Mobile Computer Cart

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Team 12

Concept Generation and Selection

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1. Project Summary

A Northern Arizona University Capstone instructor is looking for two mobile computer carts designed and fabricated by students. The team will work directly with the client Dr. Srinivas Kosaraju to verify if the design meets his needs. The primary objective of these carts is to accommodate a data acquisition computer that can be taken easily outside the engineering building for outdoor experiments. Current available market designs are very expensive and are made to be used indoors only. Two computer carts must be fabricated to carry a CPU, data acquisition equipment, two widescreen monitors, keyboard and mouse. It must also have some storage space for user to keep additional cables, manuals of equipment, etc. Neither design must exceed the cost of more than $500.00 apiece.

The need statement is, “The current available mobile computer carts are too expensive and are not designed for outside use.” The project goal is to design two mobile computer stations that are less expensive than available marketed products and can be operated in outside conditions.

2. Concept Generations

Each member of the mobile computer cart team generated two full cart designs in the efforts of eventually deciding on two final products that will be used. The following section is describing the ten different designs Team 12 created for the project.

2.1. Design #1

Design #1 is designed for optimal desk and storage space. The storage section is split into three sections where you can fit a printer, CPU and material used for data testing. The middle section has shelving that is easily accessible allowing the user to get the materials needed quickly and efficiently. The two sections around it are made out of either glass or plexiglass. The use of plexiglass keeps the CPU or printer in view as well serves as a weatherproof agent. The storage will be connected to a rectangular frame where it will be bolted and secured. The desk section has a lot of room so materials can be spread out without needing to shuffle through them. Depending on the users’ height, raising or lowering the desk feature is available to make accessibility comfortable to everyone. The keyboard is attached to the bottom of the desk where the user can slide it, in and out for easy access while keeping it protected from the weather. The desk will be mounted to the main vertical pole in the middle of the design, which will make the final product sturdy. The monitor mounts allow the monitors to be swiveled at a certain angle of choice, making it easier to take data without the glare on the screen. Since this design consists of four wheels, there will be a handle on the right side of the cart where it can be pulled or pushed with ease.

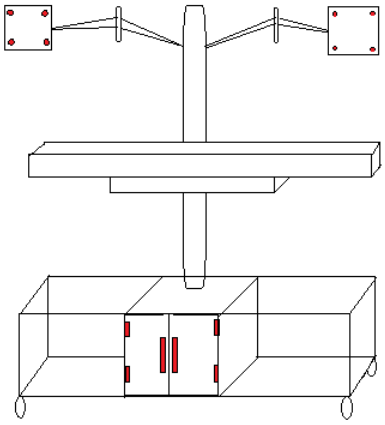

Figure 1: Design #1

2.2. Design #2

Design #2 is designed around the waterproof and maneuverability aspect of the client's need. It will function the same way a stroller works with two large wheels in the rear and one large wheel in the front. Each wheel will have individual axles, helping cut down on the overall weight. The three points of contact will give the cart more stability when traveling to different destinations, while the large wheels help it climb over rough terrains. In addition there will be a handle attached to the back so the cart can be pulled or pushed. The shape is modeled around a cylindrical garbage bin standing roughly 4 feet high and 3 feet in diameter. Two doors will be attached to the front panel, allowing for easy access to the CPU and experimental equipment. The computer monitors and keyboard adjust up and down the center poles. For weather proofing and ease of transportation the monitors and keyboard will move inside the cylinder. Once in the appropriate position the lid can be closed and locked. By doing this the center of gravity is lower making it easier to push the cart. The cart will have a metal interior shell, giving it structural rigidity while transporting. Some sort of thin material will be used for the walls, cutting down on weight. Design #2 can be seen below in figure 2.

