Implementation of Project Management Practices in Aerospace Manufacturing Industry

Parul Sharma[*]

Abstract

Boeing has been in collaboration with various suppliers all over the world who manufacture the parts and components for the aircrafts. But now the company is planning to implement vertical integration i.e., bringing the manufacturing activities in-house for some parts and cut on excess cost that their suppliers charge. Establishing a centre in India is a part of their cost cutting plan since the labour here is skilled and cheap. Not only this, it will help in losing some burden from other Boeing facilities in US by creating a similar facility in India that can run at a much lower cost. So the India centre is getting projects from the parent company but is still in the development phase.

The major project objectives are:

- *To develop a Project Management Tool capable of planning, execution, tracking and overall management of their Insourcing project.*

- *To work with the team of Project managers who were responsible for planning, execution and tracking of the entire project.*

Key words: Vertical integration, Project Management Tool, Execution

Introduction

Boeing is the world's largest aerospace company and leading manufacturer of commercial jetliners, defence, space and security systems, and service provider of aftermarket support. As America's biggest manufacturing exporter, the company supports airlines and U.S. and allied government customers in more than 150 countries. Boeing products and tailored services include commercial and military aircraft, satellites, weapons, electronic and defence systems, launch systems, advanced information and communication systems, and performance-based logistics and training.

Boeing has been in collaboration with various suppliers all over the world who manufacture the parts and components for the aircrafts. But now the

---

* Associate Consultant, Infosys Limited, Hyderabad. Email: lmparul09@gmail.com

company is planning to implement vertical integration i.e., bringing the manufacturing activities in-house for some parts and cut on excess cost that their suppliers charge. Establishing a centre in India is a part of their cost cutting plan since the labour here is skilled and cheap. Not only this, it will help in losing some burden from other Boeing facilities in US by creating a similar facility in India that can run at a much lower cost. So the India centre is getting projects from the parent company but is still in the development phase.

Methodology and Study Design

Introduction:

With Boeing India, the main role was to be a part of the strategic planning of multiple design and manufacturing departments and make the existing project management practices robust to enhance the team and overall organization productivity. Below are few of the projects.

a. Insourcing Project

Insourcing is a team committed to increasing Boeing's presence in the airplane parts aftermarket. Insourcing works across the enterprise, with Program Engineering, Supplier Management, Category Management, Regulatory Administration, and many others to bring alternative solutions to Boeing's Customers.

Insourcing increases Boeing's competitive edge by creating alternative, value added, spare parts options for airline customers. This is accomplished by increasing Boeing's Intellectual Property and growing sales of new Boeing Proprietary Parts.

This project is running in 5 different locations all over the world and India is one of them. The process flow of the project is as follows:

Department 1:

The parts are shipped from US to India port and then sent to the Department 1 in MS Ramaiah College, Bangalore for the reverse engineering process. The Team there conducts the Metrology and Material analysis and sends the report to Design team at Boeing India centre.

Department 2:

The Department 2 includes the Design Team who does the 3D modelling, Stress analysis, 2D printing and sends the design to the Department 3 in South California team for Qualification.

Department 3:

The Department 3 reviews the design sent by the Department 2 and then either qualifies, holds or rejects the design.

Department 4:

When the drawing is qualified by the department 3, it is released by the company to the suppliers for the manufacturing of the part.

b. The New Facility Project

For the first time, Boeing is investing in setting up an assembling facility of its own outside US. This facility is being planned to be located near the Bangalore International Airport in Devanhalli. This facility is going to be an assembly unit for some parts of an aircraft and is planned to be fully functional by the end of 2 years.

This facility is a replica of a facility in Smithfield, PA, USA. The Smithfield facility is responsible for assembling Avionic parts for the plane. These are the main parts that are used in the central flight management and Smithfield is the only facility in the world assembling them.

The main objective of setting up a facility in India is to mitigate the risk that is associated with the Smithfield PA facility. The risks can be a machine breakdown, facility shutdown, weather calamity etc. If the Smithfield facility is unable to produce avionics parts for some reason, then there should be some other facility that must produce and provide the parts to the aircraft.

Advantages of setting up a facility in India are:

- The labour is cheap and skilled
- Cost for constructing the unit is also less
- The land is big and easily available
- Setting up a facility in India is beneficial to the Boeing US because of the Make In India initiative as they have many potential orders for aircrafts in both defence and commercial segment in future.

The facility is in a very nascent stage. It has planned to have an assembly unit in the ground floor and then office and administrative floor above it.

The parent company and India centre have decided to release their first product by January of 2020. So the Project manager who has been assigned on this project has the main task of first creating a project plan that will

give a clear picture of all the activities that are required to release the first product. The Parent company is very invested in getting the facility functional as soon as possible.

As the idea of setting up an entirely new facility for an electronic product is very new for the India centre. So the project started with

- Weekly meetings with the Program Managers of Smithfield facility
- Understanding the product and its specifications
- Understanding the project plan sent by the Smithfield Program Manager
- Understanding the cost estimation
- Understanding the types of machines that will be required for the unit
- Understanding different types of qualifications and certifications required in order to produce the product
- The type of labour that will be required and what kind of training should be given
- Understanding the different types of licenses required at different points of time
- Creating our own project plan and getting an approval from the managers in US
- Developing a Business case after understanding the business case sent by Smithfield
- Creating our own cost estimation sheet and presenting the same to US
- Creating our own Risk Register
- Setting up meetings in India centre with different stakeholders like Architects, System Engineers, Manufacturing Engineers etc. on a regular basis.

