2018

Green Computing Research Project

ISDS 551-51

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Part 1: Task 1 – What Is Green Computing?

Introduction

Unlike past decades, computing is now a necessity in almost all business processes. As organizations seek to optimize profits, sustainable and efficient computing is very essential. However, as this happens, (Bawden, 2016) takes note that the amount of energy used in the world's data centers is 416.2 terawatt hours, which he termed, "far higher than the UK's total consumption." The author projects this to treble over the next decade. Dependence on computing may lead to increased energy demand and high costs, in a pool of scarce resources. Additionally, e-waste is likely to increase, therefore, disposal can be challenging.

Green Computing

Green computing is the application of computing practices that are eco-friendly and sustainable to an organization to mitigate the challenges in the introduction. These categories include:

i. **Virtualization:** It is considered as one of greatest innovations that comprises a range of quantifiable benefits. Virtualization is simulation of a resource or object in software such that it identically corresponds to the physical object and brings along benefits such as flexibility, cost, reliability and scalability (Mathias, 2017). Types of virtualization include server, application, network, storage, and desktop like Thin Client solutions. Key benefits of virtualization are reduced energy and e-waste disposal.

   Example: "Through the implementation of VMWare Infrastructure data center optimization and management software, Data Guard cut down its power costs by as much as $10,000 per month and they paid off the infrastructure cost within one year" (vmware).

ii. **Power/Energy Management:** Proper practices may help reduce consumption of power in computing. Power management on a laptop or desktop PC, through the power settings or when not in use, one can shut-down or hibernate and in some cases turn off the screen. In data centers, implementation of scalable and smart power management is becoming a practice.

   Examples:

   - **The Stanford Research Computing Center (SRCC)** – The is daily monitoring and review of the facility checking for issues, leaks, rodents and energy-wasting situations (SRCC, 2018). The center was certified by EPA for their effective power management. In context, the center reduced its energy per square foot by 40%, which translates to prevention of more than 1300 metric tons of greenhouse gas emissions annually

iii. **Recycling and Electronic Waste Disposal:** (Debnath, Roychoudhuri, & Ghosh, 2016) states that in 2014, there was 41.8 million metric tons of e-waste. Such amount of e-waste can lead to a debilitating effect if not well-handled. Countries and states are taking e-waste threat seriously and are beginning to implement laws and regulations to govern recycling and e-waste disposal.

Example: Through IBMs' battery recycling and disposal programs the following items are recycled- Sealed Lead-Acid, Nickel Cadmium, Nickel Metal Hydride, Lithium and Lithium Ion batteries.

iv. **Cloud Computing:** Cloud computing offers almost similar benefits as virtualization. Cloud computing guarantees reduced energy and resource costs which may decrease carbon emissions. According to (Sloane, 2015) clouds reduce energy use and carbon emissions by 30 to 60% in comparison to on-premise IT infrastructure. The author affirms that in small business entities, e-waste reduction could go well over 90%. The author concludes that IT-enabled energy efficiency can lead up to $946.5 billion worth of savings globally within the next 5 years.

v. **Telecommuting:** Lately firms are exploring non-IT practices that can reduce congestion, lowered fuel consumption, reduced construction of office space, low carbon-emissions, etc. Telecommuting and carpooling are examples which contribute to the cause of green computing (Reynolds, 2016).

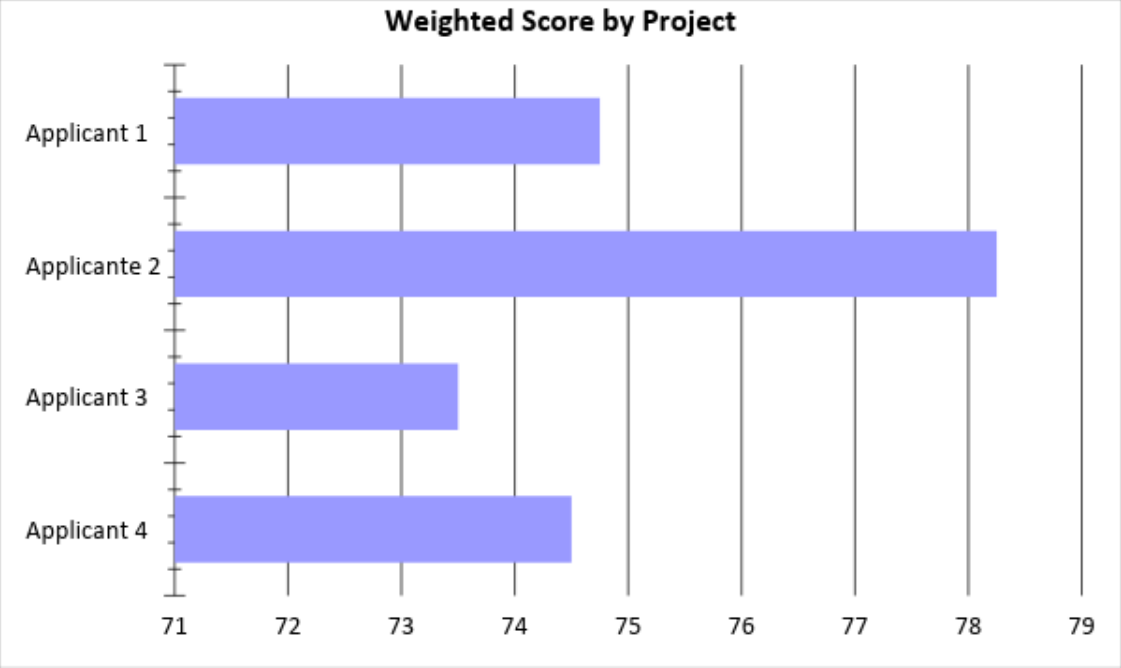
Example: According (Reynolds, 2016), Dell's remote workforce saved the company over $1,000,000 in fuel costs, avoidance of 136 million travel miles and reduced carbon emissions by up to 35,000 metric tons/year.

Part 1: Task 2 – Weighted Decision Matrix

Weighted Decision Matrix for Green Computing

Created by: Jana **Date:** 5/1/2018

Criteria	Weight	Applicant 1	Applicante 2	Applicant 3	Applicant 4
Management Experience	25%	90	80	85	80
Technical competence	30%	70	85	70	80
Able to do research	15%	60	75	60	50
Able to write & edit	15%	90	75	80	80
Knowledge of Green Computing	5%	50	45	65	90
Works well with others	5%	50	70	80	45
Start quickly	5%	75	90	60	85
Weighted Project Scores	**100%**	**74.75**	**78.25**	**73.5**	**74.5**



Four applicants have applied for the project manager position. Their eligibility will be assessed based on seven criteria. The highest weighted criterion is technical competence at 30%. In a close second, management experience is weighted 25%. The project is spanned over six months and will be worked on virtually. The project manager will need to have the skills to coordinate the project and resolve any issues that are bound to come up. The abilities to do research and be able to write and edit are both weighted at 15%.

In addition, knowledge of green computing, works well with others, and can start quickly are each weighted at 5%. Since the project is on green computing, it is expected that the applicants should possess some knowledge on the subject. The project manager should be able to work well with others since this is a group project. There will be fewer conflicts if team members are team players. Finally, the applicant needs to be able to start quickly if they are not an internal hire.

The applicants' scores are as follows: applicant 1- 74.75%, applicant 2- 78.25%, applicant 3- 73.50%, and applicant- 74.50%. As evident, applicant 2 has the highest score. A further breakdown of the results will determine the eligibility of applicant 2 for the position.

