Mechanical Shredder

By
Ryon Baloo, Kendall Meyer, Mohammed Molani,
and Sultan Alshahrani
Team 10

Problem Definition and Project Plan
Document

Submitted towards partial fulfillment of the requirements for
Mechanical Engineering Design I – Fall 2014

Department of Mechanical Engineering
Northern Arizona University
Flagstaff, AZ 86011

Table of Contents

Executive Summary

Paper shredders are usually electric driven with sensors that operate the system when paper is detected. The goal of our team is to design a mechanical driven paper shredder that can either be leg or hand operated. The criteria for our design include: Visibility, Meets Client Priorities, Economic Feasibility, Program Longevity, Reasonable Timeline, and Impact for Third World countries or areas that have limited access to electricity.

Statement of Problem

Operating an electric shredder can cost up to $65.00/year at $0.12 per kw/h and emits greenhouse gases into the atmosphere [1]. Random power outages can defect an electric shredder at the most crucial time. Third World countries are limited to electricity, unlike the United States. Disposing important documentation will prevent stolen ideas, identity thefts, and frauds.

Our team will help prevent and assist individuals that are in need of disposing credit cards, tax return, company research, and even CD files with our mechanical paper shredder.

Goals, Objectives, and Constraints

The ultimate goal is to design a mechanically operated shredder that holds no source of electrical components. Our team is to research and communicate with our client to perfect our design accurately. The outlined below are the specific project goals, objectives, and constraints that show relation to designing the mechanical shredder.

Goals

- Mechanical shredder needs to be highly reliable and portable
- Environmental Friendly
- No source of electronic components so it can be usable at any time without a necessary electrical power source.

Objectives

- Competes with electrical paper shredders
- Has a container to hold shredded paper
- Inexpensive
- Shreds paper with minimum power (leg or hand operated)
- Type of material shredded: Papers, CDs, Credit cards

Constraints

- The design cost must be less than $100.00 for fabrication
- 10 Sheets per feed
- Speed: 36 pages per minute

- Paper size: 8.5 x 11 inches
- Volume: 5 ft^3
- Noise level less than 65 decibel (dB)

Testing Environment

An office that can fit mechanical system volume of $5ft^3$. When running the test, there are four essential data to analyze and collect.

- Runtime: How long the machine takes to operate
- Shred Speed: The shredder's speed to shred one feed of paper
- Sheet Shred Capacity: Amount of paper that is shredded in one feed
- Noise Level: Make the design quiet as possible. Noise eligibility for quiet environment

Quality Function Deployment (QFD)

Two competitors that we looked into for a mechanical paper shredder was the Premium Connection Paper Shredder shown in Figure 1 [2], and the Manual Paper Shredder developed by IDEA as shown in Figure 2 [3]. Both of these mechanical paper shredders are fully mechanical, but are not reliable enough. These shredders are close to novelty items and the client asked our group to develop a reliable mechanical paper shredder that is going used constantly in a busy office environment. These two shredders are the common types of mechanical shredder that you can find on the internet.

(Figure 1: Competitor 1: Premium Connection Paper Shredder [2])

(Figure 2: Competitor 2: Manual Paper Shredder from IDEA[3])

As shown in our Quality Function Deployment (QFD) (Table 1), both competitors do not properly meet with our customer requirements. They are not reliable systems and not durable enough for the office use that is requested for this project. Trends in our QFD shows that our system has to have a focus on reliability, being inexpensive, but also being cost effective. We can focus on meeting these customer requirements by focusing on the weight and size of the system and makes sure it performs its required tasks of being able to shred 36 pages per minute, and being able to shred at least 10 sheets of paper in one cycle.

