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An Impact Assessment of Agile Ceremonies on Sprint Velocity Under Agile Software Development

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***Abstract*— the agile software development process has a set of standard agile ceremonies, which are must for an agile team to conduct in order to preserve its agility. However, there is always a challenge for agile teams to decide how much agile sprint time should be spent on hosting agile ceremonies and agile product build tasks. This is due to the fact that if most of the agile sprint time is spent on hosting agile ceremonies then the time for agile product build tasks will be reduced significantly impacting the velocity of the agile team. Hence, there is a need to find a solution with the help of which agile team can strike a right balance among various agile ceremonies and agile product build tasks during a sprint. To overcome this gap, this research paper analyses the data for 14 agile sprints to understand the agile time distribution across agile sprint ceremonies and agile product build tasks under current approach. Because of which, this research paper proposes the values for two newly introduced agile co-efficient namely co-efficient of agile ceremony time and co-efficient of agile product build time to suggest the ideal time to be spent on agile ceremonies during a sprint. From the research results, it was evident that the velocity of the agile team following the proposed approach reported an increase in velocity by 13.96% for sprints when compared to the velocity of the agile team following the existing approach. The research work also highlighted that the duration chosen for agile ceremony by agile teams is independent of sprint lengths.**

Keywords*— *Agile Methodology, Agile Ceremonies, Sprint Length, Agile Team, Velocity

I. Introduction

Agile is more about communication and collaboration between team members working on agile software project [1]. Therefore, it is evident that agile ceremonies are essential components for maintaining agility in agile software development. There are primarily four agile ceremonies which governs the agile product build process namely sprint planning, product grooming session, daily stand-up(s) and retrospective meetings. The key issues with agile ceremonies is agile methodology does not have any stringent guideline to define how much time needs to be spending agile ceremonies in a sprint. Each sprint starts with a sprint-planning event that aims to define a sprint backlog, identify the work for the sprint, and make an estimated forecast for the sprint goal. Each sprint ends with a sprint review and sprint retrospective, [2] that reviews progress to show to stakeholders and identify lessons and improvements for the next sprints. However, it should be noted that sprint retrospective meetings are performed once the sprint is over but the time spend on sprint retrospective meetings is still considered within sprint length. As per [3] if the velocity is stable from sprint to sprint, it means planning and the execution is well aligned. The product backlog grooming session is another key agile ceremony performed in the beginning of the sprint where detailed requirement provided to agile team. The product backlog is quite complex in nature and difficult to manage [4]. The daily stand-ups are short duration status meetings to highlight the status of user stories in general and to raise a blocker if any.

This paper suggests to put a check on the amount of time spend on agile ceremonies during an agile sprint to overcome the risk of eating up most of the agile product build time resulting into decreased velocity. In addition to this, the proposed approach provides a clear picture to agile scrum master on the actual amount of sprint time being spend agile product build in relation to the expected planned time for agile ceremonies. Hence, which can be considering as a strong discussion point for retrospective meetings in case the actual time spends on agile ceremonies exceeds significantly the planned time. Thus, a true picture of team velocity will report, which can be further improve by controlling the agile ceremony time.

This research paper structured as follows. The section II presents the literature review whereas the section III explains the problem statement and section IV deals with the proposed approach in detail. The section V throws light on how this research work designed to compare the results between the current and proposed approach. Further Section VI, performs the empirical assessment of results captured from the execution of the research project. The last section VII concludes the research and suggests the future prospects of the research work.

II. Literature Review

Most AGILE teams work in iterations of two to four weeks. It's possible to go slightly longer, and some teams have experimented with even shorter iteration [5].As per Agile guidelines, the short development cycles should deliver working software in a fixed span of time commonly known as sprint or iteration. A sprint (or iteration) is the basic unit of development in agile. The sprint is a time-boxed effort; that is, it is restricted to a specific duration [6]. Usually, the duration of sprint is two to four weeks. Therefore, agile team has limited time for agile product build during a sprint. Hence, due to smaller delivery cycles it becomes more important for scrum master to closely track how the sprint time spent by agile team. To fulfill this existing gap, the research paper proposes to split the agile time into two broad categories namely agile sprint ceremony time (ASCT) and agile sprint product build time (ASPBT).

