MICRO IT PROJECTS SUCCESS FACTORS – A SMALL SCALE SCIENTIFIC RESEARCH*

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Abstract

A project is a temporary endeavour undertaken to create a unique product, service or result (PMBOK, 2013). The unique nature of projects and the fact that they are usually undertaken in a business environment makes the scientific approach to studying project success factors almost impossible.

In this paper a small scale scientific research on micro IT projects success factors is presented. Six teams of students who specialize in Game Development in B.Sc. "Information Technologies" programme, led by six students from M.Sc. "Information Technologies Project Management" programme at New Bulgarian University are assigned to work on comparable project in terms of both: organizational environment, stakeholders expectations, available information and existing communicational channels, and also in terms of project parameters as project scope, time and resources. The paper presents the research set-up and the monitoring processes. The projects' plans, progress, recovery activities, milestones and final outcomes are described in details. The project management challenges, risks and issues, the decision making process, and the success rate in decision implementation are analysed. Key factors for project success are identified.

The proposed method for scientific research of project success factors is critically examined and compared to alternative approaches. Scaling up of the research is discussed.

Key words: *project management, education in IT PM, project success factors*.
JEL code: *M15, I21, I23*

Introduction

Teamwork is an essential requirement to complement theoretical knowledge and practical engineering skills in computer science and informatics. In their article about teaching teamwork to software engineers, presented to IEEE's Frontiers in Education Conference – 2011, Lingard and Barkitaki quote Ben Amaba (Worldwide Executive of IBM since 2005): "Software engineers need good communication skills, both spoken and written. They need an analytical capability, and they need to be able to manage a project from end to end while working well with their colleagues." (Lingard and Barkataki, 2011).

Informatics department at New Bulgarian University undertook a large-scale research project "Preparation of IT specialists for the Knowledge Economy" (scheme: BG051PO001-3.1.07,

* *Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally presented at the 5th Scientific Conference on Project Management in the Baltic States, University of Latvia, April 2016. It is republished here with the permission of the author and conference organizers*

contract: BG051PO001-3.1.07-0072) on the most recent world-class practices on ensuring synergy of academic knowledge and yet building professional skills demanded by the IT industry in a higher educational setting. As a result of the project, the individual assignments in the third year of the undergraduate programmes were redesigned into larger scale multidisciplinary students' group projects (micro IT projects). Using group projects as pedagogical tools raises some concerns, mainly based on scarcity of scientific evidence for or against the effectiveness of the method (Ashraf, 2004). Nevertheless, group projects are becoming an essential part of software engineering curricula (Mead, 2009, Sancho-Thomas et al., 2009, and van Vliet, 2006).

Recently the Bulgarian Industrial Association – Union of the Bulgarian Business (BIA) introduced a sector oriented competence framework. Each competence description includes both sector specific requirements and behavioural indicators. All competences in the ICT sector require strong teamwork skills (Competence Assessment Information System, 2015). Based on these structured industry requirements, on the recent good practices in software engineering curricula development (Mead, 2009), and considering the known drawbacks (Ashraf, 2004), Informatics department had selected micro IT group projects as the pedagogical tool for teaching teamwork in their academic setting.

Micro IT projects are considered an educational innovation in the context of undergraduate education at Informatics department. This paper presents a small scale research on the success factors of the micro IT projects implemented at Informatics department at NBU.

Research, results and recommendations

Piloting Micro IT Projects

Set-up: Pilot phase started in 2013/2014 academic year. Two micro IT projects were assigned to two students' groups.

Project characteristics:

- **team selection criteria** – self-selected teams; fixed size of three students;
- **year of study** – first and second year;
- **assignment** – based on a project charter, clearly defined project scope and time, measurable acceptance criteria;
- **management** – the PM is a faculty member; the teams were mentored by a field expert from the industry;
- **motivation of the team members** – commitment to the success of the micro IT project as a contribution to the success of the main project "Preparation of IT specialists for the Knowledge Economy".

The groups were self-selected teams of three. The students in the first group were in their second year of study, the students in the second – in their first year. The only criterion for participation was strong commitment. Both teams successfully completed their tasks during the experimental phase of the project. The size of the group predefined the complexity and the build-in interdependences of the project assignments. The projects were managed by a faculty member and the students were mentored by the CTO of one of the Bulgarian game development companies.

