IMPLEMENTING DISTRIBUTED ANALYTICAL SYSTEMS ON A CLOUD ARCHITECTURE

PROJECT PLAN

NOVEMBER 29, 2020

TEAM 2
GALAXY CORPORATION, CLEVELAND, OH

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I. Project Overview

Project Title: Implementing Distributed Analytical Systems on a Cloud Architecture

I.1 Purpose, Scope and Objectives, and Business Case

The recent enormous data flow into Galaxy Corporation's traditional legacy system has led to a loss in revenue. This is attributed to slow lagging, data loss, and data leakage in the corporation. The objective of this project is to develop a high performance and resilient cloud based analytical system to improve scalability, optimize data query, and reduce processing and storage cost.

The success of the project can be ascertained if the project is completed and fully functional by the end of the 8th month of its life cycle. Another measure of the success of the project is that the system must lead to 80% reduction in data storage cost. The analytical system's data query optimization's throughput must be improved by 50 seconds from 60 seconds. Thus, reducing the wait time of complex query results to 10secs. The major project deliverable is an integrated distributed cloud-based analytical system that would promote an efficient and effective environment to minimize loss in the corporation.

1.1.1 Scope

The IT department of Galaxy Corporation has witnessed a spike in the volume and variety of data generated from our business areas in recent time, which are used for analytics and making decisions. As the data grows, the current traditional data warehousing techniques cannot efficiently handle the data requirements from our functional areas, which is a threat to our strategic goals. In consultation with stakeholders, namely employees (end users of the system), customers, and government agencies, three main challenges were identified. These current challenges are:

I. Scaling the systems linearly incurs huge software licenses and maintenance costs.

II. Analytical processing ability of the systems becomes increasingly inefficient as data computation is performed centrally.

III. Maintenance and Operations are difficult as users of the system have limited control over the infrastructure.

The purpose of the project is to develop and implement a cloud-based distributed analytical system for data processing.

1.1.2 Statement of Work

Date Submitted	11/23/2020
Project Name	Implementing Distributed Analytical Systems on a Cloud Architecture
Revision Number	1.0.0
Project Identification Number	TM2-0145
SOW Prepared by:	Felix Bediako

1. Key milestones

These indicates significant progress or events during the evolution of the project and its timeline. The list below indicates key milestones to be achieved from the execution of the project to its termination.

Date	Milestone/Event
11/3/2020	Project Kickoff
12/9/2020	Successful Requirement Gathering & Analysis
1/29/2021	System Design Approval
3/26/2021	Develop a Prototype System
5/3/2021	Completion of Implementation and Testing

Date	Milestone/Event
7/1/2021	System Deployment

2. Resource requirements

Organizational Resources	
Human Resources Department	This department oversees the hiring of new personnel to partake in the project if needed.
Consumer Relations Department	Responsible for interacting with partners and customers in order to ensure that the new system being implemented is to their satisfactory.
Marketing & Sales Department	Responsible for researching systems utilized by competitors, its impact on sales, and growth of the corporation.
IT & Analytics Department	This department is responsible for developing data dictionary and key requirements needed in the new system
Material Resources	
$1.5 million overall project budget	This budget will be used for personnel renumerations, consumer relations activities, software and hardware components if needed.
Software Components	The project will require new software components that will be acquired from Amazon Web Services (AWS). This will be an annual based subscription.

Hardware Components	The project will also require a high-tech ultra-modern computer that will be determined during the implementation phase of the project.

3. Risks and concerns

Category of Risk	**Assessment of Concern**
Financial Risk	Budget overrun has a high probability to occur with a high impact. However, we can mitigate it by implementing a contingency reserve.
Technical Risk	The project system development team will come across system technical compatibility and bug issues. However, the project team will accept the risk but would apply a active solution by putting together an IT Help Desk to help resolve such issues.
Legal Risk	Security and Data Integrity/Availability has a moderate probability of occurring with a very high impact. However, we entered into an agreement with our vendors to indemnify and compensate if it should occur. The team expects to transfer the risk to the vendors.
Execution Risk	Economic recession has a very low risk of occurring but a high impact if it should occur. The project team plans to mitigate this risk and has set aside 70% of the total project cost to ensure that the project continues in such a situation.

4. Acceptance criteria

Acceptance	Success
System Design: The platform must be user and color blind friendly. The tools or algorithms used in the analysis must be faster and better than that of our competitors.	**System Design:** The system must be fully functional and ready to be integrated into the corporation's platform.
Storage Cost: The system must reduce the overall storage cost by 80%.	**Storage Cost:** The new system must achieve 80% cost reduction for data storage.
Data Query: Data query optimization must be improved by 50 seconds from 60 seconds.	**Data Query:** Data query optimization must produce results in 10seconds or less, reducing wait or lag time.
Bugs & System Failure: The system should be free of bugs that would lead to a system failure.	**Bugs & System Failure:** The system must have a low probability of crashing or failing. It must withstand stress.

1.1.3 Business Case

Galaxy Corporation has witnessed a spike in the volume and variety of data generated from our business areas in recent time, that is utilized by the IT department for analytics and making decisions. As the data grows, the current traditional data warehousing techniques cannot efficiently handle the data requirements from our functional areas, which is a threat to our strategic goals. Thus, the existing

traditional data warehouse is gradually failing in handling big data within the organization. These current challenges are:

- Scaling the systems linearly incurs huge software licenses and maintenance costs.
- Analytical processing ability of the systems becomes increasingly inefficient as data computation is performed centrally.
- Maintenance and Operations are difficult as users of the system have limited control over the infrastructure.

Proposed Solution: We proposed an implementation of a distributed analytical system on a cloud-based architecture for data processing. This solution is in line with best practices to manage efficiently the processing, storage, and analysis of big data at a lower cost.

Project Scope, Budget, and Time: Design and implement a distributed analytical system using AWS Elastic Computing instances. The project is estimated to cost $1.5m with a timeline of 8mths.

Objectives: extracting timely value from big data; reduce processing and data storage cost, improve scalability and data query optimization; build a high performance and resilient system.

Deliverables:

- Customize and implement an Apache Spark analytical processing engine for big data.
- Implement a Hadoop distributed file system (HDFS), which makes it easy to plug in distributed analytics applications.
- Construct cloud tools for implementing solutions on AWS Elastic Computing instances.

I.2 Project Deliverables

The major items or project feature to be delivered to the client are outlined below:

- Customize and implement an Apache Spark analytical processing engine for big data.
- Implement a Hadoop distributed file system (HDFS), that makes it easy to plug-in distributed analytics applications.
- Construct cloud tools for implementing solutions on AWS Elastic Computing instances.

I.3 Project Organization

The project manager is the lead in this project and must be accorded the necessary respect and information. The project manager must ensure that the project team members are working to achieve the scope of this project. The project manager in consultation with functional managers must create a work breakdown structure to track tasks, milestones, and budgets. The team members must ensure that there is uniformity and communication within the team. Team members should communicate with their functional heads when a challenge arises during the execution of this project. The chart below illustrates the level of authority and position of the project manager and the team.

