Deliverable 3

Engineering of Systems

2/27/15

Nick Morris

Jared Raphael

Darin Berrigan

Jacob Klaus

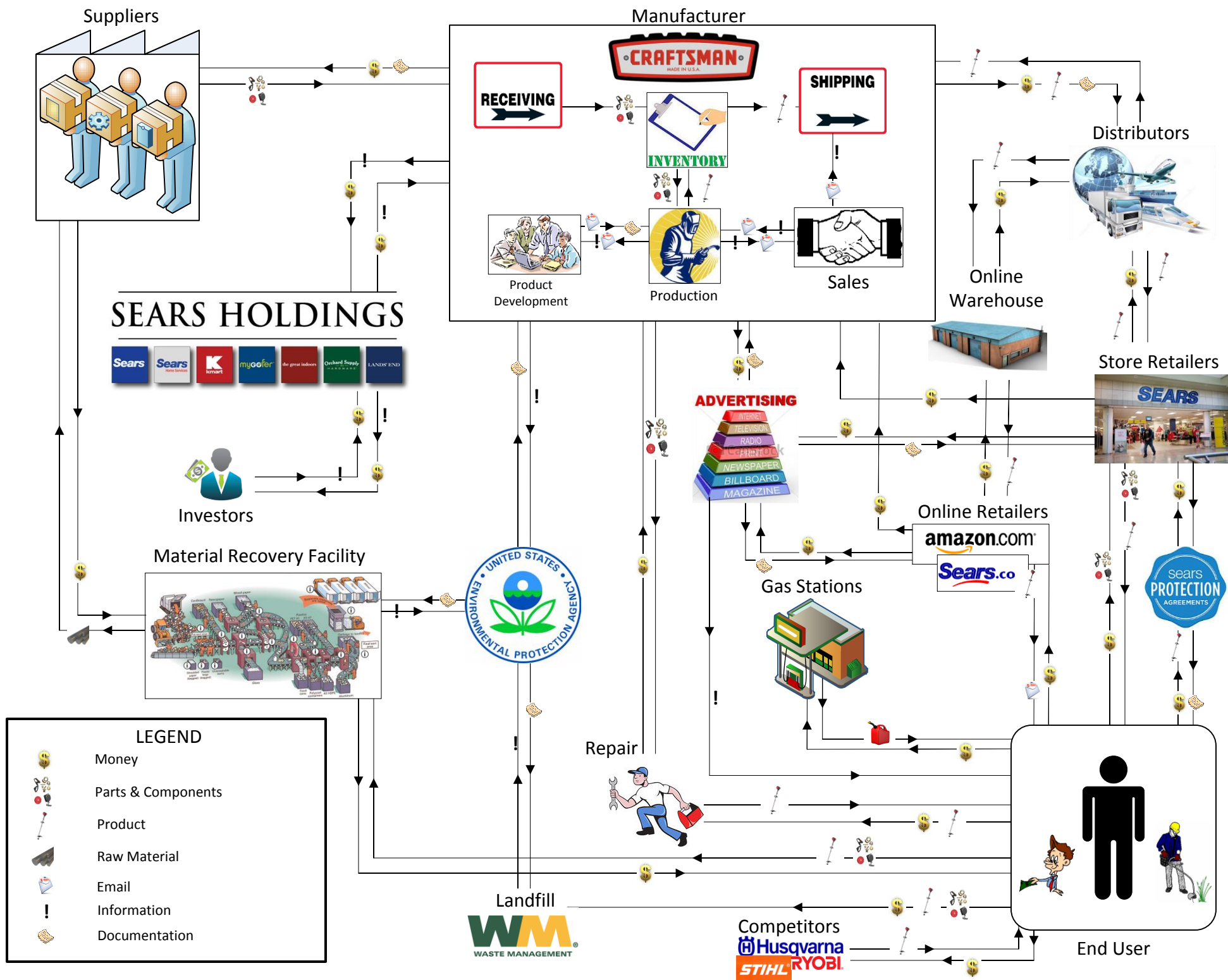# Table of Contents

From-To Relationship Charts

MONEY FLOW TO ($)

