PROJECT CHARTER

MICRO WASTE MANAGEMENT SOLUTION:
GENERATING ENERGY FROM WASTE FOR DEVELOPING COUNTRIES – USING MICRO AUTO GASIFICATION SYSTEM (MAGS)

A.C.M.E
Association to Conservatively Manage the Environment

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Purpose/Justification

A common problem among developing countries is the lack of appropriate institutional mechanisms and technological advancement to address the proliferation of solid waste generation. Rapid urbanization, accelerated population growth and inadequate resources constrains the ability of developing countries to manage waste collection, disposal services and repurposing was for usable energy [C3]. Consequently, these inadequacies results in numerous social and environmental ills. ACME aims to capitalize on the economic opportunity to leverage and promote technological advancement to transform waste into sustainable energy for developing countries. The pursuit of Turn-key solutions to convert waste into valuable resources (e.g. clean water, thermal energy, electricity etc.) in order to promote healthy environment is one of our highest values.

Objectives

The business objectives for this project are in direct support of our corporate strategic plan to improve waste management in developing countries and transform waste into valuable resources.

- Deploy the micro waste management solution called MAGS (Micro Auto Gasification System) in Bangalore, India
- Conduct a pilot or experiment at a small scale beginning with 100 homes in order to evaluate feasibility, time, cost, and any uncertainties prior to full scale production launch.
- Repurpose rising waste & e-waste production that will output 70 to 1300kw of usable energy for local consumption
- Capitalize on economic opportunity to harness waste at a low cost and double ROI by year end.
- Reduce environmental hazardous waste effects (diseases) and create healthy local communities
- Obtain government environmental agency backing and NGO sponsors' financial support for proposed project cost (~ $260k) through fund raising.

Description

MAGS solution is a compact-portable omnivorous system that takes in various waste products including consumer, bio-medical, industrial and output usable energy. MAGS gasifies all organic [C1] waste, including paper, plastic, cardboard, food, used oils, sludge, oily rags, wood pallets and others. Compared to conventional waste management solutions, such as incinerators, MAGS consumes very little fuel, has clean emissions, improves efficiency [C2], and reduces greenhouse gases. Fuel consumption is 23 liters (6 US gal/day). And outputs 70-80 kW of heat/refrigeration.

Figure 1. MAGS Overview

Requirements

This project must meet the following list of requirements in order to achieve success.

- The solution must be tested in the lab and demonstrate the claimed capabilities prior to meeting with project sponsors and stakeholders
- Identify Target Plant Location for deployment
- Obtain community buy-in for the designated area of operation within the next 36 days prior to project commissioning
- Secure full grant seed funding for project budget cost within the next 32 days in order to finalize Go/No-Go decision
- Complete referendum for voting on land and location with full community and local governmental buy-in prior to commissioning
- POC/pilot experiment must achieved success criteria of 100 homes outlined prior to production launch

Constraints

The following constraints pertain to the ***MICRO WASTE MANAGEMENT SOLUTION*** project:

- All Secure grant/seed funding activities must be successfully completed in order to initiate MAGS purchase and project.
- MAGS hardware and software must be purchased and shipped in accordance with the allocated budget and timeline
- Referendum on voting on land must be approved as part of community buy-in in order to proceed
- As part of PR, we must accumulate a community sample size of 1000x homes in order to achieve pilot experiment target of 100 homes
- Infrastructure creation must be completed within the timeline specified to avoid pilot and production delay
- PR team must be provided as a critical resource to project initiation.

Assumptions

The following are a list of assumptions. Upon agreement and signature of this document, all parties acknowledge that these assumptions are true and correct:

- MAGS project has the full support of project sponsor, stakeholders, and local authorities backing
- The purpose and objectives of MICRO WASTE MANAGEMENT SOLUTION project will be communicated throughout the deployment process.
- Project sponsors and stakeholders will provide additional resources if and when necessary

Scope Statement

The MICRO WASTE MANAGEMENT SOLUTION project requires successful completion of the following preliminary deliverables:

- Ensure all preliminary activities such as lab validation testing of MAGS solution, Grant/seed funding and Pilot experiment testing are all completed within the agreed timeline
- Complete Research and Planning tasks within the allotted calendar period
- Obtain the Community Buy-In and all related activities by the assigned date
- Ensure MAGS plant Commissioning is completed
- Create the Infrastructure required according to scheduled
- Complete Sludge cleanout/In-house service and hire maintenance company by the designated time
- Conduct retrospective and submit report on how to reproduce how project objectives/deliverables were achieved

All personnel, hardware, and software resources will be managed by the PM and project team. All project deliverables and tasks statuses will be reported on the weekly cadence basis to ensure project schedule is on track. All project funding will be managed by the project manager up to and including the allocated amounts from grant/seed funding. Any additional funding needed will be accounted for through the contingency budget as planned. MICRO WASTE MANAGEMENT SOLUTION project will conclude when the final post-mortem report is submitted within 30 days after successful production launch and all technical knowledge documentations as well as the following deliverable, ***Report on how to reproduce what we did*** are handed off to our client.

Schedule

Important Schedule Considerations
The crucial times which need to be noted are:

- Community Buy-In
- Secure the Grant or Seed Funding
- Monsoon Season
- Long Delivery Time for MAGS

Community Buy-In
There are have been other attempts to place incinerators in communities in India and they have failed. [M1] Although there are various reasons for their failure, the common reason for failure were:

- Excessive exhaust pollution[M2]
- Too costly[M3]
- Community was not committed to project[M4]

There are several instances where the incinerators used in India have excessive exhaust. It is so bad that incinerators are being shut down due to lawsuits from the people whose health is being effected [M2]. The MAGS unit is assured to not be heavily polluting due to its water filtration system [M3].

Cost is very important in poorer countries and has caused various communities in India to purchase cheap incinerators from China which are heavy polluters. We are getting around this issue by seeking grant and seed funding to significantly lower the community cost.

The last barrier to success is community buy-in. Communities in India have given up on waste management systems when issues have come up because they did not believe in the project. This is because well-meaning NGOs created a system without the community believing in the system. In order for this to not be a problem for our project, we are requiring a vote by the community to gift us a parcel of land on which the incinerator and ash disposal site will sit. This will be a show of commitment by the community. We also believe that this will cause the community to be more committed to the project because they helped pay for part of it.

In order for the community to understand the value of this project and to vote for the referendum for the land gift, we will be hiring a local public relations person to coordinate the following:

- Create and disperse flyers.
- Hire local university professors to hold seminars to educate the community
- Have a town hall meeting to discuss the referendum?
- Campaign for the referendum

The importance of this referendum cannot be overstated. If the referendum is not voted for, then we will not do the project in that community. An additional benefit of the process of getting the community informed and agreeable to the project is that the goal of getting 100 homes to join the pilot project is virtually assured.

There are three tasks on the schedule which must complete or we will stop the project and restart/re-try in another community. Those things are:

- Grant/Seed Funding is Acquired
- Referendum is voted for
- 100 Homes agree to be part of pilot

The lead up to referendum is an intense campaign to convince the community to vote for the project and to get 100 homes to agree to be part of the pilot. It is nearly certain that if the community votes for the referendum, then we will have enough people approving of the project that getting 100 homes to join the pilot is certain. Looking at the numbers: to get the referendum to pass, we will need approximately 100,000 votes. Out of 100,000 people who are voting to gift us the land, we feel certain that 100 homes will volunteer to join the pilot. If that proves to not be the case, then we will have to pull back and rethink our strategy by not going forward with the project in that community.

Securing Grant Money or Seed Funding
The schedule also has a stop point based on acquiring grant money or seed funding. Although our company has sufficient money to fund this project, it is important to set this project up as an example for future projects. The capital cost is very high and we wish to prove that the capital costs can be offset by grants or seed funding.

Because of this the schedule has a go / no go point at the end of the task to acquire the funding. Everything in the schedule is put on hold until the funding is acquired. It is part of the critical path by design. If we do not acquire the funding, then the project will be ended and the company will not proceed with the project anywhere. This is different than the community buy-in, in which we will re-start the project in a different location if the referendum fails or if we do not get a sufficient number of homes to participate in the pilot.

An important consideration in the schedule is how to stage the grant acquisition and the referendum and pilot. We have decided that the task of getting 100 homes to be in the pilot program should finish at the same time as the referendum vote. Our thinking is that the PR campaign will be at a maximum in order to influence the vote on the referendum. The same PR campaign will be used to convince 100 homes to sign-up for the pilot.

Monsoon Season
We want to make sure that the physical parts of the project are done before the start of Monsoon Season on June 1. That would be all tasks except for the report writing. Currently using 3-point estimating, our schedule shows the physical part of the project being done by March 30. This gives us a potential slip of nearly 2 months before we have a problem. There is a 95% likelihood of finishing the entire project by May 23rd, 2017. This leaves the project with 5 extra weeks of slippage because the physical part of the project ends 4 weeks before the project finish.

Long Delivery Time for MAGS
Currently Terragon takes 4 months to create a MAGS unit with 2 drums, which is the type we will be purchasing. They assure us that by November 2016, (when our project will start) their

time to build will be down to 2 months. For the 3-point estimation of the time of the task to wait for the MAGS to be built, we have used 2 months for the optimist and expected time and have used 4 months as the pessimistic time. This has given us an estimated time of 53 work days (11.5 weeks). If things were to go very wrong on this estimate, then we could expect this one task could increase the schedule by as much as 37 work days (6.5 weeks). This could push the schedule for the physical part of the project to May 22. May 22 is too early to expect the Monsoon Season, but slippage in other parts of the project could push us to finish the physical part during the Monsoon Season, which will make this much more difficulty. To mitigate the possibility of the MAGS impacting the schedule by being late to finish building, we will stipulate in the contract with Terragon that we will charge them an extra $500 per week that they exceed 2 months for their build. That amount exceeds our expected overhead at that stage of the project. The probability of this is low and entirely mitigated by this stipulation.

Summary Milestone Schedule

Milestone	Date
Hire Public Relations Firm	Nov 11
Create in-house service and maintenance company	Nov 11 - Dec 6
Referendum for Voting on Land Donation	Dec 8
100 Homes Sign-up for Pilot	Dec 8
Finish Grant / Seed Funding	Dec 15
Purchase MAGS	Dec 13
Create Infrastructure	Dec 16 - Jan 6
MAGS Arrives On-Site	Feb 28
System Operational	Mar 30
Report Generation	Mar 31 - Apr 27

Hire Public Relations Firm
Hire a local PR firm to handle educating the community so that they will be fully informed as to the benefit of this system and therefore vote for the referendum to gift the project with a piece of land as well as to motivate 100 homes to sign-up for the pilot project.

Create in-house service and Maintenance Company
Create a new independent company that we will continue to run the incinerator system after the project is done. The new company will be responsible for:

- Collecting the non-moist waste (e.g. plastics, paper, non-food refuse) and bringing it to the incinerator [M5]
- Maintaining the incinerator
- Removing and disposing of the ash
- Making a profit to keep the process running

Referendum for Voting on Land Donation
The importance of this to the project was discussed previously in great detail in the section labeled: Schedule / Community Buy-In

100 Homes Sign-up for Pilot
The importance of this to the project was discussed previously in great detail in the section labeled: Schedule / Community Buy-In

This task is set to finish at the same time that the referendum voting is finished because we feel that the highest community support and enthusiasm should be at that same time.

Finish Grant / Seed Funding
The timing of this task has been somewhat controversial within the project- planning team due to the question of how this task should fit with the vote for the referendum. Ultimately we have come to the conclusion that this task should finish after the referendum because committees which hand out grants are far more likely to issue a grant if we have the proof that the community is backing the project with the land gift from the referendum.

If the Grant funding does not go thru, then the project will not be run. This poses a problem because we will not be certain of that until after the referendum has been voted for. To mitigate making the community angry at ACME for stopping the project after we promoted is heavily and them voting for it, we will be putting a disclaimer in the flyers and other information that this project is dependent on funding thru grants which might not come thru. This information can be skewed to be that the community is getting an additional benefit by ACME applying for a grant and seed funding for this community project.

Purchase MAGS
This is the task of waiting for the MAGS to be built after we put in the purchase order. As previously discussed this needs to occur after the Grant / Seed Funding and after the referendum. Also as previously discussed this is expected to take 53 work days based on 3-point estimation. Looking at the Planned Value Chart (Appendix M) and the detailed Schedule (Appendix E), many things will be delayed in waiting for this task to finish.

Create Infrastructure
This task deals with everything that is needed to be in place to allow the system to work correctly. This includes:

- Ensuring that power is at all times available to the incinerator either thru the electrical grid or from the backup power generator
- Create roads and paths for the vehicles to travel to the MAGS
- Preparing the site, foundation, and cement pad for the MAGS
- Hiring personnel to connect the MAGS to the electrical system. Note that Terragon will supply personnel to do this part, but we expect to have extra people ready to assist. These personnel will also be trained in maintenance and running of the system, so they are the personnel who will be taking over when the project is done and will be part of the spin-off company.
- Creating an ash dump site

MAGS Arrives On-Site
The arrival of the MAGS at the site kicks off the beginning of several activities. Before this event there is considerable wait time when nothing further can happen.

System Operational
At this point everything about the project is operating correctly. The running of the MAGs is handed off to the spin-off company.

Report Generation
The report is one of the key deliverables. The report's purpose is to enable ACME, other companies, NGOs, or local governments to duplicate this project across other communities. The report must include at least the following:

- This project planning document
- Details on what went right with the project
- Details on what went wrong with the project
- A revised project planning document based on this project's actual implementation
- All documentation used to acquire the grant money or seed funding
- Suggestions on how to seek further funding
- Important considerations regarding every foreseen risk and its mitigation and how well the mitigations worked
- Which unforeseen events and risks occurred, their impact on the project, and how should they have been dealt with
- Actual use of the contingency funds
- Complete layout of every task's actual schedule with details on why there was a difference from the planned schedule
- Earned Value Chart compared to Planned Value Chart
- Best Practices white papers
- Information on how to contact each key person involved in the project

Resources: Personnel

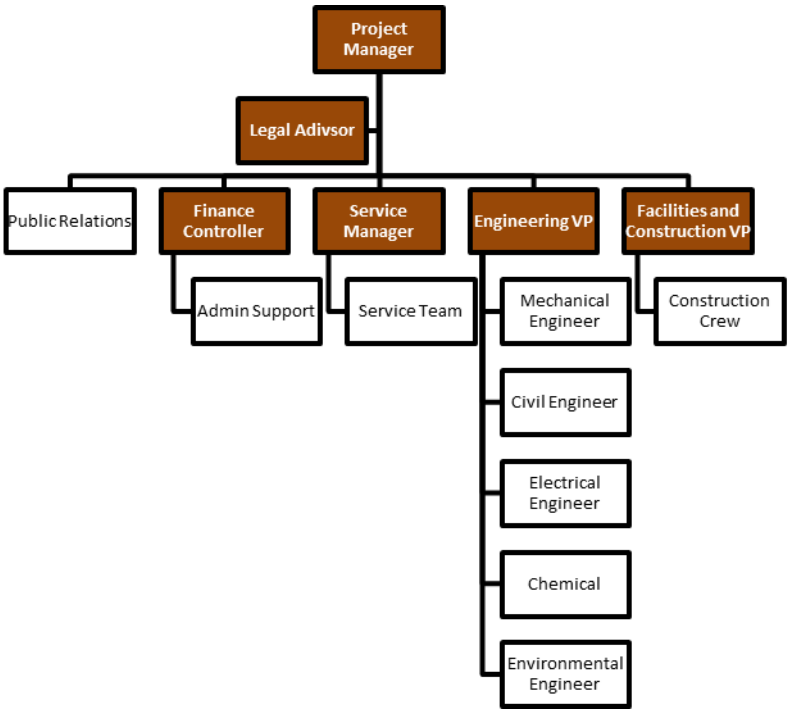

Figure 2: Personnel Involved in the project.
Brown boxes indicate current employees within ACME

Referring to Figure 2, the people indicated by the brown boxes are currently employed by ACME. The people indicated by the white boxes are personnel which will need to be hired for the project. The various engineers listed under the Engineering VP could be consolidated into a few people because the detailed knowledge in each engineering field is not needed. Terragon will provide the installation personnel with the detailed engineering background.

Planned Value

The capital cost ($240,000) is so much higher than the personnel cost ($17,400), that it would overwhelm the planned value chart and incorrectly skew the perspective and utility of the chart. Due to this, we left the capital costs out of the planned value chart. Using 50/50 planning the planned value chart is shown in Figure 3.

