Optimized Measures to Improve TAT in Product Maintenance

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***Abstract*— Success of a software product is highly dependent on customer orientation and on time delivery as per market demand. It is one of the critical factors especially in cases of legacy products where the domain knowledge, infrastructure and the knowhow of the resources is crucial. Software industry spends maximum cost into maintenance after a successful product delivery. The objective is then oriented towards solving the bugs and issues and moving towards a defect free product Sometimes bug fixing gets quite time consuming. To deliver quick solutions it is important to identify the causes responsible for longer Turnaround Time (TAT) for customer defects and finding measures to resolve them. Quick solutions can be delivered by efficiently implementing the agile and lean methodologies in addition with the virtualization techniques. This paper will present the best practices like defining priorities, reducing inter-dependencies, efficient utilization of resources, building expertise with knowledge sharing and creating generalized infrastructure templates in the work environments, all of these contribute towards optimizing the TAT. A team with strong domain expertise will boost the customer confidence and improve business prospective.**

Keywords— virtualization; agile; lean; turnaround time; software maintenance;

I. INTRODUCTION

Software product is an intangible product. Different quality processes are followed by teams in the entire life cycle of the product and even after that it is quite obvious to have bugs and issues in the product. After successful delivery of the product to customers, defects are found and reported to the concern team eventually coming down to development team. The challenge here lies in delivering a quick solution to the bugs in the maintenance phase. Developer fixes the issue in a timely manner. The total time taken by the development team to provide a fix is called "Turnaround Time (TAT)" for that particular issue.

To deliver fast and reduce TAT, effort estimation is crucial; it becomes a complex process for the giant legacy products which are difficult to maintain. Over the time these cash cow products gets handed over to new virgin teams. The reason for such transition to the new teams could be due to the attrition of existing employees or the project getting outsourced to third parties for cost cutting purposes. In any of the cases, the major challenge remains the same i.e. providing quality solutions within defined TAT. Recently few works are done in this area. How proper measuring and monitoring helps to generate good quality in industrial product is presented by Kurtel, K [1]. Planning and systematic process is very important for better time effect and same is mentioned by Junio, G.A et. al. [2]. To solve the problems, it is very important to understand the underlying the factors and addressing the root cause. The prime factors could be in two different areas – either people lack domain knowledge [4, 5] or the lack of hardware with improper infrastructure [3]. To address these issues a blend of lean and agile methodologies were implemented. Lean methodologies were utilized mostly in infrastructure areas where the time consuming processes were either restructured or eliminated. On the other hand agile principles were used basically to address the changing customer requirements and empowering the new team with the critically required resources like training, knowledge sharing and better collaboration. Further sections will present what strategies [8] were followed to manage parallel versions of the product with defined priorities, supporting multiple flavors of operating systems, etc. All of these matter in

order to improve the TAT and the solution for above mentioned problem by approaching systematic methodologies [6, 7] of lean and agile along with virtualization techniques.

II. IDENITIFYING THE CAUSES FOR LONGER TAT

By considering a case where a legacy project is being run by a novice team. The concerns would probably be infrastructure, hardware, people and management strategies. Mismanagement of resources in any of these segments would result in a delay to the project delivery as shown in Fig. 1.

A. Multiple Version Support

Old projects will have a long list of customers and most of them will be specially customized versions. Each customer would require a particular fix for his own version. Along with this there will several parallel release for different versions in quick successions. Apart from this there are untimely hot fixes and patches to be delivered. The team needs to address for all such requests with specified deadlines within the designated milestones and not allowing their inexperience hamper the production line. Prioritizing becomes a critical issue. Releases are not anymore time for celebration but become routine of life in such maintenance projects.

B. Bug Reproduction

Bug reproduction is one of first and the most important thing to be accomplished for each request. For products like industrial automation where the customers use highly complex projects, most of the times it is difficult to reproduce the exact scenario without which there cannot be any solution. A dedicated lab with a collaborative setup of all the hardware and software becomes must in such circumstances. The large systems should be able to communicate to reproduce the integrated business scenarios.

C. Infrastructure

Adding to the above list of challenges the greatest hurdle is to have systems with appropriate product related software and operating systems. For instance, if the product has four versions with at least three update lines then it is required to have twelve systems to have all the combination of setups. Now if each of these versions supports five different of operating system with two versions (32 and 64 bit) of each with three flavors making it a total of thirty different combination of Operating systems. To have one system of each type will need a huge infrastructure to support such a huge list of systems.

