Digital Communication Tools as a Success Factor of Interdisciplinary Projects

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This article considers the important role of digital communication in interdisciplinary projects. This paper describes the experience of interdisciplinary project teams and points to the consequences of the choice of communication channels and tools influencing project deliverables within those teams.
The first section of this paper considers the influence of digital transformation on project management. The second section describes key project success factors concerning all types of projects and concludes that communication is one of important factors. The third section briefly defines interdisciplinary projects: SQUAD and BIM. This section also describes the communication methods and techniques that were used within these projects. Finally, the thesis that communication is one of the key factors of an interdisciplinary project's success is confirmed.

Keywords: interdisciplinary projects, hybrid project management, agile project management, communication.

Cyfrowe narzędzia komunikacji jako czynnik sukcesu projektów interdyscyplinarnych

Artykuł zawiera rozważania na temat roli komunikacji cyfrowej w projektach interdyscyplinarnych. Jego celem jest pokazanie, na bazie doświadczeń interdyscyplinarnych zespołów projektowych, konsekwencji wyboru kanałów i cyfrowych narzędzi komunikacji wpływających na wyniki projektów. W pierwszej części artykułu rozważono wpływ transformacji cyfrowej na zarządzanie projektami. Druga część opisuje kluczowe czynniki sukcesu projektów i potwierdza istotną rolę komunikacji jako jednego z elementów wpływających na osiągnięcie zamierzonych celów. Trzecia sekcja krótko charakteryzuje narzędzia komunikacji zastosowane w dwóch wybranych projektach interdyscyplinarnych: SQUAD i BIM z perspektywy ich koordynatora. W rezultacie artykuł potwierdza tezę, że komunikacja jest jednym z kluczowych czynników sukcesu projektów interdyscyplinarnych.

Słowa kluczowe: projekty interdyscyplinarne, hybrydowe zarządzanie projektami, zwinne zarządzanie projektami, komunikacja.

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1. Introduction

The current digital transformation effort affects almost every type of activity within a project team. The use of artificial intelligence (e.g. Watson), which can interpret events and facts and use them to recommend decisions to achieve further goals, is no longer a phenomenon; on the contrary, it is quickly becoming commonplace in today's world (Corea, 2018). Global robotics spending is expected to grow from US$ 15 billion in 2010 to US$ 67 billion in 2025, where the share of tasks performed by robots will increase from a global average of ca. 10 percent to ca. 25 percent across all manufacturing industries (Project Management Institute [PMI], 2017, p. 12). The Internet of Things (IoT) as a source of Big Data, which – properly processed and analyzed – can be used to build patterns, procedures, forecasts, is also having an impact on the direction of today's business. As a result, the needs of the labor market force research universities to implement new forms of education that will prepare students to work in modern companies (Ghobakhloo & Azar, 2018). In many large organizations, interdisciplinary teams whose members are often located thousands of kilometers away from each other are typically attempting to implement agile projects. Agile project management is seen as the answer to the growing dynamics of change and the emphasis on delivering results faster (Bishop, Rowland, & Noteboom, 2018). Increasingly, however, hybrid methods are used that combine elements of classic project management (PM) methodologies (such as Work Breakdown Structure (WBS)) with agile methods that allow for obtaining results in the shortest time possible (Münch, 2018). In both cases, communication between members of the interdisciplinary team is crucial as it helps them to work effectively in a modern and dynamic environment.

In this paper, we claim that digital communication is one of the key success factors of agile project management that helps in collaboration and coordination among multiple disciplines. The analyzed cases indicate the growing role of effective digital communication tools in terms of interdisciplinary project planning and execution.

2. Classic vs. Agile vs. Hybrid PM

The notion of digital transformation has been actively discussed in the industry since the late 1990s. Most modern companies have already implemented digital activities across their organizations. It can be seen across all dimensions of our life: at school, at home, at work. People no longer become frustrated when artificial intelligence produced by various Information Systems helps individuals to make decisions based on various

activities in our everyday lives (McDaniel, 2018). Also, today's businesses need to transform, having to face new challenges that are coming from increased digitalization. International enterprises need to change their business models to gain a bigger market share or just stay relevant in the marketplace. Today, a common model for services is the *subscription model*, where the customer has to pay a fee, allowing them unlimited access to data or files during their subscription period. Another model is the *freemium model* – in this form, a client obtains data or files for free and, as they become more comfortable with the software, they eventually buy additional functions or simply accept advertisements while using the free service. The *on-demand* model is a service with a standard price and is available to the customer when needed. A list of the modern business models that come from digitalization is presented in Table 1. The evolution of the business models is still on-going; therefore the list is not closed yet.