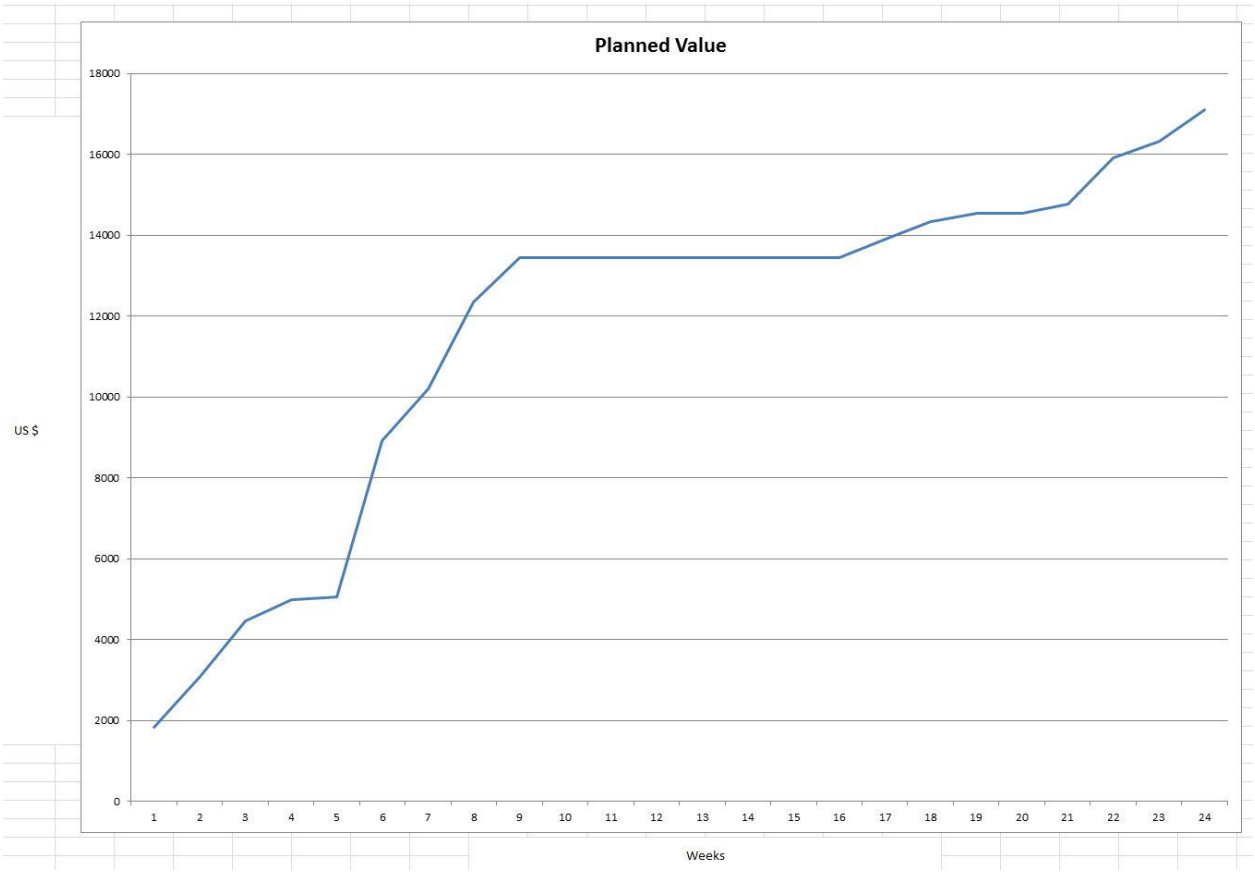

Figure 3: Planned Value chart using 50/50 planning and leaving out capital expenditures

Capital Costs

Capital Expenditures are shown in Table 1.

Item	Date	Cost ($ US)
Infrastructure	Dec 3 – Jan 5	6,500
Vehicles[M1]	Dec 9 – 13	3,500
MAGS	Dec 9 – Feb 9	230,000
Backup Power Generator	Dec 9 – Dec 27	4,000
Insurance	Dec 9	5,000
Fuel	Feb 1	150
Total		249,150

Table 1: Capital Expenditures

Infrastructure

Infrastructure is discussed in detail above under the heading Summary Milestone Schedule / Create Infrastructure

Vehicles
The spin-off company will be collecting non-moist waste from the homes and delivering it to the incinerator location. The vehicles will also be taking the ash product to the ash disposal site. Vehicles include one transportation van and two push carts.

MAGS
Refer to the Description in the earlier section of this document for details on the MAGS.

Backup Power Generator
Due to the sporadic electrical power availability, a power generator is required.

Insurance
This cost covers insuring the delivery of the MAGS and incidental insurance to use during the construction of the project.

Fuel
Fuel is needed to initially heat up the incinerator. This fuel cost will also cover the running of the transportation van for the first 6 weeks.

Summary Budget

For the bar chart shown in Figure 4, we left out the MAGS purchase in week 6 of $230,000 because it makes the bar chart unusable. Note that the total budget is $266,550, with capital costs of $249,150 and labor costs of $17,400

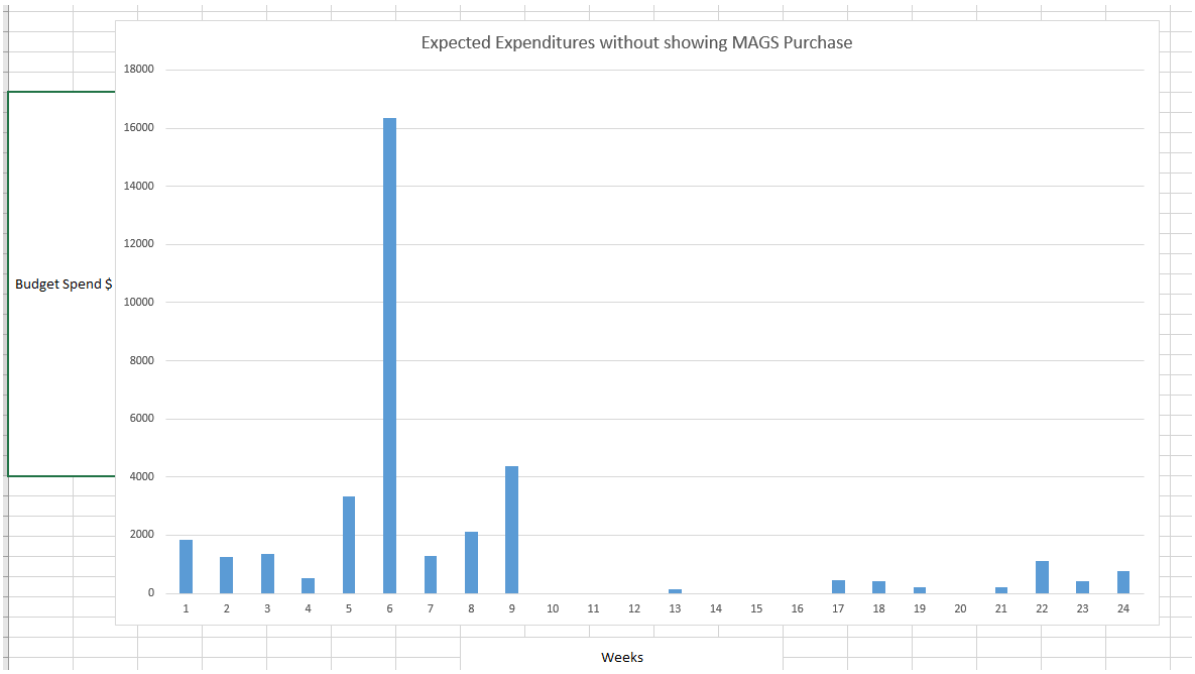

Figure 4: Expected Expenditures without showing MAGS Purchase in week 6

Risks

A systematic process of identifying, analyzing and responding to project risk was done. As mentioned in the book **[**A1] 7 stages of risk management was conducted for the project.

1. **Risk management planning**

The team decided to look into the risks during the planning stage itself. At first the external factors that can affect the risk where looked into and made note of. Once the project was in the scheduling and budgeting phase other internal factors that can potential affect the project started forming shape and the team conducted meetings and brainstormed to list out the internal factors that can potentially affect the project.

Both the external and the internal risks that affect the project where noted down and monitored on a regular basis.

2. **Risk identification**

For identifying the risks the team used the PESTEL framework. The initial process for the team was to brainstorm in the areas of political, economical, social, technological, ethical and legal.

In addition to this the team contacted experts in this area to get their feedback on potential risks associated with respect to deploying this new technology, engineers and sales managers involved in executing similar projects, individuals in India who helped provide information on the societal conditions and political and environment factors that can affect the project. The team did the analysis at all stages of the project cycle to account for factors that get formed at each phase of the project execution.

With all these inputs the list of risks identified by the project team is shown in Figure 5.

PESTEL	**Risk**
Political	(Administration change)
Economic	Grant not obtained
Social	Community is against deploying the MAGS in their community
Technological	• Power Outage • MAGS is delayed
Ethical	There can be issues related to graft
Legal	Law suits

Figure 5: List of risks

In addition to the above risk analysis the risks present in planning, scheduling and budget face was brainstormed. This was tracked on a regular basis during each phase to make sure that there were no new risks that were getting formed that had to be tracked.

In the scheduling stage:

- The scheduling was done by having the task to secure grant and the community buy-in to happen in parallel. There was a potential risk that the money used for obtaining the community buy in(related to the below tasks) would be lost if the referendum for voting on the land does not get through(the referendum had to be signed by 50% of the population), but the project team decided to carry out the execution in this manner because the probability of **not** getting the grant was very low as it was the organization providing the grant and the local government in India who had come to the company to request them to carry out the project. Thus to expedite the project execution duration the project team decided to get both these activities done in parallel.

Research & Planning	**32 days**	**Wed 11/2/16**	**Thu 12/15/16**	
1. Financial Analysis and Model	5 days	Wed 11/2/16	Tue 11/8/16	
2. Secure grant/seed funding for project	**32 days**	**Wed 11/2/16**	**Thu 12/15/16**	
3. Identify Target Plant Location	8 days	Wed 11/2/16	Fri 11/11/16	
4. Complete contract negotiations for the incinerator	5 days	Wed 11/2/16	Tue 11/8/16	
5. Complete perperutal service funding model	8 days	Wed 11/2/16	Fri 11/11/16	
Community Buy-In	**19 days**	**Mon 11/14/16**	**Thu 12/8/16**	
6. Hire Public Relations Firm	3 days	Mon 11/14/16	Wed 11/16/16	5
7. Flyers/Campaigns	6 days	Thu 11/17/16	Thu 11/24/16	9
8. University lectures	7 days	Thu 11/17/16	Fri 11/25/16	9
9. Town-hall meeting	16 days	Thu 11/17/16	Thu 12/8/16	10FF+2 days,11F
10. Referendum for voting on land and location	14 days	Mon 11/21/16	Thu 12/8/16	9FS+2 days
11. Sign up for the pilot installation - X sign ups required (X will be based upon a financial analysis that will make the MAGS self-sustaining)	10 days	Fri 11/25/16	Thu 12/8/16	10

Figure 6: Schedule

- Another scheduling risk that came up was at which point the MAGS had to be bought. This had to be carefully considered because the cost of the MAGS was the major cost in the overall project budget. The team decided to go ahead with buying the MAGS only after the community buy in was obtained so that there would be no sunk-in cost associated with respect to losing money on the MAGS if the community buy-in was not obtained. The project team will get the confidence that the community buy-in is obtained when the referendum for voting on land and location is approved. For approving this at least 50% of the community should agree to have the MAGS installed. Once this is done then the project team will take the additional step of

having 100 houses signed up for the initial pilot which should be easy once the referendum is obtained. Only after both the above steps are done the team will go ahead with purchasing the MAGS and this s reflected in the schedule.

3. **Qualitative risk analysis**

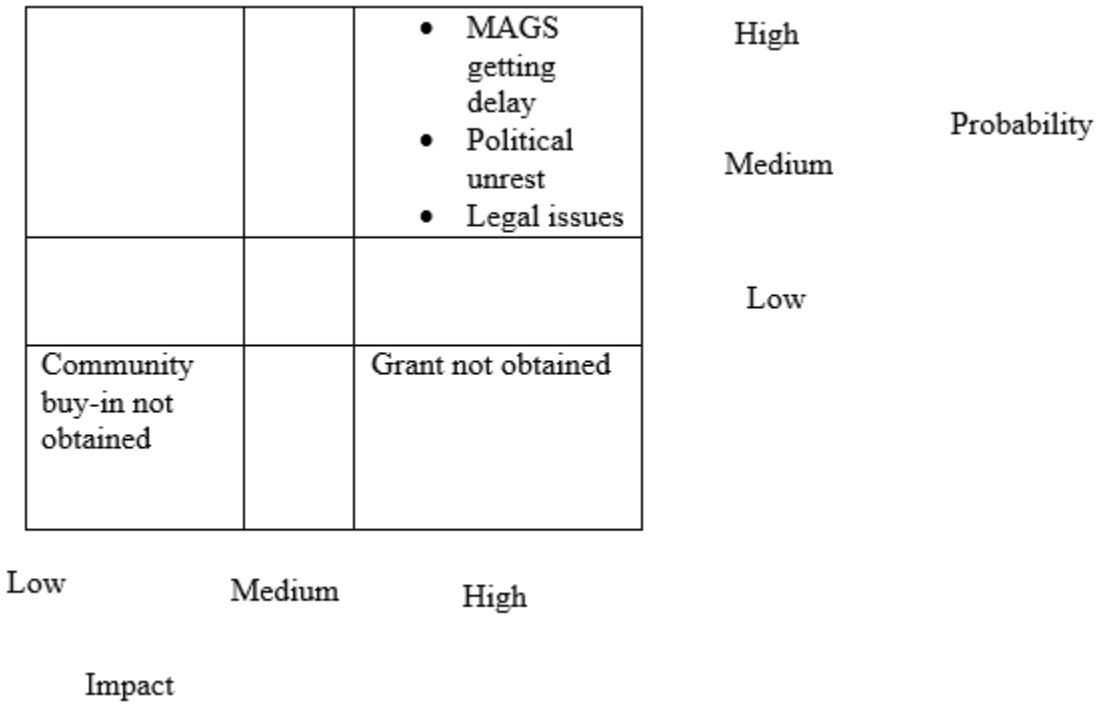

Figure 7: Risk Matrix

The team did a qualitative risk analysis to prioritize the risk identified in the previous stage. The high priority risks that were identified were:

- MAGS being delayed for delivery to the deployment site
- Political unrest in the local area that can delay the project. Looking into the past history and the current political environment since the elections are expected in the year that the project execution is targeted there is a high probability that there will be a schedule delay.
- Another key issue that can come up is that of the legal issues affecting the contracts and other local legal expectations. For projects of similar nature there has been a high probability of legal issues delaying the project.

4. **Quantitative risk analysis**

In this stage the probability and the consequence of the risks was analyzed. The implications of the risk was calculated using historical data of similar in projects and the impact of risks of the similar nature in such projects. The below table provides the probability of occurrence and the impact of each risks.

Risk	Impact	probability	Plan
Administration change (political issue)	Schedule delay (3000)	0.5	To have money in reserve
Grant not achieved	Go/No Go	0.1	To have money in reserve
Community is against	Loss of $4,500		Community Buy-in OR no project
Power Outage	Process Shutdown		$4,000 extra power generator(no risk now)
MAGS is delayed	Cost of Extending employee pay(420$/week - 8 week delay)	0.2	Post the 2 months the company will charge Terragon $500 so no additional cost is incurred to the project. The probability of this occurring is very low.
There can be issues related to graft	Company will uphold highest values per PMI		
Law suits	Estimated expense(4000$)	0.3	To have money in reserve

Figure 8: Analysis of risk

Using the decision tree analysis for the 3 critical risk the contingency reserve was calculated for the project using the EMV (expected monetary value) methodology. The 3 high priority risks that was selected to do the EMV calculations were:

- MAGS is delayed
- Law suits
- Administration change(political unrest)

5. **Risk response planning**

The four standard approach of dealing with risk threats avoid, transfer, mitigate and accept was used to understand how the high risk cases can be dealt with. For the critical risks the contingency reserve was calculated. After doing the EMV calculation using the decision tree the contingency reserve was calculated to be 3372

6. **Risk monitoring and control**

The monitoring techniques used for the project are:

- CV(cost variance): Weekly review
- SV(Schedule variance): Bi-weekly review
- CPI (Cost Perf. Index): Monthly review

Further details on the monitoring mechanism is provided in Appendix O.

