Title: Electric Bike Charging Stations

Course Title: Project Management
Course Number: ETM 545
Instructor: Dr. Richard Sperry
Term: Winter
Year: 2015
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Daniel Lee

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Report No.:
Type: Student Project
Note:

Electric Bike Charging Station Charter

The installation of electric bike charging station will be a platform projection within the City of Portland. The City of Portland already sponsors existing electric car charging stations, and it is believed that electric bikes charging stations will be the next generation in electrical transportation charging stations. This would be an expansion of the "Electric Vehicles – The Portland Way" project [1]. Bikes are a commonly used mode of transportation in Portland, and it is believed that even more citizens would use bikes if they had the option to charge their electric bikes within city limits. This project would also target tourists in the area. Portland boasts a strong transit system that allows easy access to the local sites and attractions. This would be another option available for seeing what the city offers to its visitors. The benefits of this project include additional revenue to the City of Portland, perpetuating the image of Portland being a 'green' city and also one that is on the forefront of electrical vehicle technology and making it readily available to the citizens and tourists.

The Electric Bike Charging Station team is requesting funds from Charge Portland. Over $20 million in federal funding has come to Oregon for infrastructure development since 2010 [2]. Additionally, City Fleet, the Bureau of Development Services, City of Portland: Planning and Sustainability, City of Portland: Bureau of Transportation and the Portland Development Commission all financially back Charge Portland. It is believed that the Electric Bike Charging Station would be an excellent investment for Charge Portland in their quest for additional electric transportation.

Bike racks will be installed near existing electric car charging stations, electrical hook ups will be installed, as well as a card swipe system to charge individuals for charging their electric bikes. This will necessitate permits to break ground, install racks, and make changes to the existing electrical grid at the point of installation. Contracts must be drawn up for the card swipe system which would include cooperation from banks, and interfacing with companies that provide the card swipe hardware. Due to the existing "Electric Vehicles – The Portland Way" project, there is already a relationship in place with Portland General Electric to tap into the energy supply. This relationship will again be utilized to make existing infrastructure changes.

In the event that Charge Portland decides to take on the Electric Bike Charging Stations, there is much on the horizon. There are potential for relationships to be forged with local electric bike manufacturers to set up a bike rental system. The three electric bike sellers in the area are The eBike Store, Cynergy E-Bikes, Field Electric – Electric Bikes. There is a potential for bikes from these stores to be available for rental from the electric bike charging racks for an additional cost. It is believed this would be an attractive concept for the three bike shops as a marketing opportunity, and a way for consumers to test out an electric bike before a purchase is made.

Within the scope of this project is the purchase of bike locks. It is not within the scope of the project to design new bike locks.

Table of Contents

Appendix A: WBS

Integrating Electric Bicycle Charging Stations with Vehicular Charging Stations				
Steps	**Responsibility**	**Time (Weeks)**	**Precedent**	**Resources**
1. Research Existing EV charging Norms				
a. Areas with EV stations	Project Manager			EV charging map
b. Owners of EV stations	Project Manager			EV charging map
c. Card Swipe/Payment system	Project Manager			Internet and Car2Go
2. Research Permits and Laws Associated with Installs				
a. Areas where it is allowed/zoning	Lead Engineer		1.a	EV charging map
b. Effects on Grid	Lead Engineer		1.a	BPA, NERC, FERC articles
c. NEC code Guidelines	Lead Engineer		1.a	NEC code book article 625 EV charging stations
3. Design Card Swipe System				
a. Estimates debit/credit card system	Lead Engineer			BANKS
b. Contact banks/set up system	Lead Engineer		3.a	BANKS
c. Contract electrical design to shut off once unplugged	Lead Engineer		3.b	BANKS
d. Install Card Swipe System	Field Manager		3.c	
4. Obtain Permission with Owners of Existing Charging Stations				
a. Contact owner	Lead Engineer			EV charging map
b. Make deal	Project Manager		4.a	EV charging map
5. Get Quotes				
a. Bike Racks	Field Manager			construction firms
b. Installation of bike racks	Field Manager		5.a	construction firms
c. Construction materials	Field Manager		5.a	construction firms
6. Contract out Work for Retrofit of Charging Stations				
a. Estimates for excavation	Project Manager			construction firms
b. Estimates for electrical work done to grid	Field Manager			construction firms
c. Estimates for labor	Field Manager		2.c	construction firms

d. File for permits	Project Manager		2.a	City of Portland Permitting office
e. Installation of bike racks	Field Manager		5.a	construction firms
f. Installation of changes to grid	Field Manager		6.e	PGE
g. Installation of card swipe system	Field Manager		6.f	Banks
h. Power up grid	Field Manager		6.g	PGE
I. Power up card swipe system	Field Manager		6.h	Banks
j. Testing of system	Field Manager		6.i	
k. Final Turn over of project	Project Manager		6.j	construction firm/Project Manager
l. Turn over card swipe banking information	Project Manager		6.j	Banks
m. Turn over card swipe software	Project Manager		6.j	Banks
n. Turn over final accounts and ledgers	Project Manager		6.j	
o. Turn over final drawings/change orders	Project Manager		6.j	

Appendix B: RACI

	Project Office					Field Operations
WBS	**Task**	**PM**	**Contract Admin**	**Proj. Eng**	**Industrial Eng**	**Field Manager**
Subproject						
Determine Need	A	A		C	I	R
Research: -Card swipe -Zoning -Parking -Electrical codes						
	B1	A	C/I	I	R	
	B2	A	C/I	I	R	
	B3	A	C/I	I	R	
	B4	A	C/I	I	R	
Get Quotes: -Bike racks -Install racks -Install card swipe -Install electrical hook ups -Existing car charging stations						
	C1	I		A	C	R
	C2	I		A	C	R
	C3	A	C	R	I	
	C4	A	C	R	I	
	C5	A	C	R	I	
Write Requests -Materials -Labor -Permits -Bank Collaboration						
	D1	A	R	I		C
	D2	A	R	I		C
	D3	A	C	R		I
	D4	A	C	R	I	
Implement	E	A		I	C	R
Documentation	F	C	R	A	I	
Final Turn Over	G	R		A	I	C

Legend:
R Responsible
C Consult
I Inform
A Accountable

Appendix C: Figure of Positioning

1. Define the project with a statement of the objective(s) that identifies the major outcomes desired.

    a. Integration of bike charging racks with vehicle charging stations

    b. Installation of stand-alone bike charging racks

2. Determine the key tasks associated with each objective and locate the units in the parent organization that serve as functional "homes" for these types of tasks.

Task 1: Rules and regulations-Research and Development functional group

    Existing documentation of Vehicle Charging Station

    Permits-NEC Article NEC Article 625 Public charging

    Material and Resource Selection

    City Permit

    Bank Collaboration

    Suitable Locations

Task 2: Bank System, Card design-Finance Functional Group

    Connection requirements

    Charging Fee

Task 3: Design Electrical System with collaboration from power companies-Engineering functional group