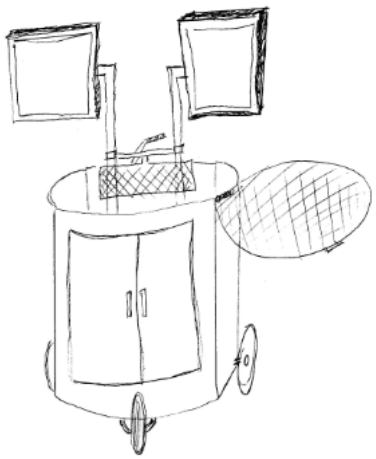

Figure 2 : Design #2

2.3. Design #3

Design #3 is a triangular shaped cart with a canopy for weather protection. The canopy on this cart will provide an umbrella over the whole cart and the person using the computer. It will protect from sun and moisture directly above but will have limited coverage for weather coming from the side. The post holding the canopy is also what the monitors are mounted to. The monitors are adjustable up and down and can spin around to be seen from any angle. The top of the cart allows space for a mouse, keyboard and a limited amount of workspace. The side of the cart is a door that opens to allow access to the storage inside. The storage includes a specific place for the CPU and cords, as well as general storage space. The design contains three wheels, one at the monitor point and two at the keyboard side. The wheel in the front swivels to allow for easier maneuverability. The two wheels on the rear are connected with an axle and do not pivot. Above them is a handle mounted to the side to allow for easy movement of the cart.

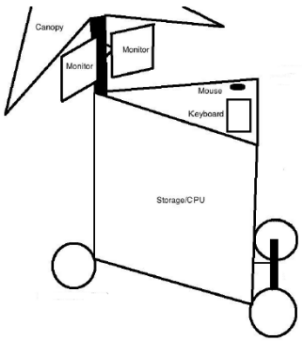

Figure 3 : Design #3

2.4. Design #4

Design #4 will have garden rubber wheels that are used in garden carts with the same pulling mechanism, where a rod is attached to the wheels shaft to direct the wheels and pull the cart. The garden wagon frame could be made or bought. The wheels from a garden wagon will be able to withstand rough terrains. The wheels will be attached to an aluminum cabinet with a garage like door to have the electronics protected when needed and for storage purposes. The garage door can be opened and closed manually. Inside the cabinet there will be a storage space, a space for the CPU, keyboard, and adjustable monitors. There will be a large storage space and can be shelved and designed to meet the client's needs. The keyboard will be retractable for ease of use. The cart should be easily moved by one person because of the wagon mechanism and should fit through doors easily.

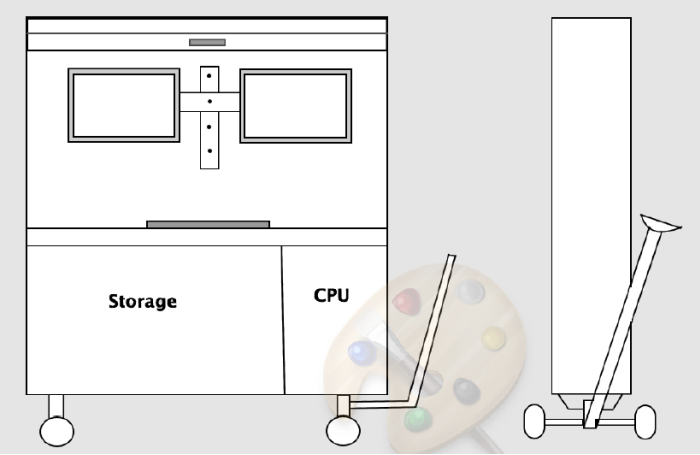

Figure 4 : Design #4

2.5. Design #5

Design #5 will be sectioned into three different parts; the storage, desk and monitor mounts. The storage is circular in shape giving the design a unique attribute. Shelves will be installed in the storage section where you can put a backpack, pencils, etc. The storage unit will be bolted on a circular frame. Since the storage is split into two sections, the right side will consist of just the CPU and the left will be for personal needs and data testing materials. The design will allow the CPU to be protected during harsh and wet weather. The desk section will have the keyboard on it and enough room to take notes on. The desk will be held by two carefully placed poles, which connect the storage and the desk together. The monitor mounts will allow the user to adjust it to any desired height and angle providing

maximum comfort. The mounts will be bolted and secured to the desk keeping the monitors safe during transportation. Since this design consists of only two wheels, there will be a handle at the back of the desk that will allow the user to tip the desk backwards and pull it to the desired location, just like a furniture dolly.