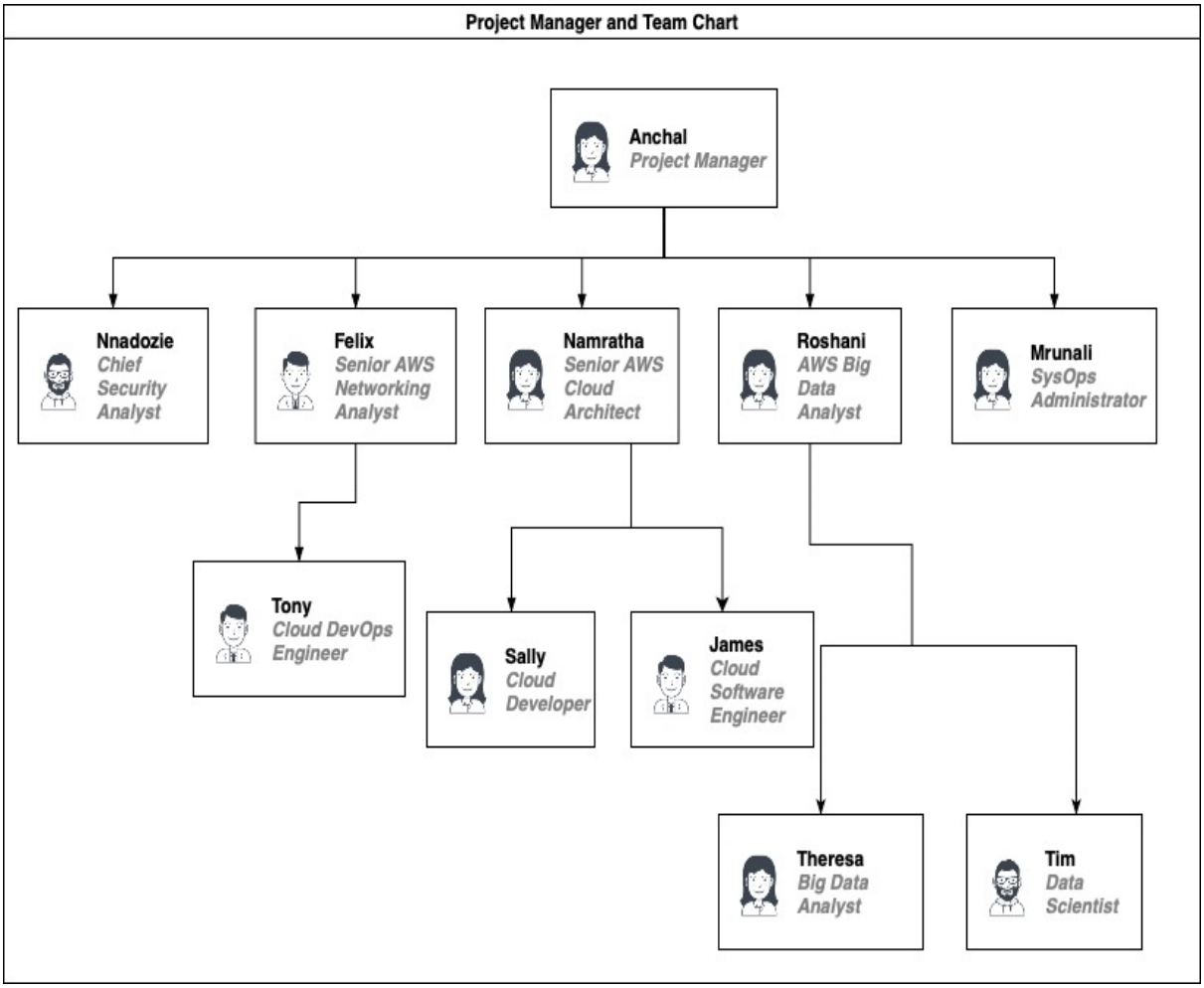


Figure 1. Project Manager & Project Team Members based on hierarchy. The project manager oversees the actions and inactions of the project team, touching base with the team through frequent weekly check-in meetings.

I.4 Work Breakdown Structure (WBS)

Insert the WBS for the project, including all key deliverables and work packages.

ID	WBS	Task Name	Duration	Predecessors
0		**Cloud-based Analytical System**	**165 days**	
1	**A**	**Scope**	**4 days**	
2	A.1	Determine Scope of the Project	1 day	
3	A.2	Secure funding	1 day	2
4	**B**	**Requirements Gathering/Analysis**	**23 days**	

ID	WBS	Task Name	Duration	Predecessors
5	B.1	Perform Needs Analysis	5 days	3
6	B.2	Prepare preliminary specifications for the platform	4 days	5
7	B.3	Prepare Initial Budget	3 days	6
8	B.4	Review preliminary specification, and budget with project team and client	1 day	7
9	B.5	Integrate feedback received into the specification	2 days	8
10	B.6	Develop project timeline	2 days	9
11	B.7	Secure approval for timeline, budget, and concept	1 day	10
12	B.8	Define resources	1 day	11
13	B.9	Secure needed resources	5 days	12
14	B.10	Requirements Gathering/Analysis Complete	0 days	
15	**C**	**System Planning & Design**	**29 days**	
16	C.1	Review and determine the initial system specification and requirements of the system	2 days	13
17	C.2	Develop functional requirements	2 days	16
18	C.3	Perform risk assessment	4 days	17
19	C.4	Design & produce prototype of the system	20 days	18
20	C.5	Procure Design Approval	1 day	19
21	C.6	System Planning & Design Complete	0 days	
22	**D**	**System Development**	**40 days**	
23	D.1	Develop Database System	20 days	20
24	D.2	Develop Platform & Tools	30 days	20
25	D.3	Testing & Initial Debugging	5 days	23,24
26	D.4	Document Metadata & Irregularities	5 days	25
27	D.5	System Development Complete	0 days	
28	**E**	**Testing & Implementation**	**26 days**	
29	E.1	Functional Testing	4 days	26
30	E.2	Performance Testing	2 days	26
31	E.3	Stress Testing	3 days	26

ID	WBS	Task Name	Duration	Predecessors
32	E.4	Storage Testing	1 day	31,29,30
33	E.5	Operability Testing	5 days	29,30,31
34	E.6	Throughput Testing	3 days	33,32
35	E.7	Failure mode testing	5 days	34
36	E.8	Identify irregularities/inconsistencies (bugs)	4 days	35
37	E.9	Document & Fix irregularities/inconsistencies (bugs)	9 days	35
38	E.10	Testing & Implementation Complete	0 days	
39	**F**	**System Deployment**	**43 days**	
40	F.1	Integrate system into the firm's operation platform	9 days	37,36
41	F.2	Develop user manuals	12 days	40
42	F.3	Train end-users	5 days	40
43	F.4	Deploy analytical system	10 days	42,41
44	F.5	Document challenges encountered	5 days	43
45	F.6	Organize system maintenance team	2 days	44
46	F.7	Complete Final Report	5 days	45
47	F.8	System Deployment Complete	0 days	

I.5 Responsibility Assignment Matrix

The RACI Matrix below identifies personnel working on this project. However, some of these personnel have subordinates they are working with that was not represented on here. These superiors must ensure that their subordinates are kept in the “loop” during the entire project life cycle. This matrix is to aid the project manager to easily track who is responsible for what, who must approve what, and who must be informed.

Legend:

R – Responsible **C – Consult**

A – Accountable. **I – Inform**

RACI Chart	**Person**					
Activity	***Anchal***	***Nnadozie***	***Felix***	***Namratha***	***Roshani***	***Mrunali***
Create Charter	A	I	I	I	I	I
Requirement Gathering	I	C	R	C	I	A
System Planning & Design	I	C	C	R	I	C
System Integration/Implementation	I	R	R	R	C	R
System Test Plan	A	I	I	I	R	C
Submit Change Request Due to Bugs or unforeseen Circumstances	A	R	R	C	I	C
Final Report	A	R	R	R	R	C

II. Risk Assessment

Every project has some element of risk involved, which manifests in various folds and emanating from the project's environment, organizational structure/culture, seismic or abrupt changes in the ecosystem or resulting from a natural disaster. Therefore, as professionals, we incorporated risk management knowledge in our project to help identify, monitor, and mitigate adverse effects of identified/projected risks on the project's success. The following sub-sections detailed some identified risks, its probability assessment, consequences, as well as some risk control strategies.

II.1 Risk Identification

Identify all relevant risks for the project.

No	Risks	Description	Owner of the Risk	Strategy	Contingency Reserve
1	Loss of critical staff	Exit of some key project team members from the organization/unit	Anchal	Mitigate	Ensure there is a backup Staff to fill in loss position
2	Economic Recession	A significant decline in economy activity caused by low aggregate demand	Nnadozie	Mitigate	Contingency fund set aside to support the project if the risk occurs
3	Technical Compatibility and bugs issues	Systems incompatibility and bugs fixing	Felix	Accept	Having a dedicated team of IT Professionals to timely respond to this
4	Security and Data Integrity	This is related to the availability, integrity and security of data stored in the cloud operated by third parties	Felix	Transfer	Service Level Agreement with Proprietary Software Owners
5	Design Complexity	Amorphous design that is inherent with distribution systems	Roshani	Avoid	Switch to a less complex design
6	Lack of Industry Standards	This involves protocols and standards that govern various layers of information technology	Murali	Accept	Monitoring development in the industry and readjusting to acceptable standards
7	Budget Overrun	When actual cost is more than budgeted cost	Namratha	Mitigate	Ensure cost overrun does not exceed 10 percent more of total cost
8	Scope Creep	Adding features and requirements that are beyond the agreed-upon product scope	Namratha	Mitigate	Project scope will be properly defined and objectives well documented and controlled at each stage of the project

II.2 Assessment of Probability and Impact (Qualitative)

- **Probability Scale**

Level names	Level Values (%)
Very low	5%
Low	10%

Medium	40%
High	50%
Very High	70%

- **Impact Scale for each dimension**

Schedule & Cost

	Name	**Schedule**			Name	**Cost**
	# of impact levels	5			# of impact levels	5
Impact	**Description**	**Value**		**Impact**	**Description**	**Value**
Very Low	An increase of 1 to 10 days	0.1		**Very Low**	0-5% over budgeted cost	0.1
Low	Between 11-20 days	0.3		**Low**	> 5% but < 11 %	0.3
Medium	30 days	0.5		**Medium**	Between 12 and 20%	0.5
High	between 30 and 90 days	0.7		**High**	Between 20 and 24%	0.7
Very High	More than 90 days	0.9		**Very High**	25% or more	0.9

Technical/Security & Scope.

