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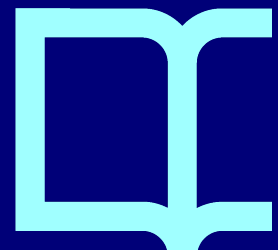
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Management of a Multidisciplinary Research Project:

A Case Study on Adopting Agile Methods

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Abstract

Agile methods, initially used by cross-functional teams in software development projects, can also facilitate teamwork in collaborative research processes. For this, project management-related issues need to be addressed, including the challenge of finding practical means for coordinating scientific collaboration, while garnering commitment from all participants. This article explores the utilisation of agile methods by a semi-distributed scientific team, for coordinating a multidisciplinary research project. It examines how these methods can contribute to task coordination in scientific research and highlights key factors for successful adoption of the agile framework in collaborative research projects. Data are collected from a research team, after a 10-week phase of implementing agile methods. Data analysis focuses on the effectiveness of the team dynamics and digital tools used for communication and coordination during the project. The findings indicate a perception that agile methods contribute to coordination and improved teamwork during project development, with less agreement on the utility of some of the tools used. Also, it suggests the importance of involvement of the principal investigator and the role of a facilitator.

Index Terms: collaborative research; multidisciplinary; research management; knowledge management; team science; agile methodology

1. Introduction

The agile methodology entails a set of principles and practices meant for application in software development settings. These principles and practices enable cross-functional teams to develop project requirements and solutions internally, through their collaborative work (Hoda, Noble, & Marshall, 2013). This article examines how agile principles and practices can contribute to task coordination in collaborative research. It highlights key factors for successful application of agile methods in this context and presents recommendations for research teams interested in using agile methods in multidisciplinary projects. Despite several limitations in the scale and depth of this case study, and the need for more research on the perceptions of early practitioners in this field, the results seem to concur with those reported in the literature on the adoption of agile methods in software development and other contexts.

2. Agile Principles and Practices for Collaborative Research Projects

Originally, the term *agile* was used in reference to software development (Hoda, Noble, & Marshall, 2013). The core principles of the agile framework were defined in 2001 by a group of software developers (Beck et al., 2001) in response to the weaknesses and rigidity of plan-based methods of software development, criticised primarily for its lack of responsiveness to change (Cockburn, 2002, p. 74). The core principles and practices of the agile framework could be summarised as follows:

1. Emphasis on people and teamwork, and the social aspects of project development (Stephens & Rosenberg, 2003, chap. 3).
2. Use of shared visualisation systems, focused on doable and transparent tasks (West & Grant, 2010).
3. Iterative cycles of development, with a self-managed team following “light-but-sufficient” communication-oriented rules (Cockburn, 2002, p. xxii).
4. Key role of a facilitator—helping with coordination and conflict resolution, and ensuring that team members contribute (Rigby, Sutherland, & Takeuchi, 2016).
5. Use of a “Kanban board” (i.e., a workflow visualisation tool) for reflecting progress, which is an artefact that enables documentation and transparency of project activities (Sharp, Robinson, & Petre, 2009).

Studies on the use of agile methods report predominantly positive results (Abrahamsson, Salo, Ronkainen, & Warsta, 2017; Serrador & Pinto, 2015). Some of the acclaimed advantages include the positive influence on team performance (Fernandez & Fernandez, 2008), contribution to quality levels (Huo, Verner, Zhu & Babar, 2004), and the improvement of outputs (Dybå & Dingsøyr, 2008), as well as the fostering of trust and cohesion in teams (McHugh, Conboy, & Lang, 2012).

The adoption of agile methods has expanded recently to contexts beyond software development (Rigby & Edler, 2016; West & Grant, 2010). In parallel with evidence that agile practices can lead to a more “agile organizational culture” beyond the software development world (Küpper, 2016), some studies focus on the adoption of agile principles and practices in research projects. These studies suggest that agile methods can bridge the gap between industry and academia (Barroca, Sharp, Salah, Taylor, & Gregory, 2015; Ota, 2010; Sandberg & Crnkovic, 2017), or describe how these methods can be used to coordinate distributed teams working on large-scale research projects (Marchesi, Mannaro, Uras, & Locci, 2007). Other studies focus on the use of agile methods to develop prototypes in “action design” research projects (Keijzer-Broers & de Reuver, 2016), to manage a research and development laboratory (Lima, de Castro Freire, & Costa, 2012), for experimental ethnography in the workplace (Mara, Potts, & Bartocci, 2013), for evidence-based projects for behavioural interventions (Hekler et al., 2016), and for product development in the biopharmaceutical sector (DeWit, 2011).

