Snooze

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Table of Contents:

Section 1: Executive Summary

The Snoozie is an innovative sleeping device that allows the user to efficiently wake up without having to disturb the people around them. We understand that restful sleep is the most important part of starting a good day and we want to change the way our customers wake up every morning. The slick rectangular design of the Snoozie comes with the choice of two different fillings of choice and a mobile application which tracks the sleep cycle of the user.

The Snoozie is suitable for all households, apartments, and dormitories due to its user-friendly design. With the Snoozie, you can not only use your pillow for sleeping, but also use as a trustworthy alarm clock. Our product takes healthy sleeping to the next level, providing efficiency and productivity that will make an everlasting impact on the way we sleep. In addition, our product is also focused on helping the hearing impaired individuals since they have trouble hearing the ring of alarm clocks. With the Snoozie, waking up every morning will bring no worries for being late because the smooth vibration will make sure our customers will wake up in time. We decided to develop the Snoozie for the benefit of customers who strongly believe that sleep is an integral part of daily function.

Our company aims to promote healthy sleeping habits and allow our customers to wake up on time without having to wake up everyone else sleeping around them. We focus on the core value of customer success and we put the customer in the front and center of everything we do. We are the pioneers of sleep technology and we believe that living a healthy lifestyle is most important.

Our company strives to decrease the all the costs involved with delivering our product to the customer, while increasing our sales. Costs like material, manufacturing, holding, shipping, and transporting. We plan to hold low safety stock(inventory), but enough to adjust for customer's demand and we plan to keep our transportation costs to a minimal, as we will have multiple warehouse locations. We will be using the forecasting method referred to as Winter's Method to calculate our inventory safety stock and cycle, as it resulted in the smallest average percent error. Our company will be using a continuous review policy since we are a new company and have high levels of demand uncertainty. Given that we will develop an information system to track the flow of products in and out of our facilities, it will be fairly easy to implement this continuous review policy.

Section 2: Our Company

Section 2.1: Vision Statement

To revolutionize the way people wake up in the morning so they never have to sleep through an clock alarm ever again.

Section 2.2: Mission Statement

Our mission is to promote a healthy and happy lifestyle by supplying our customers with a product that will effectively wake them up in the morning through gentle vibrations.

Section 2.3: Business/Developmental Goal

We plan to create a product called Snoozie. On a basic level, it is a vibrating alarm clock pillow. This pillow will have unique features that will give our company a distinct edge over our competitors. It will meet the many needs of our customers through its comfort, effectiveness, innovative idea, and advanced technology implementation. The Snoozie has potential to expand to updated versions, thus allowing for great product scalability.

Our product will not only be a crucial step for the future efficiency but it will will also shorten the line of people with hard of hearing and the general public. It will be a great source of profit for our company. For example, we expect to generate the following monetary values:

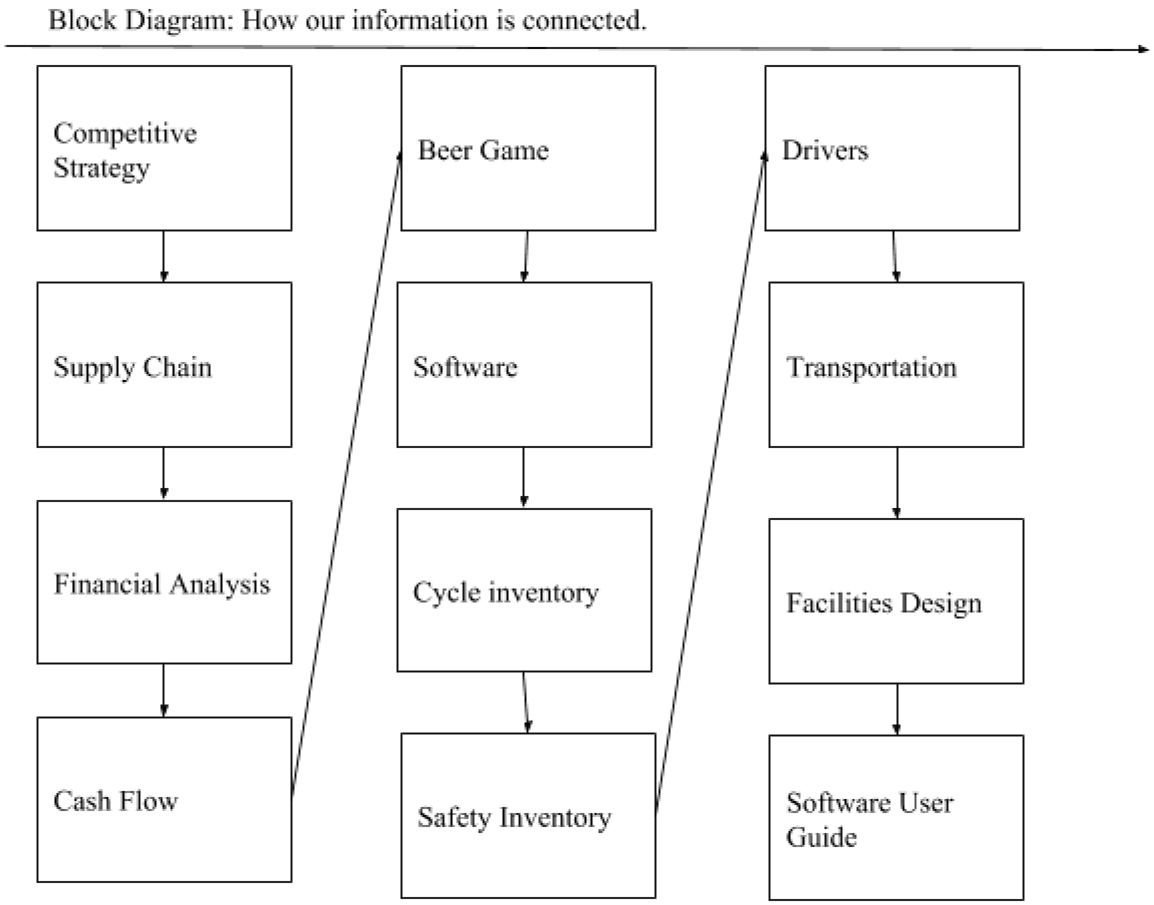
- Overall project cost = 36.5M
- Sales Revenue = $54.4M
- Profit = $17.9M
- Profit Margin = 49%

Source: NPV Analysis

The following calculations further portray that our product will be a huge success and eventually we plan to accumulate a large chunk of the alarm clock market. Our development plans are to continually update our design, through investments in research and development, and we plan to make multiple designs, one high-end, one for traveling, and one for the low-end customers. It will be a product that will adapt easily to the current market because our company pays close attention to our customer needs.

Section 3: Project Plan

Section 3.1: Block Diagram



Section 4: Supply Chain Strategy

Section 4.1: Product Life-Cycle in the Market

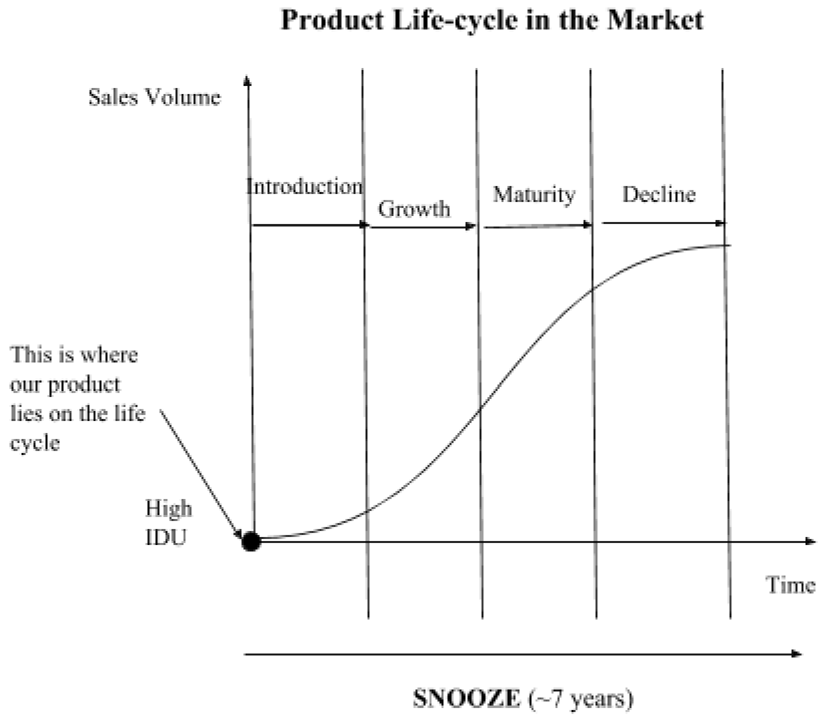


Figure 1-1

Analysis: Because we are creating a new product, we are currently in the "Introduction" stage within the life cycle.

Section 4.2: IDU Spectrum

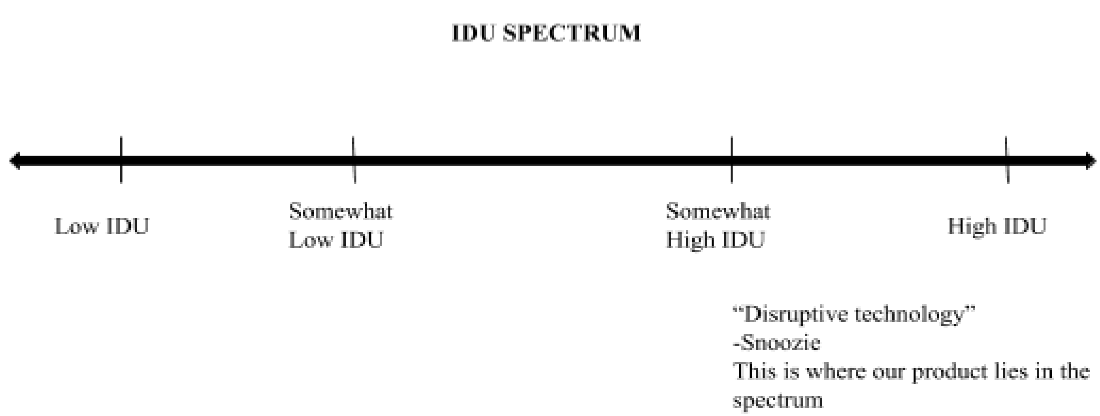


Figure 1-2

Analysis: Since we are creating an entirely new product (Snoozie), it will have a high IDU meaning there is a high uncertainty in demand for the product *implied* by the customer needs for   the product during the *life cycle* in the market.