MONEY FLOW FROM ($) / STAKEHOLDERS	Advertisors	Distributors	EPA	Product Protection	Land Fills	Manufacturers	MFG Competitors	Online Retailers	Partner Products	Repairman	Investor	Store Retailers	Suppliers	Users	Connections
Advertisors	■														0
Distributors		■													0
EPA			■												0
Product Protection				■											0
Land Fills					■										0
Manufacturers	✔	✔	✔	✔		■					✔		✔		6
MFG Competitors	✔	✔	✔				■						✔		4
Online Retailers	✔					✔	✔	■							3
Partner Products	✔	✔							■				✔		3
Repairman						✔	✔			■					2
Investor						✔					■				1
Store Retailers	✔	✔					✔					■			3
Suppliers				✔									■		1
Users			✔	✔			✔	✔	✔	✔		✔		■	7

INFORMATION FLOW TO (!)

INFORMATION FLOW FROM (!) / STAKEHOLDERS	Advertisors	Distributors	EPA	Product Protection	Land Fills	Manufacturers	MFG Competitors	Online Retailers	Partner Products	Repairman	Investor	Store Retailers	Suppliers	Users	Connections
Advertisors	■														0
Distributors		■													0
EPA			■	✔		✔	✔		✔					✔	5
Product Protection			✔	■		✔	✔		✔					✔	5
Land Fills			✔		■										1
Manufacturers	✔	✔	✔	✔		■		✔	✔	✔	✔	✔	✔	✔	11
MFG Competitors	✔	✔	✔	✔			■	✔	✔	✔		✔	✔	✔	10
Online Retailers							✔	■	✔					✔	3
Partner Products	✔	✔				✔	✔	✔	■		✔		✔		7
Repairman						✔	✔			■					2
Investor						✔					■				1
Store Retailers	✔	✔					✔		✔			■		✔	5
Suppliers						✔	✔		✔				■		3
Users			✔	✔		✔	✔	✔	✔	✔		✔		■	8

MATERIAL FLOW TO (M)

MATERIAL FLOW FROM (M) / STAKEHOLDERS	Advertisors	Distributors	EPA	Product Protection	Land Fills	Manufacturers	MFG Competitors	Online Retailers	Partner Products	Repairman	Investor	Store Retailers	Suppliers	Users	Connections
Advertisors	■											✔			1
Distributors		■						✔		✔		✔		✔	4
EPA			■												0
Product Protection				■											0
Land Fills					■								✔		1
Manufacturers		✔				■							✔		2
MFG Competitors		✔					■								1
Online Retailers						✔	✔	■						✔	3
Partner Products		✔						✔	■	✔		✔			4
Repairman		✔								■				✔	2
Investor											■				0
Store Retailers		✔										■		✔	2
Suppliers		✔							✔				■		2
Users		✔						✔		✔		✔		■	4

Suppliers

Manufacturer

CRAFTSMAN
MADE IN U.S.A.

RECEIVING

SHIPPING

INVENTORY

Product Development

Production

Sales

SEARS HOLDINGS

Sears | Sears Home Services | kmart | myGofer | the great indoors | Orchard Supply Hardware | LANDS' END

Investors

Material Recovery Facility

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Distributors

Online Warehouse

Store Retailers
SEARS

ADVERTISING
INTERNET
TELEVISION
RADIO
PRINT
NEWSPAPER
BILLBOARD
MAGAZINE

Online Retailers
amazon.com
Sears.co

sears PROTECTION AGREEMENTS

Gas Stations

Repair

Landfill
WM WASTE MANAGEMENT

Competitors
Husqvarna RYOBI
STIHL

End User

LEGEND

💲	Money
🔧	Parts & Components
⚙	Product
⛰	Raw Material
✉	Email
!	Information
📜	Documentation

