Gina Cody School of Engineering and Computer and Science

INSE-6230 TOTAL PROJECT QUALITY MANAGEMENT

A project report on

Design Improvement and Quality Control of Boeing 737 Max Aircraft

Submitted to

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Submitted by

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1. Introduction

1.1 Abstract:

The predominant change in the aircraft was Engine. To obtain more fuel efficiency, the engine size was increased and its positioning was altered. This change has disturbed the Centre of Gravity (CoG) of the aircraft. In lieu of this rectification, a new software called MCAS (Maneuvering Characteristics Augmentation System) was annexed to the aircraft. MCAS is directly referring to angle-of-attack (AoA) of the aircraft. As a result, any slightest variations to the AoA can lead to catastrophes, which had actually happened. The main purpose of the project is to investigate the root cause involved with the Boeing 737 Max design failure. With the integration of concepts like project Integration and time management, we aim to improve the overall quality issues and failures the caused the crash of Boeing 737 Max aircraft. The documentation of the scope of the project will explain the boundaries of the project and set up procedures for how a work that is completed will be verified and approved. The Risk Management plan would be incorporated to identify potential problems by the introduction of the changes into the pre-designed aircraft system.

1.2 Background:

On **October 29, 2018: Lion Air Flight 610**, a 737 MAX 8, enlistment PK-LQP, on a departure from Jakarta, Indonesia to Pangkal Pinang, Indonesia, collided with the ocean 13 minutes after departure, with 189 individuals on board the airplane: 181 travelers (178 adults and three children), just as six cabin crew and two pilots. The accident executed all on board. This is the deadliest air mishap including all variations of the Boeing 737 and furthermore the principal mishap including the Boeing 737 MAX.

On **March 10, 2019: Ethiopian Airlines Flight 302**, a 737 MAX 8, enlistment ET-AVJ, on a departure from Addis Ababa, Ethiopia to Nairobi, Kenya, smashed 6 minutes after departure, killing every one of the 157 individuals on board: 149 travelers and 8 group individuals. The plane was just 4 months old at the hour of the mishap. Accordingly, various flying specialists around the globe grounded the 737 MAX arrangements, and numerous aircrafts went with the same pattern on a willful premise. On March 13, 2019, the FAA turned into the last position to ground the airplane, switching its past position that the MAX was protected to fly.

Boeing is the world's biggest aviation organization and driving producer of business jetliners, safeguard, space and security frameworks, and specialist co-op of post-retail uphold. As America's greatest assembling exporter, the organization upholds aircrafts and the U.S. also, united government clients in excess of 150 nations. Boeing items and customized administrations incorporate business and military aircraft, satellites, weapons, electronic and protection frameworks, dispatch frameworks, progressed data and correspondence frameworks, and execution based co-ordinations and preparation.

Boeing has a long convention of aviation administration and development. The organization keeps on growing its product offering and administrations to meet arising client needs. Its wide scope of abilities incorporates making new, more proficient individuals from its business plane family; planning, building and coordinating military stages and protection frameworks; making trend setting innovation arrangements; and masterminding inventive financing and administration choices for clients.

Boeing is coordinated into three specialty units: Commercial Airplanes; Defense, Space and Security; and Boeing Global Services, which started activities July 1, 2017. Supporting these units is Boeing Capital Corporation, a worldwide supplier of financing arrangements. What's more, useful associations working over the organization center around designing and programming the board; innovation and advancement program execution; progressed plan and assembling frameworks; wellbeing, money, quality and profitability improvement and data innovation.

Commercial Airplanes: Boeing has been the head maker of business jetliners for quite a long time. Today, the organization fabricates the 737, 747, 767, 777 and 787 groups of planes and the Boeing Business Jet reach. New item advancement endeavors incorporate the Boeing 787-10 Dreamliner, the 737 MAX, and the 777X. In excess of 10,000 Boeing-constructed business jetliners are in administration around the world, which is practically a large portion of the world armada. The organization additionally offers the most complete group of vessels, and around 90% of the world's load is conveyed by installed Boeing planes.

Defense, Space & Security: Defense, Space & Security (BDS) is an expanded, worldwide association giving driving answers for the plan, creation, alteration, administration and backing of business subordinates, military rotorcraft, satellites, human space investigation and independent frameworks. It assists clients with tending to a large group of prerequisites through an expansive portfolio that incorporates KC-46 ethereal refueling airplane, in view of the Boeing 767 business plane; AH-64 Apache helicopter; the 702 group of satellites; CST-100 Starliner rocket; and the self-governing Echo Voyager. Driven by the Boeing vision to associate, ensure, investigate and rouse the world through aviation advancement, BDS is looking for approaches to all the more likely influence data innovations and keeps on putting resources into the innovative work of improved abilities and stages.

Boeing Global Services: As the main producer for business and safeguard stages, Boeing is situated to give unmatched secondary selling backing to blended armadas around the world. Boeing Global Services conveys creative, thorough and cost-serious assistance answers for business, protection and space clients, and paying little mind to the gear's unique maker. With designing, advanced investigation, gracefully chain and preparing support traversing across both the public authority and business administration contributions, Boeing Global Services' superb, nonstop help keeps our clients' business airplane working at high proficiency, and gives mission confirmation to countries around the globe.

Boeing Capital Corporation: Boeing Capital Corporation (BCC) is a global provider of financing solutions for Boeing customers. Working closely with Commercial Airplanes and Defense, Space & Security, BCC ensures customers have the financing needed to buy and take delivery of their Boeing products. With a year-end 2016 portfolio value at approximately $4.1 billion, BCC combines Boeing's financial strength and global reach, detailed knowledge of Boeing customers and equipment and the expertise of a seasoned group of financial professionals.

2. Project Definition

Efficient transportation is important for getting to work, obtaining health care, education, training, recreation, culture and ensuring the community’s economic prosperity. However, other equally important issues must now be taken into account when making our personal and collective travel choices. These issues include protecting the environment, air quality, quality of life, the peace, quiet and character of neighborhoods; the health and safety of residents; the quality, comfort and design of urban development; social equality and investment cost.

The safety of the passengers is of utmost importance than any other thing. It is necessary that the design of the aircraft serves the purpose besides ensuring the safety parameters failing which lead to catastrophes. After the 2 major accidents involving the most advanced Boeing 737 Max aircraft, it makes us revisit the design inevitably considering the contingent adversities.

3. Project Initiation

3.1 Project Business Case

A business case is a proposition for an undertaking, methodology or game-plan. It expresses the purpose behind beginning an undertaking or an assignment and it tends to be introduced either in very much organized composed records or in type of short verbal arrangement.

Introduction

Aircraft industry is one of the finest industries in the world. On **October 29, 2018: Lion Air Flight 610** collided with the ocean 13 minutes after departure, with 189 individuals on board the airplane. On **March 10, 2019: Ethiopian Airlines Flight 302,** smashed 6 minutes after departure, killing every one of the 157 individuals on board. This deadliest air mishap includes all variations of the Boeing 737 and furthermore the principal mishap including the Boeing 737 MAX.

Business Objective

It's very important to define the business objective clearly. The main objective is to do the Design improvement and Quality control on the Boeing 737 Max aircraft. The aircraft was initially priced at $121.6. The research and development is estimated to be around $10M USD and the duration is 2 years.

Highly Recommended

Coming up next are the key components which are suggested for an effective undertaking

1. Creation of a venture plan is fundamental as it incorporates all the errands and their term which lead to the ideal finish of the task inside the assessed spending plan.
2. Once a development plan is created it should be fixed and utilized as a method for estimating progress.

Budget

$300M USD estimated

Time Estimate

The total time estimate for the project is 1 year 10 months approximately.

Risk Management

The given are the risks associated with the project

- Natural disasters
- Technician shortages
- New problems that may arise due to these modifications
- Unexpected changes can result in over budget

Table 1: Project Business Case

3.2 Project Scope Statement

Below is the Project Scope Statement that represents the scope and exclusions, Project Objectives, Schedule constraints, Acceptance criteria and related assumption. It is used by the project managers as a written confirmation of project results, constraints and assumptions.

Project Name	Design Improvement and Quality Control of Boeing 737 Max Aircraft
Project Scope Description	All the aircrafts must be double checked for the proper functioning of all the sensors and data input equipment. The functioning of the MCAS needs to be in pilots control
Project Exclusion	● Hazardous Products ● Damage to the aircraft ● Software testing training
Project Objectives	The main objective of this project is to give an improvised design for Boeing 737 Max aircraft and do Quality Control by doing various tests. The estimated cost of the project is about $300M USD and the estimated time is 2 years.
Schedule Constraints	As per the client requirements, we need to complete the project as soon as possible. So an estimated time of 2 years was decided to finish the project.
Acceptance Criteria	● The Electrical Equipment used in the project must be of a high quality. ● It must be ensured to use the sensors that are accurate, precise and reliable. ● The project must have essential documentation. ● The readings must be digitally displayed in the cockpit without any errors. ● There should not be any harmful consequences on the environment.
Assumptions	After carefully observing the client's requirements, the Owner and the contractor agreed for below terms: ● **Design Technology**: Automatic Sensors with airflow input data system ● **Software Required**: Ansys, AutoCAD, ProE, Gambit, Fluent

	• **Project Duration**: 1 Years 10 months. • **Contract Type**: Fixed Price Incentive Contract (FPI) • **Target Cost:** $300M USD

Table 2: Project Scope Statement

3.3 Project Charter

A Project Charter is a formal, normally short report that depicts your venture completely including what the targets are, the manner by which it will be done, and who the partners are. It is an urgent fixing in arranging out the task since it is utilized all through the undertaking lifecycle.

Project Identification

Name	Design Improvement and Quality Control of Boeing 737 Max Aircraft
Description	Providing an improvised design for the existing Boeing 737 Max aircraft and to do Quality Control on the design.
Sponsor	Boeing Aerospace Company
Project Manager	Mr. Venkat SK Dutt

Project Manager and Authority Levels

For this project Mr. Venkat SK Dutt will be the venture supervisor in the interest of MIcrobitz Solutions Pvt Ltd Company. He is the organizer, coordinator and answerable for driving the undertaking. He guarantees that the undertaking is finished inside the predetermined cutoff time. The main function of the undertaking director is to collect and lead the venture group. He every now and again surveys the undertaking to ensure that the venture is inside its set spending plan.

Project Objectives

The main objective of this project is to give an improvised design for Boeing 737 Max aircraft and do Quality Control by doing various tests. The estimated cost of the project is about $300M USD and the estimated time is 1 years 10 months.

Stakeholders

Key stakeholders are Boeing Aerospace Company as sponsor of the project, Venkat SK Dutt, Hina Shivhare and Taranjyot Singh as the project team members, Engineers, Technicians and Workforce. All these stakeholders provide financial and practical support to the successful completion of the project.

Key Project Deliverables

1. Proposing an improvised design for Boeing 737 Max Aircraft.
2. Ensuring no sensor malfunctioning or failure
3. Testing the model using various software for stability and reliability.
4. Doing a Quality control to ensure the new design

Project Budget and Duration

The total budget allocated to this project is $300M USD

The estimated duration of the project is 1 years 10 months no later than 10th Dec, 2020.

Project Key Milestones

S. No.	Milestones	Completion Date
1	Procurement Planning	30-Jun-2019
2	Detail Design Approval	16-Dec-2019
2	Integrated System Implementation	25-April-2020
4	Integrated System Installation	30-Oct-2020
5	Wind Tunnel Testing	10-Nov-2020
6	Flight Testing	15-Nov-2020
7	Quality Checklist Completed	30-Nov-2020
8	Product Delivered	06-Dec-2020

Project Approval Requirements

- The project sponsor provides funding and project statement of work.
- Before the Project Planning WBS should be approved by the sponsor.

• The sponsor will approve the final project management plan during project planning. • The sponsor will approve the specification of the equipment. • The sponsor provides the formal acceptance of the deliverables
Project Sponsor Authorizing this Project Project Sponsor: Boeing Aerospace Company Project Manager: Venkat SK Dutt Date:

Table 3: Project Charter

3.4 Stakeholder Register

S. No.	Name	Position	Role	Internal / External	Contact Information
1	Venkat SK Dutt	Director	Assistant Manager	Internal	venkat.aero12@gmail.com
2	Hina Shivhare	CFO	Financial Analyst	Internal	hinashivhare26@gmail.com
3	Hina Shivhare	HR Manager	HR Manager	Internal	hinashivhare26@gmail.com
4	Taranjyot Singh	Senior Project Manager	Project Manager	Internal	taranjyotsingh357@gmail.com
5	Venkat SK Dutt	Project Manager	Project Manager	Internal	venkat.aero12@gmail.com
6	Hina Shivhare	Team Lead	Project Lead	Internal	hinashivhare26@gmail.com
7	Taranjyot Singh	Business Analyst	Analyst	Internal	taranjyotsingh357@gmail.com
8	Venkat SK Dutt	Aeronautical Engineer	Aeronautical Engineer	Internal	venkat.aero12@gmail.com
9	Taranjyot Singh	Mechanical Engineer	Mechanical Engineer	Internal	taranjyotsingh357@gmail.com

10	Venkat SK Dutt	Software Engineer	Software Engineer	Internal	venkat.aero12@gmail.com
11	Venkat SK Dutt	Electrical Engineer	Electrical Engineer	Internal	venkat.aero12@gmail.com
12	Taranjyot Singh	Quality Engineer	Quality Engineer	Internal	taranjyotsingh357@gmail.com
13	Hina Shivhare	Automation Engineer	Automation Engineer	Internal	hinashivhare26@gmail.com

Table 4: Stakeholder register

3.5 Project Stakeholder Analysis

Project Stakeholder analysis is a project management tool that tells about internal and external stakeholders. The expectations of the stakeholders in a company are also described in it. Below table represents the stakeholders involved in the project, their objectives and their needs.

