STUDENT PAPER

# Evaluating an Agile Method for Planning and Controlling Innovative Projects

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## ABSTRACT

This article presents an extensive investigation carried out in two technology-based companies of the São Carlos technological pole in Brazil. Based on this multiple case study and literature review, a method, entitled hereafter IVPM2, applying agile project management (APM) principles was developed. After the method implementation, a qualitative evaluation was carried out by a document analysis and questionnaire application. This article shows that the application of this method at the companies under investigation evidenced the benefits of using simple, iterative, visual, and agile techniques to plan and control innovative product projects combined with traditional project management best practices, such as standardization.

**KEYWORDS:** agile project management method; project planning and controlling; innovative product projects

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## INTRODUCTION

Research on product development methods and tools has grown fast since 1995 (Brown & Eisenhardt, 1995). A recent study (Cooper, 2008) emphasizes some aspects of product development that require further investigation (e.g., lean and agile procedures and better adaptation of methods to fit innovative product development). Although best practices in project management have been widely disseminated since 1960 (Crawford, 2006; Kloppenborg & Opfer, 2002; Kolltveit, Karlsen, & Grønhaug 2007; Shenhar & Dvir, 2007; Söderlund, 2004), there are some barriers when these practices are applied to innovative and complex projects (Maylor, 2001), especially concerning product development.

Project managers are used to dealing with an ever-growing demand for projects that aim at developing innovative and complex products. A project complexity definition is necessary in order to cope with project management challenges (Williams, 1999). Lean and agile project management (APM) approaches have emerged to assist the adaptation of consolidated project management practices to improve these projects. However, few authors have proposed well-defined and pragmatic methods to apply these approaches or provided systematic evaluations of their results. One of the challenges that companies must face is the development of new tools and methods to suit specific project management environments. This article proposes a method for planning and controlling innovative product projects using APM principles, followed by a procedure to use it, and the results of two implementation cases.

### Literature Review

Innovation is treated (Tijssen, 2002) as a consequence of basic research and inventions that can be introduced in the market. Other authors (Dillon, Lee, & Matheson, 2005) have argued that innovation is a source of value to customers. However, a question remains in the field: How do companies plan and control projects of innovative products in a project environment laden with uncertainties? In an attempt to answer this question, a set of principles and concepts for innovative product development projects has recently emerged from the software development area (Chin, 2004; Highsmith, 2004), known in the literature as APM. APM is "a set of values, principles, and practices that assist project teams in coming to grips with this challenging environment" (Highsmith, 2004, p. 16).

Core APM values address both the need to build agile and adaptable products and the need to create agile and adaptable development teams (Highsmith, 2004, p. 16). APM principles, similar to Lean Thinking principles

(Smith, 2005), are based on flexibility and simplicity. They are developed by iterations and add value to customers by means of short-time deliverables (Chin, 2004; Highsmith, 2004). Core APM values are : (1) employ iterative feature delivery, (2) deliver customer value, (3) champion technical excellence, (4) build adaptive teams, (5) encourage exploration, and (6) simplify (Highsmith, 2004, p. 28). APM focuses on people development, self-management and self-discipline, participatory decision making, customer focus, and less bureaucracy. Although the literature on APM proposes a set of values and principles to be applied in the context of innovative products, there are not many empirical studies evaluating the effectiveness when applied to the development of project management tools and methods.

***Project Planning***

There are many techniques and methods to manage projects, each one for a specific project management process (PMI, 2004). However, some authors, such as White and Fortune (2002), have identified that a restricted set of methods and tools are used in practice, of which project management software and Gantt charts are the most relevant. In addition, theoretically, research on project management has taken into account common assumptions, such as prescriptive, normative theory, grounded on ideal project planning and control models (Cicmil & Hodgson, 2006). This evidence leads to the question of how properly project managers have been using project management tools and which actions have been taken to adapt these tools to meet project requirements. Another study (Maylor, 2001) with transnational companies also evidenced the wide use of Gantt charts by project managers to plan and control projects, but with limited results. Most innovative products are developed under uncertainties in turbulent environments, characterized by project complexity, unpredictable activities, and changes where the traditional approaches have presented limitations (Chin, 2004). Despite the extensive literature available on project management (Kloppenborg & Opfer, 2002), there are few studies that present advances on how to plan and control innovative product projects.