Section 4.3: Snooze Competitive Strategy

We are between cost-leadership and differentiation as we want to provide a unique high quality item that is not expensive.

Section 4.4: Overall Supply Chain Strategy

Figure 1-3

Supply Chain Strategy for Snoozie

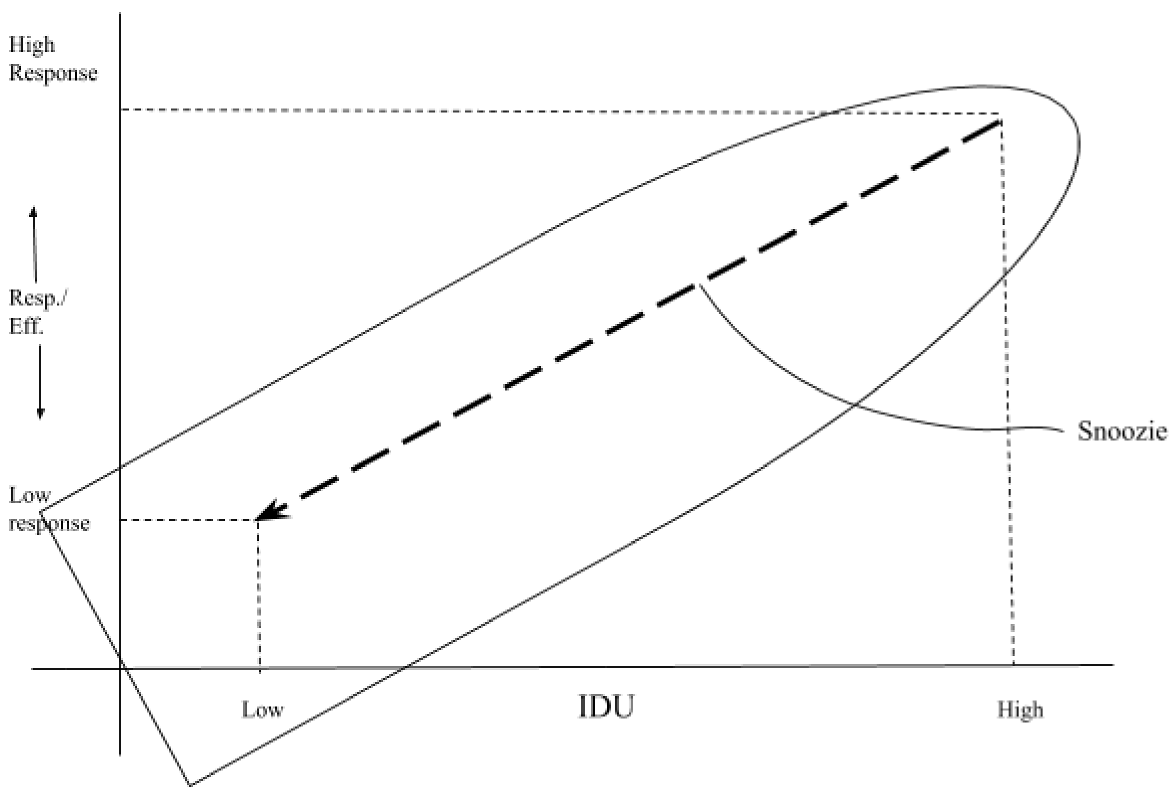
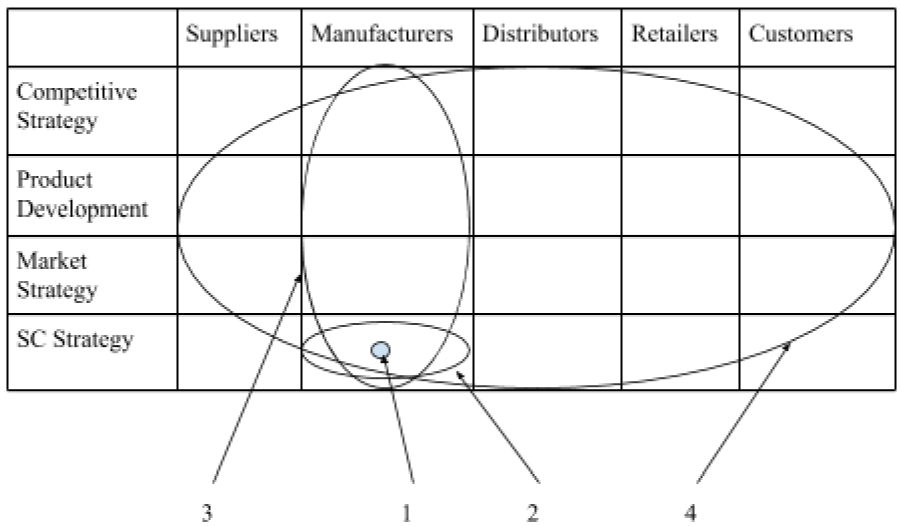


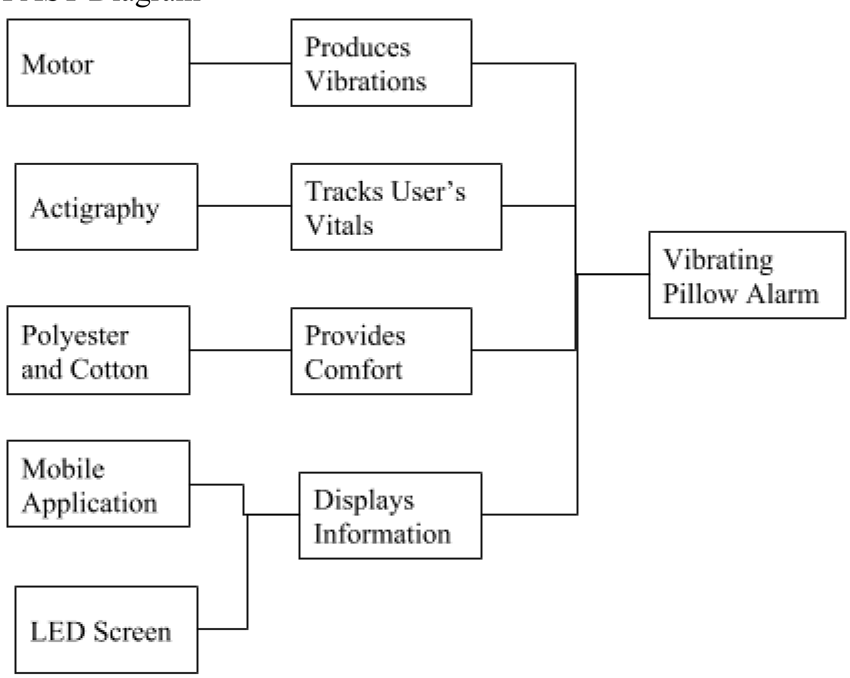
Figure 1-4

Snoozie is a product that can have a somewhat efficient supply chain since it will need a lead time of several months. However, we are a new company with a high implied demand uncertainty. Consequently, we must have a higher responsiveness to attract and maintain new customers. Therefore, we must increase the responsiveness of the supply chain to appease these factors.

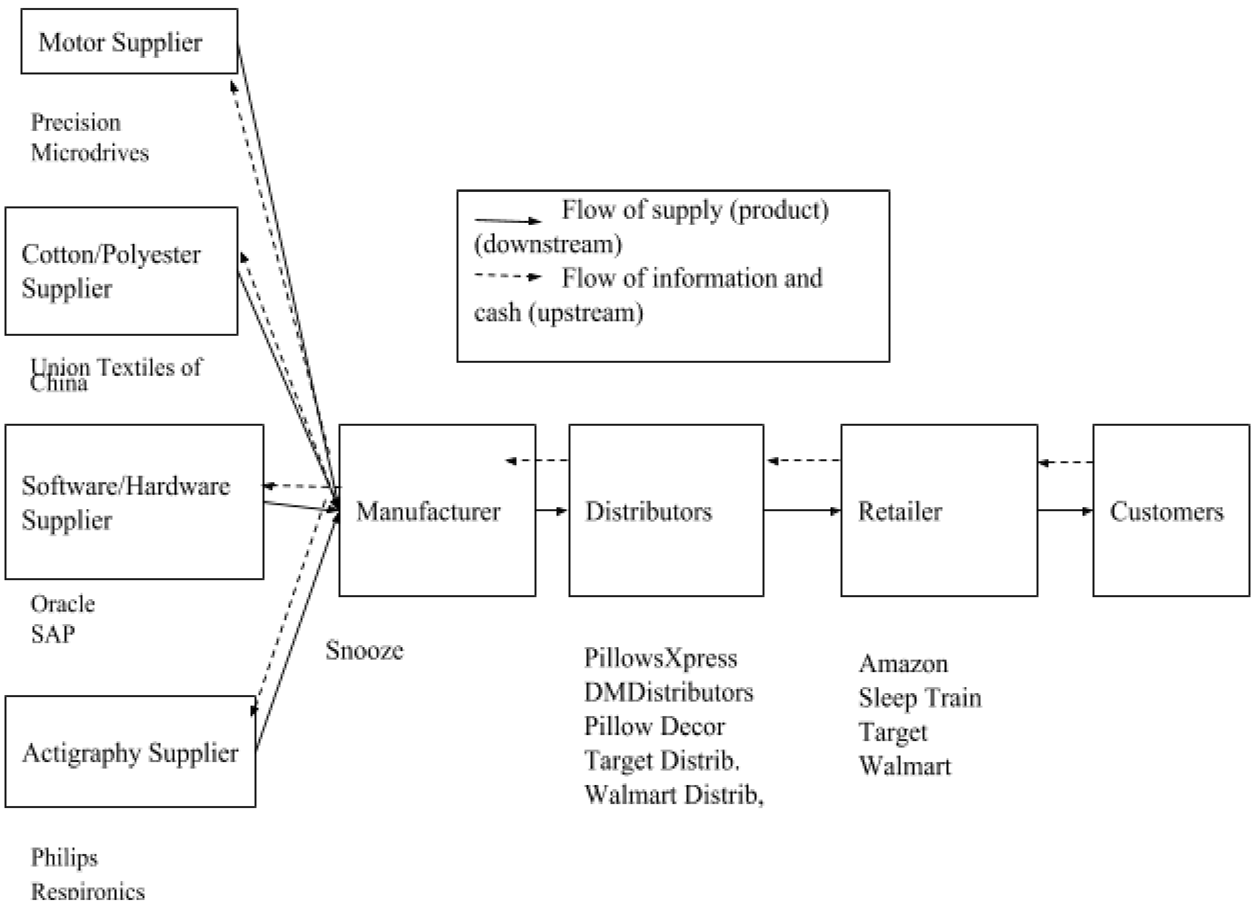


Result: This shows all the organizational functions in SPC and the goal here is to maximize responsiveness associated with a specific operation.

