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Title of the Paper:

Agile for Low cost country Aerospace Manufacturing Sector

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Abstract:

With rapid globalization in last 10 years, manufacturing organizations in low cost countries are attracting a lot of transition projects from various developed countries in the industry involving skilled resources and precision manufacturing – Example - Aerospace.

In such scenario, managing the project trouble free and yet delivering it on time within budget and as per the initial charted scope is a challenge to most of the organizations within India in such industry.

As per CEB report, tier II organizations are losing as much as 8 Million USD on average in managing the troubled projects across portfolio which in an aerospace tier II manufacturing organization can account up to the loss of 5% - 10% of revenue of the organization.

The major root cause of this loss is low agility in the management of projects.

The projects in tier II aerospace manufacturing companies in India run on the waterfall methodology of IT where individual teams / departments including vendors involved work in isolation through development phases without any strong interconnect with other teams / departments until milestone dates arrive, however it's too late by then to fix the problems and enable the project to get back on track to be delivered on schedule, as per the budget and scope.

This paper mainly focuses on developing an agile based methodology for low cost country aerospace manufacturing companies through case study of successfully executed project in Agile based process and the ways to extend agile methodology to PMO of the organization.

Intent: (Mandatory)

The intent of this paper is to discuss a Transition project success story achieved by using the agile methodology on one of the Aerospace project at Tier II organization in India for the development of the smaller level machined parts.

The key findings and observations from the project are a successful on schedule delivery of the project with robust quality of the hardware within prescribed budget.

Further the intent is to focus on developing an agile methodology which can be extended to the upcoming projects through PMO for similar development projects in Aerospace and other industrial manufacturing companies.

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Figures and Tables

1.0 Introduction

With rapid globalization, India is attracting a lot of transition projects from Aerospace manufacturing sector. The major reason for this is a rapid development in India in the manufacturing sectors and availability of Semi-Skilled and Skilled resources in these sectors. India has also picked up really fast in the technological advancements as far as the manufacturing facilities and technical know-how and experience is concerned.

However Indian Tier II organizations still need a lot of improvement from technical and managerial aspects. One of the major hurdle is the traditional project management approach followed in the Tier II organizations. In this approach, each of the functions within organizations are working in isolation and each of the task or function is waiting for the previous one to complete for majority of the parts in the development.

Because of this, a lot of issues, challenges and risks are discovered at the later stage of the project wherever the interdependencies within the departments or functions is realized. This creates a low agility in responding through the development cycles and phases.

These organizations need a very close coordination amongst different functions and with customer's different functions to rapidly resolve the technical issues and also to discover any risks upfront and avoid

issues by appropriately de-risking it with a mitigation plan. This paper is mainly focused on the use of the agile methodology and planning which has helped to complete a troubled project faster.

2.0 Project Details and Key Challenges Faced

This project was a hardware transition project to establish and develop two critical hardware's at our Indian Supplier. These hardware's were then to be assembled in our facility (in the US) followed by the final dispatch to the end customer.

The initial timeline planned by the supplier to complete the transition and fully develop the hardware was a time period of 5 months from establishing the design, development of the tooling, manufacturing, basic processing, secondary processing, and special processing on the hardware at third party source, followed by the final inspection and then the dispatch.

The project involved all the major supplier functions of design, engineering, production, supply chain and quality teams of the Supplier with majority of the schedule being vested at the design, engineering and production. The project saw a significant delay until May 2016. However, when delivered in June 2016 had following major points which were discovered in production lots.

- Lot of rejections. PPM more than 300,000.
- Slow delivery. OTD less than 50%.
- Flawed Design at the tooling.
- Too much of rework on the hardware because of the design flaws.
- More risks being identified because of the uncontrolled processes.
- Quality department realizing the higher internal rejections at the later stage.
- Inspection inaccuracies.

The end customer ramp up was approaching rapidly and it was required to fix all the design issues in a tight schedule of 2 months. With all the points observed above, it was realized that the project needs to start afresh with the earlier design and tooling to be scrapped entirely because of high rejections.