The APM approach is indicated for innovative product development projects (Highsmith, 2004). Highsmith suggests some directions for project planning and control. For example, a project plan should start with the "product vision" ("vision box and elevator test statement"), followed by the definition of the project scope (project data sheet), and end with the project plan (iterative feature plan). However, there are two aspects to be considered. First, the majority of the APM proposals cannot be properly considered as techniques. In the perspective of traditional project management best practices, such as a Gantt chart, program evaluation and review technique (PERT), and critical path method (CPM), a technique is based on a well-established theory with well-specified procedures for its use and implementation. Iterations and other APM recommendations do not address this wide spectrum and have been treated as guidelines and principles that are not supported by the literature. The second aspect refers to the guidelines. They must be appropriately evaluated because not many studies have evaluated these applications. In turbulent environments, product development projects rarely end according to the original plan (Steffens, Martinsuo, & Artto, 2007). Steffens et al. also emphasize that in the traditional project management approach, changes are negative aspects, whereas in turbulent environments they are prerequisites to successful projects.

***Project Control***

Project control implies observing project execution so that potential problems may be identified in a timely manner and corrective action may be addressed, whenever necessary, to control the execution of the project (PMI, 2004). Similarly to project planning, the control process includes many tools and techniques. This study focuses only on scope, time, and deliverables control. The literature on project control presents many dimensions and approaches to apply control techniques and tools. Rozenes, Vitner, and Spraggett (2006) provided an extensive review of the literature on project control. They concluded that in the project management literature authors use a one-dimensional control system in spite of not integrating project objectives at all. Rozenes et al. also found evidence that the most utilized multidimensional control system is the earned value (EV). The disadvantage of EV analysis is its lack of integration with other project dimensions such as technology, quality, and design.

The role of APM control and planning surpasses merely taking corrective actions and following plans (Highsmith, 2004). APM control plays an important role in learning-in-progress and not following a rigid plan, which does not imply that the control process or standardization and procedures should be given up, according to Highsmith (2004). Highsmith emphasizes the definition of "what control." He discusses the necessity of simplicity, added value to the customer, and focus on leadership and development of team competences. He also argues that if plans are speculations or hypotheses about the future, then frequent and effective feedback is required to test them. Considering the context and values derived from the application of APM principles to project management practices, Highsmith noted a self-disciplined and self-managed team development. The success of projects that adopt the exploration approach depends on reality-based feedback. Adapting the plan and project scope depends on apprehending a wide range of information, which includes the assessment of

the project progress, technical risks, evolution of requirements, and ongoing competitive market analysis, argued Highsmith (2004).

## Research Methodology

The research methodology was divided into four phases: (1) a systematic literature review was carried out to identify empirical studies of implementations of agile methods in innovative product development projects, which indicated issues to be investigated in this field; (2) a diagnosis of project management practices was carried out at two small companies, where some problems and difficulties in project management were identified; (3) a method to plan and control projects was developed by means of action research (Coughlan & Coghlan, 2002), and subsequently implemented; and (4) after the implementation, the method was evaluated using a case-study method (Yin, 1989). Data collection was carried out through interviews, weekly observations, and document analysis. A questionnaire was applied to address two research questions (RQs):

- RQ1: Did the method benefit the companies' project management?
- RQ2: Could it be considered agile?

The data collected were analyzed in a qualitative manner. It is important to emphasize that there are many outputs and activities in the planning and control phases (PMI, 2004), but only the project scope, time, and deliverables were evaluated in this study.

## Results

### *Project Management Method*

The method developed is entitled IVPM2 (Iterative and Visual Project Management Method). It was based on APM principles as described in the literature review. Figure 1 presents the IVPM2; its components, followed by their description; and a seven-stage procedure to use the method. All five components of the IVPM2 were integrated into planning and control projects in a simple, visual, and interactive way.