D. People and Domain knowledge

To solve all the above problems it is required to have people with either strong experience in the domain or the team needs to be trained to handle such a complicated product. It requires people who could understand complex customer business scenarios and be able to reproduce the same with the available resources. Also to be able to appreciate the business logic and provide solutions to the problems without adding any unwanted impact to the product.

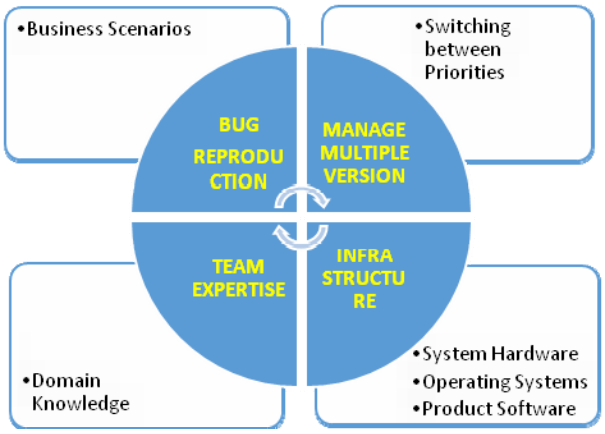

Figure 1 - Causes for Longer TAT

III. SOLUTION TO THE CHALLENGES

To solve the above mentioned problem areas and to improve the TAT, it is important to identify waste by implementing lean methodologies. Need to follow systematic agile practice to make strategic planning in an iterative and incremental

manner to remain focused and take corrective actions. A fish bone analysis style is presented in Fig. 2 to solve this problem, the text marked in yellow color are the prime challenges addressed.

A. Multiple Version Support

In a scenario, where the customer issues are obtained for at least four different versions of product, the priorities often change. Frequent task switching between issues of different versions is required to address the need. It is always difficulty to prioritize issues, like a defect can be of low severity but immediate release compared to a show stopper of the next release. Sometime no priorities are defined at team level and team members are left to decide. As a result lot of effort and time gets wasted in task switching resulting in high TAT for the task.

Waste Identification- Task switching should be avoided and strict priorities should be defined to improve focus and efficiency.

Solution- Ranking system was introduced based on a checklist of few critical factors to rank the issues like customer generated defects over system test raised defects, deferred defects of previous release over current defects, show stoppers or crash issues over functional defects, etc. Based on many such factors ranking system was defined which gives a very clear picture for the developer to take up the task. Regular sync meeting with customers helped to clarify the priorities and based on that priorities are defined at team level by using the rank field.

B. Bug Reproduction

Often issues are complex in nature and need dedicated attention for reproduction. Few issues need specific configuration and require time to reproduce. Developers end up spending their time in mere reproducing the issue rather fixing the defects. Once fixed, this needs to be pre-tested before merging, which consumes a good time of developers.

Impact-

1. TAT for reproducing the bugs was high i.e. 3.5 days / bug
2. Reduced number of closed issues due to time spent in reproduction
3. Delay in analyzing the backlog issues
4. Pre-testing consumed more time for developers ~ 1 day

Waste Identification- Once a system is prepared it should be made re-usable. Developers should focus more on fixing issues rather than bug reproduction. Testing team can be brought into picture to conduct pre- test rather than developers.

Solution Implemented- System Images were prepared for multiple use cases. System test was made responsible to reproduce complex issues or scenarios and also given the responsibility for pre-testing the bug before merging. A dedicated lab with 20 physical machines was setup in a special network.

C. Infrastructure

A Customer issue can occur on 5 different OS (XP, WIN7, WIN8.1, Server 2008, Server 2012; 2 versions (32 / 64 bit); 3 flavors of OS (Standard, Professional, Ultimate) resulting in 30 Combinations on OS itself. The customer issue could be raised on, 4 versions of SCADA software. Hence a bug could arrive in any of the 30 x 4 = 120 different combinations.

Microsoft releases Patches or updates very often, consuming 8 hrs every month.

Impact-

1. Physical machine were falling short due to several variations in environments.
2. Creating a required setup took 15 hrs, resulting in high TAT for reproducing Issues.
3. For X developers time consumed was = 15 x X = 15X hrs
4. High dependency on Infra structure support team, causing more waiting time.

Waste Identification - Preparing a known environment consumes 15 hrs on average. In this scenario physical machines are not needed. Software could be installed by support staffs and no need to wait for Infrastructure installation support. Microsoft update is not required for the project.