FAST Diagram



Stage view of the Supply Chain for Snoozie alarm clock pillow



Section 4.5: Supply Chain Decision-Making Framework

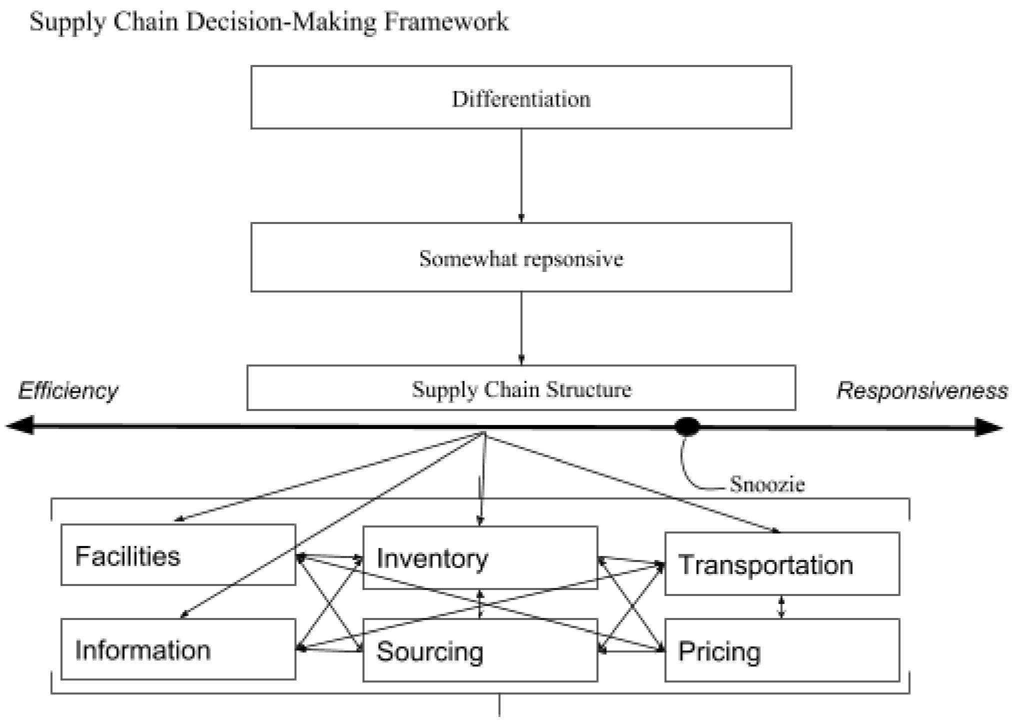


Figure 2-1

Figure 2-1 explains the supply chain for Snoozie. Because we are a new company, we must be responsive to get products to new customers quickly.

Section 4.6: High-Level Plan for Software

Step 1: What is the main goal of the SCM software?

To automate all parts of the supply chain including the various demand forecasts, cycle inventory, safety inventory, transportation management, and facilities management given various input parameters.

Step 2: Identify the main functions/requirements of the software.

-- demand forecasting using all five methods
-- calculating cycle inventory
-- calculating safety inventory
-- detail our facilities including the number, location, and capacity of our facilities
-- detail our transportation including the suppliers, modes of transportation, days to deliver, and total cost

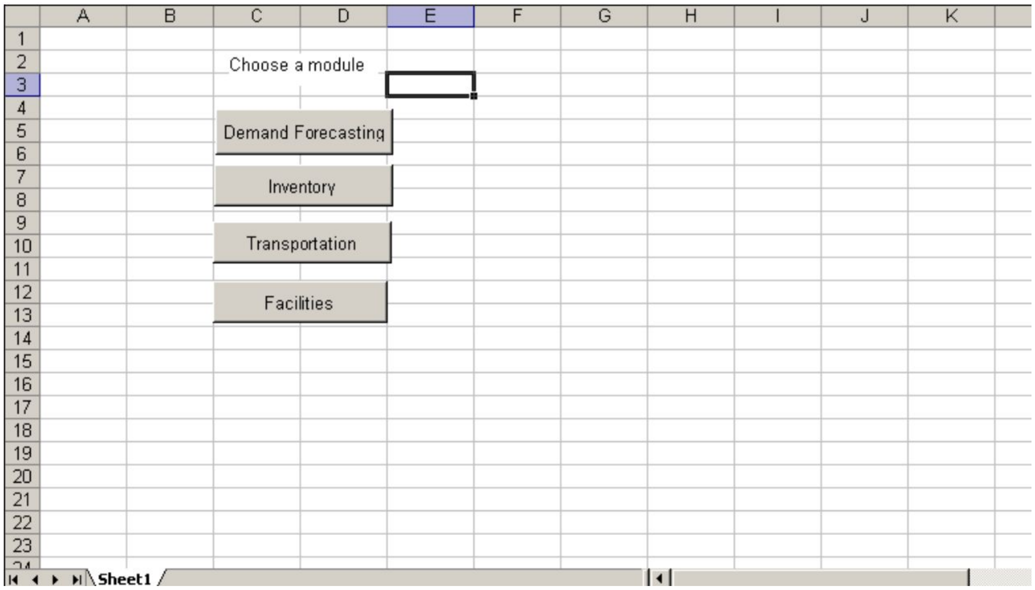
Step 3: What software components need to be created to fulfill these requirements.

-- We will use Excel and Visual Basic to create the software

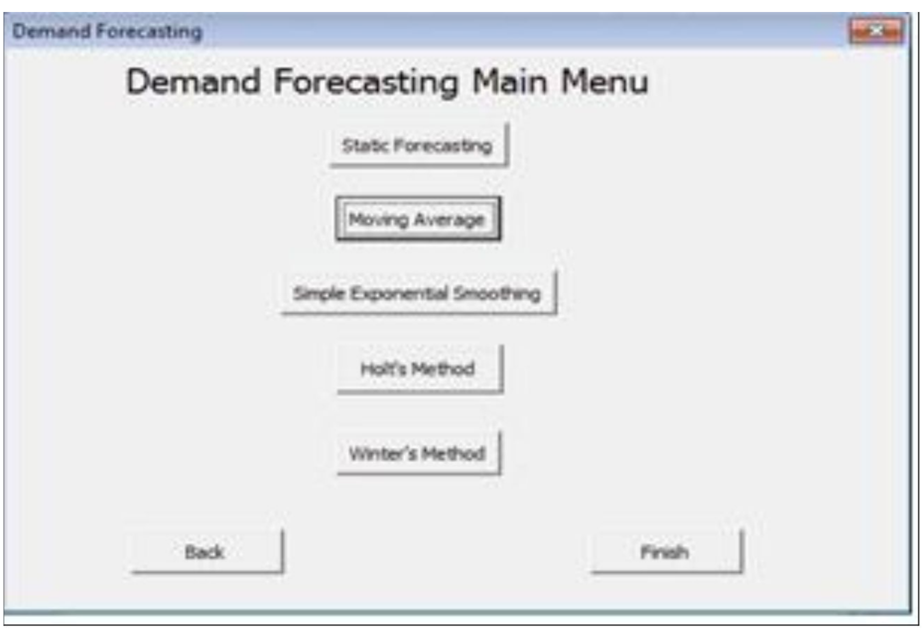
Step 4: General Plan for the software.

We will use a simple layout for the software, similar to what is shown in the Visual Basic

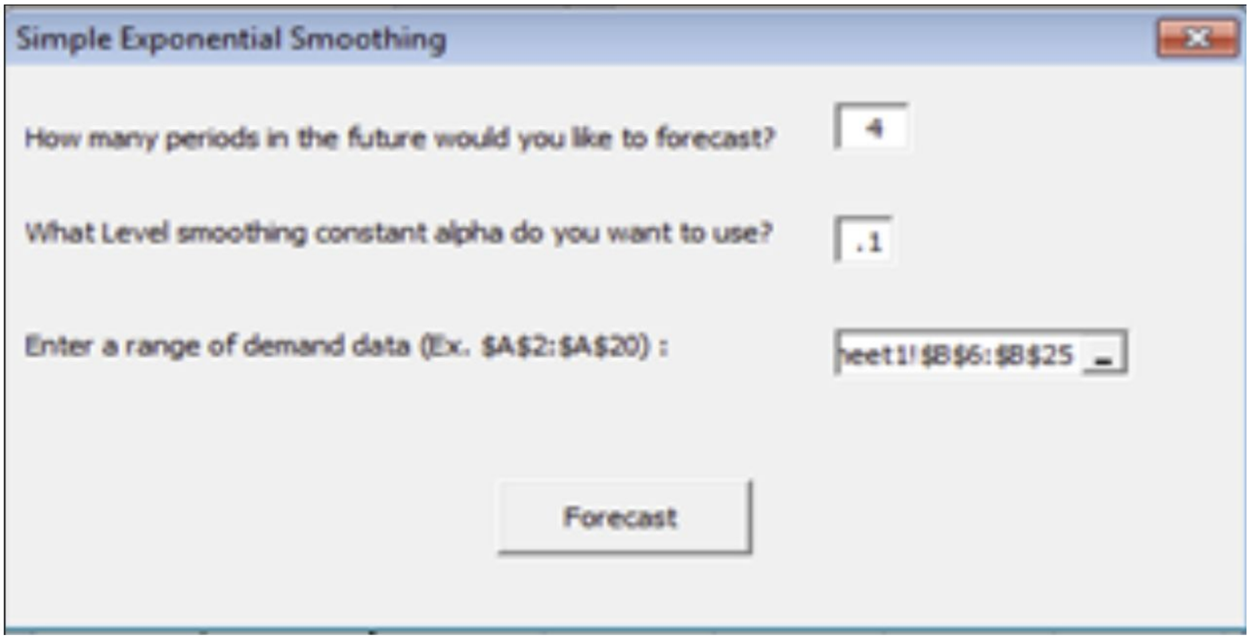
tutorial on the course website. The reason for using a simple layout is to avoid complicating what the user sees, improving the ease of use. The initial menu will look like:



After the initial menu we will show the user all the options for whatever module they select, allowing them to change the inputs to the scenario and see how the forecast or module changes. If the user selects the demand forecasting module they will be presented with a menu similar to the one shown in Visual Basic tutorial asking them to choose a method:



If the user were to select the static forecasting option they would be presented with a menu asking them to enter more inputs into the scenario. The next menu would be similar to:



This general process will be followed throughout the software. The initial menus will be fairly simple, and get progressively more involved as the user progresses through the modules. We will stick with the same layout to make the software more predictable and easier to use.