	Name	**Security**			Name	**Scope**
	# of impact levels	5			# of impact levels	5
Impact	**Description**	**Value**		**Impact**	**Description**	**Value**
Very Low	Nil	0.1		**Very Low**	Nil	0.1
Low	Bugs fixing	0.3		**Low**	Scope not properly defined	0.3
Medium	Technical compatibility	0.5		**Medium**	Lack of stakeholder participation	0.5
High	Data unavailability/downtime	0.7		**High**	Requirements not monitored	0.7
Very High	Data breach and Integrity	0.9		**Very High**	Poor communication	0.9

- **Severity Matrix**

On the severity matrix, we adopted values of 0.15 and 0.35 for the *upper limit for a low severity risk* and *lower limit for a high severity risk, respectively.* The diagram below shows the severity matrix for **schedule.** The severity matrixes for cost, scope, and security look much the same since we used the same values to map out the chart. This explains why just diagram is depicted below.

		Probability				
		Very low	Low	Medium	High	Very High
Impact		0.05	0.1	0.4	0.5	0.7
Very Low	0.1	0.01	0.01	0.04	0.05	0.07
Low	0.3	0.02	0.03	0.12	0.15	0.21
Medium	0.5	0.03	0.05	0.20	0.25	0.35
High	0.7	0.04	0.07	0.28	0.35	0.49
Very High	0.9	0.05	0.09	0.36	0.45	0.63

Risks Severity Analysis Table

# Risk	Cause	Probability score	Impact score	Severity Score	Severity
1	Loss of Critical Staff	0.1	0.3	0.03	Low
2	Economic Recession	0.1	0.7	0.07	Low
3	Technical Compatibility and Bug Issues	0.7	0.5	0.35	Medium
4	Security and Data Integrity	0.4	0.9	0.36	High
5	Design Complexity	0.1	0.5	0.05	Low
6	Lack of Industry Standards	0.1	0.5	0.05	Low
7	Budget Overrun	0.5	0.9	0.45	High
8	Scope Creep	0.7	0.7	0.49	High

The severity analysis table provides a risk scoring weight for each of the identified risk. As could be read from the table, each risk was scored based on the probability of it occurring, and if it does, what could be the impact. The scores range from very low to very high. The severity score was derived simply from multiplying corresponding values of the probability and impact scores. As we stated under the severity matrix, we set our *upper limit for a low severity risk* and *lower limit for a high severity risk* at 0.15 and 0.35, respectively. The risk scoring model ranked the risks as either low, medium, or high. This ranking is as shown on the last column.

II.3 Mitigation Strategies

No	Risks	Strategy	Description of Strategy
1	Loss of critical staff	Mitigate	Through effective communication, team members understand the role of each member and can readily carryout task originally assigned to a member of his team if the assignee is absent or exit the project/organization. This strategy creates a back-up plan and ensure tasks are being completed
2	Economic Recession	Mitigate	Though occurrence of this risk is low, the organization has set aside additional 70 percent of the total project cost to ensure that project continues, and it's not impacted by negative economic changes that might affect the income stream of the organization
3	Technical Compatibility and bugs issues	Accept	Systems incompatibility and bug fixing will arise as the project is being executed, and that explains why we accept this risk. However, our response to this is active, as we have a dedicated team of IT expert to resolve this issue whenever they occur
4	Security and Data Integrity/Availability	Transfer	We entered a Service Level Agreement with our vendors, which indemnify and compensate us in case of a data breach, massive disruption of service or prolong accessibility downtime
5	Design Complexity	Avoid	Our strategy is to adopt a design that captures key functional data areas of the organization, rather than a system that reveals every minute area of the company.
6	Lack of Industry Standards	Accept	Distributed systems architecture is an evolving technology and its protocols are yet standardized. This is a known risk we accept, and we have a monitoring team that follows up with latest developments as they unfold in the industry.
7	Budget Overrun	Mitigate	The strategy is to strictly stick with the project's scope and schedule, which are the major determinants of our budget plan. However, without being too rigid on cost given some changes that could occur and beyond our control, we allow for budget overrun not exceeding 10% of the budget cost.
8	Scope Creep	Mitigate	Our mitigating strategy involves a properly defined scope and project's objectives, which is well documented at each stage and effectively communicated and agreed by all stakeholders.

III. Project Schedule

III.1 Activity Duration Estimates

Activity Duration Estimates					
S.No	**Activity**	**Optimistic Duration**	**Pessimistic Duration**	**Most Likely Duration**	**Expected Activity Duration (EAD)**
A1	Determine scope of the project	2	3	1	1.5
A2	Secure funding	3	4	2	2.5
B1	Perform needs analysis	7	10	5	6.16
B2	Prepare preliminary specification for the platform	6	11	4	5.5
B3	Prepare initial budget	5	10	3	4.5
B4	Review preliminary specification and budget with project team and client	3	5	1	2.66
B5	Integrate feedback received into the specification	3	5	2	2.66
B6	Develop project timeline	3	5	2	2.66
B7	Secure approval for timeline ,budget,and concept	2	4	1	1.66
B8	Define resources	2	5	1	1.8
B9	Secure needed resources	7	14	5	6.83
C1	Review and determine the initial system specification and requirements of the system	3	5	2	2.66
C2	Develop functional requirements	3	5	2	2.66
C3	Perform risk assessment	5	7	4	4.66

Activity Duration Estimates					
S.No	**Activity**	**Optimistic Duration**	**Pessimistic Duration**	**Most Likely Duration**	**Expected Activity Duration (EAD)**
C4	Design & produce prototype of the system	22	30	20	22
C5	Procure Design approval	2	3	1	1.5
D1	Develop database system	24	33	20	22.83
D2	Develop platform and tools	33	45	30	33
D3	Testing & initial debugging	6	10	5	6
D4	Document metadata & irregularities	6	10	5	6
E1	Functional testing	5	8	4	4.83
E2	Performance testing	3	5	2	2.66
E3	Stress Testing	4	6	3	3.66
E4	Storage testing	2	4	1	1.66
E5	Operability testing	6	11	5	6.16
E6	Throughput testing	4	9	3	4.16
E7	Failure mode testing	6	12	5	6.33
E8	Identify irregularities/inconsistencies	5	8	4	4.83
E9	Documents & fix irregularities/inconsistencies(bugs)	10	17	9	10.5
F1	Integrate system into the firm's operation platform	10	15	9	10.16
F2	Develop user manuals	13	20	12	13.5
F3	Train end users	6	10	5	6

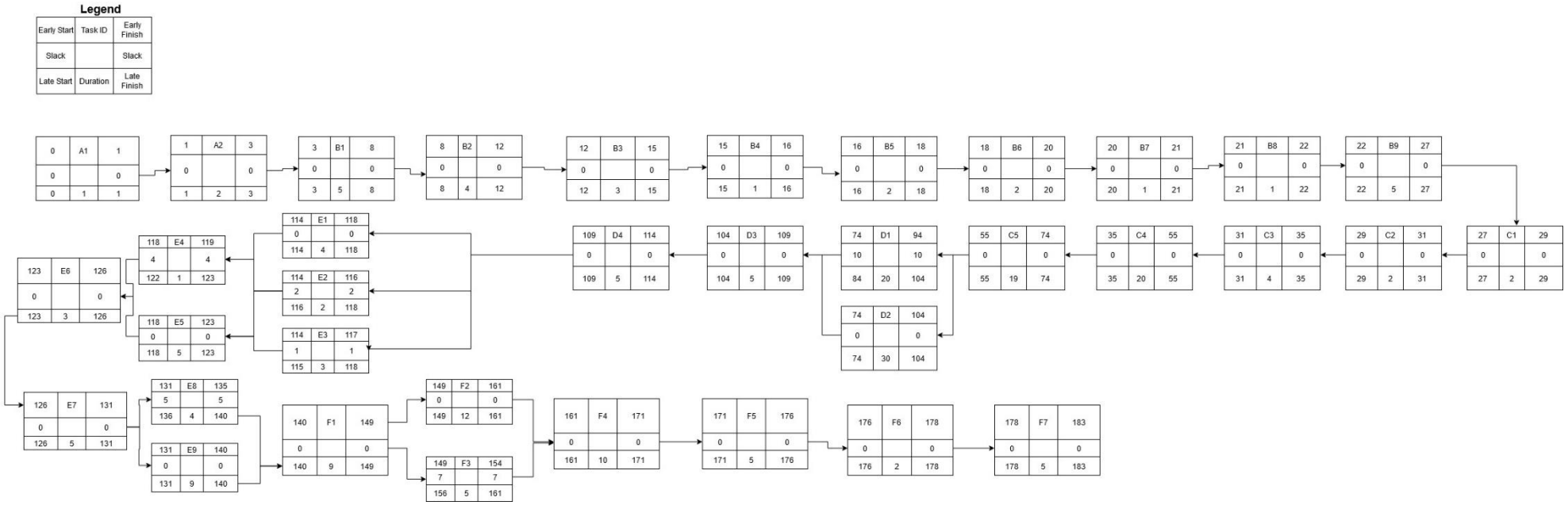
Activity Duration Estimates					
S.No	**Activity**	**Optimistic Duration**	**Pessimistic Duration**	**Most Likely Duration**	**Expected Activity Duration (EAD)**
F4	Deploy analytical system	11	16	10	11.16
F5	Document challenges encountered	6	12	5	6.33
F6	Organize system maintenance team	3	6	2	2.83
F7	Complete final report	6	10	5	6