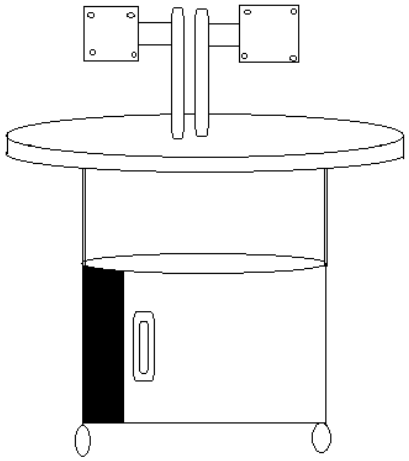

Figure 5 : Design #5

2.6. Design #6

Design #6 will have rubber gate wheels with suspension to ease maneuvering. The suspension could be designed or bought online. The cart will have four wheels. The wheels will be mounted to an aluminum cabinet. The aluminum cabinet will have the storage space and the CPU. The storage space can be modified depending on the client's needs. Then a bar will be mounted to the top of the aluminum cabinet to hold up the keyboard and the two monitors. The bar will be adjustable for both the monitors and the keyboard. Also, if needed the design can be modified to have the keyboard and screen rotate. Furthermore, the box will have hooks to attach a plastic cover to cover the monitors and keyboard when needed. The cover will be transparent to be able to see the monitors while covered. Also, there is a handle on each side to be able to pull the cart easily.

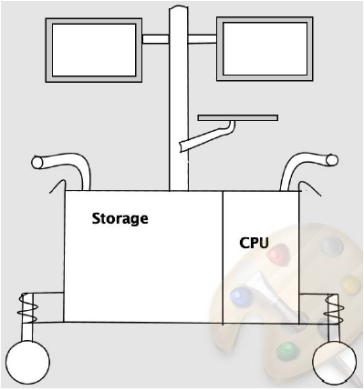

Figure 6 : Design #6

2.7. Design #7

Design #7 is generated around the weight, weather proof, and maneuverability aspects of the client's needs. This design will resemble a dolly that can be moved by one individual. Two large wheels will be attached to the back end, allowing for it to be tilted around the axle and pulled to the desired destination. The long handle on the back allows for two hands to be used, which gives the operator more stability. Once at the destination the cart will be tilted forward and rested on two adjustable legs in the front to keep it level. The cart will consist of a metal frame in the shape of a rectangle. Sheet metal will then be welded on the outside for weather proofing. A single door in the front gives access to the CPU, adjustable shelving, and experimental equipment. The dual monitors and keyboard will adjust up and down the center pole, allowing for multiple users. When the cart needs to be transported the monitors and keyboard slide down into the component and the top lid is slid shut. The same lid can be used as a table that has extending arms for support. A plastic window will be incorporated on the side wall so the monitors can be seen when the lid is shut. The overall size of the rectangle will be 4 feet tall by 2.5 feet wide. Design #7 can be seen in figure 7 below.

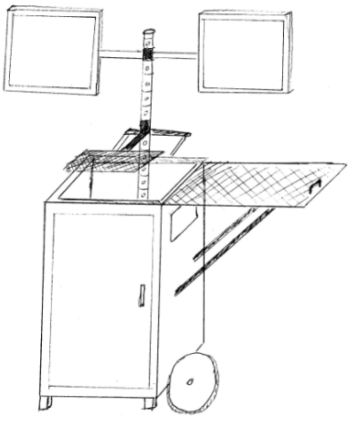

Figure 7 : Design #7

2.8. Design #8

In this concept design, there is a column on both sides of the cart. Both columns are on top of a bar connecting two tires on each side of the cart. Each one of the two monitors will be attached to one column with a few inches in between the two monitors when placed in the vertical position. Both the CPU and the storage space will be placed between the second and the third horizontal bars in the middle between the three columns. A horizontal bar will be placed between the two columns to hold the keyboard stand and any other equipment needed by the client. This horizontal bar will be held by the third column that rises from the middle of the lower horizontal bar between the CPU and the storage space. The third and middle column can also rise higher to hold a circular umbrella cover to provide extra protection to the monitors and top parts of the cart. For easier moving of the cart, there will be a handle attached to each of the two sides of the cart. The cart moves using four medium sized wheels that are placed on each corner to allow for maximum stability.