Results: Both teams completed their micro IT project successfully within time and scope. The success rate of the pilot was 100%. The insights from this phase of the project "Preparation of IT specialists for the Knowledge Economy" were used as a first step for institutionalization of the micro IT project management projects and the corresponding academic and professional practices in the department. Internal standards and templates for micro IT projects charter and requirements documentation, recommendations for project management, group evaluation guidelines, and pilot group project case-studies were developed according to known good practices (Swaray, 2012, CMU, 2015) and the specific finding on NBU case.

Outcomes: After the successful experimental phase, the micro IT projects were introduced in the third year of all undergraduate programmes at Informatics department. At that point of their study the students have enough theoretical knowledge and classroom practices to be able to implement the assigned task individually. The challenge is to do it in a small team. Grounded on the positive pilot experience, the expected success rate was the same or higher than the success rate of individual projects.

First Year of Implementation

Set-up: Five small scale game development projects started during the first year of implementation of the micro IT projects as part of the compulsory activities within the standard programme of undergraduate education in Informatics.

Project characteristics:

- **team selection criteria** – self-selected teams; flexible size of two to five students;
- **year of study** – third year;
- **assignment** – based on students' ideas and consulted with the faculty; flexible scope, fixed time; measurable acceptance criteria;
- **management** – self-organized teams, supervised and consulted by a faculty member;
- **motivation of the team members** – the students have to do it as part of their undergraduate education.

The groups were self-selected teams of two to five. All students were in their third year of study. The assignments were developed by the students and approved by the faculty. The teams were self-organized, supervised and consulted by a faculty member.

Results: Only two teams successfully completed their tasks within scope and time. Both teams had members who had participated in the pilot phase during the previous year. Although the overall success rate is 40%, the success rate of 0% of the newly formed teams was disconcerning. Another 40% of the projects were implemented with significant delay. The outcome of the first year of implementation of the micro IT projects led to students' and faculty dissatisfaction both of the process and the results.

Feedback process: Project post-mortem interviews with students revealed that they were not able to utilize enough resources in a resource rich set-up and to benefit from the available support. Most of the students described team member behaviour as indifferent or passive, waiting for others to do the job (as signs of absenteeism and free-riding) or as aggressive and unwilling to discuss and compromise on technical issues, creating excuses instead of solutions.

Identified issues: The main conclusion after the first year of implementation was that students lack commitment and project management competences to overcome initial team dysfunctionality.

Overcoming initial team dysfunctionality

Literature review

Positive teamwork experience is a requirement for, not a result from success (Chapman et al, 2009).

Even though the group projects and the cooperative learning initiatives gain wider support as a vehicle to meet industry demand for team-savviness of the undergraduate students, the approach is challenging. Reported issues are: mismatch in students' conception of staff – student roles (Watson, 2002); problematic evaluation of group participation and member's free-riding (Swaray, 2012); dealing with the feeling of reduced responsibility manifested by social-loafing (Dommeyer, 2012); and resistance to teamwork (Smith et al, 2011). Students groups manifesting these and related issues are considered as dysfunctional teams.

Fixing dysfunctional teams is exhaustively discussed both in academic and in business publications. Based on a brief literature review we may differentiate the following approaches:

- Project management approach – applying sound project management knowledge, processes, skills, tools, and techniques (Project Management Institute, 2013), managing resource amalgamations, and process formalization through rules, procedures, and periodic reviews for project control and review (Tatikonda and Rosenthal, 2000);

- Micro-OB approach – building trust and team cohesiveness (Field, 2009), approaching with positive assumptions (Kruse, 2013), promoting mutual learning team members' mindset (Schwarz, 2013).

In addition, researchers discussing how to fix dysfunctional teams in an academic setting, utilize different evaluation schemes (Swaray, 2012) and peer-assessment techniques (Goldfinch, 1994).

The fact that student's dissatisfaction with the group projects affects negatively their attitudes about the benefits of teamwork (Aldridge and Swamidass, 1996) emphasizes the responsibilities of the faculty for micro IT projects set-up and implementation. The key role of the instructor in creating a positive group work experience is often underestimated. Instructors' positive and proactive approach to group projects, timely discussions on team dynamics, project processes and phases, clear rules that reduce tension on grade equity significantly impact the overall students' satisfaction of the group project and contribute to positive attitude towards teamwork and increase the perceived benefits (Chapman and Van Auken, 2001).

