A Comparison of Scrum, Kanban with their Hybrids - Scrumban and Scrumbanfall to identify their Selection factors

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Abstract: The Underlying cause for a successful operation and the completion of a Project is the Project Management framework used which affects its efficiency, project oriented operations, and thus business processes and its market. Software development can be defined as creating new software or fixing the existing one. Technology developments led to increasing demand for software. IT Companies should be able to project well maintenance. The use of inappropriate method or practice leads to software development processes that are inflexible and wasteful. Adopters of Scrum and Kanban believe that wrong practices of both methods are risky. Therefore, Agile team members should be assisted in their decision making. The aim of this study is to determine the main factors to consider during the selection of Kanban , Scrum, Waterfall, or the hybrid - Scrumban and Scrumbanfall method. The identification of the factors was through in-depth review of the relevant work. Then, content analysis was employed in the analysis of data.

Keywords —Scrum, Kanban, Scrumban, Srumbanfall, Selection Factors.

I. INTRODUCTION

Agile is an umbrella term used to describe a project management methodology that breaks down large complex projects into smaller, more manageable chunks. Agile project management has been used in software development to speed up the completion of projects for many years. Scrum and Kanban methods are developed based on these values and principles[1]. The values emphasize on: "individuals and interactions, working software, customer collaboration, and responding to change". Alliance refines the values captured in their manifesto into 12 principles; the following are the examples of the principles:

- Stakeholders (customers and users) and developers must work together daily throughout the project.
- Build projects around motivated individuals.
- Face-to-face conversation is the most effective and efficient method of conveying information to and within a delivery and development team.
- Working software which quantifies the business value is the best way to measure progress.
- Sustainable delivery and development by maintaining a constant pace.

Kanban is a project management method that helps visualize tasks, while Scrum is a method that provides structure to the team and schedule.

Kanban and Scrum are project management methodologies that complete project tasks in small increments and emphasize continuous improvement. But the processes they use to achieve those ends are different. While Kanban is centered on visualizing tasks and continuous flow, Scrum is more about implementing timelines for each delivery cycle and assigning set roles.

Both Kanban and Scrum borrow from Agile and Lean approaches, though Scrum is often more heavily associated with Agile. That means Kanban and Scrum are both adaptive, transparent, and reduce inefficiencies in the project process.

Different factors have to be considered while selecting the suitable Agile method, or scaling Agile methods. To ensure successful software projects, team members of any organization must be concerned with project management, both Kanban and Scrum methods are appropriate in managing the projects and develop them successfully. This review of the current studies demonstrates that the decision to select either the Scrum or the Kanban method or develop a hybrid method of both requires a comprehension of the factors impacting the selection. It is also important to balance the strengths of each method according to the value of method prescription, roles and responsibilities, adoption time, team size, batch size, requirements prioritization, feature size, lead time, technical practices, cost and quality as this would help the team in choosing the fitting method or mixing both methods together.

II. RESEARCH WORK

This section discusses a brief of all the factors responsible to choose Scrum and Kanban or their hybrids – Scrumban and Scrumbanfall.

A. Scrum

Scrum is an Agile methodology designed for complex projects where it is frequently necessary to adapt to change. Scrum is based on short development cycles called sprints,

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which generally last from one to four weeks. A Scrum team is self-organized, small (typically no more than eight people), and includes one Scrum Master and one product owner. The rest of the team is called the development team.

As typical of Agile frameworks, Scrum uses an iterative approach to completing projects. Instead of delivering a project all at once, teams complete and deliver tasks in stages. This makes it easier to adapt to changes and evolving priorities.

Scrum is built on three pillars:

- **Adaptation:** Scrum is adaptive, meaning it embraces change. Scrum can easily accommodate a project changing tactical directions.
- **Transparency:** Transparency ensures everybody on the team knows what is going on and why.
- **Inspection:** Team members and stakeholders inspect projects consistently. This encourages a culture of improvement.

Scrum also has five core values: courage, focus, commitment, respect, and openness. These values emphasize the importance of clear and honest communication, as well as a sense of ownership by each member of the team.

A Scrum team is made up of three roles: the Scrum master, the product owner, and development team members.