On the other hand, in the field of collaborative research management, among the main challenges addressed in the *team science* literature are: (a) cooperation between disciplines and the requisite of learning curves and progressive adaptation to a shared language and different types of tools (Jeffrey, 2003); (b) uncertainty about working methods and precise outcomes (Turner & Cochrane, 1993); (c) difficulty of coordinating a type of activity that is continually evolving (König, Diehl, Tscherning, & Helming, 2013); (d) importance of dynamism when adding new tasks to research plans (Lenfle, 2008); and (e) critical aspects of trust and shared vision in collaborative research (Bennett & Gadlin, 2012; Stokols, Misra, Moser, Hall, & Taylor, 2008).

Vom Brocke and Lippe point to three unresolved paradoxes pertaining to the management of collaborative research projects, which indicate the potential for the application of agile methods in this context:

(1) On the one hand, research projects operate under considerable uncertainty and require freedom and flexibility if they are to generate innovative results. On the other hand, uncertainty needs tight management in order to avoid failure, and creativity needs firm structures in order to be transformed into widely usable project outcomes.

(2) On the one hand, collaborative research fosters the integration of the research perceptions, ideas, and views that are needed in order to solve problems comprehensively. On the other hand, the resulting heterogeneity of partners leads to problems with respect to inter-cultural, inter-organisational, and inter-disciplinary management.

(3) On the one hand, the manager is assigned only limited authority because of the autonomy of partners and governance structures. On the other hand, the findings show that certain tasks, such as

management of the project vision and integration of results, require the commitment and involvement of all project parties. (Vom Brocke & Lippe, 2015, p. 1031)

These three paradoxes are directly related to the research questions addressed in this article. The first and second paradoxes are the bases of the following research questions:

- (a) To what extent could agile principles and practices offer engaging, transparent, and easy-to-adopt coordination mechanisms in collaborative research projects?
- (b) How can agile methods contribute to communication among participants in collaborative research projects?

The third paradox gives rise to the following research questions:

- (c) Can agile principles and practices help integrate different disciplinary perspectives for working towards quality research outputs?
- (d) Can agile principles and practices help facilitate commitment and involvement of the participants in collaborative research projects?

3. Case Study: Multidisciplinary Collaboration at the Dimmons Research Group

The case study focuses on the first phase of [a](#) multidisciplinary collaboration, spanning a 10-week period, during which agile principles and practices were adopted by a scientific team of [10](#) members. The scientific team is part of a network of collaborators of the research group [Dimmons](#), from the Internet [Interdisciplinary Institute \(IN3\)](#) of the Open University of Catalonia, Spain. The team was created for [Col·lacy](#), a specific research sub-project that is part of the European project [DECODE](#), which required collaboration from experts in several disciplines for generating a theoretical framework for analysing the “collaborative economy” (Fuster-Morell et al., 2017). The objective of the collaboration was to generate a research deliverable from multidisciplinary perspectives: legal, economic, technological, gender, sustainability, and policy-related. With the autonomous but coordinated effort of all members of this semi-distributed team, the goal was the production of a report integrating different states of the art, paradigmatic cases, theoretical debates, and results from interviews, following a research process that [was](#) engaging, transparent, and flexible.

The scientific team, [consisting](#) of 2 senior researchers (one of them being the Principal Investigator [PI]), [5](#) PhD candidates from different disciplines, and [3](#) communication and design professionals, implemented [a](#) the first phase of adoption of the agile framework. There were [4](#) women and [6](#) men in the team. The findings are based on a survey administered to the members of the team (to which 8 of the researchers responded) and notes from participant observation by the author (as one of the PhD-candidate members of the team).

The survey covered [2](#) main areas: first, perceptions about the digital tools used and the team dynamics during the process, and second, specific questions related to the agile methods and how these

influenced several aspects of the project. This second part of the survey measured eight key factors relevant to the adoption of agile principles and practices in collaborative research. These factors are: (i) communication, (ii) visualisation, (iii) task distribution, (iv) transparency, (v) trust building, (vi) engagement, (vii) quality of results, and (viii) efficiency (for literature references, see Table 1).