3.0 Methodology

The entire project methodology and approach was redesigned. A majority of changes were proposed to go about the planning of this development to meet the tight schedule deadline of 2 months.

The following Goals were to be achieved

- Successful Delivery of both the Hardware's in time frame of 2 months.

- Achieve Zero Quality issues. (Zero PPM)
- Achieve More than 90% on time Delivery result.
- Sustain the results as the end customer ramp up was approaching.

Following Approach was taken up at execution on the project

- Identify (What went wrong earlier)
- Analyze (What Needs to change)
- Plan in Agile (What Needs to be done)
- Implement (Put in Action)
- Control (Sustain)

4.0 Execution

4.1 Identify (What went wrong)

Initially team was setup comprising of all the resources who were already a part of the project from beginning from the supplier as well as our end. A comprehensive deep-dive was carried out at our end involving inputs from the supplier to systematically list down all possible things that went wrong and what should be done to avoid.

A few of the major items identified directed towards the Management and Method of execution of the project. The following were the most critical major causes identified out of the total exercise

- Escalations did not happen timely and effectively
- Backup plan execution was missed / not realized.
- Wrong process selections.
- No process / deliverable / documentation baselining done with the customer and supplier's concerned departments / functions.

The figure 1 depicts the out of the detailed Fish bone analysis done to arrive at the major causes.

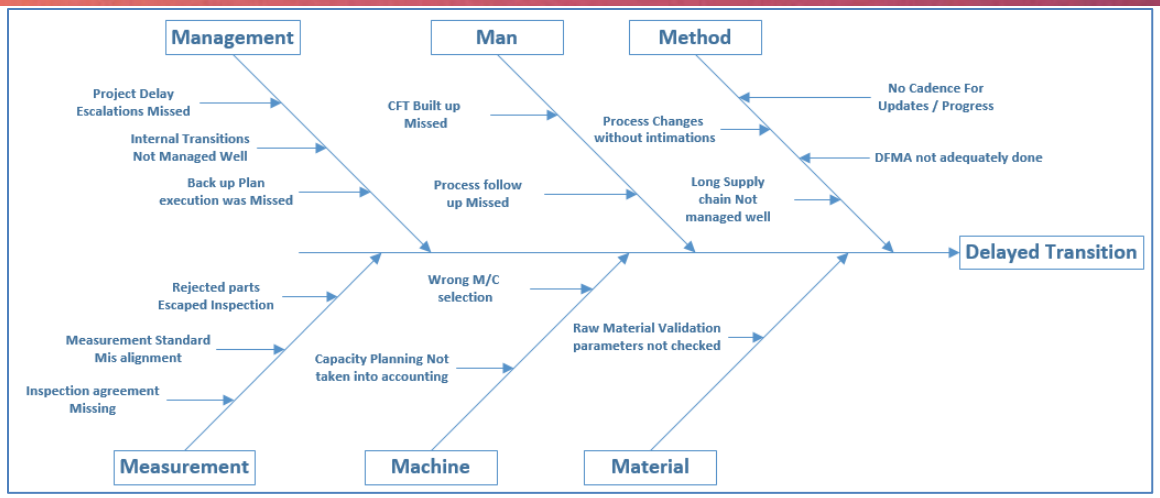

Figure 1 - Fishbone Analysis

4.2 Analyze (What needs to change)

Further, a 5 why analysis was carried out on the major causes identified to understand the exact reason and the steps to be taken moving forward. Each of the causes indicated the project management flaw as far as the adherence to schedule was concerned. A majority of the outcome pointed towards

- Improper Planning.
- No Review, Authorization and feedback mechanism setup.
- No clear picture on the project updates.
- Functions working in Isolation where a close coordination and inputs from other functions were expected.

The major root cause identified for all the above pointers was Suppliers inflexibility to respond quickly to the failed design and flawed manufacturing processes. This was majorly because of the isolated work environment between the engineering and quality departments.