7. **Risk management register**

The team also kept a risk management register that helped to keep track of the risk identified, steps used to resolve and to track the risk management activities.

Evaluation Methods

In this project, we will employ various evaluation methods through the course of the project targeting specific milestones and expected values, technical or non-technical, to ACME. This is shown in the Figure 9, where the evaluation methods used are shown in the bottom half, overlaid against the schedule and milestones on the top half of the figure.

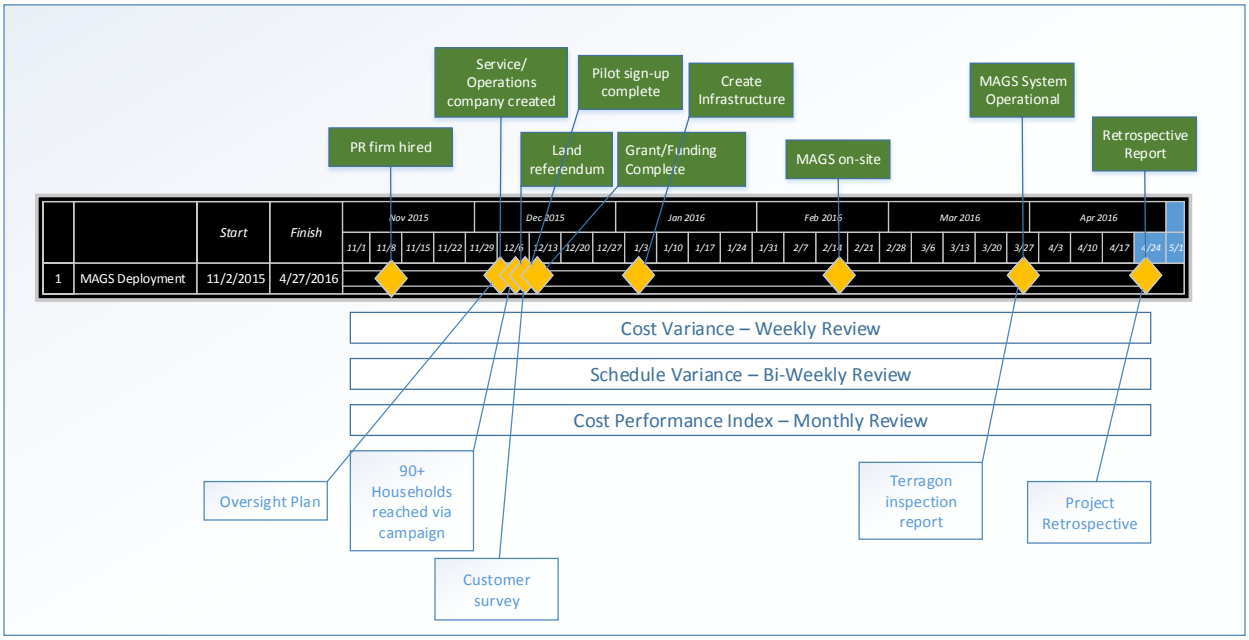

Figure 9: Evaluation Methods

The project core team will meet weekly where the project manager will review the project dashboard with updates on the weekly progress of actual costs, earned value and expected costs at completion. The project core team will make a decision during those reviews on any preventative or corrective actions that needs to be taken to adjust the course of the project.

Given that cost is a major focus in this project, Cost Variance (CV) will be reviewed weekly to detect if the variance is significant. Although there is some leeway in terms of onset of the monsoon and the retrospective on the project can be done during that period as well, we do want to release the resources as soon as the project is completed, so there is some sensitivity on the schedule. Hence, Schedule Variance (SV) will be reviewed every other week. On a monthly basis the Cost Performance Index (CPI) will be monitored. Details of these calculations are included in Appendix N and O.

An oversight plan will be developed to ensure that the system will be monitored for performance against environment regulations. Given that the land referendum is a critical milestone, the public relations firm will be tasked with tracking the households reached during the various campaigns to maximize the probability of success at the referendum, we are expected to reach 90+% households in the community during the campaign. A customer survey will be performed at the referendum to capture any learnings if the referendum fails and will be performed again at the end of the pilot during the retrospective. The detailed learnings from the project will be collected during the Retrospective and included in the project final report. In terms of quality, an expert audit by Terragon is expected to evaluate that the system is performing as expected.

This project will terminate by extinction. If the project completes successfully per scope, the project team will not be needed anymore and can return to the parent organization. If the project does not receive the grant funding to at least cover the cost of MAGS or does not get the land allocated for physically locating MAGS, the project will terminate per defined project gates. Appendix P contains the detailed project termination checklist when termination occurs.

Conclusion

In this report, the detailed plan to deploy a Micro Auto Gasification system in Bangalore has been presented. The complex challenges faced by municipal authorities in India for solid waste management indicate that waste composition and management costs continue to grow [S1]. MAGS reduces the need for land allocation to landfills and reduces healthcare costs from stagnant garbage that takes years to disintegrate and contaminate groundwater. It is specifically better suited for materials that don’t biodegrade easily and is faster than composting. The resulting residue is about 8% in volume. In addition, during the process, the gases released is used to generate energy.

The project will cost a total of $266,550; with $249,150 in capital expenditure and $17,400 for labor. A contingency reserve of $3,372 will need to be allocated in the event of impact on cost and schedule due to political administration changes or other delays identified during risk analysis. With a mean duration of 129.17 worker-days for the critical path tasks of the project, we can meet the desired duration of 152 days prior to the onset of the southwest monsoon rains. The quality assurance task and expert audit by Terragon will ensure that the system meets the technical specifications identified in the project scope.

With the aid of grants from non-profit agencies that support environment improvement programs and land allocated by the community for deploying MAGS, the Bangalore metropolitan area can greatly benefit from this project.

References

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Appendix A – Organization Chart and Project Team Structure

ACME Organization Chart

ACME (Association for Conservatively Managing the Environment) Pvt. Ltd. is a Non-Governmental Organization (NGO) based in Bangalore, Karnataka, India. The company is committed to resolving environment issues and dedicates its resources in building environmental solutions especially in economically challenged locations primarily in India, but also across the world. Being well-versed and connected with leading philanthropic organizations across the globe and with a strong engineering team, the company is able to bring effective solutions to areas that is lacking the infrastructue, finance and knowledge in solving local environment problems. ACME will hire and train a local self-sustaining team that assemble the system on-site and will be responsible to maintain the system into the future. The company's organization chart is shown in Figure A-1:

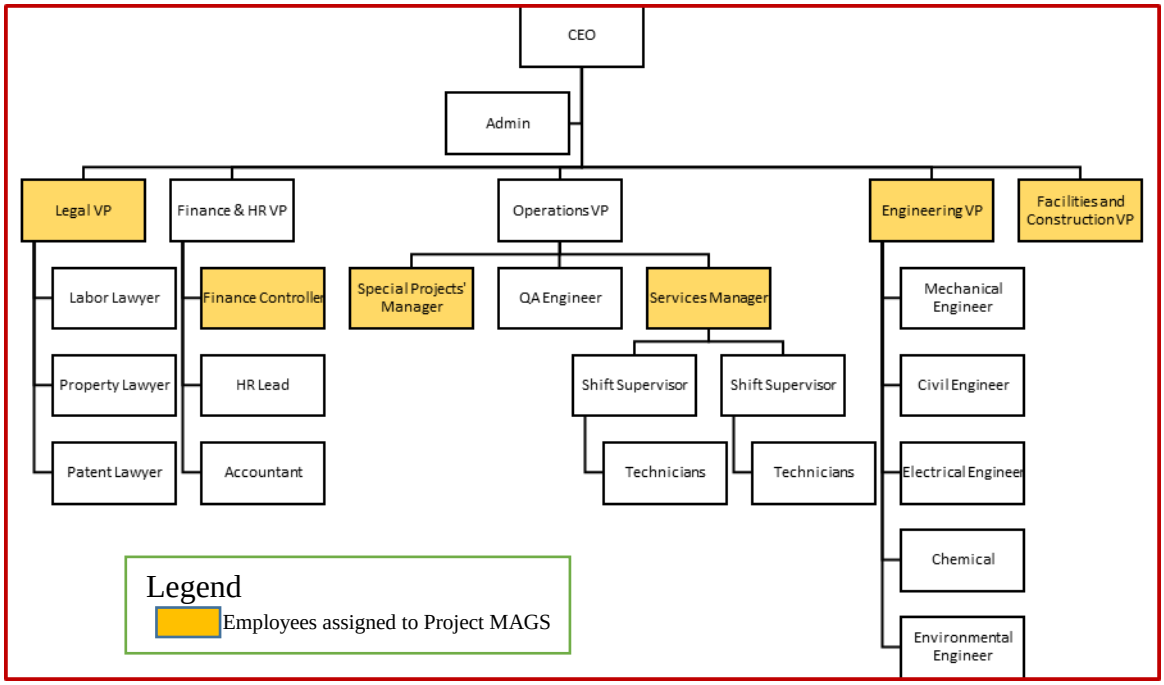


Figure A-1. ACME Organization Chart

Project Team Organization Chart

The team chartered to deploy MAGS into the chosen city of Bangalore, is organized as a matrix structure with employees from the parent organization. The team members are organized into the project team structure shown in Figure A-2. In Figure A-2, the Level 0 and Level 1 team members form the project core team and Level 2 are the extended project team members. The project core team will meet at a minimum weekly, to manage and track the projects' monitoring and control indexes. In Figure A-2, the project team members' role in the parent organization is indicated within parentheses.

The contracted employees shown on the team structure are either:
(a) Hired temporarily during the course of, as needed, or, for the duration of the project (Public Relations, Construction and Quality Assurance teams), or,
(b) Eventually planned to be hired permanently into the local organization (Engineering and Service teams) that will be responsible for assembling and maintaining the system after the system is qualified for production.

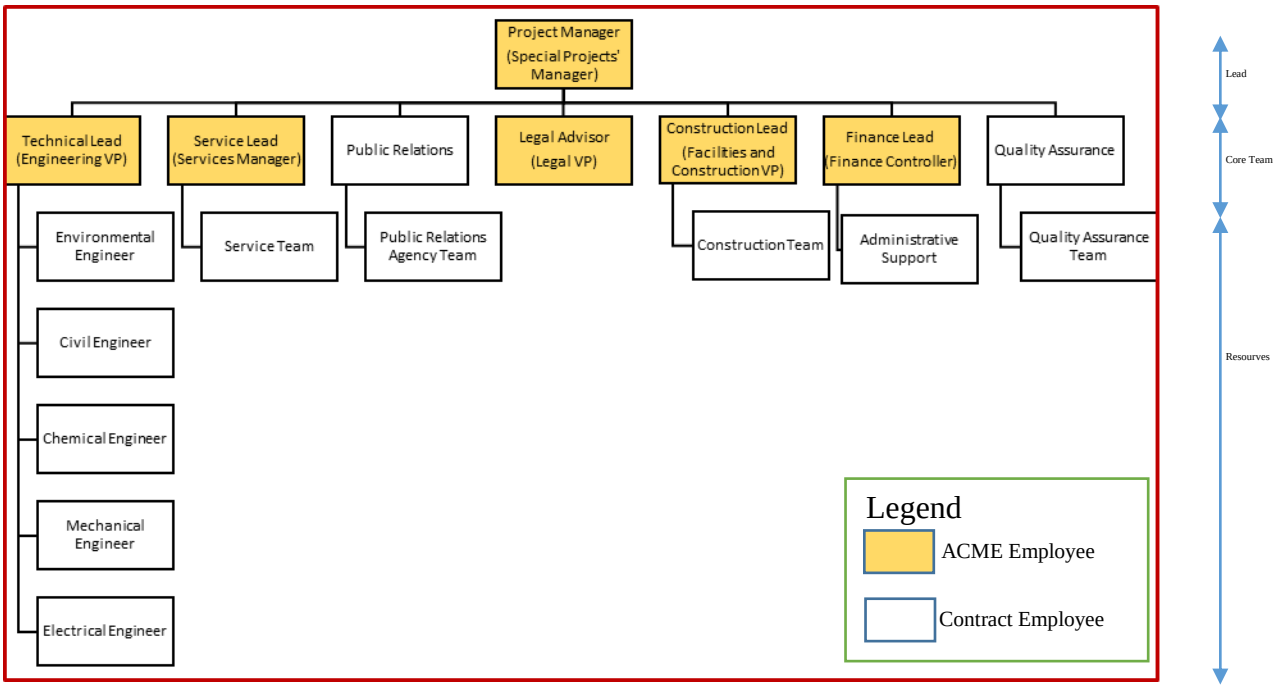


Figure A-2. MAGS Deployment Team Structure

Appendix B – Work Breakdown Structure

The Work Breakdown Structure for the MAGS deployment (Level 0) is shown in Table B-1. Effort in terms of most likely worker-days; resources and precedence dependencies are also noted.

#	Level 2 Task	Description	Resources	Effort (worker-days)	Precedence Dependency
Level 1 Task: 1. Research & Planning					
1	Financial Analysis and Model	Before the team starts execution, we need to decide how much funding will be needed for initial deployment and how much funding is required for sustaining operations. This initial funding costs needs to be submitted in the proposal to secure basic funding from philanthropic grants/governmental funding sources.	R – Finance Lead A – Technical Lead, Project Manager C – N/A I – Executive Team	4	0
2	Secure grant/seed funding for project	The team will submit proposal to various philanthropic and governmental sources to secure grant/funding intended to cover the cost of the MAGS hardware.	R – Finance Lead A – Technical Lead, Legal Advisor C – Project Manager I – Executive Team	28	0
3	Identity target location where MAGS will be deployed	The city where the MAGS will be deployed needs to be identified. Discussions with the local community leaders will be initiated to narrow down the top contenders and finally a decision on the location based upon anticipated support from the local leaders.	R – Construction Lead A – Technical Lead, Legal Advisor C – Project Manager I –Executive team	5	0
4	Complete contract negotiations & quote for the MAGS incinerator	Now that the city and some grant funding has been secured, the cost of the MAGS incinerator can be complete with a Request for Quote (RFQ) with the vendor.	R - Finance Lead A – Technical Lead, Legal Advisor C – Project Manager I – Executive Team	10	0
5	Complete perpetual service funding model	The funding model for the remaining tasks involved in deployment and ongoing sustaining costs for MAGS is finalized.	R – Finance Lead A – Engineering Lead, Service Lead C – Project Manager I – Executive Team	7	0
Level 1 Task: 2. Community Buy-in					
6	Hire Public Relations Firm	Given that the target location has been identified the Project Manager finds a local PR firm in the targeted city. The PR firm will be responsible for coordinating all the community activities to secure the land and pilot customers.	R & A– Project Manager C – Technical Lead, Finance Lead, Legal Advisor I – N/A	3	3
7	Flyers/Campaign	The PR firm sets about by initiating a public relations campaign using flyers and door-to-door canvassing and any other effective method of reaching out to the city residents. The PR team works	R & A - PR lead & team R – Engineering sub-team C&I – N/A	6	6

#	Level 2 Task	Description	Resources	Effort (worker-days)	Precedence Dependency
		with the engineering team to make sure the content is accurate.			
8	University Lecture	Acme needs to increase confidence in the community by getting the academic community who can endorse the project providing a sound scientific support that the local community will trust	R & A - PR lead & team R – Engineering sub-team C&I – N/A	7	6
9	Town Hall Meeting	The university lectures and door-to-door campaigns will be followed by a town hall meeting that Acme will use to answer any remaining questions from the public	R & A - PR lead & team R – Engineering sub-team C&I – N/A	14	6
10	Referendum for voting on land and location	The public relations campaign will culminate in a referendum where the public will be agree on the parcel of land that will be used to locate the incinerator and residue.	R – PR lead & team A – Engineering sub-team, Legal advisor C – Project manager I – Executive team	14	6
11	Sign up for the pilot installation - 100 sign ups required	The Service Manager will work with PR firm to get 100 pilot customers	R – PR lead & team A – Engineering sub-team, Service Lead C – Project manager I – N/A	14	7
Level 1 Task: 3. Create Infrastructure					
30	Electrical Grid	The Electrical Grid and setup that the MAGS will connect to send in the power generated during the incineration process needs to be prepared for deployment	R – Eng lead A – Engineering sub-team C&I – N/A	14	2, 10
31	Prepare Site and Lay Foundation	Prepare the site and complete the required leveling and other steps prior to laying foundation	R – Eng lead A – Engineering sub-team , Legal Advisor C&I – N/A	10	2, 10
32	Purchase Transport Equipment	Purchase the required equipment to transport waste to the MAGS and residue disposal site	R – Service lead A – Engineering sub-team C&I – N/A	3	2, 10
33	Prepare Road & Paths	The roads and required access to the MAGS needs to constructed	R – Engineering lead A – Engineering sub-team C&I – N/A	14	2, 10
34	Network infrastructure	The required network infrastructure for remote monitoring of MAGS needs to be incorporated and setup on the site	R – Engineering lead A – Engineering sub-team C&I – N/A	3	30
35	Prepare Residue Disposal Site	The residue from the incinerator needs to be disposed and that location needed to be prepared	R – Service lead A – Engineering sub-team	14	10