Applicant 2 has the highest score for technical competence, which is the criterion with the highest weight. On the other hand, applicant 2 has one of the lowest scores when it comes to managerial experience. This will not hinder their ability since experience is a skill developed and gained with more exposure. Therefore, this project is a perfect opportunity for applicant 2 to increase his/her managerial experience score.

Compared to the other three applicants, applicant 2 has the lowest score when it comes to the ability to write and edit. However, applicant 2 can make up for that skill with his/her ability to do research. His/her research ability also makes up for the low score on knowledge of green computing. Nevertheless, this will not hamper the success of the project since knowledge can always be gained with further research.

The last two criteria are works well with others and start quickly. Applicant 2 has the second highest score for works well with others. Being able to work well with others is always an advantage when working in a group setting. The final criterion is starting quickly. Applicant 2 can start sooner than any of the other applicants. After reviewing the scores of each applicant, applicant 2 has the highest score, which makes him/her the most suitable person for the project management position.

Part 1: Task 3 – Financial Analysis

Financial Analysis for Green Computing Research Project

Created by: Kuan-Yin Lu

Date: 5/1/2018

Discount rate	7.00%				
Assume the project is completed in Year 0		Year			
	0	1	2	3	Total
Costs	500,000	2,000,000	600,000	600,000	
Discount factor	1.00	0.93	0.87	0.82	
Discounted costs	**500,000**	**1,860,000**	**522,000**	**492,000**	**3,374,000**
Benefits	0	500,000	2,500,000	2,500,000	
Discount factor	1.00	0.93	0.87	0.82	
Discounted benefits	**0**	**465,000**	**2,175,000**	**2,050,000**	**4,690,000**
Discounted benefits - costs	(500,000)	(1,395,000)	1,653,000	1,558,000	**1,316,000** ← NPV
Cumulative benefits - costs	(500,000)	(1,895,000)	(242,000)	1,316,000	
				Payback of this project occurs during year 3	
ROI →	**39%**				

Part 1: Task 4 – Project Charter

Project Title: Green Computing Research Project

Project Start Date: May 1, 2018 **Projected Finish Date:** October 31, 2018

Budget Information: The firm has allocated $500,000 for the Green Computing Research Project. The budget will be used for the labor needed to execute on this project as well as hiring consultants for expert advice and purchasing materials like books or scholarly articles.

Project Manager: TBD

Project Objectives: Research possible applications of green computing that can be implemented into We Are Big, Inc. operations. Areas of focus include-

- Data center and overall energy efficiency
- Disposal of electronic waste and recycling
- Telecommuting
- Virtualization of server resources
- Thin client solutions
- Use of open source software
- Development of new software to address green computing for internal use and potential sale to other organization

Main Project Success Criteria: An extensive report that includes detailed financial analysis and actionable recommendations on which green computing technologies to implement. This report is to be delivered no later than October 31, 2018.

Approach:

- Within two weeks, source a project manager to lead the research project. This project manager may be selected internally, but open to selecting someone externally.
- Within 4 weeks, the project manager will source 4 other employees to work on this project, either an internal or external resource as long as the employees are able to begin immediately.

- Focus on selecting the best candidates with direct industry experience, regardless of geography. This means allowing those selected to potentially work virtually on the project.
- Within the first month, develop a scope statement, define project roles, create the project timeline, set milestones and create a Gantt chart to keep the research project on course.
- At the start of the project, source an experienced consultant to provide preliminary direction and input on the Green Computing Research project. This will be used as an outline for the entire research project
- Hold bi-weekly progress review meetings to ensure the project is on track as well as discuss and provide feedback on current research findings.
- Vet all preliminary recommendations with internal and external stakeholders involved as they come to fruition to ensure that the recommendation is viable and actionable. Include these stakeholders in bi-weekly meetings as needed.

Roles and Responsibilities

Role	Name	Organization/ Position	Contact Information
Project Manager	TBD	Manager	TBD
Team Member	TBD	IT Expert / Software Engineer	TBD
Team Member	TBD	HR Solutions Consultant	TBD
Team Member	TBD	Energy Efficiency Consultant	TBD
Advisor	TBD	Client Representative	TBD

Sign-off: (Signatures of all above stakeholders. Can sign by their names in the table above.)

Comments: (Handwritten or typed comments from above stakeholders, if applicable)

Part 1: Task 5 – Change Requests

The integrated change control system will be implemented to ensure that there are processes in place to allow a change request to be properly analyzed, approved or rejected, and managed. A Change Control Procedure document will be written that will describe the policies and procedures that need to be followed in order to make changes to the project baseline. A Change Control Board (CCB) will comprise of three people who will be responsible for approving or rejecting the proposed changes. The three members of CCB will be Ben, the project sponsor, Ito, the program manager, and the project manager of the Green Computing Research Project. The CCB will meet once a week and the project manager will be responsible for informing the members of the CCB when there is a written request for a change in the project.

A change request can be made in writing by completing the change request form. The form will be a soft copy and will reside on the network such that all the members of the team can have access to it. The change request will then be submitted to the project manager by email. The form will ask for general information such as project name, date request submitted, title of the change request, change order number, and submitted by. The form will have five broad categories in total upon which a project can be changed. Four of the categories are project specific and the fifth one is an open-ended category labeled as “other.” The four categories upon which a project change request can be made are Scope, Schedule, Cost, and Technology.

In order to better understand the request, a description of the change request is required. The events that made this change necessary or desirable along with the justification for the change is also required. To ensure that the request passes through integrated change control the impact of the proposed change to six areas of the project are required. The five areas of the project that the change request can affect are Scope, Schedule, Cost, Staffing, and Risk. The sixth area is an open-ended category labeled as Other.

The change request form which is submitted to the Project Manager is then submitted to the change control board for approval. The change requestor is informed of the decision. The document and decision are documented and kept for future references. If the request is approved then project documents are updated to include the proposed change. All the relevant areas that are affected due to this change needs to have the respective documents updated.

To ensure that the changes are made in a timely manner, urgent requests will be decided upon by the Project Manager. This way if there is any change that needs to be made urgently then a decision is made by a person who is easily available to the team members. However, the

request still needs to be approved by the CCB. If the CCB rejects the request then the team will have 48 hours to revert the changes and continue without the change. If the CCB approves the request then the request can be made official and can be reflected on the project documents as well.

Part 2: Task 1 – Requirements Traceability Matrix

The Green Computing Research seeks to achieve computing efficiency through the application of various green computing practices that will be researched as listed in **R003** of the comprehensive requirement traceability matrix below:

Project Name	**Green Computing Research Project**				
Requirement No.	**Associated No**	**Name**	**Category**	**Source**	**Status**
R001	1.0	Team Selection -Internal	Human Resource	Human Resource Management System	Pending
	1.1	Team Selection – External Consultant	Human Resource	Project Charter	Pending
R002	2.0	Develop WBS	WBS	Project Charter	Pending
	2.1	Create Scope Statement	Scope Management Plan	Project Charter	Pending
	2.2	Create Gantt Chart	Gantt Chart	Project Charter	Pending
R003	3.0	Research on data center and overall energy efficiency	Energy Efficiency Report	Project Charter, External resources	Pending
	3.1	Research on disposal of electronic waste and recycling	Waste management Report	Project Charter, External resources	Pending
	3.2	Research on telecommuting	Research Summary Report	Project Charter, External resources	Pending
	3.3	Research on server virtualization	Functionality and feasibility Report	Project Charter, External resources	Pending
	3.4	Research on thin client solutions	Technical feasibility Report	Project Charter, External resources	Pending
	3.5	Research on use of open source software	Functionality Report	Project Charter, External resources	Pending
R004	4.0	Discussion of Research Findings	Deliverable	Internal Documentation	Pending
	4.1	Recommendations & Vetting	Deliverable	Internal Documentation	Pending
R005	5.0	Requirements Documentation	Requirements Management Plan	Requirements Management Plan	Pending
R006	6.0	Project progress summary and review	Deliverable	Progress Report	Pending

Questions to ask project sponsor:

- What do you consider as the most important functionalities?
- Are there any organizational politics or risks that may influence the direction of the project?
- What recycling and disposal options do they use currently?
- What capacity building plans do you have to ensure sustainability of selected solutions?
- What is the status of telecommuting? Do you anticipate more people joining the program?