Stakeholder	**What do we need from them?**	**What do they need from us ?**	**Current success in collaborating**			**Actions we can take to eliminate/ Minimize obstacles**
			Low	Med	High	
Project Sponsor	Budget and approval for project			♦		Monthly Meetings
Project Manager	Project Planning and Regular inspection	Proper Contribution to complete project on time			♦	Communication with team members and Key Stakeholders
Procurement Manager	Material and Resources needed for the project	Information for material required			♦	Creating Coordination between Vendors and internal Stakeholders
Risk Manager	To assess and identify the potential risks	Risk Checklists			♦	Attend Risk Control Meetings

Table 5: Stakeholder Analysis

3.6 SWOT Analysis

This is an analysis that gives us a clear picture about the strengths, weaknesses, the opportunities and the threats about the project. This will help us understand and implement the steps of doing the project in a better way concentrating on the weaknesses more and taking the advantage of the strengths.

Strengths	● Management of Supply Process through Vertical Integration ● Digital Technology used for assembling ● Growth through acquisitions ● Focus on Research and Development ● Enhancement of Operational Performance
Weaknesses	● Constraints to reach break-even point without reaching the projected demand ● Complex assembly by aircraft ● High volume of customers ● Delay in Commercial Aircraft Development program
Opportunities	● Global outlook for Aircraft demand ● Growth of transcontinental traffic ● Demand for more frequent non-stop flights
Threats	● Increase of jet fuel prices ● Suppliers falling behind the schedule designing for project ● Environmental regulations ● Government Regulations ● Increased prices of raw materials (titanium and aluminium)

Table 6: SWOT Analysis

3.7 Company Organization Structure

The Organization structure of a company is the pictorial representation of the various levels of the employees in the organization. The Organization Structure of Microbitz Solutions Private Limited may be shown in the diagram below.

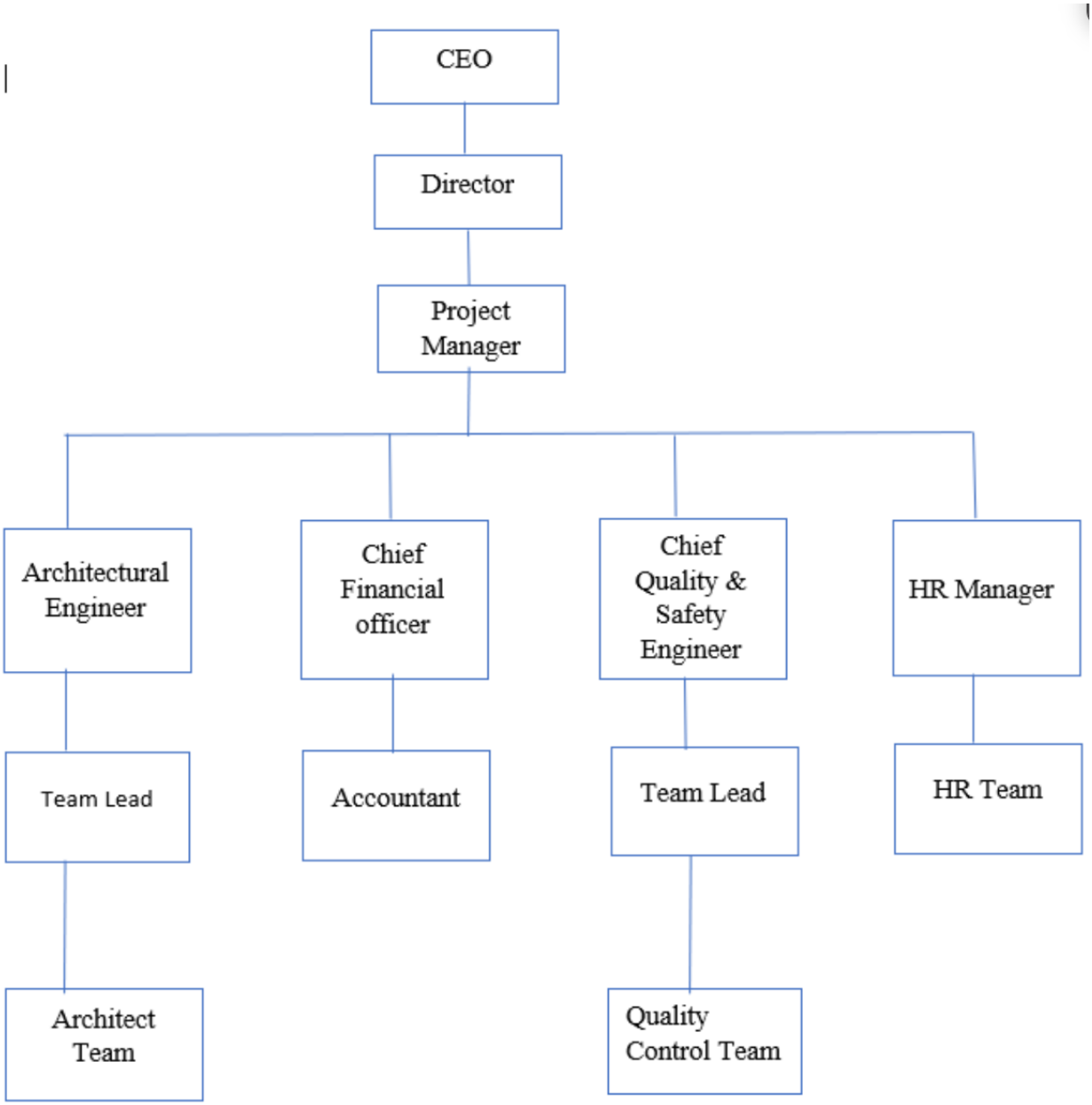


Figure 1: Company Organization Structure

4. Project Planning

The method of creating an actionable project schedule remains the same even though projects differ. Good executives know how to do this and always adhere to a standard project planning procedure before any work starts.

4.1 Kick-Off Meeting

The first meeting between the project team members and the clients while setting-off a new project is called a kick-off meeting. The goal of this meeting is to understand the project contexts and its needs, team introduction, discussion of the efficient execution process. It is an opportunity to set the level and get the team and customer on the same page.

DATE: 01-April-2019
PROJECT NAME: Design improvement and Quality Improvement of Boeing 737 Max Aircraft.
Meeting Objective: Introduction of all the stakeholders of the project and to discuss the overall project process and needs. To make sure that all the team members are on the same page of the project.
Agenda of Meeting:- ● Introduction of the attendees ● Review on Project Background ● Discussion on Business Case and Project Charter ● Discussion on project organization structure ● Review on project plan and resources available ● Discussion on project's timeline, scope and budget ● Roles and Responsibilities ● Current active plans and upcoming meeting schedules ● Review and summary of the meeting ● Question and answer session ● Inputs for improvement for the attendees

ACTION ITEMS	**ASSIGNED TO**	**DUE-DATE**
Human Resource	HR Team	01-Jun-2019
Project Requirement	Product Owner	21-June-2019
Design Feasibility Analysis	Business Analyst	28-Aug-2019
Setup of hardware, software and servers	Procurement Team	31-Oct-2019
System access allotment	Project Manager	05-Nov-2019
Distribution of tasks	Project Manager	12-Nov-2019
Risk Analysis	Monitor and Control Team	21-Nov-2019
Module Design implementation and installation(phase 1)	Development and Installation Team	13-Feb-2020
Module testing (phase 1)	Testing Team	19-Mar-2020
Integration and installation of integrated modules (phase 2)	Development and Installation Team	25-April-2020
Integration testing(phase 2)	Testing Team	02-Jun-2020
System design implementation and installation (phase 3)	Development and Installation Team	20-July-2020
System testing (phase3)	Testing Team	19-Aug-2020

Final Installation	Deployment Team	30-Oct-2020
Flight testing	Testing Team	15-Nov-2020
Product sign-off	Manager	06-Dec-2020

Table 7: Kick-Off Meeting

4.2 Responsibility Assignment Matrix

A Responsibility Assignment Matrix (RAM) defines the distribution of the task execution for project individuals and various other stakeholders in the organization. It is generally used by the Project Manager to explain the roles and responsibilities.

It is often referred to as a matrix of Responsible, Accountable, Consulted, and Informed (RACI).

Responsible: Those who do the work to accomplish the task.

Accountable: One who is ultimately accountable for the execution of deliverables.

Consulted: One whose opinions are needed and with whom two way correspondence is achieved.

Informed: One who is up-to-date on progress and with whom one-way contact always exists.

Activity based on WBS	PM	BA	Procurement Team	Dev. Team	HR	Testing Team	Deployment Team	Product Owner	Monitor and Control Team
Resource Planning	R	C	C	I	A	I	I	C	I
Requirement Gathering	C,A	R	C	I	I	I	I	C	I
Procurement Plan	C,A	C	R	I	I	I	I	I	I

Budget Analysis	C,A	R	C	I	C	I	I	C	I
Feasibility Analysis	C,A	R	I	C	I	C	C	I	C
Risk Analysis	C,A	R	I	I	I	C	R,A	I	R,A
Quality Control Plan	C,A	C	I	C	I	R,A	C	I	C
Module Design Implementation and Module testing	C,A	C	I	R,A	I	R,A	I	I	I
Design integration and testing	C,A	C	I	R,A	I	R,A	R,A	I	C
System Testing	C,A	I	I	C	I	R,A	I	I	C
Flight Testing	C,A	I	I	I	I	R,A	I	C	C
Launch	C,A	C	I	I	I	I	R,A	C	R
Regression Testing	C	I	I	I	I	R,A	I	I	C
Product Maintenance	R,A	I	I	R	I	R	R	I	R
Documentation	C,A	R	R	R	I	R	R	I	R
Project Closing	R	C	I	I	I	I	I	C	C

Table 8: Responsibility Assignment Matrix

4.3 Project Work Breakdown Structure (WBS)

A Work Breakdown Structure (WBS) is a common productivity strategy used to make the job more doable and achievable by splitting the work into smaller tasks. This technique is an instrument and most relevant document for project management. It can alone combine all the 4 main constraints of scope, time, cost and quality.

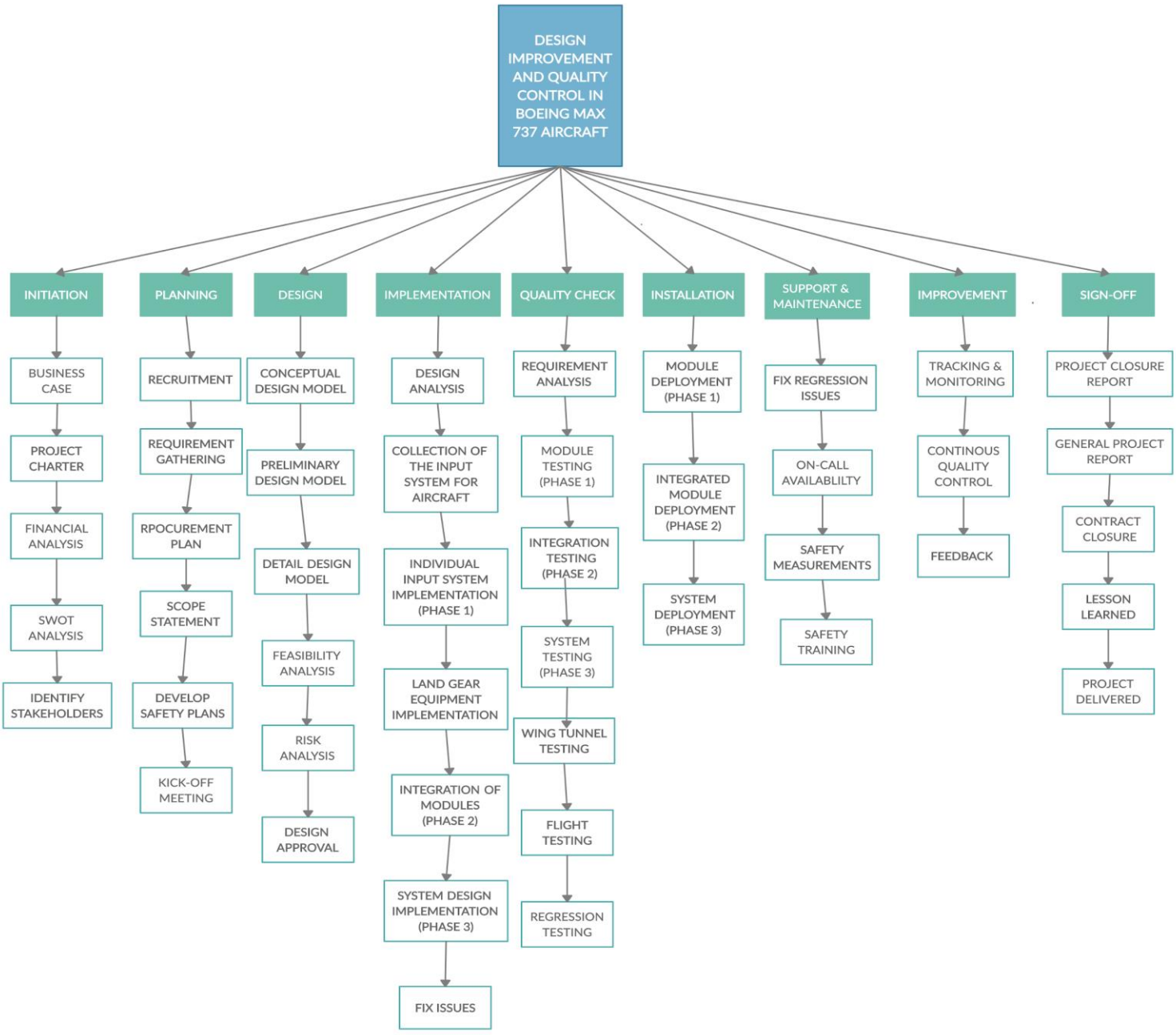


Figure 2: Work Breakdown Structure

4.4 Project Schedule

4.4.1 Project Gantt chart

Gantt-Chart is a method that explains the project schedule using horizontal bars with an added feature of relationship dependencies which are depicted using arrows. In our project we have also added the resource allotment along with their cost and the material needed for construction. We also added an extra feature of cost estimation for each WBS item and all of it is done in Project Plan 365 tool. Please find the Gantt-chart diagrams in appendix.