#	Level 2 Task	Description	Resources	Effort (worker-days)	Precedence Dependency
			C&I – N/A		
Level 1 Task: 4. MAGS Plant Commissioned					
12	Acquire site and Prepare Site for installation	This activity involves site surveys and master site plan for locating MAGS	R – Construction lead A – Construction sub-team, Engineering Lead Engineering sub-team C – Project Manager I – Executive Committee	1	10
13	Purchase MAGS	The Purchase Order is now placed per the pricing set in the RFQ response and the incinerator is shipped to the location	R – Construction lead A – Construction sub-team, Engineering Lead Engineering sub-team C – Project Manager I – Executive Committee	45	2, 10
13.5	Ship MAGS	MAGS is shipped to the location	R & A – Finance Controller C & I – N/A	5	13
14	Hire Personnel for Assembling, Power-On and Maintaining MAGS	The Engineering lead sets about getting the hiring activity completed with adequate participation from the Engineering and Construction team members	R – Engineering Lead A – Construction sub-team, Engineering sub-team C & I – N/A	21	10
15	Assemble & Installation MAGS	The MAGS system is put together	R – Engineering Lead A – Construction sub-team, Engineering sub-team C – Construction Lead I - N/A	3	12, 13.5
29	Quality Assurance and Verification	The basic system goes through various inspection and validation steps (can start at assembly) with a final signoff by the QA Engineer along with the required permits for operation from the local government. This will run parallel through the entire project once construction on the land starts and until the service is in operation.	R & A - QA Engineer C – Engineering Lead, Construction Lead, Service Lead, Construction sub-team, Engineering sub-team	18	11
16	Get MAGS up to	After final QA signoffs and permits are obtained, the required chemical delivery	R – Engineering lead	7	15

#	Level 2 Task	Description	Resources	Effort (worker-days)	Precedence Dependency
	production	and power grid are all enabled to the site in preparation for servicing the pilot customers	A – Engineering sub-team C&I – N/A		
Level 1 Task: 5. Sludge cleanout/maintenance service					
17	Hire & Train service personnel (garbage collectors) /maybe subcontracting	Once the MAGS is ready for the pilot, the garbage collection service for the pilot customers' needs to be in place. The training will include what type of material needs to be collected and what instructions needs to be provided to the customers during the time of collection.	R – Service lead A – Engineering Lead, Engineering sub-team, Service Sub-team C&I – N/A	14	5, 32 and 33
18	Develop contingency plan for business continuity	If the garbage collection service team is unable to make it or there is a catastrophic event; a business continuity plan needs to be developed.	R – Service lead A – Finance Lead, Legal Advisor, Engineering sub-team, Service Sub-team C&I – N/A	6	3
19	Setup customer payment system	The finance systems for the monthly service collection from the customers' needs to be in place.	R – Service lead A – Finance Lead, Engineering sub-team, Service Sub-team C&I – N/A	7	5
20	Create oversight plan (meet standards of clean environment)	All EPA standards and local governmental requirements needs to be met at all times. The required committee and a plan to monitor for this internally and independent of external auditors is a priority for Acme.	R – Service lead A – Finance Lead, Engineering lead, Engineering sub-team, Service Sub-team C&I – N/A	8	18
21	Deploy collection service into production to service the 100 pilot homes identified	Once the MAGS system is up to production, the garbage collection service and the payment system is in place, the service can now be enabled.	R – Service lead A – Project Manager, Engineering sub-team, Service Sub-team C&I – Engineering lead and Executive Committee	8	16, 17 and 18
Level 1 Task: 6. Retrospective					
22	Compile lessons learned	After a few weeks of operation, a retrospective needs to be conducted to compile all the learnings from the project	R – Project Manager A – Project Core Team, Engineering sub-team, Services Sub-team C&I – N/A	7	21
23	Identify scaling factors and	The next step is to identify the changes required to scale the service to the entire community	R – Service Lead A – Engineering Lead, Engineering	7	22

#	Level 2 Task	Description	Resources	Effort (worker-days)	Precedence Dependency
	dependencies		sub-team, Services Sub-team C – Construction Lead, Finance Lead I – N/A		
24	Deploy scaling related changes	All the changes needed to scale to the community needs to be put into place	R – Service Lead A – Engineering Lead, Engineering sub-team, Services Sub-team, Construction Lead C – Finance Lead I – N/A	3	23
25	Expand service	Once all the scaling changes are in, the Service lead will now announce and expand the service	R – Service Lead A – Engineering sub-team, Services Sub-team C – Engineering lead, Project Manager I – Executive Team	2	24

Table B-1. WBS

The hierarchical layout of the WBS is shown in Figure B-1. Note that the dependencies are not reflected in a hierarchical structure, it is reflected in the table above and in the subsequent appendices. The hierarchical WBS is only to show the Level 0, 1 and 2 work breakdown structure:

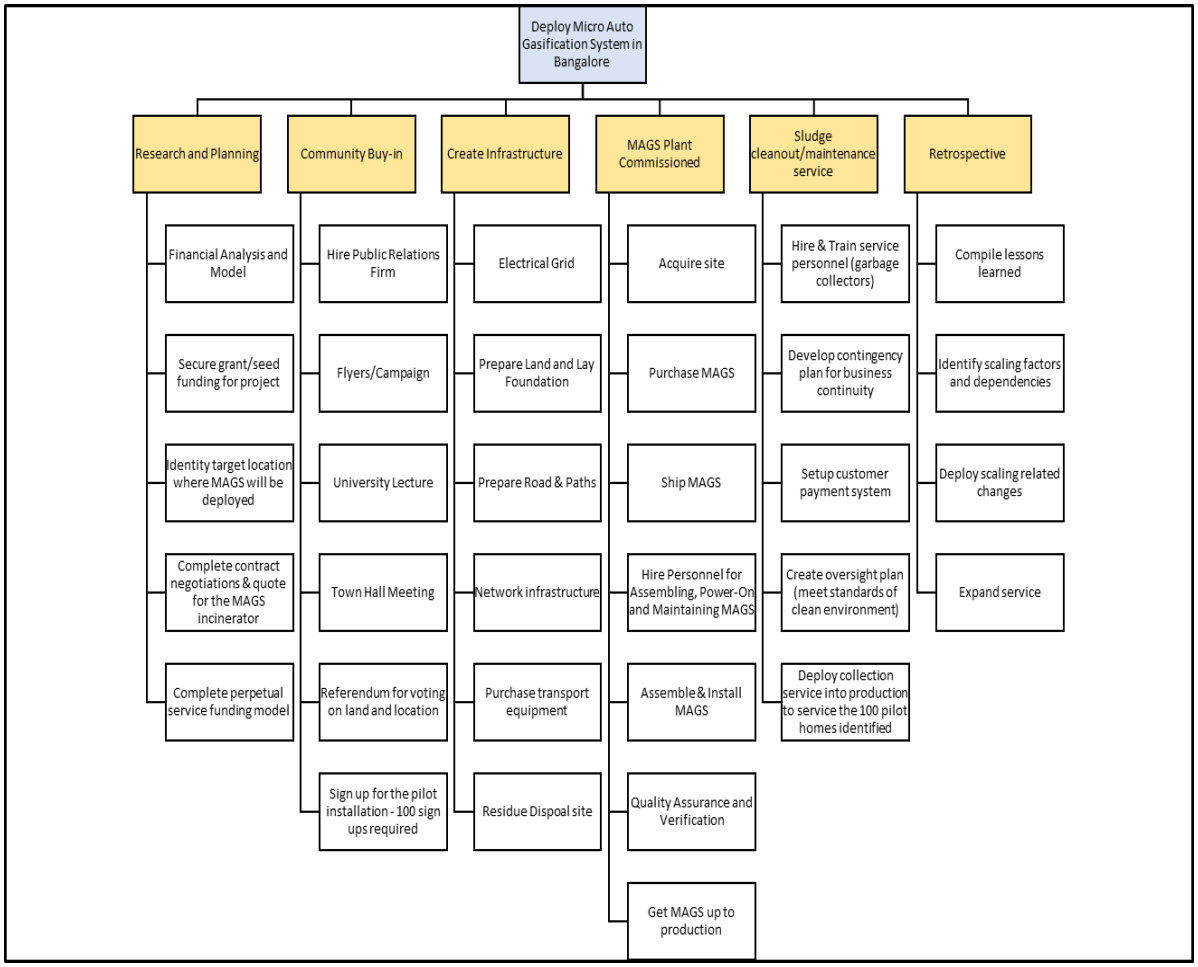


Figure B-1. Hierarchical WBS

Appendix C: RACI Matrix

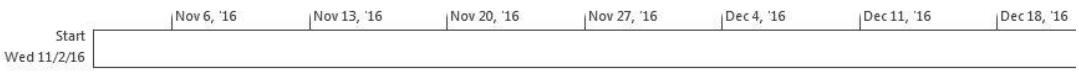
	Executives		Project Team Members							Project Sub-Teams					
Project Deliverable (or Activity) / Role	CEO	Executive Team	Project Manager	Engineering Lead	Service Lead	Construction lead	PR Lead	Finance Lead	Legal advisor	PR Sub-Team	Engineering Sub-team (Electrical -1, Mechanical -1, Environmental -1, Chemical -1, Civil -1)	Administrative Support	QA Engineer	Construction Sub-team	Services Sub-team
Research & Planning															
- Financial Analysis and Model		I	A	A				R							
- Secure grant/seed funding for project	I	I	C	A				R	A						
- Identity target location where MAGS will be deployed	I	I	C	A		R			A						
- Complete contract negotiations & quote for the MAGS incinerator		I	C	A				R	A						
- Complete perpetual service funding model		I	C	A	A			R							
Community Buy-in															
- Hire Public Relations Firm			A	C				C	C						
- Flyers/Campaign							R			A	A				
- University Lecture							R			A	A				
- Town Hall Meeting							R			A	A				
- Referendum for voting on land and location	I	I	C				R		A	A	A				
- Sign up for the pilot installation - 100 sign ups required			C		A		R			A	A				
Create Infrastructure															
- Electrical Grid				R							A				
- Prepare Site and Lay Foundation				R					A		A				
- Prepare Road & Paths				R							A				
- Network infrastructure				R							A				
- Purchase Transport Equipment					R						A				
- Prepare Residue Disposal Site					R						A				
MAGS Plant Commissioned															
- Acquire Site	I	I	C	A		R					A			A	
- Purchase MAGS	I	I	C	R		A					A			A	
- Ship MAGS			C					R							
- Hire Personnel for Assembling, Power-On and Maintaining MAGS				R		A					A				
- Assemble & Installation MAGS				R		A					A				
- Quality Assurance and Verification				C	C	C					C		A		
- Get MAGS Up to Production				R							A				
Sludge cleanout/In-house maintenance service															
- Hire & Train service personnel (garbage collectors) /may be subcontracting				A	R						A				A
- Develop contingency plan for business continuity					R			A	A		A				A
- Setup customer payment system					R			A			A				A
- Create oversight plan (meet standards of clean environment)				A	R			A			A				A
- Deploy collection service into production to service the 100 pilot homes identified	I	I	A	C	R						A				A
Report on how to reproduce what we did															
- Compile lessons learned			R	A	A	A	A	A	A		A				A
- Identify scaling factors and dependencies				A	R	C		C			A				A
- Deploy scaling related changes				A	R	A		C			A			A	A
- Expand service	I	I	C	C	A						A				A

Appendix D: Bottom Estimate Tasks based on RACI Matrix

	Project Leadership		Project Team Members							Project Sub-Teams						Total Time (days)
	Exec Sponsor	Steering Committee	Project Manager	Engineer Lead	Service Lead	Construction Lead	PR Lead	Finance Controller	Legal advisor	PR Team (PR Firm) Does not count against resources	QA	Engineering Sub-team (Electrical -1. Mechanical - 1, Environmental -1, Chemical - 1, Civil -1)	Administrative Support	Construction Sub-team (Contract)	Services Sub-team	
Research & Planning																
Financial Analysis and Model	I	C	1					A/2					1		R	4
Secure grant/seed funding for project	I	C	C					A/14	1				1			16
Identity target location	I	C	C			1	A		2	1			1			5
Complete contract negotiations for the incinerator			C	3				A/3	2			1	1			10
Complete perpetual service funding model	I	I	A	R				5				1	1			7
Community Buy-in																
Hire Public Relations Firm			C				A						3			3
Flyers/Campaign			C				A			3			1			4
University Lecture			C				A			1		1	2			4
Town Hall Meeting			C				A			3		1	1			5
Referendum for voting on land and location			C				A		1	5			1			7
Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)			C		A		A			2			1		1	4
MAGS Plant Commissioned													R			
Acquire Site	I	I	C	1		A/3						4	1	2		11
Purchase MAGS	I	I	C	A/4		2						7	1			14
Ship MAGS	I	I	C	A				1								1

Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS			A	3		2						4	2	2		13
Assemble MAGS			I	A/1		C							1	3		5
Quality Assurance											18					18
Get MAGS up to production	I	I	I	A/1								1	1			3
Create Infrastructure																
Electrical Grid				2								7		7		16
Prepare Site & Lay Foundation				1					1			3		2		7
Foundation				1								1		3		5
Roads / Paths				1									1	7		9
Network Infrastructure														3		3
Purchase Transportation Equipment					3								2	1		6
Residue Disposal site					2				1				1	7		11
Sludge cleanout/In-house maintenance service													R			
Hire & Train transportation personnel			C	1	A/7							1	2		1	12
Develop contingency plan for business continuity			C		A/2			1	1				1		1	6
Setup customer payment process			I		A/2			3					1		2	8
Create oversight plan			C	5	A/4			1	C			3	1		2	16
Deploy collection service into production to service the 100 pilot homes identified	I	I	1	C	A/2							C	2		7	10
Report on how to reproduce what we did													R			
Compile lessons learned			A	2	2	3	1	1	1	1		3	2	3	2	21
Identify scaling factors and dependencies			A	1	1	C		C				2	1	C	2	7
Deploy scaling related changes			A	1	1	1						1	1	1	1	7
Expand service	I	I	C		A/2								1		1	4
Total																283