Section 5: Market Need Analysis

Section 5.1: Target Market

Markets our product overlaps into:
Pillow Market
Alarm Clock
Alarm Clock Pillow

Market Need Analysis/Target Market:

<table>
<tr><td>Sleeping Challenges that Snooze will help the buyer overcome</td><td>Our Solutions</td></tr>
<tr><td>Exhaustion/Poor Sleep Quality

Waking up in between REM cycles can often cause fatigue and exhaustion during the day.</td><td>Having a great start to the morning can determine how the day turns out.

Our pillow fosters starting the day with energy by detecting REM cycles via:
<table>
<tr><td>Heart Rate: detected through fiber optic sensors, which is capable of detecting a heart rate frequencies between 50 - 300 bpm with almost a linearity of 100%</td></tr>
<tr><td>Eye Movements: Detects the Rapid Eye Movement cycles to facilitate better sleep and the optimal time to wake up accordingly.</td></tr>
<tr><td>Actigraphy Motion Biosensor technology: Detects and monitors
1.Electroencephalography (EEG) [brain]
2. Electrooculogram (EOG) [eye movements]
3. Electromyography (EMG)[skeletal muscle activation]
4. Electrocardiography (ECG) [heart rhythm]</td></tr>
</table>
SWS deep sleep</td></tr>
</table>

<table>
<tr><td></td><td></td></tr>
<tr><td>Disturbance Prevention</td><td>The smart pillow will allow for only the user to wake up at a specified time while allowing others to continue their sleep with almost no disturbance via:
<table><tr><td>Use of vibration as an alarm clock</td></tr></table>
</td></tr>
<tr><td>Sleeping Disorders</td><td>With the advanced Actigraphy Motion Biosensor technology, the smart pillow has the ability to diagnose sleep disorders of:
<table>
<tr><td>Narcolepsy (decreased ability to regulate sleep cycles)
1. Cataplexy (sudden episode of muscle weakness), since cataplexy affects roughly 70% of people who have narcolepsy</td></tr>
<tr><td>Idiopathic hypersomnia (EDS - excessive daytime
1. The smart pillow will readily regulate sleep cycles for the best quality of sleep and rest</td></tr>
<tr><td>REM behavior disorder</td></tr>
</table>
By preventing multiple sleeping disorders, the advanced polysomnography technology could also potentially assist the prevention of:
<table><tr><td>Epilepsy</td></tr></table>
Since sleeping actively “charges” the brain, and epilepsy is a form of neurological disorder stemmed from exhaustion of the brain.
</td></tr>
</table>

Hearing Impaired	The smart pillow will allow for facilitating waking up on time yet with ease for the hearing impaired via: Vibration from the smart pillow. Eliminate traditional alarms for the hearing impaired.

Key demographic base analysis.

Key audience	Size
College Students and Young adults who may be in a roommate or partner living situation in which an alarm clock would be too noisy for waking up	Men and Women 18-29 years old 47 million people (15%)
Individuals with hearing disabilities that don’t have the extra help of someone else to personally wake them up.	Men and Women 18-59 years old 2.5 million people (0.8%)
Individuals who want the peace of a non-noise alarm clock and a system to help dictate healthy and restful sleep.	500,000 people (0.2%)
Individuals who are experiencing sleeping disorders such as Narcolepsy, Idiopathic hypersomnia (EDS - excessive daytime sleepiness), and REM behavior disorder	27 Million people (8.35%)
Individuals who are experiencing epilepsy and cataplexy from lack or disrupted sleep	3.2 Million people (0.9%)
Individuals who are experiencing brain disorders due to lack or disrupted sleep	42.5 Million people (13.15%)

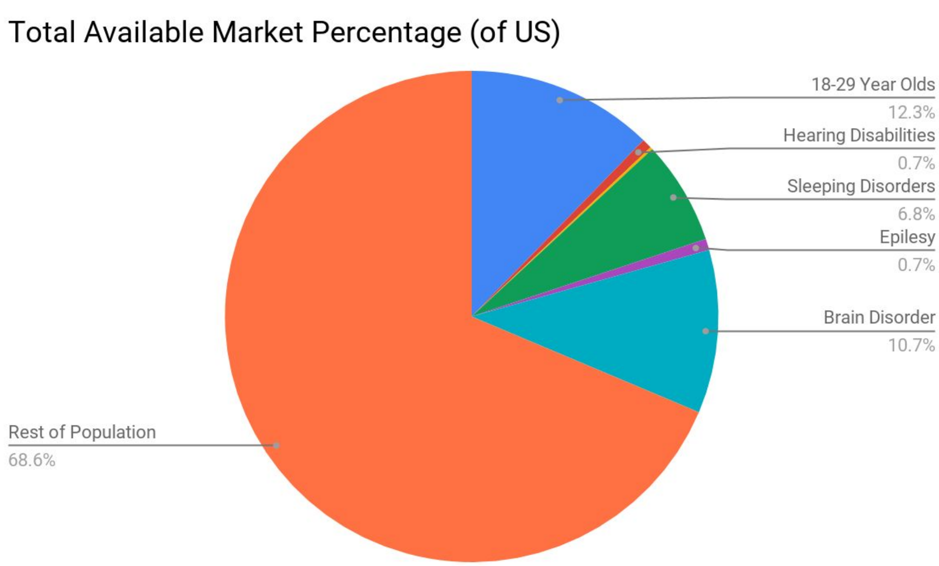
Section 5.2: Similar Channel Analysis

Although the Neybox Pillow is an advanced sleep tracking alarm clock that can "effortlessly measure and track your sleep quality, wake up refreshed and learn more about the benefits of great sleep", it is operated on a handheld device with accelerometer and gyroscope technology, a technology that does not provide the best data on sleep cycles of individuals.

Accelerometer and gyroscope technologies measures linear acceleration based on vibration, initially created to give people a direction of gravity, and is further intended to determine an angular position based on the principle of rigidity of space. Technologies designed to measure the direction of gravity and the angular position cannot full and is not meant to be used for detecting sleepy cycles. Therefore, yes there are currently a handful of successful existing channels in the market that are fulfilling the market need, however we bring new polysomnography technology to the table to coinciding with our vibrating technology to ensure healthy and restful sleep.

With this in mind, we can make our own fit in the alarm clock industry and draw a loyal audience to our technology

Section 5.3: Total Available Market Percentage



Given the described audience above and a feasible marketing strategy of a medium-sized company, our TAM would cover the US region. For example:

- College Students and Young Adults = 47 million

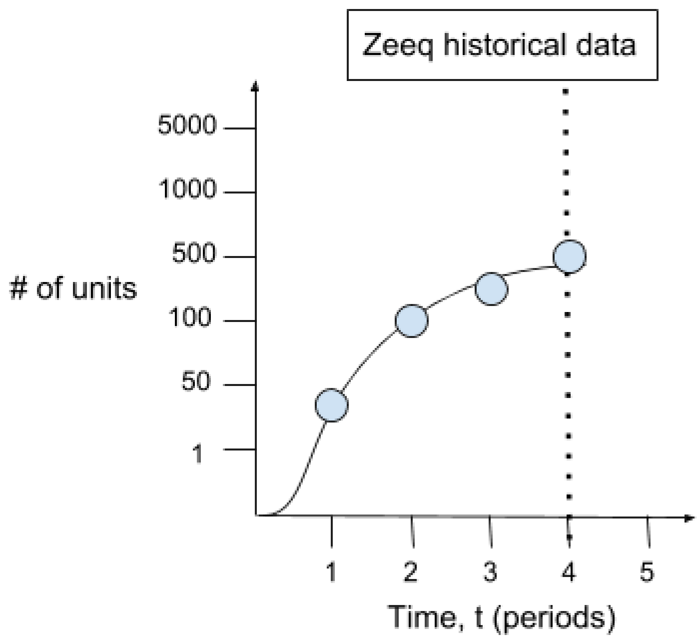
- Individuals with hearing disabilities = 2.5 million (1.75% of americans with moderate to severe hearing loss)
- Individuals with sleeping disorders: 27 million (8.35% of Americans)
- Individuals with brain disorders: 42.5 million (13.15% of Americans)
- Individuals with epilepsy and cataplexy: 3.2 million (0.9% of Americans)
- Various other individuals = 500,000 (at least interested and targetable)
    - This value is an incalculable number as it is very subjective, but you could expect at the very least that 1 in every 600 Americans could see themselves showing interest or even using this product.

Section 6: Financial Analysis

Section 6.1: Estimated Demand Data

1. Because we are a new company and must have high-responsiveness in the supply chain structure to succeed with our product in sales, our demand forecasting will dictate a Time Series analysis.
    a. Since we have no historical demand data to use, we will model our historical data off competing product data to setup our demand forecasting to make "future" predictions.
        i. Zeeq Smart Pillow - About 900 units in sales over its year long life span (data retrieved from Zeeq website https://rem-fit.com/zeeq)

2. Observed Demand: Below is a chart showing the historical data of the competing product "Zeeq" of demand in number of units in relation to the period.