    Connecting to grid rules, PGE

    Telecommunications to the bank

    Rated output 120 RMS VAC

    Works closely with bank system

Task 4: Structural Design-engineering functional group

    Material Selection-Galvanized weathering steel

Task 5: Design Show Case-Project Management functional group

Final product for install

Tested

Has to work closely with finance and engineering

Task 6: Contractor Hire-project management functional group

Contruction-Excavation

Construction-General

Construction-Electrician

Construction-foreman

Has to work closely with engineering

Task 7: Verification-Project Management functional group

City Inspection up to code

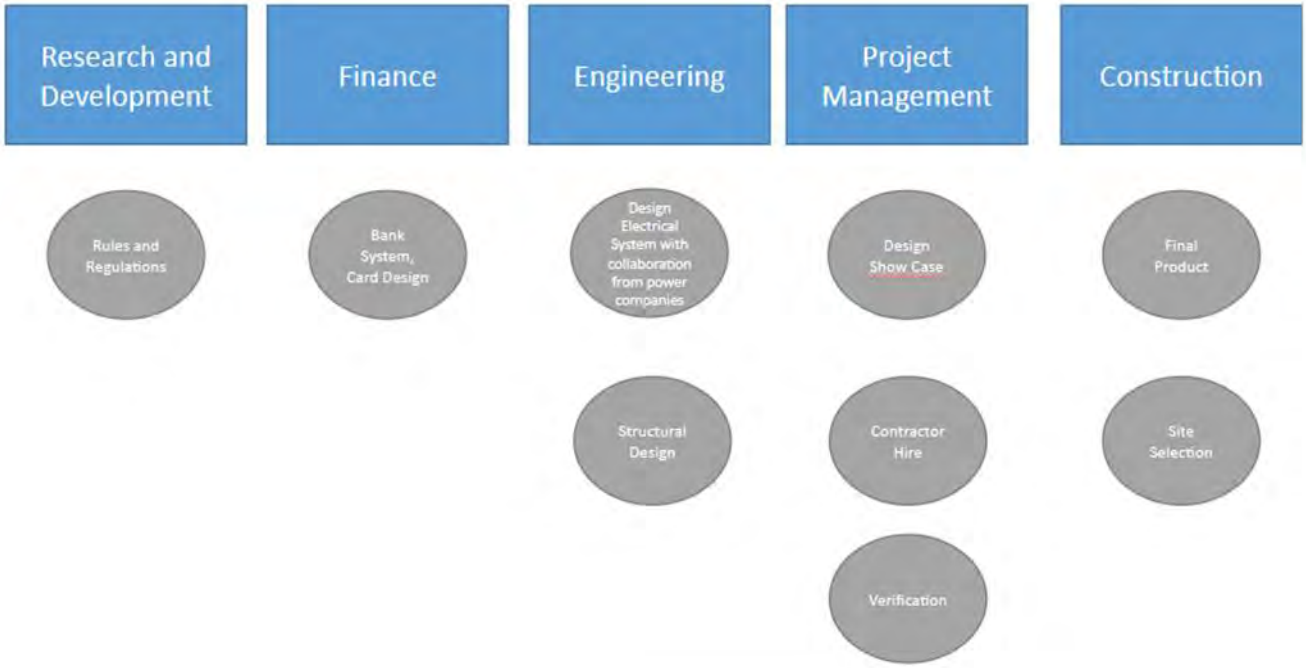
Initial power up

Bank system connected

Final Test

Has to work closely with engineering

The functional groups provide the resources for the project while the project manager organizes and watches over. This is a weak matrix due to the size of the project being small and the project manager not having full authority.


Research and Development
Finance
Engineering
Project Management
Construction
Rules and Regulations
Bank System, Card Design
Design Electrical System with collaboration from power companies
Structural Design
Design Show Case
Contractor Hire
Verification
Final Product
Site Selection

Appendix D: Baseline Schedule

		Name	Duration	Start	Finish	Predecessors
1		1.AExisting documentation of Vehicle Charging Station	5 days	6/1/15 8:00 AM	6/5/15 5:00 PM	
2		1.B Permits-NEC Article NEC Article 625 Public charging	5 days	6/1/15 8:00 AM	6/5/15 5:00 PM	
3		1.C Material and Resource Selection	10 days	6/1/15 8:00 AM	6/12/15 5:00 PM	
4		1.D City Permitting	10 days	6/1/15 8:00 AM	6/12/15 5:00 PM	
5		1.E Bank Collaboration/Negotiations	10 days	6/1/15 8:00 AM	6/12/15 5:00 PM	
6		1.F Suitable Locations Research	5 days	6/1/15 8:00 AM	6/5/15 5:00 PM	
7		2.A Connection requirements Research	5 days	6/15/15 8:00 AM	6/19/15 5:00 PM	1;2;3;4;5
8		2. B Charging Fee/Bank Negotiations	10 days	6/15/15 8:00 AM	6/26/15 5:00 PM	1;2;3;4;5
9		3. PGE/Grid Connection Regulations	10 days	6/22/15 8:00 AM	7/3/15 5:00 PM	7
10		3. B Telecommunications to the bank Design	20 days	6/29/15 8:00 AM	7/24/15 5:00 PM	8
11		3. C Voltage Output Design	10 days	7/6/15 8:00 AM	7/17/15 5:00 PM	9
12		4. A Material Selection-Galvanized weathering steel	5 days	6/1/15 8:00 AM	6/5/15 5:00 PM	
13		5. A Final product Coalescence	20 days	7/27/15 8:00 AM	8/21/15 5:00 PM	8;9;10;11;12
14		5. B Final Product Testing	10 days	8/24/15 8:00 AM	9/4/15 5:00 PM	13
15		6. A Contruction-Excavation	5 days	9/7/15 8:00 AM	9/11/15 5:00 PM	14
16		6. B Construction-General	5 days	9/28/15 8:00 AM	10/2/15 5:00 PM	17
17		6. C Construction-Electrical	5 days	9/21/15 8:00 AM	9/25/15 5:00 PM	18
18		6. D Construction-Mechanical	5 days	9/14/15 8:00 AM	9/18/15 5:00 PM	15
19		7. A City Inspection	5 days	10/5/15 8:00 AM	10/9/15 5:00 PM	16
20		7. B Initial power up	5 days	10/12/15 8:00 AM	10/16/15 5:00 PM	19
21		7. C Bank system connected	5 days	9/28/15 8:00 AM	10/2/15 5:00 PM	17
22		7. D Final Test	5 days	10/19/15 8:00 AM	10/23/15 5:00 PM	20