4.4.2 Milestones Planned

Milestone is a significant event selected at a particular stage on a project. This process helps the team to achieve a set of targets within the given time and makes it easier for managers to recognize and improve holdups. Given below are the selected stages that our team has to reach by their respective dates.

SERIAL NO.	MILESTONES	COMPLETION DATE
1	Procurement Planning	30-Jun-2019
2	Detail Design Approval	16-Dec-2019
2	Integrated System Implementation	25-April-2020
4	Integrated System Installation	30-Oct-2020
5	Wind Tunnel Testing	10-Nov-2020
6	Flight Testing	15-Nov-2020
7	Quality Checklist Completed	30-Nov-2020
8	Product Delivered	06-Dec-2020

Table 9: Milestones Planned

4.5 Required Project Resources

Kindly find the table below that shows the resources required for the project with its standard rates. The terminology related to the table is also given below:-

There are three types of divisions:-

WORK: When work is used as a type, standard rate is on per day or per hour basis.

Example: employee

MATERIAL: When material is used as a type, standard rate is according to cost per unit material.

Example: tools.

COST: When cost is used as a type, the price is a fixed price per commodity.

Example: transportation cost

Max: Maximum number of employees needed for a particular task.

Standard Rate: It is rate per hour or rate per unit.

There are three types of Accrue Rate

PRORATED: When resources are paid as the project advances.

Example: Salary of an Employee

START: When you pay to a resource at the beginning of the project

END: The payment is done when the project or work is completed.

Resource Name	Type	Max	Standard Rate	Ovt Rate	Cost/Use	Accrue Rate	Base
Senior Project Manager	Work	1	$200/hr	$0.00/hr	$0.00	Prorated	Standard
Project Manager	Work	5	$130/hr	$0.00/hr	$0.00	Prorated	Standard
Team Leads	Work	10	$90/hr	$0.00/hr	$0.00	Prorated	Standard

Design Engineer	Work	10	$70/hr	$0.00/hr	$0.00	Prorated	Standard
Aeronautical Engineer	Work	10	$70/hr	$0.00/hr	$0.00	Prorated	Standard
Quality Engineer	Work	15	$40/hr	$0.00/hr	$0.00	Prorated	Standard
Mechanical Engineer	Work	6	$60/hr	$0.00/hr	$0.00	Prorated	Standard
Cost Engineer	Work	3	$30/hr	$0.00/hr	$0.00	Prorated	Standard
Electrical Engineer	Work	4	$50/hr	$0.00/hr	$0.00	Prorated	Standard
Automation Engineer	Work	4	50$/hr	$0.00/hr	$0.00	Prorated	Standard
Logistics	Work	5	20$/hr	$0.00/hr	$0.00	Prorated	Standard
Marketing	Work	4	20$/hr	$0.00/hr	$0.00	Prorated	Standard
HR	Work	1	40$/hr	$0.00/hr	$0.00	Prorated	Standard
Catering Staff	Work	20	12$/hr	$0.00/hr	$0.00	Prorated	Standard
Supervisors	Work	7	15$/hr	$0.00/hr	$0.00	Prorated	Standard
Laborer’s	Work	50	13.5$/hr	$0.00/hr	$0.00	Prorated	Standard
Fabrication Inspectors	Work	5	30$/hr	$0.00/hr	$0.00	Prorated	Standard
Carpenter	Work	7	13.5$/hr	$0.00/hr	$0.00	Prorated	Standard

Electrician	Work	6	13.5$/hr	$0.00/hr	$0.00	Prorated	Standard
Miscellaneous/ others	Work	27	15$/hr	$0.00/hr	$0.00	Prorated	Standard

Nickel alloys	Material	-	-	48$/kg	$0.00	start	-
Aluminium Lithium alloys	Material	-	-	50$/kg	$0.00	start	-
Polymer Matrix	Material	-	-	$50/kg	$0.00	start	-
Composite Material	Material	-	-	$30/kg	$0.00	start	-
Metal Matrix	Material	-	-	2$/kg	$0.00	start	-
actuators and sensors	Material	-	-	$500	$0.00	start	-
Ceramic Matrix Composite	Material	-	-	$10/kg	$0.00	start	-
Computer Hardware	Material	-	-	-	$0.00	start	-
silica	Material	-	-	0.8$/kg	$0.00	start	-
Zirconia	Material	-	-	78$/kg	$0.00	start	-

Fabrication	Material	-	-	-	$0.00	start	-
Resin Matrix Composite	Material	-	-	-	$0.00	start	-
Graphite Reinforced Polymer	Material	-	-		$0.00	start	-
Graphite Fibre Composites	Material	-	-	-	$0.00	start	-
Machine Parts	Material	--	-	-	$0.00	start	-
Landing Gear Equipment	Material	-	-	-	$0.00	start	-
Nickel and Cobalt based superalloy	Material	-	-	-	$0.00	start	-
Carbon-Fibre reinforced polymer	Material	-	-	-	$0.00	start	-
Sound-proof manufacturing	Material	-	-	-	$0.00	start	-
Functionally graded panels	Material	-	-	-	$0.00	start	-
Aluminium Alloy 6061,6063,6066	Material	-	-	50$/kg	$0.00	start	-
Turbine Blade	Materi	-	-	-	$0.00	start	-

	al						
Discs	Material	-	-	-	$0.00	start	-
Rings	Material	-	-	-	$0.00	start	-
Aero Engine Casings	Material	-	-	-	$0.00	start	-
Engine Nacelle	Material	-	-	-	$0.00	start	-
Nose Landing Gear	Material	-	-	-	$0.00	start	-
Canopy	Material	-	-	-	$0.00	start	-
Cockpit	Material	-	-	-	$0.00	start	-
Pitot static Tube	Material	-	-	-	$0.00	start	-
Software system	Cost	-	-	10000$	$0.00	start	-

Internet Facility	Cost	-	-	-	$0.00	start	-
Washroom fitting	Cost	-		5000$	$0.00	end	-
Office chair and	Cost	-	-	200$	$0.00	start	-

tables							
Windows	Cost	-	-	50$	$0.00	start	-
Doors	Cost	-	-	100$	$0.00	start	-
Floor tiles	Cost	-	-	$6	$0.00	start	-
Generator	Cost	-	-	5000$	$0.00	start	-
Electricity Supply	Cost	-	-	-	$0.00	end	-
Batteries	Cost	-	-	-	$0.00	start	-
Generator Assemblers	Cost	-	-	-	$0.00	start	-
Power Generator	Cost	-	-	-	$0.00	start	-
Sound system	Cost	-	-	-	$0.00	start	-
Water supply	-	-	-	-	$0.00	end	-
others	-	-	-	-	$0.00	start	-

Table 10: List of Recourses Required

4.6 Project Target Signing Contracts

The above two figures show the cash required for the top 10 spend categories needed in order to execute the complete project. This also gives us a clear idea about what amount of money will be spent in what kind of resources and in what quantity. It also gives us the idea that other services and steps are equally costly as that of the aircraft. Hence, our team must be provided with the funding by our sponsors before the due date.

4.6.1 Contract Terms and Conditions

After a lot of discussion with our client and stakeholders, we have come to a conclusion that we

prefer to sign a Fixed Price Incentive (FPi) contract with our client. Hence, we have agreed on the following specification:-

Target Cost	**300000000$**
Fixed Fee	**17500000$**
Target Price	**317500000$**
Ceiling Price	**350500500$**
Point of Total Assumption	**347143571.4$**
Buyer's Share	**70%**
Contractor's Share	**30%**

Table 11: Contract Terms & Conditions

4.7 Project Risk Management

Risk Management is a process of analyzing, identifying and finding the different types of risks throughout the project growth. These threats can vary from legal liabilities to natural disasters. On the top of it IT related threats and data leakage or data related threats are like the cherry on the cake, which might disrupt the whole company progress in a couple of days. As a result, risk management plans have become the company's first priority to be included in all phases of planning and implementation.

Every company faces these kinds of unexpected risks that can cost a company fortune or can permanently close them. Hence, risk management plans help them to be prepared for these unexpected events by reducing threats and extra cost before they happen. This can happen by minimizing negative risks and maximizing positive risks. For our project we have 6 main categories of risks: political risks, financial risks, operational risks, constructional risks, natural disasters and it-related risks .

Each risks is divided into its sub-categories as you can see in the below diagram as well as in the risk breakdown structure.

Risk Breakdown Structure: The risk breakdown structure is the hierarchical representation of the threats according to the top categories. For our project, risk breakdown structure is developed

according to the 6 main risks that are mentioned above and below in the diagram.

4.7.1 Project Risk Breakdown

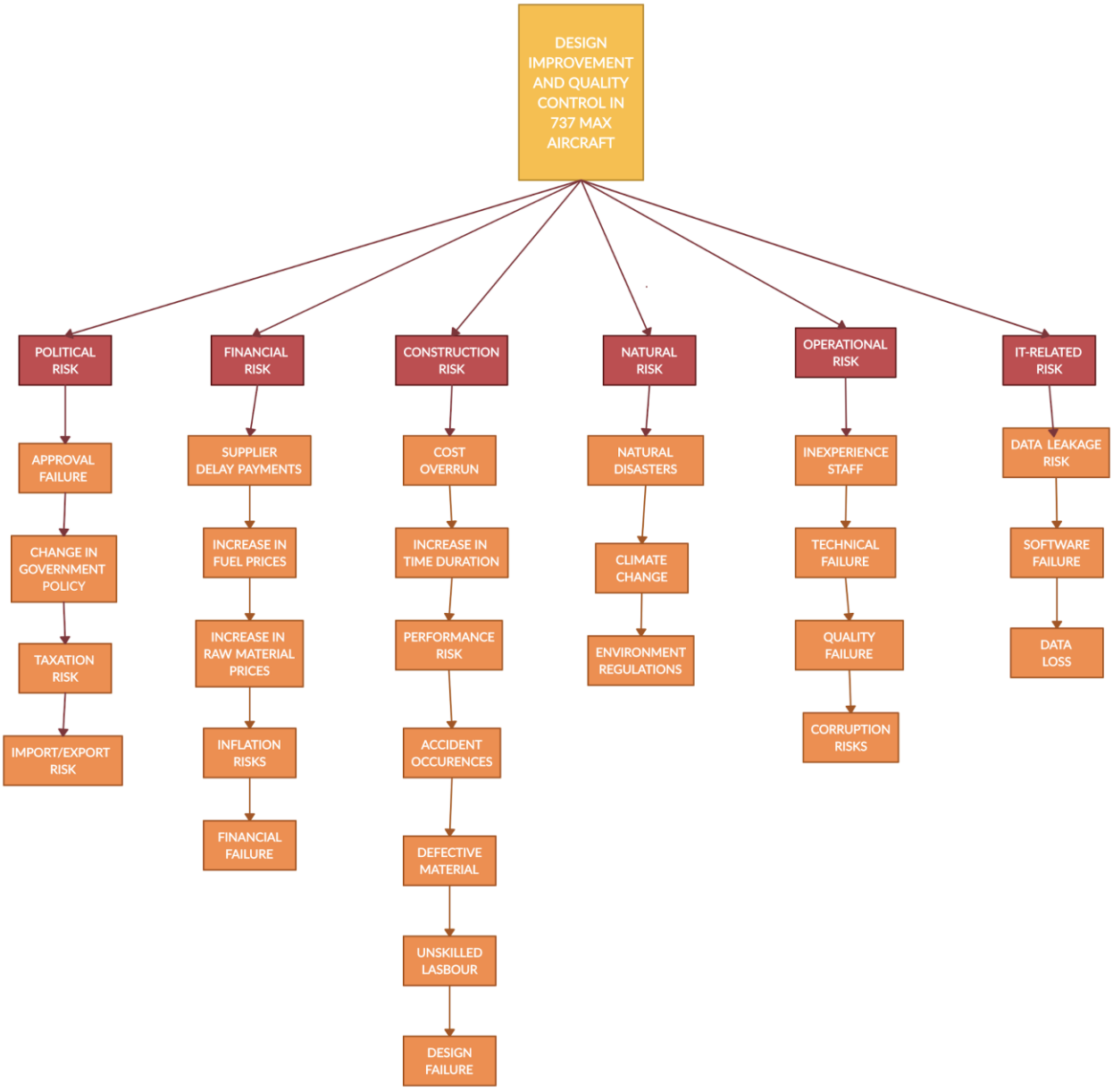


Figure 3: Risk Management

4.7.2 Project Risk Register

Risk Register helps to document the risk management process in a tabular form. With this method, a project manager can rank the list of risks according to the impact or probability of occurrence. The Risk Register for our project is given below:-

RISK ID	RISK NAME	RISK IMPACT	RISK AREA	RISK DESCRIPTION	PROBABILITY
R1	Change in government policy	High	Political Risk	Some change in government policy	Low
R2	Approval Failure	High	Political Risk	Not timely response or request rejection.	Low
R3	Taxation Risk	High	Political Risk	Change in taxation policy.	high
R4	Import/ Export Risk	Medium	Political Risk	Change in import/export rules.	high
R5	Supplier delay payments	Medium	Financial Risk	Delay in regular payment due date	high
R6	Increase in fuel prices	Medium	Financial Risk	Change in price of fuels.	Hugh
R7	Increase in raw material prices	Medium	Financial Risk	Change in the price of raw material.	high
R8	Inflation risk	High	Financial Risk	Market shutdown or recession.	low
R9	Financial failure	High	Financial Risk	Market shutdown or recession. Not enough sponsors.	low