Part 2: Task 2 – Scope Statement

Project Title: Green Computing
Prepared by: Jana Hammoud

Project Justification:

With increasing waste, green computing is aimed at reducing waste, which improves the environment. Not only will green computing improve the environment but will also increase revenue and decrease cost. It does so by increasing efficiency on an organizational level. Therefore, further researching green computing and its applications should be considered necessary and a natural next step for the organization.

Product Characteristics and Requirements:

1. Data center and overall energy efficiency
2. Disposal of electronic waste and recycling
3. Telecommuting
4. Virtualization of server resources
5. Thin client solutions
6. Use of open source software
7. Development of new software to address green computing for internal use and potential sale to other organizations

Summary of Project Deliverables

Project management-related deliverables: business case, charter, team contract, scope statement, WBS, schedule, cost baseline, status reports, final project presentation, final project report, lessons-learned report, and any other documents required to manage the project.

Product-related deliverables: research reports, design documents, software code, hardware, etc.

1. Four recommendations to implement some of these technologies
2. At least 20 different project ideas
3. A work breakdown structure (WBS) for the project
4. Gantt chart
5. Cost estimate for the project

Project Success Criteria:

The success of the project will be determined by the quality of the deliverable and their feasibility. Another criterion includes remaining within budget and finishing the project during the allotted time.

Part 2: Task 3 – Work Breakdown Structure

Work Breakdown Structure for Green Computing Research

Prepared by: Kuan-Yin Lu **Date: 5/1/2018**

1 Initiation
- 1.1 Advertise Team Purpose
  - 1.1.1 Inside the Company
  - 1.1.2 Outside the Company
- 1.2 Team Member Selection
- 1.3 Project Research
- 1.4 Prepare Business Case
- 1.5 Create Project Charter
- 1.6 Prepare Change Request Form
- 1.7 Charter Signed

2 Planning
- 2.1 Develop Work Plans
  - 2.1.1 Task Collaboration
  - 2.1.2 Schedule Project Meetings
- 2.2 Develop Project Plans
  - 2.2.1 Create Requirement Matrix
  - 2.2.2 Develop Scope Statement
  - 2.2.3 Develop Work Breakdown Structure
  - 2.2.4 Create Gantt Chart
- 2.3 Finalize Project Plans
- 2.4 Get Feedbacks

3 Analysis
- 3.1 Data Center and Overall Energy Efficiency
  - 3.1.1 Identify Data Center and Overall Energy Efficiency
  - 3.1.2 Collect Information
  - 3.1.3 Analyze the Findings
- 3.2 Disposal of Electronic Waste and Recycling
  - 3.2.1 Collect Information
  - 3.2.2 Analyze Costs and Benefits
- 3.3 Telecommuting
  - 3.3.1 Identify impact on the environment
  - 3.3.2 Collect outcomes
- 3.4 Virtualization of Server Resources
  - 3.4.1 Identify Virtualization Requirements and Costs
  - 3.4.2 Analyze Virtualization Benefits

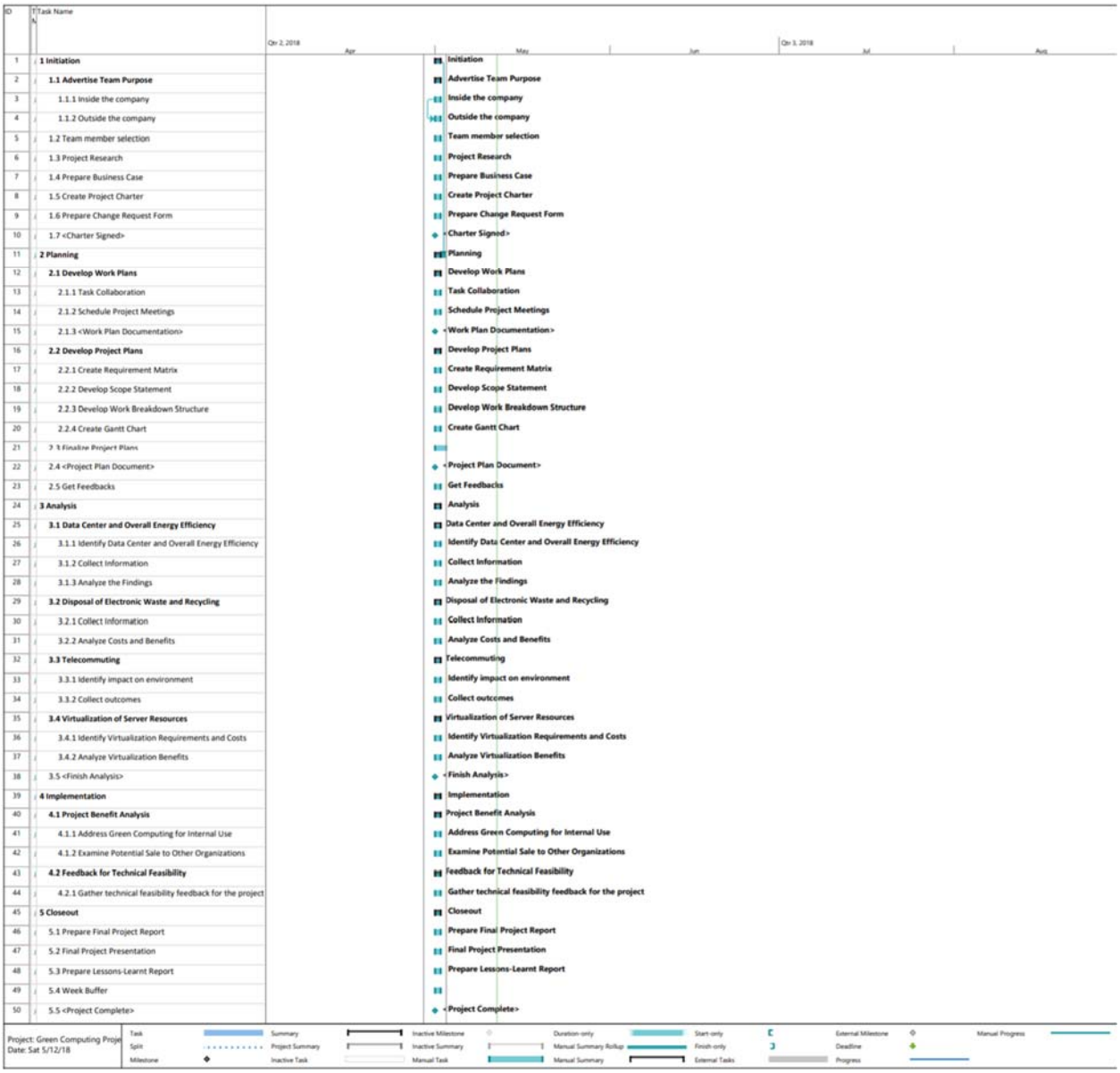
4 Implementation

- 4.1 Project Benefit Analysis
  - 4.1.1 Address Green Computing for Internal Use
  - 4.1.2 Examine Potential Sale to Other Organizations
- 4.2 Feedback for Technical Feasibility
  - 4.2.1 Gather Technical Feasibility Feedback for the Project