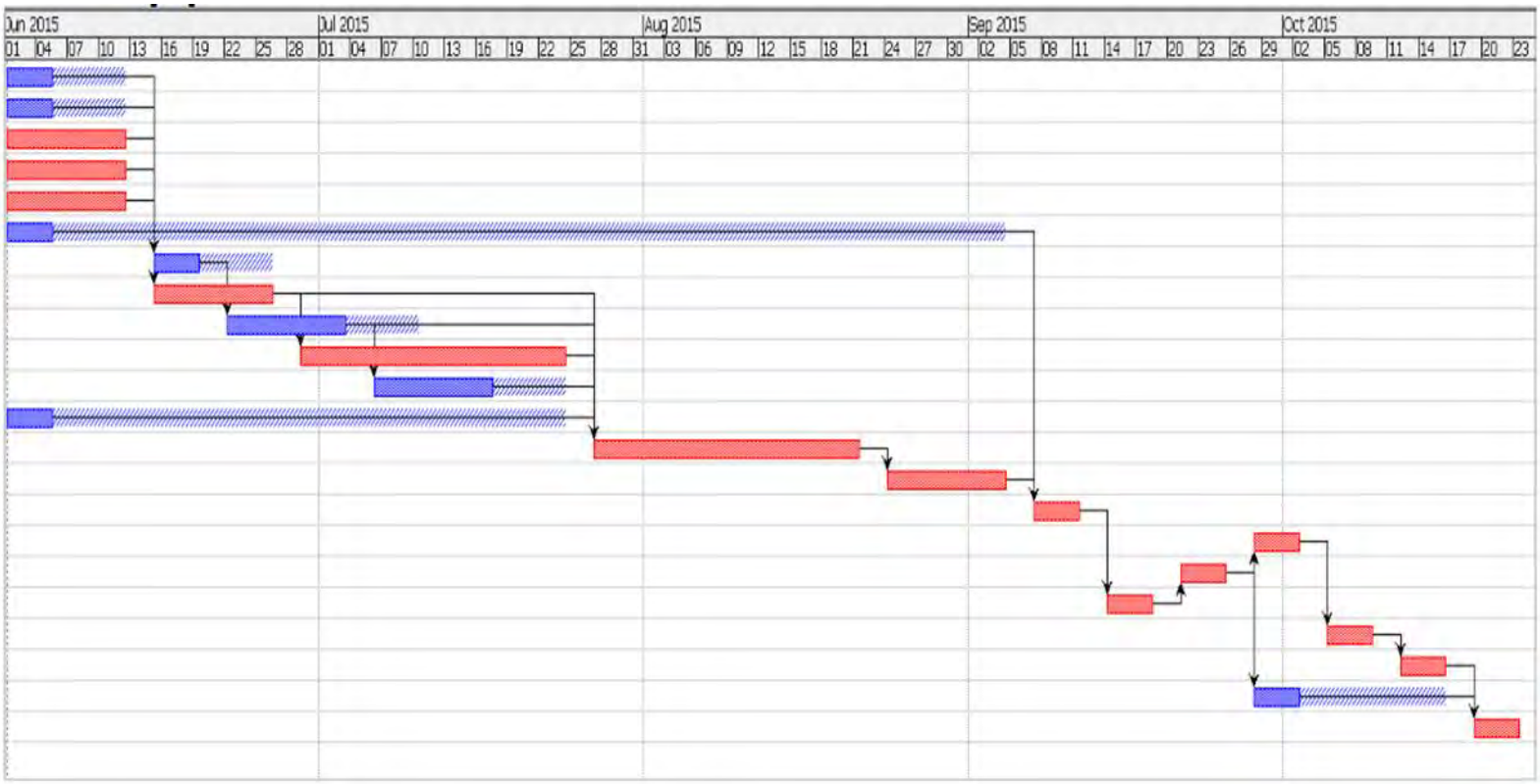
Appendix E: Baseline Schedule

	Estimated Costs	WeeK																					
Activity			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.AExisting documentation of Vehicle Charging Station	1500		750	750																				
1.B Permits-NEC Article NEC Article 625 Public charging	5500		2750	2750																				
1.C Material and Resource Selection	2500+1500		1250	2750																				
1.D City Permitting	4500		2250	2250																				
1.E Bank Collaboration/Negotiations	10000		5000	5000																				
1.F Suitable Locations Research	1000		500	500																				
2.A Connection requirements Research	8500			4250	4250																			
2. B Charging Fee/Bank Negotiations	10000			5000		5000																		
3. PGE/Grid Connection Regulations	5000					2500		2500																
3. B Telecommunications to the bank Design	37500						18750		18750															
3. C Voltage Output Design	3500						1750	1750																
4. A Material Selection-Galvanized weathering steel	17500		8750			8750																		
5. A Final product Coalescence	75000								32500	32500	10000													
5. B Final Product Testing	30000										15000	15000												
6. A Contruction-Excavation	15000											7500	7500											
6. B Construction-General	12500																6250	6250						
6. C Construction-Electrical	17500														8750	8750								
6. D Construction-Mechanical	17500												8750	8750										
7. A City Inspection	27500																		13750	13750				
7. B Initial power up	25000																				12500	12500		
7. C Bank system connected	15000																7500	7500						
7. D Final Test	17500																						8750	8750
Total		21250	23250	4250	16250	20500	4250	51250	32500	25000	22500	16250	8750	8750	8750	13750	13750	13750	13750	12500	12500	8750	8750	
Cumulative Total		20500	43000	47250	63500	84000	88250	139500	172000	185750	207000	223250	232000	240750	249500	263250	277000	290750	304500	317000	329500	338250	347000	

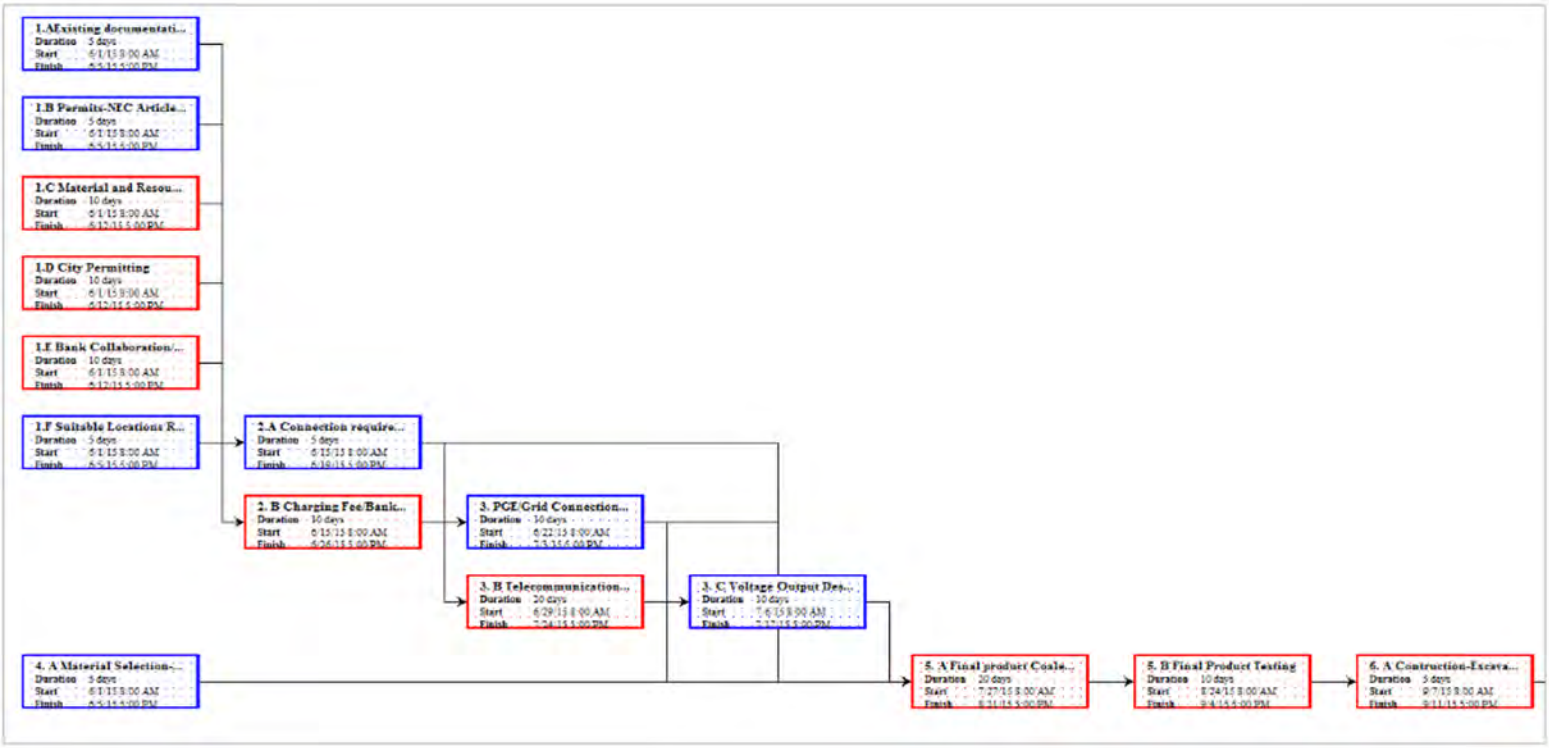
Appendix F: Detailed Tasks and Variances

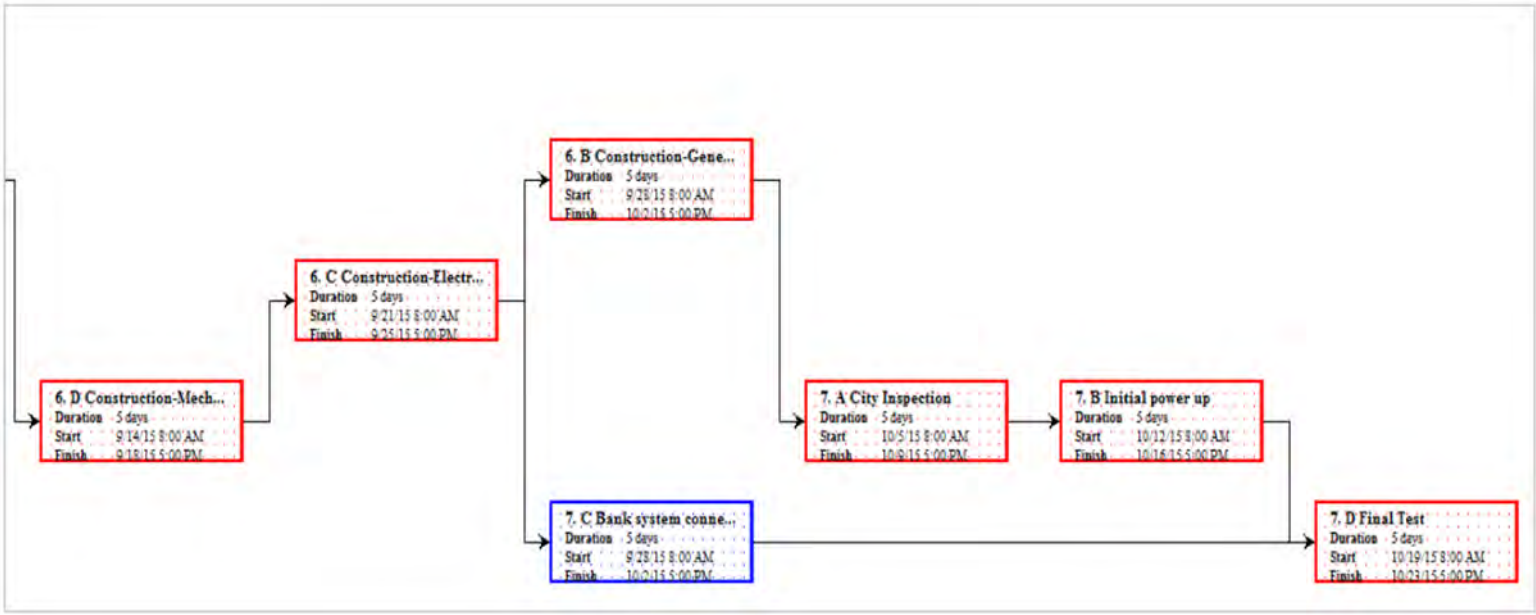
Activities	Optimistic Time	Pessimistic Time	Most Likely Time Estimate	TE	Variance	Standard Deviation	Expected Costs
1.AExisting documentation of Vehicle Charging Station	0.5	1.5	1	1	0.027778	0.166666667	1500
1.B Permits-NEC Article NEC Article 625 Public charging	0.5	1.5	1	1	0.027778	0.166666667	5500
1.C Material and Resource Selection	0.5	3	2	1.916667	0.173611	0.416666667	4000
1.D City Permitting	0.5	3	2	1.916667	0.173611	0.416666667	4500
1.E Bank Collaboration/Negotiations	0.5	3	2	1.916667	0.173611	0.416666667	10000
1.F Suitable Locations Research	0.5	1.5	1	1	0.027778	0.166666667	1000
2.A Connection requirements Research	0.5	1.5	1	1	0.027778	0.166666667	8500
2. B Charging Fee/Bank Negotiations	0.5	3	2	1.916667	0.173611	0.416666667	10000
3. PGE/Grid Connection Regulations	0.5	3	2	1.916667	0.173611	0.416666667	5000
3. B Telecommunications to the bank Design	3	5	4	4	0.111111	0.333333333	37500
3. C Voltage Output Design	0.5	3	2	1.916667	0.173611	0.416666667	3500
4. A Material Selection-Galvanized weathering steel	0.5	1.5	1	1	0.027778	0.166666667	17500
5. A Final product Coalescence	3	5	4	4	0.111111	0.333333333	75000
5. B Final Product Testing	0.5	3	2	1.916667	0.173611	0.416666667	30000
6. A Contruction-Excavation	0.5	1.5	1	1	0.027778	0.166666667	15000
6. B Construction-General	0.5	1.5	1	1	0.027778	0.166666667	12500
6. C Construction-Electrical	0.5	1.5	1	1	0.027778	0.166666667	17500
6. D Construction-Mechanical	0.5	1.5	1	1	0.027778	0.166666667	17500
7. A City Inspection	0.5	1.5	1	1	0.027778	0.166666667	27500
7. B Initial power up	0.5	1.5	1	1	0.027778	0.166666667	25000
7. C Bank system connected	0.5	1.5	1	1	0.027778	0.166666667	15000
7. D Final Test	0.5	1.5	1	1	0.027778	0.166666667	17500
			Sum of Variances	1.798611			
			Standard Deviation of Sum of variances	1.341123			