R10	Cost Overrun	Low	Construction Risk	Actual price greater than target price leading to cost overrun.	Medium
R11	Increase in time duration	Low	Construction Risk	Actual time exceeds the due date.	high
R12	Performance risk	Medium	Construction Risk	Issues in performances.	high
R13	Accident Occurrence	Medium	Construction Risk	Accidents while construction.	high
R14	Defective Material	High	Construction Risk	Improper material quality.	Medium
R15	Unskilled labor	High	Construction Risk	Labors are not properly trained.	high
R16	Design Failure	High	Construction Risk	Issues in product design.	high
R17	Natural Disaster	Low	Natural Risk	Natural disasters like earthquakes.	low
R18	Climate Change	Low	Natural Risk	Climate change due to global warming	high
R19	Environmental Regulations	Medium	Natural Risk	Change in environmental regulations.	low
R20	Inexperienced Staff	High	Operational Risk	Inexperienced staff	low
R21	Technical Failure	High	Operational	Some technical issues	high

			Risk	in software	
R22	Quality Failure	Medium	Operational Risk	Quality issues in the aircraft.	medium
R23	Corruption Risks	Medium	Operational Risk	Corruption in quality of raw material	low
R24	Data leakage Risks	Medium	IT-Related Risk	Attack from outside sources on the software systems.	medium
R25	Data Loss	High	IT-Related Risk	Data loss due to software issues	low
R26	Software Failure	High	IT-Related Risk	Software failure in the system	High

Table 12: Risk Register

4.8 Probability Impact Matrix

Probability impact matrix technique is used to prioritize the risk according to the label and probability mentioned on it in risk register, which can be as low, medium or high. For out project, probability impact matrix is given as below:

PROBABILITY	**HIGH**	**R11,R18**	**R12,R13**	**R3,R15,R16, R21,R27**
	MEDIUM	**R10,**	**R22,R24**	**R4,R5,R6,R7, R14**
	LOW	**R17**	**R19,R23**	**R1,R2,R8,R9, R20,R25**

		LOW	**MEDIUM**	**HIGH**
	IMPACT			

Table 13: Probability Impact Matrix

STATUS	**PROBABILITY ON THE PROJECT**	**IMPACT ON THE PROJECT**
LOW	Less than 30%	Time, cost, quality
MEDIUM	Less than 30%	Time, cost, quality
HIGH	More than 60%	Time, cost, quality

Table 14: Risk Occurring Probability

4.9 Project Quality Management

Project quality control is an important part of any project plan. It involves the methods and practices that are used to check the quality of all the products delivered by any organization.

4.9.1 Project Quality Metrics

Project Quality Metrics is a description list of all the attributes of the product. This metrics contains the method of testing these attributes, metrics for them and references to clarify if needed. For our project, the project quality metrics is given below:-

QUALITY METRICS					
PROJECT NAME: Design Improvement and Quality Control of Boeing 737 Max Aircraft.				**DATE: 30-Oct-2020**	
PROJECT LOCATION: US				**Revision: AP-00**	
ID	**ITEM**	**DESCRIP**	**METHOD OF**	**METRICS**	**REFERENCES**

		TION	**MEASUREMENT**		
1	Aluminium Alloy Structure	Execution	Stress Analysis Testing	According to the project specification.	https://www.boeing.com/commercial/737max/
2	Sensors	Material	Resolution Testing	According to the project specification table.	http://www.aqmd.gov/docs/default-source/aq-spec/resources-page/us-epa---sensor-evaluation-report.pdf?sfvrsn=0
		Execution	Hairclips Sensor Testing	According to the project specification table.	http://www.aqmd.gov/docs/default-source/aq-spec/resources-page/us-epa---sensor-evaluation-report.pdf?sfvrsn=0
3	Weight Distribution	Static	Pivoting Axis Test	According to the parameters needed.	https://www.hindawi.com/journals/ijae/2018/3582508/
		Dynamic	Spin Balance Testing	According to the parameters needed.	https://www.hindawi.com/journals/ijae/2018/3582508/
4	Pressure Distribution	Design Model	Wind-Tunnel Testing	Pressure at various points on the aircraft	https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-are-wind-tunnels-58.html
		Actual Aircraft	Flight Testing	Pressure at various points on the aircraft	https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-are-wind-tunnels-58.html

Table 15: Quality Metrics

5. Project Execution

The execution of the project is the stage in which planned work is carried out and production or service is provided. It is the longest stage of the life cycle of the project and takes the most commitment, time and money. It is critical that the deliverables of the project follow the specifications and requirements of the project.

5.1 Project Execution Scenario

The execution of the project started on April 1, 2019. The initial phase was to look for all the defects that at first caused the crash for earlier models and get the approval the new detail design. All the materials and resources required for the project were procured through vendors verified by sponsors.

On April 25, 2020, the second phase was initiated which included implementation and testing of the aircraft system. The first phase was almost completed on time and executed with the budget decided for the phase. For the second phase, the project completion was on time but it was a little over-budget. Overall, we managed to complete the project on time but we were slightly over-budgeting.

5.2 Measuring Project Progress

After the execution had started, the progress was evaluated on quarterly basis. Earned Value Management (EVM) was used as basic tool for measuring the project progress by comparing the Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP) and Actual Cost of Work Performed (ACWP).

5.2.1 Earned Value Management (EVM)

Earned Value Management is a project management tool to measure the performance and progress of project in terms of time and cost.

Performance Report 1 (April 2019 – April 2020):

During the first 12 months project was almost on schedule and costs are almost as budgeted. After 12 months as our EAC was more than the budget at completion we were expecting cost over-run for our project in future.

Table 16: Performance Report 1

PV	AC	EV	SPI	CPI	EAC	BAC
$150000000	$150026871	$149992125	0.9999475	0.9997684	$300034700	$300000000

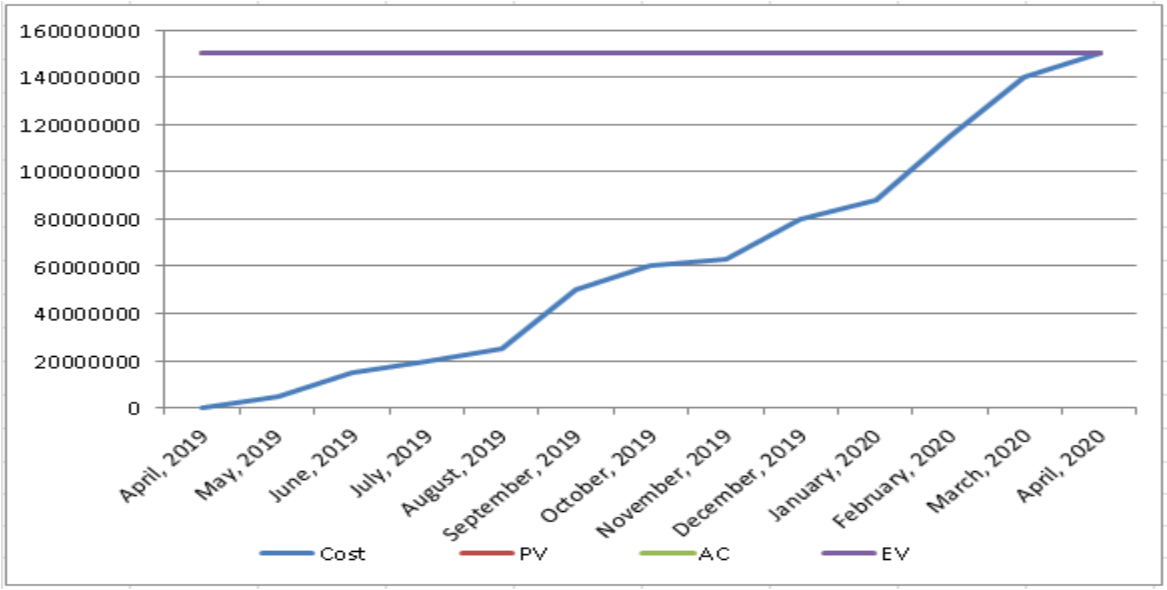


Figure 4: Performance Report 1

Performance Report 2 (April 2020 – December 2020):

During this period project was on schedule and over-budget because of the cost overruns. The final report shows that our project was completed on time but it was slightly over-budget.

PV	AC	EV	SPI	CPI	EAC	BAC
$300825000	$307043553	$300825000	1	0.979747	$306218550	$300000000

Table 17: Performance Report 2

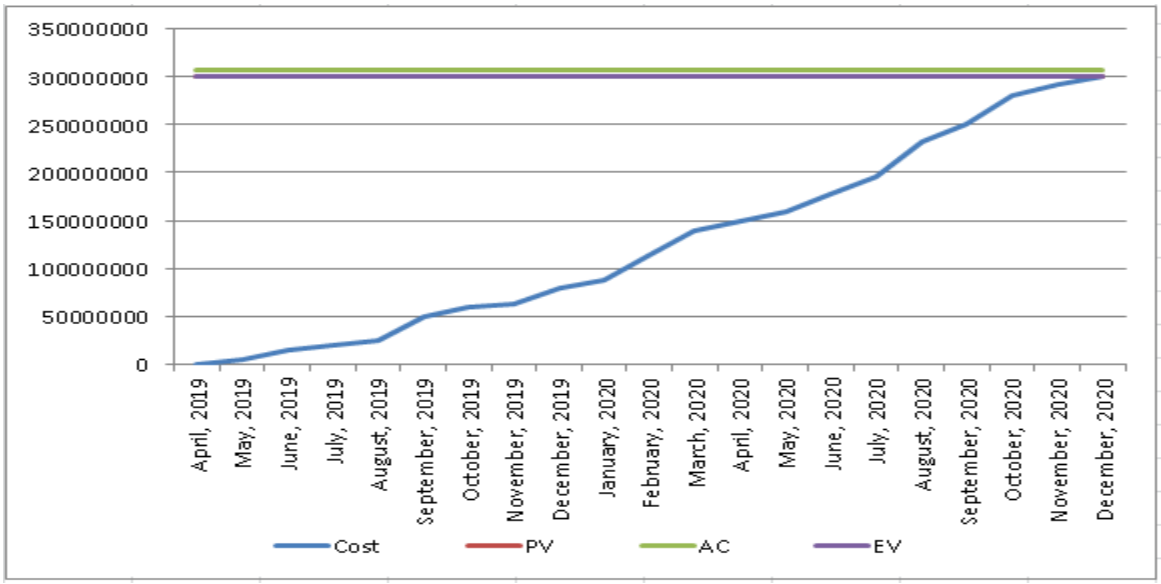


Figure 5: Performance Report 2

5.3 Project Resources Procurement

The materials that needed to be purchased were divided into different categories i.e. Raw Material, Airborne Structural Components, Self-made parts, Airborne System Finished products, Equipment delivered together with Aircraft System and Software.

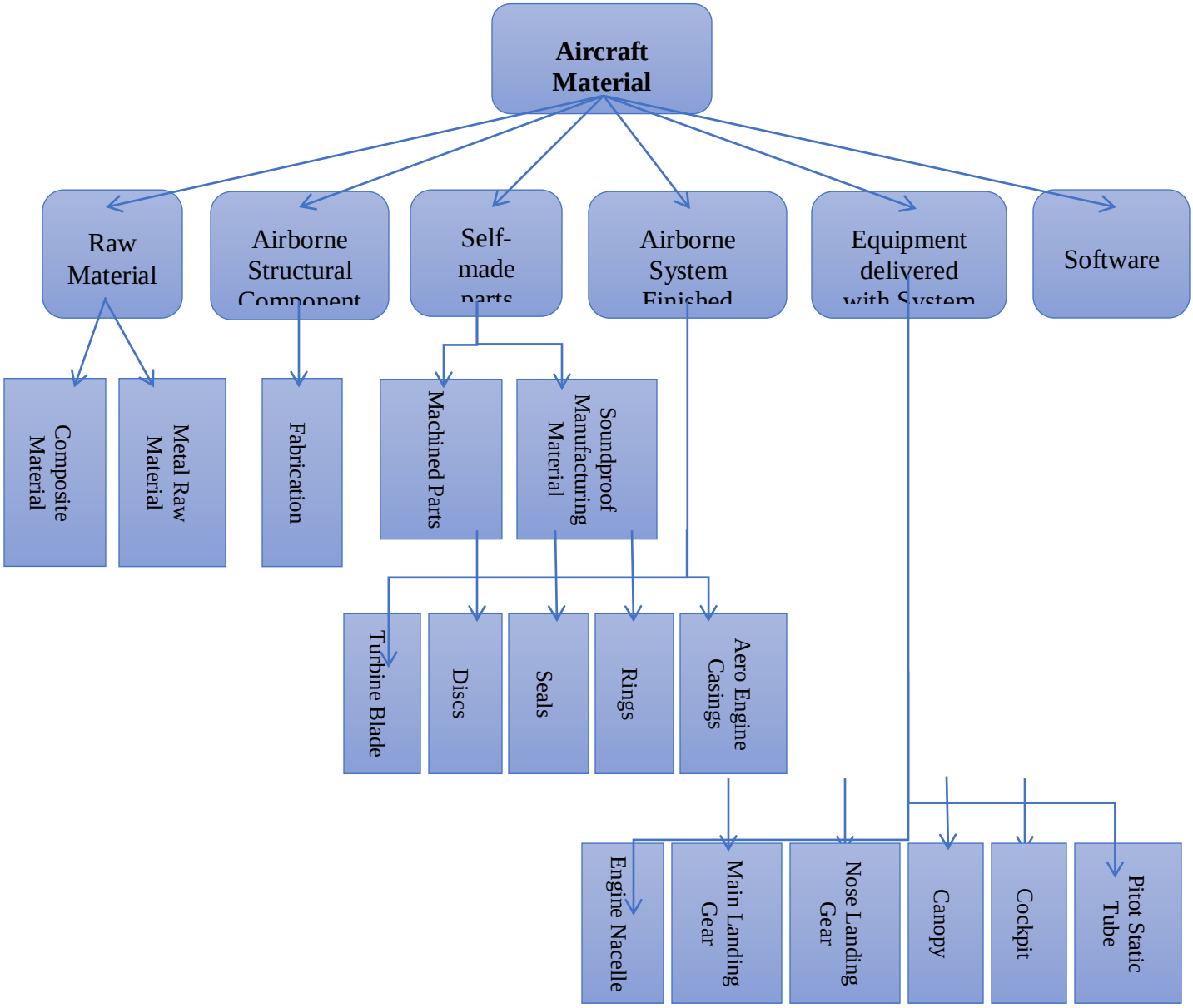


Figure 6: Aircraft Material Breakdown

The table below represents the detailed information about the amount of duration for each material to be procured and transported. Every vendor had to provide the materials within the time allocated to avoid any delay in the completion of project.