Source of data:

- Primary Data source
  - ➢ Internal Project Plans
  - ➢ Presentations

➢ Cost estimation sheet

➢ Business case

➢ Boeing templates

➢ Internal Templates

• Secondary Data Source

➢ Weekly meetings with the Program managers

➢ Internal meetings with different stakeholders

➢ One-on-one meetings with the functional managers and Project managers

➢ Reading many different articles on the internet about the cost estimation sheet and its components.

Tools for analysis:

Excel was used as an analytical tool for analyzing, displaying and generating final inferences. Below are the various formulas and tools used within excel for interpretation of the data

• **Macro**

A macro is an action or a set of actions that you can run as many times as you want. When you create a macro, you are recording your mouse clicks and keystrokes.

Various Formulae

Offset, Indirect, Countifs, Averageifs, Index, Mod, Sum, If, Match, If error, Count

Statement of the Problem:

The organization is newly established in India and intends to bid more projects from the Parent organization. However, they didn't have an infrastructure in place to start with design and manufacturing.

For the existing business in India, the company was struggling to measure the productivity and efficiency of the employees, team and organization as a whole. The existing project management was extremely weak and incapable to handle large upcoming projects.

Scope of the Study:

This project aims to improve and standardize the project management practices and perform the planning for the installation of the new facility.

Objectives of the Project:

Primary Objective:

- To develop a robust excel based Project Management Tool capable of planning, execution, tracking and overall management of the project.

- To develop an excel based tool that will calculate the depreciated value of the plant and machinery.

Secondary Objective:

- Understand the project requirement documents like Cost Estimation sheet, Project Plans, Presentations about the device to be produced, Business Case etc

- Rigorous brain storming sessions with my manager

- Create a Risk Register for the project

- Create a project plan that will contribute in giving an idea to create the major plan

- Attend various meetings with different stakeholders and create minutes of the meetings

Methodology

a. Insourcing Project:

As the project in India was in fairly nascent stage, there was no proper project management in place to track the performance. Main task here was to work with the Project manager and assist him in the planning, tracking and execution of the project. This included creating a robust Project Management Tool that will be capable of monitoring the overall project status and the also the statuses of departments and different parts individually.

Following is the list of Project Management tools that were created.

- MSRT (Monthly Status Reporting Tool)
- EVM(Earned Value Management)

- Ageing Tool

- Average Planned Hours VS Average Actual Hours

b. The New Facility Project:

For the New Facility Setup project and a robust excel based tool was developed that will generate the depreciated value for the machines to be installed in the facility and then this cost will be incorporated in the regular Business functions. This process involved understanding of the depreciation concept and the straight line depreciation.

Straight Line Depreciation

Straight line depreciation method charges cost evenly throughout the useful life of a fixed asset. This depreciation method is appropriate where economic benefits from an asset are expected to be realized evenly over its useful life. Straight line method is also convenient to use where no reliable estimate can be made regarding the pattern of economic benefits expected to be derived over an asset's useful life.

- Depreciation per annum = (Cost − Residual Value)/Useful Life

- Depreciation per annum = (Cost −Residual Value) x Rate of depreciation

Results, Analysis and Discussions

Insourcing Project

1. MSRT (Monthly Status Reporting Tool)

Introduction:

This Tool produces the monthly report of all the departments and their statuses (Completed, Not started, Hold, and WIP). This tool will take the data from a different sheet that the team uses to put the weekly hours and update the status of the parts in each department. This sheet is known as "Work Allocation to Design Team". The Team updates this sheet on a weekly basis and through this sheet the Monthly Progress Report is generated.

Description of the "Work Allocation to Design Team" Sheet:

This sheet consist includes the following entities:

- **Part Names** of the parts on which the teams are working on.

- **Department Names** through which the parts move.

- **Parts complexity** ranging from Simple, Medium and Complex.

- **Responsible Owner** which includes the names of the engineers working on the designing of a part.

- **Status** includes the current status of that part in a particular department. They are Completed (CO), Not Started (NS), Hold, Work in Progress (WIP).

- **Status Hours** includes the planned hours allocated to each department and Actual hours completed by the team in each department.

- **Month of status update** includes the month in which the status of a particular part in a particular department is updated. For example, for Part 1 in Department 4, the status is CO (completed) in the month of February.

- **Start dates of the weeks** helps the engineers to put their planned hours and actual hours under the respective week against the part on which they are working on in a particular department.

The team does the activity of updating the sheet on a weekly basis either themselves or with the help of their manager or Project manager. Once they update it, the Monthly Report is generated on a different sheet.

Working of the Tool:

Inputs required for the tool:

- Working status of each department(CO, WIP, Hold, NS)
- Month of the status update

Formula used to extract the data from the "Work Allocation to Design Team" Sheet:

= COUNTIFS(Range 1, Criteria 1, Range 2, Criteria 2, Range 3, Criteria 3)

- **Range 1:** The name of the range that includes the department names in the "Work Allocation to Design Team" tab.

- **Criteria 1:** Reference to a cell named 'Department 1'

- **Range 2:** Name of the range that includes the statuses of each part in a particular department.

- **Criteria 2:** The completed status of a part in a particular department

- **Range 3:** Name of the range that includes the Months of the status updates.