5 Closeout

- 5.1 Prepare Final Project Report
- 5.2 Final Project Presentation
- 5.3 Prepare Lessons-Learnt Report
- 5.4 Week Buffer
- 5.5 Project Complete

Part 2: Task 4 – Gantt Chart



ID	Task Name
1	**1 Initiation**
2	**1.1 Advertise Team Purpose**
3	1.1.1 Inside the company
4	1.1.2 Outside the company
5	1.2 Team member selection
6	1.3 Project Research
7	1.4 Prepare Business Case
8	1.5 Create Project Charter
9	1.6 Prepare Change Request Form
10	1.7 <Charter Signed>
11	**2 Planning**
12	**2.1 Develop Work Plans**
13	2.1.1 Task Collaboration
14	2.1.2 Schedule Project Meetings
15	2.1.3 <Work Plan Documentation>
16	**2.2 Develop Project Plans**
17	2.2.1 Create Requirement Matrix
18	2.2.2 Develop Scope Statement
19	2.2.3 Develop Work Breakdown Structure
20	2.2.4 Create Gantt Chart
21	2.3 Finalize Project Plans
22	2.4 <Project Plan Document>
23	2.5 Get Feedbacks
24	**3 Analysis**
25	**3.1 Data Center and Overall Energy Efficiency**
26	3.1.1 Identify Data Center and Overall Energy Efficiency
27	3.1.2 Collect Information
28	3.1.3 Analyze the Findings
29	**3.2 Disposal of Electronic Waste and Recycling**
30	3.2.1 Collect Information
31	3.2.2 Analyze Costs and Benefits
32	**3.3 Telecommuting**
33	3.3.1 Identify impact on environment
34	3.3.2 Collect outcomes
35	**3.4 Virtualization of Server Resources**
36	3.4.1 Identify Virtualization Requirements and Costs
37	3.4.2 Analyze Virtualization Benefits
38	3.5 <Finish Analysis>
39	**4 Implementation**
40	**4.1 Project Benefit Analysis**
41	4.1.1 Address Green Computing for Internal Use
42	4.1.2 Examine Potential Sale to Other Organizations
43	**4.2 Feedback for Technical Feasibility**
44	4.2.1 Gather technical feasibility feedback for the project
45	**5 Closeout**
46	5.1 Prepare Final Project Report
47	5.2 Final Project Presentation
48	5.3 Prepare Lessons-Learnt Report
49	5.4 Week Buffer
50	5.5 <Project Complete>

Network Diagram- See Part 3, Task 3

Part 3: Task 1 – Staying on Track

Accurate estimates are essential to the completion of a project within budget and its completion date. While that is essential, the process can be a very complex task, more so where many stakeholders are involved. In this section, we discuss a couple of activities or methods that may aid the process of estimating resources and duration.

The PERT Technique: PERT is a time management technique that can be used to estimate a project duration where degree of uncertainty is high on the individual activity duration estimates. PERT uses three duration estimates for each individual activity, that is; optimistic, realistic and pessimistic time. Using the three estimates, a weighted average and variance is calculated for each activity duration as a measure of the average duration and the corresponding variability, respectively.

Critical Path Analysis: It's a network diagraming tool used to estimate the duration of a project. Critical Path Analysis helps in keeping projects on track. Also known as Critical Path Method, this technique is useful in:

- Identifying activities that can be completed on time to stay on track.
- Calculation of the minimum amount of time it will take to complete the project.
- Determination of earliest and latest dates as to which an activity can start while keeping to the schedule.
- Determination of tasks that may be delayed and for how long without impacting the project schedule.

Arrow on Activity: This method for a long time has been used to determine to clarify the order of tasks in a project. In addition, it is used to identify resource problems and viable solutions. Lastly, it can be used to come up with the best schedule for the whole project.

Expert Judgement: By reviewing the project WBS and the Gantt chart, project managers and knowledge experts use their experience and knowledge to determine estimated resources such as cost of a project. While doing this, they consider the unique factors to a given project. This method carries along some bias though.

This method may be used alongside **parametric estimating** which uses historical data of key cost drivers to calculate an estimate for different estimates such as duration and cost.

Part 3: Task 2 - Milestones

When creating our milestones, we took into considerations the SMART criteria. Each milestone is specific, measurable and assignable. Project members will be able to know what to do, how it should be done, and who should do it. They are also realistic and time-framed. All the milestones are achievable and have the appropriate time.

The first milestone is getting the **charter completed and signed** by members of the project. The charter needs to identify the objective of the project and basic budget information. It also needs to contain the preliminary breakdown of roles and responsibilities of each of the group members. The charter should be signed four weeks after the project has started.

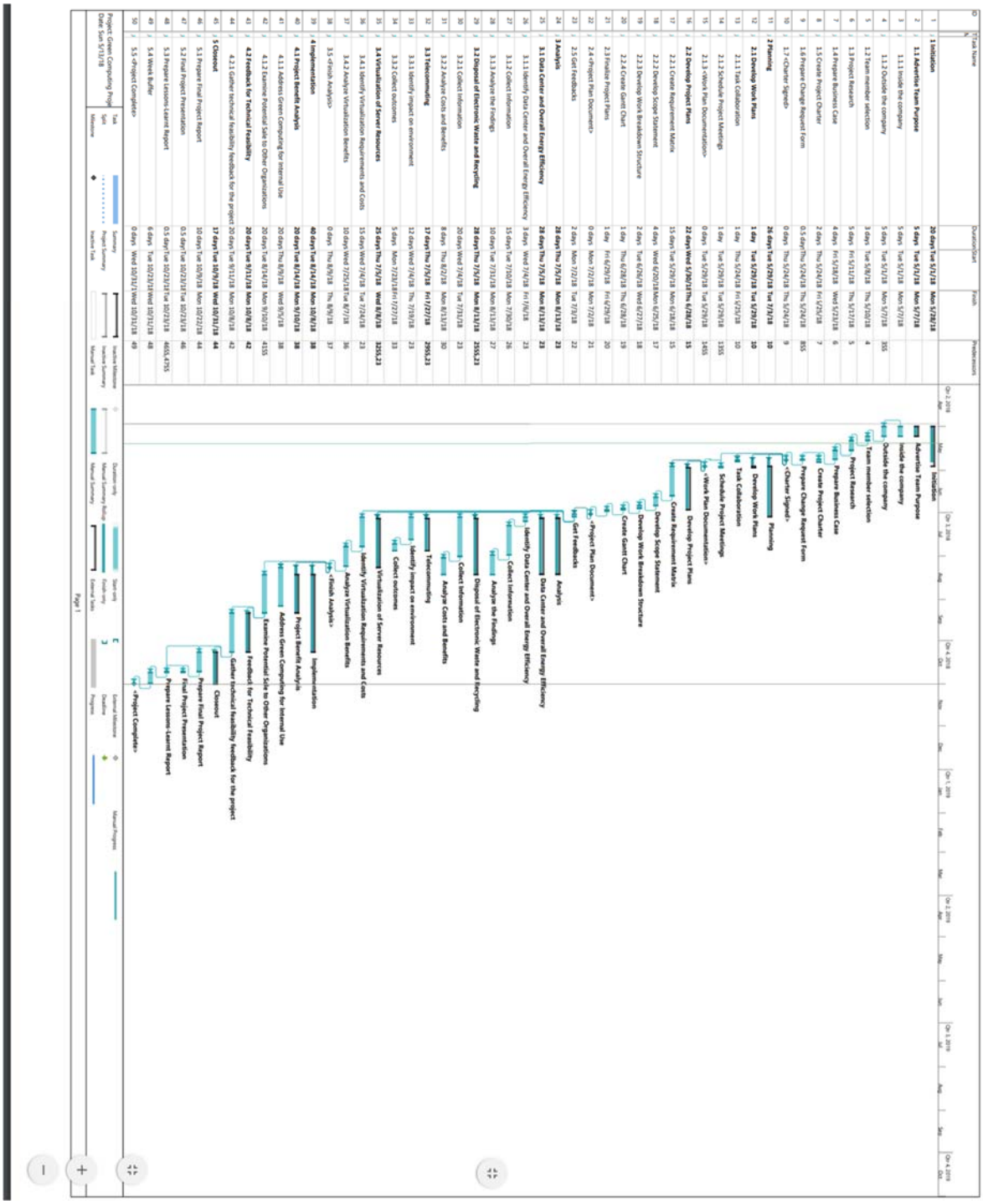
The next milestone is to **finalize the project plans**. There are two sets of plans that need to be developed and finalized. The first is a work plan. A work plan will include task collaboration and schedule meeting times for the team. The second plan to be developed is a project plan. This entails creating a requirement matrix, developing a scope statement, developing a work breakdown structure, and creating a Gantt chart. Once all the plans have been agreed upon, a final draft should be established. The final plans should be ready for feedback within four weeks.

