How to Manage an Agile/Kanban Software Project Using EVM

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Abstract— **This article describes a method of using Earned Value Management (EVM) tools to plan and monitor an agile project implemented by Kanban methodology. According to our approach, at specific points in time, in order to monitor and manage the project's progress, the project manager calculates an overall current "value" for the project, determined according to the current status of the various tasks. To evaluate the project's progress at the specific point in time, the manager calculates a schedule performance index, which is the ratio of the project's actual value to a planned value that the manager has determined in advance.**

Keywords- Project Management, Agile, Software project
Introduction (Heading 1)

I. INTRODUCTION AND BACKGROUND

"To succeed with agile, management's need for results must be greater than their need for control."

Israel Gat, formerly of BMC Software

Agile project management methodology provides team leaders and project managers with tools for effectively focusing on task completion and results. In contrast to traditional management paradigms, which focus on delivering products that satisfy requirements, in agile projects requirements are continually refined and re-planned on the basis of ongoing business feedback. Accordingly, agile methodologies tend not to include many of the metrics and reports that are commonly used in traditional management practices such as the waterfall method. This means that in many cases agile project management tools (depending on how they are implemented) lack the ability to provide managers with answers to basic questions such as, "Are we on track?" or "Which direction are we moving in?" Thus, managers who implement agile methodology frequently encounter the dilemma of how to monitor and control the processes they are managing. This article objective is to provide a project management approach that enables managers to overcome this challenge.

The method proposed herein applies to projects that are managed through Kanban, a popular project management framework for agile projects. Kanban is a visual system in which the various tasks composing a project are displayed as cards on a board. The flow is separated into different stages, represented as "lanes" on the Kanban board, and cards are moved from lane to lane as they progress through different stages (see example in Figure 1).

In line with the fundamental premises of the agile approach (see below), the Agile Kanban management framework typically focuses less on management tools and documentation. The Agile Manifesto is emphasizing - "Individuals and Interactions over Processes and tools" and also "Working Software over Comprehensive Documents".

"While there is value in the items on the right" (e.g. Business Requirements), "we value the items on the left more" (e.g. Completed Tasks)

Beck, Kent (Manifesto for Agile Software Development).

The main measures used in Kanban are cycle time and flow measurements. Particularly for projects that are already running and have historical data, more tools and methods are available for monitoring progress. For example CFD - Cumulative Flow Diagram. The tool can give the manager an idea of the pace at which tasks are "closed" (i.e. finished the last step), a prediction of the gap between planned outcomes and actual outcomes if the current pace continues, the completion pace that is needed in order to complete all tasks on time, and the delta between the current pace and the required pace. Example for a CFD graph is shown in Figure 5.

Because these monitoring methods only measure the speed of delivery, not the project's cost or the business value it generates, many project managers are resistant to implementing Agile Kanban. This paper proposes incorporating Earned Value Management (EVM) tools to handle the challenge of monitoring a project's progress. A case study shows how a software company implemented this approach.

II. LITERATURE REVIEW

In February of 2001, the Agile Manifesto (http://agilemanifesto.org/) was composed at a summit of 17 practitioners of several programming methodologies, who sought to uncover "better ways of developing software". The participants reached a consensus around four main values: (i) Individuals and interactions over processes and tools; (ii) Working software over comprehensive documentation; (iii) Customer collaboration over contract negotiation; and (iv) Responding to change over following a plan.

The motivation for the monitoring tool proposed herein stems from the inherent conflict between the Agile Manifesto - a methodology that diminishes the importance of following a

plan - and the need to monitor and control projects. Indeed, Chow and Cao [1] carried out a survey to identify success factors in agile projects, evaluating projects according to four project success categories: Quality, Scope, Time, and Cost. They found that the need for a strong project management process with a good progress tracking mechanism is still a key factor in the success of an agile project.