From the recent literature review, it is quite clear that not much research work done on the ideal time spent on agile ceremony during an agile sprint. In [7] discusses three categories of project matrices in detail namely process metrics, project metrics and product metrics but none of these metrics captures the amount of time spent on agile ceremonies and the agile product build. Hence, this paper attempts to fill this gap by studying the ratio of time spent on agile ceremonies and the agile product build under agile software development.

In [8] monitors the project management activities under agile software development and recommends improvement for communication, team motivation, and adaptation agility but does not consider agile ceremony time duration during the study. In [9] provides a comparative study of agile methods namely XP versus scrum on communication, product build and feedback for the project but does perform any comparison on the time spent on agile ceremonies under both the agile methodologies.

In [10] suggests ways to improve the quality agile software projects in terms of cost and effort but does not provide any guidance how to spend the agile sprint time. In [11] introduces Review-Scrum which is basically reversion of Scrum and aimed to sort the critical issues in scrum framework like agile ceremonies but failed to provide any concrete guidance on the over-all time to be spent on agile ceremonies. However, it proposed to change the frequency of some of the agile meetings.

In [12] proposed NPL and in [13] suggested use of any-colony for sprint planning in agile but none of them commented on the actual time spent on release planning ceremonies under agile methodology. In [14] suggests to use feature as a unit to measure the length of sprint but does not provide any guidance how to spilt sprint time between agile ceremony time and agile product building time.

In [15] highlights the impact of Covid19 on the future of agile and acknowledges the fact that communication tools are not always adequate for high-bandwidth or informal interactions, such as brainstorming, side discussions, or hallway conversations during virtual collaboration among agile teams. Hence, it raises the need for an agile ceremony guideline following which the agile ceremonies hosted in most effective way.

In [16] identifies nine activities associated with role of scrum master which includes agile ceremony facilitation where involves moderation of the daily scrum, backlog grooming, and sprint planning but it does not provide any details around the permissible time limit to be spent on these agile ceremonies by scrum master. Hence, this research work fulfils this gap provides the proposed approach to come up an ideal ASCT for an agile sprint. In addition to this, the latest agile research work focuses on the overall impact of on-going Covid-19 pandemic on agile practices [15] [17] [18]. Hence, there is a limited research study primarily focusing on agile ceremony is available for agile practitioners.

III. Problem Statement

In general, we know that sprint time is the sum of time spent on agile ceremony and agile product build as shown below in equation (1).

As we know;
AST = ASCT + ASPBT ….........................eq(1)

Where,
AST is agile sprint time in man-hours
ASCT is agile sprint ceremony time in man-hours
ASPBT is agile sprint product build time in man-hours

The object of this research paper is to find an appropriate value for C1 and C2 in equation (2).

Since,
ASCT = (C1)* AST….............................eq(2)

ASPBT = (C2)* AST…..........................eq(3)

Therefore,
AST = (C1)* AST + (C2)* AST …........eq(4)

Where;
C1 is a co-efficient of agile ceremony time
C2 is a co-efficient of agile product build time
With two below given conditions:

$$C1 + C2 = 1$$
$$C1 > 0 \text{ and } C2 > 0$$

The value of C1 and C2 will help us to determine how much time ideally an agile team should spend on agile ceremony and agile product build time. Now, taking a step further the agile ceremony time explained as the sum of time spent on various agile ceremonies as shown in equation (5).

As we know:
ASCT = DSt + SPt + PBGt + RVt + RMt…..eq(5)

Where;
DSt is agile daily stand-up in minutes
SPt is agile sprint planning in minutes
PBGt is agile product backlog grooming in minutes
RVt is agile sprint review time in minutes
RMt is agile retrospective time in minutes

This research work focuses on the finding optimal values for the co-efficient of agile ceremony time (C1) and the co-efficient of agile product build time (C2).

IV. Proposed Approach

A. Research Assumptions

The purpose of this research is to determine the impact of agile ceremonies on the velocity of the agile sprint. The proposed approach is instrumental in deciding the optimal time spent on agile ceremonies during an agile sprint. The two research assumptions considered during this study are:

1) The proposed approach will not violate the agile guidelines and principles mentioned in [19]

2) By putting a check on time spends on agile ceremonies will increase the agile product build time and will have a positive impact on agile sprint velocity

B. Proposed Algorithm

Step1: Collect the data for the process attributes namely, time spent on agile ceremonies namely daily stand-up, sprint planning, product backlog grooming, sprint review and agile retrospective meetings along with the time spent on the agile product build during a sprint from the agile project repository.