III.2 Gantt Chart

Please refer to the attached MS-Project file.

III.3 Activity Network

Below is the activity-on-node (AON) project network developed in draw.io.



4. Project Budget

Task	Activity	Direct Cost	Overhead Cost	Total Cost
1	Phase1(Requirement Gathering)	$150,000	$100,000	$250,000
2	Phase 2 (System Plan & Design)	$160,000	$140,000	$300,000
3	Phase 3 (System Development)	$170,000	$130,000	$320,000
4	Phase 4 (Testing &Implementation)	$190,000	$160,000	$350,000
5	Phase 5 (System Deployment)	$150,000	$130,000	$280,000
Project Total:				$ 1,500,000

4.1 Project Resources

	Hours Needed						
Project Team Member	Phase1	Phase2	Phase 3	Phase 4	Phase 5	Overhead Rate	Hourly Rate
Anchal	128	8	-	-	136	2	300/hr
Felix	16	160	240	96	72	1.9	200/hr
Nndozie	-	232	320	-	344	1.9	450/hr
Mrunali	16	176	280	128	208	1.7	80/hr
Roshani	72	-	200	80	96	1.7	80/hr
Namratha	64	208	40	64	192	1.9	200/hr
Total	296	784	1080	368	1048	11.1	1310/hr

4.2 Other Costs

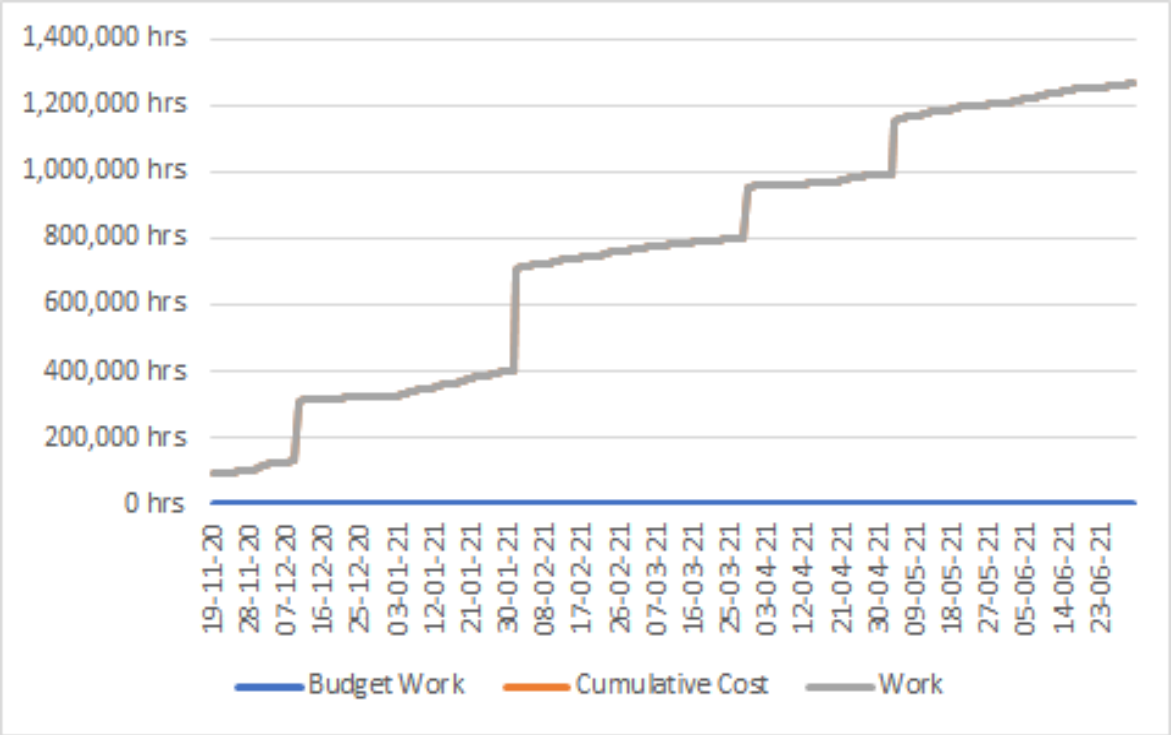
Resource	Cost
Material Components	$20000
Logistics Expenses	$15000

Facility Construction	$10000
Marketing Research Reports	$6000
Vendors	$12000
Contingency Reserve	$50,000

4.4 Time-phased budget

	Year	Month								
	2020		2021							Grand Total
Task 1	November	December	January	February	March	April	May	June	July	
Scope	54400	0	0	0	0	0	0	0	0	54400
Requirements Gathering/Analysis	30560	23680	0	0	0	0	0	0	0	54240
System Planning & Design		189720	75360	0	0	0	0	0	0	265080
System Development				362600	36800	0	0	0	0	399400
Testing & Implementation					157160	34880	1600	0	0	193640
System Deployment							211640	58880	2400	272920
	84960	213400	75360	362600	193960	34880	213240	58880	2400	1239680

Cumulative Project Budget



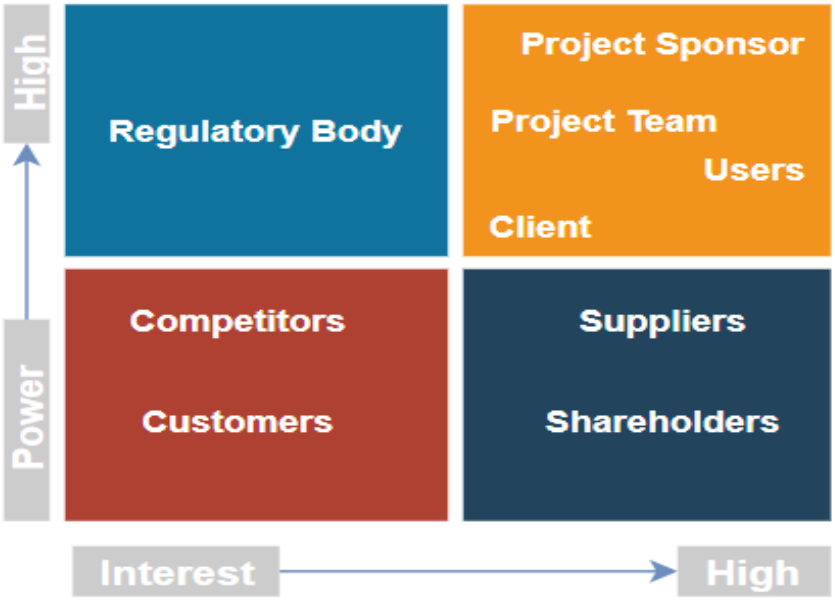
IV. Stakeholder Management

Identifying and managing stakeholders was giving utmost priority, because the success of this project was intricately tied to our stakeholders' interests. Though each stakeholder has different degrees of influence on the project, we identified every stakeholder in the project life cycle from stage to stage, evaluated (re-evaluated) their priorities, and adopted professional conflict managements skills, diplomacy, and negotiation in addressing their conflicting concerns. This was never an easy task, but realizing the influence of some key stakeholders, we were able to prioritize interests and open an effective channel of communication to always keep interested stakeholders informed about the progress of the project. The figures below depict key stakeholder list and the power/interest grid of stakeholders.