- The above data can help us determine what to expect for our products demand during its first four quarters in sales.
    - Analysis: With demand starting around 40 units in the first quarter and ending just above 500 units in the fourth quarter, we can expect a significant increase in demand during our products first year.

3. Obtained Demand Data: Using the information above we get the following data.
    a. t1 = 40, t2 = 100, t3 = 250, t4 = 500

4. Our financial model parameters, based and collected from our competitors:

	A	B
1	Scenario Parameters	
2	Sales & Production Volume(units/year)	500,000
3	Development Cost($/year)	5,000,000
4	Unit Price($/unit)	30
5	Unit Productions Cost($/unit)	18
6	Ramp-up Cost($/quarter)	500,000
7	Marketing & Support Cost($/year)	666,667
8	Annual Discount Factor(%)	10

We have decided to price our product at $30, to slightly undercut similar products such as the iLove for affordability and a wider range of clients. We expect that our costs, including marketing and developmental, however to be similar to those of iLove. Since we are supplying our products for a cheaper value, we plan to make more models available from year to year while expanding our marketing efforts through continuous year-on-year investments. We expect this model to sell relative well at 500,000 units, for an NPV of a little over $5 million.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	($ values in thousands)																
2		Year 1				Year 2				Year 3				Year 4			
3	Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5																	
6	development Cost	-1,250	-1,250	-1,250	-1,250												
7	ramp-up cost				-250	-250											
8	marketing & support cost					-167	-167	-167	-167	-167	-167	-167	-167	-167	-167	-167	-167
9	production cost						-2,250	-2,260	-2,271	-2,275	-2,277	-2,282	-2,284	-2,290	-2,292	-2,296	-2,297
10	production volume						125,000	125,120	125,225	125,301	125,302	125,410	125,430	125,501	125,511	125,590	125,612
11	unit production cost						-0.01800	-0.01806	-0.01814	-0.01816	-0.01817	-0.01820	-0.01821	-0.01825	-0.01826	-0.01828	-0.01829
12	sales revenue						3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
13	sales volume						125,000	125,030	125,046	125,120	125,201	125,255	125,267	125,311	125,324	125,333	125,345
14	unit price						0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
15																	
16	period cash flow	-1,250	-1,250	-1,250	-1,500	-417	1,333	1,323	1,312	1,308	1,306	1,301	1,299	1,293	1,291	1,287	1,286
17	pv year 1, r=10%	-1,250	-1,220	-1,190	-1,393	-377	1,178	1,141	1,104	1,074	1,046	1,017	990	962	937	911	888
18																	
19	project NPV, $	5,818.322															
20		$5,818,322															

From this model, we can see that our production costs will continue to increase as we produce more units and models, yet by a slight amount. We will be spending more on marketing each year as well in order to create brand awareness while building our company’s image to pull clients and reach our NPV of $5 million.

Section 6.2: Cash Flow Analysis

- Data was drawn from our financial model

1	**CASH FLOW**		
2			
3	**Operations**		
4		Cash receipts from customers	5,818,322
5		Cash paid for:	
6		Inventory	-500,000
7		General operation	-5,000,000
8		Net cash flow from operations:	**318,322**
9			
10	**Investing Activities**	Cash receipts from:	
11		Property and equipment	33,600
12		Cash paid for:	
13		Purchase of property and equipment	-75,000
14		Net cash flow from investing	**-41,400**
15			
16	**Financing Activitie**	Cash receipts from:	
17		Issuance of stock	0
18		Borrowing	0
19		Cash paid for:	
20		Treasury stock	0
21		Repayments of loans	-34,000
22		Dividends	-53,000
23		Net cash clow from financing activities	**-87,000**
24			
25		Net increase in cash	**189,922**

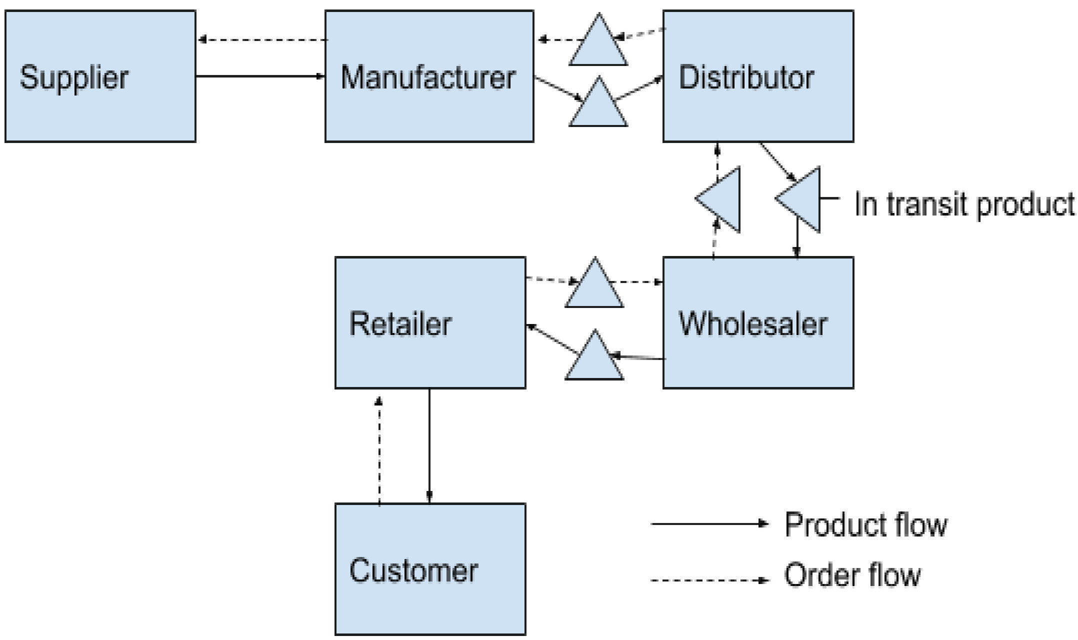
Section 7: Information System Plan

Section 7.1: High-Level Software Plan

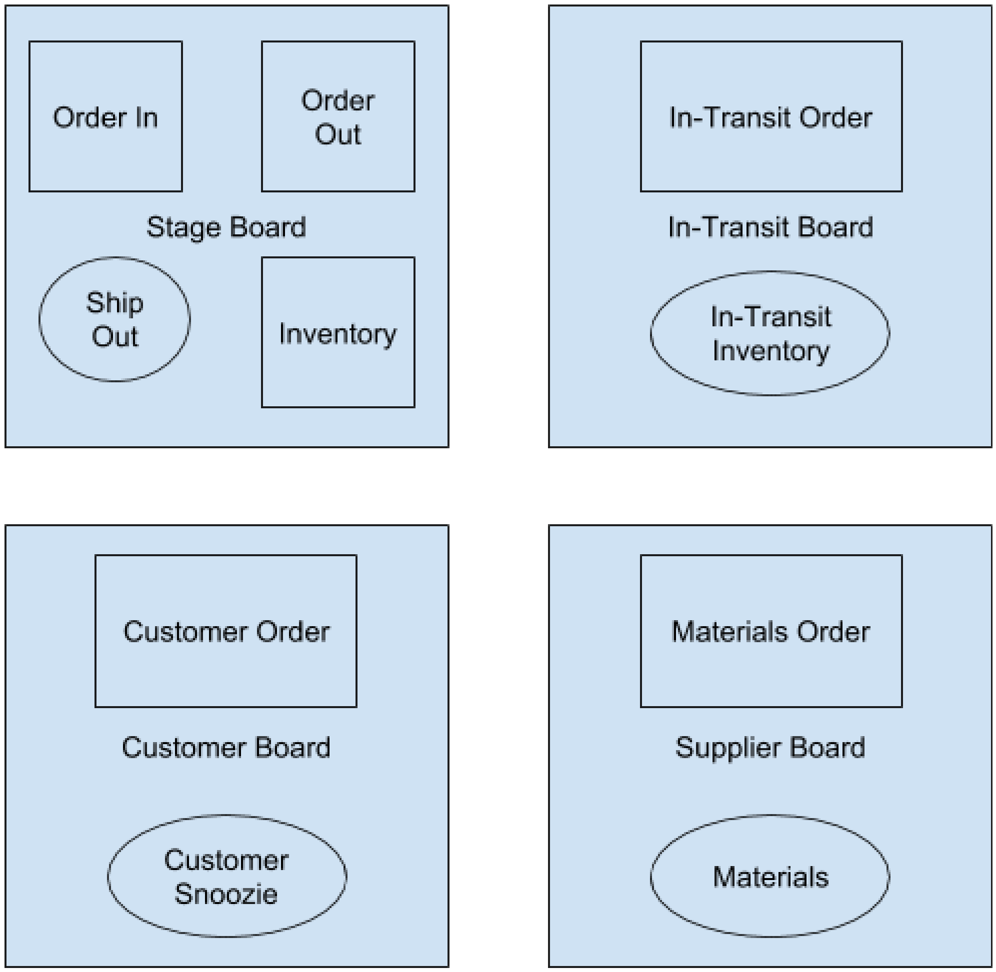
Our company will use an Information System (IS) to keep track of all of our supply chain information including our suppliers so we can manage our inventory. To get a good idea of how many units of our product to store on hand, we first need to figure out customer demand through *forecasting.* Through forecasting we can start planning on how much to store on hand.