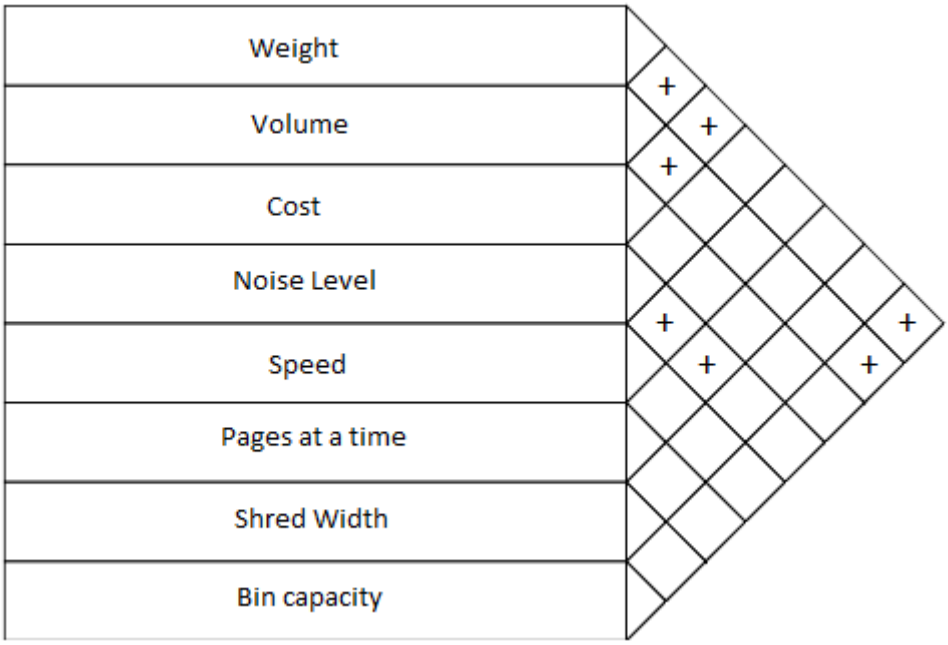
Table 1: Quality Function Deployment

		Engineering Requirements								Competitors	
		Weight	Volume	Cost	Noise Level	Speed	Pages at a Time	Shred Width	Bin Capacity	Product 1	Product 2
Customer Requirements	Minimum Carbon Footprint		X								
	Reliable					X	X	X			
	Inexpensive	X	X	X					X	O	O
	All Mechanical System				X	X				O	O
	Cost Effective			X		X	X			O	
	Units	lbs	ft^3	$	db	Pages/Min	x Pages/Iteration	inches	gallons		
		20-25	5	100	65	36	10	0.25	5.25		

House of Quality (HOQ)

Our House of Quality (HOQ) (Table 2) shows the common trends that we will encounter when designing and fabricating this system. As the weight of the system goes up, that could possibly lead to an increase of volume, but we could increase the size of the paper collection bin. If we decide to build a bigger system that could potentially add in our cost. The categories such as: noise level, speed, pages at a time, and shred width, all factor into the reliability of the system. Being limited to $100.00 and a $5ft^3$ volume, we have to find a way to maximize reliability while keeping to our given constraints.

Table 2: House of Quality

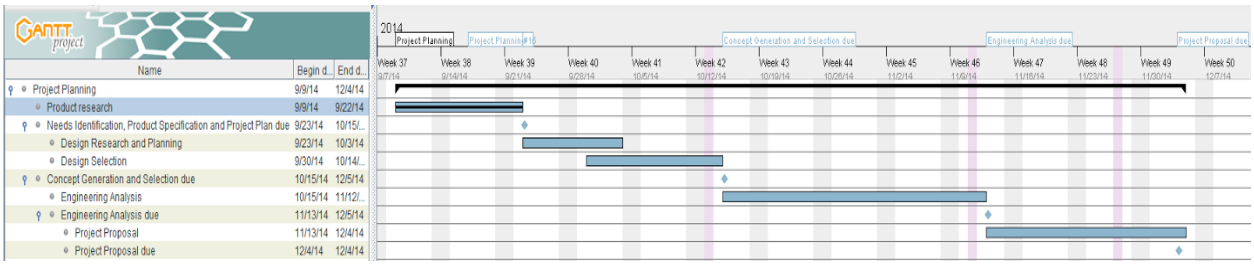


Project Planning

We have done our project planning through the use of a Gantt Chart as seen in Table 3. We are currently at the conclusion of our product research stage and are continuing into design research and planning. During this stage we will begin to do further research into the technology and current designs of paper shredders, both electrical and mechanical, and find a system that we believe to fulfill all requirements set to us. Our group will compile numerous resources and when we feel that we have enough to work with, we will take our customer requirements, along with our engineering specifications and start to narrow down designs that we would like to further analyze and develop our system around

The next step is to bring our chosen designs into an engineering analysis phase. During this stage we will start to calculate the different features of our designs to make sure that they do meet the requirements for this project. This will be another step towards narrowing down our results and choosing a few final designs. After analyzing our designs, we will put together all of our past research and design calculations to develop a project proposal. The project proposal will document our research from product research all through our engineering analysis and we will have a final design that we will want to develop that meets all requirements for this project.

Table 3: Gantt Chart for Fall semester planning



Conclusion

Our team plans to build a mechanical paper shredder, which needs to be operated manually and be able to compete with an electric paper shredder. There are not many mechanical shredders out on the market that can compete with the work of an electronic paper shredder. Our goal is to design an environmentally friendly, inexpensive paper shredder that is fully mechanical and can shred 10 sheets of paper in one cycle, at a rate of 36 pages per minute, and shred the same materials as electric paper shredders are able to, such as: paper, CDs, and credit cards.

When completed, the paper shredder will need to be tested in an office environment that can contain the unit, and we will test that it meets the performance requirements given to us. By the QFD that we have developed, while working on the project, we will put focus into making a mechanical paper shredder reliable and inexpensive. We plan to find a balance between those categories that will be considered cost effective.

References

[1] Science Club. *How Many Watts of Electricity does a Paper Shredder Use* [Online]. Available: http://www.cockeyed.com/science/power_use_database/paper_shredder.html

[2] Amazon. *Paper Shredder* [Online]. Available: http://www.amazon.com/The-Premium-connection-290-SHRED-Shredder/dp/b006J99PQQ

[3] Better Living Through Design. *Manual Paper Shredder* [Online]. Available: http://www.betterlivingthroughdesign.com/accessories/manual-paper-shredder/