CVCA Discussion:

Process

     To start the process of creating a Customer Value Chain Analysis we started by having each member of the group individually create a list of all of the stakeholders that they thought were involved with or affected by our product. We then got together as a group and combined all of our ideas in an excel document and proceeded to combine and expand on each others ideas. Throughout this process we noticed several stakeholders that a few group members had thought of but the others hadn't, such as Manufacturing Competitors, EPA, and Local Gas Station. This sparked ideas for other stakeholders that we had not come up with on our own. After exhausting all of the ideas that we had for potential stakeholders, we created several relationship charts to see how the stakeholders interacted. We created a money flow chart, information flow chart, and a material flow chart. In each of these we went through and marked the flow from one stakeholder to the other while including what specific thing flowed from one to the other in the final CVCA. An example of this is raw materials flowing from suppliers to manufacturers and finished products/components flowing from manufacturers to distributors. After we had filled out all of the flow charts we moved on to creating the actual CVCA. We began by finding an appropriate benchmark for a good CVCA by talking to a graduate student in the Toyota Lab. We received advice on the internal value chain in the Manufacturing Plant *Craftsman* and external value chain outside of *Craftsman* flowing to the end user.

     Before starting the electronic creation of the CVCA in Visio, we drew all of our ideas out on paper as we found this was an easy and flexible way to capture the overall life cycle of the weed whacker. It was much quicker for us to make changes on the physical paper than on the flowchart software. Once we organized all of our thoughts on paper,we began by finding an icon for each stakeholder and element of value that needed to be included in the overall flow of money, information, and materials. From here, we used a *B-Matching* integer-linear programming model to minimize the distances of high flow interaction between stakeholders. This helped to minimize visual confusion of flow as it reduced the overlap of value flow. The next step we took was to represent the flow of money, information, and materials by connecting the nodes with arrows where necessary. On these nodes we illustrated this flow by including relevant icons. The last step was to make sure we created a legend to help the reader identify what each icon represents.

Analysis

     For the Customer Value Chain Analysis we started with each of the stakeholders listed out and started from the beginning of the chain. We started with the supplier and looked at each of the flows of materials, information, and money between them and Craftsman. The supplier sent information and raw materials and received money from Craftsman. From Craftsman's perspective, we looked at what other stakeholders we would interact with and made connections with the different components of the interaction. Craftsman had interactions with multiple stakeholders. They interact with the Sears Holding through the flow of money and information and then with the EPA through information being sent to the EPA and regulation documentation being sent to Craftsman. Craftsman also interacts with repairman by sending parts and components to them in exchange for money. Additionally, Craftsman interacts with advertisers through the exchange of money and information and retailers through the exchange of money. Craftsman also interacts with distributors by sending them money, finished products, and information and distributors send back defective products to

Craftsman. Sears Holdings then has interactions with investors through the exchange of money and information back and forth between the two. The EPA has interactions with both landfills and recycling facilities by sending documentation to them and receiving information in return. Repairman have an interaction with customers by receiving damaged products and money in exchange for a working final product. Advertising interacts with both online retailers and store retailers by receiving both money and information from both of them and then sending out advertisements to the end user. Distributors then have an interaction with both the online retailer's warehouses and the store retailers. There is an exchange of products going from the distributors to the warehouses and the stores in exchange for money. Online retailers then interact with the end users by sending them the product and a confirmation email in exchange for money. Store retailers interact with end users by giving them either final products or components in exchange for money. End users interact with gas stations by getting fuel which is needed to run the weed whacker, in exchange for money. The end user also interacts with Sears Protection when the product is defective by sending them the product and some money in exchange for documentation which can be used to procure a new product from the store retailer. The user also interacts with competitors by buying their products instead of Craftsmans. When it comes to getting rid of the product at the end of its life the user will then interact with either the landfill or a recycling facility. In the case of sending the product to the landfill, the user will give the landing fill the products/components as well as some money. For the interaction with the recycling facility, the user will give the product/components to the recycler in exchange for some money. The recycler will then turn the product into raw material which the recycler will then sell to the supplier in exchange for money.