As part of "Simon Initiative" Eberly Center for Teaching Excellence and Educational Innovation had published recommendations for designing group projects based on CMU practices and the practices summarized in "Active learning: Cooperation in the college classroom" (Johnson et al, 1991). The recommendations include but are not limited to the following three areas: the

instructors should design the project task for collaboration by creating complex task with built-in interdependencies; the instructors should devote time to teaching and promoting teamwork skills in students by facilitating the discussions within the group, the decision-making processes, and handling conflicts, mentoring planning, task delegation and the progress of monitoring and control; build individual accountability (CMU, 2015).

Approaches to overcoming team dysfunctionality

Project Management approach: Project management approach requires professional application of sound project management knowledge, processes, skills, tools, and techniques (Project Management Institute, 2013). The size of the project team, the complexity of the project and the academic organizational context reduce the required project management activities to the following main project knowledge areas: project integration, scope, time, quality, communication, and risk and stakeholder management.

Third year students in technological undergraduate programmes do not have knowledge about project management processes, do not possess the skills to use the appropriate management tools and techniques. In the first two years of their higher education they acquire enough theoretical knowledge and classroom skills to manage the scope of the project. Students are able to identify the quality of the developed software product but they do not benefit from quality processes and do not use quality management techniques for building a quality product, such as design and code reviews and inspections.

The project management approach to fixing dysfunctional project teams requires introduction of the missing project management knowledge and experience. The team manager should be able to perform project integration management; should facilitate scope management by focusing the group effort on the main product features and guide the team out of scope creeps; should guide the team in building a project plan and scheduling project activities and in tracking progress against the current plan; should promote quality processes and quality assurance practices as early in the implementation of the software product as possible, and insist to measuring quality factors and monitoring of quality indicators; manage communication and information sharing; identify and discuss the risk with the team, mentor risk monitoring and mitigation; build awareness of the importance of stakeholder management and take care for stakeholders' expectations.

Faculty members responsible for group projects may introduce the missing knowledge and experience to students' teams. Tutoring sessions synchronized with the current project phase and team dynamics should guide the group project progress. The problem with the tutoring sessions is their scalability. Project management theory recommends fulltime project managers in industrial settings. The equivalent of this recommendation in academic settings would be each faculty member to lead just one group project but it is hardly implementable in an institution with standard student-faculty ratio of fifteen. Faculty should manage five to ten group projects bearing the consequences of split of focus and attention.

Faculty as instructors may use close guidance or micromanagement techniques to overcome interpersonal issues and technical obstacles but the instructor risks imprinting the team with dependencies from external decision-making that will deepen their dysfunctionalities. On the other hand, empowering students' teams may also lead to dysfunctionalities due to lack of management knowledge and experience.

Faculty may involve as team managers for undergraduate students' group project graduate students in "IT Project Management" programme who have the appropriate theoretical background, rich classroom and industrial experience and are able to manage projects but managing undergraduate group projects is not part of the curriculum.

Micro-OB approach: Micro organizational behaviour (micro-OB) approach studies individual and group behaviour and how they affect organizations. The Micro-OB approach to fixing dysfunctional teams recommends building trust and team cohesiveness (Field, 2009), approaching with positive assumptions (Kruse, 2013), promoting mutual learning team members' mindset (Schwarz, 2013).

From the micro-OB point of view faculty members could hardly be perceived as genuine team members. The authority of the faculty dominates the student's mindset and creative, collaborative, and cohesive team environment is in some aspects in contradiction with the traditional student-lecturer relations in the academia. The problem is multilevel – macro-OB level focuses the risk of negative consequences of disrupting the perception of academic hierarchical levels on the overall process in the university; micro-OB level emphasizes the need of close collaboration between students and group project managers for promoting teamwork and increasing the students' group projects success rate.

A micro-OB approach would require reducing the gap in the perception of the authority levels between the team members and the project manager – the first step in building team cohesiveness is strengthening the bonds between individual members (Field, 2009).

A possible solution would be involvement of mediators between the faculty and the students' groups who could build strong bonds in both directions – with the faculty members and with the undergraduate students. Strong candidates for this specific role of mediators are graduate students who volunteer to lead undergraduate students' teams in their group projects. As volunteers, the graduate students are expected to approach the group project with positive assumptions, and to be proactive in emphasizing the benefits of teamwork, contributing to the overall positive perception of the project of the undergraduate students (Chapman and Van Auken, 2001). Lack of project management knowledge or lack of experience in the specific technical domain could be a drawback.