- Scrum Master: A Scrum Master is the person responsible for making sure a Scrum team is operating as effectively as possible with Scrum values. This means they keep the team on track, plan and lead meetings, and work out any obstacles the team might face.

  Following are the responsibilities of a Scrum Master:

  - Facilitate daily Scrum meetings (also called "daily standups")
  - Lead sprint planning meetings
  - Conduct "retrospective" reviews to see what went well and what can be improved for the following sprint
  - Keep a pulse on team members, through individual meetings or other means of communication.
- The Product Owner: A product owner makes sure the Scrum team is aligned with the goals of the overall product that the team is contributing to [4]. They understand the business needs of the product, like customer expectations, and market trends. Following are the responsibilities of a Product Owner:

  - Managing the Product backlog.
  - Set the Product Vision for the Team
  - Communicate with External Stakeholders.
  - Make Sure the Team is Focused through communication.
- The Development Team: A development team is composed of Professionals who do Hands-on work of completing the task in a Scum Sprint. This means development team members can be computer engineers, designers, writers, data analysts, or any other role needed to reach sprint goals. Following are the responsibilities of a development Team:

  - Help in Sprint Planning and Goal setting.
  - Lend expertise to Program, and design.
  - Test product, Prototypes and other forms of quality Issurance.

B. Advantages of Scrum:

- Iterative and Incremental Methodology: allows complete tracking of Project workflow with Intermediate Results.
- Cooperation: Improved Customer, Client and Development Team Cooperation through daily Communication.
- Participation: All Team Members are involved in the Process and motivated to express their opinions to improve Efficiency.
- Adaptability: Scrum allows one to change priorities and thus requirements.

C. Disadvantages of Scrum:

- Need for an Experienced Team: Usually the team size is small around 6-8 Team members but they must be experienced as there is always a risk of not completing the Project in time by Novice Team Members.
- Time Management: After each Sprint, a new Sprint Planning needs to be done, which may take a lot of time if a longer Sprint is planned.
- Iteration: The Scrum Estimation is one of the hardest and wasteful part as tasks must be well defined else estimated Project Cost and time won't be Precise.

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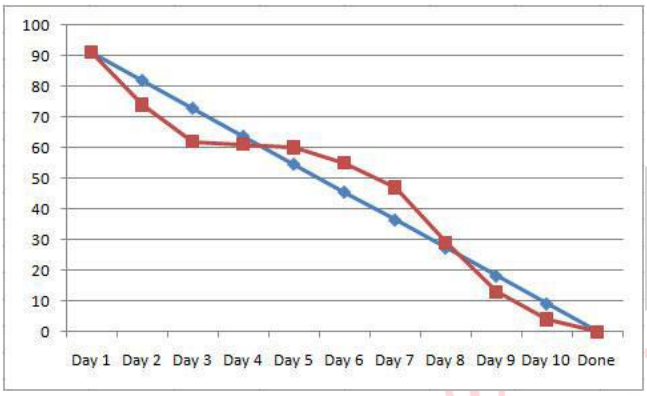
D. How does Scrum Work:

- Team Members must know what is going on in a project. Use separate columns to define "To Do", "Done", "WIP (Work In Progress). They allows one to follow the workflow of a Project.
- All Team Members need to have a Plan to govern and to complete the Project Successfully. Each Sprint starts with a Team Meeting in which Goals, Priorities, Deadlines and Quality are set.
- Now to Implement a Task; Assign it by yourself or assign them by Drag and Drop.
- Use Daily Burn down charts to see if everything is working according to the plan.



Graph 1: Daily Burn down Chart of a Random project.

In Graph 1 - the Vertical axis shows the amount of work remaining at the start of each sprint while the Horizontal axis demonstrates the sprints or one sprint timeline. The ideal blue line shows the sum of the estimates for all tasks that need to be completed. Red line depicts real situation of your team's workflow. The actual work line fluctuates above and below the ideal line depending on how effective according to timeline the team is. This allows you to follow whether your team will complete the Project on time.

E. When to Use Scrum:

Scrum has been linked to higher productivity, faster delivery, lower costs, and higher quality. Many project managers also see Scrum as an effective method to tackle complex projects, or projects that might see frequent change.

