

Retractable Pool Cover

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Team 12

Problem Definition and Project Plan

Document

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Introduction

We have been hired to assist our client, Brian Herzog, with his problem. Brian is a retired engineer who started his own company out of his garage. After a few years as the CEO of Frontline Energy Services, he retired. He now resides in Flagstaff, AZ spending his time at home with family and friends. He is looking for a pool cover to go over his in-ground infinity pool. Additionally, he is looking for this pool cover to support the weight of multiple people walking on top of it and be affordable to the consumer of the product. He informed us that the closest product that he has found to fit his problem cost \$50,000. However, there is nothing currently on the market that meets his need and is a more reasonable cost. In addition, we should develop a product that suits our client's needs, in order to have this product marketed and possibly developed and sold on a mass scale.

In order for the team to be successful in completing this task, we need to have a clear goal as to what needs to be done. Our goal is to design and manufacture a retractable pool cover system which is: automated, easily maintained and installed, rigid, lightweight, and customizable to be aesthetically pleasing based on customer interests. The objectives for this project have been laid out in Table 1, as shown below.

Table 1: This shows the important objectives for the product and their correlated measurement and unit.

Objective	Measurement	Units
Lightweight	Weight	kg
Rigid	Strength	kPa
Spans entire pool	Area	m ²
Retractable (motor)	Torque	N·m
Easily maintained	Number of Parts	-

A problem that the design will encounter is the weight of the pool cover. By increasing the ability to withstand a higher weight on the cover, this will lead to an increase in the required yield strength of the system which will cause an increase in the weight of the system. Also, the design has to be rigid enough to hold people crossing over the cover. The design must have a motor, as the client has requested that the cover is automated. Another objective is to consider the number of parts for the design. This is essential, as the number of parts changes how maintainable the design is.

Mr. Herzog is open to different ideas that can fix his problem. However, there are a few constraints that he has given us that must be accounted for. When we met with him he instructed us that

he would like the pool cover to be strong enough to at least support 827 kPa of pressure. This is an important constraint as it protects not only the product, but more importantly it protects the individuals who are walking on top of it. The cover must span the area of his pool. If the cover did not completely cover the pool, items could be dropped into the pool and damaged and more importantly someone could get injured if there is a gap between the flooring and cover. Another requirement is to create this product significantly under \$50,000. If this product can be created with even half that cost, it will likely be a success in the market. He is also looking for the design to be automated and can fully operate in one direction in one minute. The final requirement is that it must be easily maintainable as any sort of mechanical system near water needs to be checked and taken care of as to not corrode and break.

Project Plan

The outline for this semester can be seen in Figure 1 as shown below. The important categories for our timeline are color coated on the left hand side. Furthermore, the important milestones are displayed on the bottom of the figure, which shows when a major component of the project is to be completed.

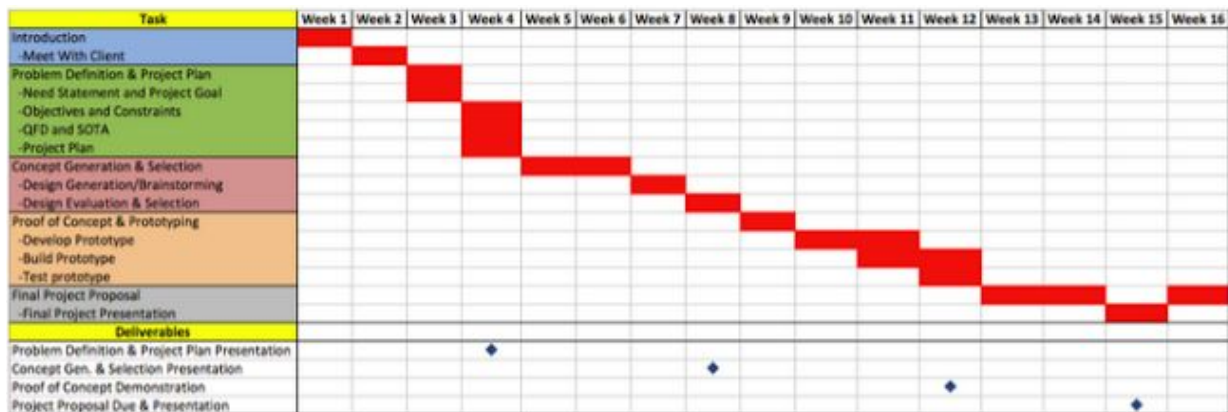


Figure 1: Gantt Chart displaying the timeline for the project.