Appendix G: Gantt Chart



Appendix H: AON Network





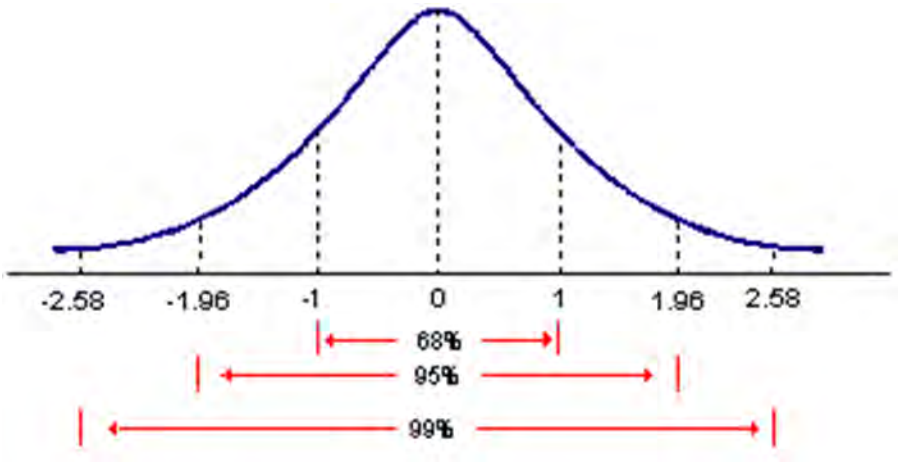
Appendix I: Probability Diagram

The probability diagram of completing the critical path.
Critical path: 22weeks

$$Z=(D-\mu)\sigma\mu 2$$

D = desired project completion time, 25 weeks
μ = Critical time of the project, 22 weeks
σ_{μ}^2 = Variance
where σ2=((b-a)/6)2
b= pessimistic time estimate
a = optimistic time estimate
Z = Number of standard deviations of a normal distribution

Z = ((25- 22)/1.798)= 2.237 standard deviations
A Z score of 2.237 gives a probability of 99.01% of completing the project on time.



(Example of Normal Distribution taken from analystnotes.com)