- **Phase and Project Deliverables Model (PPDM):** The phase and project deliverables model combined the

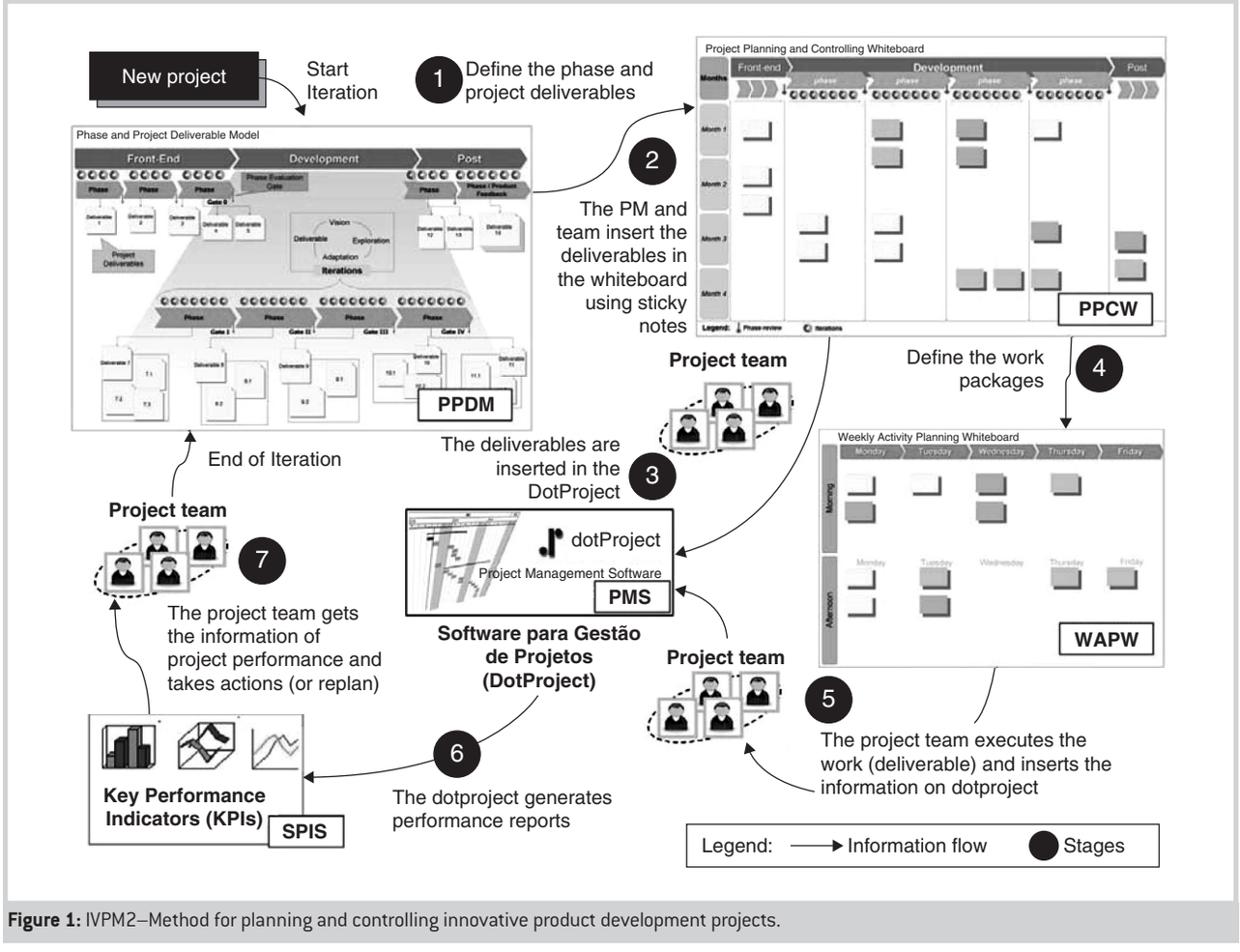


**Figure 1:** IVPM2—Method for planning and controlling innovative product development projects.

principles of stage-gates (Cooper, Edgett, & Kleinschmidt, 2001) and project life-cycle management. Some standard phases and deliverables were defined to guide the project planning and execution. PPDM also includes a simplified set of templates used to collect, document, and organize all project information produced. The templates have two objectives: to organize the project information and to guide the documentation and standardization of project process.