Key Stakeholder List

Name	Position/Organization	Role
Galaxy Corporation	Client	IT Department and project initiator
Employees	Users/Galaxy Corporation	Systems end users
Suppliers	Vendors/Various Organizations	Proprietary software owners/supply chain partners
Competitors	Various Organizations	Industry's rivals
Project Sponsor	Senior Manager/Galaxy Corp	Monitors the project progress
Govt. Agencies	Data Regulatory Agency	Regulates data privacy and usage
Project Team	Various Depts/Galaxy Corp	Executing the project
Customers	Various Entities	Entities from which data are collected
Shareholders	Various Entities	Owners of Galaxy Corporation

Stakeholder Power/Interest Grid



Eight stakeholders were identified/ranked in the order of high or low interest(power) stakeholders. The different quadrant in the power grid is explained below:

High power, high Interest: Users from relevant functional areas, client, project team, and project sponsor are placed in this quadrant because these stakeholders determine the scope, budgets and deliverables of the projects, and the final product must meet their requirements. We invited them to product strategy and road mapping workshops, program iteration events and sprint review meetings, as they are empowered to make decisions that shapes the scope and schedule of the project.

High power, low interest: Relevant regulatory bodies that set standards on IT protocols and data privacy were placed here. Though they have limited or no interest in the implementation of this IT solution in our organization, we are guided by these regulations, which in turn influenced our scope and deliverables. The project team was well grounded and conversant with related and relevant IT protocols and standards. We did seek clarifications from these agencies on grey areas.

High Interest, Low power: The suppliers of proprietary software (and shareholders) fall in this quadrant. The owners of cloud-based software and distributed file systems had lot of influence on the tools deployed in this project, because a change in some modifications could alter some functionalities of the project scope. Thus, we kept them engaged and reached some negotiations through service level agreements.

Low power, Low Interest: This quadrant houses competitors and customers. Their influence on the project was ranked low; some of these stakeholders are unaware that such project is being undertaken by the client. However, we did not ignore this category of stakeholders but kept them under our monitoring radar, ensuring that interest levels remained the same.

V. Communications Management

For this project, Galaxy Corp. will utilize standard organizational formats and templates for all formal project communications. Formal project communications are detailed in the project's communication matrix:

Kickoff Meeting – project team will utilize Galaxy Corp. standard templates for meeting agenda and meeting minutes. Additionally, any information is to be shared via shared document on Google Drive.

Brainstorming – project team will utilize Galaxy Corp, will use zoom calls and Google Drive document to brainstorm about ideas and new information/Changes.

Monthly Project Status Meetings – project team will utilize Galaxy Corp. standard templates for meeting agenda and meeting minutes. Additionally, any slides presented will use the Galaxy Corp. standard slideshow template.

Project Status Reports – The standard project status report document, available on the share drive and Projectmanager.com, will be used to provide project status.

Informal project communications should be professional and effective but there is no standard template or format that must be used.

The following table presents contact information for all persons identified in this communications management plan. The email addresses and phone numbers in this table will be used to communicate with these people.

Project Member Directory

Title	Name	Role	Organization/ Department	Email	Phone
Project Manager	Anchal	Project Manager	PMO	a.bhamore@vikes.csuohio.edu	2319761325
Chief Security Analyst	Nnadozie	Product Manager	IT	k.anyanwu@vikes.csuohio.edu	6268171326
Senior AWS networking Analyst	Felix	Technical Manager	IT	f.asarebediako@vikes.csuohio.edu	1275864932
Sysops Admin	Mrunali	Program Manager	PMO	m.patel46@vikes.csuohio.edu	1236798098
AWS Big Data Analyst	Roshani	Data Scientist	IT	r.sonawane83@vikes.csuohio.edu	9876543209
Senior AWS Cloud Architect	Namratha	Technical Lead	IT	n.shamirpet22@vikes.csuohio.edu	3287659832

Communication Management Matrix

Purpose of communication	Schedule Frequency	Media or Mechanism Used	Called by	Participant
Kickoff Meeting	Once	Zoom,Google Docs	Project Manager	Full Project Team
Report Status	Monthly	Zoom, Projectmanager.com	Anyone	Required Team Members
Team Project Proposal	Twice	Google Docs, Zoom	Project Manager	Full Project Team
Status Updates	Weekly	Projectmanager.com	Project Manager	Full Project Team
Exception/Variance Reports	As needed	WhatsApp	Anyone	Impacted team Members and Client
Configuration Changes	As changes are required/Approved	Email/ MS project	Cloud Architect	Impacted team Members and Client
Emergency or Critical events	As Needed	WhatsApp	Anyone	Full Project Team
Task Breakdown and Completion	Monthly or at the milestone	Trello	Project Manager	Full Project Team
Brainstorming and Resolving Issue	Weekly	Zoom	Data analyst and Networking Analyst	Full Project Team
Project Reviews	At milestone	Zoom and Google Docs	Project Manager	Full Project Team

VI. Tracking and Status Updates

To track the status of this project, the MS project application is being used. Tracking the project is one of the important steps, to evaluate the budget and time constraints of the project at a particular time.

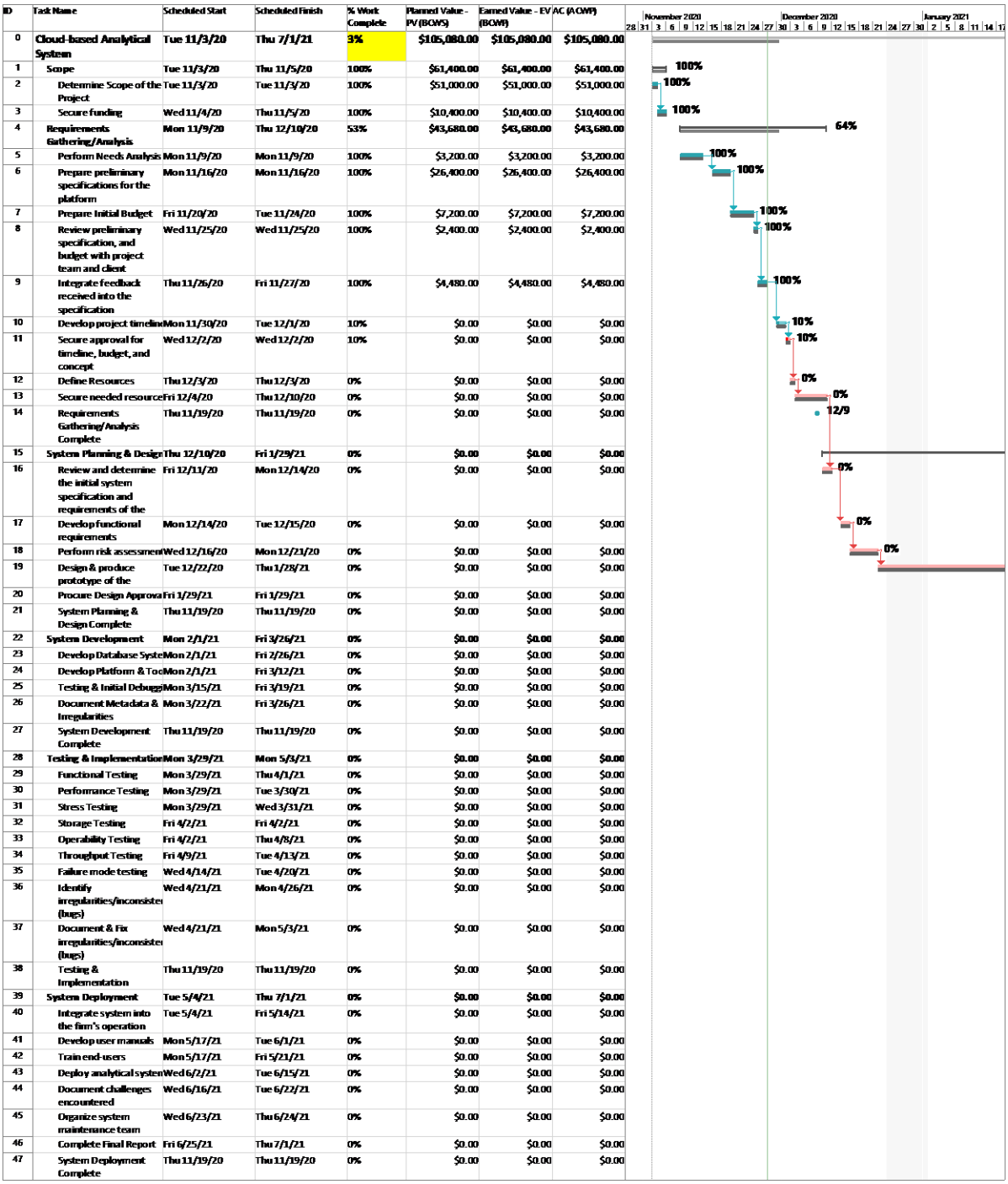
The method opted to track the status of the project is the Earned Value Management (EVM) method and the Gantt Chart. The tracking intervals are weekly and to be precise, the project data is extracted on every Monday and shared with the project manager and the clients.