Table 1. *Key Factors Relevant to the Use of Agile Methods in Collaborative Research*

Key Factor	Literature on Collaborative Research	Literature on Agile Methods
(i) Communication	Keraminiyage, Haigh, & Amaratunga, 2009; König, Diehl, Tscherning, & Helming, 2013	Abrahamsson, Salo, Ronkainen, & Warsta, 2017; Hoda, Noble, & Marshall, 2013; Ota, 2010
(ii) Visualisation	Bennett & Gadlin, 2012	Anderson, Concas, Lunesu, Marchesi, & Zhang, 2012; Sharp, Robinson, & Petre, 2009
(iii) Transparency	Jeffrey, 2003; Keraminiyage, Haigh, & Amaratunga, 2009	West & Grant, 2010
(iv) Task distribution	Bennett & Gadlin, 2012	Dybå & Dingsøyr, 2008; Fernandez & Fernandez, 2008; Hoda, Noble, & Marshall, 2013
(v) Trust building	Bennett & Gadlin, 2012; Stokols, Misra, Moser, Hall, & Taylor, 2008	Dybå & Dingsøyr, 2008; McHugh, Conboy, & Lang, 2012
(vi) Engagement	Stokols, Misra, Moser, Hall, & Taylor, 2008	Stephens & Rosenberg, 2003
(vii) Quality of results	Rigby & Edler, 2005	Huo, Verner, Zhu & Babar, 2004; Serrador & Pinto, 2015
(viii) Efficiency	Stokols, Hall, Taylor, & Moser, 2008	Fernandez & Fernandez, 2008; Serrador & Pinto, 2015

Only 4 of the 8 participants from the team who answered the survey declared any significant previous experience in multidisciplinary research projects, while 6 had previous experience with the

preparation of similar types of academic publications. Only 3 respondents declared any previous experience with agile methods.

From February to May 2017, the team adopted several practices derived from the most popular agile methods (Anderson, Concas, Lunesu, Marchesi, & Zhang, 2012), as well as specific digital tools for communication, with one of its members acting as a facilitator. These practices are outlined below.

Regular Releases. This is an agile practice to ensure incremental development of results. In the present case, it took the form of regular planning meetings held every 2 weeks, in which all team members working on various aspects of the project participated to establish and discuss the objectives of the deliverables. There were periodic agreements on tasks and subtasks for each team member.

Agile Facilitation. In order to achieve a cross-functional team working iteratively towards the defined goals, the process was coordinated by one researcher who fulfilled the role of facilitator or “Scrum Master,” maintaining communication routines. The Principal Investigator (PI) as “product owner,” assessed the overall quality and alignment with the broader European project.

Weekly Stand-Up. This practise refers to a regular but informal face-to-face meeting, where the participants update each other on the progress of their project activities. In the present case, a weekly virtual conversation took the place of face-to-face meetings. This was enabled by a web chat using the [Telegram](#) software. Each member made weekly reports to the team on accomplishments since the last weekly stand-up, planned tasks before the next one, and challenges likely to be faced in the interim.

Digital Kanban Board. This refers to the agile practice of using a workflow visualisation tool to reflect the status of project tasks. Task items, with their descriptions on virtual sticky notes, were reflected on a shared board using the [Odo](#) software, so workflows could be visible to all team members (Figure 1).