Step2: Calculate the total sprint time split in percentage for time spent on agile ceremonies, which includes daily stand-up, sprint planning, product backlog grooming, sprint review and agile retrospective meetings along with the time spent on the agile product build for the sprint, taken into consideration from agile project repository.

Step3: Take an average of percentage from step 2 for sprint time spent on agile ceremonies and agile product builds to get overall optimal value of time spent on agile ceremonies and agile product build across all the sprints.

Step4: Substitute the average time calculated for agile ceremonies and product build time from step 3 as the optimal values for the co-efficient of agile ceremony time (C1) and the co-efficient of agile product build time (C2).

Step5: Using the optimal values from Step4 in equation (4) calculate the ideal time to be spent on agile ceremonies and agile product build time

Step6: Execute the sprint

V. Model Implementation

This research work considered the data from the 14 agile sprints and analysed the various process metrics associated with it to calculate the values for the co-efficient of agile ceremony time (C1) and the co-efficient of agile product build time (C2). The input parameters, calculated parameters and output parameters considered during this research work discussed below.

A. Input Parameters

The below discussed input parameters are considering research.

Sprint ID: Unique identification number to identify a sprint

Sprint Length: It is the duration of agile sprint in days. It is assumed that an agile day is of eight working hours therefore the total number of sprint days is multiplied by 8 man-hours to get the length of sprint in man-hours.

Scoped Velocity: The total number of story-points expected to be delivering through a sprint.

Agile Ceremony Time: The total time spent on hosting agile ceremonies during a sprint namely daily stand-up, sprint planning, product backlog grooming, sprint review and agile retrospective meetings.

Agile Product Build Time: The total time spent on building agile product during a sprint.

B. Calculated Parameters

From the 14 agile sprints data, sourced from agile project repository, as shown in table I, it was found on an average that 81.09% of total agile sprint time was spent on agile product build tasks and 18.91% of total agile sprint time was spent on hosting agile ceremonies. Hence, the values of C1 and C2 in equation 2 were set as C1 = 0.1891 and C2= 0.8109 as per traditional approach sprint data. Hence, an analysis was conducted using the minutes of meeting to find out the opportunities for further reduction in agile ceremony duration time. Some of the key reasons identified for longer agile ceremonies were some of the agile team members were not familiar with the agile processes as they were new to agile methodology, incomplete user-stories leading to longer product grooming sessions and inability of scrum-master to complete daily scrums in defined time-period. Hence, after eliminating all these lag components the values for C1 set to within 0.2 and for C2 set to 0.98. However, keeping the agility in mind the proposed approach allowed the scrum-master to further adjust the values for C1 and C2 by ±1% if required.

TABLE I
EXISTING APPROACH

Sprint ID	Sprint Length (man-hours)	Initially Scoped (Story Points)	Velocity (Story Points)	ASPBT (%)	ASCT (%)
P1:SP1	64	150	130	78.13	21.88
P1:SP1	72	180	180	83.33	16.67
P1:SP1	72	190	160	86.11	13.89
P1:SP1	88	280	250	82.95	17.05
P1:SP1	80	185	180	83.75	16.25
P1:SP1	72	165	140	83.33	16.67
P1:SP1	112	320	280	80.36	19.64
P1:SP2	128	380	360	76.56	23.44
P1:SP3	112	280	240	82.14	17.86
P1:SP4	112	340	320	82.14	17.86
P1:SP5	80	170	160	86.25	13.75
P1:SP6	128	400	370	75.00	25.00
P1:SP7	96	290	280	76.04	23.96
P1:SP8	120	370	340	79.17	20.83

Also, it was noted irrespective of sprint length the time spent among various agile ceremonies was almost consistent for the above sprints as shown in table II.

TABLE II
AGILE CEREMONY TIME

Agile Ceremony Name	Agile Ceremony Time
Daily Stand-Up	30 minutes per sprint day
Sprint planning	180 minutes per sprint
Product Backlog Grooming Session	180 minutes per sprint
Review Meeting	120 minutes per sprint
Retrospective Meeting	60 minutes per sprint

Since, now we have successfully derived the values for the co-efficient of agile ceremony time (C1) and the co-efficient of agile product build time (C2) therefore, all the 14 agile sprints we now executed using the proposed ideal time for agile ceremonies and agile product build time. The data for the 14 agile sprints executed as per proposed approach as shown in table III.