As a result, the escalations / risks and challenges, which would have been observed efficiently by the quality teams at the right time, were not observed and thereby were not raised appropriately.

Post completion of the development phase, when the hardware was handed over to the quality team, the rejections were identified but a lot of time was elapsed and wasted which otherwise would have been avoided by flexible approach within departments.

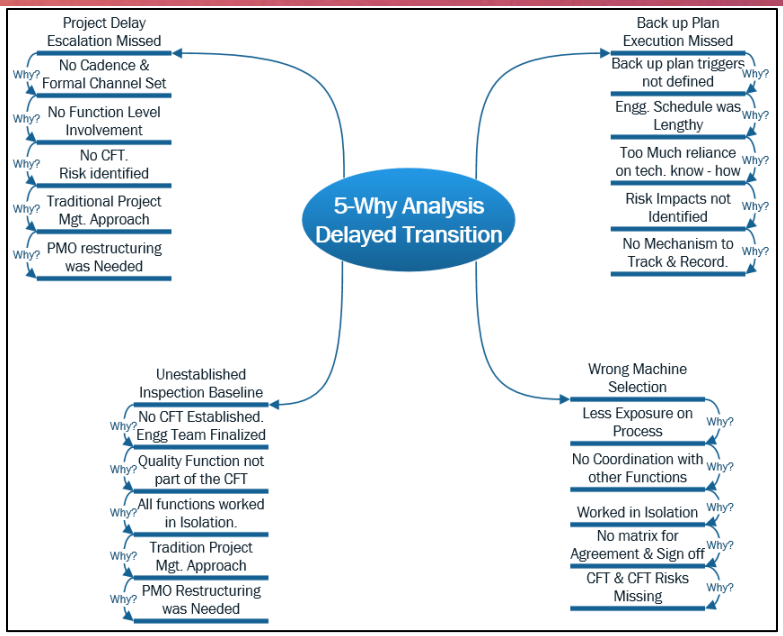

Figure 2 - 5-Why Analysis

4.3 Plan in Agile (What Needs to be done)

Based on the overall analysis, the following important points were considered for planning the project.

- Majority of the risks were not identified at the right stage.
- The risks that were identified, were not appropriately highlighted or worked upon

Many risks are identified at the early stages of the project and the cost of fixing them is less. It was imperative that the risks are to be identified at as early stage as possible so that the impact on the project is less and also the alternatives to mitigate the risks are more and rework is possible. Figure 3 depicts the traditional approach that was followed by the supplier before implementation of the agile methodology.

The Development phase initially had all the tasks and deliverables from development phase completed one after the other. The supplier did employ on the line inspection after each of the defined phase. However, the major risks identified at each of the stages were neither appropriately highlighted nor

escalated to the customer team or the quality teams.