Section 8: Beer Game Simulation

Section 8.1: Simulation

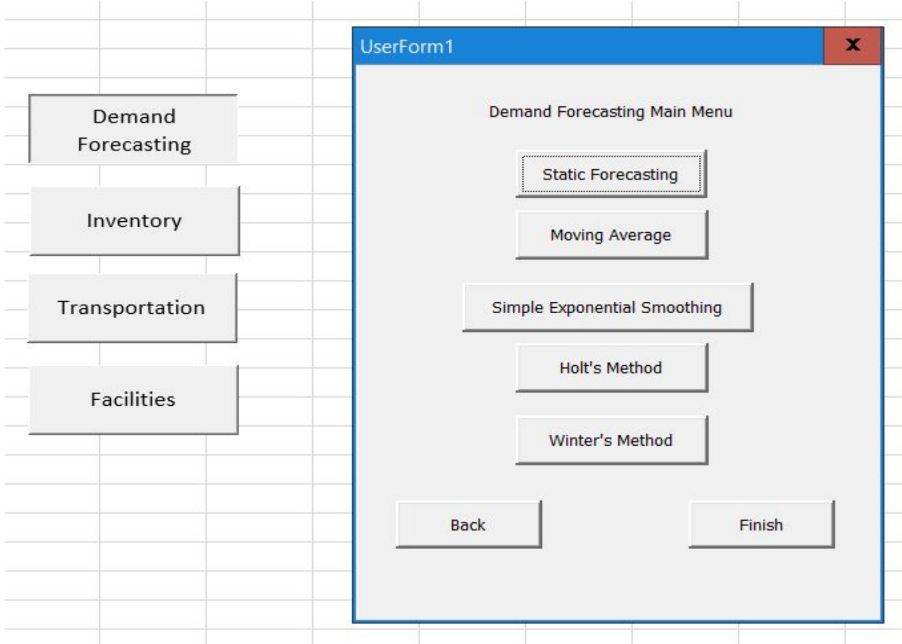


Game Board:


Order In
Order Out
Stage Board
Ship Out
Inventory
In-Transit Order
In-Transit Board
In-Transit Inventory
Customer Order
Customer Board
Customer Snoozie
Materials Order
Supplier Board
Materials

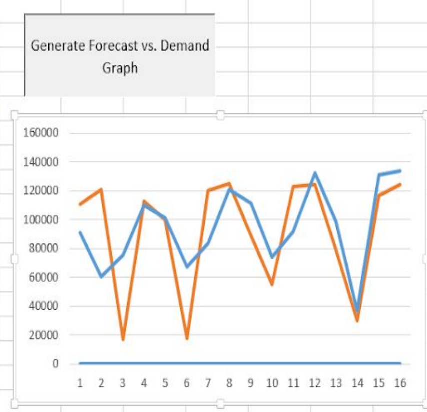
Section 9: Software Development

Section 9.1: Demand Forecasting Software

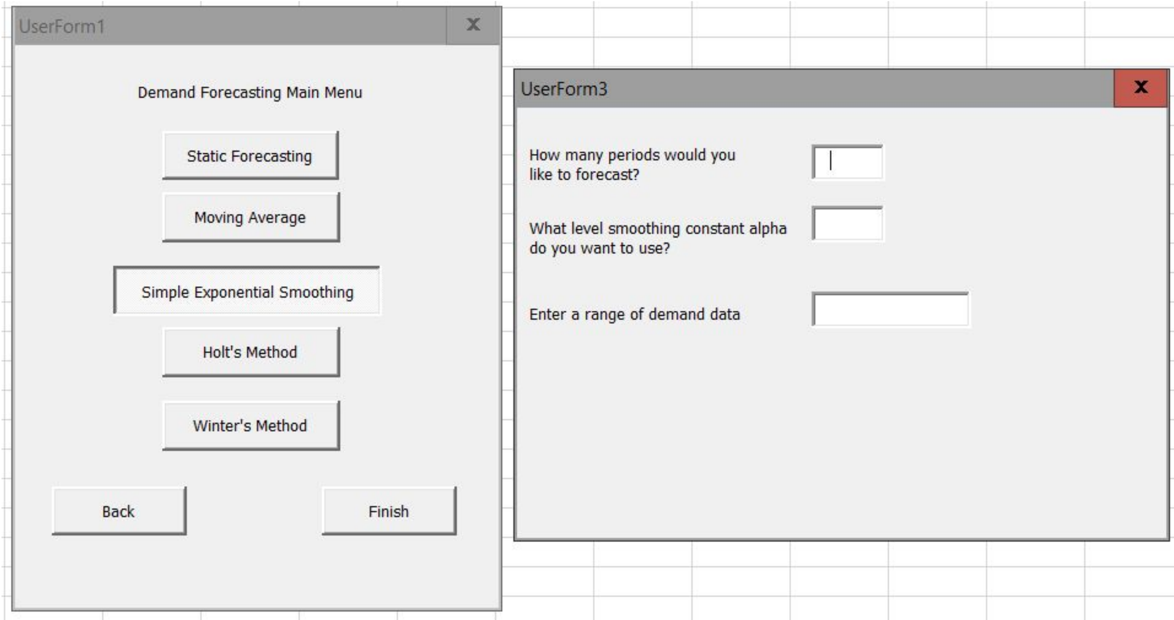


Analysis: To simplify our forecasting, we implemented a software framework using Excel and Visual Basic. Shown above is our GUI which allows the user to navigate through the different methods of forecasting with ease. Each button will forward the user to the appropriate spreadsheet where they can input data and see the forecast.

Period	Demand	Deseasonalized Demand	Seasonal Factor	Average Seasonal Factor	Forecast	Error	Forecast	Squared Error	MAD	Percent Error	MAPE	Bias	TS
1	111,000	18963	5.85	4.82	91311	-19,689	19689	3.88E+08	19689	18	17.74	-19,689	-1
2	120,700	19487	6.19	3.12	60738	-59,962	59962	1.99E+09	39825	50	33.71	-79,650	-2
3	17000	20011	0.85	3.79	75773	58773	58773	2.48E+09	46141	346	137.71	-20,877	-0.45
4	113,000	20535	5.5	5.35	109800	-3,200	3200	1.86E+09	35406	3	103.99	-24,077	-0.68
5	100,000	21059	4.75	3.91	101404	1404	1404	1.49E+09	28605	1	83.47	-22,673	-0.79
6	18,000	21583	0.83	1.44	67271	49271	49271	1.65E+09	32050	274	115.18	26,599	0.83
7	120,000	22107	5.43	4.99	83710	-36290	36290	1.6E+09	32656	30	103.05	-9,692	-0.3
8	125,000	22631	5.52	5.08	121008	-3992	3992	1.4E+09	29073	3	90.57	-13,684	-0.47
9	89,000	23155	3.84	2.32	111497	22,497	22497	1.3E+09	28342	25	83.31	8,813	0.31
10	55,000	23679	2.32		73804	18,804	18804	1.21E+09	27388	34	78.4	27,617	1.01
11	123,000	24203	5.08		91646	-31,354	31354	1.19E+09	27749	25	73.59	-3,737	-0.13
12	124,000	24727	5.01		132215	8,215	8215	1.09E+09	26121	7	68.01	4,478	0.17
13	79000	25251	3.13		98654	19654	19654	1.04E+09	25623	25	64.69	24,132	0.94
14	30,000	25775	1.16		37122								
15	117,000	26299	4.45		131136								
16	124,000	26299	4.72		133714								

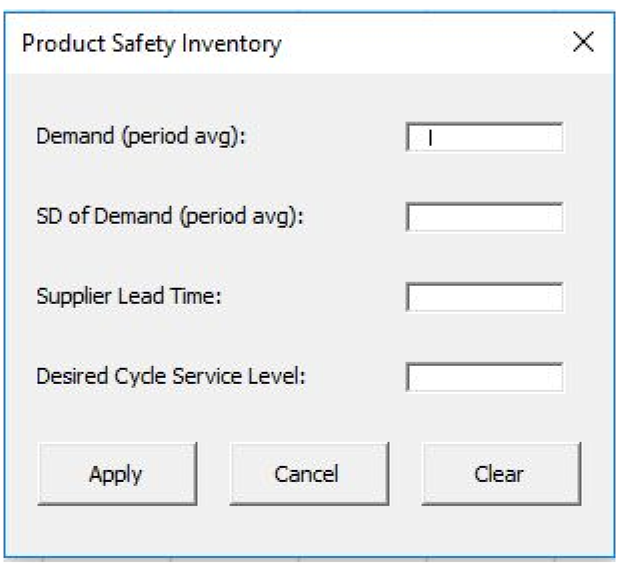


Analysis: We also added a button that will automatically plot the period, forecast and demand so we can easily see how demand compares to forecast. In adding this function, we will save a lot of time from trying to graph manually.



Analysis: Additionally, we implemented userforms for certain methods which will allow the user to input custom data to test different **case scenarios.** This will speed up the process for us in trying to input different data. The userform will read in the data inputted and update the spreadsheet accordingly.

Section 9.2: Inventory Software

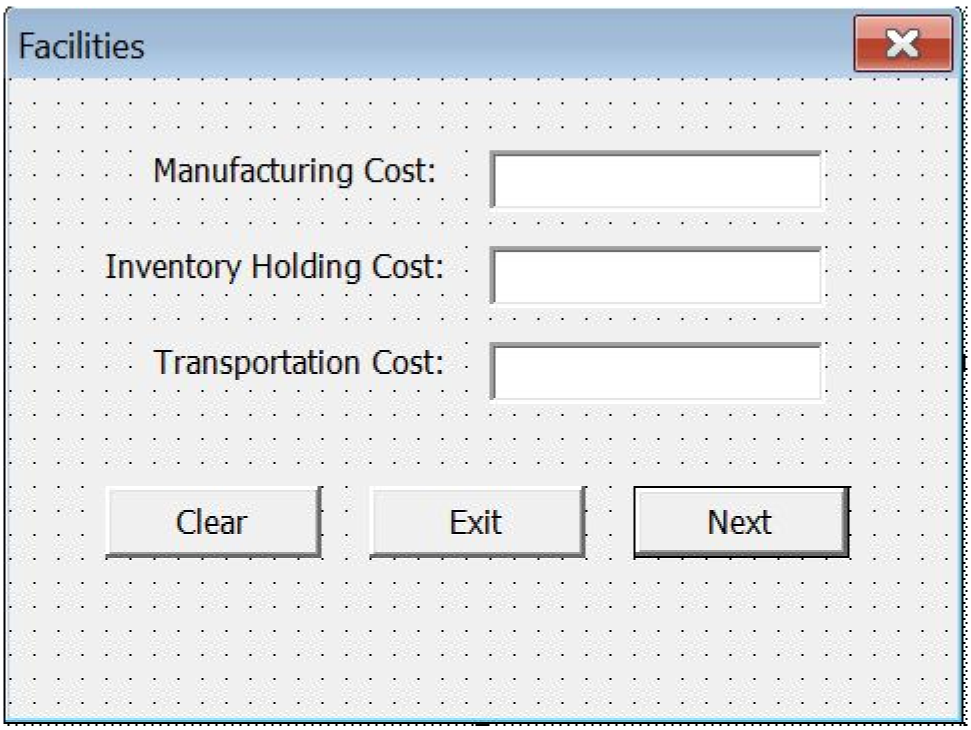


Analysis: We've implemented a faster way to calculate the required safety stock and re-order point by using the GUI seen above. By simply retrieving the data for demand, standard deviation of demand, supplier lead time, and desired cycle service level, the software implemented will compute the desired data.