Scrum can make sense to use if one is in an industry that sees frequent change, or if your project might need space to adapt to feedback. This might include industries that have frequent technology updates, or projects creating new products.

F. Kanban

Kanban is a Lean scheduling visual method of project management used to track tasks and reduce inefficiencies in a project. The heart of the Kanban method is the Kanban board—physical or digital—in which phases of the project are divided into columns utilizes to calculate what to produce, when to Produce and How to Produce. Tasks are written on cards that progress from one column to the next, until the task is completed.

Kanban has been linked to several benefits. Kanban increases transparency in a project by visually clarifying what tasks need to be completed and where tasks are piling up. This visual aid makes it easier to delegate resources where they need to go, reducing inefficiencies. Kanban uses principles from both Agile and Lean.

Other Key Concepts:

- Definition of Workflow (DoW): The DoW defines key parts of the Kanban workflow, such as "Start" or "Finish" of an item, time taken for an item to be finished etc.
- Work in Progress Limits (WIP): Teams can set WIP limits in a column, groups of columns, or the entire board. WIP limits can help surface bottlenecks in the production process.
- Kaizen:Means "Improvement" i.e. to continually improve and get better. This encourages team to better share insights and work to improve the entire Team.

G. Advantages of Kanban:

- Flexibility: It provides Flexibility to not to stuck at the excess inventory if there is sudden drop in demand.
- Improves Productivity and Efficiency: Kanban helps to eliminate the wastage of time and so resources are able to focus on Current work.
- Inventory Management: Kanban provides a large number of inventory practices which smoothens out inventory levels and thus reduces their carrying cost.

H. Disadvantages of Kanban:

- Production Flow: Since Kanban requires planned weekly and monthly Schedules with day-to-day flexibility, it may not be possible in an environment where multiple or short length product types are manufactured.
- Variability elimination: system can be disrupted by unpredictable and lengthy down times.
- Less effective in shared-resource situations.

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I. How Does Kanban work:

- Create a Kanban board with "Input", "Work In Progress" and "Output" sections. Put task cards on the board and tag important tasks with short descriptions. Use different columns to show your team members which quality control and to verify if work item is ill-formed, controlling tasks are the most important and should be started first.

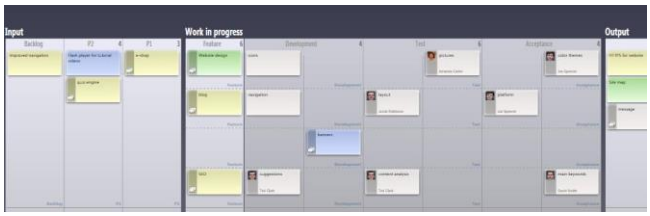

Figure 1:- "Kanban Board" of a Random Project.

In figure 1 – the Kanban Board of a Random Project is shown with different columns showing the status of different tasks with short descriptions wherever it is required. Like WIP (Work in Progress, Ill formed etc).

- Backlog can be split into two columns – backlog and backlog priorities. Now that a backlog is created, stories or tasks can be assigned to team members, where every team member chooses his own task according to him. Tasks that are in priorities column are assigned and thus developed first.

- According to Kanban there should always be work limits per column to avoid multitasking, which may result in a wasted time. WIP limits helps to match team's development capacity.

- Kanban uses lead and cycle times to measure performance. Lead time shows how long it takes to complete a task from its request until that request is done and delivered to the end consumer.

- Kanban does not use a precise planning routine. Either release/iteration planning is used, when a new product or feature set is released.

J. When to Use Kanban:

Kanban can fit in with processes that already exist—including Scrum. If you don't want to overhaul your entire work process but are hoping to gain the benefits that an Agile process can bring, Kanban can be a good way to start.

K. Scrumban:

Scrumban is a hybrid method that combines both Kanban and Scrum. Scrumban uses the processes of Scrum and the visualization tools of Kanban[3]. Scrumban can be a good way for teams familiar with either Scrum or Kanban to incorporate the other into their process.