Appendix E: Project Schedule



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1				Wed 11/2/16			
2		**Research & Planning**	**32 days**	**Wed 11/2/16**	**Thu 12/15/16**		
3		1. Financial Analysis and Model	5 days	Wed 11/2/16	Tue 11/8/16		
4		2. Secure grant/seed funding for project	32 days	Wed 11/2/16	Thu 12/15/16		
5		3. Identify Target Plant Location	8 days	Wed 11/2/16	Fri 11/11/16		
6		4. Complete contract negotiations for the incinerator	5 days	Wed 11/2/16	Tue 11/8/16		
7		5. Complete perperutal service funding model	8 days	Wed 11/2/16	Fri 11/11/16		
8		**Community Buy-In**	**19 days**	**Mon 11/14/16**	**Thu 12/8/16**		
9		6. Hire Public Relations Firm	3 days	Mon 11/14/16	Wed 11/16/16	5	
10		7. Flyers/Campaigns	6 days	Thu 11/17/16	Thu 11/24/16	9	
11		8. University lectures	7 days	Thu 11/17/16	Fri 11/25/16	9	
12		9. Town-hall meeting	16 days	Thu 11/17/16	Thu 12/8/16	10FF+2 days,11F	
13		10. Referendum for voting on land and location	14 days	Mon 11/21/16	Thu 12/8/16	9FS+2 days	
14		11. Sign up for the pilot installation - X sign ups required (X will be based upon a financial analysis that will make the MAGS self-sustaining)	10 days	Fri 11/25/16	Thu 12/8/16	10	
15		**MAGS plant Commissioned**	**80 days**	**Thu 12/8/16**	**Thu 3/30/17**		
16		**12. Acquire Site (Finalize Site Acquistion)**	**1 day**	**Thu 12/8/16**	**Fri 12/9/16**	**13**	
21		Purchase MAGS (2 months)	53 days	Fri 12/16/16	Tue 2/28/17	13,4	
22		13. Ship MAGS Infrastructure	7 days	Wed 3/1/17	Thu 3/9/17	21	
23		14. Hire Personnel for Assembling, Power-On, and Maintaining MAGS	20 days	Fri 12/9/16	Thu 1/5/17	13	
24		40. Quality Assurance	52 days	Wed 1/18/17	Thu 3/30/17	14,39FF	QA[10%]
25		15. Assemble MAGS	3 days	Fri 3/10/17	Tue 3/14/17	22,16	
26		16. Get MAGS up to Production	2 days	Wed 3/15/17	Thu 3/16/17	25	
27		**Create Infrastructure**	**21 days**	**Fri 12/9/1**	**Fri 1/6/17**		
28		30. Ensure Electrical grid	13 days	Fri 12/16/16	Tue 1/3/17	13,4	
29		31. Prepare Site & Lay Foundation	10 days	Fri 12/16/16	Thu 12/29/16	13,4	
30		32. Purchase Transportation Vehicles	3 days	Fri 12/16/16	Tue 12/20/16	13,4	
31		33. Create Roads / Paths	13 days	Fri 12/16/16	Tue 1/3/17	13,4	
32		34. Network Infrastructure	3 days	Wed 1/4/17	Fri 1/6/17	28	
33		35. Create Residue Disposal Solution	13 days	Fri 12/9/16	Tue 12/27/16	13	
34		**Sludge cleanout/In-house service and maintenance company**	**99 days**	**Mon 11/14/16**	**Thu 3/30/17**		
35		17. Hire & Train transportation personnel	14 days	Wed 1/4/17	Mon 1/23/17	7,30,31	
36		18. Develop Contingency plan for business continuity	7 days	Mon 11/14/16	Tue 11/22/16	5	
37		19. Setup customer payment process	9 days	Mon 11/14/16	Thu 11/24/16	7	
38		20. Create oversight plan (meet standards of clean enviroment)	10 days	Wed 11/23/16	Tue 12/6/16	36	
39		21. Deploy collection service into production to service the 100 pilot homes	10 days	Fri 3/17/17	Thu 3/30/17	35,36,26	
40		**Report on how to reproduce what we did**	**20 days**	**Fri 3/31/17**	**Thu 4/27/17**		
41		22. Compile lessons learned	7 days	Fri 3/31/17	Mon 4/10/17	39,27,34,15	
42		23. Identify scaling factors and dependencies	7 days	Tue 4/11/17	Wed 4/19/17	41	
43		24. Deploy scaling related changes	3 days	Thu 4/20/17	Mon 4/24/17	42	
44		25. Expand Service	3 days	Tue 4/25/17	Thu 4/27/17	43	

Appendix F: Project Completion Time-Cost

Deliverables/Tasks	Time-Phase Project Budget																					
	November				December				January				Febuary				March				April	
	ww01	ww02	ww03	ww04	ww05	ww06	ww07	ww08	ww09	ww10	ww11	ww12	ww13	ww14	ww15	ww16	ww17	ww18	ww19	ww20	ww21	ww22
Research & Planning																						
- Financial Analysis and Model	$300																					
- Secure grant/seed funding for project	$1,300																					
- Identity target location	$280																					
- Complete contract negotiations for the incinerator	$626																					
- Complete perpetual service funding model		$513																				
Community Buy-in																						
- Hire Public Relations Firm			$155																			
- Flyers/Campaign			$286																			
- University Lecture			$205																			
- Town Hall Meeting			$235																			
- Referendum for voting on land and location			$314																			
- Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)						$151																
MAGS Plant Commissioned																						
- Acquire Site						$740																
- Purchase MAGS						$820																
- Ship MAGS													$80									
- Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS						$827																
- Assemble MAGS													$390									
Quality Assurance									$1,400													
- Get MAGS up to production																						
Create Infrastructure																						
Electrical Grid						$1,204																
Prepare Site & Lay Foundation							$488															
Create Roads / Paths						$772																
Network Infrastructure								$288														
Purchase Transportation Equipment						$396																
Create Residue Disposal site						$914																
Sludge cleanout/In-house maintenance service																						
- Hire & Train transportation personnel								$676														
- Develop contingency plan for business continuity			$342																			
- Setup customer payment process			$459																			
- Create oversight plan				$870																		
- Deploy collection service into production to service the 100 pilot																$438						
Report on how to reproduce what we did																						
- Compile lessons learned																	$865					
- Identify scaling factors and dependencies																			$328			
- Deploy scaling related changes																					$410	
- Expand service																					$201	

Table F-1. MAGS Deployment Time-Phased Project Budget

Appendix G: Project Activity Times and Precedence

#	**Task**	Optimistic time(a)	Most likely time(m)	Pessimistic time(b)	**Precedent**
	Research & Planning				
1	- Financial Analysis and Model	4	4	6	
2	- Secure grant/seed funding for project	21	28	56	1
3	- Identity target location where MAGS will be	5	7	14	2
4	- Complete contract negotiations & quote for the incinerator	4	5	6	2
5	- Complete perpetual service funding model	6	7	11	4
	Community Buy-in				
6	- Hire Public Relations Firm	3	3	3	5
7	- Flyers/Campaign	5	6	7	6
8	- University Lecture	7	7	7	6
9	- Town Hall Meeting (occurs after tks# 7&8)	14	14	21	6
10	- Referendum for voting on land and location	14	14	14	6
11	- Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)	14	14	28	9
	Create Infrastructure				
30	Electrical Grid	1	14	21	
31	Prepare Site & Lay Foundation	7	10	13	
32	Foundation	3	3	3	
33	Road & Paths	1	14	21	
34	Network infrastructure	1	3	3	
35	Purchase Transportation Equipment	3	3	3	
36	Residue Disposal Site	7	14	28	
	MAGS Plant Commissioned				
12	- Acquire Site	1	1	1	10
13	- Purchase MAGS Process	45	45	90	10
	Ship MAGS	4	5	9	
14	- Hire Personnel for Assembling, Power-On and Maintaining MAGS	7	21	28	10

15	- Assemble & Installation MAGS	3	3	3	13
29	- Quality Assurance (runs in parallel to everything)	N/A	N/A	N/A	14
16	- Get MAGS up to production (Post QA)	5	7	9	15
	Sludge cleanout/maintenance service				
17	- Hire & Train service personnel (garbage collectors) / maybe subcontracting	6	14	21	5
18	- Develop contingency plan for business continuity	5	6	8	3
19	- Setup customer payment process	5	7	21	5
20	- Create oversight plan (meet standards of clean environment)	6	8	21	18
21	- Deploy collection service into production to service the 100 pilot homes identified	6	8	21	16 and 17
	Retrospective				
22	- Compile lessons learned	7	7	7	21
23	- Identify scaling factors and dependencies	7	7	7	22
24	- Deploy scaling related changes	3	3	3	23
25	- Expand service	2	2	7	24

Table G-1

Expected Activity Times (TE) Standard Deviation (σ) and Variance (σ^2)

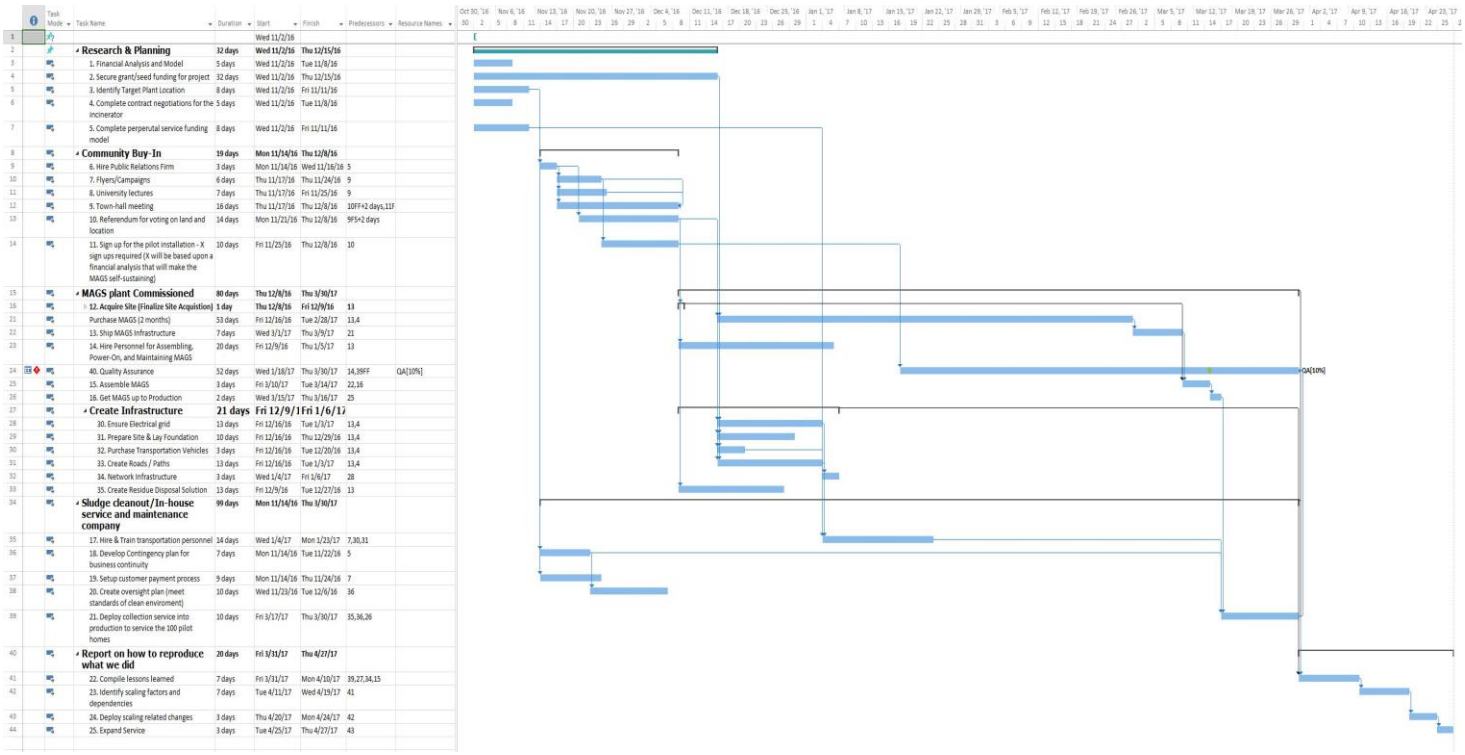
Activity		Expected time, TE	Variance	Standard deviation
#	**Task**			
	Research & Planning			
1	- Financial Analysis and Model	4.33	0.11	0.33
2	- Secure grant/seed funding for project	31.5		5.833.98893
3	- Identity target location where MAGS will be	7.83	2.25	1.5
4	- Complete contract negotiations	5	0.11	0.33

	& quote for the incinerator			
5	- Complete perpetual service funding model	7.5	0.694	0.83
	Community Buy-in			
6	- Hire Public Relations Firm	3	0	0
7	- Flyers/Campaign	6	0.11	0.33
8	- University Lecture	7	0	0
9	- Town Hall Meeting (occurs after tks# 7&8)	15.167	1.361	1.67
10	- Referendum for voting on land and location	14	0	0
11	- Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)	16.33	5.444	2.33
	Create Infrastructure			
30	Electrical Grid	13	11.11	3.33
31	Prepare Site & Layout Foundation	10	?	?
32	Foundation	2.5	0	0
33	Road & Paths	13	11.1	3.33
34	Network infrastructure	2.67	1.11	0.33
35	Purchase Transportation Equipment	3	0	0
36	Residue Disposal Site	12.83	12.25	3.5
	MAGS Plant Commissioned			
12	- Acquire Site	1	0	0
13	- Purchase MAGS	52.5	?	?
	Ship MAGS	5.5		
14	- Hire Personnel for Assembling, Power-On and Maintaining MAGS	19.83	12.25	3.5

15	- Assemble & Installation MAGS	22.17	1.361	1.167
29	- Quality Assurance (runs in parallel to everything)			
16	- Get MAGS up to production (Post QA)	7	0.4467	0.67
	Sludge cleanout/maintenance service			
17	- Hire & Train service personnel (garbage collectors) / maybe subcontracting	13.83	6.25	2.5
18	- Develop contingency plan for business continuity	6.17	0.25	0.5
19	- Setup customer payment process	9	7.12	2.67
20	- Create oversight plan (meet standards of clean environment)	9.83	6.25	2.5
21	- Deploy collection service into production to service the 100 pilot homes identified	9.833	6.25	2.5
	Retrospective			
22	- Compile lessons learned	7	0	0
23	- Identify scaling factors and dependencies	7	0	0
24	- Deploy scaling related changes	3	0	0
25	- Expand service	2.83	0.694	0.833

Table G-2. MAGS deployment tasks estimation

Appendix H: Gantt Chart:



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1				Wed 11/2/16			
2		**Research & Planning**	**32 days**	**Wed 11/2/16**	**Thu 12/15/16**		
3		1. Financial Analysis and Model	5 days	Wed 11/2/16	Tue 11/8/16		
4		2. Secure grant/seed funding for project	32 days	Wed 11/2/16	Thu 12/15/16		
5		3. Identify Target Plant Location	8 days	Wed 11/2/16	Fri 11/11/16		
6		4. Complete contract negotiations for the incinerator	5 days	Wed 11/2/16	Tue 11/8/16		
7		5. Complete perperutal service funding model	8 days	Wed 11/2/16	Fri 11/11/16		
8		**Community Buy-In**	**19 days**	**Mon 11/14/16**	**Thu 12/8/16**		
9		6. Hire Public Relations Firm	3 days	Mon 11/14/16	Wed 11/16/16	5	
10		7. Flyers/Campaigns	6 days	Thu 11/17/16	Thu 11/24/16	9	
11		8. University lectures	7 days	Thu 11/17/16	Fri 11/25/16	9	
12		9. Town-hall meeting	16 days	Thu 11/17/16	Thu 12/8/16	10FF+2 days,11F	
13		10. Referendum for voting on land and location	14 days	Mon 11/21/16	Thu 12/8/16	9FS+2 days	
14		11. Sign up for the pilot installation - X sign ups required (X will be based upon a financial analysis that will make the MAGS self-sustaining)	10 days	Fri 11/25/16	Thu 12/8/16	10	
15		**MAGS plant Commissioned**	**80 days**	**Thu 12/8/16**	**Thu 3/30/17**		
16		**12. Acquire Site (Finalize Site Acquistion)**	**1 day**	**Thu 12/8/16**	**Fri 12/9/16**	**13**	
21		Purchase MAGS (2 months)	53 days	Fri 12/16/16	Tue 2/28/17	13,4	
22		13. Ship MAGS infrastructure	7 days	Wed 3/1/17	Thu 3/9/17	21	
23		14. Hire Personnel for Assembling, Power-On, and Maintaining MAGS	20 days	Fri 12/9/16	Thu 1/5/17	13	
24		40. Quality Assurance	52 days	Wed 1/18/17	Thu 3/30/17	14,29FF	QA[10%]
25		15. Assemble MAGS	3 days	Fri 3/10/17	Tue 3/14/17	22,16	
26		16. Get MAGS up to Production	2 days	Wed 3/15/17	Thu 3/16/17	25	
27		**Create Infrastructure**	**21 days**	**Fri 12/9/1**	**Fri 1/6/17**		
28		30. Ensure Electrical grid	13 days	Fri 12/16/16	Tue 1/3/17	13,4	
29		31. Prepare Site & Lay Foundation	10 days	Fri 12/16/16	Thu 12/29/16	13,4	
30		32. Purchase Transportation Vehicles	3 days	Fri 12/16/16	Tue 12/20/16	13,4	
31		33. Create Roads / Paths	13 days	Fri 12/16/16	Tue 1/3/17	13,4	
32		34. Network Infrastructure	3 days	Wed 1/4/17	Fri 1/6/17	28	
33		35. Create Residue Disposal Solution	13 days	Fri 12/9/16	Tue 12/27/16	13	
34		**Sludge cleanout/In-house service and maintenance company**	**99 days**	**Mon 11/14/16**	**Thu 3/30/17**		
35		17. Hire & Train transportation personnel	14 days	Wed 1/4/17	Mon 1/23/17	7,30,31	
36		18. Develop Contingency plan for business continuity	7 days	Mon 11/14/16	Tue 11/22/16	5	
37		19. Setup customer payment process	9 days	Mon 11/14/16	Thu 11/24/16	7	
38		20. Create oversight plan (meet standards of clean enviroment)	10 days	Wed 11/23/16	Tue 12/6/16	36	
39		21. Deploy collection service into production to service the 100 pilot homes	10 days	Fri 3/17/17	Thu 3/30/17	35,36,26	
40		**Report on how to reproduce what we did**	**20 days**	**Fri 3/31/17**	**Thu 4/27/17**		
41		22. Compile lessons learned	7 days	Fri 3/31/17	Mon 4/10/17	39,27,34,15	
42		23. Identify scaling factors and dependencies	7 days	Tue 4/11/17	Wed 4/19/17	41	
43		24. Deploy scaling related changes	3 days	Thu 4/20/17	Mon 4/24/17	42	
44		25. Expand Service	3 days	Tue 4/25/17	Thu 4/27/17	43	