Recommended combined approach: The group projects organizational design is faculty leading team of graduate students who are project managers of undergraduate students' group projects. Based on micro-OB approach the recommended organization design promotes mutual learning team members' mind-set – an important prerequisite for team success (Schwarz, 2013).

The role of the faculty is recontextualized in the terms of micro-OB from manager of group projects to management team leader. In this setting the faculty role is to lead by example the team of graduates – to follow organizational policies and best practices, to create environment of trust, to promote open communication, facilitate constructive discussions, knowledge and experience sharing; to employ coaching principles and empower graduate students to maximize their efficiency as project managers in their day to day work with undergraduate teams.

The challenge to the approach is the required behavioural transformation of the faculty members from lecturers and micromanagement professionals to leaders, facilitators and coaches.

Combining both project management approach and micro-OB approach may compensate the negative and increase the positive outcomes of the recommended changes. The recommended amalgamation is achieved by recruiting graduate students from IT Project Management programme as project managers and team leaders of undergraduate students' group projects. The faculty effort should be targeted on leading by example and coaching this group of graduate volunteers. Creating a positive experience for the project management team is likely to propagate and have a multiplicative effect as a positive experience for the development team members and impact the overall students' group projects success rate.

The recommended mixed approach is backed by sound management knowledge, processes, skills, tools, and techniques, in addition, it focuses on trust and team cohesiveness, promotes mutual learning by group projects organizational design, and utilizes coaching as empowering strategy.

Second Year of Micro IT Projects

Set-up: Six small scale game development projects started during the second year of implementation of the micro IT projects. The project organization used the combined project management and micro-OB approach to overcoming team dysfunctionality. The micro IT project assignments were part of the compulsory activities within the standard programme of undergraduate education in Informatics.

Project characteristics:

- **team selection criteria** – self-selected teams; fixed size of three students;
- **year of study** – third year;
- **assignment** – based on a pproject charter, clearly defined project scope and time, measurable acceptance criteria;
- **management** – graduate students from IT Project Management programme; the PM was coached by a faculty member;
- **motivation of the team members** – the students have to do it as part of their education; the team members depend on each other and relay on each other, they share the responsibilities for the project success.

The groups were fixed size self-selected teams of three undergraduate students and a project manager from the graduate programme IT PM. All undergraduate students were in their third year of study. The graduate students were in their final term of study. Each team had a PM, and the PM team was lead and coached by a faculty member – certified PMP.

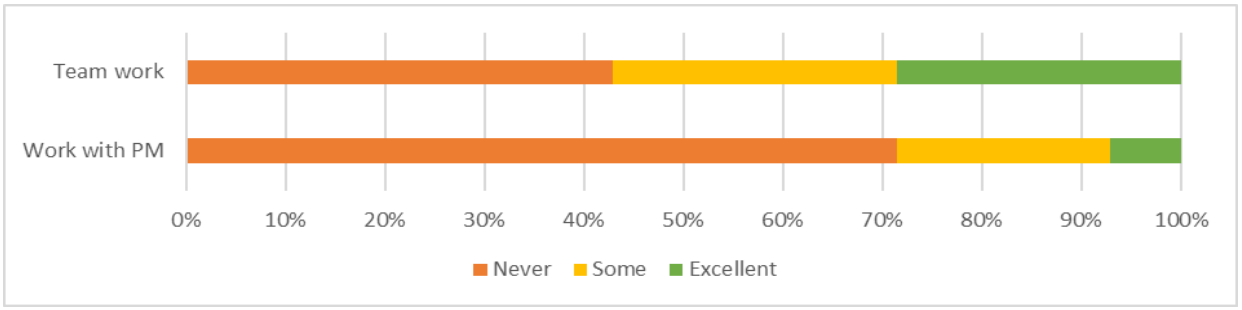

Fig. 1. **Prior Experience of the Team Members**
Source: author's construction based on new data

The magority of the students had no or negligable prior teamwork experience. The majority of them had never worked with a project manager.

The assigned micro IT projects were comparable both in terms of: organizational environment, stakeholders' expectations, available information and existing communicational channels, and also in terms of project parameters as project scope, time and resources. They were developed the faculty members as project charters – structured, clearly specified the scope, the time and the acceptance criteria. The time estimation was 90 task hours per team member, 120 management hours, and 30 hours of communication per team member (incl. PM).