Quality Function Deployment & House of Quality

The Quality Function Deployment (QFD) represents the relationships between the customer requirements and the engineering requirements which are needed to design the retractable pool cover. This method is used to have a better understanding of the client needs and hence addressing the problem through the engineering design requirements. Mr. Herzog, has specified the design requirements for the pool cover and the engineering requirements must meet these specifications. Therefore, the QFD matrix employs fundamental requirements for the design and then illustrates the amount of importance to the

customer requirements. When a customer requirement and an engineering requirement have a relationship it is denoted with a marker. This can be seen below in Figure 2.

Our QFD contains two markers, a full dot and an empty dot, each representing a strong relationship and a lesser relationship, respectively. The customer requirements are then rated based on the number of correlations it has to the engineering requirements. Customer requirements with the most correlations are the most important as it becomes a very essential way that we are to design our cover. Therefore, the ability to sustain weight is the most important factor due to the fact that it has six relationships and most of these are strongly correlated.

The House of Quality (HoQ), which is the half diamond on top of the QFD in Figure 2, displays the relationships between the engineering requirements for the pool cover. The relationships are signified by two icons, symbolizing a positive or negative correlation. Similar to the QFD, the relationships between the engineering requirements are signified and rated by the number of relationships they share. However, because some of the relationships will impact others negatively these must be closely monitored to come up with a design that still satisfies the functionality of the cover system. The factor of safety has the most negative correlations. If an electric motor is used the factor of safety decreases because we have an electrical component near water. Additionally, if the factor of safety increases too much due to make the components being too large, it will require a larger hub to house the cover. This then leads to a bulkier system which may not be able to work for the designated area to work.