- **Criteria 3:** Name of a particular month

The **COUNTIFS** function applies criteria to cells across multiple ranges and counts the number of times all criteria are met. The main objective was to count the total number of Completed (CO) status, Not started (NS), Hold and Work in Progress (WIP) status for each department and in a particular month.
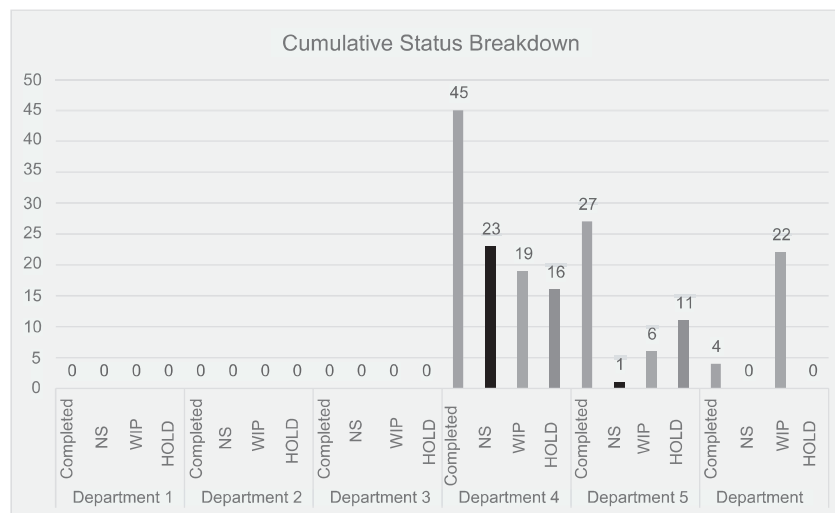
For the MSRT report, there were 3 criteria i.e., the Department name, the statuses, the months.

This Tool helps in giving a clear picture of the current status of all the departments in every month in both numerical and graphical form.

Results:

The MSRT tool gives us the following reports:

1. Cumulative Performance

Graph 1: Cumulative Status Breakdown graph using MSRT

The Cumulative performance graph shows the overall status of all the departments till date. This helps to understand which department is acting as a bottleneck and where is the need for improvement.

2. Planned Performance VS Actual Performance

Each department has a planned target for them for each month which is given by either the Program Managers sitting in US or by the Manager in India.

The MSRT Report helps in comparing the planned performance of the team with their actual performance as it provides the monthly data for each department.

Planned Performance VS Actual Performance is given below in Tabular form for 2 departments as an example
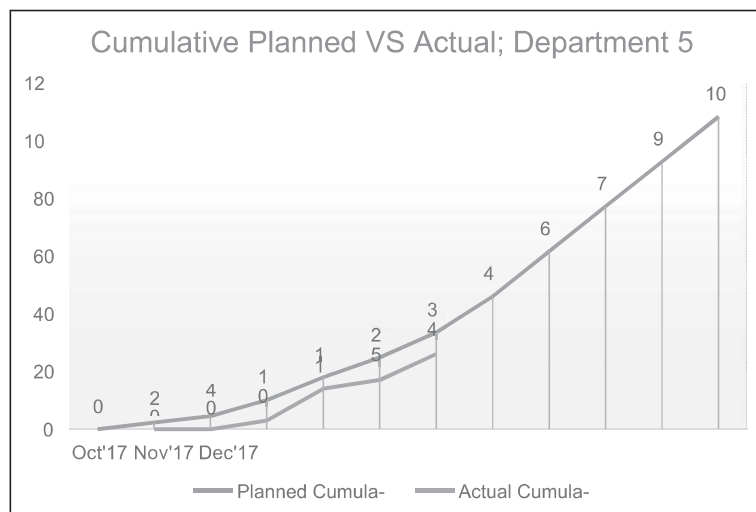
Department 5:

Department 5				
Months	Planned Monthly	Actual Monthly	Planned Cumulative	Actual Cumulative
Dec'17	0	0	0	0
Jan	2	0	2	0
Feb	2	0	4	0
Mar	6	3	10	3
Apr	8	11	18	14
May	7	3	25	17
Jun	9	9	34	26
July	12	1	46	0
Aug	16	0	62	0
Sep	16	0	77	0
Oct	16	0	93	0
Nov	16	0	108	0
Dec	0	0	108	0

Table 1: Comparison of Actual and Planned Performance for Department 5

Department 6:

Department 6				
Months	Planned monthly	Actual Monthly	Planned Cumulative	Actual Cumulative
Jan	0	0	0	0
Feb	2	0	2	0
Mar	2	0	4	0
Apr	6	2	10	2
May	8	1	18	3
Jun	7	1	25	4
July	9	0	34	0
Aug	12	0	46	0
Sep	16	0	62	0
Oct	16	0	77	0
Nov	16	0	93	0
Dec	16	0	108	0

Table 2: Comparison of Actual and Planned Performance for Department 6

Planned VS Actual Performance in Graphical Form:

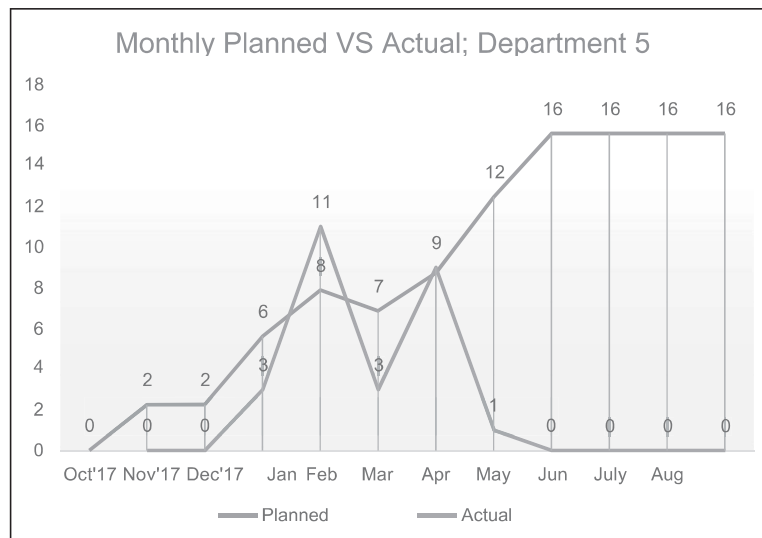1. Cumulative Planned VS Actual Performance of Department 5