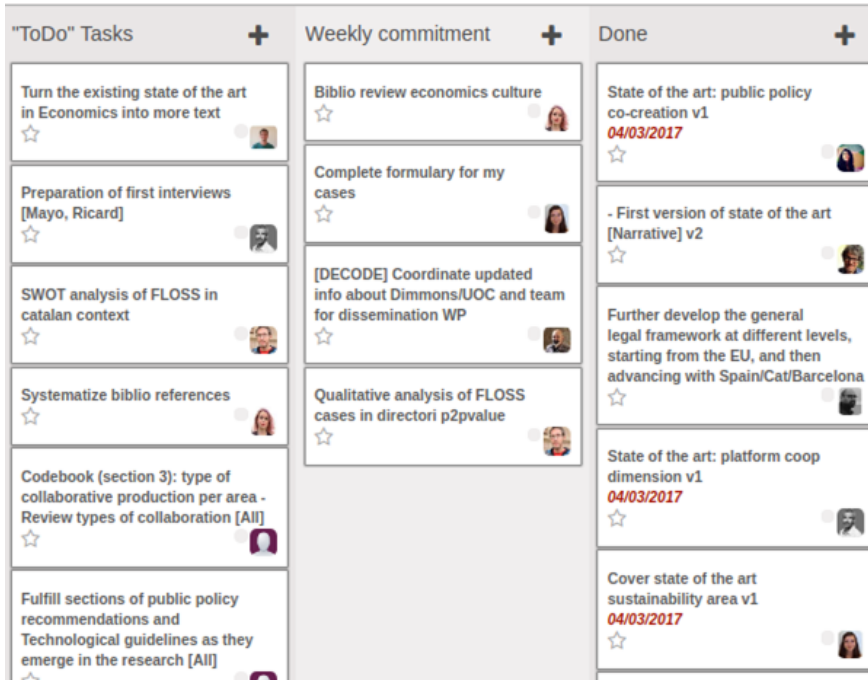


Figure 1. Sample Odoo interface with list of tasks.

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3.1. Using Agile Methods to Balance Flexibility and Coordination

In this case study, the role of the facilitator was instrumental in the research team's adoption of the selected agile principles and practices. It is noteworthy that, on a scale of 1 to 5 (*1 Very Negative . . . 5 Very Positive*), survey participants evaluated the work environment positively.

The perception of survey participants was highly positive in relation to how the research process developed, from distribution of tasks, and coordination of the group, to the possibility of individuals influencing the research design. The perception was also highly positive in relation to the adequacy of the digital tools used for the project.

With different levels of engagement, all members of the team adapted to the logic of the Kanban board interface when using it, focusing on a continuous flow of tasks, involving iterations where necessary (Al-Baik & Miller, 2015). The agile practice of "fixed development sprints" (i.e., a segment of time, usually between 2-4 weeks, during which teams work to achieve specified goals towards the eventual release of the final deliverable) was not utilised in this case. Instead, the team opted to use a chat convened via the *Telegram* software to communicate when needed in relation to the agreed tasks, as well as a dedicated mailing list created with the *Mailman* software for discussions beyond

agile coordination. In parallel, the *Google Docs* software was used to share documents online for collaborative writing and modular development of texts prior to publication.

Initially, some participants were not actively engaged in tasks related to research design, but this changed progressively as the practices of agile management (regular releases, facilitation, stand-ups, etc.) evolved and weekly updates and bi-weekly meetings occurred with regularity. The survey results also indicate positive opinions in relation to gender and the various social dynamics (i.e., listening and respectful communication, emotional support in times of stress or difficulty, celebration of achievements, etc.). However, in relation to the project's roadmap (i.e., differentiation of stages, progress planning, intermediate objectives, work conclusion, etc.), the results indicate less agreement and, on average, more neutral opinions.

Overall there was a positive perception of the regular monitoring and coordination by the facilitator (with responsibility for messages to the mailing list or *Telegram* chat, individualised messages, reminders, and assistance in specific matters). There were also positive perceptions of the individual attention given by the PI and her management of the team (from defining the general framework of research for the project, to indications and supervision for development of the contents), consistent with the observations in the field notes as well. The PI outlined the indications and recommendations for elaborating the state of the art of the project during the first face-to-face coordination meeting, prior to a workshop on the basic agile principles to be adopted during the project and the establishment of the agile practices. The observations correlate with the survey results, as a majority of the participants expected the PI to provide the main vision about goals and work strategies.

In terms of the level of commitment of the team in performing the assigned tasks and in following the agreed "feedback loops" (in this case, the weekly stand-ups), a quick analysis of the communication generated around the volume of tasks assumed by each participant, which were all completed, shows that there was regularity in all cases. With the exception of the PI, the rest of researchers followed the agreed routine of sending updates about their progress and planned tasks for the week via the *Telegram* chat, which represented a total of 64 stand-up messages (6.4 on average per participant). An analysis of the volume of tasks and online communication activity per participant, as shown in Figure 2, indicates that in parallel to the research tasks performed by each participant, there was a relevant exchange of messages related not only to the stand-up practices, but also to other coordination needs and for different types of knowledge sharing.