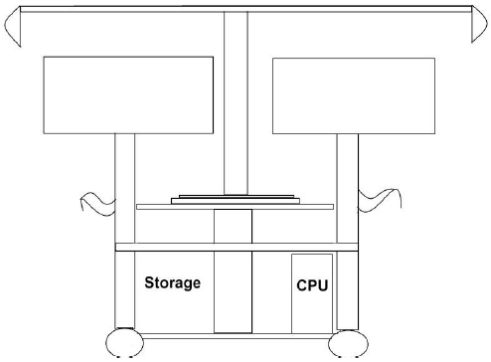

Figure 8 : Design #8

2.9. Design #9

Design #9 is a completely enclosed, completely waterproof cabinet on wheels. The outer shell will be sealed so that no water can get inside. The top portion of the front is a door that will swing up and be held up by hydraulic arms. This will give shade and weather protection while working on the computer. The inside of the top portion will have a large platform to hold the mouse, keyboard, and give ample space to work on. Two monitors will mount side by side at the back and will have height adjustable stands. The bottom portion of the cart will have doors that open and will be split into two sections. One section will be designed specifically to hold a CPU. The other side will be a storage area that will have the option of adjustable shelving. The design will have four wheels mounted to the bottom of the cart. Two of the wheels will have swiveling capabilities to aid in maneuvering the cart. The other two will be fixed to add stability. The wheels will have a braking system that can be activated when the cart is not in motion to prevent it from rolling away.

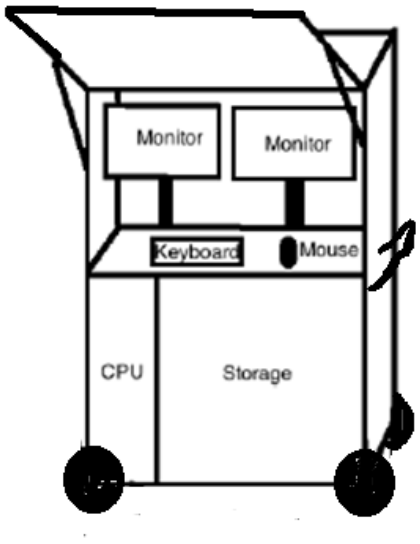

Figure 9 : Design #9

2.10. Design #10

In this concept design, there are two sidebars connecting the tires on each side. A horizontal base will be placed on top of two sidebars that will be the base for the cart. The CPU will be held on top of this horizontal base. A second horizontal shelf will be placed between two sides of the cart on top of the CPU space. This will allow for a large storage space above this second horizontal shelf that will be able to hold multiple medium sized pieces of equipment as needed by the client. Between the two sides

and on the top, there will be a horizontal base holding the keyboard and serving as the working table for the client. From this base, a middle column rises holding the attachment of the two screen monitors. Both screen monitors can be adjusted up or down to allow for better positioning for the client. This cart has four medium sized wheels attached to the four corners of the cart to allow for a good stability when rolling indoor or outdoors.

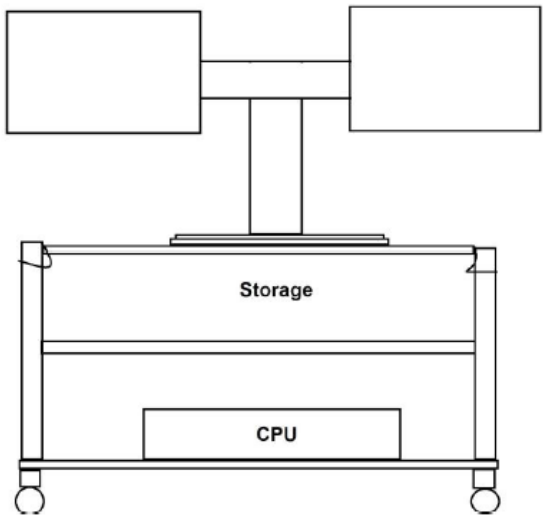

Figure 10 : Design #10

3. Concept Selection

The ten design ideas were created, shared, and evaluated using the decision matrices shown in Table 1 and Table 2. The matrices gave an in depth understanding of the constraints and objectives of the project. Based on the scores obtained from each of the designs, determination on the best solution to the problem was made. Decision Matrix 1 evaluated the cost, ease of manufacturing, and the aesthetics of each design. Decision Matrix 2 evaluated how weather proof the design was as well as the durability, adjustability, maneuverability, storage space, weight and size. Once the designs were evaluated, the scores were added and the top two designs are being taken to the next step in the design process.