Figure H-1. MAGS Deployment Gantt Chart

Appendix I: Activity on Node Network Diagram

Tasks estimated durations based upon Appendix G:

Activity #	Task	Est. Comp. Time (Worker Days,TE)	Precedent
Level 1	***Research & Planning***		
1	- Financial Analysis and Model	4.33	0
2	- Secure grant/seed funding for project	31.50	0
3	- Identity target location where MAGS will be	7.83	0
4	- Complete contract negotiations & quote for the incinerator	5.00	0
5	- Complete perpetual service funding model	7.50	0
Level 1	***Community Buy-in***		
6	- Hire Public Relations Firm	3.00	3
7	- Flyers/Campaign	6.00	6
8	- University Lecture	7.00	6
9	- Town Hall Meeting (occurs after tks# 7&8)	15.17	6
10	- Referendum for voting on land and location	14.00	6
11	- Sign up for the pilot installation – 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)	16.33	7
Phase 3	***Create Infrastructure***		
30	Electrical Grid	13.00	2, 10
31	Prepare Site & Lay Foundation	13.00	2, 10
32	Purchase Transportation Equipment	3.00	2, 10
33	Create Road & Paths	13.00	2, 10
34	Network infrastructure	2.67	30
35	Residue Disposal Site	15.17	10
Phase 4	***MAGS Plant Commissioned***		
12	- Acquire Site	1.00	10
13	- Purchase MAGS Process	52.50	2, 10
13.5	- Ship MAGS	5.50	13
14	- Hire Personnel for Assembling, Power-On and	19.83	10

	Maintaining MAGS		
15	- Assemble & Installation MAGS	3.00	12, 13.5
29	- Quality Assurance (runs in parallel to everything)	52.00	11
16	- Get MAGS up to production (Post QA)	7.00	15
Phase 5	***Sludge cleanout/maintenance service***		
17	- Hire & Train service personnel (garbage collectors) / maybe subcontracting	13.83	5, 32 and 33
18	- Develop contingency plan for business continuity	6.17	3
19	- Setup customer payment process	9.00	5
20	- Create oversight plan (meet standards of clean environment)	9.83	18
21	- Deploy collection service into production to service the 100 pilot homes identified	9.83	16, 17 and 18
Phase 5	***Retrospective***		
22	- Compile lessons learned	7.00	21
23	- Identify scaling factors and dependencies	7.00	22
24	- Deploy scaling related changes	3.00	23
25	- Expand service	2.83	24

Table I-1. Project tasks duration 3-point estimation

AON Diagram:

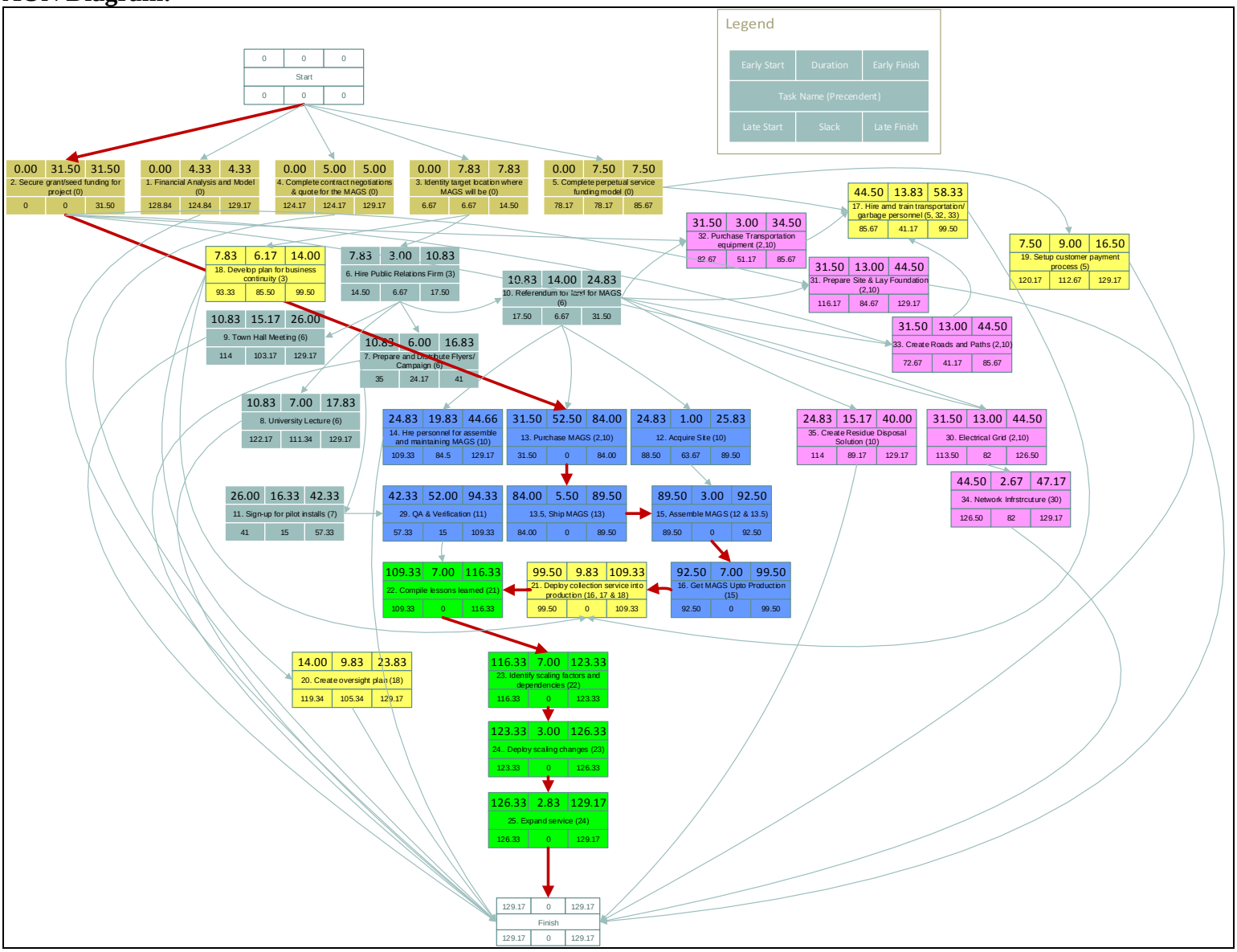


Figure I-1. MAGS Activity on Node Diagram

The calculations of the AON is shown in detail in Table I-2 below:

Effort (Worker Days)								Activity On Node Calculations (Worker-days)					
Phase	Task #	Task	Optimistic time(a)	Most likely time(m)	Pessimistic time(b)	Estimated Completion Time (TE)	Precedent	Critical Path (Y/N)	ES	EF	LS	LF	Slack
Research & Planning	1	- Financial Analysis and Model	4.00	4.00	6.00	4.33	0	N	0.00	4.33	124.84	129.17	124.84
	2	- Secure grant/seed funding for project	21.00	28.00	56.00	31.50	0	Y	0.00	31.50	0.00	31.50	0.00
	3	- Identity target location where MAGS will be	5.00	7.00	14.00	7.83	0	N	0.00	7.83	6.67	14.50	6.67
	4	- Complete contract negotiations & quote for the incinerator	4.00	5.00	6.00	5.00	0	N	0.00	5.00	124.17	129.17	124.17
	5	- Complete perpetual service funding model	6.00	7.00	11.00	7.50	0	N	0.00	7.50	78.17	85.67	78.17
Community Buy-In	6	- Hire Public Relations Firm	3.00	3.00	3.00	3.00	3	N	7.83	10.83	14.50	17.50	6.67
	7	- Flyers/Campaign	5.00	6.00	7.00	6.00	6	N	10.83	16.83	35.00	41.00	24.17
	8	- University Lecture	7.00	7.00	7.00	7.00	6	N	10.83	17.83	122.17	129.17	111.34
	9	- Town Hall Meeting (occurs after tks# 7&8)	14.00	14.00	21.00	15.17	6	N	10.83	26.00	114.00	129.17	103.17
	10	- Referendum for voting on land and location	14.00	14.00	14.00	14.00	6	N	10.83	24.83	17.50	31.50	6.67
	11	- Sign up for the pilot installation - 100 sign ups required	14.00	14.00	28.00	16.33	7	N	26.00	42.33	41.00	57.33	15.00
Create Infrastructure	30	Electrical Grid	1.00	14.00	21.00	13.00	2, 10	N	31.50	44.50	113.50	126.50	82.00
	31	Prepare Site & Lay Foundation	10.00	13.00	16.00	13.00	2, 10	N	31.50	44.50	116.17	129.17	84.67
	32	Purchase Transportation Equipment	3.00	3.00	3.00	3.00	2, 10	N	31.50	34.50	82.67	85.67	51.17
	33	Create Road & Paths	1.00	14.00	21.00	13.00	2, 10	N	31.50	44.50	72.67	85.67	41.17
	34	Network infrastructure	1.00	3.00	3.00	2.67	30	N	44.50	47.17	126.50	129.17	82.00
	35	Residue Disposal Site Solution	7.00	14.00	28.00	15.17	10	N	24.83	40.00	114.00	129.17	89.17
MAGS Plant Commissioned	12	- Acquire Site	1.00	1.00	1.00	1.00	10	N	24.83	25.83	88.50	89.50	63.67
	13	- Purchase MAGS	45.00	45.00	90.00	52.50	2, 10	Y	31.50	84.00	31.50	84.00	0.00
	13.5	- Ship MAGS	4.00	5.00	9.00	5.50	13	Y	84.00	89.50	84.00	89.50	0.00
	14	- Hire Personnel for Assembling, Power-On and Maintaining MAGS	7.00	21.00	28.00	19.83	10	N	24.83	44.66	109.33	129.17	84.50
	15	- Assemble & Installation MAGS	3.00	3.00	3.00	3.00	12, 13.5	Y	89.50	92.50	89.50	92.50	0.00
	29	- Quality Assurance	52.00	52.00	52.00	52.00	11	N	42.33	94.33	57.33	109.33	15.00
	16	- Get MAGS up to production (Post QA)	5.00	7.00	9.00	7.00	15	Y	92.50	99.50	92.50	99.50	0.00
Sludge Cleanout/Maintenance Service	17	- Hire & Train service personnel (garbage collectors)	6.00	14.00	21.00	13.83	5, 32 and 33	N	44.50	58.33	85.67	99.50	41.17
	18	- Develop contingency plan for business continuity	5.00	6.00	8.00	6.17	3	N	7.83	14.00	93.33	99.50	85.50
	19	- Setup customer payment process	5.00	7.00	21.00	9.00	5	N	7.50	16.50	120.17	129.17	112.67
	20	- Create oversight plan (meet standards of clean environment)	6.00	8.00	21.00	9.83	18	N	14.00	23.83	119.34	129.17	105.34
	21	- Deploy collection service into production to service the 100 pilot homes identified	6.00	8.00	21.00	9.83	16, 17 and 18	Y	99.50	109.33	99.50	109.33	0.00
Retrospective	22	- Compile lessons learned	7.00	7.00	7.00	7.00	21	Y	109.33	116.33	109.33	116.33	0.00
	23	- Identify scaling factors and dependencies	7.00	7.00	7.00	7.00	22	Y	116.33	123.33	116.33	123.33	0.00
	24	- Deploy scaling related changes	3.00	3.00	3.00	3.00	23	Y	123.33	126.33	123.33	126.33	0.00
	25	- Expand service	2.00	2.00	7.00	2.83	24	Y	126.33	129.17	126.33	129.17	0.00

Table I-2. AON Calculation Details

Appendix J: Probability Diagram

In this project, we want to hit a desired completion date of 6/1/2017 based upon the onset of the southwest monsoon season in the area; this makes the desired duration value, which is now 152 worker-days.

With the durations estimated in Appendix G, the estimated duration is 129.17 worker-days. This yields 2.30 standard deviations which is a confidence level of 98.98% as shown in table J-1. The 95% confidence level duration is 145.48 worker-days. Given that the confidence level with our current schedule is 98.98%, we are well within our ability to hit the desired completion date of 6/1/2017.

Desired completion Date	6/1/2017
Start date	11/2/2016
Max Duration (worker days)	152
Planned completion	4/27/2017
Planned duration (worker days)	129
Standard deviations	2.3022772
Confidence	98.98%

Table J-1. Project Confidence level

The details of the probability diagram calculations are shown in table J-2.

Effort (Worker Days)							Probability Diagram					
Phase	Task #	Task	Optimistic time(a)	Most likely time(m)	Pessimistic time(b)	Estimated Completion Time (TE)	Variance	Standard Deviation	Critical Path (Y/N)	Inc. TE in Prob Dist calc.	Inc. μ Prob Dist calc.	95% confidence duration (Worker days)
Research & Planning	1	- Financial Analysis and Model	4.00	4.00	6.00	4.33	0.11	0.33	N	0.00	0.00	145.48
	2	- Secure grant/seed funding for project	21.00	28.00	56.00	31.50	34.03	5.83	Y	34.03	31.50	
	3	- Identity target location where MAGS will be	5.00	7.00	14.00	7.83	2.25	1.50	N	0.00	0.00	
	4	- Complete contract negotiations & quote for the incinerator	4.00	5.00	6.00	5.00	0.11	0.33	N	0.00	0.00	
	5	- Complete perpetual service funding model	6.00	7.00	11.00	7.50	0.69	0.83	N	0.00	0.00	
Community Buy-In	6	- Hire Public Relations Firm	3.00	3.00	3.00	3.00	0.00	0.00	N	0.00	0.00	
	7	- Flyers/Campaign	5.00	6.00	7.00	6.00	0.11	0.33	N	0.00	0.00	
	8	- University Lecture	7.00	7.00	7.00	7.00	0.00	0.00	N	0.00	0.00	
	9	- Town Hall Meeting (occurs after tks# 7&8)	14.00	14.00	21.00	15.17	1.36	1.17	N	0.00	0.00	
	10	- Referendum for voting on land and location	14.00	14.00	14.00	14.00	0.00	0.00	N	0.00	0.00	
	11	- Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining)	14.00	14.00	28.00	16.33	5.44	2.33	N	0.00	0.00	
Create Infrastructure	30	Electrical Grid	1.00	14.00	21.00	13.00	11.11	3.33	N	0.00	0.00	
	31	Prepare Site & Lay Foundation	10.00	13.00	16.00	13.00	1.00	1.00	N	0.00	0.00	
	33	Road & Paths	3.00	3.00	3.00	3.00	0.00	0.00	N	0.00	0.00	
	34	Network infrastructure	1.00	14.00	21.00	13.00	11.11	3.33	N	0.00	0.00	
	35	Purchase Transportation Equipment	1.00	3.00	3.00	2.67	0.11	0.33	N	0.00	0.00	
	36	Residue Disposal Site	7.00	14.00	28.00	15.17	12.25	3.50	N	0.00	0.00	
MAGS Plant Commissioned	12	- Acquire Site	1.00	1.00	1.00	1.00	0.00	0.00	N	0.00	0.00	
	13	- Purchase MAGS Process	45.00	45.00	90.00	52.50	56.25	7.50	Y	56.25	52.50	
		Ship MAGS	4.00	5.00	9.00	5.50	0.69	0.83	Y	0.69	5.50	
	14	- Hire Personnel for Assembling, Power-On and Maintaining MAGS	7.00	21.00	28.00	19.83	12.25	3.50	N	0.00	0.00	
	15	- Assemble & Installation MAGS	3.00	3.00	3.00	3.00	0.00	0.00	Y	0.00	3.00	
	29	- Quality Assurance	52.00	52.00	52.00	52.00	0.00	0.00	N	0.00	0.00	
	16	- Get MAGS up to production (Post QA)	5.00	7.00	9.00	7.00	0.44	0.67	Y	0.44	7.00	
Sludge Cleanout/Maintenance Service	17	- Hire & Train service personnel (garbage collectors) /	6.00	14.00	21.00	13.83	6.25	2.50	N	0.00	0.00	
	18	- Develop contingency plan for business continuity	5.00	6.00	8.00	6.17	0.25	0.50	N	0.00	0.00	
	19	- Setup customer payment process	5.00	7.00	21.00	9.00	7.11	2.67	N	0.00	0.00	
	20	- Create oversight plan (meet standards of clean environment)	6.00	8.00	21.00	9.83	6.25	2.50	N	0.00	0.00	
	21	- Deploy collection service into production to service the 100 pilot homes identified	6.00	8.00	21.00	9.83	6.25	2.50	Y	6.25	9.83	
Retrospective	22	- Compile lessons learned	7.00	7.00	7.00	7.00	0.00	0.00	Y	0.00	7.00	
	23	- Identify scaling factors and dependencies	7.00	7.00	7.00	7.00	0.00	0.00	Y	0.00	7.00	
	24	- Deploy scaling related changes	3.00	3.00	3.00	3.00	0.00	0.00	Y	0.00	3.00	
	25	- Expand service	2.00	2.00	7.00	2.83	0.69	0.83	Y	0.69	2.83	

Table J-2. Probability Diagram calculations

The probability distribution diagram is shown in the figure J-1.