The micro IT projects were designed to have a core functionality, that had to be developed in close collaboration between all participants, and three interdependent tracks that build upon the core. The students had to learn to use a new graphics API (SDL). The API was implemented in a programming language they had studied during the previous two years in 90 lecture hours and 90 lab hours. At that point of their study the students are supposed to have enough theoretical knowledge and classroom practices to be able to implement the assigned task individually.

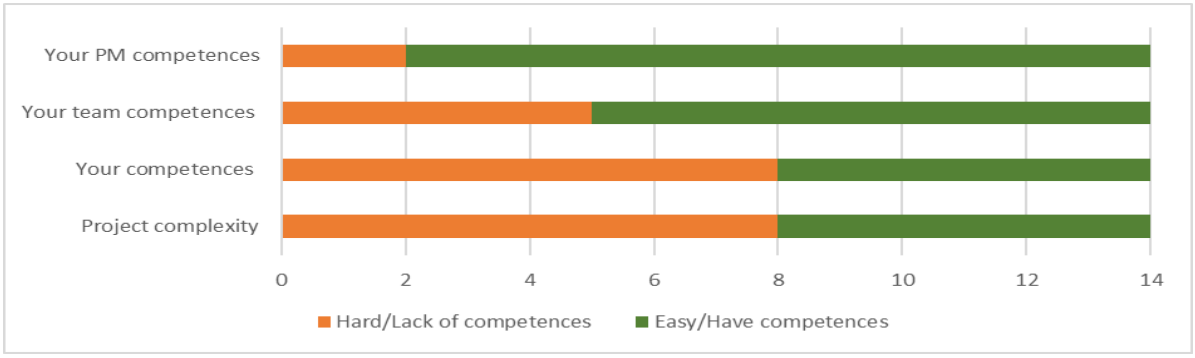

Fig. 2. **Self-Assessment of the Complexity of the Project and the Competences of the Team and of the PM at the Start of the Micro IT Project**
Source: author's construction based on new data

The majority of the undergraduate students considered the assignment micro IT projects as difficult to implement. They assessed their competences at the project start as not sufficient.

More than 85% of the undergraduate students were convinced from the very beginning that their project managers from the master degree programme had the required competences to lead the project.

The subset of the management processes was selected to correspond to the micro IT projects scope complexity, the available management time and the size of the project team. The responsibility for the execution of the management processes, and the selection of the supporting tools and techniques was delegated to the graduate students - the project managers.

Project communication was considered as a major ongoing prevention activity of team dysfunctionality. It included:

- kick-off meeting – once in the beginning of the project;
- work progress – daily from the team members to the PM;
- scope status, schedule status – weekly from the team members to the PM;
- scope status, schedule status, risk status, stakeholder engagement status, communication status – biweekly from the PMs to the project management team leader (faculty member);
- emergency status related to risks, need of additional information, discussions of urgent issues – ad hoc (24/7) from all participants to the project management team leader;
- presentation of project results – once at the end of the project; date and time fixed at project kick-off meeting.

Table 1

Subset of the PMBoK Processes used for the Micro IT Project Management

	Initiating	**Planning**	**Executing**	**Monitoring & Controlling**	**Closing**
Project Integration Management			Direct and Manage Project Work	Monitor and Control Work	Close
Project Scope Management		Create WBS		Validate Scope Control Scope	
Project Time Management		Define Activities Sequence Activities Estimate Activity Resources Estimate Activity Duration Develop Schedule		Control Schedule	
Project Cost Management					
Project Quality Management					

Project Human Resource Management			Develop Project Team Manage Project Team		
Project Communication Management		Plan Communication Management	Manage Communications	Control Communications	
Project Risk Management		Identify Risks Plan Risk Responses		Control Risks	
Project Procurement Management					
Project Stakeholders Management			Manage Stakeholders Engagement		

Source: author's construction based on (PMBOK, 2013)

Results: Five of the six teams completed their micro IT project successfully within time and scope. The success rate of 83% is two times better than the success rate of the previous year. The sixth micro IT project was rescheduled and it is under implementation at the moment when this article is written. Although it may be closed within the newly defined deadlines, it will be considered as unsuccessful for the purpose of the current study.

Feedback process and conclusion: As part of the project's closure phase all participants filled in a survey. The analyses of some of the insights from the survey are presented below.