A case study of a nine-person software development team working for BBC Worldwide [2] showed how the use of Lean or Agile methods (that are both considered as non-traditional methods), including visual management, team-based problem solving, and smaller batch sizes, can improve software development. In particular, the study pointed to the use of a statistical control approach as a factor in the success of the software development process. Many agile implementation methods adopt statistical methods to measure the lead time of tasks from the design phase until the completion phase. However, such statistical methods can only be implemented in later stages of the project, after data have accumulated. Likewise, in a discussion of the metrics and reporting mechanisms that are applicable in a Kanban context, Anderson [3] recommends the use of cumulative flow diagrams (see case study below for an example of such a diagram), which are also applicable only when substantial quantities of statistical data are available.

The current paper proposes the EVM technique as an alternative to statistical control processes (see [4] for a description of how to use EVM to track the progress of software projects). EVM (Earned Value Management) is a project management technique for measuring project performance and progress. EVM enables projects to be monitored even in the early stages, before statistical data are available. The compromise is that we are not following the Agile methodology that focuses on the flow with minimal planning but having a phase of progress simulation in order not to have a project that cannot be monitored at all.

III. Main Methodology

The below "How To" manual describes a method of planning and managing an Agile project-specifically, a project that uses the Kanban methodology-using EVM tools. Briefly, according to this approach, at specific points in time, in order to monitor the Project's progress, the project manager calculates an overall current "value" for the project, determined according to the current status of the various tasks. Specifically, each project stage (lane) represented on the Kanban board is assigned a value factor, and this factor is multiplied by the number of tasks (cards) in that stage. The obtained values are summed up across lanes. To evaluate the progress of the project, the manager compares the current value of the project against a Planned Predicted Value that he or she has determined in advance.

A. *Advantages*

- Continue to work under an Agile paradigm; no need to plan the due date of each specific task in advance and be forced to complete the task according to the predefined estimated time to complete.
- Prediction based on value earned following the flow of as cards as they move ahead in the project lifecycle.
- Not limited to Kanban boards with agile card flow - can be used for waterfall or hybrid approaches as well.
- Easily provides answers to the basic questions that each manager/team leader must ask: "Are we on track?" and "What is the direction of our progress?"
- Planned value can be manually adjusted based on project resource allocation and/or other factors such as new project needs or changes in circumstances.
- Can be applied to tasks, projects and releases of any size.

B. *Steps*

1) Set Up:

The precondition of this monitoring tool is an implementation of a Kanban Agile Methodology. Preconditions:

a. Implementing a Kanban board (Figure 1).
b. Defining all Kanban entities: lanes, policies, cards, WIP (work in progress) Limits.
c. Each card should include an estimation of the amount of work involved, quantified according to previously agreed-upon terms (e.g., man days/hours/man weeks, etc.). It is recommended that the project tasks should be broken down such that the cards represent tasks of similar size.
d. Determining the Planned Predicted Value for each lane in the Kanban board.

2) Defining the strategy

Defining the strategy by which the earned value will be calculated over the course of the project life cycle. This can be done according to historic measurements, management decisions, or simulation of week by week predictions.

3) Calculating the SPI

Calculating a schedule performance index (SPI) for each evaluation point. SPI is calculated as the ratio between the project's actual earned value at the evaluation point and its planned value for that point.

4) Simulation

Simulation – Checking how unpredicted changes in workload or added/removed tasks impact the plan. Trying to predict how much capacity the project has to deal with such unpredicted changes.

5) Monitoring

6) Dealing with changes (more work added to the project).

IV. CASE STUDY

The Kanban Agile methodology was implemented in a software company whose main business is developing software for the telecommunications industry. The project we focus on was undertaken by the company's European division to address the needs of a western European client that owned the number one mobile company and the largest 4G network in its country. The project was planned to take place over the course of 9 weeks.

This project implemented a Kanban management strategy in order to handle ongoing changes required by the customer and a demand for shorter cycle times. These types of changes reflect a global trend of fast business changes that are driven by rapid advancements in technology and fierce competition.