Graph 2: Cumulative Planned VS Actual Performance of Department 6

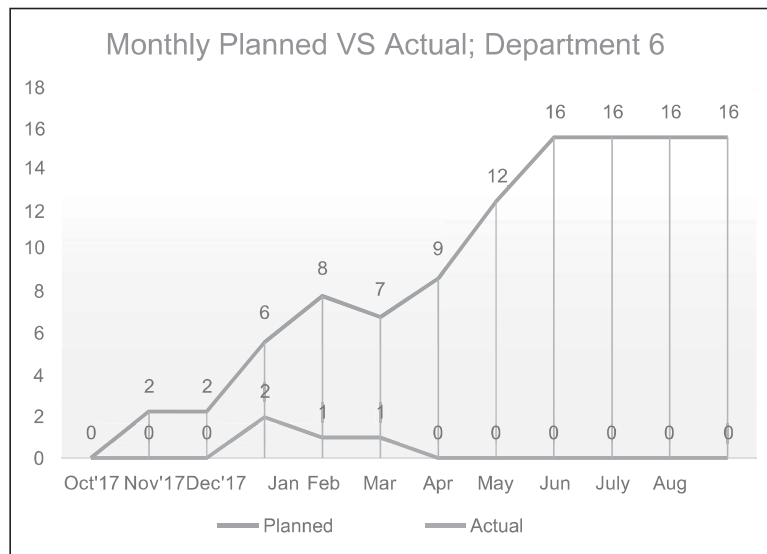## 2. Cumulative Planned VS Actual Performance of Department 6
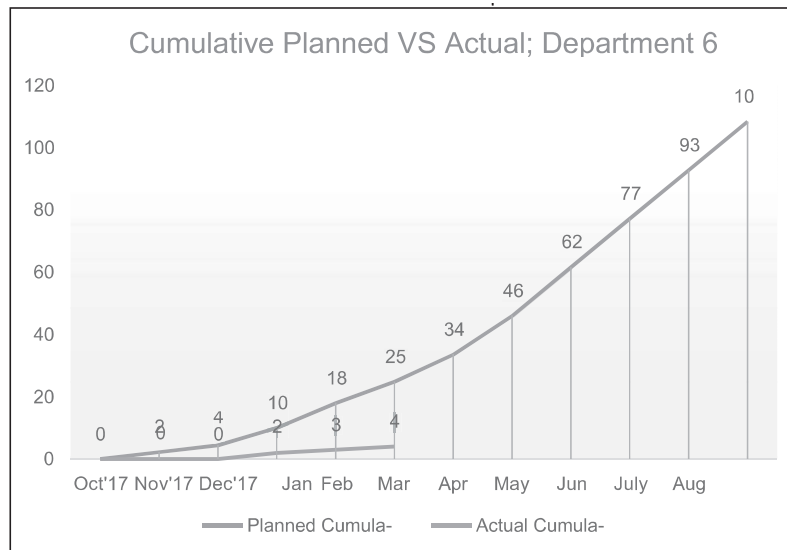
Graph 3: Cumulative Planned VS Actual Performance of Department 6

3. Monthly Planned VS Actual Performance of Department 5

Graph 4: Monthly Planned VS Actual Performance of Department 5

4. Monthly Planned VS Actual Performance of Department 6

Graph 5: Monthly Planned VS Actual Performance of Department 6
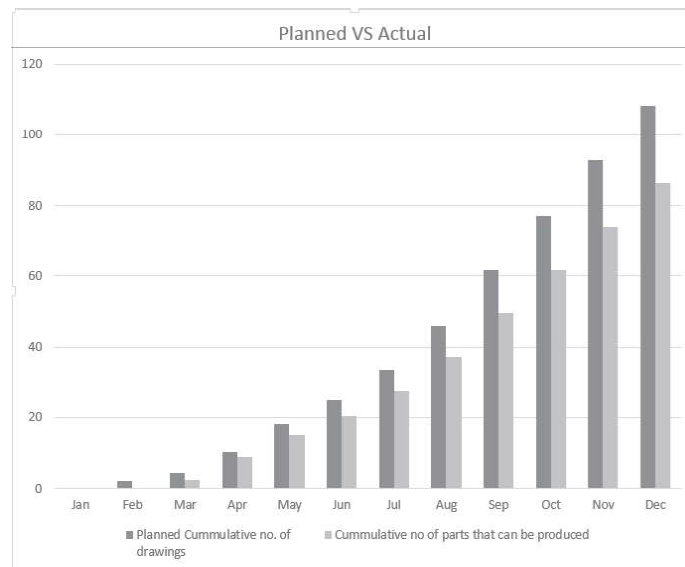
3. Design efficiency calculations

The data gathered from the MSRT is further used in another template that calculates the efficiency of the team of Department 5 according to the parts completed.

This template consists of all the data regarding:

- The number of resources currently in the team and will join the team in future.

- Number of productive hours of all the resources in a week

- Number of hours taken by each drawing on an average (considering 60% simple parts, 30% medium parts and 10% complex parts).

- This will give the planned productive hours which in turn will give the planned number of drawings completed each month

- The actual data is being taken from the MSRT report.

- Through the actual and planned completion status, current efficiency with which the team is performing and if the team continues to work

at the same efficiency then how many parts will be completed by the end of the year.

Graphical report generated by this template:

Graph 6: Graphical representation of the Design Efficiency template

Inference:

From the report generated using MSRT, following were the observations

- The graphs give us the comparison between the actual performances of the departments against the planned target on a monthly and cumulative basis.

- Through the graphs we understood that Department 6 was acting as the bottleneck as the team's actual performance was way behind the planned target.