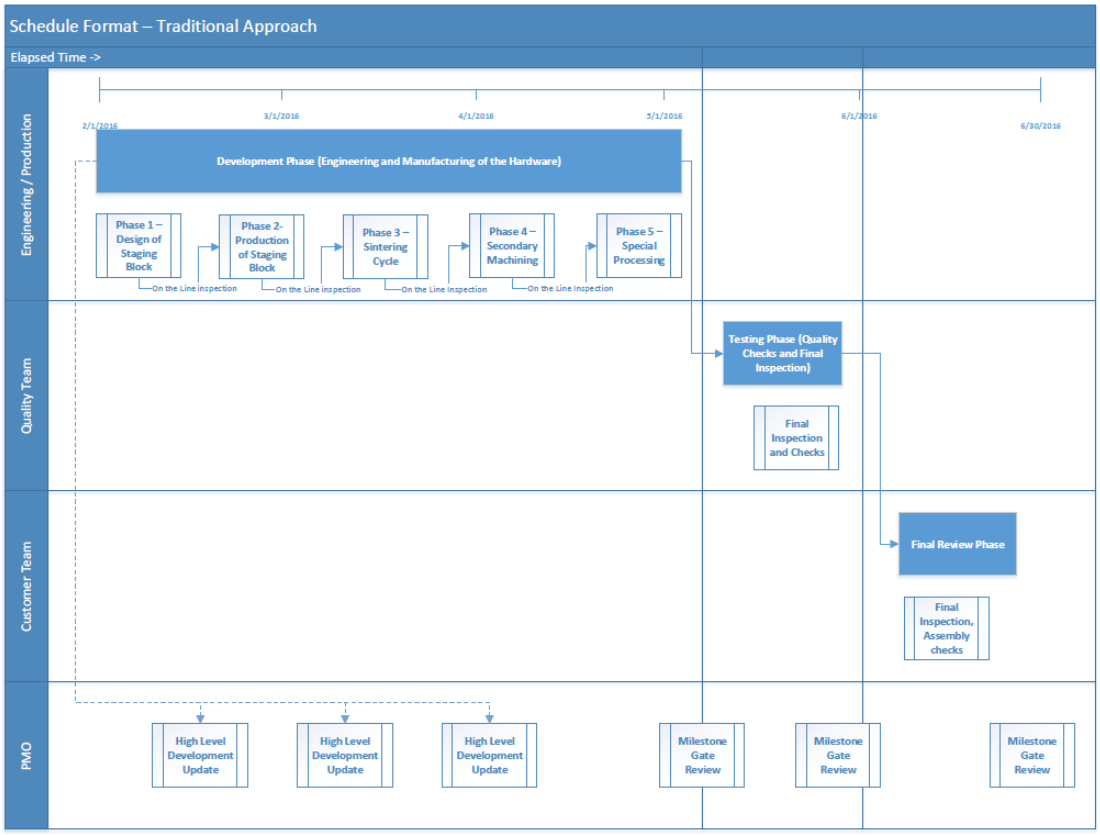

Figure 3 - Schedule Format (Traditional Approach)

For Example, if the Sintering lot showed a higher stock available on the hardware, the team made a decision to clean it off in the final machining to compensate without consulting the customer team or the quality team. As a result some risks were never highlighted. In the example mentioned above, there was a risk of the material losing some of its electromagnetic properties due to excess machining.

The new schedule was developed to introduce a close coordination within the cross functional teams. The figure 4 details out the process flow and schedule in accordance. The basic idea for re-scheduling was

- To ensure the risks are identified early
- To have an increased flexibility between the functions by enabling the supplier to respond to those effectively and efficiently.
- To have the customer review updates, PMO control and schedule checks at appropriate stages.