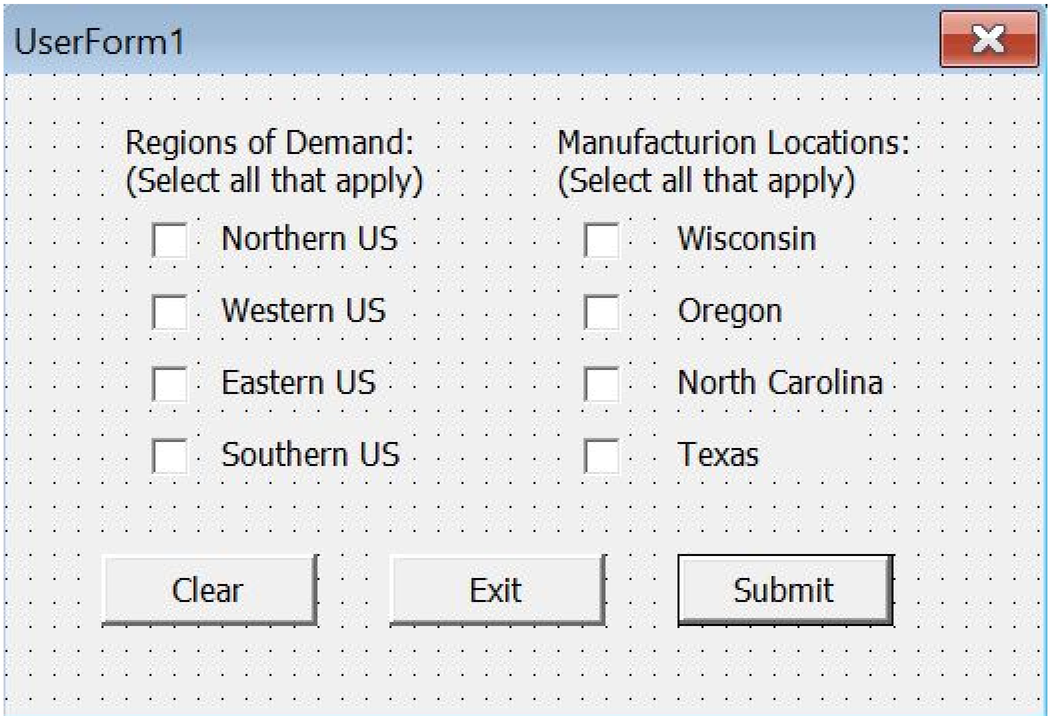
Section 9.3: Facilities Software

1. The first step in designing the facilities software is to identify the logistical values that we will need to manipulate in order to decide optimal facility location for price. These logistics cover the topics of regions of demand, manufacturing locations, region to region distances, manufacturing cost, inventory holding cost, and transportation cost.

2. From this we have developed two forms in order to populate a list to choose from to select optimal facility location for price.
   a. The first form as seen below, takes input of manufacturing costs, inventory holding costs, and transportation costs which are to be collectively evaluated in the total transportation cost given set locations.



   b. The second form, gives a variety of options for both regions of demand and manufacturing locations that are possible to produce and sell in. This information will be computed along with the above costs to produce a table that explains the costs of transportation of a product from a specific production location to a specific demand region. This is helpful in deciding the best location for facilities.



Analyze: This software can be used to help our company decide the costs of transportation given a facility's location. This is important as it is helpful in reducing costs in the supply chain, which is the ultimate goal in SCM.

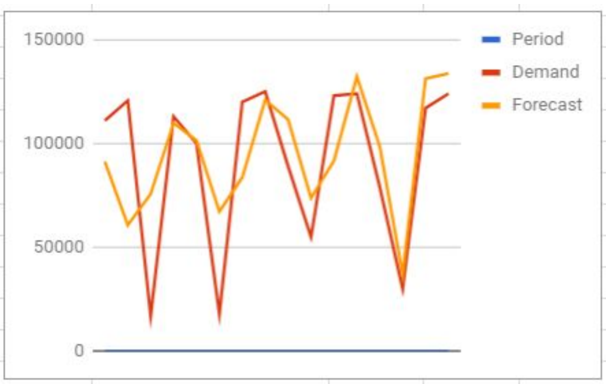
Section 10: Demand Forecasts

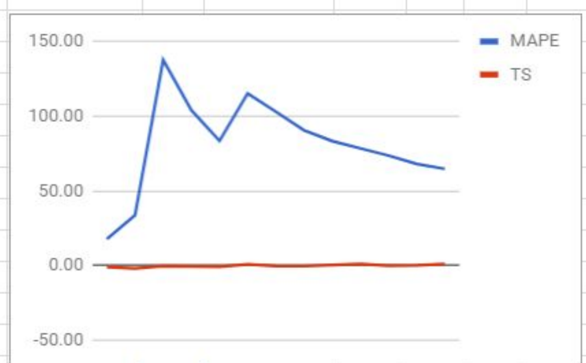
Section 10.1: Static Method

Static Forecasting

- Here the number of demand has been drawn from our financial model, and the numbers are not to exceed our production volume. There does lie seasonality in our demand, as customers will adjust what they want throughout the year.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Year	Quarter	Period	Demand	Deseasonalized Demand	Seasonal Factor	Average Seasonal Factor	Forecast	Error	Forecast	Squared Error	MAD	Percent Error	MAPE	Bias	TS
2	1	2	1	111,000	18963	5.85	4.82	91311	-19,68	19689	387638627	19689	18	17.74	-19,68	-1.00
3	1	3	2	120,700	19487	6.19	3.12	60738	-59,96	59962	1991518851	39825	50	33.71	-79,65	-2.00
4	1	4	3	17000	20011	0.85	3.79	75773	58773	58773	2479098503	46141	346	137.71	-20,87	-0.45
5	2	1	4	113,000	20535	5.50	5.35	109800	-3,200	3200	1861883301	35406	3	103.99	-24,07	-0.68
6	2	2	5	100,000	21059	4.75	3.91	101404	1,404	1404	1489901002	28605	1	83.47	-22,67	-0.79
7	2	3	6	18,000	21583	0.83	1.44	67271	49,271	49271	1646194383	32050	274	115.18	26,59	0.83
8	2	4	7	120,000	22107	5.43	4.99	83710	-36,29	36290	1599165916	32656	30	103.05	-9,692	-0.30
9	3	1	8	125,000	22631	5.52	5.08	121008	-3,992	3992	1401262541	29073	3	90.57	-13,68	-0.47
10	3	2	9	89,000	23155	3.84	2.32	111497	22,497	22497	1301801502	28342	25	83.31	8,813	0.31
11	3	3	10	55,000	23679	2.32		73804	18,804	18804	1206981343	27388	34	78.40	27,61	1.01
12	3	4	11	123,000	24203	5.08		91646	-31,35	31354	1186624864	27749	25	73.59	-3,737	-0.13
13	4	1	12	124,000	24727	5.01		132215	8,215	8215	1093363210	26121	7	68.01	4,478	0.17
14	4	2	13	79000	25251	3.13		98654	19654	19654	1038972469	25623	25	64.69	24,13	0.94
15	4	3	14	30,000	25775	1.16		37122								
16	4	4	15	117,000	26299	4.45		131136								
17	1	1	15	124,000	26299	4.72		133714								
18																



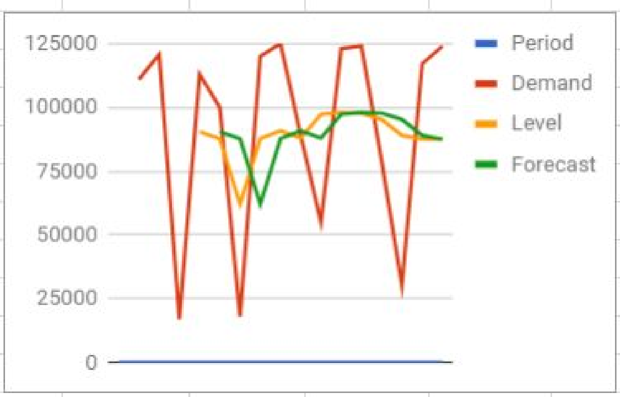


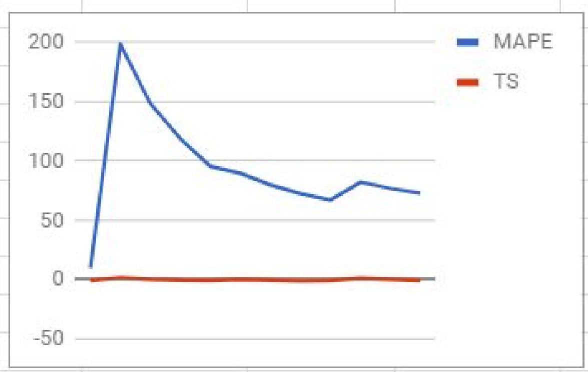
Results: The TS and MAPE are two of the more important variables when looking at a forecast. Since the TS has a range from -2 to 0.94 and within the +/- 6 bracket, the forecast is considerably acceptable with little bias. The MAPE, however, entails a fairly high percentage of 81.03%, and should not be completely based upon.