The total estimated duration of this project is 165 days and below is the schedule for the entire project.

VI.1 Tracking Method

ID	WBS	Task Name	Duration	Start	Finish
0	**0**	**7.1**	**165 days**	**Tue 11/3/20**	**Thu 7/1/21**
1	**1**	**Scope**	**3 days**	**Tue 11/3/20**	**Thu 11/5/20**
2	1.1	Determine Scope of the Project	1 day	Tue 11/3/20	Tue 11/3/20
3	1.2	Secure funding	2 days	Wed 11/4/20	Thu 11/5/20
4	**2**	**Requirements Gathering/Analysis**	**24 days**	**Mon 11/9/20**	**Thu 12/10/20**
5	2.1	Perform Needs Analysis	5 days	Mon 11/9/20	Fri 11/13/20
6	2.2	Prepare preliminary specifications for the platform	4 days	Mon 11/16/20	Thu 11/19/20
7	2.3	Prepare Initial Budget	3 days	Fri 11/20/20	Tue 11/24/20
8	2.4	Review preliminary specification, and budget with project team and client	1 day	Wed 11/25/20	Wed 11/25/20
9	2.5	Integrate feedback received into the specification	2 days	Thu 11/26/20	Fri 11/27/20
10	2.6	Develop project timeline	2 days	Mon 11/30/20	Tue 12/1/20
11	2.7	Secure approval for timeline, budget, and concept	1 day	Wed 12/2/20	Wed 12/2/20
12	2.8	Define Resources	1 day	Thu 12/3/20	Thu 12/3/20
13	2.9	Secure needed resources	5 days	Fri 12/4/20	Thu 12/10/20
14	2.10	Requirements Gathering/Analysis Complete	0 days	Wed 12/9/20	Wed 12/9/20
15	**3**	**System Planning & Design**	**29 days**	**Thu 12/10/20**	**Fri 1/29/21**
16	3.1	Review and determine the initial system specification and requirements of the system	2 days	Thu 12/10/20	Fri 12/11/20
17	3.2	Develop functional requirements	2 days	Mon 12/14/20	Tue 12/15/20
18	3.3	Perform risk assessment	4 days	Wed 12/16/20	Mon 12/21/20
19	3.4	Design & produce prototype of the system	20 days	Tue 12/22/20	Thu 1/28/21
20	3.5	Procure Design Approval	1 day	Fri 1/29/21	Fri 1/29/21
21	3.6	System Planning & Design Complete	0 days	Fri 1/29/21	Fri 1/29/21
22	**4**	**System Development**	**40 days**	**Mon 2/1/21**	**Fri 3/26/21**
23	4.1	Develop Database System	20 days	Mon 2/1/21	Fri 2/26/21
24	4.2	Develop Platform & Tools	30 days	Mon 2/1/21	Fri 3/12/21
25	4.3	Testing & Initial Debugging	5 days	Mon 3/15/21	Fri 3/19/21
26	4.4	Document Metadata & Irregularities	5 days	Mon 3/22/21	Fri 3/26/21
27	4.5	System Development Complete	0 days	Fri 3/26/21	Fri 3/26/21
28	**5**	**Testing & Implementation**	**26 days**	**Mon 3/29/21**	**Mon 5/3/21**
29	5.1	Functional Testing	4 days	Mon 3/29/21	Thu 4/1/21
30	5.2	Performance Testing	2 days	Mon 3/29/21	Tue 3/30/21
31	5.3	Stress Testing	3 days	Mon 3/29/21	Wed 3/31/21
32	5.4	Storage Testing	1 day	Fri 4/2/21	Fri 4/2/21
33	5.5	Operability Testing	5 days	Fri 4/2/21	Thu 4/8/21
34	5.6	Throughput Testing	3 days	Fri 4/9/21	Tue 4/13/21
35	5.7	Failure mode testing	5 days	Wed 4/14/21	Tue 4/20/21
36	5.8	Identify irregularities/inconsistencies (bugs)	4 days	Wed 4/21/21	Mon 4/26/21
37	5.9	Document & Fix irregularities/inconsistencies (bugs)	9 days	Wed 4/21/21	Mon 5/3/21
38	5.10	Testing & Implementation Complete	0 days	Mon 5/3/21	Mon 5/3/21
39	**6**	**System Deployment**	**43 days**	**Tue 5/4/21**	**Thu 7/1/21**
40	6.1	Integrate system into the firm's operation platform	9 days	Tue 5/4/21	Fri 5/14/21
41	6.2	Develop user manuals	12 days	Mon 5/17/21	Tue 6/1/21
42	6.3	Train end-users	5 days	Mon 5/17/21	Fri 5/21/21
43	6.4	Deploy analytical system	10 days	Wed 6/2/21	Tue 6/15/21
44	6.5	Document challenges encountered	5 days	Wed 6/16/21	Tue 6/22/21
45	6.6	Organize system maintenance team	2 days	Wed 6/23/21	Thu 6/24/21
46	6.7	Complete Final Report	5 days	Fri 6/25/21	Thu 7/1/21
47	6.8	System Deployment Complete	0 days	Thu 7/1/21	Thu 7/1/21

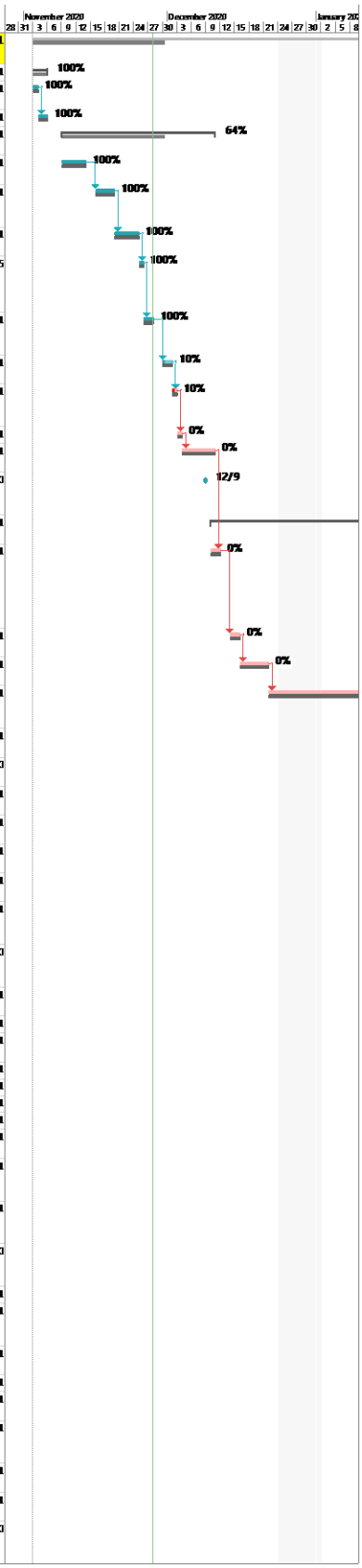
The baseline cost of the project with 3% of project completion as of 11/27/2020 is $105,080. The scheduled start and finish dates for all the tasks are shown below.