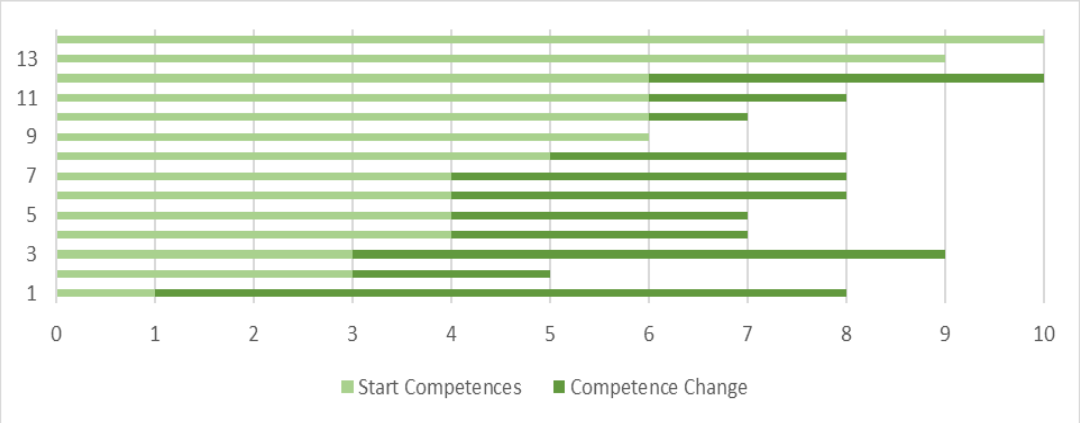

Fig. 3. **Self-Assessment of the Technical Competences Before and After the Micro IT Project**
Source: author's construction based on new data

The self-assessment of the competences of the undergraduate students changed from 3.64 points to 7.86 points on a 10 points scale where one indicates lack of competences, and ten indicates student's confidence that they have the required competences to fulfil all project related tasks.

Although the data is not sufficient to draw conclusions, we may suggest that these results show two important processes:

- learning by doing – building on the existing knowledge and learning new APIs based on known technologies;
- building self-confidence – some of the students lack experience and overestimate the complexity of the assignment; successful execution of the project is an important feedback that shows to the students what they can do using the knowledge and the training from the first two years of their undergraduate study.

The vast majority of the undergraduate students (83%) report high satisfaction with the micro IT project administration, management and process. The rest (17%) give positive feedback but express some discontent. These results are a major improvement in comparison to the overall negative feedback from the previous year.

All graduate students give positive feedback about their experience as micro IT project managers. Ability to explore new PM practices and to work to improve specific PM skills are outlined as major advantages of project management activities in a learning environment. Even the project manager of the team that missed its deadline considers the experience as enriching, positive, and very useful.

Identified issues: Only one of the teams was not able to finalize the project in time. The data is not sufficient to identify significant differences with the successful teams. The team members and the project manager report issues very similar to the issues reported by all teams during the first year – lack of commitment, free-riding, absenteeism, not enough time, etc. Based on the feedback we may conclude that the team did not overcome its initial dysfunctionality despite the changes in the micro IT projects management.

Table 2

Communication Activities vs. Success

Activity type	Periods	Team1	Team2	Team3	Team4	Team5	Team6
Kick-off meeting	**once**	yes	yes	yes	yes	yes	yes
Work progress	**daily**	yes	yes	**no**	yes	yes	yes
Scope, schedule status	**weekly**	yes	yes	yes	yes	yes	yes
Scope, schedule, risk, stakeholder engagement, communication status	**biweekly**	yes	yes	yes	yes	yes	yes
Emergency status related to risks, need of additional information, discussions of urgent issues	**ad hoc (24/7)**	yes	yes	yes	yes	yes	yes
Presentation of project results	**once**	yes	yes	yes	yes	yes	yes
Success (scope/time)		yes	yes	**no**	yes	yes	yes

Source: author's construction based on new data

Most of the teams communicated on daily bases in the project execution phase. Team3 reports difficulties in establishing communication routines, absenteeism, and long periods without successful communication. They failed to reach the execution phase because they could not negotiate team members' responsibilities and the project manager was not able to get the team's commitment.

Conclusions

The scale of the current research does not allow us to draw conclusions but the analysis of the data could be used to make suggestions about some of the success factors of micro IT projects.

- Overcoming initial team dysfunctionalities is a pre-requirement for the success of micro IT projects.
- Commitment to the project and the team success should be established as early as possible.
- Long periods without communication between the PM and the team may lead to project failure.

The research on the success factors of micro IT projects is work in progress. Further research will build upon the suggestions identified in this article.

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