The Result

This Customer Value Chain Analysis Diagram helps with understanding the flow of money, information, and materials between stakeholders. This can be a useful tool for identifying costs that could be reduced or even eliminated. This can be a vital tool for a company to stay competitive in the market. Companies in today's society are always looking for a competitive advantage. The CVCA is a fairly low-cost way of adding to that competitive advantage. Another useful feature of this tool is that it can be applied to a wide range of companies or networks. Capturing value flow is useful in almost every scenario, it all depends on whether the time is worth investing.
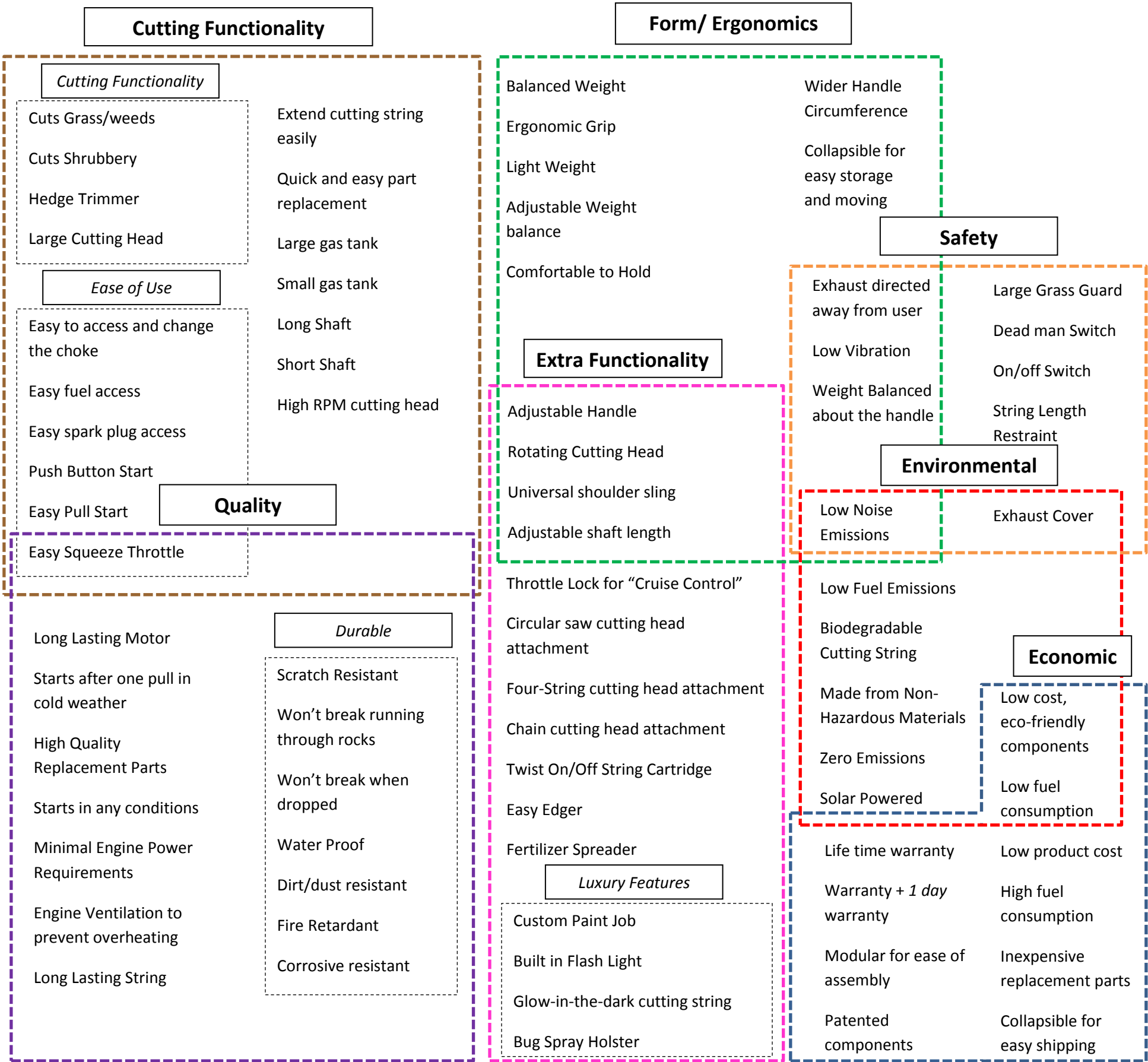
Our CVCA captures a total of 23 stakeholders involved in the life cycle of the *Craftsman Weedwacker.* This model captures value-added activities and necessary non-value added activities throughout the entire diagram. The main flow of the value chain is from Suppliers to Craftsman to Distributors to Store Retailers to End User to Material Recovery Facility to Suppliers, which is captured in a clockwise fashion along the perimeter of the diagram.