The following project goals were defined in accordance with the Kanban system:

a) Visualize - Make the different tasks more visible to managers and teams.

b) Manage the Flow – Manage the whole lifecycle. Deal with issues and mitigate problems at a local level.

c) Establish a pull system.

d) Make process policies explicit.

e) Improve collaboration between the different teams.

f) Focus on end results.

A. Setting up a Kanban board.

a. In this case study the project life cycle corresponds to that of a typical software development project, broken up into lanes according to the traditional software lifecycle (Figure 1):

- Design: Requirement Gathering from the customer;, High Level Design; Detailed Design (In Progress / Done)
- Coding (In Progress / Done)
- Unit Testing (In Progress / Done)
- Environment Set Up (Done)
- Customer Acceptance Test (In Progress / Done)

Backlog	Design		Coding		Testing		Setup	Customer Acceptance Test	
	In Progress	Done	IP	Done	IP	Done	Done	IP	Done

Figure 1: Example of a Kanban board lane set up for the investigated case study

B. Constructing the value factor for each lane on the Kanban board.

Every lane defines a stage of the project, and every stage is associated with a factor of value earned (Figure 2). The value factor is determined in accordance with the agile philosophy. As the agile approach focuses on task completion, the "Done" stage of each phase of the life cycle is attributed a larger value factor compared with the corresponding "In Progress" (IP) stage, and later stages are attributed higher value factors compared with earlier stages See Figure 2 for an example of the construction of the value factors for the Kanban board in our case study (e.g., "Customer Acceptance Test – Done" is attributed a value of 7, and "Design – In Progress" is assigned a value of 0).

Value Factor	Design		Coding		Testing		Setup	Customer Acceptance Test	
	In Progress	Done	IP	Done	IP	Done	Done	IP	Done
	0	1	1	2	2	4	4	5	7

Figure 2: Factor Set Up

C. Calculating the Planned Predicted Value for each evaluation period.

The next step is to plan, for each period, what the project "picture" should be, that is, which tasks should be included on the board, and in which lanes. This planning can be done by implementing a waterfall planning approach for each task, using historic knowledge and data of how tasks are progressing in the project, or by using a linear plan or any other progress plan.

In the 9-week project we investigate in our case study, planning is carried out according to a weekly schedule. For example a 2 week simulation is shown in Table 1. By the end of week 1, for example, the plan is that 6 tasks will have completed the Design phase, 2 will be in the process of Coding, and 1 task will have completed the Coding phase (total planned value of 6+2+2=10).

TABLE I. EXAMPLE OF PREDICTION AND PLANNING; 2 WEEKS ARE ELABORATED IN DETAIL

Project Week	Planned Value	Description Of Planned Value
1-Jan	**10**	6 Tasks are in Design phase, 2 In coding phase, 1 task that will finish Coding (6+2+2 = **10**)
8-Jan	**24**	2 Tasks are in Design phase, 2 In coding, 4 In Coding done. 3 In Testing done (2+2+8+12 = **24**)
15-Jan	34	
22-Jan	50	
29-Jan	75	
5-Feb	90	
12-Feb	97	
19-Feb	105	

TABLE II. MONITORING: PLANNED VALUE VS. ACTUAL VALUE AND SPI ON FEB. 10 – END OF WEEK 6

Project Week	Planned Value	Earned Value	Schedule Performance Index (SPI)
1-Jan	10	9	90%
8-Jan	24	20	84%
15-Jan	34	25	74%
22-Jan	50	30	60%
29-Jan	75	52	69%
5-Feb	90	80	89%
12-Feb	97		0%
19-Feb	105		0%
			0%

D. Monitoring: Calculating the Schedule Performance Index (SPI.

Once the plan is in place the project can be monitored. At the end of each week, the actual status of the project is evaluated and compared against the plan. Let's take a snapshot of February 10 – End of week 6:

For example, the plan for week 6 was to earn a value of 90, but the actual work summed up to a value of 80 - meaning that the project achieved only 89% of its planned value for week 6.

Figure 3 shows the project status as shown on the Kanban board on February 10 – End of week 6. The summary of the earned value of all cards is 80.