- **Project Planning and Controlling Whiteboard (PPCW):** The PPCW was designed to integrate the project phases with the deliverables in a simple timescale. The deliverables can be defined according to their execution phase. The project planning focuses on defining deliverables instead of activities. At this stage, the project team does not define the exact work that must be done, but only what is going to be delivered, because they do not yet have a clear view of the tasks and activities; they are only certain of the project goals and mission. The deliverables are inserted in the whiteboard using colored sticky notes. Each project uses a different color, and the deliverables are organized on the board according to a top-down priority sequence (highest priority at the top).
- **Weekly Activity Planning Whiteboard (WAPW):** This whiteboard is used to define some activities and work packages (WPs). Each activity is connected to one or more PPCW deliverable. The WAPW uses an iteration concept, by having fast short-time results. The whiteboard has the weekdays printed at the top, divided into two periods on each day (morning and afternoon). WAPW also uses sticky notes to show the input of tasks, activities, and WPs.
- **Simplified Performance Indicator System (SPIS):** A simple set of performance indicators was adapted to measure the lead time of deliverables by means of earned value added (EVA). Based on the project baseline, the project is measured in terms of time spent, current progress, value added, and deviation plan. The SPIS is not applied to resources control.
- **Open-source project management software tool for supporting the portfolio control (DotProject):** DotProject consists of an online Internet-based and open-source software for project management (available at www.dotproject.net). A customized module was developed to generate project performance reports based on the SPIS. The role of the software is quite different from traditional project management. It is not used for planning and controlling project tasks, but for registering project data to enable the team to make decisions and manage the project portfolio. The team uses the PPCW and WAPW to plan and control projects.

Described next are seven stages that represent a procedure to use the IVPM2, as shown in Figure 1. The adapted procedure was the same at both companies (hereinafter referred as Company A and Company B), but some changes were made in PPDM and PPCW components, especially concerning time-scale positioning.

It starts with the demand for a new project (Stage 1). By means of a project plan template, the risk analyses and most of the product requirements are defined. Changes may occur, but it is important to have a general view of the project goals and constraints. The project team defines the deliverables and the phases of the PPDM-based project, taking into account its deadlines, constraints, and goals. The project manager and the team insert the deliverables on the PPCW (Stage 2) according to descriptions of the project phases. Each phase has standard activities. The PPCW deliverables are inserted by means of different-colored sticky notes (one color for each project—in case the company has more than one). Each sticky note represents a deliverable and contains the deliverable name and short description, estimated delivery date, and person in charge. Each sticky note is organized on the PPCW according to its priority, phase, and delivery date.

Once the deliverables are placed on the PPCW, they must be uploaded onto DotProject (Stage 3). The software was customized to fulfill the PPCW and PPDM standards. It has "templates" of each phase and deliverable to guide users in their work. The DotProject deliverables must have the estimated starting and ending dates to enable the baseline creation. The project managers, with all team members, were able to define, at weekly short meetings (average 40 minutes), the WPs by decomposing the deliverables into measurable tasks (Stage 4). Team members input the tasks into the WAPW by means of sticky notes. The information on these sticky notes comprises the deliverable name, task name, person in charge, and estimated end date. The sticky note is inserted on the day of the week that the work starts. The team member can break the tasks and even reorganize his or her schedule to better respond to project changes. Once a WP is completed, the person in charge of it logs in on DotProject and inserts a brief comment with respect to the task, and the percentile of each task represented by the deliverable defined on the PPCW (Stage 5).

At Stage 6, the DotProject software generates the reports with project performance indicators, as defined in the SPIS. The reports are used to control the project progress, value added, deviation, and time spent. At Stage 7, the project team analyzes the information from the DotProject reports and uses it to check the value added to customers, their learning about the project uncertainty, and the project progress to be able to take adaptive actions and anticipate changes. All stages of this method have been designed to be iterative, integrated, and repeatable during the project life cycle. The quantity of iterations will depend on the type of the project; its complexity and uncertainty level must be considered. An iterative project life-cycle management implies