TABLE II
PROPOSED APPROACH

Sprint ID	Velocity (Story Points)	Product Build Time (in %)	Ceremony Hours (in %)	Additional Velocity (Story Points)
P1:SP001	170.00	96.88	3.13	20.00
P1:SP001	190.00	97.22	2.78	10.00
P1:SP001	220.00	97.22	2.78	30.00
P1:SP001	280.00	97.73	2.27	-
P1:SP001	210.00	97.50	2.50	25.00
P1:SP001	180.00	97.22	2.78	15.00
P1:SP001	350.00	98.21	1.79	30.00
P1:SP002	400.00	98.44	1.56	20.00
P1:SP003	320.00	98.21	1.79	40.00
P1:SP004	380.00	98.21	1.79	40.00
P1:SP005	250.00	97.50	2.50	80.00
P1:SP006	450.00	98.44	1.56	50.00
P1:SP007	350.00	97.92	2.08	60.00
P1:SP008	410.00	98.33	1.67	40.00

C. *Output Parameters*

The objective of this research work is study the impact of agile ceremony time on sprint velocity. Hence, sprint velocity studied carefully to draw the results interpretations.

Output Velocity: The actual story points delivered by the agile team per sprint.

VI. EMPIRICAL ASSESSMENT OF RESULTS

The research data for all the 14 agile sprints executed under existing approach and proposed approach were compared thoughtfully to arrive at the below assessment of results.

A. *Sprint Size:* First and foremost, it was observed from table 2 that the time kept by scrum master for agile ceremonies namely daily stand-up, sprint planning, product backlog grooming, sprint review and agile retrospective meetings were consistent across all sprints irrespective of sprint length. That is whether the length of sprint was 2 weeks or 4 weeks the agile ceremonies have a fixed allotment of for them. The only difference was the frequency of the daily stand-up that changes the overall agile ceremony time across all the sprints. Since, the daily stand-up meeting occurs on all sprint days. For example, if a sprint is of 5 days then there will be 5 daily stand-up meetings and if a sprint is of 15 days then there will be 15 daily stand-up meetings. Hence, the frequency of daily stand-ups is the major component of agile ceremony time when compared to other agile ceremonies namely sprint planning, product backlog grooming, sprint review and agile retrospective meetings. Since, sprint planning, product backlog grooming, sprint review and agile retrospective meetings happened only once a sprint. Therefore, reducing the frequency and time for daily scrums the overall agile ceremony time can be further reducing.

B. *Output Velocity:* Under the proposed approach, the product build time for the smaller sprints increased to 97.26% from 83.48% when compared to smaller sprints under traditional approach and the product build time for larger sprint increased to 98.19% from 79.30% under traditional approach. Hence, the proposed approach proved equally beneficial for beneficial for smaller as well as larger sprints. From table 3, it is quite evident that an over-all additional velocity of 460 story-points across all sprints including smaller as well as larger sprints delivered successfully. These 460 story-points are over and above the initially scoped 3390 story-points. Hence, an increase of 13.56% observed for sprint velocity when compared to traditional approach.

C. *Agile Practitioners:* It is observe that the proposed model is more beneficial for beginners as they have lesser experience in hosting agile ceremonies. Hence, the lesser experienced agile practitioners sometimes ends up in extended meetings eating up most of time kept for agile product build resulting in reduced velocity.

D. *Agile Product Costing:* The 13.56% increase in velocity will have an impact on the agile product cost. Since, the product build time significantly increased to 98.19% from 79.30% for smaller sprints and to 98.19% from 79.30% for larger sprints. Therefore, using the same amount of resources more sprint velocity delivered resulting into speedy delivery of agile product resulting into decreased cost.

VII. CONCLUSION AND WAY FORWARD

Throughout this paper, we have examined the impact of duration for agile sprint ceremonies on the sprint velocity and came out with the findings that agile sprint ceremonies are critical part of agile sprint as they are building blocks of agile communication. Therefore, this research work concludes that it should be the key responsibility of scrum master to keep a track of agile team time spent on agile team ceremonies and agile product build in order to maximize the agile sprint velocity using the proposed approach. The use of proposed approach resulted in the increased velocity of 13.56%when compared to traditional approach. Hence, an indirect reduction in the cost of agile project due the increased sprint velocity. Keeping in mind the effective application of machine learning algorithms for agile product backlog optimization, agile test automation, etc. the researcher plans to predict the values for the co-efficient of agile ceremony time (C1) and the co-efficient of agile product build time (C2) using machine learning algorithms in near future.

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