Scrumban = Scrum + Kanban

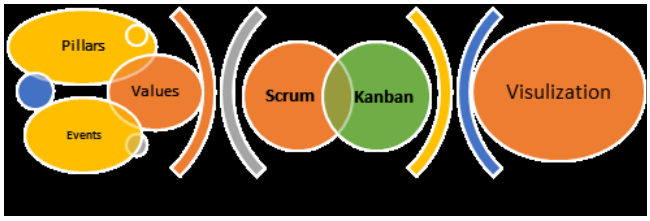

Figure 2:- Combination (Hybridisation) of Scrum Methdology and Kanban Methodology.

In Figure 2 - it has been shown that characteristics (Pillars and Events) of one methodology combined with the characteristics (Values) of other resulting in the hybridized Scrumban method which can be visualized as a single methodology with combined features.

L. Advantages of Scrumban:

- Saves Time:Scrumban uses planning on demand technique so there is no need to do estimating or sprint planning. Team plans only when there is a demand.

- Minimum Wastage: Scrumban uses inter-process buffers and flow diagrams to show weaknesses and opportunities of the process eliminating everything that is not adding value to the customer.

- Quality: Time saved in planning allows to focus on a manufacturing process and to inspect if work is promoted to the ready queue. If something ill-formed is found, then it gets bounced and troubles are eliminated, then process is repeated once again.

M. Disadvantages of Scrumban:

- Role: Scrum limits role of team members between Product Owner, Scrum Master and Development Team Member. Task specific roles are essential within development team members and it defines their involvement into team. Kanban has no specification about roles of team members.
- Skill and Expertise: According to Scrum, development team is cross functional [42] team and they have all the expertise to accomplish required goal, during the Sprint. But in real world situation [40], development team members are dependent on skilled experts to complete their tasks.
- Team Size: Scrum limits size of team members between 3-9 for a single Scrum team which is the best phenomena for small or mid-size of project. But it limits progress for large scaled project and Kanban has no specifications about team size.

N. How does Scrumban works:

- Create columns which consist of "To do", "Work in progress" and "Done". Divide "Work in progress"

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into more sections, then indicate the particular stage of task in new columns, therefore everybody knows the current situation and tasks are completed as soon as possible.

- Make a list of tasks, put them into backlog and set work in progress limit for this column. Because Scrumban does not have regular plan meetings. Team assigns items from the backlog into the process until it becomes empty.
- Divide your work in progress section into smaller columns to implement separate WIP limits.

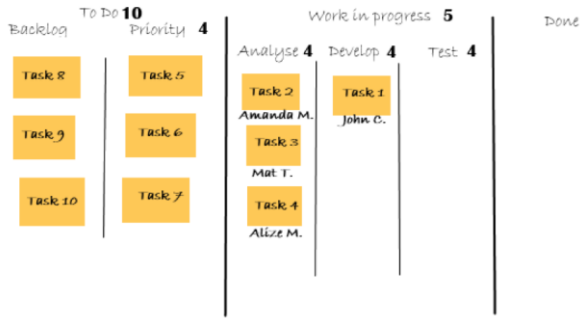

Figure 3:- Division of Work in Progress into more details to find bottlenecks.

Figure 3 – explains how to find bottlenecks (which block the process flow) in a project by dividing the work in progress section into smaller columns to implement separate WIP Limits.

- Scrumban uses average lead and cycle time as its key metrics for performance. If lead and cycle time is under control, then one can understand the time it takes for a task to reach the end consumer, the time it takes to develop and the time it takes to manage management.

O. *When to Use Scrumban:*

Scrumban is a great solution for teams who need the structure of Scrum with the flexibility of a flow-based method, or for teams who are looking to transition from Scrum to Kanban. Many teams use Scrumban as a transition point between a less mature and more mature Agile practice.

P. *Scrumbanfall:*

Scrumbanfall is the agile hybridization and integration of Scrum and Kanban with Waterfall in Software Engineering Management (SEM)[1].