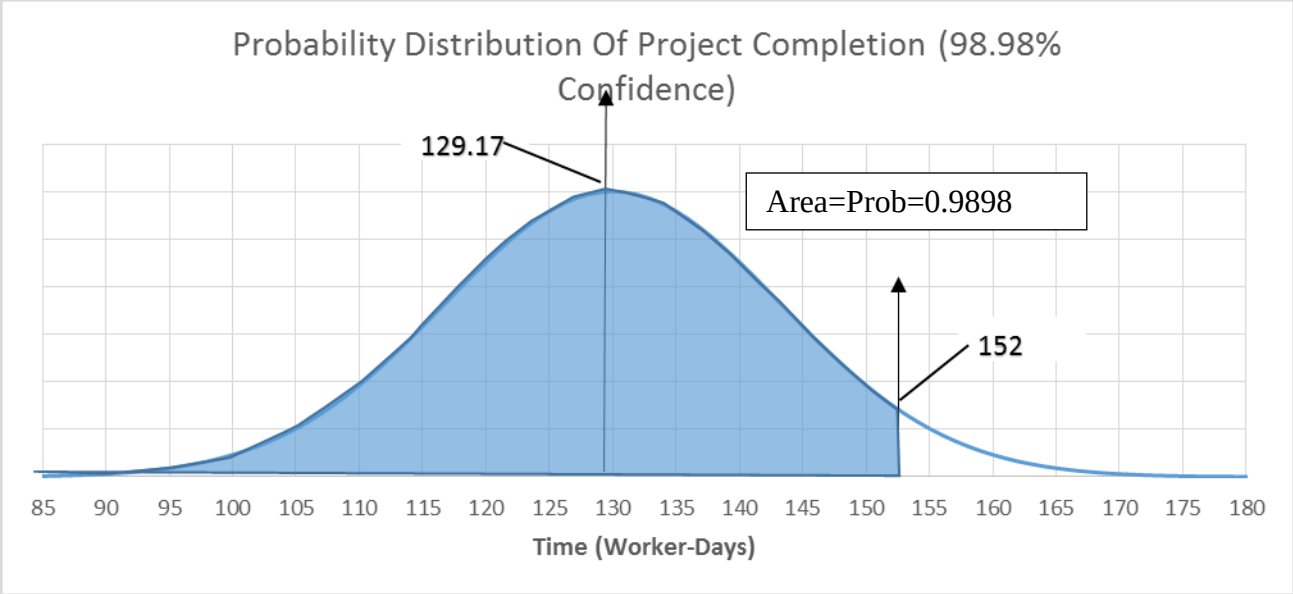


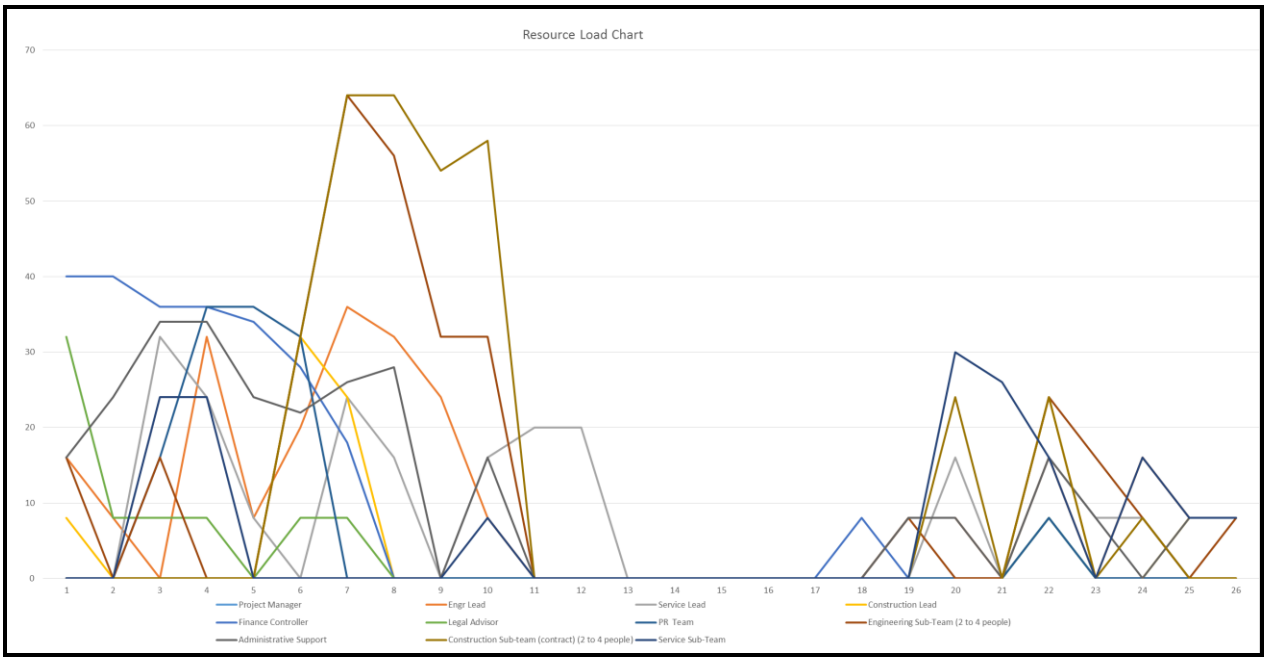
Figure J-1. Probability distribution of project completion

Appendix K: Resource Table

Project Manager	8																		8						
Engr Lead	16	8	0	32	8	20	36	32	24	8	0	0	0	0	0	0	0	0	8	8	0	16	0	16	8	
Service Lead	0	0	32	24	8	0	24	16	0	16	20	20	0	0	0	0	0	0	0	16	0	16	8	8	0	
Construction Lead	8	0	0	0	0	32	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	8	
Finance Controller	40	40	36	36	34	28	18	0	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	0	0	
Legal Advisor	32	8	8	8	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	
PR Team	0	0	16	36	36	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	
Engineering Sub-Team (2 to 4 people)	16	0	16	0	0	32	64	56	32	32	0	0	0	0	0	0	0	0	8	0	0	24	16	8	0	8
Administrative Support	16	24	34	34	24	22	26	28	0	16	0	0	0	0	0	0	0	0	8	8	0	16	8	0	8	8
Construction Sub-team (contract) (2 to 4 people)	0	0	0	0	0	32	64	64	54	58	0	0	0	0	0	0	0	0	0	24	0	24	0	8	0	0
Service Sub-Team	0	0	24	24	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	30	26	16	0	16	8	8

Table K-1

Resource Load Chart:



Engr Lead																									
Complete contract negotiations for the incinerator (24 h)	16	8																							
Acquire Site (8 h)						8																			
Purchase MAGS (32 h)							32																		
Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS (24 h)						8	4	8	4																
Assemble MAGS (8 h)																			8						
Get MAGS up to production (8 h)																				8					
Electrical Grid (16 h)								16																	
Prep Site & Lay Foundation (24 h)								8	16																
Roads / Paths (8 h)									4	4															
Hire & Train trans personnel (8 h)						4				4															
Create Oversight plan (40 h)				32	8																				
Compile Lessons Learned (16 h)																						16			
Identify scaling factors and dependencies (16h)																								16	
Deploy scaling related changes (8h)																									8
Total	16	8	0	32	8	20	36	32	24	8	0	0	0	0	0	0	0	0	8	8	0	16	0	16	8
Service Lead																									
Purchase Transportation Equipment (24 h)							24																		
Residue Disposal Site (16 h)								16																	
Hire & Train transportation personnel (56 h)										16	20	20													
Develop contingency plan for business continuity (16 h)			16																						
Setup customer payment process (16 h)			16																						
Create oversight plan (32 h)				24	8																				
Deploy collection service into production to service the 100 pilot homes identified (16 h)																				16					
Compile lessons learned (16 h)																						16			
Identify scaling factors and dependencies (8 h)																							8		
Deploy scaling related changes (8 h)																								8	
Total	0	0	32	24	8	0	24	16	0	16	20	20	0	0	0	0	0	0	0	16	0	16	8	8	0
Construction Lead																									
Identity target location (8 h)	8																								
Acquire Site (24 h)						24																			
Purchase MAGS (16 h)							16																		
Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS (16 h)						8	8																		
Compile lessons learned (24 h)																						24			
Deploy scaling related changes (8 h)																									8
Total	8	0	0	0	0	32	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	8
Finance Controller																									
Financial Analysis and Model (16 h)	16																								
Secure grant/seed funding for project (112 h)			20	20	26	28	18																		
Complete contract negotiations for the incinerator (24 h)	8	16																							
Complete perpetual service funding model (40 h)	16	24																							
Ship MAGS (8 h)																		8							
Develop contingency plan for business continuity (8 h)			4	4																					
Setup customer payment process (24 h)			12	12																					
Create oversight plan (8 h)					8																				
Compile Lessons Learned (8 h)																						8			
Total	40	40	36	36	34	28	18	0	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	0	0
Legal Advisor																									
Secure grant/seed funding for project (8 h)		8																							
Identity target location (16 h)	16																								
Complete contract negotiations for the incinerator (16 h)	16																								
Referendum for voting on land and location (8 h)				8																					
Prepare Site & Lay Foundation (8 h)							8																		
Residue Disposal site (8 h)						8																			
Develop contingency plan for business continuity (8 h)			8																						
Compile Lessons Learned (8 h)																						8			
Total	32	8	8	8	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
PR Team																									
Identity target location (8 h)			8																						
Flyers/Campaign (24 h)			8	16																					
University Lecture (8 h)				8																					
Town Hall Meeting (24 h)				4	12	8																			
Referendum for voting on land and location (40 h)				8	16	16																			
Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining) (16 h)																									
					8	8																			
Compile lessons learned (8 h)																						8			
Total	0	0	16	36	36	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0

Table K-2

Engineering Sub-Team (2 to 4 people)																										
Complete contract negotiations for the incinerator (8 h)	8																									
Complete perpetual service funding model (8 h)	8																									
University Lecture (8 h)			8																							
Town Hall Meeting (8h)			8																							
Acquire Site (32 h)						32																				
Purchase & Study MAGS (56 h)							16	40																		
Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS (32 h)							16		16																	
Get MAGS up to production (8 h)																		8								
Electrical Grid (56 h)							16		16	24																
Prepare Site & Lay Foundation (24 h)							16	8																		
Foundation (8 h)								8																		
Hire & Train transportation personnel (8 h)										8																
Create oversight plan (24 h)																										
Compile lessons learned (24 h)																					24					
Identify scaling factors and dependencies (16 h)																						16				
Deploy scaling related changes (8 h)																							8			
Total	16	0	16	0	0	32	64	56	32	32	0	0	0	0	0	0	0	0	8	0	0	24	16	8	0	

Administrative Support																										
Financial Analysis and Model (8 h)	8																									
Secure grant/seed funding for project (8 h)	8																									
Identity target location (8 h)		8																								
Complete contract negotiations for the incinerator (8 h)		8																								
Complete perpetual service funding model (8 h)		8																								
Hire Public Relations Firm (24 h)			24																							
Flyers/Campaign (8 h)				8																						
University Lecture (16 h)				16																						
Town Hall Meeting (8 h)					4	4																				
Referendum for voting on land and location (8 h)					4	4																				
Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining) (8 h)			2	2		4																				
Acquire Site (8 h)						4	4																			
Purchase MAGS (8 h)						4	4																			
Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS (16 h)						2	2	12																		
Assemble MAGS (8 h)																		8								
Get MAGS up to production (8 h)																			8							
Roads / Paths (8 h)							8																			
Purchase Transportation Equipment (16 h)							8																			
Residue Disposal site (8 h)								16																		
Hire & Train transportation personnel (16 h)										16																
Develop contingency plan for business continuity (8 h)				8																						
Setup customer payment process (8 h)			8																							
Create oversight plan (8 h)					16																					
Deploy collection service into production to service the 100 pilot homes identified (16 h)																										
Compile lessons learned (16 h)																					16					
Identify scaling factors and dependencies (8 h)																						8				
Deploy scaling related changes (8 h)																								8		
Expand service (8 h)																									8	
Total	16	24	34	34	24	22	26	28	0	16	0	0	0	0	0	0	0	0	8	8	0	16	8	0	8	8

Construction Sub-team (contract) (2 to 4 people)																										
Acquire Site (16 h)						16																				
Identify & Hire Personnel for Assembling, Bringing up and Maintaining MAGS (16 h)							16																			
Assemble MAGS (24 h)																				24						
Electrical Grid (56 h)							8	40		8																
Prepare Site & Lay Foundation (16 h)								16																		
Foundation (24 h)									24																	
Roads / Paths (56 h)									30	26																
Network Infrastructure (24 h)										24																
Purchase Transportation Equipment (8 h)								8																		
Residue Disposal site (56 h)						16	40																			
Compile lessons learned (24 h)																					24					
Deploy scaling related changes (8 h)																							8			
Total	0	0	0	0	0	32	64	64	54	58	0	0	0	0	0	0	0	0	0	24	0	24	0	8	0	0

Service Sub-Team																										
Sign up for the pilot installation - 100 sign ups required (100 will be based upon a financial analysis that will make the MAGS self-sustaining) (8 h)				8																						
Hire & Train transportation personnel (8 h)										8																
Develop contingency plan for business continuity (8 h)			8																							
Setup customer payment process (16 h)			16																							
Create oversight plan (16 h)				16																						
Deploy collection service into production to service the 100 pilot homes identified (56 h)																				30	26					
Compile lessons learned (16 h)																						16				
Identify scaling factors and dependencies (16 h)																							16			
Deploy scaling related changes (8 h)																								8		
Expand service (8 h)																									8	
Total	0	0	24	24	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	30	26	16	0	16	8	8

Month	Nov					Dec				Jan					Feb				Mar				Apr				
Day of Month	2	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20	27	6	13	20	27	3	10	17	24	31
Week	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14	w15	w16	w17	w18	w19	w20	w21	w22	w23	w24	w25	w26	w27