No.	Task Name	Duration	Start Date	Finish Date
	Raw Material			
1.	Composite Material			
I.	Polymer Matrix	25 days	10/06/2019	04/07/2019
	Procurement	10 days	10/06/2019	19/06/2019
	Transportation	15 days	20/06/2019	04/07/2019
II.	Ceramic Matrix Composite	18 days	10/06/2019	27/06/2019
	Procurement	6 days	10/06/2019	15/06/2019
	Transportation	12 days	16/06/2019	27/06/2019
III.	Metal Matrix	24 days	12/06/2019	05/07/2019
	Procurement	10 days	12/06/2019	21/06/2019
	Transportation	14 days	22/06/2019	05/07/2019
IV.	Silica	12 days	15/06/2019	26/06/2019
	Procurement	5 days	15/06/2019	19/06/2019
	Transportation	7 days	20/06/2019	26/06/2019
2.	Metal Raw material			
V.	Aluminium-Lithium Alloy	14 days	10/06/2019	23/06/2019
	Procurement	7 days	10/06/2019	16/06/2019
	Transportation	7 days	17/06/2019	23/06/2019
VI.	Nickel Alloy	10 days	11/06/2019	20/06/2019
	Procurement	4 days	11/06/2019	14/06/2019
	Transportation	6 days	15/06/2019	20/06/2019

VII.	Zirconia	15 days	10/06/2019	24/06/2019
	Procurement	7 days	10/06/2019	16/06/2019
	Transportation	8 days	17/06/2019	24/06/2019
	Airborne Structural Components			
3.	Fabrication			
VIII.	Resin Matrix Composites	22 days	22/06/2019	13/07/2019
	Procurement	6 days	22/06/2019	27/06/2019
	Transportation	16 days	27/06/2019	13/07/2019
IX.	Graphite reinforced polymer	27 days	18/06/2019	14/07/2019
	Procurement	12 days	18/06/2019	29/06/2019
	Transportation	15 days	30/06/2019	14/07/2019
X.	Graphite Fibre composites	25 days	20/06/2019	14/07/2019
	Procurement	9 days	20/06/2019	28/06/2019
	Transportation	16 days	29/06/2019	14/07/2019
	Self-made parts			
4.	Machined Parts			
XI.	Nickel and Cobalt based superalloy	16 days	10/06/2019	25/06/2019
	Procurement	7 days	10/06/2019	16/06/2019
	Transportation	9 days	17/06/2019	25/06/2019
XII.	Carbon-fibre reinforced polymer	20 days	10/06/2019	29/06/2019
	Procurement	12 days	10/06/2019	21/06/2019

	Transportation	8 days	22/06/2019	29/06/2019
5.	Soundproof Manufacturing Material			
XIII.	Functionally Graded Panels	12 days	25/07/2019	05/08/2019
	Procurement	4 days	25/07/2019	28/07/2019
	Transportation	8 days	29/07/2019	05/08/2019
	Airborne System Finished products			
6.	Turbine blade	15 days	15/06/2019	29/06/2019
	Procurement	6 days	15/06/2019	20/06/2019
	Transportation	9 days	21/06/2019	29/06/2019
7.	Discs	10 days	15/06/2019	24/06/2019
	Procurement	4 days	15/06/2019	18/06/2019
	Transportation	6 days	19/06/2019	24/06/2019
8.	Seals	10 days	15/06/2019	24/06/2019
	Procurement	4 days	15/06/2019	18/06/2019
	Transportation	6 days	19/06/2019	24/06/2019
9.	Rings	10 days	15/06/2019	24/06/2019
	Procurement	4 days	15/06/2019	18/06/2019
	Transportation	6 days	19/06/2019	24/06/2019
10.	Aero engine Casings	18 days	15/06/2019	02/07/2019
	Procurement	8 days	15/06/2019	22/06/2019
	Transportation	10 days	23/06/2019	02/07/2019

	Equipment delivered together with Aircraft system			
11.	Engine Nacelle	9 days	10/06/2019	18/06/2019
	Procurement	3 days	10/06/2019	12/06/2019
	Transportation	6 days	13/06/2019	18/06/2019
12.	Main landing gear	12 days	10/06/2019	21/06/2019
	Procurement	4 days	10/06/2019	13/06/2019
	Transportation	8 days	14/06/2019	21/06/2019
13.	Nose landing gear	12 days	10/06/2019	21/06/2019
	Procurement	4 days	10/06/2019	13/06/2019
	Transportation	8 days	14/06/2019	21/06/2019
14.	Canopy	14 days	10/06/2019	23/06/2019
	Procurement	4 days	10/06/2019	13/06/2019
	Transportation	10 days	14/06/2019	23/06/2019
15.	Cockpit	10 days	10/06/2019	19/06/2019
	Procurement	4 days	10/06/2019	13/06/2019
	Transportation	6 days	14/06/2019	19/06/2019
16.	Pitot Static Tube	10 days	10/06/2019	19/06/2019
	Procurement	4 days	10/06/2019	13/06/2019
	Transportation	6 days	14/06/2019	19/06/2019
	Software	390 days	26/05/2019	18/06/2020

Table 18: Project resources Procurement schedule

5.4 Project Quality Assurance

Quality Assurance is a process-oriented approach that guarantees that project quality meets the expectations of the customers. In this the material and the equipment are tested by the Inspection team to ensure that the plan is sufficiently successful to prevent any expected defect. The quality checklist includes a list of items that include information about activities for quality assurance.

Quality Checklist				
Project**: Design Improvement and Quality Control of Boeing 737 Max**				Date: 13 August 2019
	Verification			

Quality Criteria	**Yes**	**No**	**N/A**	**Comments**
Employee Welfare	☐			
Availability of personal protective equipment	☐	☐		Require safer equipment's
Procurement Management	☐	☐		
Quality Control	☐	☐		
Quality Metrics	☐	☐		
Quality Management Plan	☐	☐		
Project Quality Review	☐	☐		
Requirement for Construction area fulfilled	☐	☐		
Wastes are properly disposed	☐	☐		
Environmental considerations addressed		☐		

Table 19: Quality Checklist

Quality checklist for materials				
S. No	**Checklist**	**Yes**	**No**	**Comments**
1	Nickel-alloy resistant to 600 C	✔		
2	Is metal matrix and silica durable	✔		
3	Metal corrosion protection	✔		
4	Is the quality of materials as per specifications	✔		

Table 20: Quality Checklist for materials

Quality checklist for items delivered with Aircraft System				
S. No	**Checklist**	**Yes**	**NO**	**Comments**
1	Items are free of damage	✔		
2	Are rings and discs resistant to heavy vibrations	✔		
3	Items have been tested and tag date is within service period	✔		
4	Checked Pitot Static tube	✔		
5	Turbine blade Checked	✔		

Table 21: Quality Checklist for items delivered with Aircraft System

6. Project Monitoring and Controlling

6.1 Change Requests

6.1.1 Change Request 1

Request Statement	Give priority to the aircraft control surfaces over the MCAS.
Description	The control surfaces of the aircraft are the aerodynamic devices that allow a pilot to adjust the altitude of the aircraft. Thus, development of necessary flight control surfaces is a critical development in an aircraft.
Impact on Scope	Yes

Impact on Cost	Yes
Impact on Schedule	No
Impact on Resources	No
Reason for Change	The control surfaces are attached to airframe on hinges; it deflects the air stream passing over them. This directly results in providing a stable flight.

Table 22: Change Request 1 Description

6.1.2 Change Request 2

Request Statement	MCAS should be made manual rather than automatic.
Description	Maneuvering Characteristics Augmentation System or MCAS is a flight control software that enhances aircraft handling and decreases the pitching up tendency of the flight at elevated angle of attack.
Impact on Scope	Yes
Impact on Cost	Yes
Impact on Schedule	No
Impact on Resources	Yes
Reason for Change	The automated MCAS system changed the angle of attack sensor thus creating a room for errors and taking aircraft control off the pilot's control. Thus, the manual system is required so that the main control stays in the hands of the pilot.

Table 23: Change Request 2 Description

6.2 Quality Control

The goal of the Quality Management plan is to monitor the quality or improper operation of various equipment and instruments and to ensure that the project meets the needs for which it has been carried out. It requires monitoring the quality of products and equipment. Quality management is about quality preparation, quality monitoring and assurance being carried out. QTP consists of different activities required during the project life cycle to define quality control. It is duty of project manager to create the project plan at the beginning of the project to check its impact on scope, time and cost. The three most important criteria included in quality are:

- Final product should be used for the purpose as it was intended for.

- Final product should fulfill the objective for which it was made.
- All the written particulars should be met.

Quality management and Quality assurance are the two most important elements of the Boeing 737 Max. To verify the quality of the work, different tests must be performed. The failed tests should follow the steps given below:

- Retesting: If the first test results are incorrect, then this should be performed.
- Improper operation of equipment: In this situation, it is possible to replace obsolete equipment with new equipment.

The quality of the project is regulated by various instruments.

6.2.1 Flowchart

It is the graphical representation of a sequence of processes that is used to analyze the problem and how it can be solved. In our project, we are using the flow chart to represent the various steps to check the quality or functioning of equipment and materials.

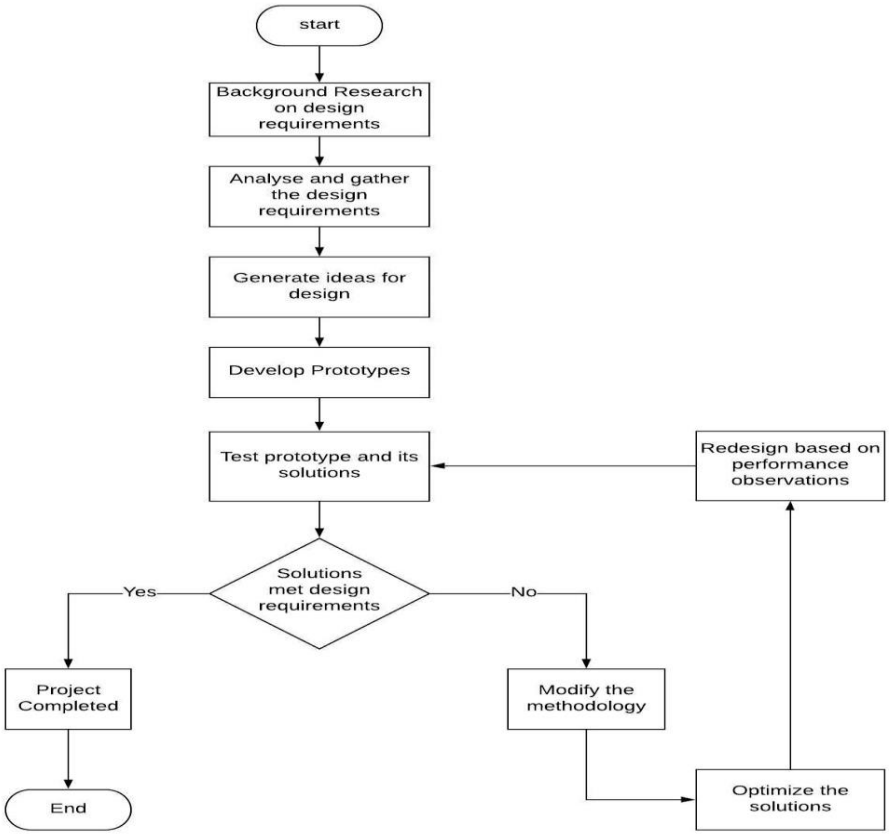


Figure 7: Quality Flow Control

6.2.2 Cause-Effect Diagram

A fishbone diagram, additionally called an Ishikawa diagram, is a representation apparatus for classifying the potential reasons for an issue to distinguish its main causes. The issue or impact is shown at the head or mouth of the fish. Conceivable contributing causes are recorded on the littler "bones" under different reason classes. A fishbone graph can be useful in distinguishing potential foundations for a difficult that may not in any case be considered by guiding the group to look at the classifications and consider elective causes.