ID	Task Name	Scheduled Start	Scheduled Finish	% Work Complete	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)
0	**Cloud-based Analytical System**	**Tue 11/3/20**	**Thu 7/1/21**	**3%**	**$105,080.00**	**$105,080.00**	**$105,080.00**
1	Scope	Tue 11/3/20	Thu 11/5/20	100%	$61,400.00	$61,400.00	$61,400.00
2	Determine Scope of the Project	Tue 11/3/20	Tue 11/3/20	100%	$51,000.00	$51,000.00	$51,000.00
3	Secure funding	Wed 11/4/20	Thu 11/5/20	100%	$10,400.00	$10,400.00	$10,400.00
4	Requirements Gathering/Analysis	Mon 11/9/20	Thu 12/10/20	53%	$43,680.00	$43,680.00	$43,680.00
5	Perform Needs Analysis	Mon 11/9/20	Mon 11/9/20	100%	$3,200.00	$3,200.00	$3,200.00
6	Prepare preliminary specifications for the platform	Mon 11/16/20	Mon 11/16/20	100%	$26,400.00	$26,400.00	$26,400.00
7	Prepare Initial Budget	Fri 11/20/20	Tue 11/24/20	100%	$7,200.00	$7,200.00	$7,200.00
8	Review preliminary specification, and budget with project team and client	Wed 11/25/20	Wed 11/25/20	100%	$2,400.00	$2,400.00	$2,400.00
9	Integrate feedback received into the specification	Thu 11/26/20	Fri 11/27/20	100%	$4,480.00	$4,480.00	$4,480.00
10	Develop project timeline	Mon 11/30/20	Tue 12/1/20	10%	$0.00	$0.00	$0.00
11	Secure approval for timeline, budget, and concept	Wed 12/2/20	Wed 12/2/20	10%	$0.00	$0.00	$0.00
12	Define Resources	Thu 12/3/20	Thu 12/3/20	0%	$0.00	$0.00	$0.00
13	Secure needed resource	Fri 12/4/20	Thu 12/10/20	0%	$0.00	$0.00	$0.00
14	Requirements Gathering/Analysis Complete	Thu 11/19/20	Thu 11/19/20	0%	$0.00	$0.00	$0.00
15	**System Planning & Design**	**Thu 12/10/20**	**Fri 1/29/21**	**0%**	**$0.00**	**$0.00**	**$0.00**
16	Review and determine the initial system specification and requirements of the	Fri 12/11/20	Mon 12/14/20	0%	$0.00	$0.00	$0.00
17	Develop functional requirements	Mon 12/14/20	Tue 12/15/20	0%	$0.00	$0.00	$0.00
18	Perform risk assessment	Wed 12/16/20	Mon 12/21/20	0%	$0.00	$0.00	$0.00
19	Design & produce prototype of the	Tue 12/22/20	Thu 1/28/21	0%	$0.00	$0.00	$0.00
20	Procure Design Approva	Fri 1/29/21	Fri 1/29/21	0%	$0.00	$0.00	$0.00
21	System Planning & Design Complete	Thu 11/19/20	Thu 11/19/20	0%	$0.00	$0.00	$0.00
22	**System Development**	**Mon 2/1/21**	**Fri 3/26/21**	**0%**	**$0.00**	**$0.00**	**$0.00**
23	Develop Database Syste	Mon 2/1/21	Fri 2/26/21	0%	$0.00	$0.00	$0.00
24	Develop Platform & Too	Mon 2/1/21	Fri 3/12/21	0%	$0.00	$0.00	$0.00
25	Testing & Initial Debuggi	Mon 3/15/21	Fri 3/19/21	0%	$0.00	$0.00	$0.00
26	Document Metadata & Irregularities	Mon 3/22/21	Fri 3/26/21	0%	$0.00	$0.00	$0.00
27	System Development Complete	Thu 11/19/20	Thu 11/19/20	0%	$0.00	$0.00	$0.00
28	**Testing & Implementation**	**Mon 3/29/21**	**Mon 5/3/21**	**0%**	**$0.00**	**$0.00**	**$0.00**
29	Functional Testing	Mon 3/29/21	Thu 4/1/21	0%	$0.00	$0.00	$0.00
30	Performance Testing	Mon 3/29/21	Tue 3/30/21	0%	$0.00	$0.00	$0.00
31	Stress Testing	Mon 3/29/21	Wed 3/31/21	0%	$0.00	$0.00	$0.00
32	Storage Testing	Fri 4/2/21	Fri 4/2/21	0%	$0.00	$0.00	$0.00
33	Operability Testing	Fri 4/2/21	Thu 4/8/21	0%	$0.00	$0.00	$0.00
34	Throughput Testing	Fri 4/9/21	Tue 4/13/21	0%	$0.00	$0.00	$0.00
35	Failure mode testing	Wed 4/14/21	Tue 4/20/21	0%	$0.00	$0.00	$0.00
36	Identify irregularities/inconsiste (bugs)	Wed 4/21/21	Mon 4/26/21	0%	$0.00	$0.00	$0.00
37	Document & Fix irregularities/inconsiste (bugs)	Wed 4/21/21	Mon 5/3/21	0%	$0.00	$0.00	$0.00
38	Testing & Implementation	Thu 11/19/20	Thu 11/19/20	0%	$0.00	$0.00	$0.00
39	**System Deployment**	**Tue 5/4/21**	**Thu 7/1/21**	**0%**	**$0.00**	**$0.00**	**$0.00**
40	Integrate system into the firm's operation	Tue 5/4/21	Fri 5/14/21	0%	$0.00	$0.00	$0.00
41	Develop user manuals	Mon 5/17/21	Tue 6/1/21	0%	$0.00	$0.00	$0.00
42	Train end-users	Mon 5/17/21	Fri 5/21/21	0%	$0.00	$0.00	$0.00
43	Deploy analytical system	Wed 6/2/21	Tue 6/15/21	0%	$0.00	$0.00	$0.00
44	Document challenges encountered	Wed 6/16/21	Tue 6/22/21	0%	$0.00	$0.00	$0.00
45	Organize system maintenance team	Wed 6/23/21	Thu 6/24/21	0%	$0.00	$0.00	$0.00
46	Complete Final Report	Fri 6/25/21	Thu 7/1/21	0%	$0.00	$0.00	$0.00
47	System Deployment Complete	Thu 11/19/20	Thu 11/19/20	0%	$0.00	$0.00	$0.00

The planned values, earned values, actual costs, schedule variance, schedule performance index, cost variance, cost performance index, estimate at completion, budget at completion and variance at completion are calculated for all the steps in each task and tabluated below.

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	SV	SPI	CV	CPI	BAC	EAC	VAC	TCPI
0	Cloud-based Analytical System	$105,080.00	$105,080.00	$0.00	1	$0.00	1	$1,266,680.00	$1,266,680.00	$0.00	1
1	Scope	$61,400.00	$61,400.00	$0.00	1	$0.00	1	$61,400.00	$61,400.00	$0.00	1
2	Determine Scope of the	$51,000.00	$51,000.00	$0.00	1	$0.00	1	$51,000.00	$51,000.00	$0.00	1
3	Secure funding	$10,400.00	$10,400.00	$0.00	1	$0.00	1	$10,400.00	$10,400.00	$0.00	1
4	Requirements Gathering/Analysi	$43,680.00	$43,680.00	$0.00	1	$0.00	1	$74,240.00	$74,240.00	$0.00	1
5	Perform Needs Analysis	$3,200.00	$3,200.00	$0.00	1	$0.00	1	$3,200.00	$3,200.00	$0.00	1
6	Prepare preliminary specifications	$26,400.00	$26,400.00	$0.00	1	$0.00	1	$26,400.00	$26,400.00	$0.00	1
7	Prepare Initial Budget	$7,200.00	$7,200.00	$0.00	1	$0.00	1	$7,200.00	$7,200.00	$0.00	1
8	Review preliminary specification, and budget with	$2,400.00	$2,400.00	$0.00	1	$0.00	1	$2,400.00	$2,400.00	$0.00	4294967295
9	Integrate feedback received into	$4,480.00	$4,480.00	$0.00	1	$0.00	1	$4,480.00	$4,480.00	$0.00	1
10	Develop project timeline	$0.00	$0.00	$0.00	0	$0.00	0	$13,760.00	$13,760.00	$0.00	1
11	Secure approval for timeline, budget, and	$0.00	$0.00	$0.00	0	$0.00	0	$2,400.00	$2,400.00	$0.00	1
12	Define Resource	$0.00	$0.00	$0.00	0	$0.00	0	$2,400.00	$2,400.00	$0.00	1
13	Secure needed resources	$0.00	$0.00	$0.00	0	$0.00	0	$12,000.00	$12,000.00	$0.00	1
14	Requirements Gathering/Analy Complete	$0.00	$0.00	$0.00	0	$0.00	0	$0.00	$0.00	$0.00	0
15	System Planning & Design	$0.00	$0.00	$0.00	0	$0.00	0	$265,080.00	$265,080.00	$0.00	1
16	Review and determine the initial system specification and requirements of	$0.00	$0.00	$0.00	0	$0.00	0	$3,200.00	$3,200.00	$0.00	1
17	Develop functional	$0.00	$0.00	$0.00	0	$0.00	0	$1,280.00	$1,280.00	$0.00	1
18	Perform risk assessment	$0.00	$0.00	$0.00	0	$0.00	0	$6,400.00	$6,400.00	$0.00	1
19	Design & produce prototype of	$0.00	$0.00	$0.00	0	$0.00	0	$76,800.00	$76,800.00	$0.00	1
20	Procure Design Approval	$0.00	$0.00	$0.00	0	$0.00	0	$2,400.00	$2,400.00	$0.00	1
21	System Planning & Design	$0.00	$0.00	$0.00	0	$0.00	0	$0.00	$0.00	$0.00	0
22	System Development	$0.00	$0.00	$0.00	0	$0.00	0	$399,400.00	$399,400.00	$0.00	1
23	Develop Database	$0.00	$0.00	$0.00	0	$0.00	0	$12,800.00	$12,800.00	$0.00	1
24	Develop Platform &	$0.00	$0.00	$0.00	0	$0.00	0	$67,200.00	$67,200.00	$0.00	1
25	Testing & Initial Debugging	$0.00	$0.00	$0.00	0	$0.00	0	$8,000.00	$8,000.00	$0.00	1
26	Document Metadata & Irregularities	$0.00	$0.00	$0.00	0	$0.00	0	$6,400.00	$6,400.00	$0.00	1
27	System Development Complete	$0.00	$0.00	$0.00	0	$0.00	0	$0.00	$0.00	$0.00	0
28	Testing & Implementation	$0.00	$0.00	$0.00	0	$0.00	0	$193,640.00	$193,640.00	$0.00	1
29	Functional Testi	$0.00	$0.00	$0.00	0	$0.00	0	$6,400.00	$6,400.00	$0.00	1
30	Performance Testing	$0.00	$0.00	$0.00	0	$0.00	0	$2,560.00	$2,560.00	$0.00	1
31	Stress Testing	$0.00	$0.00	$0.00	0	$0.00	0	$4,800.00	$4,800.00	$0.00	1
32	Storage Testing	$0.00	$0.00	$0.00	0	$0.00	0	$640.00	$640.00	$0.00	1
33	Operability Testi	$0.00	$0.00	$0.00	0	$0.00	0	$3,200.00	$3,200.00	$0.00	1
34	Throughput Test	$0.00	$0.00	$0.00	0	$0.00	0	$1,920.00	$1,920.00	$0.00	1
35	Failure mode testing	$0.00	$0.00	$0.00	0	$0.00	0	$3,200.00	$3,200.00	$0.00	1
36	Identify irregularities/inc (bugs)	$0.00	$0.00	$0.00	0	$0.00	0	$11,520.00	$11,520.00	$0.00	1
37	Document & Fix irregularities/inc (bugs)	$0.00	$0.00	$0.00	0	$0.00	0	$14,400.00	$14,400.00	$0.00	1
38	Testing & Implementation Complete	$0.00	$0.00	$0.00	0	$0.00	0	$0.00	$0.00	$0.00	0
39	System Deployme	$0.00	$0.00	$0.00	0	$0.00	0	$272,920.00	$272,920.00	$0.00	1
40	Integrate system into the firm's operation	$0.00	$0.00	$0.00	0	$0.00	0	$34,560.00	$34,560.00	$0.00	1
41	Develop user manuals	$0.00	$0.00	$0.00	0	$0.00	0	$15,360.00	$15,360.00	$0.00	1
42	Train end-users	$0.00	$0.00	$0.00	0	$0.00	0	$8,000.00	$8,000.00	$0.00	1
43	Deploy analytical	$0.00	$0.00	$0.00	0	$0.00	0	$40,000.00	$40,000.00	$0.00	1
44	Document challenges encountered	$0.00	$0.00	$0.00	0	$0.00	0	$3,200.00	$3,200.00	$0.00	1
45	Organize system	$0.00	$0.00	$0.00	0	$0.00	0	$4,800.00	$4,800.00	$0.00	1
46	Complete Final Report	$0.00	$0.00	$0.00	0	$0.00	0	$12,000.00	$12,000.00	$0.00	1
47	System Deployment Complete	$0.00	$0.00	$0.00	0	$0.00	0	$0.00	$0.00	$0.00	0