- Main reason behind the delay in the performance was that the parts were sent to the South California team and they were taking months to approve a design and send it to India.

4. EVM (Earned Value Management)

Introduction

This is a performance measurement tool which would equip the user to monitor the project progress based on variances in the planned work hours

with the actual work hours of the work completed. The tracker can be used for Cost and Schedule Control which can further be used for project forecasting and efficiency management. The expected inputs for this tool to calculate the performance index are the

- **Planned Value**-This is the first element of earned value management. Planned Value is the approved value of the work to be completed in a given time. It is the value that the team should have been earned as per the schedule.

- We calculate Planned Value before actually doing the work, which also serves as a baseline. Total Planned Value for the project is known as Budget at Completion (BAC).

- Planned Value is also referred to as Budgeted Cost of Work Scheduled (BCWS). Planned Value can also be used as Planned Hours. In the case of Insourcing Team, the Planned hours are used to calculate the EVM.

- **Actual Cost**- This is the second element of earned value management. Actual Cost is the total cost incurred for the actual work completed to date. Simply put, it is the amount of money we have spent to date.

  Actual Cost is also known as Actual Cost of Work Performed (ACWP).

  For the design team, the Actual cost was termed as the Actual hours taken till date.

- **Percentage completion**- It is the percentage of completion of a part or design that a particular team in a department does.

Using these inputs from the team, following are the outputs that we get.

- **Earned Value**-This is the third element of earned value management. Earned Value is the value of the work actually completed to date. If the project is terminated today, also known as Budgeted Cost of Work Performed (BCWP).

  There is a difference between Planned Value and Earned Value. Planned Value shows us how much value we have planned to earn in a given time, while Earned Value shows how much value we have actually earned on the project.

  In the case of the design team, the earned value was calculated by using the planned hours and the percentage completion of the task.

- **Cost Variance-** It is the difference between the Earned value and the Actual hours, which tells us if the project is under or over budget.

CV= EV-AC

If the project is over budget the CV will be negative (i.e. achieved less than spent) If the project is on budget the CV = 0

If the project is under budget the CV will be positive (i.e. achieved more than spent)

- **Schedule Variance-** It is the difference between PV and EV, to tell whether the project work is ahead of / on / behind schedule

SV = EV – PV

If the project is behind schedule the SV will be negative (i.e. achieved less than what planned) If the project is on schedule the SV = 0

If the project is ahead of schedule the SV will be positive (i.e. achieved more than what planned)

- **Cost Performance Index:** The ratio between EV and AC, to reflect whether the project work is under / on / over budget in relative terms

CPI = EV/AC

If the project is over budget the CPI < 1 (i.e. achieved less than spent) If the project is on budget the CPI = 1

If the project is under budget the CPI > 1 (i.e. achieved more than spent)

- **Schedule Performance Index:** The ratio between EV and PV, to reflect whether the project work is ahead of / on / behind schedule in relative terms

SPI = EV/PV

If the project is behind schedule the SPI < 1 (i.e. achieved less than what planned) If the project is on schedule the SPI = 1

If the project is ahead of schedule the SPI > 1 (i.e. achieved more than what planned)

- **Estimated Cost at Completion:** As the project goes on, there may be variations into the actual final cost from the planned final cost, EAC is a way to project/estimate the planned cost at project finish based on the currently available data

The following formulas can be used to calculate EAC based on which information and conditions given in the question:

EAC = BAC/CPI

Inputs Required:

- Planned hours given by the managers to each department for a particular part.

- Actual hours completed by the department

- % completion till date of each department for a particular part.

The team will put the above data in the "Work Allocation to Design Team" sheet (as mentioned above) that is circulated to them. Planned hours will be updated against the planned hours column for respective departments and parts, the actual hours against the actual hours column under respective weeks and the percentage completion will be updated against the % completion column under respective weeks for respective part and departments.

Results:

Once the data is updated by the team in the sheet, following are the reports generated:

a. Detailed Report

This report is the detailed report of all the parts and all the departments of each part.

- We have the Planned hours of each department populated for each department and parts.

- Actual hours of each department of ever part.

- % completion for each department for every part.

- Earned Value is calculated as Planned hours* (%completion). This is the actual value of the work completed in hours till date.

  For example, the planned hours= 100 hours; % completion = 50%; EV= 100* 50%= 50 hours. This means we have completed 50 hours' worth of effort till date.

- Cost Variance calculated as CV= EV-AC; i.e., how much behind or ahead of cost we are. For example, EV= 50 hours but Actual cost taken to complete 50 hours worth of effort is 75 hours, so the Cost Variance will be -25 hours or 25 hours taken extra.

- Schedule Variance calculated as SV=EV-PV; i.e. how much are we ahead of schedule or behind the schedule.

- Cost Performance Index calculated as CPI=EV/AC which gives us the Cost efficiency of the team
- Schedule Performance Index calculated as SPI= EV/PV which gives us the Schedule efficiency of the team.
- Estimated Cost at completion is calculated as EAC=Planned hours / CPI which gives us the value of the total hours that will be taken to complete the activity at completion.

b. Department wise Report

Department name	Planned hours(PV)	Actual Hours(AC)	%completion	Earned Value	Cost Variance (CV=EV-AC)	Schedule Variance(SV=EV-PV)	Cost Performance Index(CPI=EV/AC)	Schedule Performance Index(SPI =EV/PV)	Estimated Cost at Completion (EAC)
Department 1	102	0	0%	0	0	-102	0%	0%	0
Department 2	0	0	0%	0	0	0	0%	0%	0
Department 3	0	0	0%	0	0	0	0%	0%	0
Department 4	102	102	100%	102	0	0	100%	100%	102
Department 5	89.07143	80.18918919	100%	101.8667	-57.56	-74.3077	101%	100%	101.7333
Department 6	102	102	100%	102	0	0	100%	100%	102
Department 7	102	102	100%	102	0	0	100%	100%	102

