Infrastructure for Implementation of Scrum Methodology
Software development using Agile Practice - Scrum

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ABSTRACT
Traditionally most organizations are using SDLC-waterfall model or incremental model for software project development, management and support activities. The process flow in these models is easy for management; activities and tasks can be defined and work can be easily track and monitor. The environment in which we are using these models are stable Whereas some environments are dynamic, as client is not clear about final product, changes in scope are introduce at rapid pace. The agility of such environment is needed to be handled by the agile software development method only. Thus in order to adapt the new model for this, called Agile software development model, organizations need to consider the various factor before implementing such methodology. The transition from traditional to the agile software development should be clear and easy and need to be result in to the benefit of the organization; for this organization are needed to provide the infrastructure that will result in high productivity and easy management of projects.

Keywords— Agile, Agile Implementation, Project Management, Scrum

I. INTRODUCTION
In order to adapt the new iterative software development model called Agile software development model organizations need to consider the various factor before implementing such methodology; It is needed to evaluate organization ability for adaptation for agile methodology. The success of the agile adaptation is completely depends on the implementation of the agile principles and the infrastructure needed to carry out agile activities.

Traditionally most organizations are using SDLC-waterfall model or incremental model for software project development, management and support activities. The process flows in these models is easy for management; activities and tasks can be defined and work can be easily track and monitor. This will also lead to the master-slave relationship between project team in which one is project manager and other entity is project team.

The traditional environment in which we are using these models is stable; as requirements are known to the client, customer is clear about problem statement, fix scope of work, changes in scope are restricted, client can wait for review of deploy product. The environment in serving organization is also stable; as roles and responsibilities are fixed for person, activities and task are known and follow traditional development cycle.

Whereas the other environment is dynamic, as client is not clear about final product, changes in scope are introduce at rapid pace, working module need to be given to client as soon as possible, review and feedback of client is necessary for current module in order to move to the next module. The team might not follow any traditional process as client satisfaction with quality product is the goal. No master slave relationship or fix responsibility for a person. Building a quality product is the entire team commitment towards client not a single person duty. Since it require strong team bounding.

As mention above the scrum development environment will lead to replacement of the role of a traditional project manager with a Scrum Master and splits the formers responsibilities into the Scrum Master, the Product Owner and the Scrum team in general.

The two different software models are applicable for the two different environments, thus transition from the existing to the new one or implementation of the agile will
require some base to be created in the organization as the agile infrastructure.

II. METHODOLOGY

Agile software development is a group of software development methods in which requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development, early delivery, continuous improvement and encourages rapid and flexible response to change.

Agile methodology applied to the situation where accelerated development is required to meet the delivery schedule and to reduce significant risk and uncertainty that generated constant change during the project, in a collaborative environment.

Scrum is a management framework for incremental product development using one or more cross-functional, self-organizing teams of about seven people each. It provides a structure of roles, meetings, rules, and artifacts. Teams are responsible for creating and adapting their processes within this framework.

Scrum uses fixed-length iterations, called Sprints, which are typically two weeks or 30 days long. Scrum teams attempt to build a potentially shippable (properly tested) product increment in iteration.

In scrum, a product represents functionality that a product owner has identified as important to customers. A product might contain the themes, epics, and user stories that describe these enhancements from the user's perspective. A user story is a brief statement of a product requirement or a customer business case created by a product owner.

A release has a start and end date during which a number of development iterations are completed after that, the scrum master creates one or more sprints from within a release. All sprints within a release must fit within the release start and end dates.

Before a sprint starts, the team and scrum master decide on what stories they can commit to completing within a sprint. The scrum master must make sure that the effort (story points) required completing the stories matches the capacity of the team.

III. PRIOR APPROACH

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IV. OUR OBSERVATIONS

a. Important characteristics of environment needed for scrum implementation

1. Self-organized team
2. Cross functional team members
3. Clear communication between members and PO, Senior Management
4. Aiding tools (advantages and disadvantages of using tools in Agile software development)
5. Organizational procedure and structure
6. Organizational support
7. Dependency for development of product on other team (as a part of organization’s structure of teams)
8. Transition from old traditional development process to new dynamic development process
9. New product development or part of support activity
10. Commitment towards work
11. Motivation
12. Maturity of team members in terms of experience, knowledge, problem solving capability
13. Multitasking capability
14. Creative
15. Sporting spirit

We can divide above characteristics into four parts. For successful implementation of Agile scrum methodology it is necessary to consider following four factors of infrastructure and their attributes, which are need to be clear and calibrated for valuable output and easy execution of work.