Since the values of estimate at completion (EAC) and budget at completion (BAC) are ($1,266,680) the same, the variance at completion (difference of estimate at completion and budget at completion) is 0 as of 11/27/2020.

Interpretation of result:

If the values of variance at completion is positive (greater than 0), the project is said to be under planned in cost. If the value of VAC is neutral or 0, project is on planned cost and if the value of VAC is negative or less than 0, the project is over planned cost. Since the variance at completion is 0 as highlighted in the above table, the project is on schedule and cost changes are also not applicable, and the project is on track. It is neither under estimated nor over estimated.

The result can be interpreted with the value of To Complete Performance Index (TCPI) as well. If the values of TCPI is greater than 1, the project is said to be harder to complete. If the value of TCPI is equal to 1, the project is scheduled perfectly and if the value is less than 1, the project is easier to complete. Since the values of TCPI highlighted in the above table is equal to 1, the project is scheduled perfectly.

VII. Project Close-out

VII.1 Lessons Learned

Working as team on this project was enriching and interesting. Team members showed remarkable understanding of the project objectives, as they assembled quality project management skills towards the successful competition of the task. First, we were bounded by a shared collective goal to deliver the best work, which was further sustained by the pool of personal skills we all tapped from. Coming to the end of this project, team members brainstormed on which risks are most likely to affect the project if it's implemented and deployed in a real-life situation, and we agreed on these three (3) risks, which will be discussed in turns. In the first two instances, we were successful.

- Scope Creep
- Budget Overrun

- Security & Data Availability

Scope Creep

The Waterfall approach for software development was adopted for this project. This method assumed a near-perfect knowledge or complete understanding of the project from start to end, and the deliverables are then executed in stages, wherein the next stage kicks off only when its predecessor stage and has been completed. Also, corrections are made at any point at the final stage; a strict waterfall model does not allow iterations. Assuming this, the team defined its project's scope during the scope and requirement gathering stages. These requirements and scope were agreed by all stakeholders at that point in time. However, during the system planning and development stages, some newly introduced requirements were introduced into the projects by the Heads of marketing and operation supply departments. The new requirements that creeped into the project at this point broaden our scope, which in turn would affect our budget and schedule. So, what did we do?

As mentioned earlier, distributed systems involve a complex architecture, which the waterfall model is not suited for. So, to accommodate the creep, we blended the model with some iterative processes. The team went back to the board and evaluated the new requirements for relevancies and formed a decision. We observed that about 75 percent of the new requirements were more duplicities of functions already contained in the original scope, which would only increase the complexity of the project. We employed diplomacy, tactful negotiation, and effective communication to inform the respective managers about why those requirements were not needed. On the few requirements that were relevant to the project, we incorporated them into the project

on the spot, which saved a lot of time, and a prototype were shown to all stakeholders to confirm if it meets their requirements.

Budget Overrun

Empirically, budget overrun is a peculiar risk in most executed projects, resulting from uncertainties that happen throughout the period the project is initiated and completed. However, it is important to keep this risk in check to avoid excessive additional cost over the estimated cost. In cognizance of this risk, we agreed to mitigate a (significant) budget over by allowing, where possible, a 10 percent increase. This does not imply we willingly allowed for an increase over the actual cost, but for we to have a contingency fund in case we needed one. However, to ensure we stick to our budget, our scope, schedule, and every other resource were accurately and quantitatively estimated at each stage of the project life circle, with a total cost of $1.5 million and a provisional fund of 10 percent of total cost to accommodate any uncertainty. This proper planning and the used of advanced quantitative tools to estimate costing worked out, because the project was completed in due time and within the cost boundaries. Also, with a well-defined scope agreed by all stakeholders, we reached agreements with proprietary vendors and obtained competitive pricing for both their soft/hardware, which constituted a major cost of total budget. Likewise, every resource needed for each stage was identified and a realistic price pegged to it. So, with the help of proper documentation or resource prices and well-articulated scope, we were able to maintain our cost-budget window.

Security & Data Availability

We deployed a distributed analytical system that is accessible via the cloud technologies. This (cloud technology) is not one of the business areas of Galaxy Corporation, so we used a third-party cloud technology to launch our system to the cloud. These services include data storage and an analytical processing interface. With most of the company's data being stored in multiple data farms and accessed through the internet, as part of the contract agreement, we reached a data security agreement with our partners, wherein they promised to indemnify us in an event of data breach or a massive disruption that resulted to we unable to access our data. This is a way of transferring this risk to our vendors, given that these storage devices are not managed by our organization. Thus far, we have not reported any known data breach, but we have witnessed some system downtime that impacted on the operations of the company in a negative way and cost us some monetary value.

However, on the impact on our operations, our partner refused to compensate us, claiming the impact was not massive. He took advantage on a clause on the service level agreement (SLA) that states 'massive disruptions', claiming this clause is ambiguous and did not categorically define at what point/level a system downtime would massively disrupt the activity of our firm. We lost out in the legal battle and incurred the losses from that risk. To avoid a reoccurrence, we have reviewed the SLA and agreed with our partner that a system downtime that exceeds a 30min time length is classified as 'disruptive' to our organization. Also, we intend to undertake a project of installing some in-house, cost-efficient storage devices as a backup to hold grade A data; data set that are mostly required for the organization to function in case of a downtime from our cloud partner.