development teams, temporary collaboration networks in the virtual environment are a scientific area which requires systematic verification.

Endnotes

[1] Note from authors – in this article the following terms: *virtual collaboration networks* and *virtual collaborative network* both have the same meaning.

References

Alsharo, M., Gregg, D., & Ramirez, R. (2017). Virtual team effectiveness: The role of knowledge sharing and trust. *Information & Management*, *54*(4), 479–490. https://doi.org/10.1016/j.im.2016.10.005.

Bendkowski, J. (2017). Zarządzanie procesami rozwoju tymczasowych sieci współpracy. *Zeszyty Naukowe Politechniki Śląskiej. Seria Organizacji i Zarządzanie*, *108*(1983), 23–34. Gliwice: Politechnika Śląska.

Bottazzi, D., Montanari, R., & Rossi, G. (2008). A self-organizing group management middleware for mobile ad-hoc networks. *Computer Communications*, 31, (13), 3040–3048.

Cantu, C. (1997). Virtual teams. *CSWT Papers*. Center for the Study of Work Teams, University of North Texas.

Carte, T.A., Chidambaram, L., & Becker, A. (2006). Emergent leadership in self-managed virtual teams. *Group Decisions and Negotiation*, *15*(4), 323–343. https://doi.org/10.1007/s10726-006-9045-7.

Clark, W.R., Clark, L.A., & Crossley, K. (2010). Developing multidimensional trust without touch in virtual teams. *Marketing Management Journal*, *20*(1), 177–193.

Czakon, W. (2012). *Sieci w zarządzaniu strategicznym*. Warszawa: Oficyna a Wolters Kluwer business.

Dulebohn, J.H., & Hoch, J.E. (2017). Virtual teams in organizations. *Human Resource Management Review*, 27(4), 569–574. https://doi.org/10.1016/j.hrmr.2016.12.004.

Ford, C.R., Piccolo, R.F., & Ford, L.R. (2017). Strategies for building effective virtual teams: Trust is key. *Business Horizons*, 60(1), 25–34. https://doi.org/10.1016/j.bushor.2016.08.009.

Gibson, C., & Cohen, S. (2003). *Virtual teams that work: Creating conditions for virtual team effectiveness*. San Francisco: Jossey-Bass.

Großer, B., & Baumöl, U. (2017). *Why virtual teams work – State of the art*. CENTERIS – International Conference on Enterprise Information Systems 2017, 8–10 November 2017, Barcelona, Spain.

Highsmith, J. (2005). *APM: Agile project management. Jak tworzyć innowacyjne produkty*. Warszawa: Mikom.

Hoch, J.E., & Kozlowski, S.W.J. (2014). Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership. *The Journal of Applied Psychology*, *99*(3), 390–403. https://doi.org/10.1037/a0030264.

Jackson, P. (2002). *The management of technology and innovation. Virtual working – Social and organisational dynamics*. London & New York: Taylor & Francis e-Library.

Kahn, B.K. (2018). Understanding innovation. *Business Horizons*, *61*(3), 453–460. https://doi.org/10.1016/j.bushor.2018.01.011.

Ko, K.B.K., Chester K.M.T., Zhang, Z.M., Ngai E.W.T., & Chan, L.K.T. (2011). Analytic collaboration in virtual innovation projects. *Journal of Business Research*, *64*(12), 1327–1334. https://doi.org/10.1016/j.jbusres.2011.01.012.

Kozarkiewicz, A., (2015). Sieci organizacji tymczasowych – nowa perspektywa badawcza w zarządzaniu portfelami projektów. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, (224), 83–95.

Laanti, M. (2014). Characteristics and principles of scaled agile. *LNBIP: Vol. 199: XP 2014: Agile methods. large-scale development, refactoring, testing, and estimation*. International Conference on Agile Software Development.

Liebert, F. (2017). Zarządzanie projektami w przedsiębiorstwach branży IT – studium literaturowe. *Zeszyty Naukowe Politechniki Śląskiej – Seria Organizacja i Zarządzanie*, (101), 271–284. Gliwice: Wydawnictwo Politechniki Śląskiej.

Liebert, F. (2018). Atrybuty innowacyjnego produktu informatycznego w postaci oprogramowania. *Zeszyty Naukowe Politechniki Śląskiej – Seria Organizacja i Zarządzanie*, (118), 275–285. Gliwice: Wydawnictwo Politechniki Śląskiej.

Martins de Resende, L.M., Volski, I., Betim, L.M., Gomes de Carhvalho, G.D., de Barros, R., & Senger, F.P. (2018). Critical success factors in coopetition: Evidence on a business network. *Industrial Marketing Management*, *68*. https://doi.org.10.1016/j.indmarman.2017.10.013.

Najafi-Tavani, S., Najafi-Tavani Z., Naude P., Oghazi, P., & Zeynaloo, E. (2018). How collaborative innovation networks affect new product performance: Product innovation capability, process innovation capability, and absorptive capacity. *Industrial Marketing Management*, *73,* 193–205. https://doi.org/10.1016/j.indmarman.2018.02.009.

Choi, O., Cho, E. (2019). The mechanism of trust affecting collaboration in virtual teams and the moderating roles of the culture of autonomy and task complexity. *Computers in Human Behavior*, *91.* 305–315. tps://doi.org/10.1016/j.chb.2018.09.032.

Olechnicka, A., & Płoszaj, A. (2010). Sieci współpracy receptą na innowacyjność regionu?. In A. Tucholska (Ed.), *Europejskie wyzwania dla Polski i jej regionów*. Warszawa: Ministerstwo Rozwoju Regionalnego.

Robertson, B.J. (2015). *Holacracy: The new management system for a rapidly changing world*. New York: Henry Holt and Company.

Schwaber, K., & Beedle, M. (2001). *Agile software development with Scrum*. USA: Pearson.

Townsend, A.M., DeMarie S.M., & Hendrickson, A.R. (1998). Virtual teams: Technology and the workplace of the future. *The Academy of Management Executive*, *12*(3), 17–29.

Yong-Kwan, L.J. (2018). IT-enabled awareness and self-directed leadership behaviors in virtual teams. *Information and Organization*, (28), 71–88. https://doi.org/10.1016/j.infoandorg.2018.02.001.

Zakaria, N., & Yusof Mohd, A.S. (2018). Crossing cultural boundaries using the internet: Toward building a model of swift trust formation in global virtual teams. *Journal of International Management*, November. http://doi.org/10.1016/j.intman.2018.10.004.