Table 3: Department wise EVM Report

This report shows the performance of the all the departments on an average. With the help of their CPI and SPI we can find out the potential bottleneck.
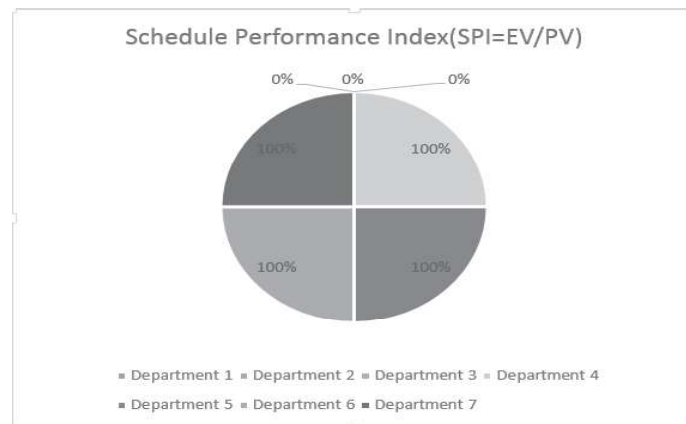
Following are the graphical reports generated for each department depicting their SPI and CPI

1. CPI
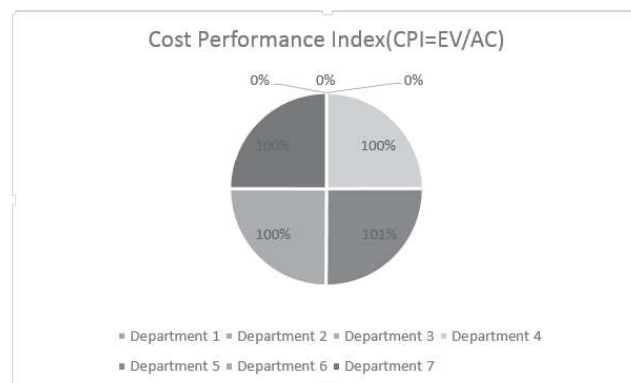
Graph 7: CPI of each department in graphical Form

2. SPI

Graph 8: SPI of each department in graphical form

We can have similar performance analysis for different parts and employees working as well.

5. Ageing Tool

Introduction

This is an age calculation tool that equips the user to monitor the duration for which a part is in WIP (Work in Progress) status in a department. Main objective of this tool is to get a clear picture of why a department is acting as a bottleneck.

This tool is primarily created for Department 6 which was taking a long time to approve the drawings and send them to India. It was getting difficult to track them and ask for a justification from the South California Team for the delay since there was no clear data as to how many months a single part was there.

So idea behind this tool was to count the number of months a particular part is in Department 6 in WIP status. And then get a consolidated report as to how many parts were in WIP status in department 6 for how long.

Working of the tool:

This tool will take the data from the main sheet i.e. "Work Allocation to Design Team" where the team has updated the statuses and the months of the status update for each department for a particular part.

As the team updates the status of Department 5 as 'CO' i.e., complete, the Ageing tool will record the month of that status update. The team will update the status of Department 6 as WIP and the month of the update. That month will be recorded as well.

Now the ageing will be calculated by taking the difference between the two months. The difference will increase as the months changes for Department 6's WIP's status.

Inputs required:

- Part status of each department
- Month of the status update

Results:

a. Ageing Detailed report

The Ageing detail sheet gives a clear picture about all the parts that are in WIP in Department 6 and for how long are they in that department in WIP status i.e., the their 'age'.
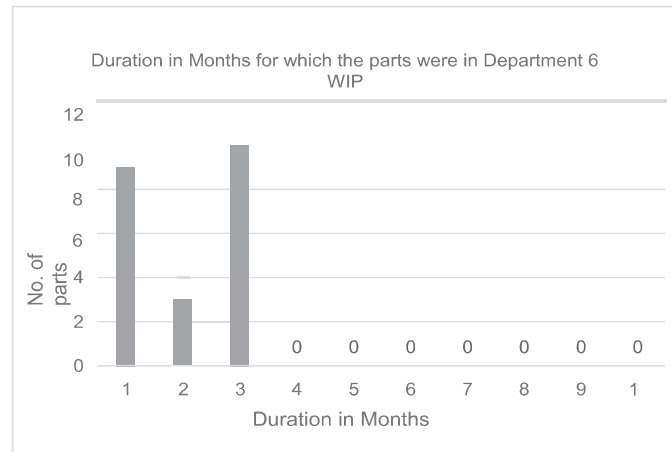
This helped the management to approach the South California team (Department 6) and ask for the reason for all those parts being in their department this long.

b. Consolidated Ageing Report

To have a more consolidated report, the final Ageing report calculates the total number of parts in WIP and for how long were they there in Department 6.

Duration in Months	No of parts in WIP
1	9
2	3
3	10
4	0
5	0
6	0
7	0
8	0
9	0
10	0

Table 4: Final Ageing report

Graph 9: Graphical representation of the final Ageing report

Inference:

a. According to the report it was clear that there were 10 parts who were in department 6 for 3 months. These were the complex parts that go through a set process in the department for the approval of the designs.

b. The 9 parts who were in the department for 1 month were the simple parts

c. 3 parts were the medium complexity parts that were in the department for 2 months.

6. Planned Hours VS Actual Hours Calculation Tool

Introduction:

The main objective of this tool is to calculate the average planned hours and average actual hours of each department separately and calculate which department is taking more time against their planned hours.