Solution Implemented- To solve the scenario physical machines are replaced by virtual machines for cost optimization. Virtual machine templates were created for all the combinations of setups. A virtual machine can be created with any required combination in 30 minutes.

D. Team Expertise

Deeper domain knowledge and technical know is an essential requirement for old project management. For example – for a particular SCADA application, developers need to know MFC, VC++, C++, C #, ATL COM/DCOM, VBS, VBA and C-Scripting etc.

Solution Implemented- Building knowledge and bringing expert advice from within the team – team collaboration is a way of solving this situation. People need to consulted and moved to the modules of their interest. Work stations were relocated to bring the related people closer for better coordination. Training and knowledge building is an important activity. For example – identifying the training needed for the people and arranging the training like crash dump analysis, COM/DCOM technical trainings play the vital role.

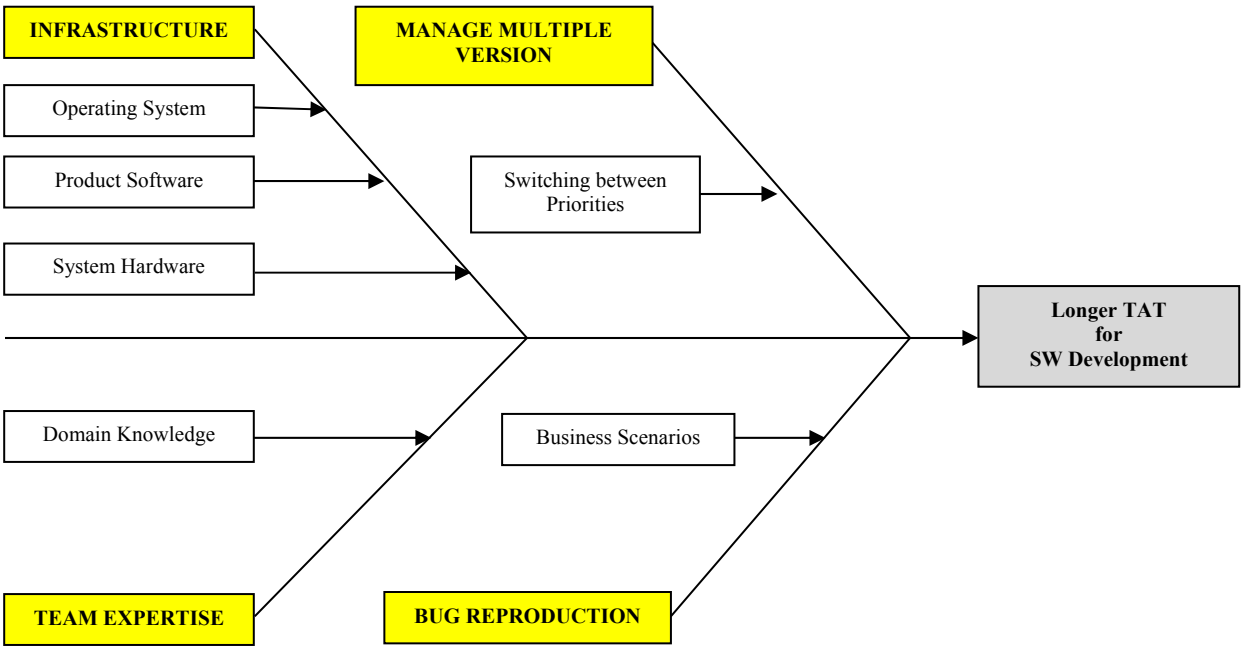

Figure 2 - Problem Analysis

IV. Experiment Results

Improvement in TAT is achieved by following the effective measure as mentioned in Fig.1 and outcome after following the optimizations can be seen in Fig 3.

Improvement achieved by using multiple version support –

- Team members were aware of the priority.
- Dependency on Project Management with respect to the priority related queries came down.
- Team member takes up only high rank tasks and solves.
- Reduced the frequency of task switching – Kanban principle.
- 83 out of 132 defects identified as non priority Issues i.e. 62 % Optimization for a major release

Improvement achieved using virtualization for bug reproduction –

- No time wasted in setting up of system due to reuse of images of all the combinations of setups.
- Reproduction of bugs was done in parallel by so that developers could focus more on fixing the issues rather than reproducing bugs.
- TAT of issues got reduced to 20 Hrs from 30 Hrs, Saved 10 Hrs per issue.
- Pre-test could be done more efficiently since a dedicated team was in place which improved the quality of the fix provided.