3.2. Achieving Integration Within Heterogeneous Teams

The third paradox highlighted by Vom Brocke and Lippe (2015) reflects the need for integration of perceptions, ideas, and views required for comprehensive problem solving in collaborative teams. Challenges can arise from intercultural, inter-organisational, and interdisciplinary diversity among team members.

In this case, an analysis of the project activities indicates that, in parallel to performing specific tasks (i.e., development of a literature review, identification of pertinent cases for analysis within a specialised area, or planning and executing of interviews), the researchers also participated in the digital stand-up updates and exchanged other types of coordination messages (mainly reminders for meetings, links to various documents in progress, or specific feedback on individual work). This additional volume of communication activity during the adoption of the agile methods, in relation to the assigned tasks, tend to correlate to the most active participants and those with most time dedicated to the project.

According to the survey, the perception of the utility of the mailing list and shared documents is positive, and also primarily so for the *Telegram* chat used during the weekly stand-ups. On the other hand, the perception of the digital Kanban board on the *Odoo* tool is less positive. This result coincides with several observations indicating that during the process (by the end of which 60 tasks in total were covered, as reflected in Figure 2) most team members did not interact as much on the digital Kanban board as initially agreed, and it was used mainly by the facilitator to reflect the status of tasks.

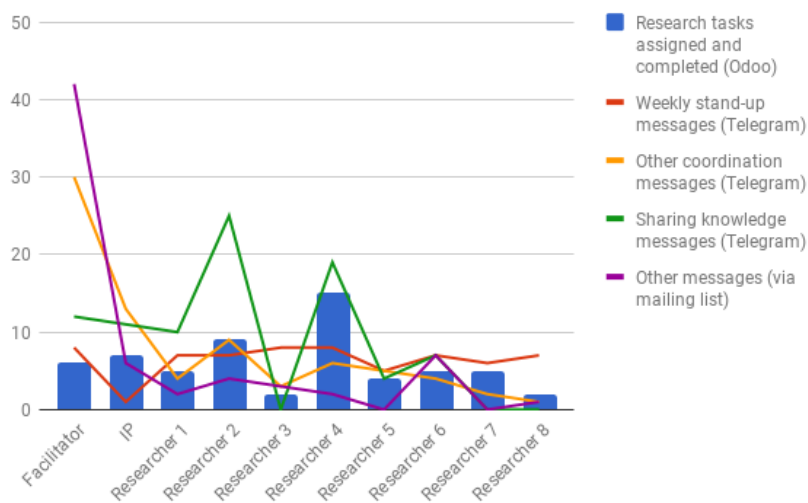


Figure 2. Volume of tasks per participant and online communication activity.

A total of 88 messages with links or comments related to academic papers, events, relevant journals, or information on digital media were shared among the team. Initially, only the facilitator and the PI engaged in this activity, but progressively other researchers took the lead and were active in sharing knowledge. On the other hand, the mailing list was not used actively during the agile management phase, and except for some isolated cases, participants did not follow the activity that the facilitator

initiated via that channel. The results indicate that the two senior researchers and the participants with less experience in research activity had less engagement in using the agreed tools for the adoption of agile practices. It was participants with an intermediate degree of experience (e.g., those in the last stages of their PhD or with some experience in working on academic publications), who usually took the lead and were more dedicated to engaging via the agile tools.

There was broad agreement on the contribution of the agile methods to improved team interaction for better communication and visualisation of the work of others. However, there was less agreement on its contribution to the distribution of tasks (Figure 3a). Observations from the process reinforce this conclusion, since the face-to-face meetings every month (where the evaluation and distribution of tasks were reviewed, and new tasks were subsequently assigned) sometimes reflected the strong influence of the PI and the most experienced researchers within the team. Also, it is probable that this lack of agreement on improved task distribution is connected to the underutilisation of the *Odoo* Kanban board mentioned earlier.