Working of the tool:

The team will put the Planned hours and actual hours in the main "Work allocation to design team" sheet (as mentioned before). The Planned hours will be put against the planned hours column and the actual hours will be put against the actual hours column below the respective.

The tool is macro enabled that will take the data from the main sheet and populate the results in numerical and graphical form.

Steps:

- Go to the sheet where the tool is created i.e. "Sheet 2" after the data is updated in the main sheet.
- Then click in the "Final Calculation" button on the top right corner.
- The macro will take a while to run because of the huge data it will calculate. In the end the data will be generated in a table.

Inference:

- From the report we could identify the department who was taking more hours to perform an activity compared with their planned hours.
- This can help the managers to understand the pain area or whether there is any help required to get the department move fast.
- The report shows that Department 6 is taking more hours actually than what was planned on an overall basis.

The New Facility Project

Depreciation Tool

Introduction

First objective for the New Facility Setup project is to create an excel based tool that will create Straight Line Depreciation for the machines to be installed in the facility and then this cost will be incorporated in the Business Case

Working of the tool

The tool works on 3 inputs:

- Cost of the machine
- Rate of depreciation
- Life time of the machine

These 3 inputs were taken from the Capex Sheet that included all the machine details.

- Cost of the machine updated in the Capex Sheet under the year of the purchase ofthat machine.
- The rate of depreciation

- The life of the machine is updated in the main sheet

This tool will calculate the depreciation from the year of purchase of the machine till the life specified in the main sheet, in a different sheet.

Results:

This tool was created in 3 phases.

- Phase 1: initially this tool calculated the depreciation for only those machine which were added for the same year.

- Phase 2: in the second phase the tool calculated the depreciation from any year in which the machine was brought.

- Phase 3: Finally, the tool calculated the depreciation from the year the machine was brought and the till the life time years of machine specified in the main sheet.

The value received from this tool was then used in the hourly rate build up for the facility.

Risk Register

Introduction:

A Risk Register, also referred to as a Risk Log, is a master document which is created during the early stages of the project. It is a tool that plays an important part in your Risk Management Plan, helping to track issues and address problems as they arise.

The Risk Register will generally be shared between project stakeholders, allowing those involved in the project to be kept aware of issues and providing a means of tracking the response to issues. It can be used to flag new project risks and to make suggestions on what course of action to take to resolve any issues.

Components of a Risk Register

There is no standard list of components that should be included in the risk register. The Project Management Institute Body of Knowledge (PMBOK) and PRINCE2 among other organizations make recommendations for risk register contents, but they are not set in stone. Some of the most widely used components are as follows:

- **Dates:** As the register is a living document, it is important to record the date that risks are identified or modified. Optional dates to include are the target and completion dates.

- **Description of the Risk:** A phrase that describes the risk.

- **Risk Type (business, project, stage):** Classification of the risk: Business risks relate to delivery of achieved benefit; project risks relate to the management of the project such as timeframes and resources, and stage risks are risks associated with a specific stage of the plan.

- **Likelihood of Occurrence:** Provides an assessment on how likely it is that this risk will occur. Examples are: L-Low (, M-Medium (31-70%), H-High (>70%).

- **Severity of Effect:** Provides an assessment of the impact that the occurrence of this risk would have on the project.

- **Countermeasures:** Actions to be taken to prevent, reduce, or transfer the risk. This may include production of contingency plans.

- **Owner:** The individual responsible for ensuring that risks are appropriately engaged with countermeasures undertaken.

- **Status:** Indicates whether this is a current risk or if risk can no longer arise and impact the project. Example classifications are: C-current or E-ended.

- Other columns such as quantitative value can also be added if appropriate.

Types of risks identified
The types of risks associated with the New Facility Projects were:

- **Executive Support**

  Wavering, inconsistent or weak executive commitment is often a project's biggest risk. This can be difficult (but not impossible) to document. We had to ask for specific commitments. Where it was denied it was documented as a risk.

- **Scope**

  The quality of our estimates, dependencies and scope management. If an estimate is just a guess, that's a risk.

- **Change Management**

  A continuous flow of complex change requests can escalate the complexity of our project and throw it off course. Change requests

may lead to a perception that a project has failed because they continually add budget and time to the project.

- **Stakeholders**

  Stakeholders with a negative attitude towards a project may intentionally throw up roadblocks every step of the way. Conflict or a lack of cooperation between stakeholders is a risk.

- **Resources & Team**

  Resource issues such as turnover and learning curves was a common project risks. There's always a risk that our key experts will leave. If the team is inexperienced or need to acquire new skills, that's another risk.

- **Design**

  The feasibility and flexibility of architecture and design are key to the project's success. Low quality design is a risk.

- **Technical**

  The risk that components of our technology stack will be low quality. There are dozens of quality factors for technical components (e.g. stability, availability, scalability, usability, security, extensibility).

- **Integration**

  Whatever we are delivering needs to integrate with the processes, systems, organizations, culture and knowledge of the environment. Integration risks are common.

- **Communication**

  Invalid stakeholder expectations are a fundamental project risk. If the stakeholders think we are building an orange but we're building an apple — our project will fail.

- **Requirements**

  Garbage in, garbage out. If requirements aren't feasible or are detached from business realities, our project may fail. We have to look at the feasibility, quality and completeness of requirements to identify risks.

- **Decision Quality**

  Slow, low quality or ambiguous decisions are common risks.

- **Feasibility**

  Risk identification is a critical time to consider the feasibility of the project. Ask the key members of the team to do their own sanity checks. We must list any doubts about feasibility as risks.

- **Procurement**

  The procurement process is ripe with risks. For example, there's a risk that we won't find an acceptable proposal to an RFP. There's also a risk that our vendors won't deliver to the terms of their contracts.