<table>
<thead>
<tr>
<th>Infrastructure Factor</th>
<th>Attributes</th>
</tr>
</thead>
</table>
| Team                  | 1. Team member roles  
2. Self-Organized Team  
3. Cross Functional Team Member  
4. Balanced set of skill  
5. Clear communication between members and PO, SM  
6. Accountability |
| Tool                  | 1. Aiding tools (Advantages and disadvantages of using tools in Agile software Development)  
2. Dependency for development of product on other team (as a part of organization’s part)  
3. Transition from old traditional development process to new (dynamic) Agile development process  
4. New product development or part of support activity  
5. Organizational support  
6. Individual dependency - Less documentation |
| Organization          | 1. Commitment/Ownership  
2. Motivation/ Self-directed  
3. Maturity of team members in terms of experience, knowledge, problem solving capability  
4. Multitasking capability-soft skills  
5. Creativity and courage  
6. Sporting spirit |

Table1: Categorization of infrastructure factors for Agile Implementation-Scrum

i. Team [3]:

On a Scrum project, there are three roles: product owner, Scrum Master and team.

The product owner is responsible for the business aspects of the project, including ensuring the right product is being built, and in the right order. A good product owner can balance competing priorities, is available to the team, and is empowered to make decisions about the product.

The Scrum Master serves as the team's coach, helping team members work together in the most effective manner possible. A good Scrum Master views the role as one of providing a service to the team, removing impediments to progress, facilitating meetings and discussions, and performing typical project management duties such as tracking progress and issues.

The team itself assumes agile project management roles when determining how to best achieve the product goals (as established by the product owner). Team members will collaboratively decide which person should work on which tasks, which technical practices are necessary to achieve stated quality goals, and so on.


Scrum Teams always have the following characteristics:
- Team members share the same norms and rules
- The Scrum team as a whole is accountable for the delivery
- The Scrum Team is empowered
- It is working as autonomous as it is possible
- The Scrum Team is self-organizing
- The skills within the Scrum team are balanced
- A Scrum Team is small and has no sub-teams
- The people within the Scrum Team work full time in the team
- People are collocated

b. Self organization & Empowerment

The Scrum Team has to be empowered to define:
- what it will commit to deliver at the end of the sprint
- how the expected results have to be broken down into tasks who will perform the task and in which order they are performed

Only if the Scrum Team is empowered to decide these things it will work with the highest possible motivation and performance.

c. Accountability

The Scrum Team as a whole is responsible to deliver the committed delivery in time and with the defined quality. A good result or a failure is never attributed to a single team member but always the result of the Scrum Team.

d. Balanced set of skill

Individuals within the Scrum Team will most certainly have specialized skills and focus. However to achieve best possible performance it would be optimal to have a balanced set of skills. Only then the Scrum Team will be able to deal with the ever-changing challenges and can act as autonomous as it is possible.

On one hand this means that a Scrum Team should be multidisciplinary (developers, tester, architects, etc) right from the beginning. On the other hand this also means that each team member should learn a little bit of
each other’s specialization, e.g. a if required to finally reach the committed goal a developer should also perform or write tests.

As a consequence this also means that within the Scrum Framework it is not differentiated between e.g. "tester" and "architect", they all share the same title "Scrum Team Member" even if the primary skill is not to develop production code.

e. Size of the Scrum Team

Scrum Teams are small. The ideal size is 7 +/- 2 people. If there are more people the communication overhead gets too large and the team should be split into multiple Scrum Teams. These Scrum Teams should be coordinated and communicate with each other but otherwise work independently.

f. Collocation

To minimize unnecessary communication overhead each Scrum Team should be collocated. If work has to be spread over multiple locations, independent Scrum Teams should be created.

g. Responsibilities of the Scrum Team

The Scrum Team and each of the team members have certain responsibilities which have to be fulfilled:

- They have to breakdown the requirements, create tasks, estimate and distribute them. In other words this means that they have to create the Sprint Backlog.
- They have to perform the short Daily Sprint Meeting.
- They have to ensure that at the end of the Sprint potentially shippable functionality is delivered.
- They have to update the status and the remaining efforts for their tasks to allow creation of a Sprint Burndown Diagram.
- Scrum environment defines some of the norms the teams have to follow, but some rules and norms are developed, this set of common rules are quite important. Examples for such norms and rules are:
  - Time and location of the Daily Scrum Meeting
  - The Definition Of Done (DoD) used to decide if work is finished or not
  - Coding guidelines
  - Tools to use

ii. Tools

Agile methodology like Scrum can be implemented through a wide range of tools. Many companies use universal tools, such as spreadsheets to build and maintain artifacts such as the sprint backlog. There are also open-source and proprietary packages dedicated to management of products under the Scrum process. Other organizations implement Scrum without the use of any software tools, and maintain their artifacts in hard-copy forms such as paper, whiteboards, and sticky notes.

The need and reasons for using tools for SCRUM are:

- Reporting and support for management level
- Tracking work of distributed teams
- Organizational law for documentation
- Collaboration with other teams

Compare to the traditional project management tools agile project management tools requires following functionalities:

- Product/Release backlog
- Release/Iteration backlog
- Burn down charts
- Task Board
- Iteration Velocity Concept

The traditional project management tools are difficult to suite the dynamic environment of agility. Since the project domain for which they are built to support are completely different from agile development methodology. One can refer following criteria for the selection of the tool.

- Iterative and Feature-driven Development
- Integrated Life Cycle Management within One Agile Tool
- Cross-Functional Teams
- Flexible Configuration of Agile Tools
- Simplicity and easy to access
- Customized view for different roles
- Flexibility to adopt process change
- Simultaneous editing facility
- Extensibility
- Tracking and reporting facility for user stories

iii. Organization:

Transition from old traditional development process to new (dynamic) agile development process - difference and similarities

PMBOK defines the knowledge areas, phases and activities of a project that are conducted during the life of a project. The PMBOK does not explicitly prescribe a development methodology, however the Waterfall methodology is most commonly associated with it. An Agile and iterative methodology like Scrum can also be mapped to the PMBOK definition of a project.

The PMBOK defines 5 Process Groups (Initiating, Planning, Executing, Monitoring and Controlling, and Closing), and 9 knowledge areas (Integration, Scope, Time, Cost, Quality, Human Resource, Communication, Risk and Procurement Management).
Table 2: Scrum Process mapping with PMBOK process

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Process Group</th>
<th>Scrum PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initiation</td>
<td>Scrum has Initiation processes that are responsible for the definition of the project roadmap, releases and sprints, and project kick-off.</td>
</tr>
<tr>
<td>2</td>
<td>Planning</td>
<td>Scrum defines a Release Planning Meeting which establishes a plan and goal. Sprint Planning Meeting is used to define and plan the goals and tasks of a phase or sub-phase of the project. A Daily Scrum (meeting) is conducted to plan the day for individual team members.</td>
</tr>
<tr>
<td>3</td>
<td>Execution</td>
<td>Project execution is done throughout the Scrum project, with the intent of providing a piece of working software at the end of each sprint. The Scrum Master plays the role of a facilitator to ensure all the roadblocks are removed so that the team can “execute”.</td>
</tr>
<tr>
<td>4</td>
<td>Monitoring and Controlling</td>
<td>Regular reviews conducted by the team as part of sprint release retrospectives as well as the daily Scrum. Additionally, burn-down charts are used to monitor the progress of the team.</td>
</tr>
<tr>
<td>5</td>
<td>Closure</td>
<td>The final sprint (Sprint N+1) can be used to perform Administrative closure of the project.</td>
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</table>