Table 2 shows the Schedule Performance Index (SPI) for each of the first 6 weeks of our case study.

Figure 4 shows a graph of the project's planned values (Blue Line) versus its actual earned values (Red Line). We can understand from the trend that the gap is getting smaller and the project will soon be on track

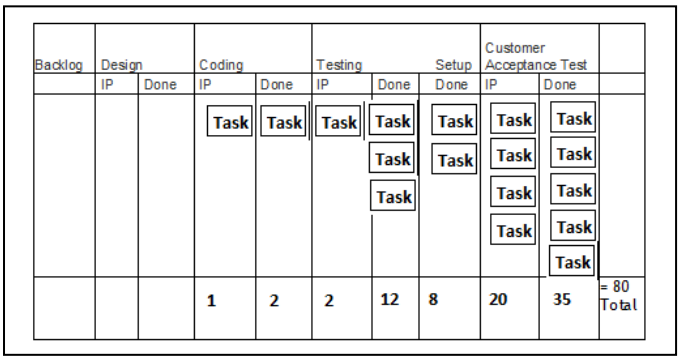

Figure 3: Example of a Kanban board on February 10 – End of week 6

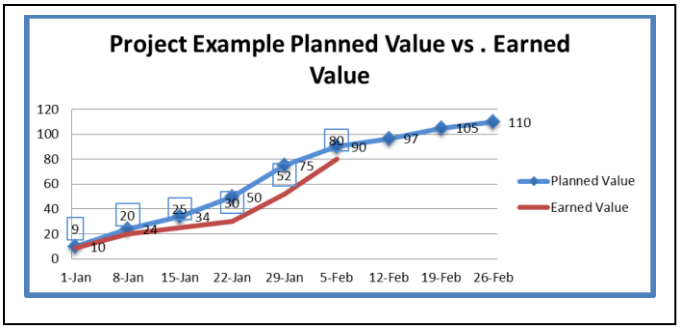

Figure 4: Planned Value vs. Earned Value graph on February 10 – End of week 6

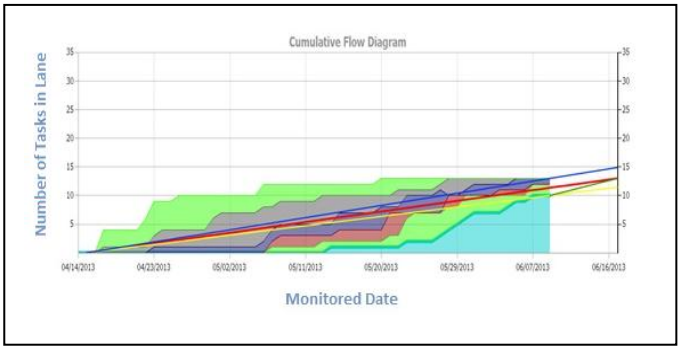

Figure 5: CFD – Cumulative Flow Diagram

V. SUMMARY AND CONCLUSIONS

One of the major differences between traditional and agile projects is that traditional projects focus on satisfying closed requirements, whereas agile projects need to deal with changes and continuous re-planning. As a result, agile projects pose

more of a challenge in terms of planning, prediction and control. This article proposes a methodology for mitigating the dilemma between running a project in accordance with the agile methodology—i.e., without due dates and plans, and using a "pull system" driven mainly by teams on the ground—and the need of a manager to monitor a project's progress. The methodology, which combines Agile Kanban with principles of EVM, is based on attributing a value to the status of the project at a given point in time and comparing it against a planned value. The ratio between the project's actual value and its planned value indicates whether the project is on track. The limitation of the method and its weak point is to be able to simulate and predict the planned values, which can be more challenging in projects that are less stable and tend to have frequent plan changes.

Future studies can extend this methodology to ensure that it provides managers with flexibility to incorporate changes to the original plan. It would also be of interest to identify means of evaluating a work plan's capacity to accommodate change prior to the commencement of the project.

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