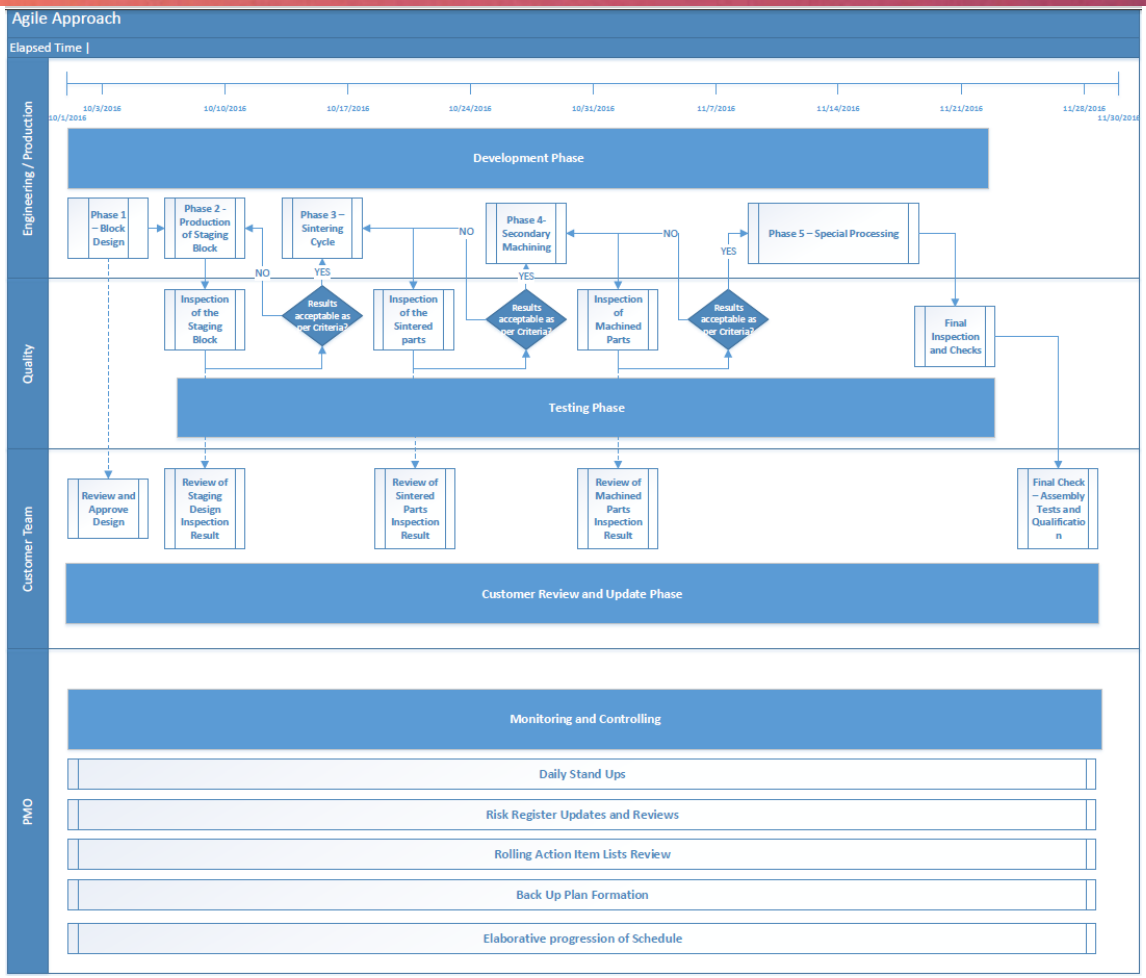

Figure 4 - Schedule Format (Agile Approach)

Further, each of the Development phase was to be checked by the quality team and the results review by the customer team to check and see all the parameters are in place before the development team can proceed with the next phase. If major risk is identified at this stage, it allowed an appropriate time for taking up the risk mitigation path or it also enabled PMO team to make a decision on activation of the Backup plan for hardware support.

4.4 Implement (Put in Action)

Implementation was divided into the following major steps.

4.4.1 Step 1 – Restructuring the Supplier PMO team

The design or planning of the activities started with restructuring the Supplier PMO team by appointing a full time central Program manager from Supplier who would be working irrespective of any department or function. The major responsibility will be to ensure that the schedule is followed and highlight risks if the schedule adherence is deviated for any reasons at a daily cadence set. The restructuring ensured that

the risks are highlighted effectively at each stage or phase without departmental influence or overshadowing.

4.4.2 Step 2 – Setup Cross Functional Team (Supplier & Customer)

It was required to assemble a cross functional team which would consist of the representation from all the concerned departments.

Furthermore, the representation in the team was formed such that each of the representative should have an input baselining and a review sign off authority. The team representation was required to be involved in the daily cadence as that would ensure a close coordination with different teams where required.
This was already done as a part of planning however this was not recognized or appreciated formally as a true cross functional project team as each of the function worked in isolation for long development phases and cycles.

Each of the team representatives schedule commitments also became the part of the formation

4.4.3 Step 3 – Build up the Baseline Schedule

The next step was creation of the baseline schedule based on the schedule format of Figure 4 (On the previous page). The following activities were carried out.