Many insights were discovered during the process of creating our CVCA diagram. We realized the practical importance of mapping the flow of value between all stakeholders while also realizing the complexity of the product life cycle. As mentioned earlier, each team member helped the others discover stakeholders, customers, and value flow that they would not have normally considered. For example, when looking at the product the stakeholder "investors in the company" would not be initially intuitive to everyone. Working together helped the team to better understand each aspect of the product life cycle as each person has their own way of thinking. Overall, the Customer Value Chain Analysis was a moderately easy to use, useful tool in understanding our Craftsman product.

Brainstorming: Sticky Notes

Basic Functionality	Form/Ergonomics	Quality	Extra Functionality	Economic	Environmental	Safety
Cuts grass/weeds	Balanced Weight	Long lasting motor	Throttle lock "cruise control"	Low Product cost	Low Emissions	Large grass guard
Hedge Trimmer	Light Weight	Minimal engine power requirements	Circular saw cutting attachment	High fuel consumption	Biodegradable Cutting string	Dead man Switch
Cuts Shrubbery	Exhaust directed away from user	Engine Ventilation to Prevent	4 string cutting head attachment	Low fuel Consumption	Low cost, Eco-friendly components	On/Off Switch
Large cutting head	Ergonomic grip	Won't break running through rocks	Chainsaw attachment	Inexpensive Replacement parts	Made from non-hazardous materials	Exhaust Cover
Extend cutting string easily	Adjustable weight balance	Reliable performance	Chain cutting head attachment	Lifetime warranty	Zero Emissions	String Length Constraint
Quick and easy part replacement	Comfortable to hold	Corrosive resistant components	Universal shoulder sling	Modular for easy assembly	Solar powered	
Easy squeeze throttle	Low Noise Emissions	Scratch resistant	Twist on twist off string cartridge	Warranty +1 day life span		
Small gas tank	Low vibration	Won't break when dropped	Adjustable Handle	Patented components		
Easy Pull Start	Wider Handle circumference	Starts after one pull in cold weather	Cutting head rotation about shaft axis	Collapsible for easy shipping		
Push Button Start	Weight balanced about handle	High Quality replacement parts	Adjustable shaft length	Fertilizer spreader		Luxury Features
Large gas tank	Collapsible for easy storage and moving	Water proof	Long lasting string	Easy Edger		Bug spray holder
Longer shaft	Easy to access and change the choke	High RPM	Starts in any conditions	Dirt/dust resistant		Custom Paint Job
Shorter shaft	Easy fuel access	Easy spark plug access	Fire retardant			Glow in the dark string
						Built in Flash Light