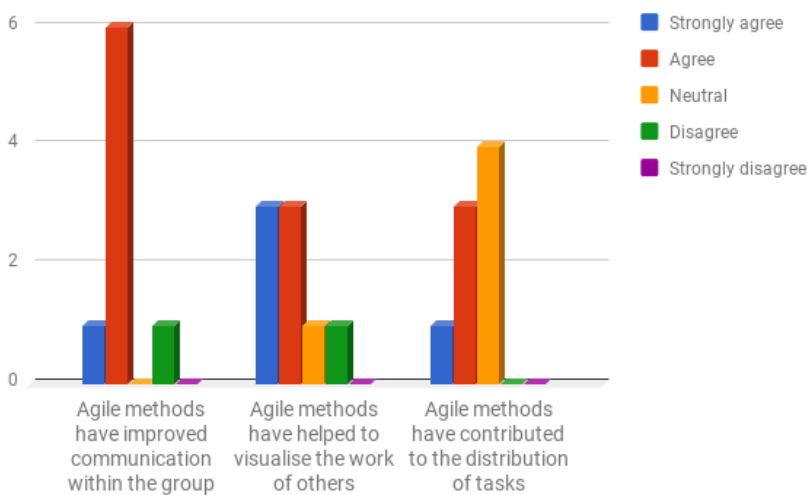


Figure 3a. Perceptions on the contribution of agile methods (towards communication, visualisation, and task distribution).

As Figure 3b illustrates, the adoption of agile methods seems to promote values related to transparency, trust building, and engagement. It was observed that certain factors, other than agile principles and practices, can also exert influence in that direction. For example, a mutually caring atmosphere among team members, which usually favours the transfer of knowledge (Zarraga & Bonache, 2005). Generally, participants portrayed positive perceptions of the contribution of agile methods. The participant observations reflect that engagements took place in regular cycles. On

average, the pace of communication increased at the beginning of each week, in parallel with the stand-up messages, and was maintained at more irregular intervals until the end of each week, through diverse conversation topics (other than basic coordination).

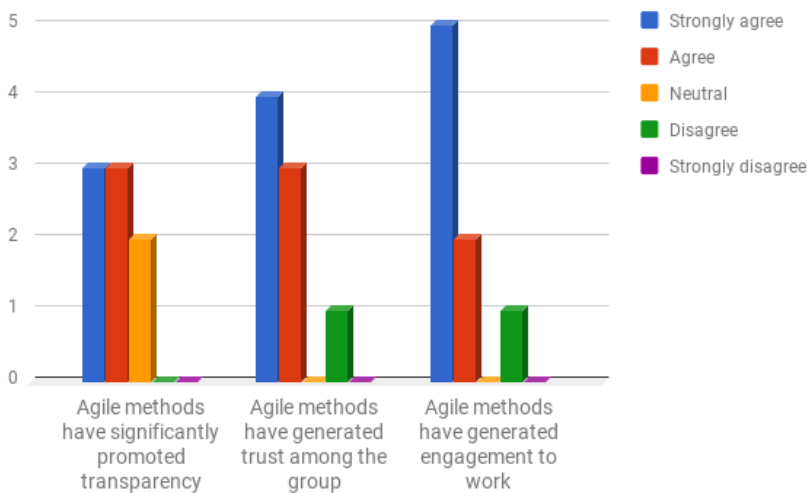


Figure 3b. Perceptions on the contribution of agile methods (towards transparency, trust building, and engagement).

Finally, more ambivalence is evident in the perceptions of the contribution of agile methods to improved efficiency and quality. While there is broad agreement with respect to improved team efficiency, there is less agreement on the contribution to improving the quality of the work (Figure 3c). Here, it is important to highlight that the incremental, modular outputs consistent with the agile methodology were new to most team members, and differed from their usual ways of conducting research. In this case, adoption of agile principles and practices led to intensive documentation (from lists of literature reviewed, to articles prepared). This difference may have influenced the perception of quality to the closing stage of the project, when the main deliverable was published. Other observations reflect the reluctance of senior researchers to share their work with the rest of the team unless an extensive draft or final version was underway.