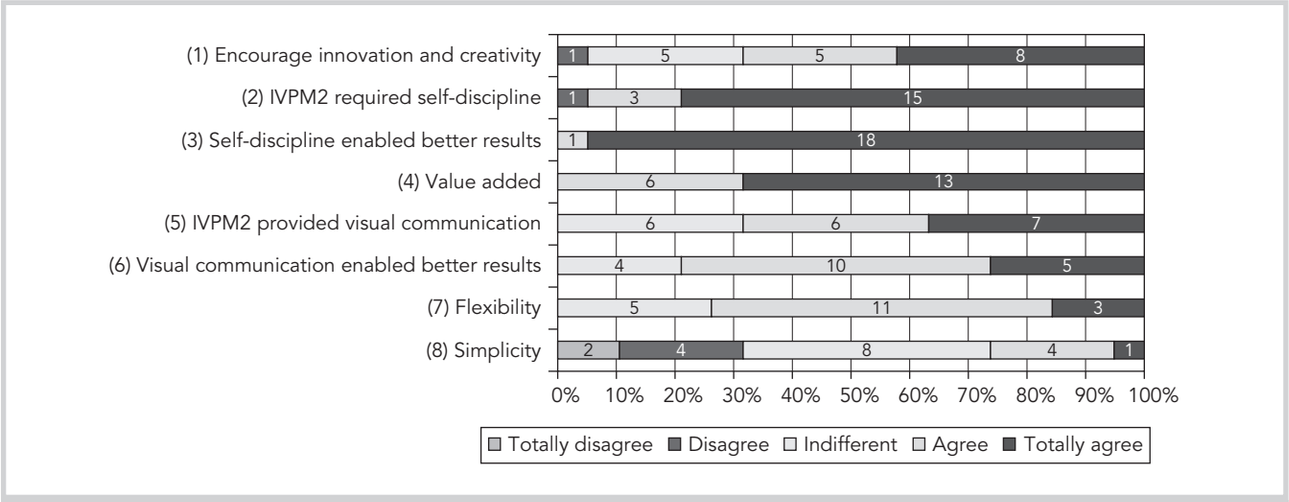


**Figure 2:** Frequency of the answers extracted from the data interview reports.

defining deliverables, inputting them into DotProject, defining, executing, controlling WPs, and informing the project team.

### *Case Application*

Founded in 2003, Company A is a small company that develops highly technological products involving hardware and software. They are specialized in computer programming and integrative hardware systems for education and entertainment. The method was applied to one of its projects in which the goal was to develop a robot for education and research computer laboratories. The robot includes features that can be reprogrammed using modular programming. Company B is a small organization founded in 1998 encompassing small design enterprises that support innovative product development. It is specialized in industrial design, prototyping, and engineering, virtual simulation, and finite element analyses. Most of its projects involve collaborative tasks with partners such as research labs, universities research groups, and government agencies. The method was applied to ten of its projects of new product development, but only three were concluded by the end of the IVPM2 implementation.

### *Method Evaluation*

A questionnaire was presented to 19 participants that had applied the method. Figure 2 shows the percentile frequency of the answers regarding the method analyses considering the following criteria: (1) encourages project innovation and creativity; (2) IVPM2 required team self-discipline and self-management; (3) self-discipline and self-management contributed to better project team performance and development; (4) added value to the team and customer; (5) IVPM2 provided to visual communication and team view; (6) the visual communication contributed to better project results; (7) its flexibility suits the project changes requirement; and (8) its simplicity. Each criterion is discussed in the paragraphs that follow.

Has the method encouraged innovation and creativity (Criterion 1)? According to 68% of the respondents, the method enabled process creativity and innovation. But 32% were indifferent or disagreed. This aspect is critical and relevant to their work due to the innovative nature of product development. The method provided accurate data and organization without adding much bureaucracy to their process. They were able to adapt in face of changes. The need for self-discipline and its impact on the companies and their projects were evaluated. Ninety-four percent agreed that IVPM2 required self-discipline (Criterion 2), and 100% agreed that self-discipline had a positive impact on and improved project results and team development (Criterion 3). With both companies, the project team discussed its deliverables at short weekly meetings to keep the project scope updated.

With respect to the value added to customers and the project team (Criterion 4), the graph shows that 100% of the respondents agreed that IVPM2 added value to customers. A critical and controversial point must be addressed here. Both the approaches, traditional and agile, can add value, but in the cases in question, there is ample evidence that a simple way of planning and controlling projects-by means of sticky notes and a whiteboard, with the support of project management software, and a simple set of templates—contributes more to customers and project teams than does using concepts based on traditional planning and control tools. Iterations with customers, by means of regular phase review meetings, helped the team deliver exactly what the customer expected. In both

companies, the project managers expressed that their customers enjoyed the results and the project organization and procedures adapted.

Concerning the visual communication aspect, 68% agreed that IVPM2 contributed to the project team view (Criterion 5), and 78% agreed that the visual communication provided by the method contributed to better project results (Criterion 6). In both companies, team members highlighted the iterative development of all project phases and deliverables during the method application. In addition, the project managers became more confident about the results: "It's visual; it's easy to check whether or not the project is running smoothly."