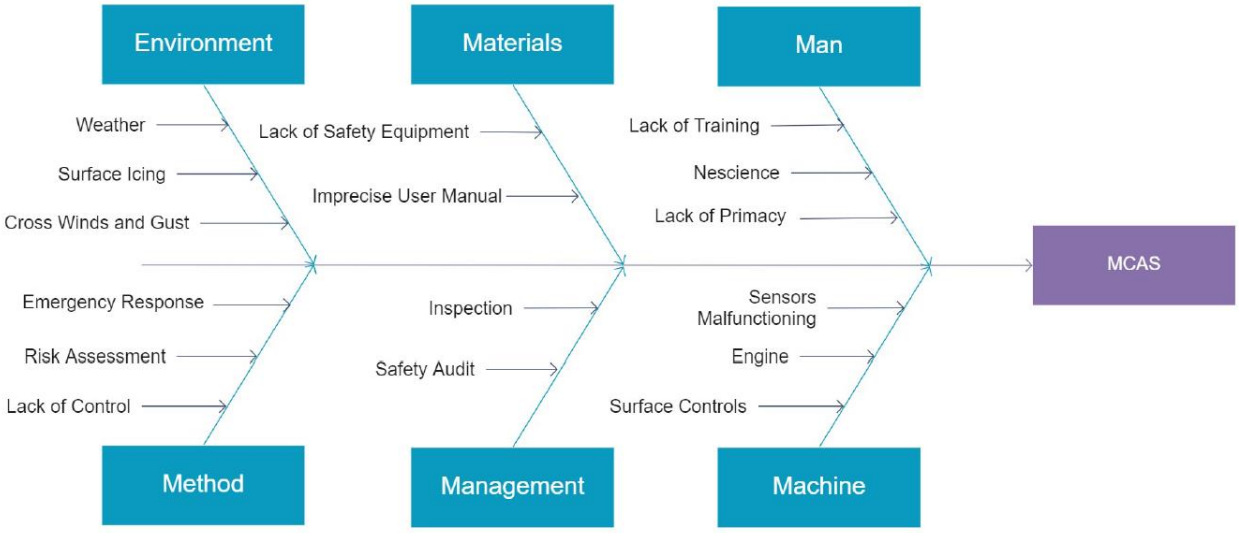


Figure 8: Cause-Effect diagram

6.2.3 Quality Control Plan

Project related results and deliverables should be monitored to check whether they meet quality standards.

S.NO.	Quality Consideration	Decisive Factors	Final Authority	Responsibility
1	Raw materials (Carbon fibre, Graphite fibre Composites, Aluminium-Lithium alloys, Zirconia)	As per US Federal Aviation Administration	Project Manager	Construction manager will inspect the quality of raw materials whether they meet Quality standards or not

2	Planning and Designing of the software system and hardware changes	As per US Federal Aviation Administration	Project Manager	The engineers must design the software according to the specifications and it must be approved by project manager
3	Self-made fittings (Machined parts, Soundproof Manufacturing Material)	As per US Federal Aviation Administration	Project Manager	The quality of the self-made fittings must be properly inspected by project engineer before getting final approval from manager
4	Aircraft Deliverables (Rings, Discs, Turbine blade, Pitot Static tube)	As per US Federal Aviation Administrati on	Project Manager	Project engineer will check quality of all the deliverables before approval from project manager
5	Project closing	Approval from client	Project Manager	The project manager will close the project as soon as it receives completed status of work from quality manager

Table 24: Quality Control Plan

6.2.4 Progress Reports

6.2.4.1 Progress Report 1

Project Name: Design Improvement and Quality Control of Boeing 737 Max Aircraft	
Date: May 23, 2020	
Start Date: March 23, 2020	
End Date: May 18, 2020	**% Completed:** 55
Status: Good	
Present Phase: Implementation	

Work Completed: • Metal extraction from the raw material. • Finished products aligned with self-made parts.
Work to be completed in the next phase: • To check compatibility of the finished products with the self-made parts and the items delivered with the Aircraft system.
Project Risks: No risks
Issues and Changes: Not applicable

Table 25: Progress Report 1

6.2.4.2 Progress Report 2

Project Name: Design Improvement and Quality Control of Boeing 737 Max Aircraft	
Date: August 28, 2020	
Start Date: May 24, 2020	
End Date: August 10, 2020	**% Completed:** 75
Status: Good	
Present Phase: Implementation	
Work Completed: • Compatibility check performed on the finished products. • Pitot static tube installed with the other finished products of the airborne system.	
Work to be completed in the next phase: • Testing of the assembled system. • Checking the system's response to the new MCAS software.	
Project Risks: No risks	
Issues and Changes: Not applicable	

Table 26: Progress Report 1

7. Project Closing

This is the fourth and the final phase of the project life cycle. In this stage the Final project receives the acceptance from Stakeholders and Customers. The closing phase may be divided into various stages as below.

7.1 Project Closure Report

This Project closure report is the official confirmation of the completion of the project. The document must be signed off by the Project Sponsor ensuring that all the objectives have met.

7.2 Project Information

The project was completed on time. Due to the changes requested in the control phase, the project was slightly over the budget. The tables below show the summary of the project.

Project Name	Design Improvement and Quality Control of Boeing 737 Max Aircraft
Project Sponsor	Boeing Aerospace Company
Project Manager	Mr. Venkat SK Dutt
Remarks	The Project is completed.

Parameters	Baseline	Actual	Comments
Start Date	15-March-2019	01-April-2019	Started Late
End Date	06-Dec-2020	07-Dec-2020	On Schedule
Budget	300000000 USD		Over Budget

Table 27: Project Information

7.3 Contract Closure

As all the deliverables expected by the client have met with the completion of the project, all the contracts related to the project have been closed.

7.4 Lessons Learnt

There is a necessity to make a list of things we learn from each project and keep these in mind when taking up a new project. This experience will help us overcome potential problems and also predict them in advance. Some of the lessons learnt from our project are listed below.

- The most important phase in the project lifecycle is the planning phase.
- The manager should coordinate and communicate constantly with the team members for the successful completion of the project.
- Regular meetings should be scheduled between Contractor, Consultant and the Project Manager.

- There should be a proper risk management plan in order to deal with unexpected risk or changes occurring in the project and to avoid any delay in the completion of the project.

7.5 Project Completion Form

Project Name : Design Improvement and Quality Control of Boeing 737 Max Aircraft

Project Manager: Venkat SK Dutt

We, hereby declare that the project has been completed successfully, all the stakeholders are satisfied and the acceptance criteria have been met.

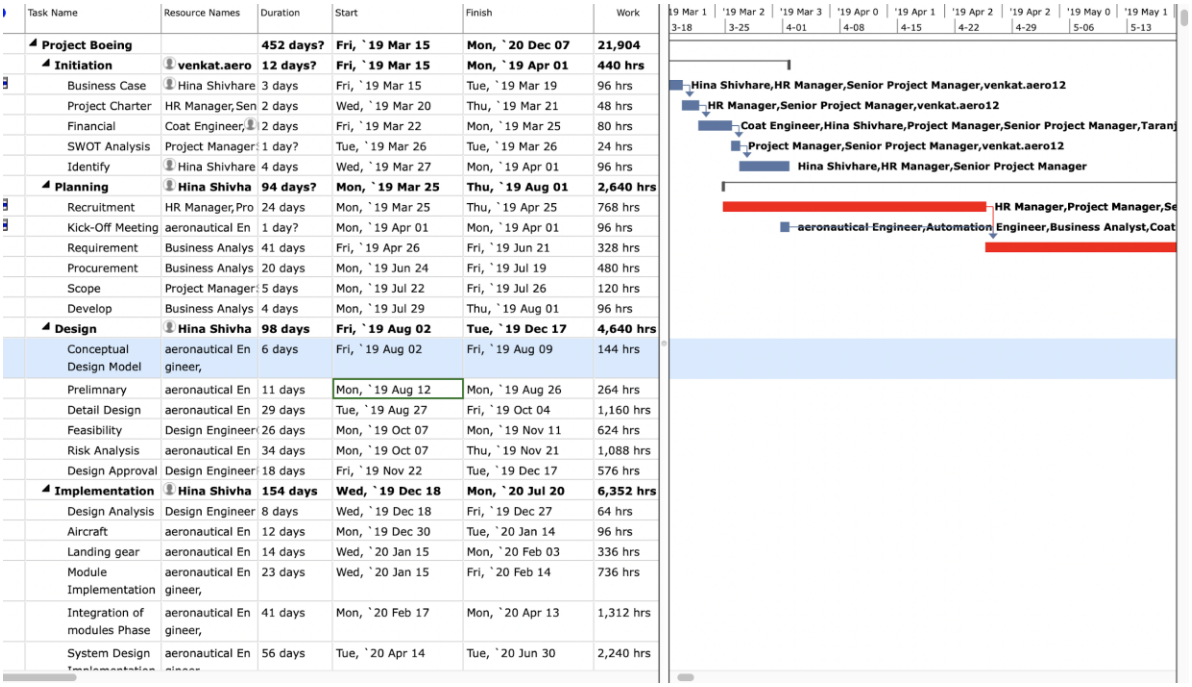
All the Sponsors, Managers, Employees and the workers have contributed towards the successful completion of the project.

The project was finished in accordance with the specified requirements and accepted by stakeholders and customers.

Name	**Position**	**Signature**	**Date**
Venkat SK Dutt	Project Manager	VS	06-Dec-2020
Hina Shivhare	Design, Risk & HR Manager	HS	06-Dec-2020
Taranjyot Singh	Quality & Procurement Manager	TS	06-Dec-2020

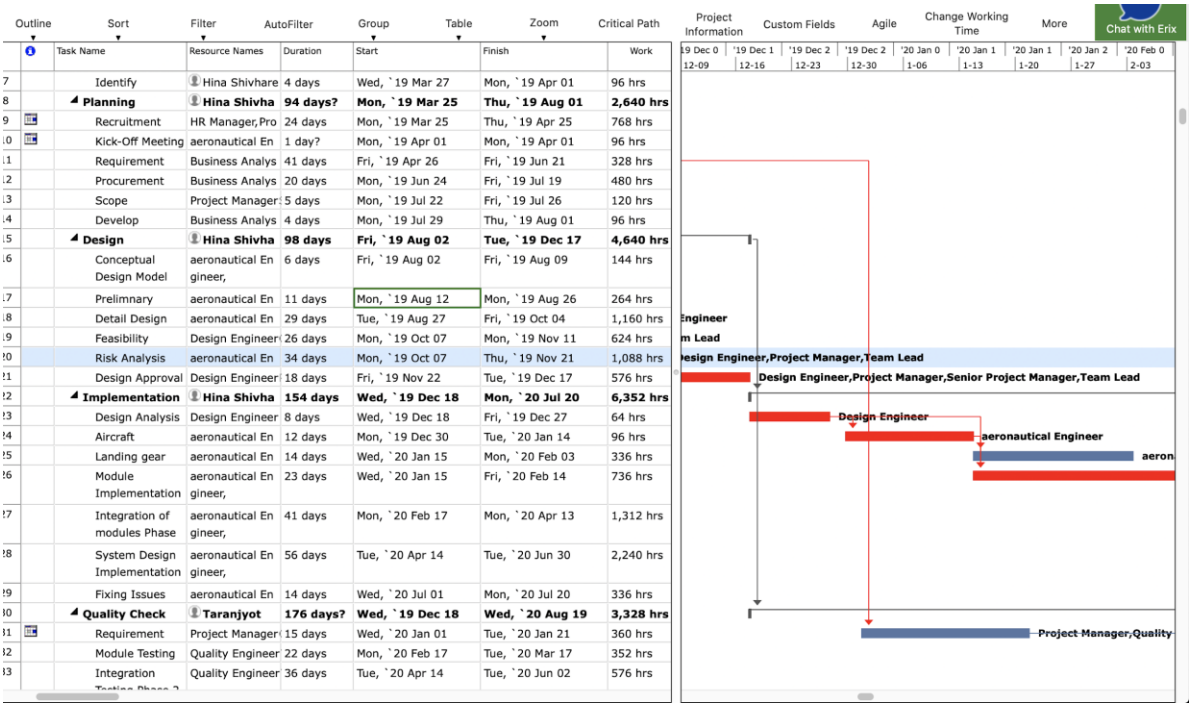
Table 28: Project Completion Form

Appendix



Task Name	Resource Names	Duration	Start	Finish	Work
Project Boeing		**452 days?**	**Fri, `19 Mar 15**	**Mon, `20 Dec 07**	**21,904**
Initiation	**venkat.aero**	**12 days?**	**Fri, `19 Mar 15**	**Mon, `19 Apr 01**	**440 hrs**
Business Case	Hina Shivhare	3 days	Fri, `19 Mar 15	Tue, `19 Mar 19	96 hrs
Project Charter	HR Manager,Sen	2 days	Wed, `19 Mar 20	Thu, `19 Mar 21	48 hrs
Financial	Coat Engineer,	2 days	Fri, `19 Mar 22	Mon, `19 Mar 25	80 hrs
SWOT Analysis	Project Manager	1 day?	Tue, `19 Mar 26	Tue, `19 Mar 26	24 hrs
Identify	Hina Shivhare	4 days	Wed, `19 Mar 27	Mon, `19 Apr 01	96 hrs
Planning	**Hina Shivha**	**94 days?**	**Mon, `19 Mar 25**	**Thu, `19 Aug 01**	**2,640 hrs**
Recruitment	HR Manager,Pro	24 days	Mon, `19 Mar 25	Thu, `19 Apr 25	768 hrs
Kick-Off Meeting	aeronautical En	1 day?	Mon, `19 Apr 01	Mon, `19 Apr 01	96 hrs
Requirement	Business Analys	41 days	Fri, `19 Apr 26	Fri, `19 Jun 21	328 hrs
Procurement	Business Analys	20 days	Mon, `19 Jun 24	Fri, `19 Jul 19	480 hrs
Scope	Project Manager	5 days	Mon, `19 Jul 22	Fri, `19 Jul 26	120 hrs
Develop	Business Analys	4 days	Mon, `19 Jul 29	Thu, `19 Aug 01	96 hrs
Design	**Hina Shivha**	**98 days**	**Fri, `19 Aug 02**	**Tue, `19 Dec 17**	**4,640 hrs**
Conceptual Design Model	aeronautical En gineer,	6 days	Fri, `19 Aug 02	Fri, `19 Aug 09	144 hrs
Prelimnary	aeronautical En	11 days	Mon, `19 Aug 12	Mon, `19 Aug 26	264 hrs
Detail Design	aeronautical En	29 days	Tue, `19 Aug 27	Fri, `19 Oct 04	1,160 hrs
Feasibility	Design Engineer	26 days	Mon, `19 Oct 07	Mon, `19 Nov 11	624 hrs
Risk Analysis	aeronautical En	34 days	Mon, `19 Oct 07	Thu, `19 Nov 21	1,088 hrs
Design Approval	Design Engineer	18 days	Fri, `19 Nov 22	Tue, `19 Dec 17	576 hrs
Implementation	**Hina Shivha**	**154 days**	**Wed, `19 Dec 18**	**Mon, `20 Jul 20**	**6,352 hrs**
Design Analysis	Design Engineer	8 days	Wed, `19 Dec 18	Fri, `19 Dec 27	64 hrs
Aircraft	aeronautical En	12 days	Mon, `19 Dec 30	Tue, `20 Jan 14	96 hrs
Landing gear	aeronautical En	14 days	Wed, `20 Jan 15	Mon, `20 Feb 03	336 hrs
Module Implementation	aeronautical En gineer,	23 days	Wed, `20 Jan 15	Fri, `20 Feb 14	736 hrs
Integration of modules Phase	aeronautical En gineer,	41 days	Mon, `20 Feb 17	Mon, `20 Apr 13	1,312 hrs
System Design	aeronautical En	56 days	Tue, `20 Apr 14	Tue, `20 Jun 30	2,240 hrs