Table 1: Decision Matrix #1

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	6.8	7.4	7.4	21.6
Design #2	4.8	6.8	6.6	18.2
Design #3	6	5.8	6.2	18
Design #4	4.8	6.6	7	18.4
Design #5	6	6	7.4	19.4
Design #6	5.8	6.4	6.2	18.4
Design #7	6.4	5.4	8.2	20
Design #8	7.4	7	6.2	20.6
Design #9	6.6	5	7.6	19.2
Design #10	8.2	8.4	6	22.6
			10 = High , 1 = Low	

- **Cost**: The project was given a cost limit of $500. All the cost are expected to be at or below this amount but the designs were graded on how much they were going to cost to build.
- **Ease to manufacture**: With limited funds and manufacturing capabilities, it is important to have a design that can be built within reasonable means. This criterion grades how easy it will be to actually build the design.
- **Aesthetics**: In order for a product to be marketable, it needs to be something that the customer wants to look at and is not an eye sore. The designs were graded based on how pleasing to the eye that each of the designs will be.

Table 2 : Decision Matrix #2

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Matrix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	1	5.4	9	8.4	5.6	6.8	6.4	42.6	64.2
Design #2	9.4	8.8	4	7.8	6.6	4.8	5.8	47.2	65.4
Design #3	5.4	6	5	5	7.2	7.2	6.8	42.6	60.6
Design #4	9	8	5.2	9	6	4.2	5.4	46.8	65.2
Design #5	1	5.6	7	6.8	5.6	6.6	6.6	39.2	58.6
Design #6	2.2	6.2	7.4	7.6	6.6	6.2	6.6	42.8	61.2
Design #7	7.6	7.6	9.2	6.6	9	7.8	8.8	56.6	**76.6**
Design #8	4.8	5.6	4.8	5.8	5.4	7	5.8	39.2	59.8
Design #9	7.6	7.2	8.8	6.4	8.4	7.2	7.4	53	**72.2**
Design #10	0.8	5.4	4	6.6	5.4	7.6	6.8	36.6	59.2
							10 = High , 1 = Low		

- **Weather proof**: One of the design requirements is that the cart needs to be able to go outside and withstand some weather when experiments are being performed outside. The cart needs to be able to withstand a reasonable amount of weather so that it can still be used even if the weather is not perfect.
- **Durability**: The cart must be designed for outside use; in areas where the terrain is not smooth and flat. The design needs to be able to withstand a reasonable amount of rough terrain travel and still perform as desired.
- **Overall Adjustability**: More than one person will be using the cart and therefore the cart needs to have a certain level of adjustability to accommodate multiple users. The designs were graded on the overall adjustability including the monitors, the keyboard/mouse, and the work platform.
- **Storage Space**: One design requirement was that the cart needed to have at least 2 ft^3 of storage space. All of the designs are expected to contain at least the minimum amount of storage. This criterion grades the designs on how much storage they offer.
- **Maneuverability inside/outside**: The cart needs to be transported by one person with a limited amount of effort. The carts were graded on how easily they could be transported inside and outside by a single person.
- **Weight**: A lighter cart will generally be easier to transport and easier to maneuver. The carts were graded on how much they would weigh in comparison to the other carts assuming the carts were all made of the same material.
- **Overall size**: The size of the cart is also related to ease of transport and maneuverability. A design requirement was that the cart had to be able to fit through an average sized door so that it could be transported outside and easily through a building. The carts were graded on their overall size.
- **Score**: The score shows the sum of the criteria for each decision matrix.
- **Total**: The total is the sum of the scores from matrix 1 and matrix 2. The top two designs from each member's matrices are highlighted to display what designs scored highest.

4. Final Design Selection

Based on our client's needs, two different mobile computer carts will be designed and fabricated. The two final design choices were based off the final averaged scores of Decision Matrix 1 and 2. The following is the top two designs selected from the decision matrices.