Business model	Company name
Subscription model	NETFLIX
Freemium model	Spotify, Skype
Free model	Facebook
On-demand model	Uber
The Ecosystem	Apple

Tab 1. New business models in the digital world. Source: Wyrozębski, P. (2018). Relationships in Management 4.0. Faculty of Management, Warsaw University of Technology conference, Warsaw, April 10, 2018.

Digital transformation impacts business models, but it also has an impact on project management. The Group of Twenty (G20) defines this trend as follows: *"(…) an artificial intelligence will emerge as the standard way of managing, interpreting, and acting on IoT. From a standards perspective, this will bring to the forefront the need for a new type of "hybrid" standard to emerge standards that go beyond technical aspects to encompass trust and ethical dimensions, among others. This will require unprecedented collaboration and co-ordination among multiple disciplines."* (Organisation for Economic Co-operation and Development [OECD], 2017, p. 60). This interdisciplinary collaboration of self-organizing project teams working on the problem from the first day, which can rapidly and flexibly respond to changes, is an answer itself to the changing requirements coming from the project environment. This characteristics is common for agile project management (Table 2).

Classic PM	Agile PM	Theory of Constraints
1. Critical Path Analysis	1. Sprint retrospective	1. Buffer management
2. Presenting the whole picture	2. Daily stand-up meetings	2. Throughput analysis
3. Focus on project stages	3. Working system from day one	3. Focus on critical chain on critical resources
4. Sequential Process (e.g., processing one stage at a time, no overlap)	4. Co-management: Customer and supplier cooperation	4. Don't start things without finishing others
5. Emphasis on documentation	5. Multi-disciplinary teams	5. Progress control by buffer consumption rate
6. Detailed requirements specification	6. Self-organizing teams	
7. Progress control by earned value management	7. Progress control by burn down chart	
8. Hierarchical organizational structure	8. Rapid and flexible response to change	
9. Formal communication	9. Informal communication	
10. High-level planning		

Tab 2. Comparison of the traditional (classic) PM, agile PM and the theory of constraints. Source: Grushka-Cockayne, Y., Holzmann, V., Weisz, H. and Zitter, D. (2015). A new hybrid approach for selecting a project management methodology. Paper presented at PMI® Global Congress 2015 – EMEA, London, England. Newtown Square, PA: Project Management Institute.
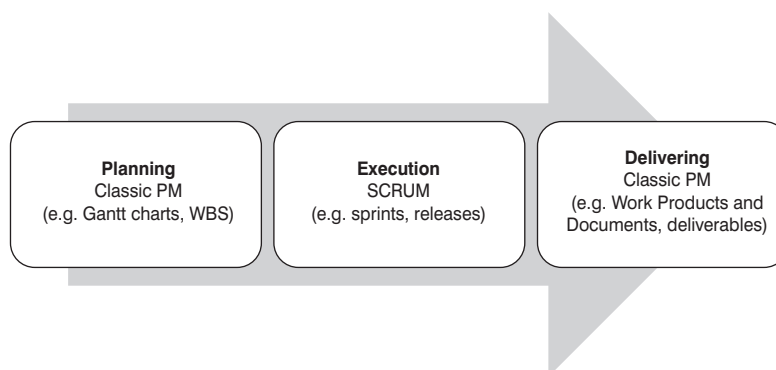

Fig. 1. Hybrid project management. Source: Own research based on Komus, A. (2018). Adaptives Projektmanagement – agil, klassisch, unimodal, bimodal, multimodal, hybrid? Retrieved from https://www.komus.de/app/download/8835564386/2017-04-PM-hybrid-adaptiv.pdf?t=1516173422 (16.05.2018).

Research results described in Status Quo Agile 2016/17 have shown that the evaluation of the success of agile methods is still very positive, but "*(…) slightly less "enthusiastic" than in previous surveys*". Often a mixture of the classic and agile methodologies is implemented as a way to allow teams to feel comfortable planning and delivering projects with the interactive and incremental work of agile software methods such as Scrum (Sulaiman & Zulkefli, 2018). This mix of elements coming from different methodologies is called hybrid project management (Figure 1).