- Splitting the project into Phase/Gate structure (Creating Sprints) under each of the major milestones. (As shown in Figure 4)
- Minute planning for each sprints. Breaking up the tasks into Daily activities (hourly activities in some cases).
- Defining of the back-up plan option and the trigger pointers for the backup plan activation.
- Defining responsibilities for each of the tasks identified.
- Review and Feedback mechanism for each of the sprints and each of the daily activity.
- Progressive Elaboration on the plan
- Review of the schedule and update daily to track the completion.

Backup Plan was a major outcome of the entire exercise as this was to ensure that there is a fall back option even if the close coordination and the entire methodology failed.

For Example, The fall back option defined was migrating to the old design for the upcoming release. The lead time for getting the hardware from the old design was 4 weeks. As per the Figure 4 (On Previous Page), the backup plan activation was to be done at the latest by the week of 29/08. The daily stand up and cadence enabled the PMO team to take more informed decisions.

5.0 Sustain

The entire effort was to be sustained over a period of 2 months until the final hardware was accepted by the quality team. There were two daily 15 mins stand up meetings set up to help keep the team on track with the schedule. One meeting was at the beginning of the day and the one towards the end of the day. The participants in the meeting was the entire cross functional team and PMO team.
The following format was set for the morning / evening meeting.

- Are we on track with the schedule
- What are the risks identified from the results / reviews?
- Are we equipped with all that is required to accomplish today's tasks?
- Open items from previous meetings.
- Review of the risk registers.
- Review of the Open Items.

The intent of the meeting was to ensure that the project is not getting off track. The detailed technical discussion were kept separate and were not involved in this meeting.

Geographically, the development team and quality team (Supplier team) was located in India and the customer review team (Our team) was based in US.

The time difference was effectively utilized by feeding the Customer review team by India end of the day with the inspection results / risks / questions / challenges. The customer review team then used to work on these requests in their day time and had their feedback, review comments fed back to India team before India start of the next day.

6.0 Results

The hardware was successfully delivered at the end of the two months' time frame without any quality defect identified.

The PPM (Parts per Million) score improved from 500,000 in June 2016 to 0 in December 2016 and onwards. Refer Figure 5 and Table 1 for the trend

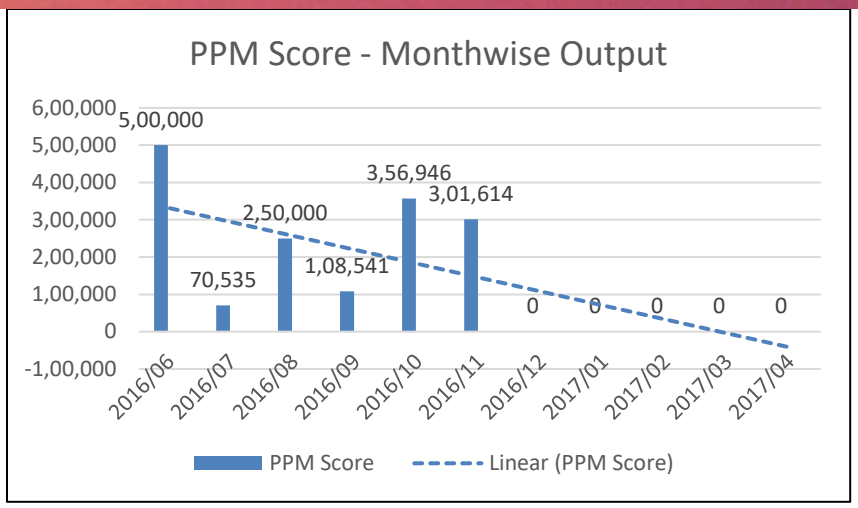

Figure 5 - Monthwise PPM Trend on both the hardware

TREND	2016/06	2016/07	2016/08	2016/09	2016/10	2016/11	2016/12	2017/01	2017/02	2017/03
Receiver Qty	60	879	828	3,934	2,174	4,834	2,692	1,747	4,061	1,845
Rejected Qty	30	62	207	427	776	1,458	0	0	0	0
PPM	500,000	70,535	250,000	108,541	356,946	301,614	0	0	0	0
PPM Goal for Project	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Table 1- PPM Trend on Hardware

The overall PPM started improving and the unstable trend was gone. Post implementation of the project, the PPM score was 0 and continued to be 0 showing the sustainable results.