a. Mapping PMBOK knowledge areas

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Knowledge Area</th>
<th>PMBOK</th>
<th>Scrum</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Integration management</td>
<td>TPM is never accepted in nature.</td>
<td>The Scrum approach is more like a controlled chaos.</td>
</tr>
<tr>
<td>2</td>
<td>Scope management</td>
<td>Scope is a part of the iron triangle of traditional project management</td>
<td>Integration of effort which is done on a high-level (release) and low-level (sprints).</td>
</tr>
<tr>
<td>3</td>
<td>Time management</td>
<td>PM is based on Activities - definition, estimation, and scheduling, conducted in a Project Plan (Schedule).</td>
<td>Costs are always estimated by the team with customer as an integral part of the team. In Scrum, estimation done at different points in the project, like the beginning, after two or three sprints, or at the end of a release.</td>
</tr>
<tr>
<td>4</td>
<td>Cost management</td>
<td>PM is based on Activities - definition, time and cost estimation, and scheduling.</td>
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</tr>
<tr>
<td>5</td>
<td>Quality management</td>
<td>Project Quality Management, describes the processes involved in planning for, monitoring, controlling, and ensuring the quality requirements of the project are achieved.</td>
<td>Cross-functional nature of the Scrum team makes Quality Assurance (QA) an integral part of Scrum.</td>
</tr>
<tr>
<td>6</td>
<td>Human management</td>
<td>Describes the processes involved in the planning, acquisition, development, and management of the project team.</td>
<td>The Agile framework establishes cross-functional teams with mutual accountability, that are self-directing and self-correcting using regular team retrospectives.</td>
</tr>
<tr>
<td>7</td>
<td>Communication management</td>
<td>Formally documenting Communications Management Plan</td>
<td>Early on the importance of Scrum teams that ensures and emphasizes direct and face to face communication.</td>
</tr>
<tr>
<td>8</td>
<td>Risk management</td>
<td>Describes the process involved with identifying, analyzing and prioritizing risks for the project.</td>
<td>Scrum is a Risk Reduction System that handles risk at both strategic and tactical level.</td>
</tr>
<tr>
<td>9</td>
<td>Procurement</td>
<td>Describes the process involved with purchasing or acquiring products, services or results for the projects.</td>
<td>Scrum teams play a more active role in evaluating and selecting suppliers.</td>
</tr>
</tbody>
</table>

Table 3: Mapping TPM and Scrum Master Role

The comparison can lead to conclusion that Scrum promotes the real time work which can be carry out with self-organized team rather than having a single person responsible for entire team work and planning.

This transition will also get affected by the organizations willingness and management support to carry out agile practice. The major factor in transition is initial resistance getting from the traditional software practitioners. Since the agile methods is quite is different from existing methods. Thus if the practice is happening for the first time and to minimize the initial transition resistance, it will require for team member to have knowledge about the same for that it is require to have agile sessions to be organized. It will also include the infrastructure (physical/ software) that need to be provided prior to the starting of the agile practice.

In order to have cross functional team of mature team members implies that organization will be following matrix structure. The structure will highly influence the agile environment since team need to work closely, everyone is known to their roles and responsibilities. Everyone is equally responsible for the failure or success of the project. This need free working environment, healthy competition with strong bonding and trust among the team members.

Agile team considers to be self-organized, since team is having high coupling among themselves.

The dependency of work would be also affecting the productivity of the team. The organization is having some kind of development strategy to follow, team structure and there arrangements, documentation requirements, templates and SOP to follow. For the traditional organization to adapt agile concept require to consider the above points. Since we cannot achieve agility in one go, using big bang approach. It needs strategy for easy implementation of agile concepts and making organization compatible for agile practice.

iv. Personal

Agile team is more coupled to work efficiently. Rather than having any leader for assignment of work and for monitoring it, scrum teams need to be self-directed. In this way they are working differently from normal teams. It requires lot of usage of soft skills specially communication for effectively and efficiently communication.

The team members need to have discipline, sense of responsibility and accountability for their work, with committed for and take ownership for their work. Some traits among the mention are taken for granted for normal team members too.

Along with the above mention (in table 1) behavioural traits, one has to be courageous to put forward any issue faced and taking aside “ego” should ask for any kind of help from colleagues. With that one needs to learn time management, leadership, and be creative in working intense environment of project in order to enjoy it.

The most important element compares to above all be the Knowledge. One has to have a good knowledge about their domain, so that one can work smoothly. It is also require if the person is new to the agile practice then
knowledge about agile method and working need to be understood before practicing it.
All are the essential traits for the scrum team members; still it need team members to groomed oneself to be part of successful agile team.

V. CONCLUSION

As to implement the agile methodology to earn over the risk in development; organizations are required to pay attention on the providing the basic infrastructure for the method implementation. They need not only groom the personal but need to calibrate the organization structure for the same. So that it will be easier for employee to start adoption of agile methodology.

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