As the Status Quo Agile 2016/17 report shows, the new hybrid methodology is most commonly used within international companies. The research was carried out in cooperation with GPM Deutsche Gesellschaft für Projektmanagement e. V., International Project Management Association and Scrum.org. on a group of 1000 PM professionals that represented enterprises from 30 countries. The time horizon of the research covered the third and fourth quarters of 2016. The results showed that 12% of the surveyed companies worked on a project with the classic methodology, 20% of them chose the agile project management methodology, and 37% selected the hybrid project management methodology for their projects (Komus, 2017). The research also confirms that more and more often collaboration and coordination focused on the project will concern multiple disciplines represented by interdisciplinary teams.

3. Digital Communication Tools as a Part of Effective Project Communication

In the past, it may have been said that effective communication had a large influence on project success. But is this still true, given the pervasive digital transformations and changes that occur in a project environment?

References distinguish project success criteria and project success factors. Success criteria should be defined in measurable terms including measures of what must be done for the project to be acceptable to all the parties that will be affected by the project (clients, stakeholders and end-users) (Office of Government Commerce, UK, 2008, p. 61). Project success factors are:
• elements of the project, or
• elements of its management,

which can cause an increase of the chance of achieving a successful outcome (Rodney, 2009, p. 53). In other words, the success factors are the elements (or activities) required for ensuring the project success criteria.

Communication is perceived as an important factor that has a strong impact on a project's success. Poor team communication can effect delays, misunderstandings, mistakes, confusion and finally failures (Sudhakar, 2012, p. 40). Despite that, "*(…) there are occasional mentions in the literature of good communications as a significant factor in project success*" (BMG Research, 2014).

Basu distinguished five main causes of failures in relevance to the quality dimensions (Basu, 2013, p. 62). Problems such as *ineffective decision making* with respect to *incoming changes* as well as *ineffective coordination with subcontractors and suppliers* correspond with *organisation quality*. But there is also an indication of a source of project failure connected with communication – *ineffective control and communication over progress* and *concealment of project status until it is too late* that correspond with the quality of the process (Table 3).

Causes of project failures	Relevant dimension of quality
1. Ineffective decision making in managing changes	Organisation quality
2. Project schedules with unachievable delivery dates	Process quality
3. Excessive 'scope creep'	Product quality
4. Ineffective coordination with subcontractors and suppliers	Organisation quality
5. Ineffective control and communication over progress, and concealment of project status until it is too late	Process quality

Tab. 3. Causes of project failures in relation to quality dimensions. Source: Basu, R. (2013). Managing quality in projects. London and New York: Routledge, p. 62.

Basu summarizes his research: "*The situation related to project failures can be significantly improved by the application of organisation quality attributed by project leadership, communications and people-related issues.*" (Basu, 2013, p. 70).

Interesting research was also conducted by Sudhakar (Sudhakar, 2012). On the basis of that research, effective communication is seen as a project success factor. By 2016, ineffective communication as a critical failure factor (CFF) had had 10 occurrences in literature.

A qualitative research of the "Factors in project success" report in the form of 25 in-depth interviews undertaken with senior project management professionals and academics revealed more emphasis in interviews explicitly on communications between and within groups involved in delivery as a success factor (BMG Research, 2014). It is relevant to effective communication within the project team, which is crucial for project success. In conclusion, last research has confirmed that communication is still a project's key success factor that has an impact on the work of the project team and the quality of its deliverables.

The project team has to choose its own communication tools. Aakhus and Ziek define tools as "*(…) instruments for communication through which*

certain sorts of communication are enabled" (Aakhus & Ziek, 2009). Adequate communication tools determine project communication efficiency (Grudin & Poltrock, 1989, p. 199). Nowadays, traditional communication tools cannot manage complexity; space for waste is created and communication efficiency is restricted (Berg, 2017, p. 4). Digital communication tools are relatively low-cost information technology that can provide an accepted level of efficiency. The paper titled "The impact of Social Networking 2.0 on organisations" considers the influence of digital communication tools on projects that are executed by organizations. Qualifying digital tools in an order of social networking, there are the following modes of computer-mediated communication (Zyl, 2009, p. 910):

1. One-on-one (e.g. Messenger);
2. One-to-many or one-to-few (e.g. Messenger, Skype);
3. Many-to-many or few-to-few (e.g. wikis).