The third milestone is to **finish analysis**. The analysis will focus on four of the green computing concepts: data center and overall energy efficiency, disposal of electronic waste and recycling, telecommuting, virtualization of server resources. The analysis is complete when enough information is completed to be used to suggest an action plan for the green computing implementation. The team members will have six weeks to finish their analysis.

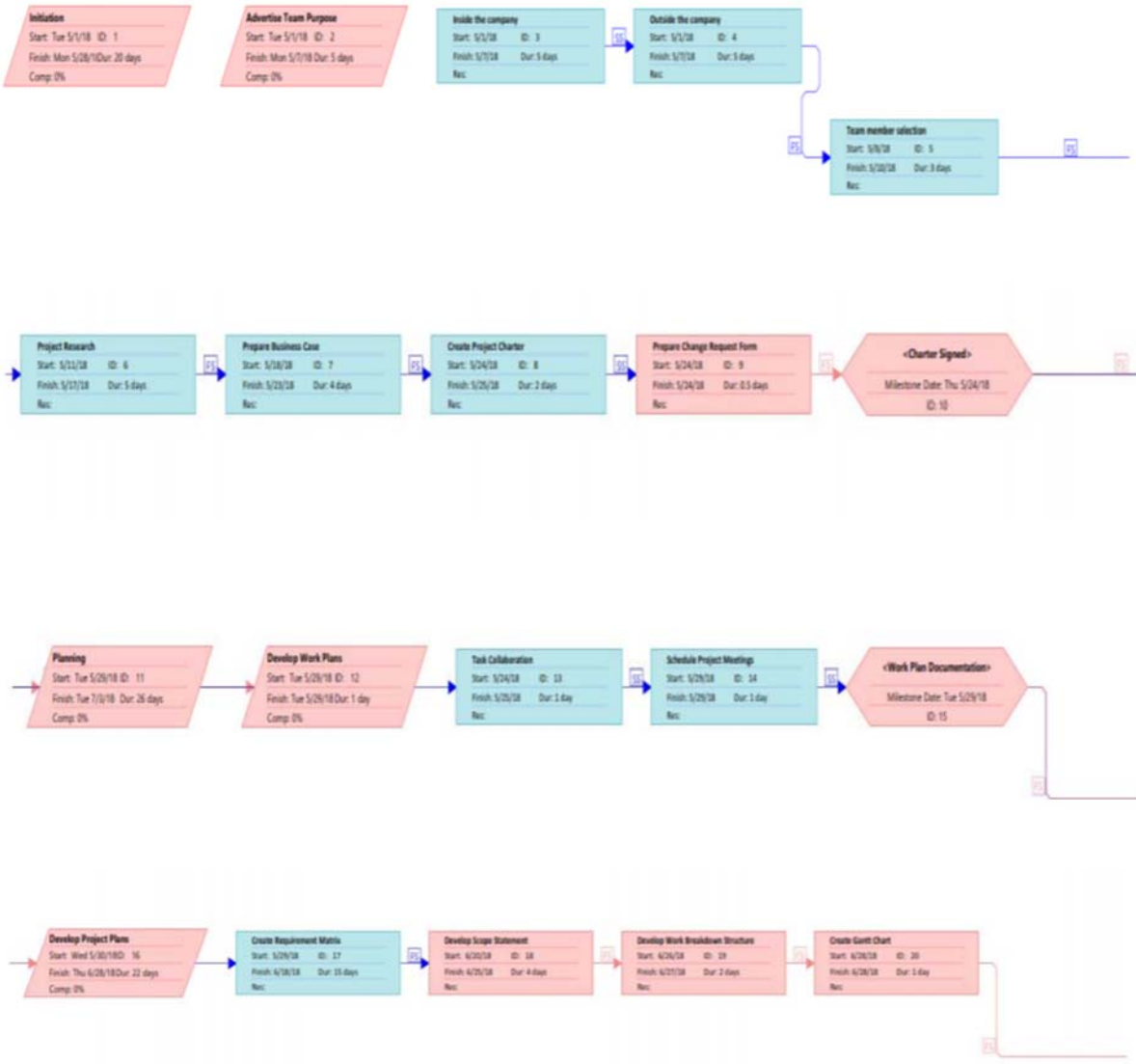
The fourth milestone is the **implementation** based on the analysis from the previous milestone. The team will run a project benefit analysis which will include addressing green computing for internal use and examining potential sale to other organization. The team will also collect feedback for technical feasibility. Implementation should be finished in eight weeks.

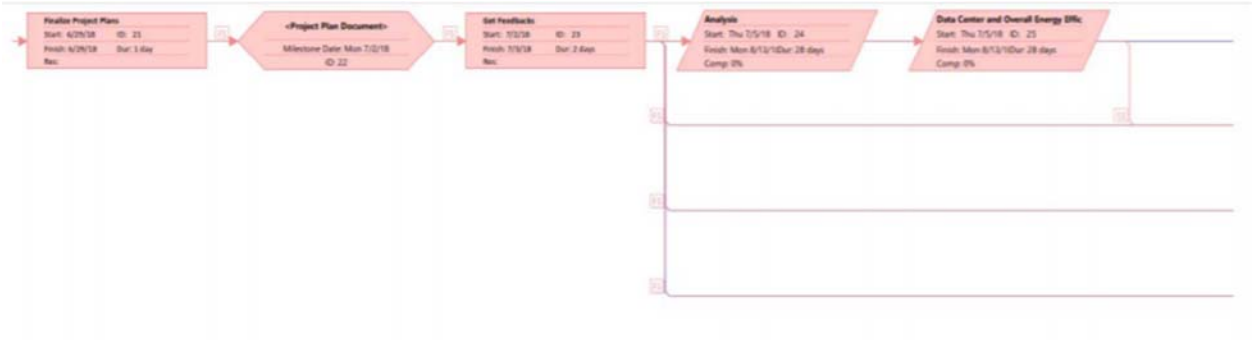
The fifth and last milestone is **project completion**. The team will have three weeks to wrap everything up. The software needs to be functional before the completion of the project with supporting analysis. The team also needs to have the following deliverables completed: the final project report, final project presentation, and lessons-learned report. Once all the following criteria are met, the project is completed and ready to be presented.