4.1. Design #7: Two Wheel Dolly

The design with the highest score in the decision matrix was design #7. Based on the two wheeled feature and compact look it will be called the two wheel dolly style cart. One of the main deciding

factors in this design was its high score in overall size, maneuverability, adjustability, and weather proofing ability. The overall size will stand about 4 feet tall when the cart is in transport mode, meaning everything is inside the compartment. It also allows for the cart to be stored inside and fit through doors with ease. The maneuverability came into play with the large wheels seen in figure 14 and handle on the back seen in figure 11. The two large wheels will allow for one person to transport it without assistance. The handle will provide a steady support to rest your hands while transporting as well. Another big factor in the decision is the unique adjustability for the monitors, keyboard, and lid. The monitors and keyboard move up and down the center pole, which will make the cart suitable for multiple users. Each monitor will be attached to the pole by the rotating arm seen in figure 12. The lid will retract outwards giving the operator a table to perform various tasks on. Furthermore this design will be protected from the outside elements because it's unique ability to store everything inside the compartment. Once he lid is closed all six sides are protected by sheet metal. Lastly the cart will have a stable metal frame as seen in figure 13, which everything will be built around.

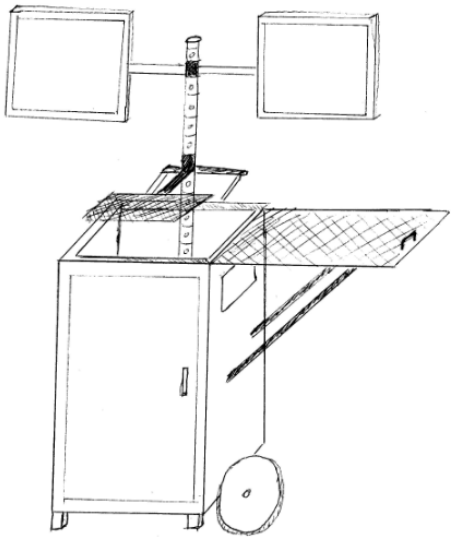

Figure 11 : Final Design #7

Figure 12 : Monitor Mounting System

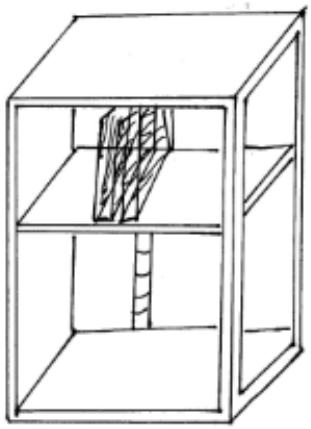

Figure 13 : Final Design #7 Frame

Figure 14 : Wheels for Final Design #7

4.2. Design #9: Four Wheel Cart

The runner up design in the decision matrix was design #9. It has four wheels and a basic rectangular cart shell and is referred to as the Four Wheel Cart. The high scores for this design were its aesthetics, its weather proof design, its adjustability, and overall maneuverability. The approximate dimensions for this design will be 6 feet tall, 4 feet wide and 2 feet deep. The cart will be split into two main sections. The top section will contain two monitors, the keyboard, mouse and a platform to provide a work space. The bottom section will be split into smaller sections with one specifically for the CPU and the others for miscellaneous storage. The wheels will be a large diameter caster with two that swivel and two that are stationary (Figure 15). The swivel wheels will increase maneuverability while the fixed wheels will add stability. The door for the top section will swing upwards and be held open by 2 hydraulic arms (Figure 16). This will keep it out of the way when in use, and provide shade and protection from weather for the monitors and the user. The front of the door will contain a plexiglass window to allow for the monitors to be seen if the door is closed. The complete enclosure allows for an aesthetically pleasing look with no exposed cords and the shell can be painted to increase the overall look. The monitors will be adjustable within the enclosure to provide better viewing options for different users.

Figure 15 : Caster Wheels

Figure 16 : Hydraulic Arms

5. Project Progression

A Gantt chart is used to give our team a rough estimate of the progression of the project, deliverables and designs goals. The group has already created a need's identification, projection specification, QFD and has done critical research on what carts are available in the market currently. With the data collected, the concept generations and selection phase was started. This process provided us with great information of what our current design will look like. The group is immediately transitioning into phase three where the planning and analysis on the two carts will be done. Our team will continue to make use of the project plan in order to guarantee that appropriate progress is fulfilled with this project.