With respect to project flexibility (Criterion 7), 73% of the participants agreed the method is flexible and enabled project changes. Before the method was implemented, they were not able to meet project changes requested by customer and market changes. They had to follow a rigid plan. The regular customer iteration inherent to this method promotes the identification of changes during the review of the phase gates. As regards simplicity (Criterion 8), 74% were indifferent or disagreed that IVPM2 is simple to use. Although only 26% agreed that the method entailed some simplicity, most agreed that it improved their project management skills. Regarding research question 1 (RQ1), the project management role in both companies became faster than it had been (i.e., when they had to define all tasks and to develop an entire project plan by means of traditional project management methods). Their focus clearly moved from project planning to project exploration (execution) (Chin, 2004; Highsmith, 2004). A parallel evaluation was carried out and included a qualitative analysis based on the data collected during the implementation process, as discussed next.

Regarding *process and standardization* by means of PPDM, the team developed a common view that provided a better understanding of the project deliverables and phases for both Company A and Company B. They usually had to reinvent the project process and documentation templates to register project information. The templates provided a historical file of the entire project, enabling a fast retrieval of any project information, which refers to RQ1. PPDM worked as a standard by providing the companies with an overview of the project management life cycle. Analyzing *project scope, deliverables, and tasks execution*, the PPCW and WAPW, in turn, provided the team with a holistic view of the major project deliverables. This is a visual and iterative way for project planning and controlling by means of sticky notes and whiteboards. The team got used to discussing project deliverables through project progress on a weekly basis, and taking adaptive actions, whenever they judged necessary, to fulfill the project goals and add value to customers. By *controlling tasks and reports* through DotProject and a simple set of key performance indicators (KPIs), faster and accurate performance can be easily checked. In addition, the software provided a chronological account of the project data covering its entire life cycle. Reports were automatically generated. The software assisted in the registration of project data by creating a single file of the project history, thus enabling preventive actions.

Regarding research question 2 (RQ2), by analyzing the *organizational benefits*, although the implementation in Company A was not as fast as in Company B due to leadership commitment and project team motivation, project management activities were reliable and organized in both companies. The visual and simplicity-related aspects of the method have contributed to project flexibility, a sine qua non in their project environment. Some disadvantages arose during the implementation (e.g., the necessity of self-managing and self-disciplined capabilities to use the method). Each team member needed to contribute, evaluate, and discuss the role of project management in the APM approach. Leadership and participant decision making are mainstream and are rooted in the lean thinking approach. The time dedicated to project management differed at both companies. The use of this method with project management software helped to reduce planning time and improve communication: "Now we can see, every day, without much effort, what we have to do, not only the project manager, but all the project team members"; "It became easier to discuss project deliverables in view of PPCW." On the subject of some specific characteristics of the method, such as visibility, user-friendliness, and agility, the team members agreed that it saves time in planning and focuses on the execution phase.

## Final Considerations

This study shows some of the gains and challenges faced during the development of a method to plan and control innovative projects using agile principles, and its results suggest directions for future research. Due to the characteristics of the chosen investigation design, this study presents some limitations. It does not mean to neglect the best project management practices available in the literature, nor does it intend to advance generalizations to all types of project and companies. For the specific companies under consideration, which develop innovative products, the results evidence the feasibility of adopting an agile method with simple and flexible techniques to plan and control projects despite their perception. Their projects are developed locally, which involves uncertainties and dynamic work requiring creativity, innovation, and flexibility. In this context, the method has contributed to improve their project results. This study has also identified that it is possible to have benefits through the combination of advanced techniques to manage a group of projects (such as software and

metrics based in time) and simple and visual techniques, which may be useful in the management of the project team schedule.

This research also provides some guidance on how to apply both approaches together (traditional and agile), such as the standardization and the use of templates and procedures in order to meet project requirements. The results also show that commitment to the role of project management is very important to achieve successful results. The participation of senior management and project sponsors contributed to the final results. The implementation provided a holistic view of the challenges found in the management of projects at small companies that have specific constraints, such as resources and knowledge about project management concepts, that impact the way they manage their projects. For these companies, regular iterations with their customers contribute to add value and to better project deliverables by anticipating project changes. Despite the research limitations, both RQs were addressed, but also need further empirical research. Therefore some questions for future research are identified: (1) How can planning and managing risk in innovative and complex projects be kept simple and practical? (2) Given that PMO plays an important role for project organization and execution, how can a project management office (PMO) be used as a strategy to implement new approaches based on APM principles? and (3) Because resource and cost planning are not dealt with by this method, how should resource planning and cost planning be dealt with?

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