Appendix J: Resource Loading Table

The probability diagram of completing the critical path.
Critical path: 22weeks

$$Z=(D-\mu)\sigma\mu 2$$

D = desired project completion time, 25 weeks
μ = Critical time of the project, 22 weeks
σ_{μ}^2 = Variance
where σ2=((b-a)/6)2
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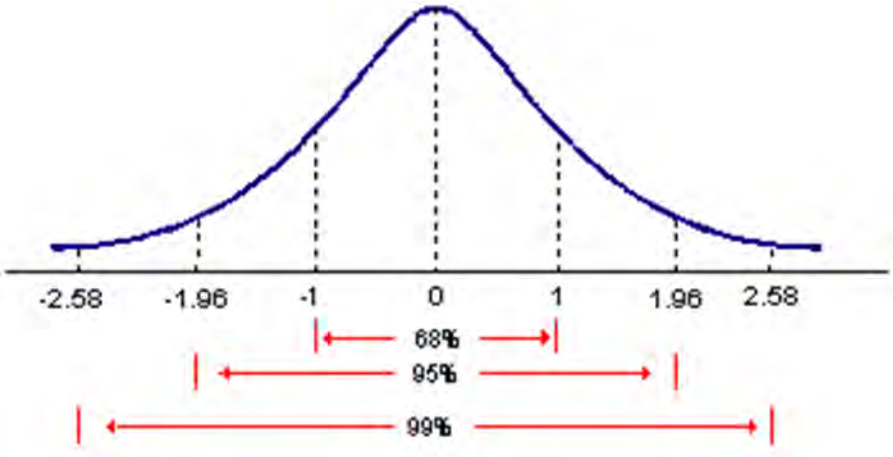
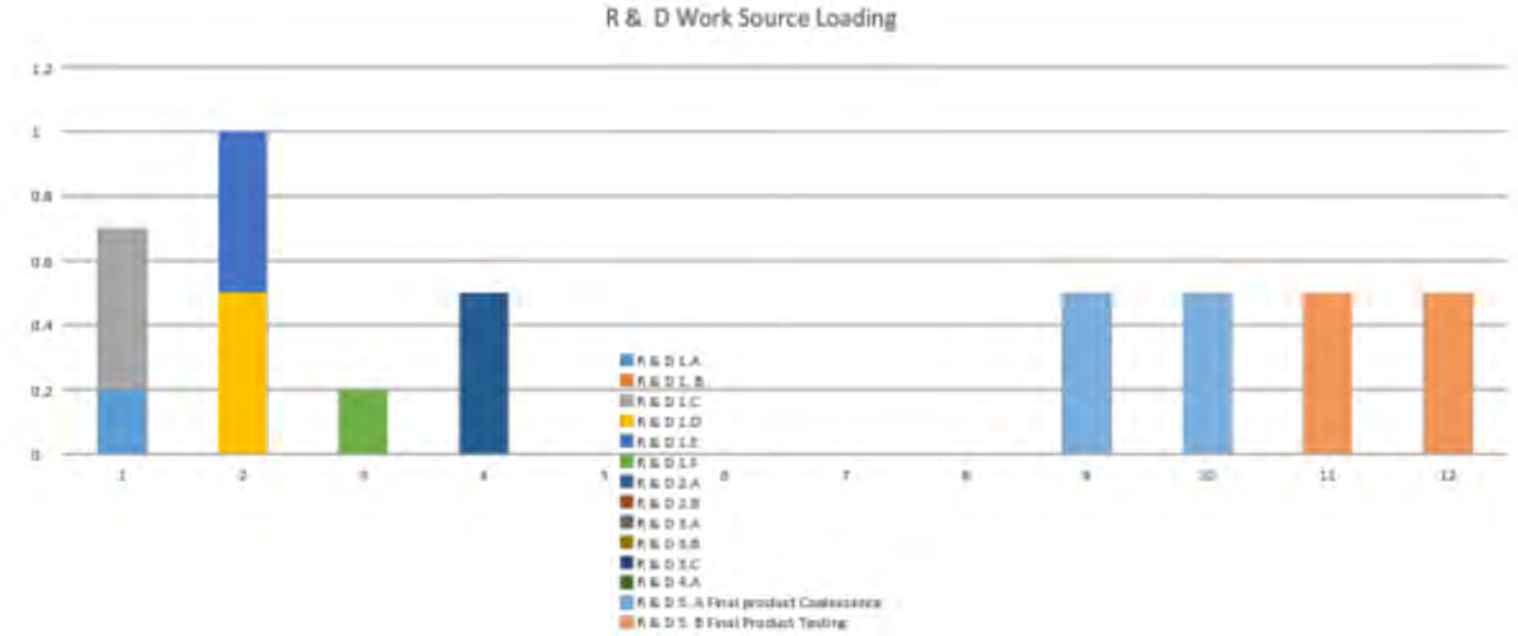
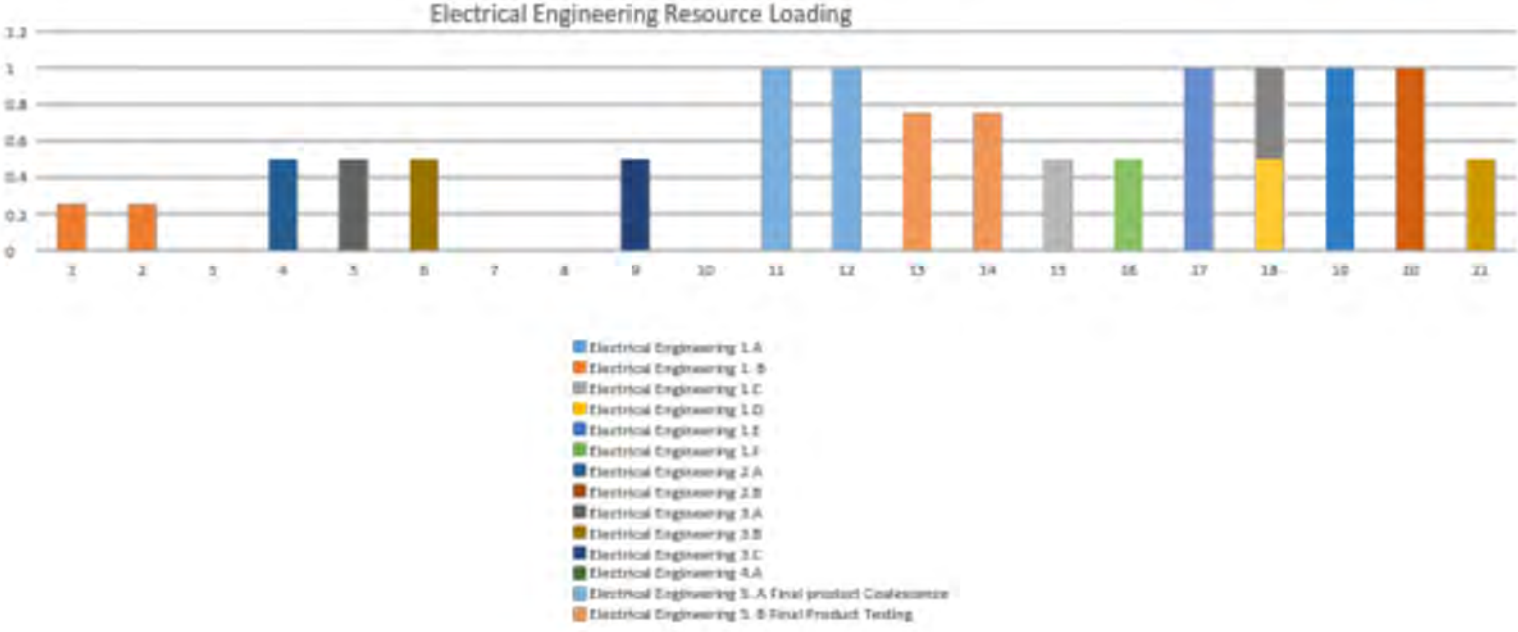


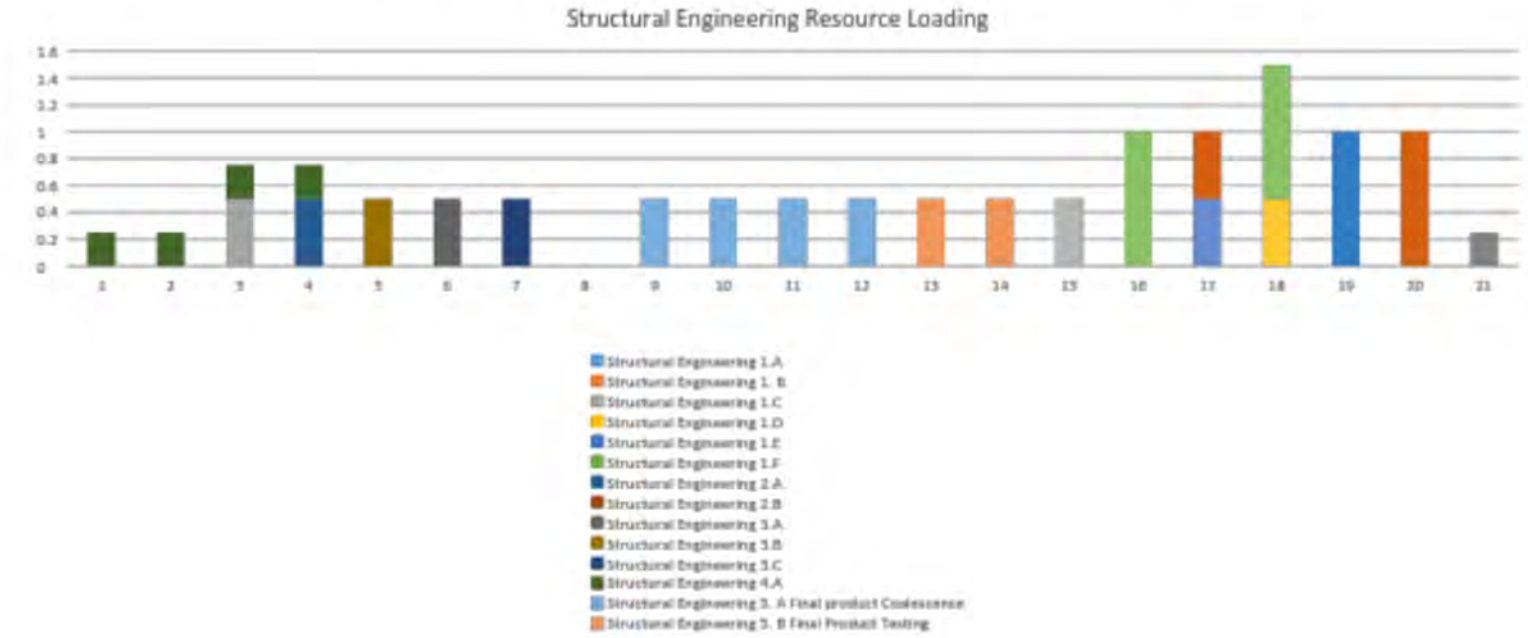
(Example of Normal Distribution taken from analystnotes.com)