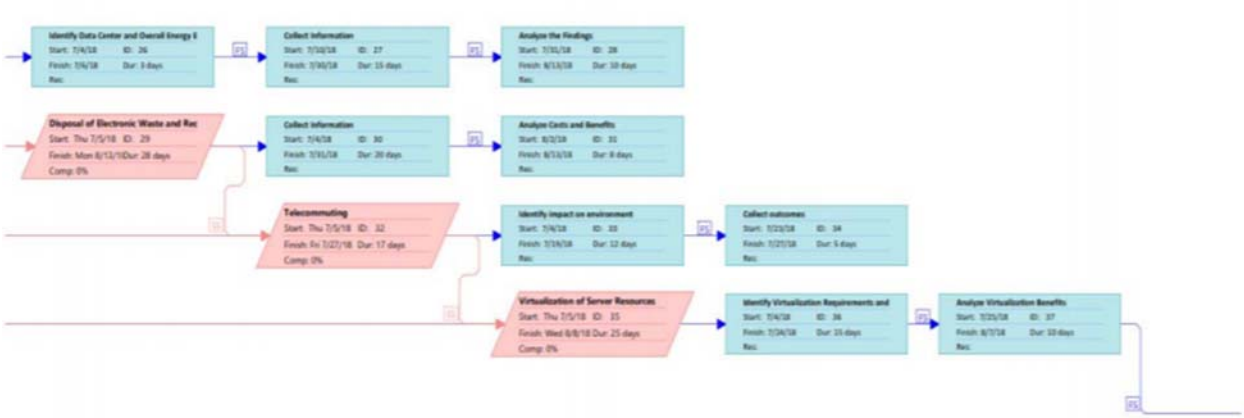
Part 3: Task 3 – Duration Estimates Gantt Chart

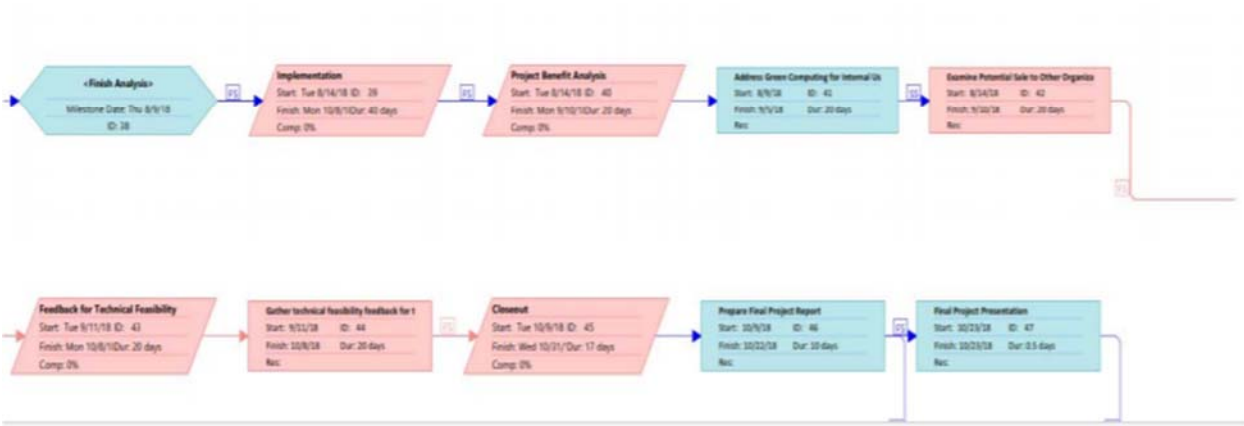


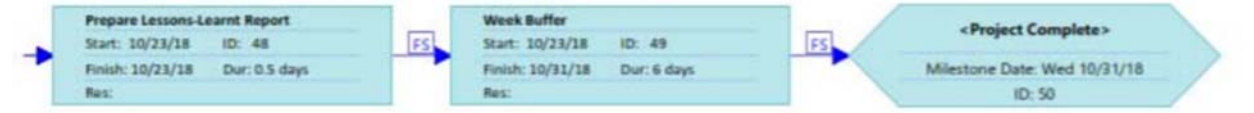
NETWORK DIAGRAM










Prepare Lessons-Learnt Report
Start: 10/23/18 ID: 48
Finish: 10/23/18 Dur: 0.5 days
Res:
FS
Week Buffer
Start: 10/23/18 ID: 49
Finish: 10/31/18 Dur: 6 days
Res:
FS
<Project Complete>
Milestone Date: Wed 10/31/18
ID: 50

Part 3: Task 4 – Resource Assignments

Initiation- Ben and I would work on selecting team members. After selecting suitable people, our team would spend about two weeks to do project research. We will also be working on creating the project charter during the first month.

Planning- Only Matt and James will be available in June since there's a big program meeting which requires me to take 2 team members with me, they will finish developing project plans. After we are back, we will finalize the project plans and move onto the analysis part.

Analysis- Le and James will be assigned to Data Center and Overall Energy Efficiency since she has more experience on green computing and would be more familiar with the similar topic. Le and I will be working on Disposal of Electronic Waste and Recycling. Matt will concentrate on Telecommuting because he is an expert in collaboration technologies. Teresa will be responsible for Virtualization since she has more experience on the subject. It will take approximately 5 weeks to finish the Analysis.

Implementation- I would break the members into two groups to finish Project Benefit Analysis. Teresa and Le will be assigned to Addressing Green Computing for Internal Use since this task involves more in green computing and they both are more suitable to do this task. Matt and James will be assigned to Examining Potential Sale to Other Organization because this task involves external business. Then, everyone has to gather feedback for the project. It will take about 8 weeks to finish this part.

Closeout- The first three weeks of this task would be preparing the final report, the project manager has to work on it; additionally, there would be a part-time editor and consultant, Deb, helping out to produce the final reports and project proposals. Then, each member would have to attend the presentation but James would be the one presenting since he is a professional in presenting. There will be a one-week buffer to ensure the project is completed on time.

Task	Date	Days	# of people	# of hours for each person
1. Initiation				
1.1 Advertise team purpose	1-May to 7-May	5	1	20
1.2 Team member selection	8-May to 10-May	3	2	24
1.3 Project Research	11-May to 17-May	5	4	40
1.4 Prepare Business Case	18-May to 23-May	4	4	32
1.5 Create Project Charter	24-May to 25-May	2	2	8
1.6 Prepare Change Request Form	28-May	0.5	2	2
1.7 Charter signed	28-May	0	4	
2. Planning				
2.1 Develop Work plans	29-May	1	4	8
2.2 Develop Project Plans	30-May to 28-Jun	22	2	88
2.3 Finalize Project Plans	29-Jun	1	5	8
2.4 Get Feedback	2-July to 3-July	2	5	12
3. Analysis				
3.1 Data Center and Overall Energy Efficiency				
3.1.1 Identify Data Center and Overall Energy Efficiency	5-July to 9-July	3	2	24
3.1.2 Collect Information	10-July to 30-July	15	2	96
3.1.3 Analyze the Findings	31-July to 13-Aug	10	2	80
3.2 Disposal of Electronic Waste and Recycling				
3.2.1 Collect Information	5-July to 1-Aug	20	2	120
3.2.2 Analyze Costs and Benefits	2-Aug to 13-Aug	8	2	64
3.3 Telecommuting				
3.3.1 Identify Impact on Environment	5-July to 20-July	12	1	72
3.3.2 Collect Outcomes	23-July to 27-July	5	1	40
3.4 Virtualization of Server Resources				
3.4.1 Identify Virtualization Requirements and Costs	5-July to25-July	15	1	90
3.4.2 Analyze Virtualization Benefits	26-July to 8-Aug	10	1	80
4. Implementation				
4.1 Project Benefit Analysis				
4.1.1 Address Green Computing for Internal Use	14-Aug to 10-Sep	20	2	160
4.1.2 Examine Potential Sale to Other Organization	14-Aug to 10-Sep	20	2	160
4.2 Feedback for Technical Feasibility				
4.2.1 Gather technical feasibility feedback for the projec	11-Sep to 8-Oct	20	5	160
5. Closeout				
5.1 Prepare Final Project Report	9-Oct to 22-Oct	10	1	80
5.2 Final Project Presentation	23-Oct	0.5	5	2
5.3 Prepare Lessons-Learnt Report	23-Oct	0.5	5	2
<One Week Buffer>	24-Oct to 31-Oct			
Total Duration	1-May to 31-Oct (6 months)			