Within the project team members, located in different areas, effective and digital communication is crucial. But here arise the following questions: Should the team choose digital communication tools itself or should they be defined by a project manager or project sponsor? Which modern digital tools are helpful for interdisciplinary communication (as it is common that every sector has its own dedicated solutions)? Which tools are nowadays selected for interdisciplinary and agile work on projects? Two cases considered below should deliver an initial set of best-practices that solve those problems.

4. Communication in BIM and SQUAD Projects

Following Emmit, the word "interdisciplinary" encompasses more than one branch of learning or instruction – it is the interface of different domains. Interdisciplinary work is the interaction of individuals from different disciplines, both within organisations and within temporary project organisations, that is held during the life of the project (Emmit, 2010, pp. 8–10). An interdisciplinary project can be therefore described as a complex undertaking, involving a temporary grouping of people and companies, with different agendas and experience, coming together to achieve a project goal (Emmit, 2010, p. 1). Within the Agile software development frameworks, this is a practice known as ***The Whole Team***. By involving all disciplines on a single team, striving to complement the knowledge of an individual, the paths to communication are shortened and often clarified (Ganis, 2009). Individuals working on a project should communicate effectively by selecting the terms and tools that are understandable to others. The distribution of project information is critical to ensure all information is communicated on time throughout all project phases (Mepyans-Robinson, 2011, p. 173). Much of the remote-work aspects should be considered, as well as different locations accompanied by different time-zones. Therefore, a project team

needs an easy-to-use, real-time and mobile tool that will be reliable in all circumstances.

Two examples of an interdisciplinary project are described in this chapter. First, a project called *SQUAD*, which is an international, interdisciplinary and educational project that shows how design-thinking can help to achieve a creative and innovative solution. Second, a project titled *mpiBIM*, which is a local, interdisciplinary project that solves the problem of parallel work of construction, architecture and engineering as well as project management specialists working with the Building Information Modeling (BIM) tools. Both cases confirm the undeniable role of communication in project success.

The SQUAD project combined students that represented three branches or disciplines: design (Polytechnic of Porto), Information Technology (Pace University, NY) and business (Faculty of Management, Warsaw University of Technology). The name of the project came from the term used for the first time by Spotify, where squad was defined as a cross-functional team that acted as a small start-up within a company. The aim of the project was to solve a real-world company problem that was presented during the project kick-off to deliver a mobile application with complex system functions. The Design Thinking theory (Dym, Agogino, Eris, Frey, & Leifer, 2005) was applied as a methodology basis for team work (e.g. learn by doing, team-based project, user-centered application) and SQUAD's methodology was heavily based on the Double Diamond process, created by D. Nessler. The methodology distinguishes four project phases (Nessler, 2018):
1. Research (insight into the problem – diverging).
2. Synthesis (the area to focus upon – converging).
3. Ideation (potential solutions – diverging).
4. Implementation (solutions that work – converging).

The company was represented by a liaison, a person who provides a continuous connection between the student team and the company. Following the agile project management guidelines indicating that the size of a team should not exceed nine members, each of three teams consisted of six persons (two students from every branch) located intercontinentally (in different time zones). The final deliverable was a Proof of Concept of the Application (screen captures cannot be published due to the Non-Disclosure Agreement (NDA)). Without effective communication, the final result could have not been achieved as there were only three direct meetings (kick-off, middle-term and final gala). But the assumption was to communicate daily, and all the teams were obliged to communicate as effectively as possible by arranging a good Internet connection, finding a quiet space and using an effective tool (following the SQUAD Handbook). Therefore, the teams chose and tested different digital communication tools.

The first team used Messenger and its video connection to meet twice a week with the team members; also Slack and Google driver worked out for constant communication. The second team tested Messenger as well, but then decided to replace it with Slack. Over the various phases of a project, communication requirements may change, and without hard and fast rules on how this change occurs, several questions arise (Cervone, 2014, p. 76). The team regularly reconsidered the questions about the function of digital communication tools they used, and it was a reason for change. The second team also used Hangouts for voice connections, video connections (once a week) and Google drive for exchanging documents. The last team attempted to use Messenger and Asana first, but then switched to Slack in the final analysis. For video connections they used Skype, and for real-time work on the documents Google drive was adopted. What is important – all the teams chose communication tools independently, project coordinators did not recommend any solutions (as they were not asked to do so). The final work was presented on May 3rd, 2018 in New York and succeeded based on feed-back from the companies.