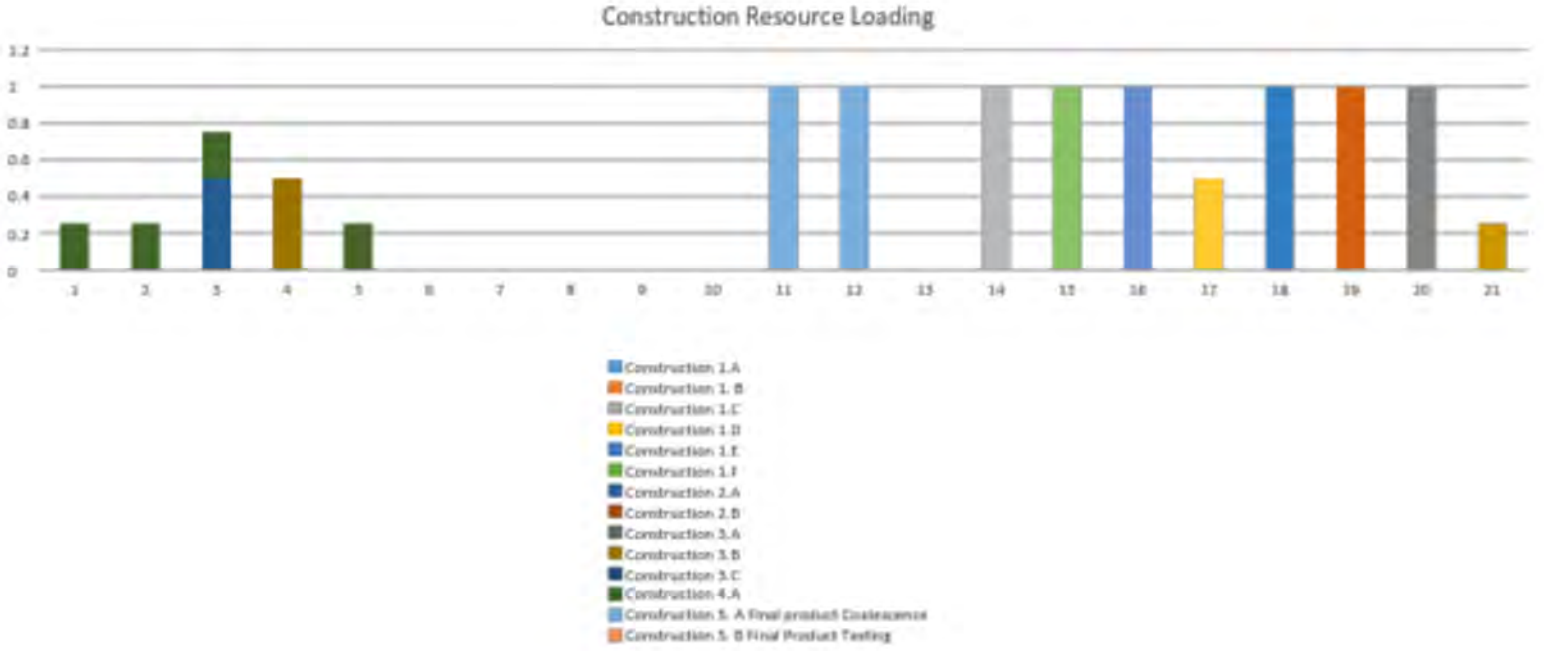
Appendix J: Resource Loading Tables





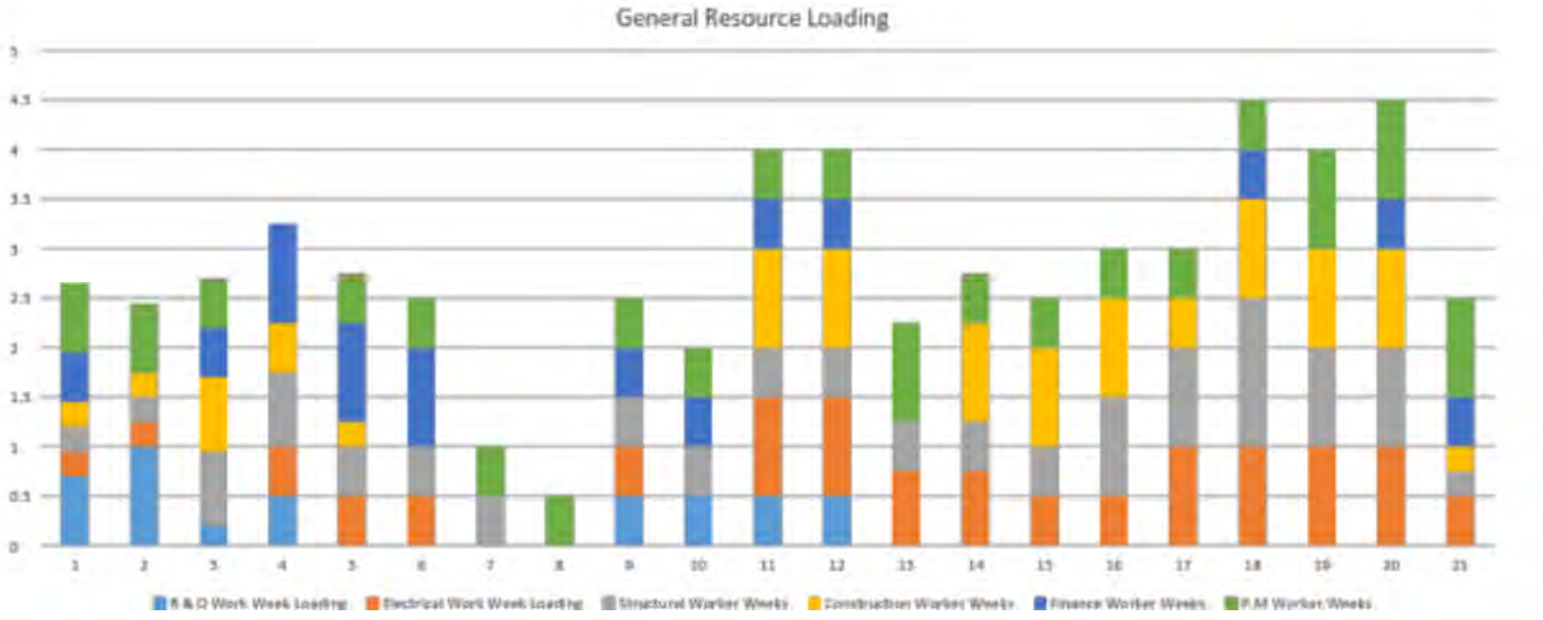
Appendix J-Resource Loading Cont






Finance Resource Loading
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Finance 1.A
Finance 1. B
Finance 1.C
Finance 1.D
Finance 1.E
Finance 1.F
Finance 2.A
Finance 2.B
Finance 3.A
Finance 3.B
Finance 3.C
Finance 4.A
Finance 5. A Final product Coalescence
Finance 5. B Final Product Testing


Project Management Resource Loading
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
PM 1.A
PM 1. B
PM 1.C
PM 1.D
PM 1.E
PM 1.F
PM 2.A
PM 2.B
PM 3.A
PM 3.B
PM 3.C
PM 4.A
PM 5. A Final product Coalescence
PM 5. B Final Product Testing


General Resource Loading
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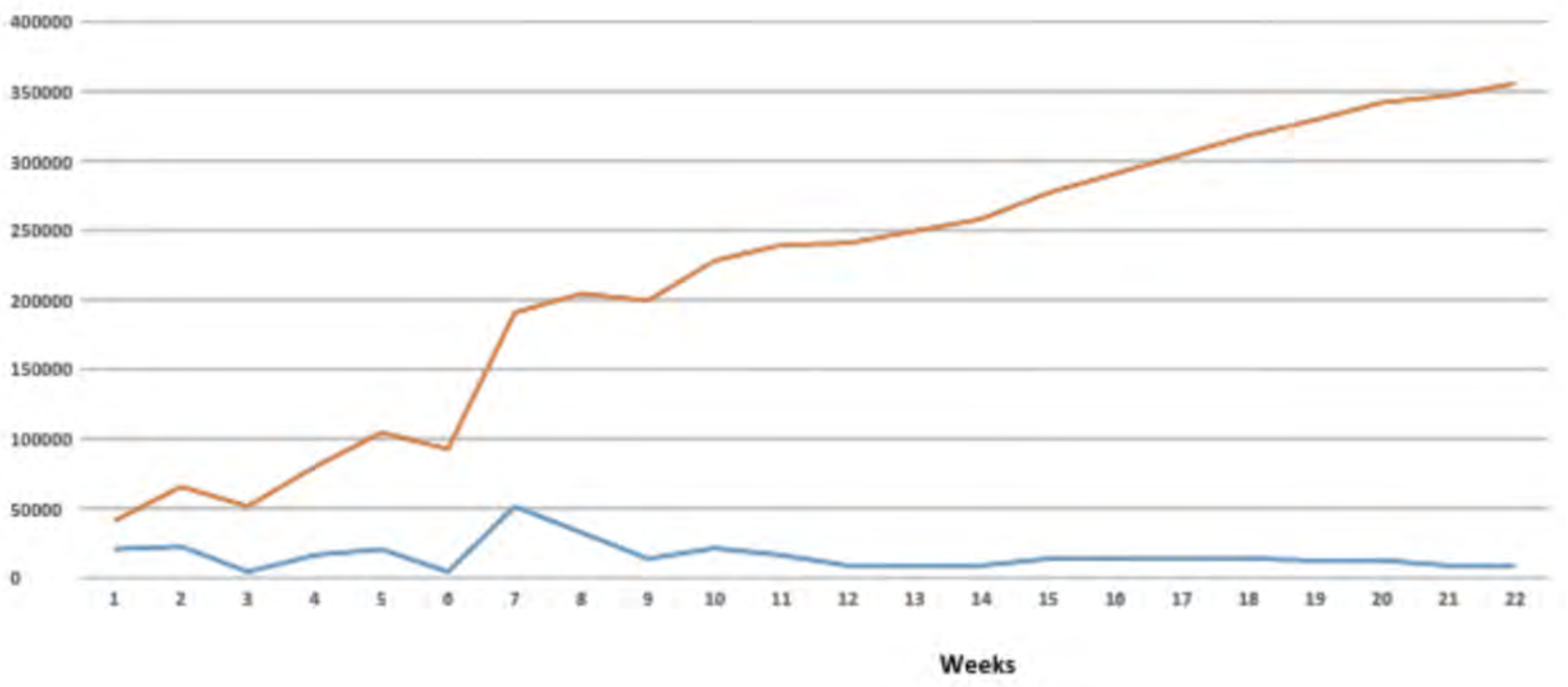
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
R & D Work Week Loading
Electrical Work Week Loading
Structural Worker Weeks
Construction Worker Weeks
Finance Worker Weeks
P.M Worker Weeks