Affinity Diagram

Cutting Functionality

Cutting Functionality

Cuts Grass/weeds

Cuts Shrubbery

Hedge Trimmer

Large Cutting Head

Ease of Use

Easy to access and change the choke

Easy fuel access

Easy spark plug access

Push Button Start

Easy Pull Start

Easy Squeeze Throttle

Extend cutting string easily

Quick and easy part replacement

Large gas tank

Small gas tank

Long Shaft

Short Shaft

High RPM cutting head

Quality

Long Lasting Motor

Starts after one pull in cold weather

High Quality Replacement Parts

Starts in any conditions

Minimal Engine Power Requirements

Engine Ventilation to prevent overheating

Long Lasting String

Durable

Scratch Resistant

Won't break running through rocks

Won't break when dropped

Water Proof

Dirt/dust resistant

Fire Retardant

Corrosive resistant

Form/ Ergonomics

Balanced Weight

Ergonomic Grip

Light Weight

Adjustable Weight balance

Comfortable to Hold

Wider Handle Circumference

Collapsible for easy storage and moving

Extra Functionality

Adjustable Handle

Rotating Cutting Head

Universal shoulder sling

Adjustable shaft length

Throttle Lock for "Cruise Control"

Circular saw cutting head attachment

Four-String cutting head attachment

Chain cutting head attachment

Twist On/Off String Cartridge

Easy Edger

Fertilizer Spreader

Luxury Features

Custom Paint Job

Built in Flash Light

Glow-in-the-dark cutting string

Bug Spray Holster

Safety

Exhaust directed away from user

Low Vibration

Weight Balanced about the handle

Large Grass Guard

Dead man Switch

On/off Switch

String Length Restraint

Environmental

Low Noise Emissions

Exhaust Cover

Low Fuel Emissions

Biodegradable Cutting String

Made from Non-Hazardous Materials

Zero Emissions

Solar Powered

Economic

Low cost, eco-friendly components

Low fuel consumption

Life time warranty

Warranty + *1 day* warranty

Modular for ease of assembly

Patented components

Low product cost

High fuel consumption

Inexpensive replacement parts

Collapsible for easy shipping

Hierarchical Need Statements

The weed whacker keeps all parts of the yard neat and clean:

! The weed whacker cuts grass and weeds.

! The weed whacker trims hedges.

! The weed whacker cuts shrubbery.

! The weed whacker has reliable performance.

* The weed whacker has an easy edger.

* The weed whacker has a rotatable cutting head to cut at any angle.

The weed whacker does the job in a timely manner:

* The weed whacker has a large cutting head.

* The weed whacker has button-press string extension.

* The weed whacker is easy to start (pull start or push start).

* The weed whacker starts after one pull in cold weather.

The weed whacker is low-maintenance:

* The weed whacker has quick, easy, and inexpensive replacement parts.

* The weed whacker has twist on twist off string cartridge.

* The weed whacker has easy access to the choke.

* The weed whacker has easy fuel access.

* The weed whacker has easy spark plug access.

LEGEND
! - Basic Need
* - Differentiating Need
+ - Excitement Need

The weed whacker has long-lasting performance:

* The weed whacker has a large gas tank.

* The weed whacker has a long lasting motor.

* The weed whacker has minimal engine power requirements.

! The weed whacker has engine ventilation to prevent overheating.

* The weed whacker has low fuel consumption.

The weed whacker is an ergonomic fit for users:

* The weed whacker has an easy to squeeze throttle.

* The weed whacker has adjustable shaft length.

* The weed whacker has an adjustable weight balance.

* The weed whacker has an adjustable handle.

* The weed whacker is light weight.

! The weed whacker's exhaust is directed away from the user.

*The weed whacker has a comfortable grip.

* The weed whacker has low vibration.

* The weed whacker has a wide handle circumference.

+ The weed whacker is collapsible for easy storage and transportation.

* The weed whacker has a universal shoulder sling.

The weed whacker is a durable power tool:

* The weed whacker doesn't break running through small rocks.

* The weed whacker has corrosive resistant parts.

* The weed whacker is scratch resistant.

* The weed whacker won't break when dropped.

! The weed whacker is water proof.

* The weed whacker starts in any condition.

* The weed whacker has long-lasting string.

* The weed whacker is dirt/dust resistant.