Figure 9: Gantt chart 1



Task Name	Resource Names	Duration	Start	Finish	Work
Identify	Hina Shivhare	4 days	Wed, `19 Mar 27	Mon, `19 Apr 01	96 hrs
Planning	**Hina Shivha**	**94 days?**	**Mon, `19 Mar 25**	**Thu, `19 Aug 01**	**2,640 hrs**
Recruitment	HR Manager,Pro	24 days	Mon, `19 Mar 25	Thu, `19 Apr 25	768 hrs
Kick-Off Meeting	aeronautical En	1 day?	Mon, `19 Apr 01	Mon, `19 Apr 01	96 hrs
Requirement	Business Analys	41 days	Fri, `19 Apr 26	Fri, `19 Jun 21	328 hrs
Procurement	Business Analys	20 days	Mon, `19 Jun 24	Fri, `19 Jul 19	480 hrs
Scope	Project Manager	5 days	Mon, `19 Jul 22	Fri, `19 Jul 26	120 hrs
Develop	Business Analys	4 days	Mon, `19 Jul 29	Thu, `19 Aug 01	96 hrs
Design	**Hina Shivha**	**98 days**	**Fri, `19 Aug 02**	**Tue, `19 Dec 17**	**4,640 hrs**
Conceptual Design Model	aeronautical En gineer,	6 days	Fri, `19 Aug 02	Fri, `19 Aug 09	144 hrs
Prelimnary	aeronautical En	11 days	Mon, `19 Aug 12	Mon, `19 Aug 26	264 hrs
Detail Design	aeronautical En	29 days	Tue, `19 Aug 27	Fri, `19 Oct 04	1,160 hrs
Feasibility	Design Engineer	26 days	Mon, `19 Oct 07	Mon, `19 Nov 11	624 hrs
Risk Analysis	aeronautical En	34 days	Mon, `19 Oct 07	Thu, `19 Nov 21	1,088 hrs
Design Approval	Design Engineer	18 days	Fri, `19 Nov 22	Tue, `19 Dec 17	576 hrs
Implementation	**Hina Shivha**	**154 days**	**Wed, `19 Dec 18**	**Mon, `20 Jul 20**	**6,352 hrs**
Design Analysis	Design Engineer	8 days	Wed, `19 Dec 18	Fri, `19 Dec 27	64 hrs
Aircraft	aeronautical En	12 days	Mon, `19 Dec 30	Tue, `20 Jan 14	96 hrs
Landing gear	aeronautical En	14 days	Wed, `20 Jan 15	Mon, `20 Feb 03	336 hrs
Module Implementation	aeronautical En gineer,	23 days	Wed, `20 Jan 15	Fri, `20 Feb 14	736 hrs
Integration of modules Phase	aeronautical En gineer,	41 days	Mon, `20 Feb 17	Mon, `20 Apr 13	1,312 hrs
System Design Implementation	aeronautical En gineer,	56 days	Tue, `20 Apr 14	Tue, `20 Jun 30	2,240 hrs
Fixing Issues	aeronautical En	14 days	Wed, `20 Jul 01	Mon, `20 Jul 20	336 hrs
Quality Check	**Taranjyot**	**176 days?**	**Wed, `19 Dec 18**	**Wed, `20 Aug 19**	**3,328 hrs**
Requirement	Project Manager	15 days	Wed, `20 Jan 01	Tue, `20 Jan 21	360 hrs
Module Testing	Quality Engineer	22 days	Mon, `20 Feb 17	Tue, `20 Mar 17	352 hrs
Integration	Quality Engineer	36 days	Tue, `20 Apr 14	Tue, `20 Jun 02	576 hrs