Appendix K:Planned Value Table

	Total Costs	WeeK																					
Activity		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.AExisting documentation of Vehicle Charging Station	1000	500	500																				
1.B Permits-NEC Article NEC Article 625 Public charging	4500	2250	2250																				
1.C Material and Resource Selection	2500+1500	1250	2750																				
1.D City Permitting	4500	2250	2250																				
1.E Bank Collaboration/Negotiations	10000	5000	5000																				
1.F Suitable Locations Research	1000	500	500																				
2.A Connection requirements Research	8500		4250	4250																			
2. B Charging Fee/Bank Negotiations	10000		5000		5000																		
3. PGE/Grid Connection Regulations	5000				2500		2500																
3. B Telecommunications to the bank Design	37500					18750		18750															
3. C Voltage Output Design	3500					1750	1750																
4. A Material Selection-Galvanized weathering steel	17500	8750			8750																		
5. A Final product Coalescence	65000							32500	32500														
5. B Final Product Testing	27500									13750	13750												
6. A Contruction-Excavation	15000										7500	7500											
6. B Construction-General	12500															6250	6250						
6. C Construction-Electrical	17500													8750	8750								
6. D Construction-Mechanical	17500											8750	8750										
7. A City Inspection	27500																	13750	13750				
7. B Initial power up	25000																			12500	12500		
7. C Bank system connected	15000															7500	7500						
7. D Final Test	17500																					8750	8750
Total		20500	22500	4250	16250	20500	4250	51250	32500	13750	21250	16250	8750	8750	8750	13750	13750	13750	13750	12500	12500	8750	8750
Cumulative Total		20500	43000	47250	63500	84000	88250	139500	172000	185750	207000	223250	232000	240750	249500	263250	277000	290750	304500	317000	329500	338250	347000

Appendix L: Planned Values Chart



Appendix M: Risk Management

Appendix M
Address control measures for the highest risks and critical or near critical tasks.
Addressing Slack, the reasoning for the tight schedule is actually that it is quite flexible after final project coalescence the project takes on a more sequential path but the project truly can expand after the project coalescences because of the scalability of the project. This allows for the project to continue on in multiple locations as per the city of portland's requests or investor's request. This is due to the project coalescence being a major deliverable. With schedule being of the lowest concern the risks of the project are as follows.

Highest risks:

Design of Telecommunications with bank

Control measures: Project manager to conduct daily morning check in meetings with staff involved to get updates on the progress, and problems. It is hoped that daily updates and contact will allow the earliest recognition of problems as possible, and begin troubleshooting as soon as possible. This will help keep the project on time during the 20 days allotted.

Final project coalescence

Control measures: Project manager to conduct daily morning check in meetings to get updates on the progress and problems. Potential problems could arise between synching up of the card swipe system, and charging station (ie individual could pay, but bike wouldn't charge). Have technicians available from card swipe system and PGE to troubleshoot potential problems as they come up.

Near Critical tasks:

City Permitting:

Necessitates monitoring government regulations with regards to parking, excavation, construction and electrical hookups. In preparation of the permitting process make contact with representative in the city permitting office who can answer questions and give updates on the progress of the permit. This is a critical task however there is also a large amount of spots that can be chosen even if this task is critical. The chance of multiple locations denying a permit is unlikely.

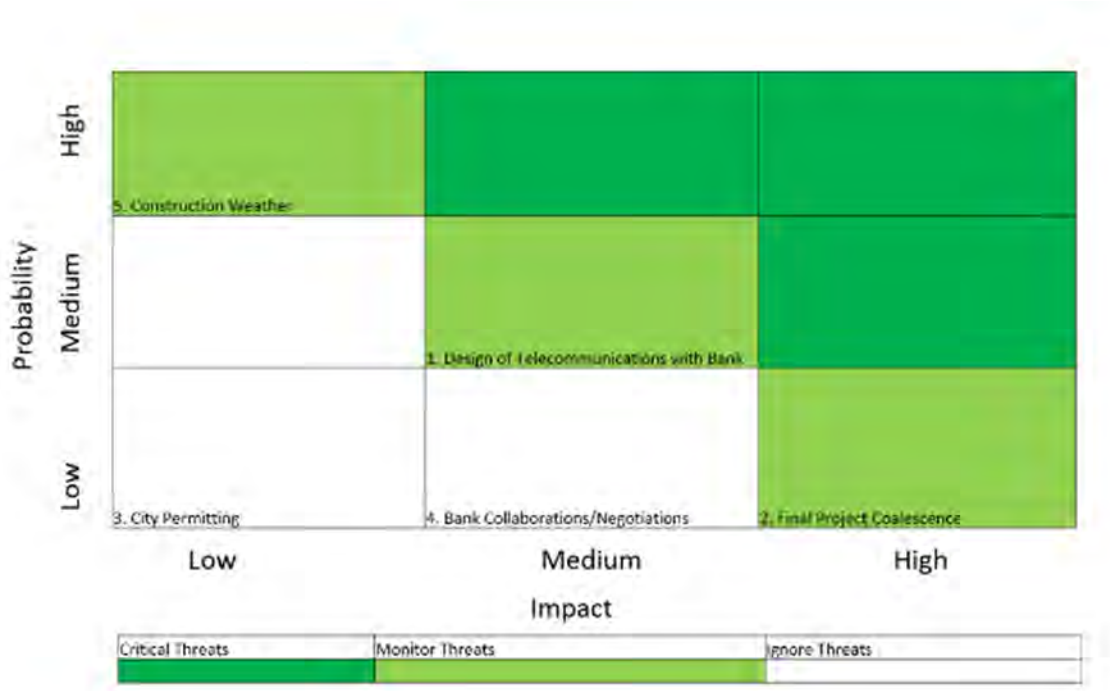
Bank Collaborations/Negotiations

The control measures for this would be a close monitoring of the progress by the project manager. This necessitates excellent communication skills, and the ability to get the collaboration and negotiations going in the event of disagreements. Monitoring the progress of paperwork and contract sign offs is also needed to ensure that progress continues. The bank

collaborations is a critical path however it is an offered service of the bank it is unlikely that the bank will deny the request of serivice.

Construction General

Necessitates monitoring the weather. This is Portland, it rains a lot. The project needs to be prepared for the potential of rain. This would include acquisition of tarps, or structures to erect over the construction space to keep rain off the area. The project also takes place during the summer months and so rain is unlikely during this phase of the project as it extends into mid to late summer.