The weed whacker is eco-friendly:

* The weed whacker has low noise emissions.

* The weed whacker has low fuel emissions.

* The weed whacker has biodegradable cutting string.

* The weed whacker is made from non-hazardous materials.

+ The weed whacker is solar powered.

! The weed whacker has an exhaust cover.

The weed whacker has multiple functions:

+The weed whacker has a throttle lock for "cruise control".

+The weed whacker has a circular saw cutting attachment.

+The weed whacker has a 4-string cutting head attachment.

+The weed whacker has a chain cutting head attachment.

+The weed whacker has a fertilizer spreader function.

The weed whacker is a safe product:

! The weed whacker has a large grass guard.

! The weed whacker has a *Dead Man Switch.*

! The weed whacker has an On/Off Switch.

! The weed whacker has a string length constraint system.

The weed whacker has luxurious features:

+ The weed whacker has a bug spray holster.

+ The weed whacker is able to be crafted with a custom paint job.

+ The weed whacker has a built in flash light for night-time jobs

+ The weed whacker has glow-in-the-dark cutting string.

LEGEND

! - Basic Need

* - Differentiating Need

+ - Excitement Need

Affinity Diagramming Discussion:

From the affinity diagram we were able to divide the customer needs into a variety of customer need categories. These categories are partitioned further to distinguish between their importance; basic, differentiating, or excitement needs. This hierarchical breakdown allows us to define the needs which must be focused on before others to deliver a consumer desired weed whacker. The resulting list broke down the customer needs into an easily digestible format. Each need fits well into its' parent category and lets us easily reference a category when searching for a consumer need.

When the team first started brainstorming needs using sticky notes, we focused mainly on the consumer. Once we opened our minds up to the other stakeholders, we thought of needs that would not normally have been considered. This greatly increased the number of needs that the group had come up with for our product in the resulting affinity diagram. When creating the physical diagram it became evident that many stakeholder desires overlap with one another even though the stakeholders have different agendas. The integration of all the major categories was difficult to organize but showed a larger representation of the value chain for a weed whacker.

When generating the affinity diagram we quickly realized that many of the needs belong to multiple categories. This made it particularly difficult at times to design a diagram that encompassed all of the needs. One thing that was unexpectedly difficult was the brainstorming stage for gathering ideas for the affinity diagram. We originally were too general with our stakeholder needs and this resulted in us not having enough needs overall. Additionally we noticed that several of the group member's ideas were the same. This is not exactly a complete shock, but considering we did not collaborate with each other during the brainstorming phase, it is worth noting. Another surprise was an instance of one need *Low Noise Emissions* being captured by three stakeholders *Form/Ergonomics, Safety, and Environmental*. This was a rare occurrence and unexpected while brainstorming ideas.

The CVCA played an important role in the creation of the affinity diagram because it showed the group all of the stakeholders involved with the product. After we knew which stakeholders were involved we were able to determine what the needs of those stakeholders were based on their position in the diagram and the money/information/material flows they had with one another. This made the brainstorming process with sticky notes run smoothly which in-turn made the affinity diagram creation much easier.

The brainstorming phase generates a lot of material and the affinity diagram lets us visualize the relationships that these needs share. To improve upon this process, for the creation of the affinity diagram there should be more steps involved with gathering the ideas in order to make it easier to come up with a sufficient list of needs. A class lecture dedicated to interactive brainstorming with sticky notes and then organization of ideas to set a standard for how a group can go about brainstorming for their affinity diagram would help.

The needs assessment and Affinity Diagram tool were helpful for making the team think outside of the box for not just the needs of the customer but the needs of each individual stakeholder as well. The needs of a manufacturer can be far different from that of a consumer but at the same time they can have some needs that overlap such as quick and easy replacement parts. The tool was useful but required a lot of time and effort from all members in order to achieve a meaningful end product. Organizing the level of chaos that developed as more ideas kept generating was difficult because of difference in opinion and perception of ideas scattered.