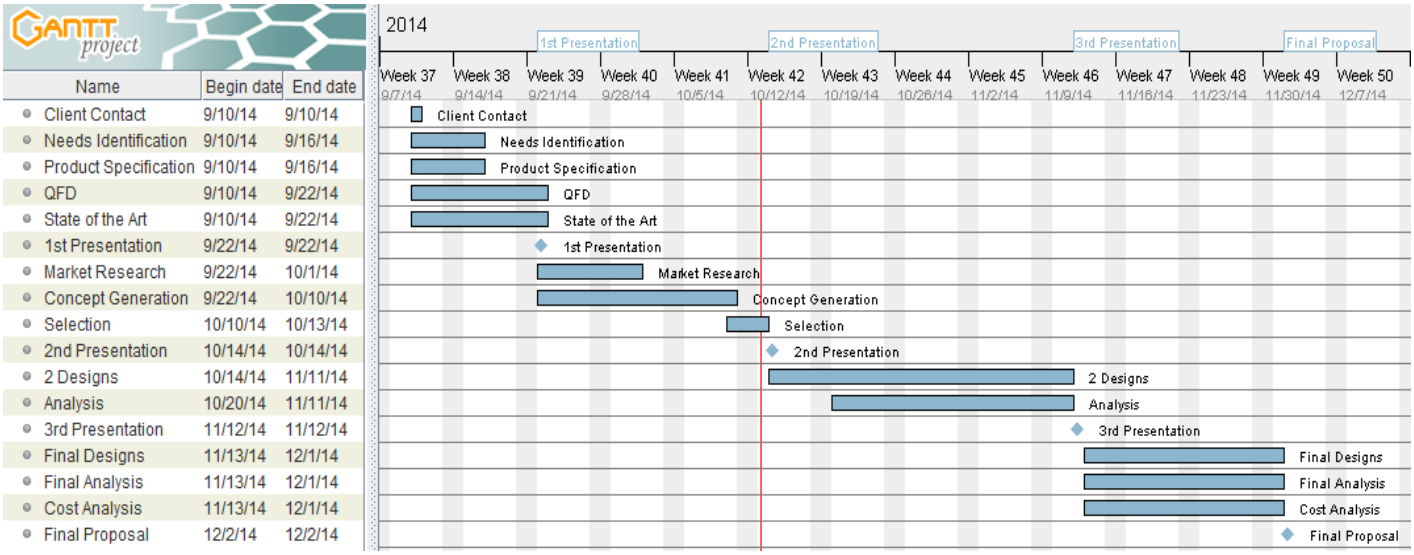

Figure 17 : Gantt chart

6. Conclusion

Each team member came up with two unique designs a piece to which a mobile computer cart could meet all the customers' needs. The ten designs were evaluated using a pair of decision matrices that covered key points ranging from cost, appearance to usability. The ten designs were narrowed down to two through the decision matrices using the criteria from the decision matrixes. The two designs with the highest score were design number 7 and 9. Based on the overall shape of the two, design 7 will be called the two wheeled dolly style and design 9 will be called the four wheeled cart. The two final designs were then looked at in more detail and given improvements to make them better. According to the Gantt chart we are on pace with the deadlines set earlier on in the semester. The two final concept designs will now be evaluated using engineering analysis to insure functionality and feasibility to build.

References

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Appendix

1. Abdulrahman Alhamdi: Decision Matrix 1 and 2

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	8	7	8	23
Design #2	5	7	4	16
Design #3	7	5	6	18
Design #4	7	7	5	19
Design #5	5	5	6	16
Design #6	7	6	6	19
Design #7	8	5	7	20
Design #8	8	7	6	21
Design #9	8	7	8	23
Design #10	8	9	6	23
			10 = High , 1 = Low	

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Matrix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	2	5	8	7	6	7	7	42	65
Design #2	9	8	3	7	6	4	5	42	58
Design #3	7	6	5	4	8	7	7	44	62
Design #4	9	7	4	8	4	3	3	38	57
Design #5	2	7	7	5	7	7	6	41	57
Design #6	3	6	6	7	8	6	7	43	62
Design #7	8	8	8	7	7	8	8	54	74
Design #8	6	6	4	7	6	8	6	43	64
Design #9	8	8	8	8	9	9	9	59	82
Design #10	2	7	3	7	6	8	7	40	63
							10 = High , 1 = Low		

2. Mohammed Aldosari: Decision Matrix 1 and 2

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	9	8	7	24
Design #2	5	6	8	19
Design #3	7	5	4	16
Design #4	4	7	8	19
Design #5	8	8	8	24
Design #6	5	5	7	17
Design #7	5	5	9	19
Design #8	7	8	6	21
Design #9	7	5	9	21
Design #10	9	9	6	24
			10 = High , 1 = Low	