Improvement achieved using infrastructure support –

- Setup preparation time reduced from 15 hrs to 0.5 hrs

- Collective team time reduced from 375 hrs to 12.5 hrs, saving 362.5 hrs
- Entire project is being run on Virtual Machines with easy maintenance
- No more demand for physical machines
- Cost reduction for at least 25 systems achieved.
- Savings achieved by releasing 7 Physical Machine
- Avoided need for updating latest OS patches in test network workgroup, hence time saved for every test machine on monthly basis = 50 M/C x 8 Hrs = 200 hrs / month

Improvement achieved by increasing the team expertise area –

- Greater collaboration amongst team members
- 97% increase in bugs addressed in 2013 compared to 2014
- 50% of customer Issues which required domain knowledge was solved, indicating domain capability
- Improved the quality by developing domain & technical expertise within the team

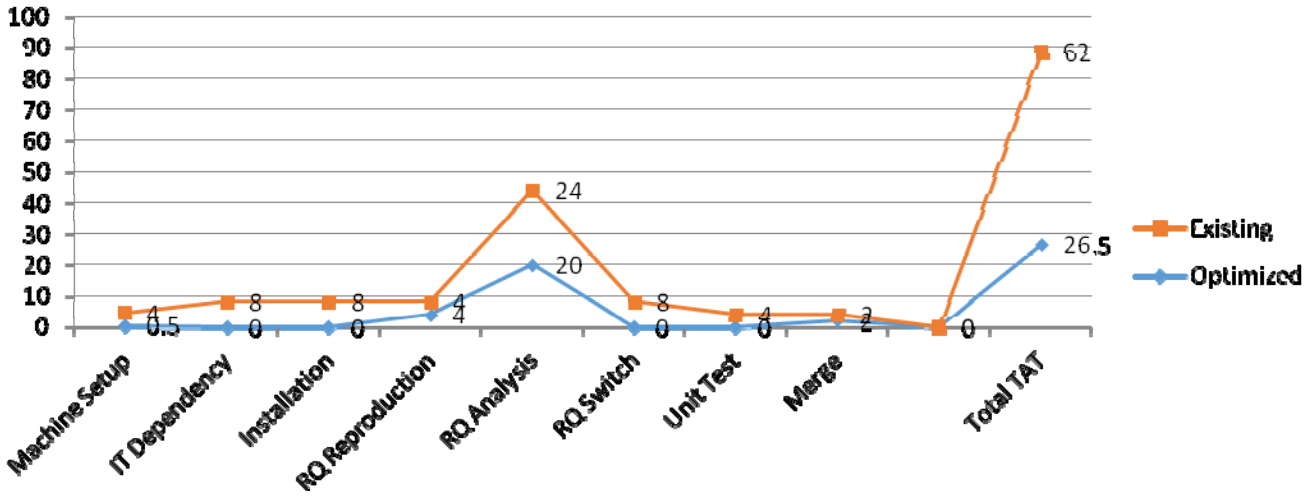

Figure. 3. Result graph

V. CONCLUSION

Root cause analysis in a systematic manner is always fruitful. Identifying the problem area in a step by step manner and taking the corrective action in a timely manner helped to reduce the turnaround time of customer issue solving and the project maintenance cost as well. By the use of virtualization and following the LEAN methodologies a huge maintenance effort was resolved. Setup preparation time reduced from 15 hrs to 0.5 hrs, collectively saved 362.5 hrs for a team of 25 employees. Cost reduction for 25 system achieved, savings by releasing 7 Physical Machine and licenses. Team saved 600 hrs by moving to isolated network. 50% improvement was observed by eliminating unimportant issues and a 97% increase in bug fix rate was achieved. 50% of customer issues which required domain knowledge were solved, which is an indication of the domain capability and also the technical skills. Easy maintenance of infrastructure using virtual machines helped to reduce cost. As a result a happy customer base was formed with trust which is the most important factor for sustained business.

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BIOGRAPHY

Vinay V Kabadi is currently a Sr. Software Engineer in Siemens Technology and Services Private Limited at Bangalore, India. He has over 8 Years of experience in Software Design and Development and has been actively involved in Lean methodologies and proposing innovative business solutions. He holds a Bachelor of Engineering degree in Electronics and Communications from Visvesvaraya Technological University, a Master of Technology degree in Embedded Systems From Jawaharlal Technology University and also holds a MBA Degree from ICFAI University.

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