Table K-3

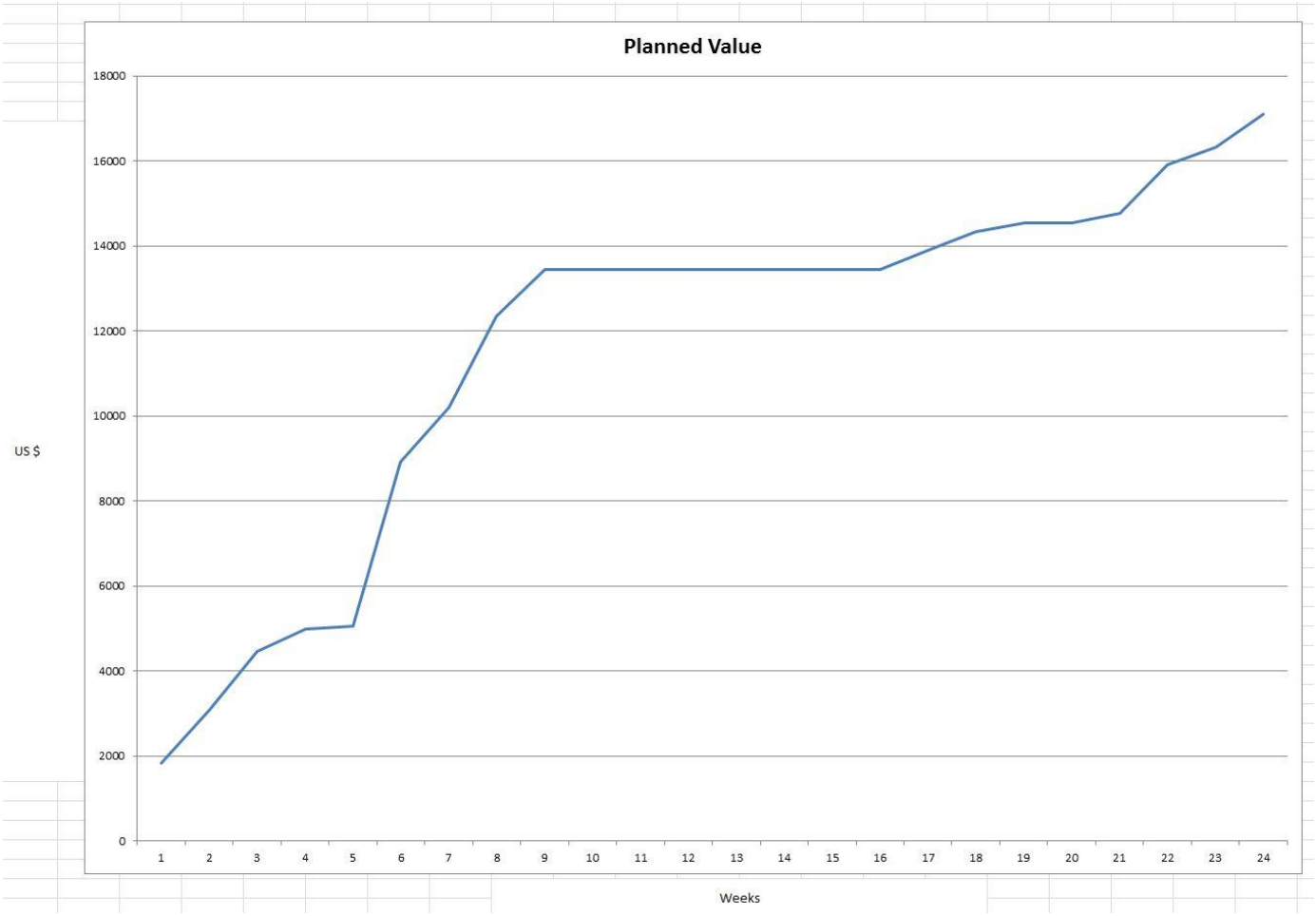
Appendix L: Planned Value Table

Issues

Appendix L : PLANNED VALUE TABLE

	November					December				January				Febuary				March					April		
Deliverables/Tasks	ww01	ww02	ww03	ww04	ww05	ww06	ww07	ww08	ww09	ww10	ww11	ww12	ww13	ww14	ww15	ww16	ww17	ww18	ww19	ww20	ww21	ww22	w23	w24
Research & Planning																								
- Financial Analysis and Model	150	150																						
- Secure grant/seed funding for project	650						650																	
- Identify target location	140	140																						
- Complete contract negotiations for the init	640																							
- Complete perpetual service funding model	260	260																						
Public Relations																								
- Hire Public Relations Firm		160																						
- Flyers/Campaign		140	140																					
- University Lecture			100	100																				
- Town Hall Meeting			120			120																		
- Referendum for voting on land and locatio			160			160																		
- Sign up for the pilot installation - 100 sign u					75			75																
Build Site Infrastructure																								
- Acquire Site						740																		
- Purchase MAGS						410											410							
Ship MAGS																	40	40						
- Identify & Hire Personnel for Assembling, I						410			410															
- Assemble MAGS																		390						
Quality Assurance									700													700		
- Get MAGS up to production																								
Build Site Infrastructure																								
Electrical Grid						600		600																
Prepare Site & Lay Foundation						240	240																	
Create Roads / Paths						380		380																
Network Infrastructure								200																
Purchase Transportation Equipment							400																	
Residue Disposal Site						450		450																
Hire & Train Personnel																								
- Hire & Train transportation personnel						340		340																
- Develop contingency plan for business con		170	170																					
- Setup customer payment process		230	230																					
- Create oversight plan			440	440																				
- Deploy collection service into production t																			220		220			
Complete																								
- Comple lessons learned																						430	430	
- Identify scaling factors and dependencies																								160
- Deploy scaling related changes																								410
- Expand service																								200
Total	1840	1250	1360	540	75	3850	1290	2135	1110	0	0	0	0	0	0	0	450	430	220	0	220	1130	430	770
Cumulative Total	1840	3090	4450	4990	5065	8915	10205	12340	13450	13450	13450	13450	13450	13450	13450	13450	13900	14330	14550	14550	14770	15900	16330	17100
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Appendix M: Planned Value Chart



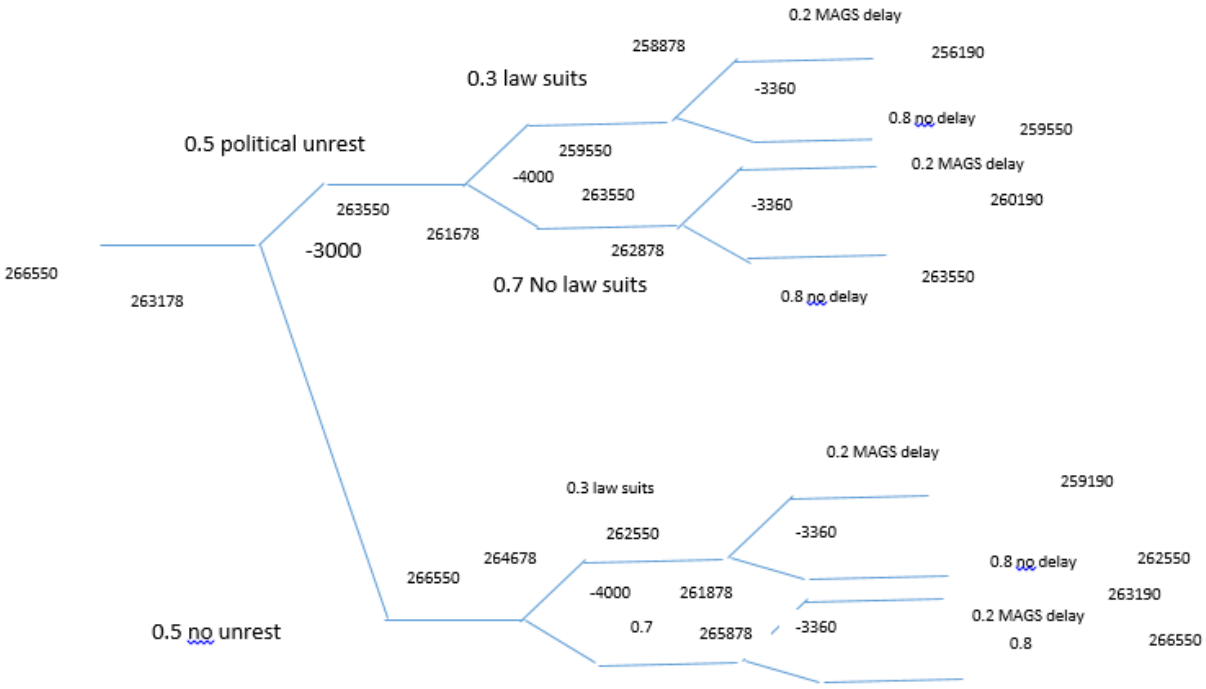
Appendix N: Risks

The critical risks identified for the project are:

- Political unrest
- Legal issues
- MAGS getting delayed.

Based on these 3 high risk items and EMV calculation was done using the decision tree below to calculate the risk contingency reserve.

Risk contingency reserve	266550 - 263178 = 3372



The monitoring techniques used for the project are:

- CV(Cost Variance): Weekly review
- SV(Schedule Variance): Bi-weekly review
- CPI (Cost Performance Index): Monthly review

The **earned value** will be calculated based on the 50-50 rule. The task at the day it starts will be obtaining 50% of the cost associated with as the credit. Once the task completes the remaining 50% of the task cost will be credited.

- The trend of the EV against the planned value chart (from appendix L) will help understand if there is a schedule slippage. SV=PV-EV

- The Actual cost incurred to the project can be compared against the planned value to understand the cost slippage (cost variance). CV=EV-AC

A **negative variance** in either of the above cases indicate that there is an issue with the cost expenditure or the schedule.

The Cost performance index can be computed on a monthly basis to understand the **trend** of the project. The Budget at completion is the summation of the planned value for each tasks and can be obtained from the planned value chart in Appendix L. A CPI ratio of **< 1** will indicate a delay in the project. $TPCI_{(BAC)}$ **< 1** indicates that the actual cost incurred to the project is more than the EV or the work that is expected to be completed till the point of monitoring and this also calls for further investigation on why the project is falling behind schedule.

$TPCI_{(EAC)}$ Indicate that the **trend** of the project. If the ratio is <1 the trend is a lag and needs further urgent investigation if the project can be brought back on track. The Estimate at completion is evaluated at a monthly basis by the PM to help with the calculation of $TPCI_{(EAC)}$.

$TPCI_{(BAC)}$ = (BAC - EV)/(BAC-AC) where,
BAC = Budget at completion
EV = Earned value
AC = Actual cost

$TPCI_{(EAC)}$ = (BAC - EV)/(EAC-AC) where,
EAC = Estimate at completion
EV = Earned value
AC = Actual cost

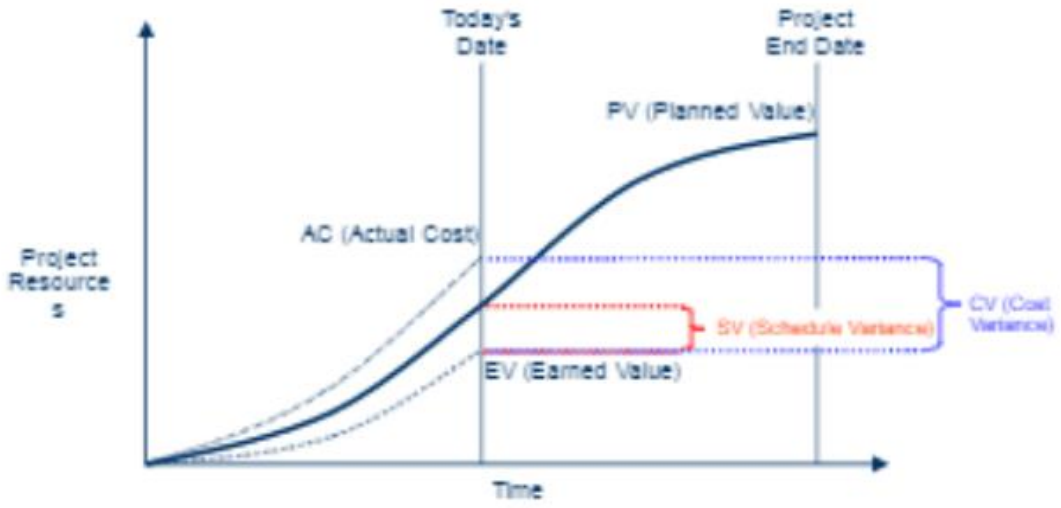


Figure N-1. Cost and schedule variance chart

There are some crucial times which need to be monitored in addition to the above variance calculations that are done weekly or monthly. The following key stages should be monitored and necessary reviews done to make sure that the activities are on track and in the case of the monsoon season the PM needs to make sure that there is no slippage in the project that can lead to the project overlapping with the monsoon season. For the below factors other than the monsoon season the cost performance index can be used to measure/review the progress of the project at these key points.

To see the trend of the project the following

- Community Buy-In
- Secure the Grant or Seed Funding
- Monsoon Season
- Long Delivery Time for MAGS

Additional factors that needs to be closely monitored are:

Environment related regulations change need to be closely monitored. A change in the environment policies can lead to additional cost be incurred by the project to take the necessary measures to meet the environment standards.

Changes to the **government regulations** also needs to be tracked very closely. This can lead to additional risks for law suits and schedule delays and the project needs to respond in the required manner to tackle the risks.

The PM has added this also to the risk register and these regulations will be tracked on a monthly basis and responses to the changes will be incorporated into the project.

Appendix O: Monitor and Control Chart

Below Monitor and Control table will be used by the PM to track project progress and ensure all deliverables are on schedule:

	Week 1	Week 2	Week 3	…..Week…	EoP
PV(Planned value)					
EV(Earned value)					
AC(Actual cost)					
BAC(Budget at completion)					
EAC(Estimated cost at completion)					
TPCI (EAC)(Cost performance index with respect to Estimated cost at completion)					
TPCI (BAC)(Cost performance index with respect to Budget at completion)					
CV(Cost variance)					
SV(Schedule variance)					

Table O-1. Performance Dashboard Format for Weekly Core Team Review

Monitor and Control Cadence will be as follows:

- CV and SV if negative indicates a lag in the project
- TPCI<1 also indicates a delay in the project.
- CV will be calculated weekly
- SV will be calculated bi-weekly
- TPCI will be calculated monthly

Appendix P: Termination

This project will conclude in extinction, out of the typical four (the others are starvation, addition and integration) possible ways that projects can terminate. The first option, if grant funding and community buy-in is received, is where the MAGS system will be deployed, the pilot concludes successfully and the independent service company entity takes over sustaining operations for the future, thereby releasing the ACME personnel and company back to their parent organization. The second scenario for terminating the project is if grant funding or community buy-in is not received, the project team has pre-decided that the project will be terminated. Termination by integration is not likely to occur as the plan is to hand over control to the independent service entity. Termination by addition is not likely either because the scope of the project is clear; to deploy the two-drum MAGS system, complete the pilot in 100 homes and transfer future sustaining to the local entity. Termination by starvation is not expected to happen as there are well-defined risks and gates for those that has been predefined. The termination checklist is shown below.

MAGS Deployment Project Termination Checklist

Reasons For Termination	
☐	Grant Funding not secured
☐	Referendum not approved by community
☐	MAGS does not meet environmental quality regulations or terminated after MAGS purchased

CHECKLIST		
Administrative closeout		
☐	Ensure all tracking and monitor/control documents are upto date	Store the information in the agreed-upon documentation repository location in ACME
Financial closeout		
☐	All project related contract payments completed to 3rd parties (PR agency, Construction, Garbage Collection, Service Payment)	All project related contracts are audited to ensure completion of payouts
☐	All project related invoices and statements completed per grant award requirements	Grant award document audited to ensure completion
Transfer of knowledge and control to local team		
☐	Training for local team completed for both expansion project and day-to-day operations	The local team needs to be fully certified to maintain the system
☐	All warranties and equipment documentation audited by local team	The local team needs to ensure they know all the support details and information on MAGS
☐	Sludge disposal and garbage collection contracts audited by local team	The local team needs to understand their obligations for collecting the garbage from the participants and to dispose of the residue or sludge properly.

☐	All project documentation transferred to both the local team and ACME	All the documentation needs to be properly deposited in both the ACME and local company repository
☐	Local team signoff of taking over	This is the final documented commitment from the local team when taking over operations and maintenance of MAGS.
Project resource release		
☐	Local team signoff on taking over	This is the final documented commitment from the local team thereby releasing the ACME team members to return to their parent organization.
☐	Project engineering resources allocated from ACME return to new/old positions	Per plan, the ACME releases will return to their home functional teams and the functional managers will assign them to new projects.
Project analysis		
☐	White-paper published based upon project experience and retrospective	ACME wants to make sure all the learning from every innovation is well documented both for future projects as well as promote research in environmental engineering through publications.
☐	Final project conclusion summary presentation (with the retrospective and local team details) made to management of ACME and the local sustaining management	A summary presentation to the management teams from ACME and the local sustaining entity will enable a clean wrap-up of the projects.

Authorization

This section provides the names and authorization, once signed, for the project to move forward in accordance with the information contained in this charter.

Approved by the Project Sponsor:

_____ Date: _____