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Matrix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	1	6	10	8	6	9	9	49	72
Design #2	10	9	7	8	8	6	7	55	74
Design #3	6	6	6	4	7	8	7	44	60
Design #4	10	9	7	9	9	5	6	55	74
Design #5	1	6	8	6	6	8	8	43	66
Design #6	5	6	8	7	9	8	8	51	68
Design #7	10	9	10	4	9	9	10	61	80
Design #8	6	7	7	6	6	8	6	46	67
Design #9	10	9	8	3	6	8	8	52	73
Design #10	1	8	7	8	6	9	9	48	71
							10 = High , 1 = Low		

3. Joel Asirsan: Decision Matrix 1 and 2

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	6	8	7	21
Design #2	6	7	6	19
Design #3	5	6	8	19
Design #4	5	5	7	17
Design #5	4	8	8	20
Design #6	6	7	6	19
Design #7	6	8	10	24
Design #8	6	7	7	20
Design #9	6	6	8	20
Design #10	6	8	6	20
			10 = High , 1 = Low	

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Martix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	1	6	9	10	4	5	3	38	59
Design #2	10	10	0	5	6	5	4	40	59
Design #3	2	3	4	5	5	7	6	32	51
Design #4	8	7	5	9	5	3	4	41	58
Design #5	1	6	5	10	5	4	5	36	56
Design #6	1	5	5	8	2	4	4	28	47
Design #7	10	7	10	10	10	7	8	62	86
Design #8	4	6	3	5	3	4	4	29	49
Design #9	10	7	10	10	10	6	7	60	80
Design #10	1	5	0	6	4	5	4	25	45
							10 = High , 1 = Low		

4. Samuel Martin: Decision Matrix 1 and 2

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	6	7	8	21
Design #2	3	8	8	19
Design #3	4	6	8	18
Design #4	3	7	8	18
Design #5	6	5	9	20
Design #6	5	7	5	17
Design #7	6	4	8	18
Design #8	9	6	6	21
Design #9	6	4	7	17
Design #10	10	9	5	24
			10 = High , 1 = Low	

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Matrix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	2	5	10	8	8	8	9	50	71
Design #2	10	10	5	10	6	5	7	53	72
Design #3	7	8	5	6	9	7	8	50	68
Design #4	10	10	5	10	7	5	7	54	72
Design #5	2	4	10	7	6	8	7	44	64
Design #6	2	6	10	8	7	8	8	49	66
Design #7	2	6	10	6	9	7	8	48	66
Design #8	5	4	5	5	7	9	7	42	63
Design #9	2	5	10	6	9	7	7	46	63
Design #10	1	2	5	5	7	10	8	38	62
							10 = High , 1 = Low		

5. Trevor Scott: Decision Matrix 1 and 2

Decision Matrix # 1				
Concepts	**Criteria**			**Score**
	Cost	Ease to manufacture	Aesthetics	
Design #1	5	5	7	17
Design #2	5	6	7	18
Design #3	7	7	5	19
Design #4	5	7	7	19
Design #5	7	4	6	17
Design #6	6	7	7	20
Design #7	7	5	7	19
Design #8	7	7	6	20
Design #9	6	3	6	15
Design #10	8	7	7	22
			10 = High , 1 = Low	

Decision Matrix # 2									
Concepts	**Criteria**							**Score**	**Total**: Matrix 1 and 2
	Weather Proof	Durability	Overall Adjustability	Storage Space	Maneuverability Inside / Outside	Weight	Overall Size		
Design #1	1	5	8	9	4	5	4	36	53
Design #2	8	7	5	9	7	4	6	46	64
Design #3	5	7	5	6	7	7	6	43	62
Design #4	8	7	5	9	5	5	4	43	62
Design #5	1	5	5	6	4	6	7	34	51
Design #6	1	8	8	8	7	5	6	43	63
Design #7	8	8	8	6	10	8	10	58	77
Design #8	3	5	5	6	5	6	6	36	56
Design #9	8	7	8	5	8	6	6	48	63
Design #10	1	5	5	7	4	6	6	34	56
							10 = High , 1 = Low		