Cost should be closely monitored. See Appendix N

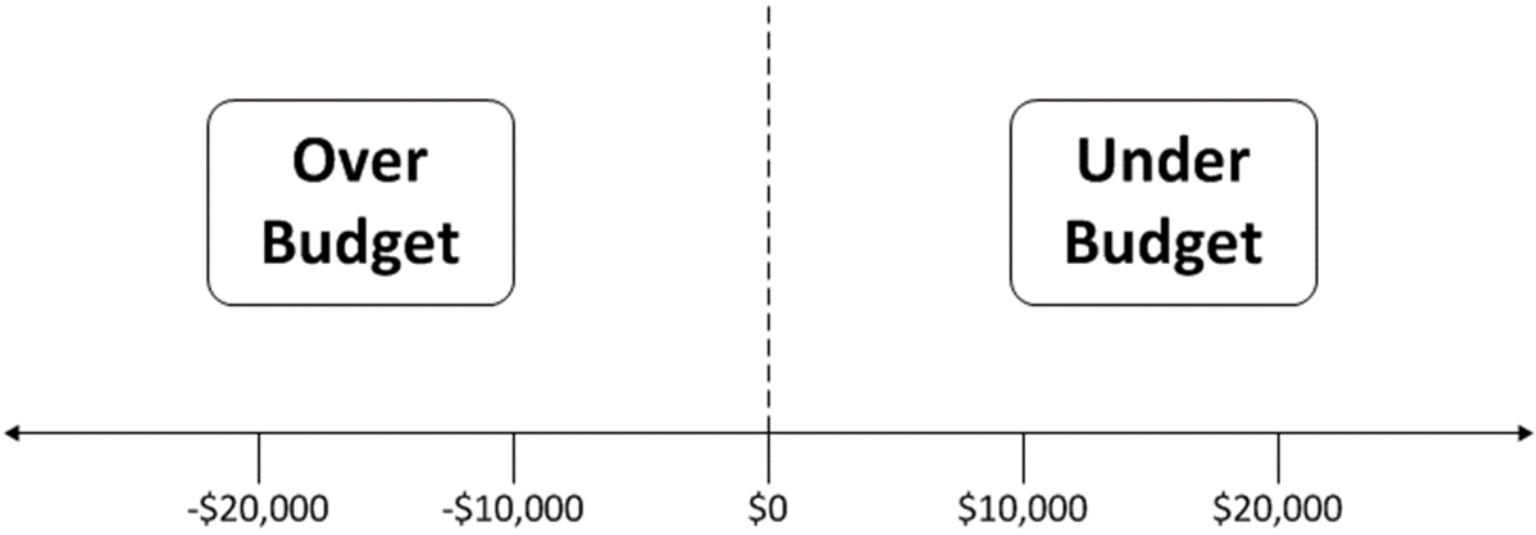
Appendix N: Control Charts

Cost Variance.

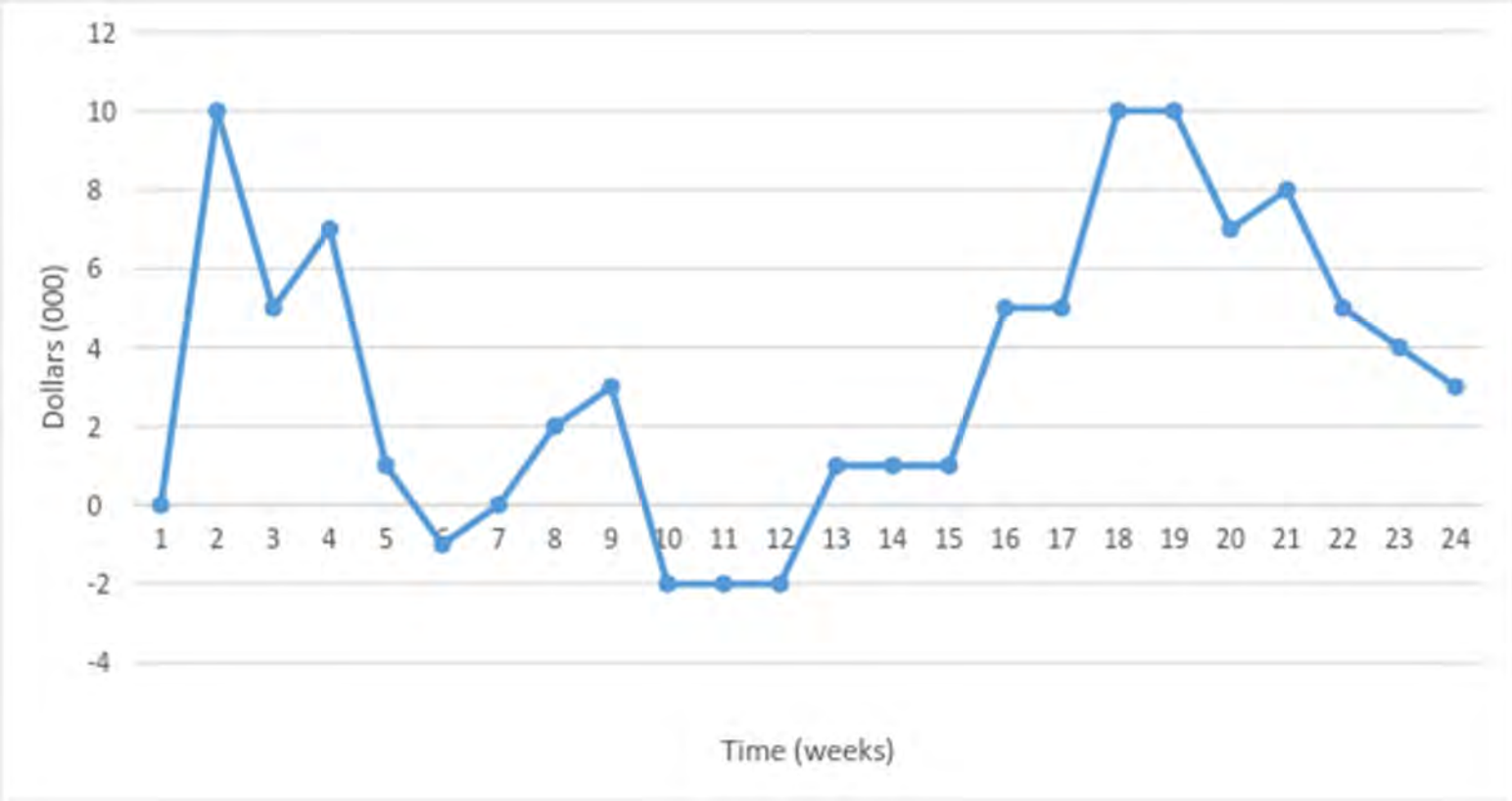
CV is the difference between the cost's actual amount and budgeted amount. CV = EV-AC

Utilized because it shows how much over, or under, budget the project is as time progresses. While the Cost Performance Index (CPI) measures the effectiveness of the money spent, CPI = EV/AC. With values over one indicating favorable conditions.

The benefit to CV is it shows the difference between the expected costs and the actual costs as the project progresses. It quickly shows the project manager, and client, that the project is either under or over budget in a 'go – no go' fashion. This shows how much the project is over, or under budget. An example below shows a simple, 'go – no go' CV chart



While this chart shows costs over the progress of the progress, giving real dollar values.



The CPI shows that the project is overall over or under budget. It does not show exactly how much the project is over or under budget, it gives a percentage.

Appendix O: Termination

The type of termination expected: Termination by integration

The equipment, infrastructure and tasks associated with the card swipe and banking system will be turned over to the City of Portland and distributed among their employees on the Charge Portland team.

Tasks required for turnover:

a. Accounting/finance:
    a. The project accounts must closed and audited.
    b. The City of Portland, Charge Portland Accounting/Finance team must take over the profit made from the electric bike charging stations.
    c. Must take over making payments to PGE for electricity.
    d. Prepare final financial report.
b. Engineering:
    a. All drawings/changes made to the existing infrastructure must be turned over to PGE and City of Portland, Charge Portland team.
    b. Maintenance schedules must be created to keep up the working condition of the bike racks, newly added electrical components and card swipe system.
    c. Turn over vendor list and spare equipment stock so appropriate repairs and replacements can be made.
    d. Close out all work orders and contracts.
    e. Prepare final evaluation report.
    f. Verify and document compliance with all terms of contracts.
c. Information Systems/Software:
    a. Turn over banking software to City of Portland, Charge Portland team.
    b. Train City of Portland, Charge Portland team on the banking and card swipe system software.
    c. Ensure that the banking and card swipe system software is fully integrated with the current car charging station software.
d. Marketing:
    a. Ensure that the City of Portland marketing team is aware of the milestones/completion dates in order to advertise.
e. Legal:
    a. Ensure that the City of Portland legal team is aware of the milestones/completion dates.

b. Turn over contract agreements with PGE and electric bike vendors.

f. Parking Enforcement:
    a. Ensure the City of Portland Parking Enforcement team is aware of the completion dates so they can start patrolling the electric bike charging systems.

g. Project Management:
    a. Notify City of Portland, Charge Portland that the project has been completed.
    b. Submit final report.
    c. Close down site operations.

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[1] City of Portland, "Electric Vehicles the Portland Way," City of Portland, 24 August 2010. [Online]. Available: https://www.portlandonline.com/shared/cfm/image.cfm?id=309915.

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[3] J. R. Meredtih and S. J. Mantel , Projet Management- A managerial Approach, Jefferson City: John Wiley and Sons, 2012.