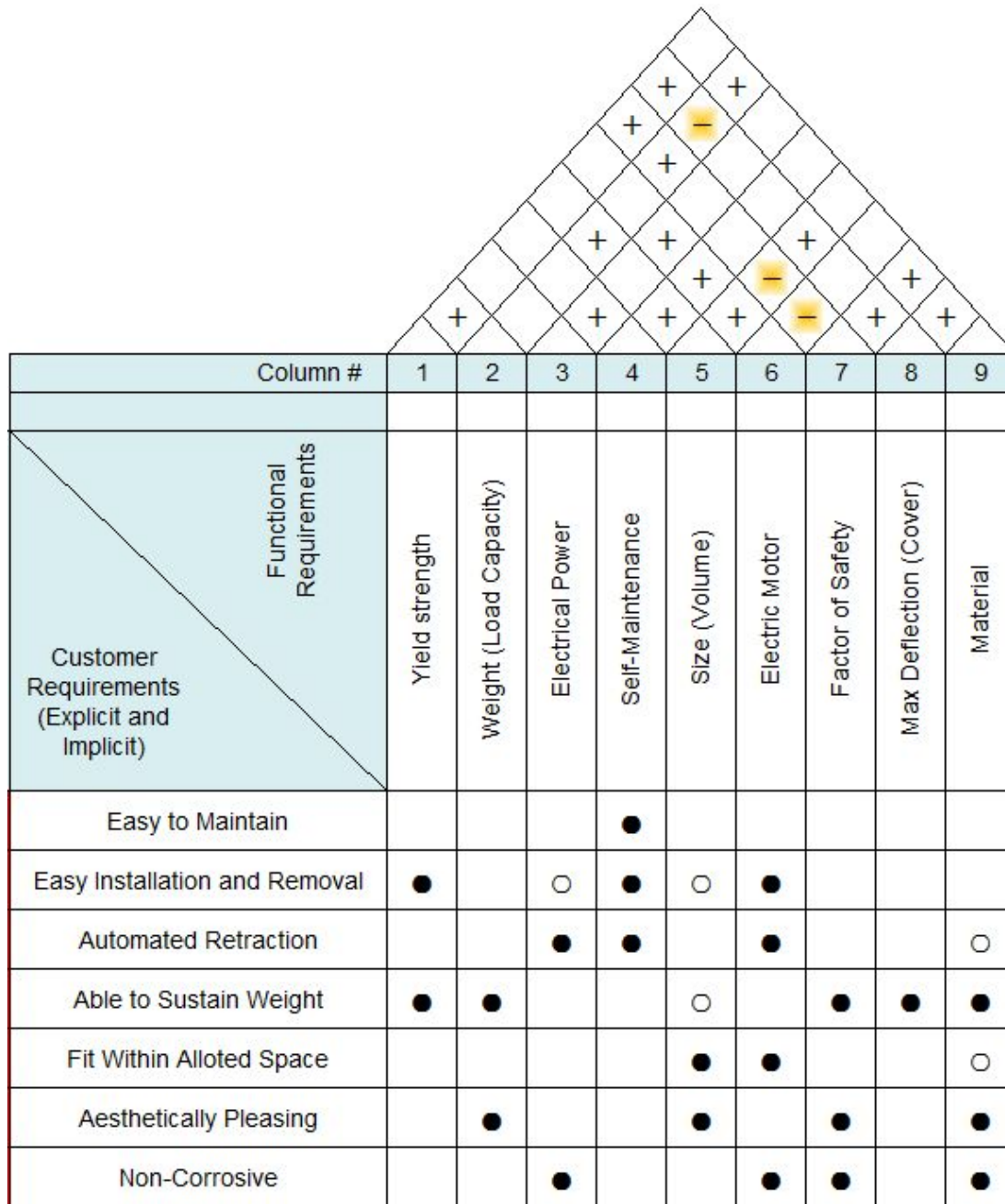


Figure 3: QFD and House of Quality showing relationships between requirements.

Research

From doing research, the group has found some designs that are close to the end result we are trying to complete. Aquamatic Cover Systems provide products that are automated, hydraulically powered, rigid, lightweight, and aesthetically pleasing [1]. However, our idea is to improve the system by redesigning it to be more affordable and able to withstand the weight of multiple people. The other source we have found is from WutPool. They provide an automated pool cover that is rigid, aesthetically

pleasing, and can withstand the weight of multiple people standing on top of it. However, this system is run by an electric motor and therefore is a safety hazard. Additionally, it is an expensive and bulky system. Therefore, we would need to address and improve upon these concerns.

Conclusions

There are no retractable pool covers on the market right now that are cost effective, automated, and can withstand the weight of multiple people. Namely the price is the only thing that is missing from these designs. However, our design needs to be lightweight, easily maintainable, rigid, automated, and aesthetically pleasing as well. Our design must be able to support more than 800 kPa of pressure to ensure the safety of those walking across it. It needs to also cover, roughly, a 3m X 5m area to ensure the enclosure for the water. This all needs to be done while reducing the cost by a significant amount and therefore making it a hot commodity on the market. Our plan is to start researching and coming up with different ideas to begin designing and manufacturing a prototype in late October. The pool covers on the market right now are close to what is needed, but some changes will need to be made for the objectives to be met.

References

[1] 'Aquamatic Cover Systems | Hydramatic | Energy Efficient Pool', 2015. [Online]. Available: <http://www.aquamatic.com/>. [Accessed: 23-Sep-2015].

[2] WutPool™, 'Retractable, Load-bearing Flooring Systems & Automatic Pool Covers', 2015. [Online]. Available: <http://wutpool.com/>. [Accessed: 23-Sep-2015].