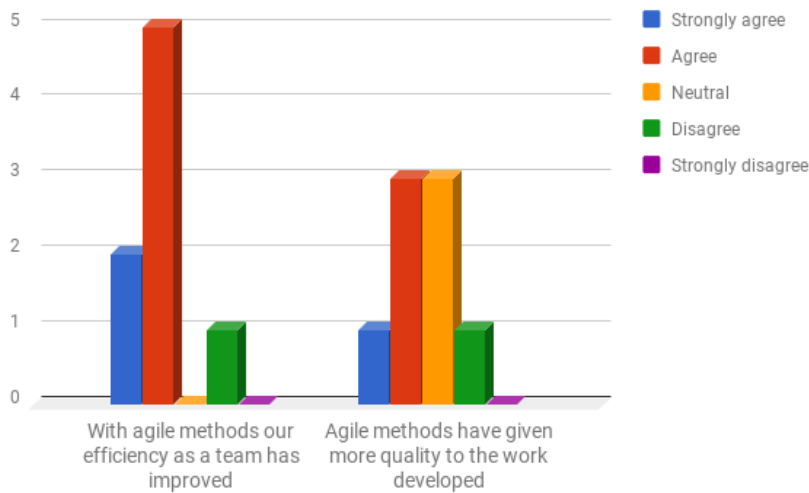


Figure 3c. Perceptions on the contribution of agile methods (towards efficiency and quality of results).

With respect to the deadlines and deliverables, it is important to highlight the timely submission of the research product, namely a 145-page report from which other publications for academic journals and proceedings were subsequently derived. Accepting the report in its first version, partners of the European project and other stakeholders agreed that it served as a valuable source of knowledge from different perspectives, produced in accordance with project standards and internally defined levels of quality and rigour.

4. Conclusion

Some of the main challenges in managing collaborative research relate to commitment, leadership, trust, transparency, clarity, communication, and progress monitoring (Keraminiyage, Haigh, & Amaratunga, 2009). When collaboration involves multiple disciplines, it requires learning and adaptation involving a shared language and accessible tools (Jeffrey, 2003). Moreover, there are the unresolved paradoxes of research collaboration, as described earlier (Vom Brocke & Lippe, 2015). The case of multidisciplinary collaboration at the Dimmons Research Group demonstrates the potential usefulness of a class of project management, with specific methods and tools, known as agile management in the context of software development projects.

The case study reveals that agile management practices offered an engaging, transparent, and easy-to-adopt coordination framework in a multidisciplinary research project. The nature and extent of engagement seemed to depend on the level of academic expertise of the participants. An analysis of regular communication via digital channels suggests that agile methods could help to balance

flexibility with structured coordination in heterogeneous research teams. On the other hand, there was less agreement among participants on the contribution of agile principles and practices to the integration of different perspectives for assuring the quality of the work produced. Likewise, there was less agreement on the utility of the digital Kanban board meant for visualisation of tasks. These observations may imply a need for more familiarisation and longer learning curves for the adoption of such agile tools and practices.

This study raises questions on the extent to which the use of agile methods in a scientific context requires coordination by a research facilitator or manager (as recommended in the literature on the adoption of agile principles and practices in other domains). The results of this case study suggest the need for this important role. The survey data and observations also indicate that an important aspect of this role is to motivate team participation and to assure that the principal investigator (PI) also participates in the regular agile coordination routines (as the other researchers do), beyond strategic points during face-to-face meetings.

Ison observes, “a method, like any social technology, depends on many people working with it, developing and refining it, using it, taking it up, recommending it, and above all finding it useful” (Ison, 2008, p. 155), something that reflects the need to deepen the identification, description, and analysis of agile principles and practices in research projects requiring multidisciplinary collaboration. In this regard, this case study aims to contribute by contrasting the benefits of the adoption of selected agile practices with the challenges of collaborative research management. Results from this experience point to the need to adopt a degree of flexibility to allow the team members to become familiar with the agile framework after understanding its basic principles. Another important consideration would be to establish basic but clear rules for regular interaction with easy-to-adopt digital tools, especially in the case of distributed research teams. In relation to the use of tools, it could be required to dedicate training and technical support for those participants who are less familiar with the relevant computer software, essential in the case of distributed teams.

While there are limitations to this case study, and the need for additional research is evident, the findings appear to be in alignment with those of earlier studies on the adoption of the agile methods in fields other than software development. In relation to the formula adopted for the case, more extensive experimentation in new projects is required for advances to be made in this relatively new area of utilising agile methods and digital tools for the coordination of teamwork in the field of scientific research.