Part 3: Task 5 – Contingency Strategies for Staying on Track

In project management, unexpected issues and problems always arise. No project is ever completed without some disruption to the originally intended plan. With some contingency policies and processes in place, project managers can ensure they stay on schedule despite these unexpected outcomes.

One of the best ways to ensure that a project remains on schedule is through communication. By setting up regular project meetings on a weekly basis to discuss where the project is at and using milestones as a time marker, project managers can begin to identify these unexpected delays and begin developing some contingency strategies to ensure projects remain on track.

One strategy is to identify additional resources that may be mobilized to ensure that projects stay on schedule. These additional resources may come from outside the organization like industry consultants or partners who have worked on similar projects. They can be brought in temporarily to work on and complete the tasks that the current staff are unable to complete on their own. If additional resources cannot be added due to budget constraints, the project manager can swap out resources internally to get a fresh perspective on the issue or release some team members temporarily to allow new resources to come in without any additional costs.

Another strategy is to double check dependencies to see if other tasks can move forward without the financial data, in parallel, rather than in a sequence following the financial data and research on some of the technologies. The project manager will essentially be fast tracking a portion of the project to ensure that the other elements of the project continue on the critical path, potentially completing those tasks earlier than expected. If this is the case then there will be additional resources available to help complete the remaining tasks on time.

Through communication, mobilizing additional resources and fast tracking the tasks that can work in parallel to others, a project manager can ensure that a project stays on track and meets the expected deadline.

Part 4: Task 1 – Cost Estimate

	#units/hrs.	PM cost/unit/hr.	T cost/unit/hr.	J cost/unit/hr.	L cost/unit/hr.	M cost/unit/hr.	Internal Subtotal	#units/hrs.	external cost/unit/hr.	External Subtotal	Total Cost
WBS Items											
1. Initiation											
Trip							6000				6000
Advertise team purpose	20	100					2000				2000
Team Member Selection	24	100					2400	2	500	1000	3400
Project Research	40	100	90	90		80	14400	4	500	2000	16400
Prepare Business Case	32	100	90	90		80	11520	3	500	1500	13020
Create Project Charter	8	100					800				800
Prepare Chang Request Form	2	100					200				200
Charter Signed											
2. Planning											
Develop Work Plans	8	100	90	90		80	2880				2880
Develop Project Plans	88		90			80	14960	12	500	6000	20960
Finalize Project Plans	8	100	90	90	90	80	3600				3600
Get Feedback	12	100	90	90	90	80	5400	4	500	2000	7400
3. Analysis											
Research databases, project management software and tools										75000	75000
Data Cener Overall Energy Efficiency											
Identify Data Center and Overall Energy Efficiency	24			90	90		4320	4	500	2000	6320
Collect Information	96			90	90		17280	10	500	5000	22280
Analyze the Findings	80			90	90		14400	8	500	4000	18400
Disposal of Electronic Waste and Recycling											
Collect Information	120	100			90		22800	10	500	5000	27800
Analyze Costs and Benefits	64	100			90		12160	10	500		12160
Telecommuting											
Identify impact on environment	72					80	5760	8	500	4000	9760
Collect outcomes	40					80	3200	8	500	4000	7200
Virtualization of Server Resources											
Thin Client Solutions	90		90				8100	10	500	5000	13100
Open Source Software	80		90				7200	10	500	5000	12200
4. Implementation											
Project Benefit Analysis											
Address Green Computing for Internal Use	160		90		90		28800	15	500	7500	36300
Examine Potential Sale to Other Organizations	160			90		80	27200	15	500	7500	34700
Feedback for Technical Feasibility											
Gather Technical Feasibility Feedback for the Project	160	100	90	90	90	80	72000	15	500	7500	79500
5. Closeout											
Prepare Final Project Report	80	100					8000	80	200	16000	24000
Final Project Presentation	2	100	90	90	90	80	900				900
Prepare Lessons-Learnt Report	2	100	90	90	90	80	900				900
Project Complete											
Total							**$ 297,180**			**$ 160,000**	**$ 457,180**

Assumptions :

1) Labor Rate/ Hour

Project Manager :	$100
Team members :	$90
Technical Specialist :	$80
Outsourced Staff :	$200
2) Average Working Hour / Month :	160
3) Project to complete in (month) :	6

Part 4: Task 2 – Cost Baseline

WBS	Task Name	Month 1 (May)	Month 2 (June)	Month 3 (July)	Month 4 (August)	Month 5 (September)	Month 6 (October)	Total
1	**Initiation**							
	Trip	$ 6,000.00						$ 6,000.00
1.1	**Advertise Team Purpose**							
1.1.1	Inside the company	$ 500.00						$ 500.00
1.1.2	Outside the company	$ 1,500.00						$ 1,500.00
1.2	Team member selection	$ 3,400.00						$ 3,400.00
1.3	Project Research	$ 16,400.00						$ 16,400.00
1.4	Prepare Business Case	$ 13,020.00						$ 13,020.00
1.5	Create Project Charter	$ 800.00						$ 800.00
1.6	Prepare Change Request Form	$ 200.00						$ 200.00
1.7	<Charter Signed>							
2	**Planning**							
2.1	**Develop Work Plans**							
2.1.1	Task Collaboration	$ 1,000.00						$ 1,000.00
2.1.2	Schedule Project Meetings	$ 1,000.00						$ 1,000.00
2.1.3	<Work Plan Documentation>	$ 880.00						$ 880.00
2.2	**Develop Project Plans**							
2.2.1	Create Requirement Matrix	$ 1,905.00	$ 12,385.00					$ 14,290.00
2.2.2	Develop Scope Statement		$ 3,810.00					$ 3,810.00
2.2.3	Develop Work Breakdown Structure		$ 1,905.00					$ 1,905.00
2.2.4	Create Gantt Chart		$ 955.00					$ 955.00
2.3	Finalize Project Plans		$ 3,600.00					$ 3,600.00
2.4	<Project Plan Document>							
2.5	Get Feedbacks			$ 7,400.00				$ 7,400.00
3	**Analysis**							
	Research databases, project management software and tools			$ 75,000.00				$ 75,000.00
3.1	**Data Center and Overall Energy Efficiency**							
3.1.1	Identify Data Center and Overall Energy Efficiency			$ 6,320.00				$ 6,320.00
3.1.2	Collect Information			$ 22,280.00				$ 22,280.00
3.1.3	Analyze the Findings			$ 1,840.00	$ 16,560.00			$ 18,400.00
3.2	**Disposal of Electronic Waste and Recycling**							
3.2.1	Collect Information			$ 25,020.00	$ 2,780.00			$ 27,800.00
3.2.2	Analyze Costs and Benefits				$ 12,160.00			$ 12,160.00
3.3	**Telecommuting**							
3.3.1	Identify impact on environment			$ 9,760.00				$ 9,760.00
3.3.2	Collect outcomes			$ 7,200.00				$ 7,200.00
3.4	**Virtualization of Server Resources**							
3.4.1	Thin Client Solutions			$ 13,100.00				$ 13,100.00
3.4.2	Open Source Software			$ 4,880.00	$ 7,320.00			$ 12,200.00
3.4.3	<Finish Analysis>							
4	**Implementation**							
4.1	**Project Benefit Analysis**							
4.1.1	Address Green Computing for Internal Use				$ 25,410.00	$ 10,890.00		$ 36,300.00
4.1.2	Examine Potential Sale to Other Organizations				$ 24,290.00	$ 10,410.00		$ 34,700.00
4.2	**Feedback for Technical Feasibility**							
4.2.1	Gather technical feasibility feedback for the project					$ 55,650.00	$ 23,850.00	$ 79,500.00
5	**Closeout**							
5.1	Prepare Final Project Report						$ 24,000.00	$ 24,000.00
5.2	Final Project Presentation						$ 900.00	$ 900.00
5.3	Prepare Lessons-Learnt Report						$ 900.00	$ 900.00
5.4	<Project Complete>							
Total		**$ 46,605.00**	**$ 22,655.00**	**$ 172,800.00**	**$ 88,520.00**	**$ 76,950.00**	**$ 49,650.00**	**$ 457,180.00**