The other interdisciplinary project, mpiBIM, was a local initiative of the Faculty of Architecture of Warsaw University of Technology. The Dean of this faculty had a vision to work parallelly on the construction project using the Building Information Modeling tools. The definition of BIM that comes from the ISO standards is: "*Construction of a model that contains the information about a building from all phases of the building life cycle*" (International Organization for Standardization [ISO], 2015). This model is digital and provides the capability to design a building, but also to simulate the construction and operation of a new or modernized facility. All data is kept in one place (e.g. cloud) that gives quick access to the information. The mpiBIM project involved students from five faculties of Warsaw University of Technology (WUT): Faculty of Architecture, Faculty of Civil Engineering, Faculty of Electrical Engineering, Faculty of Building Services, Hydro and Environmental Engineering and Faculty of Management. Although the project seemed to be local, there were many issues to solve. First, the schedule of each faculty that was not conducive to frequent meetings as team members had different duties already scheduled (so they had a meeting once a week). Second, a different language that the representatives of different faculties spoke due to the different branches. Communication (simple communication tools and solutions coming directly from BIM) integrated teamwork and allowed for receiving an instant feed-back. The results of their work impressed the rector and the board of trustees. Three modern buildings were designed with all the calculations that are important from the construction point of view (Figure 2).
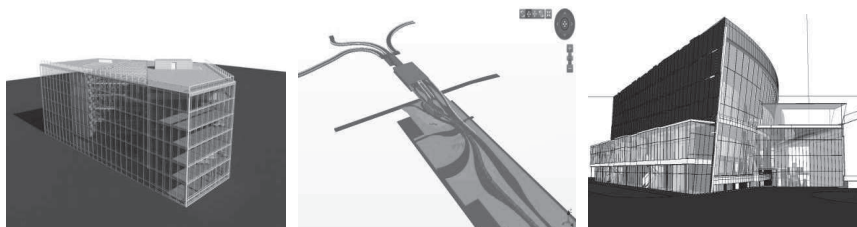
Fig. 2. Visualisation of the buildings within the mpiBIM project. Source: mpiBIM project team, WUT.

To summarize the examples presented above, all the communication tools applied for the SQUAD and BIM projects are presented in Table 4.

	SQUAD	**mpiBIM**
Communication tools	Slack, Messenger, Hangouts, Video Skype Asana Google Drive	Tekla BIMsight, Autodesk Revit 2018, ArCADia, Solibri Model Checker, Slack, Messanger, Hangouts
	International	**National**

Tab. 4. Communication tools in the educational interdisciplinary projects. Source: Own research

In both cases, team members needed a fast (real-time), reliable and easy-to-use communication tool, which helped to connect them all at the same time. Also, the quality of data transfer was important – the team demanded to have a clear and real-time voice and video transfer. The other expectation from the digital communication tool was that it had to allow for attaching reports, pictures and other work products and documents to conversations (chats).

5. Conclusion

The concept of communication as a project success factor is not new, but nowadays projects rely on communication due to the high degree of interdisciplinarity of the teams and different location of its members. The successful case studies have delivered some interesting conclusions: an interdisciplinary project cannot be run without effective communication, and team members should choose their own flexible, user-friendly and modern communication tools that perfectly match agile or hybrid project management methodologies.

The following are the conclusions drawn from the implementation of the considered cases:

- communication plays a critical role in interdisciplinary projects that is even more important comparing to "regular" projects. Without an effective communication channel, work on this kind of project is impossible;
- due to the self-organizing teams, where team members come from different units, work in different locations or according to different schedules, daily face-to-face meetings are impossible. In this situation, the communication role is assigned to the digital tools such as Slack, which was definitely the most popular between team members;
- communication tools chosen for the project should be understandable, easy to use and mobile.

Finally, based on the experience gained from the projects considered above, it can be concluded that – to adapt to the agile or hybrid project work – these communication tools have to be chosen by the project team itself.

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