- **Quality**

  Quality and risk management are intertwined. We'll expect to have defects in our project. However, there's a risk that quality won't meet basic levels. Significant rework may trigger project failure.

- **Authority**

  Project teams often lack authority to complete project work. In many cases, teams are expected to influence to achieve project objectives.

- **Approvals & Red Tape**

  If we anticipate that red tape (e.g. financial approvals) will slow down our project — add this as a risk.

- **Organizational**

  Organizational change (e.g. restructuring, mergers, and acquisitions) will throw our project off track.

- **External**

  External forces such as laws, regulations and markets.

- **Project Management**

  If our organization asks to streamline our project management methodology (drop processes and documentation) we can document this as a risk.

- **User Acceptance**

  There's always a chance that users will reject our product.

a. Additional Contribution

- Understood the project management activities and the role of the Project Manager by shadowing the Project Manager in various meetings

- Prepared project plans for the New Facility Project. Learned MS Project and created some small Project Plans that include the activities related to the initiation of the facility, different qualifications of the electronic device etc.

- Understood the documents sent by the Smithfield Program Manager about the working of the device. Helped the manager understand the meaning of Red Label, Blue, Label and Black Label (certifications required to produce an electronic product).

- Attended various meetings with different team managers, engineers and other stakeholders.

- Understood how the work was allocated to the team members and how their problems were addressed.

- Prepared minutes of the meeting and circulated that among the managers.

- Did rigorous brain storming sessions with the manager regarding the Insourcing Project and the cost estimation sheet for the Facility project and contributed in creating the cost estimation sheet of our own.

- Understood various elements like Learning Curve, Material slope and how a labour head cost is calculated.

- Updated the Insourcing Project tools multiple times as and when required by the managers and the teams.

- Created a user manual for the team for them to use the tools without any problem.

- Used to go to the functional manager alone to get the weekly data whenever the manager was not there.

- Used to work closely with the functional manager to understand their requirements and create a tool that is easily accessible by the manager and the team.

Summary of Findings, Conclusions and Suggestions

Summary of Findings

- The graphs give us the comparison between the actual performances of the departments against the planned target on a monthly and cumulative basis. (Source: Graph 2: Cumulative Planned VS Actual Performance of Departments)

- Through the graphs we understood that Department 6 was acting as the bottleneck as the team's actual performance was way behind the planned target. (Source: Graph 3: Cumulative Planned VS Actual Performance of Department 6)

- Main reason behind the delay in the performance was that the parts were sent to the South California team and they were taking months to approve a design and send it to India.

- According to the report it was clear that there were 10 parts who were in department 6 for 3 months. These were the complex parts that go through a set process in the department for the approval of the designs. (Source: Table 8: Final Ageing report)

- The 9 parts who were in the department for 1 month were the simple parts (Source: Table 8: Final Ageing report)

- 3 parts were the medium complexity parts that were in the department for 2 months. (Source: Table 8: Final Ageing report)

- From the report we could identify the department who was taking more hours to perform an activity compared with their planned hours. (Source: Table 9: Populated data planned vs actual hours)

- This can help the managers to understand the pain area or whether there is any help required to get the department move fast.

- The report shows that Department 6 is taking more hours actually than what was planned on an overall basis. (Source: Table 9: Populated data planned vs actual hours)

Achievements

The MSRT tool was widely appreciated and acknowledge by the US team.

According to them, this level of detailed tracking was being done in any of the 5 places in the world where Insourcing Project is being carried out. They asked for the tool and have planned to implement it in their projects and other related projects also. The Reports generated by my tools

i.e. MSRT, EVM, Ageing and Planned VS Actual are being shown to the Boeing India head.

Suggestions

- No specific scale of reference was there for the team. They were putting their on planned hours and then actual hours for the Insourcing project. This enabled them to show their efficiency beyond 100%

- Different teams were using different trackers to track their performance which created an issue of lack of comparisons between the departments. All the departments must get in line with each other and use 1 way of tracking the project after a mutual consensus.

- There should be some skip level interviews also conducted. As an individual, there is always a room for improvement. If a manager has the authority to review a subordinate, then the subordinate must also have an authority to give a review about the manager to his manager.

- Efficiency of the team should be checked atleast twice a month to ensure they are on track and the performance is as per the target.

Conclusion

Since the organization was fairly new in India, there were lot of issues in overall implementation of the new business. Some of the issues were:

- Lack of project management infrastructure to identify the gaps, pain areas, efficiency and productivity existed in the process of design and manufacturing.

- The organization was struggling to plan the approach for setting up their new facility.

Main role was to address these issues and provide the management with an approach that would help in easy monitoring the progress and productivity of the organization.

MS- Excel was extensively used to develop read and analyze data and eventually develop a tool that would help providing with a solution.

The below mentioned tools that were developed have, to much extent, provided the much need solution and direction of thought for future developments.

- MSRT (Monthly Status Reporting Tool)
- EVM (Earned Value Management)
- Ageing Tool

- Planned VS Actual Hours
- Straight Line Depreciation

Reference

Books:

Internal Project Reference Documents

Business Requirement Documents- Cost Estimation Sheet Business Requirement documents - Business Plan

Business Requirement Documents - Documents regarding the device details Internal reference Presentations.

Master Phasing Plans – Boeing, USA Internal Risk Registers (Ongoing projects).

Websites:

Company Profile – The Boeing Company, accessed on 30/07/2018 https://www.boeing.com

Risk Register, viewed on 30/07/2018, https://www.cio.com.au/article/401244/how_create_risk_register/

https://www.brighthubpm.com/risk-management/3247-creating-a-risk-register-a-free-excel-template/

Aerospace manufacturing Industry, viewed on 30/07/2018 https://www.aero-mag.com/