The OTD on the project started improving from 43.8 % in June 2016 to 100% in January 2017 and consistently at 100% since then.

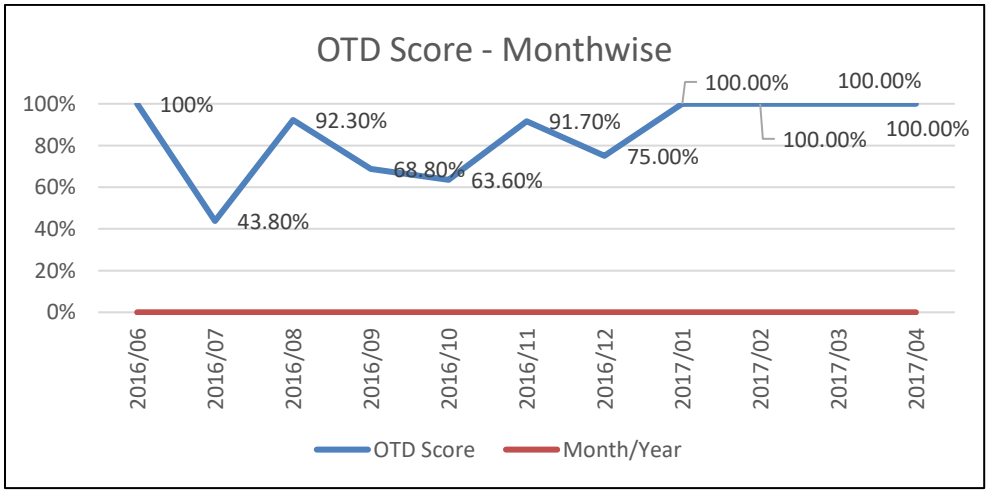

Figure 6- Monthwise OTD Trend

TREND	2016/06	2016/07	2016/08	2016/09	2016/10	2016/11	2016/12	2017/01	2017/02	2017/03	2017/04
Total Receivers	2	16	13	16	11	12	8	3	7	2	1
On Time Receivers	2	7	12	11	7	11	6	3	7	2	1
Actual	100%	43.80%	92.31%	68.75%	63.64%	91.67%	75.00%	100.00%	100.00%	100.00%	100.00%
Goal	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%

Table 2 - OTD trend on Hardware

7.0 Critical Success Factors

The critical success factors were successfully driving the project through the regular cadence with all the team members. This was a change of approach for the supplier and was being implemented the first time in agile methodology. The following were the critical parameters for the success

- Robust and detailed level of planning.
- Building of the strong Cross functional teams which had the review and sign off authorization.
- Daily stand up reviews on the progress and cadence.
- Enabling the identification of risks and challenges
- Empowering the PMO to take informed decisions on Risk mitigations.
- Empowering the PMO to take informed decision on Back up plan activation.
- Excellent coordination within teams through the medium of daily stand up meetings

8.0 Conclusion

The successful execution of this project developed an agile mind set with the supplier for execution of such transition project. Furthermore, it also lead to the successful execution of similar project which followed. With the increasing transition projects to India, Agile methodology will definitely help Tier II manufacturers to identify risks on time, mitigate those, quickly respond to the changing scenarios and ultimately help them to deliver faster and better avoiding an unnecessary wastage of money and resources.

9.0 Acronyms

PPM	Parts Per Million
OTD	On Time Delivery
PMO	Project Management Office
CFT	Cross Functional Team

10.0 References

[1] Project Artifact. – RCA tool repository

[2] Project Artifact. – Lesson Learnt sharepoint.

[3] My Organizations business object report for PPM and OTD records