Figure 10: Gantt chart 2

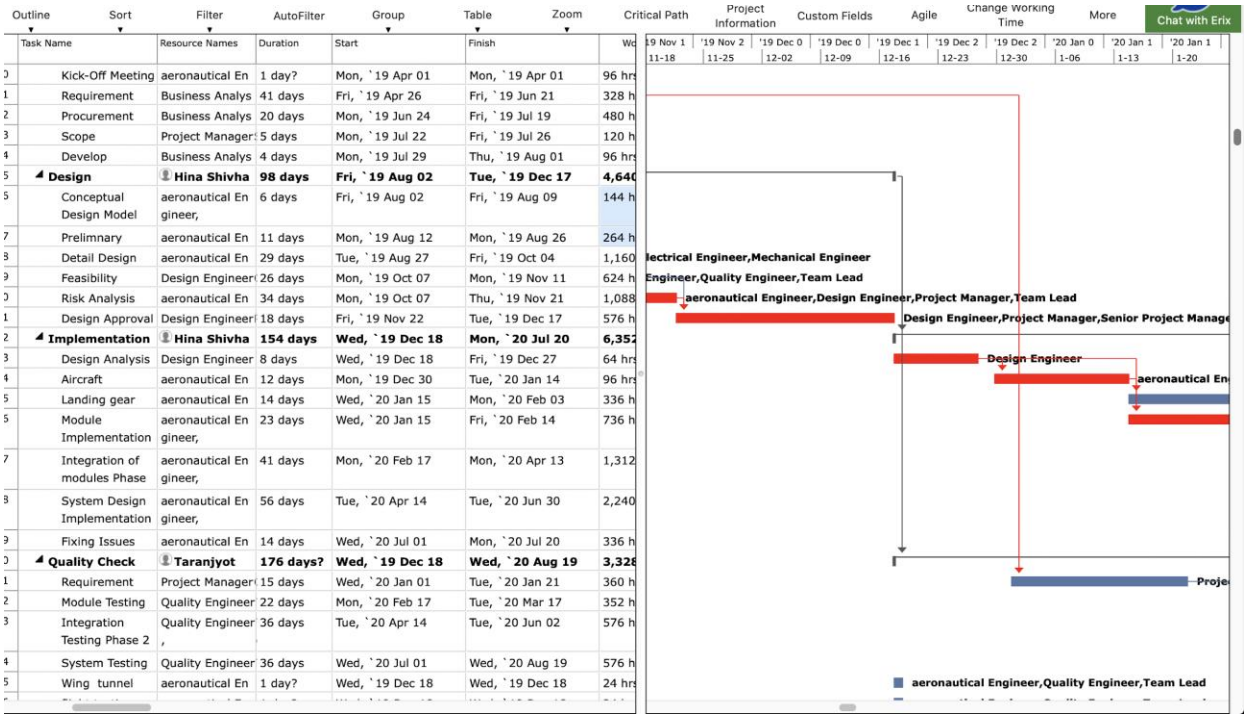


Figure 11: Gantt chart 3

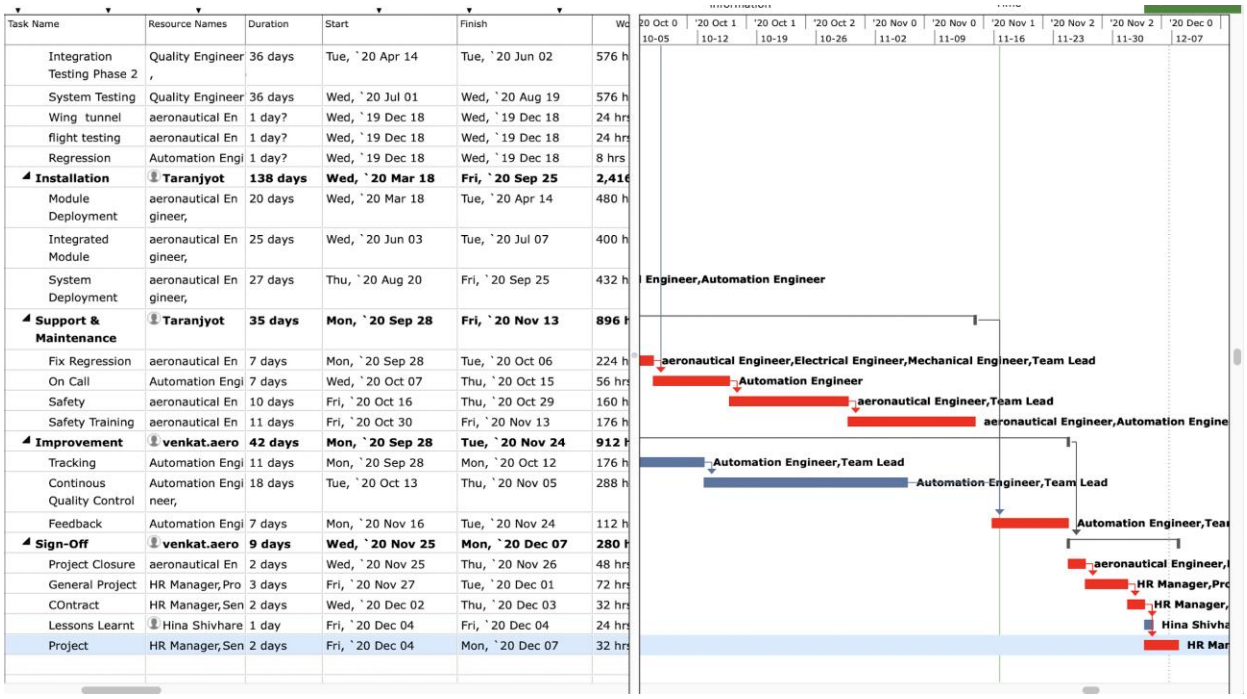


Figure 12: Gantt chart 4

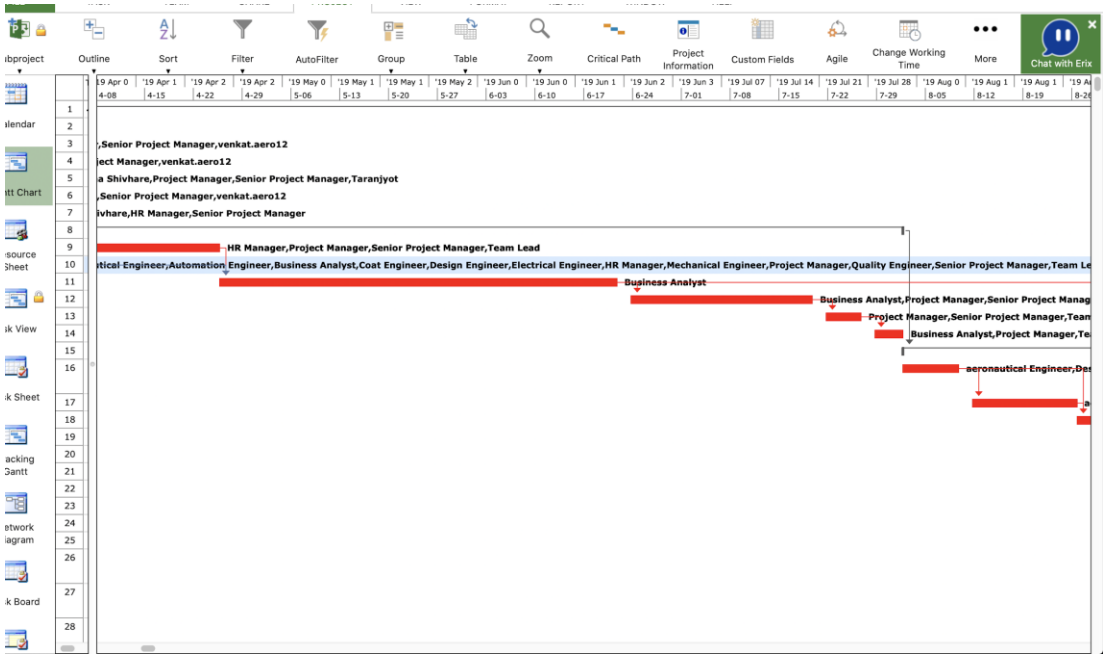


Figure 13: Gantt chart 5

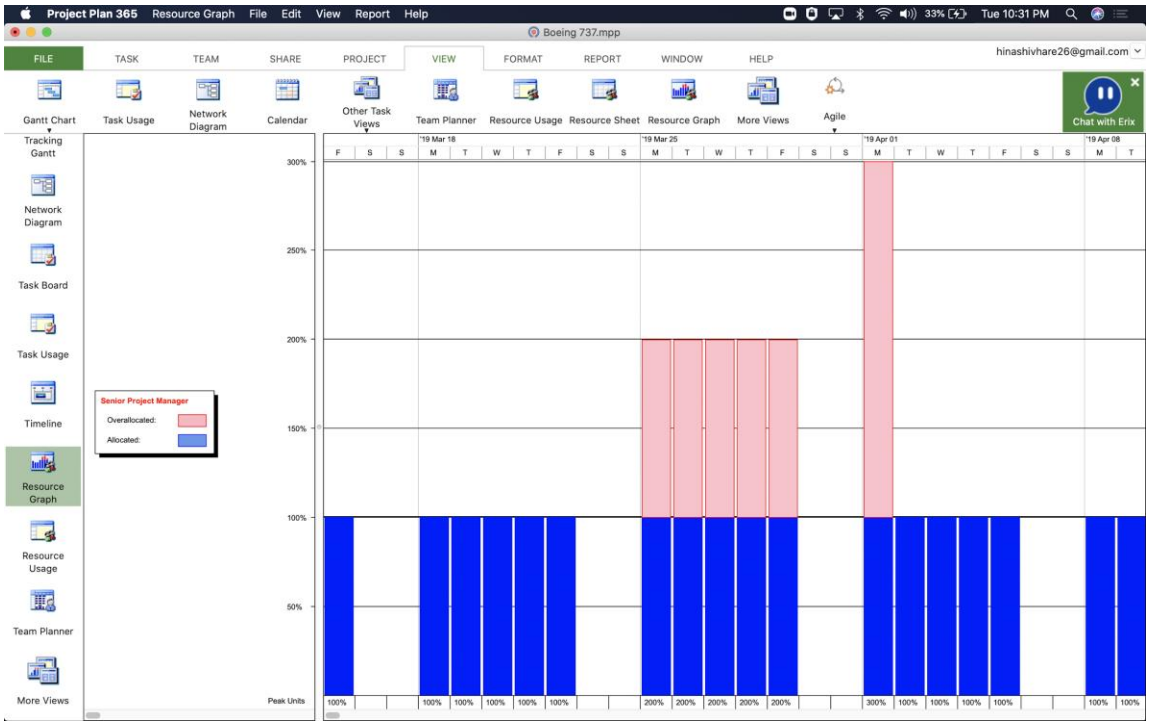


Figure 14: Resource Graph

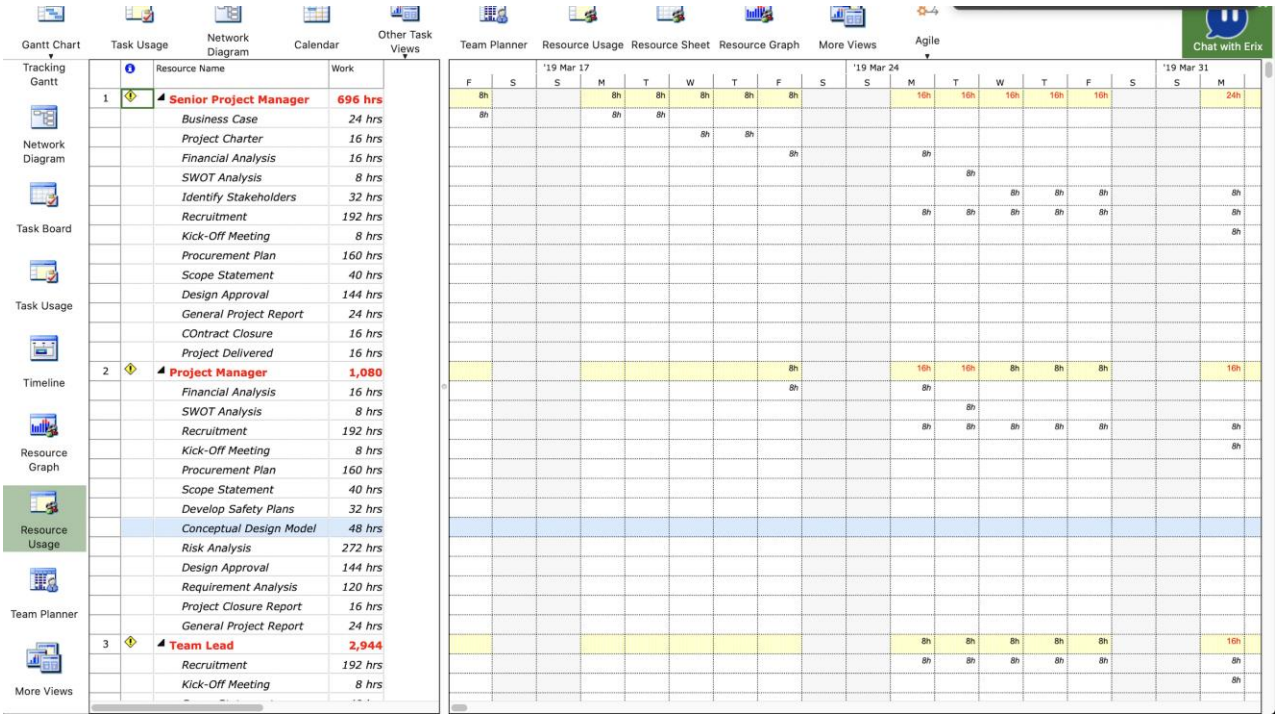


Figure 15: Resource Usage

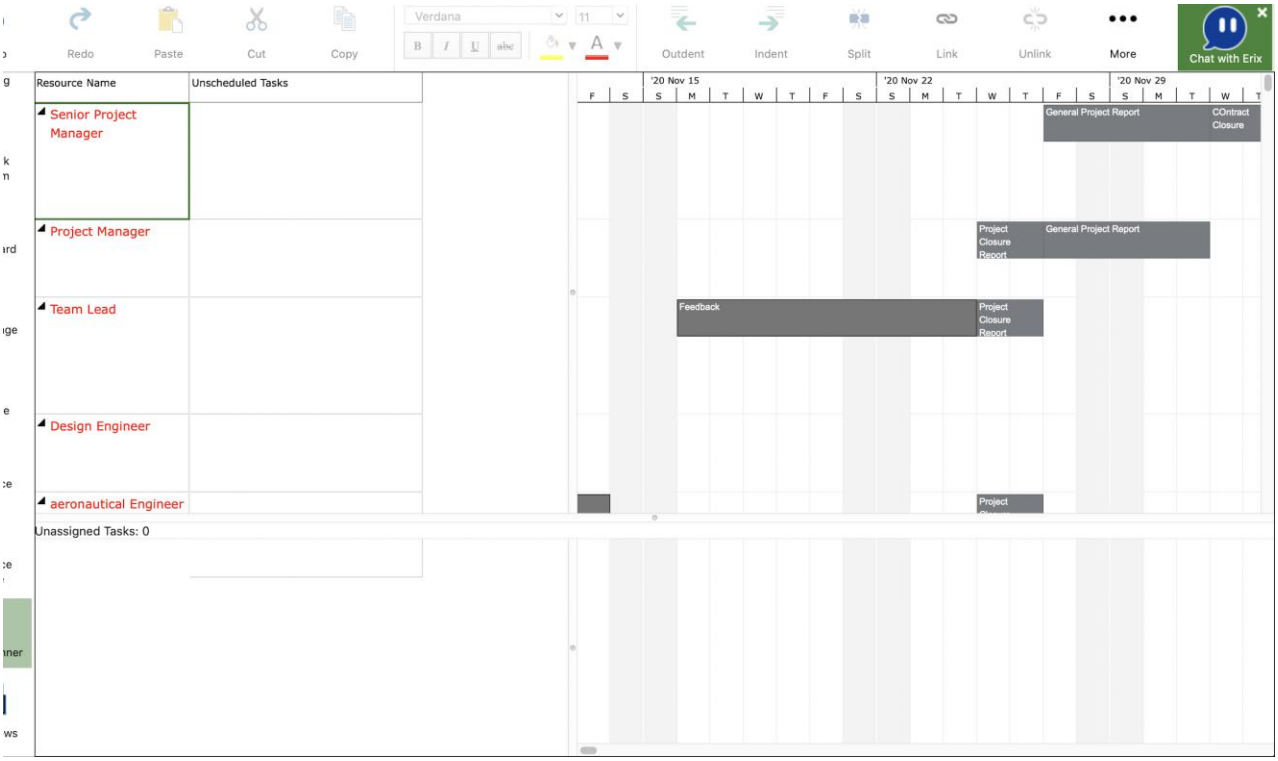


Figure 16: Critical Resources Graph

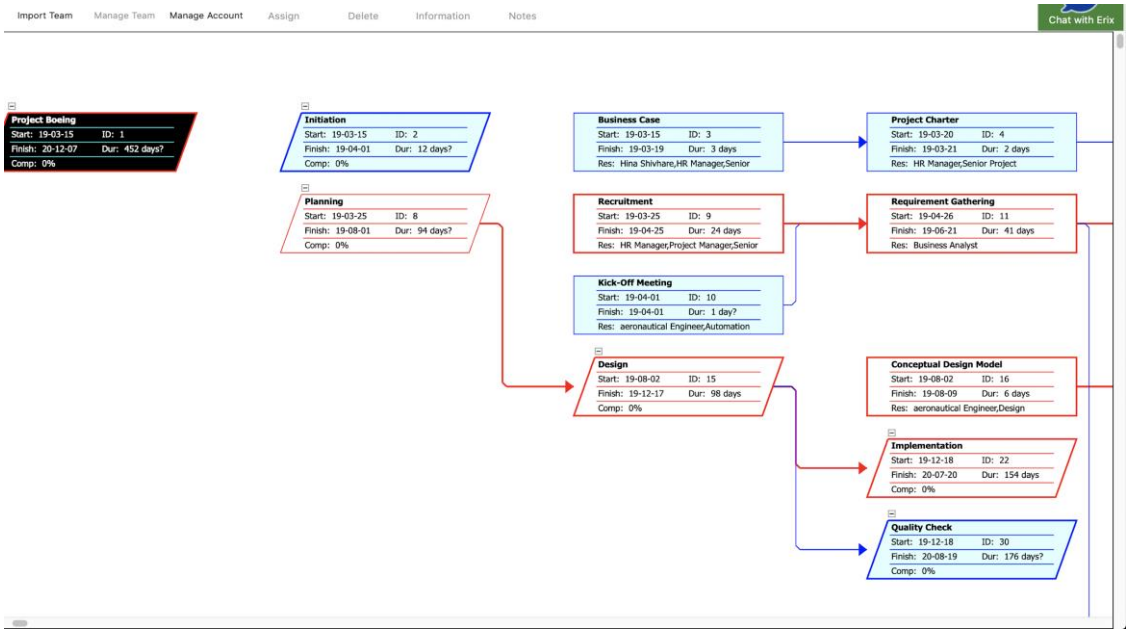


Figure 17: Critical Path View 1

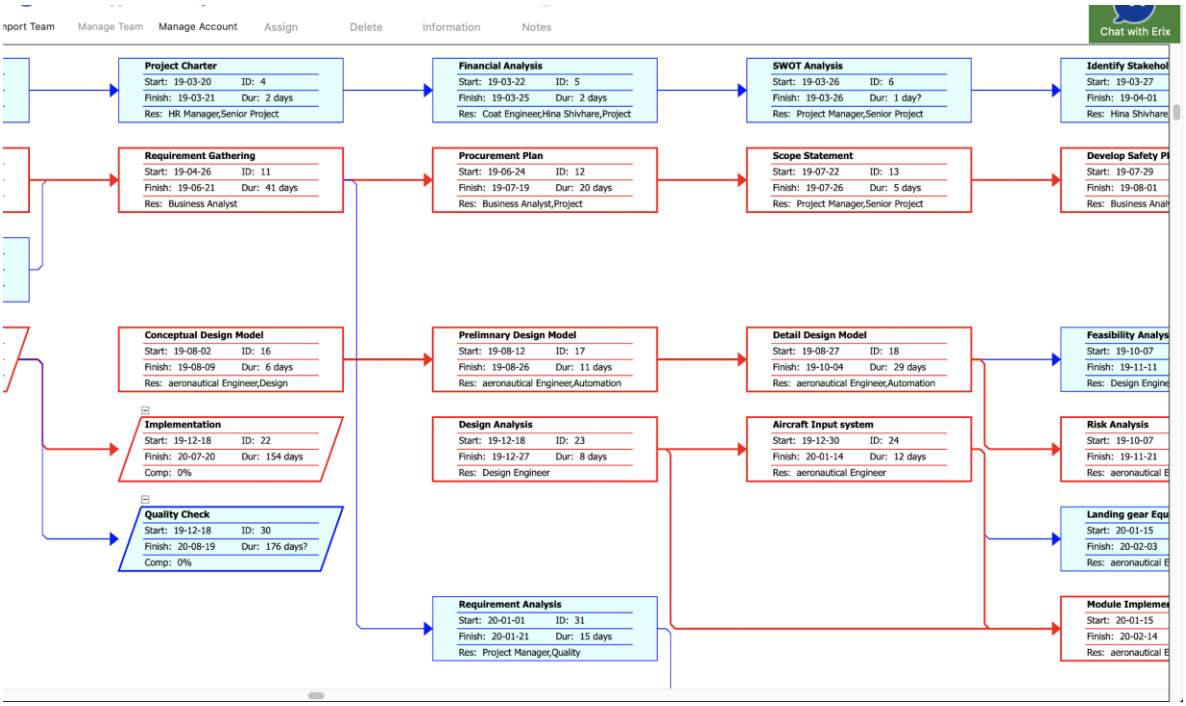


Figure 18: Critical Path View 2

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