Part 4: Task 3 – Project Analysis

TASK 3.A:

Budget at Completion = $500,000

Assumption:

Planned Value (PV) = $160,000

Estimate Value(EV) = $150,000

Actual Cost (AC) = $180,000

Cost of Variance = EV – AC

= $150,000 - $180,000 = **-$30,000**

Schedule of Variance = EV – PV

= $150,000 - $160,000 = **-$10,000**

Cost Performance Index (CPI) = EV/AC

=$150,000/$180,000 = **0.833 or 83.33%**

Schedule Performance Index = EV/PV

= $150,000/$160,000 = **0.9375 or 93.75%**

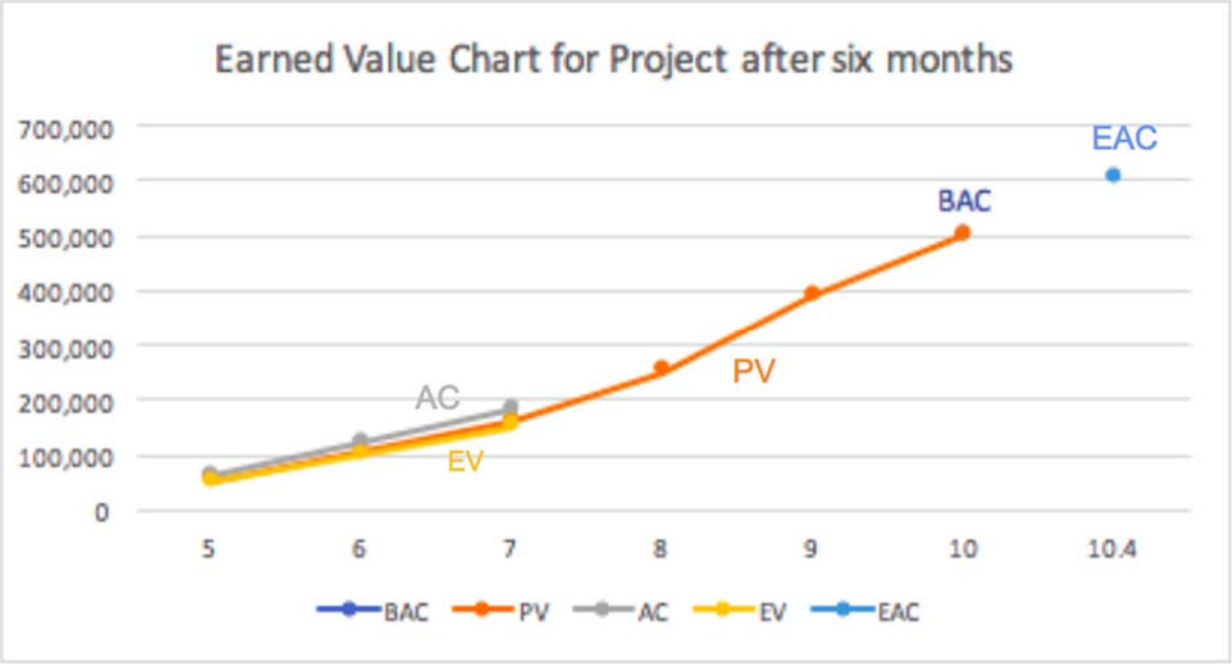
TASK 3.B

Estimate At Completion = BAC/CPI

=$500,000/0.833=**$600,240.096**

Estimate Time to Complete = Original time estimate/SPI

=6/0.9375**=6.4 months**



As we can see from the chart, if the project goes as planned, it will finish in 6 months and costs $500,000. However, the actual cost line is above earned value line, which indicates that the cost of this project is more than we expected. The planned value line is close to the earned value line, which means that the project has been on track but slightly behind schedule since EV is still a little lower than PV.

TASK 3.C

With the results in 3.a and 3.b, the cost and schedule of variance are on the negative. Further to this, the CPI and SPI are less than 100%. This outcome indicates that there are problems within the project, in that it costing more and is behind schedule. It is vital that the sponsor and senior management be alerted, that includes seeking assistance.

Part 4: Task 4 – Corrective Actions for Addressing Problems

Any time a company gets into a partnership or agreement with an outside organization, there must be due diligence in setting the expectations and requirements prior to signing any contract. By doing so, the contract can be revisited in times where an outside organization's performance is not meeting expectations.

In the case where outside consultants are taking longer than originally stated to deliver requirements or costs are higher than originally budgeted, a project manager can review the original contract for legally binding service expectations. This can be used as a tool to renegotiate expectations and set new deliverables. Once both parties agree to the new requirements, both parties should agree on dates and delivery. If these new dates and requirements are still not met, then the project manager should move on to more severe corrective actions to regain control of the project schedule.

At this point, the project manager has no choice but to break the contract and partnership with the outside organization. If an organization is not living up to the expectations as outlined by the contract that was established at the beginning of the partnership, then a company has every right to break the contract with the help of a legal consultant. If a project manager were to continue working with these underperforming consultants, the entire project is at risk for missing deadline as well as going exceptionally over budget.

While the legal counsel is working on dismissing the prior contracts, the project manager should look for a new partner or consultant that is highly qualified and experienced in Green Computing Projects. Once a new partner is found, the project manager should take extra care in clearly establishing the project requirements and deliverables, delivery dates, total budget and a formal process for re-negotiating expectations if unexpected outcomes arise.

When addressing underestimated costs, it must go through the formal change request process to properly document and review the new costs. Once approved by the Change Control Board, the team may use management reserves budget to cover the unforeseen travel costs. These new costs are then added to the cost baseline.

The project manager can follow similar steps for submitting a schedule change request if a project is unable to meet original deadlines. He or she will follow the steps outlined in the Change Request Process outlined in Part 1.

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