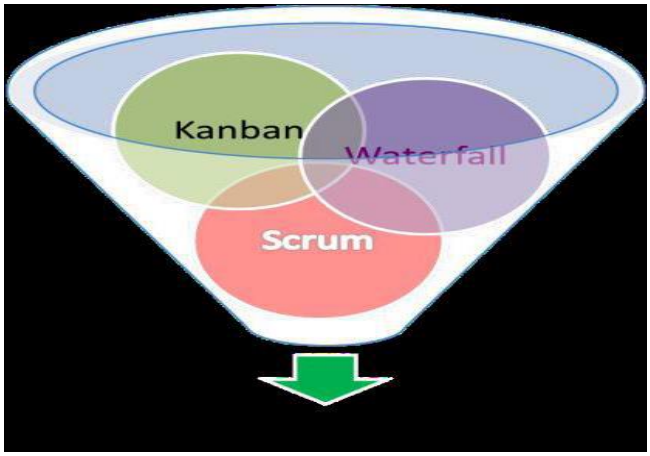

Figure 4:- Combination of Scrum + Kanban + Waterfall = Scrumbanfall

Figure 4 depicts the amalgam of Scrum and Kanban with Waterfall for the optimized formation of Scrumbanfall. Scrum lies on the base of the Scrumbanfall Model, by keeping Kanban in the center of the Scrum and covering Waterfall prior to the Scrum Sprints.

Q. *Advantages of Scrumbanfall:*

- Documentation: Requirement Analysis and Project Planning are initial phases of Scrumbanfall, derived from waterfall, which supports documentation of the PBP and planning charters.
- Estimation: Project planning and scheduling charts along with task level of documentation with help of user story and Kanban card, provides accurate estimation which is essential for product owner in identifying risk with the project.
- Project Tracker: Project Planning helps in designing a tracker at project level, which is used by development team during the Sprint and updated as soon as work item state changes in a Kanban card.
- Product Vision: An accurate estimation of project requirement and its planning enables product vision and tracker which helps in progress report and risk identification.

R. *Disadvantages of Scrumbanfall:*

- Distributed Environment: Communication between team members in the distributed environment is still limitation and general issue.
- Roles: As there is no specification about roles of the team members in Kanban and Waterfall, they are inherited from the Scrum, which is limitation of Scrumbanfall.
- Team Size: Yet the Scrumbanfall follows Scrum, which limits between 3 to 9 team members, for

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each Scrum team. For large scaled project development, large team is required that cannot be fit according to Scrum rule.

S. How Scrumbanfall works:

The Scrumbanfall life cycle model includes the following categories, based on Scrumban (Scrum + Kanban) and Waterfall as Scrumbanfall is a combination of them all[1].

- Requirement Analysis
- Project Planning
- Sprint
  - Sprint Planning
  - Daily Scrum
  - Work Item Management (WIM)
    - To - Do
    - In Progress
    - Done
- Continuous Integration and Continuous Delivery (CICD)
  - Sprint Review
  - Sprint Retrospective
- Product Release

T. When to Use Scrumbanfall:

Scrumbanfall is has a great strength compared to Scrumban. Scrum and Kanban as Scrumbanfall resolves challenging limitations of individual framework with the power of Waterfall, Kanban and Scrum.

Scrumbanfall can be used as SEM (Software Engineering Management) Practices which includes direct involvement of external stakeholder into project requirement and analysis documentation; project planning, estimation and tracker. This is an Iterative methodology where we can recursively go back to the initial phases when requirement changes and start sprint planning and effectively measures the WIP of the task items.

III. CONCLUSION

Software development organizations have been seeking ABPR (Agile Business Process Reengineering) to optimize their SEM (Software Engineering Management) practices. Scrum and Kanban are trending agile methodologies for software project development and management. This research has concluded that the proposed integration of Scrum and Kanban with Waterfall in the form of hybrid framework for SEM (Software Engineering Management) practices, overcome the limitations of Scrum and Scrumban; and empower the strength of software development organization by combining required characteristics of Scrum, Kanban and Waterfall into Scrumbanfall which has a great strength compared to stand alone framework and capabilities to answer the challenges of software development and management practices like direct involvement of external stakeholder into project requirement and analysis documentation; project planning, estimation and tracker[1].

An accurate estimation of complete project; the methodology to be followed, division of tasks in smaller units etc prior to the development should be prioritize during project documentation. Inaccurate estimation invites risks into project and unclear vision about software product, resulting into unexpected cost in the project for the software project owners or software development organizations.

Since, each method is quite distinct, so thorough understanding of methodology and the practices, to be followed in a project must be an important step – to be documented in project estimation and analysis.

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