Section 10.2: Moving Average

Moving average:

	A	B	C	D	E	F	G	H	I	J	K
1	Period	Demand	Level	Forecast	Error	Absolute Error	Squared Error	MAD	Percent Error	MAPE	TS
2	0										
3	1	111,000									
4	2	120,700									
5	3	17000									
6	4	113,000	90,425								
7	5	100,000	87,675	90,425	-9,575	9575	91680625	9575	10	10	-1.00
8	6	18,000	62000	87,675	69,675	69675	2473143125	39625	387	198	1.52
9	7	120,000	87,750	62000	-58000	58000	2770095417	45750	48	148	0.05
10	8	125,000	90,750	87,750	-37,250	37250	2424462188	43625	30	119	-0.81
11	9	89,000	88,000	90,750	1,750	1750	1940182250	35250	2	95	-0.95
12	10	55,000	97,250	88,000	33,000	33000	1798318542	34875	60	89	-0.01
13	11	123,000	98,000	97,250	-25,750	25750	1636139107	33571	21	80	-0.78
14	12	124,000	97,750	98,000	-26,000	26000	1516121719	32625	21	72	-1.60
15	13	79000	95,250	97,750	18,750	18750	1386726250	31083	24	67	-1.07
16	14	30,000	89,000	95,250	65,250	65250	1673809875	34500	218	82	0.92
17	15	117,000	87,500	89,000	-28,000	28000	1592918068	33909	24	77	0.11
18	16	124,000	87500	87,500	-36,500	36500	1571195729	34125	29	73	-0.96



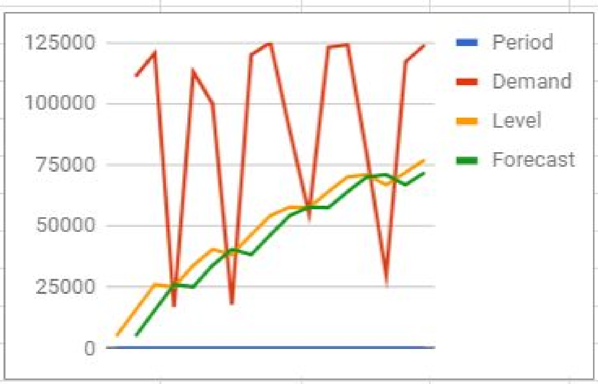


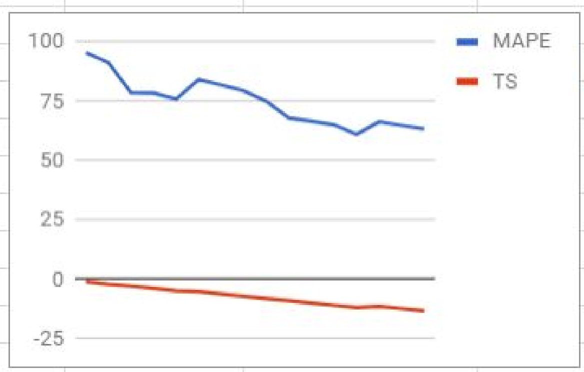
Results: Using the Moving Average method of forecasting we can identify the range of TS within the -1.60 to 1.52 bracket, and since it is within the +/- 6 range, this TS is fairly acceptable. The MAPE, however is fairly high, at 109%, which may entail a bias, and should not be completely based upon.

Section 10.3: Simple Exponential Smoothing

- Simple Exponential smoothing

	A	B	C	D	E	F	G	H	I	J	K
1	Period	Demand	Level	Forecast	Error	Absolute Error	Mean Squared Error	MAD	Percent Error	MAPE	TS
2	0		5,000								
3	1	111,000	15600	5,000	-106,000	106000	11236000000	106000	95	95	-1.00
4	2	120,700	26110	15,600	-105,100	105100	11141005000	105550	87	91	-2.00
5	3	17000	25199	26,110	9,110	9110	7455000700	73403	54	79	-2.75
6	4	113,000	33979	25,199	-87,801	87801	7518504425	77003	78	78	-3.76
7	5	100,000	40581	33,979	-66,021	66021	6886555388	74806	66	76	-4.76
8	6	18,000	38323	40,581	22,581	22581	5823781180	66102	125	84	-5.04
9	7	120,000	46491	38,323	-81,677	81677	5944829687	68327	68	82	-6.07
10	8	125,000	54342	46,491	-78,509	78509	5972188495	69600	63	80	-7.09
11	9	89,000	57808	54,342	-34,658	34658	5442078510	65718	39	75	-8.04
12	10	55,000	57527	57,808	2,808	2808	4898658875	59427	5	68	-8.84
13	11	123,000	64074	57,527	-65,473	65473	4843030273	59976	53	67	-9.85
14	12	124,000	70067	64,074	-59,926	59926	4738703973	59972	48	65	-10.85
15	13	79000	70960	70,067	-8,933	8933	4380327066	56046	11	61	-11.77
16	14	30,000	66864	70,960	40,960	40960	4187283895	54968	137	66	-11.25
17	15	117,000	71878	66,864	-50,136	50136	4075706123	54646	43	65	-12.24
18	16	124,000	77090	71,878	-52,122	52122	3990770958	54488	42	63	-13.23
19											





Results: The TS for the Simple Exponential Smoothing method of forecasting ranges from -13.23 to -1.00, and since it is not within the +/-6 range, the bias is considerably high and should not be completely based upon. The MAPE is at 70.29%, which is also a fairly high percentage error. The bullwhip effect is a distribution channel phenomenon in which forecasts yield supply chain inefficiencies. It refers to increasing swings in inventory in response to shifts in customer demand as one moves further up the supply chain.

Section 10.4: Holt's Model

Holt's Method

- I will use alpha = 0.06 and beta = 0.06 as my smoothing constants.

Step 1: First we run a linear regression on the data to obtain the initial level and trend.

L0 = 86,033 and T0 = 655.74.

Step 2: Based on the initial level and trend I calculate the level and trend for the remainder of the periods. This is shown in Excel:

	A	B	C	D
1	Period	Demand	Level	Trend
2	0		86,033	655.74
3	1	111,000	88,147	743
4	2	120,700	90,799	858
5	3	17,000	87,178	589
6	4	113,000	89,281	680
7	5	100,000	90,563	716
8	6	18,000	86,882	452
9	7	120,000	89,294	570
10	8	125,000	91,972	696
11	9	89,000	92,448	683
12	10	55,000	90,844	546
13	11	123,000	93,286	660
14	12	124,000	95,749	768
15	13	79,000	95,466	705
16	14	30,000	92,200	467
17	15	117,000	94,127	554
18	16	124,000	96,440	660
19				
20				
21				

Step 3: Based on the level and trend we now calculate the Forecast for the remainder of the periods. For any time t, Ft+1 = Lt + Tt. The complete forecast is shown in Excel as:

	A	B	C	D	E
1	Period	Demand	Level	Trend	Forecast
2	0		86,033	655.74	
3	1	111,000	88,147	743	86,689
4	2	120,700	90,799	858	88,891
5	3	17,000	87,178	589	91,657
6	4	113,000	89,281	680	87,767
7	5	100,000	90,563	716	89,960
8	6	18,000	86,882	452	91,279
9	7	120,000	89,294	570	87,334
10	8	125,000	91,972	696	89,864
11	9	89,000	92,448	683	92,668
12	10	55,000	90,844	546	93,131
13	11	123,000	93,286	660	91,389
14	12	124,000	95,749	768	93,946
15	13	79,000	95,466	705	96,517
16	14	30,000	92,200	467	96,170
17	15	117,000	94,127	554	92,667
18	16	124,000	96,440	660	94,681
19					

Step 4: Finally, we perform an error analysis calculating the error, absolute error, Mean Squared Error, Mean Absolute Deviation, Percent Error, Mean Absolute Percentage Error, and Tracking Signal. This is shown in Excel:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Period	Demand	Level	Trend	Forecast	Error	Absolute Error	Mean Squared Error	MAD	Percent Error	MAPE	TS
2	0		86,033	655.74								
3	1	111,000	88,147	743	86,689	-24,311	24,311	591,037,363	-24,311	22	21.90	-1.00
4	2	120,700	90,799	858	88,891	-31,809	31,809	801,435,224	-28,060	26	24.13	-2.00
5	3	17,000	87,178	589	91,657	74,657	74,657	2,392,179,847	6,179	439	162.47	21.17
6	4	113,000	89,281	680	87,767	-25,233	25,233	1,953,316,030	-1,674	22	127.44	-93.18
7	5	100,000	90,563	716	89,960	-10,040	10,040	1,582,811,332	-3,347	10	103.96	-49.61
8	6	18,000	86,882	452	91,279	73,279	73,279	2,213,973,579	9,424	407	154.48	25.40
9	7	120,000	89,294	570	87,334	-32,666	32,666	2,050,127,301	3,411	27	136.30	79.74
10	8	125,000	91,972	696	89,864	-35,136	35,136	1,948,178,680	-1,407	28	122.78	-218.22
11	9	89,000	92,448	683	92,668	3,668	3,668	1,733,209,651	-843	4	109.59	-368.49
12	10	55,000	90,844	546	93,131	38,131	38,131	1,705,289,034	3,054	69	105.57	114.25
13	11	123,000	93,286	660	91,389	-31,611	31,611	1,641,102,379	-97	26	98.31	-3,911.05
14	12	124,000	95,749	768	93,946	-30,054	30,054	1,579,616,381	-2,594	24	92.13	-158.30
15	13	79,000	95,466	705	96,517	17,517	17,517	1,481,709,832	-1,047	22	86.75	-408.98
16	14	30,000	92,200	467	96,170	66,170	66,170	1,688,624,339	3,754	221	96.31	131.65
17	15	117,000	94,127	554	92,667	-24,333	24,333	1,615,523,580	1,882	21	91.28	275.58
18	16	124,000	96,440	660	94,681	-29,319	29,319	1,568,279,517	-68	24	87.05	-8,039.85
19												

Results: The average tracking signal using Holt's Method is -787 which is greater than six, so this forecast is unacceptable and cannot be used going forward.

Section 10.5: Winter's Model

- We will use alpha = 0.06, beta = 0.06, and gamma = 0.06 as my smoothing constants.

Step 1: We calculate the initial level, trend, and seasonality for the first four periods. We calculate these values just as in the static forecasting method. L0 = 80,504, T0 = 1,018, S1 = 1.09, S2 = 0.65, S3 = 1.03, S4 = 1.34.

Step 2: Using the initial level, trend, and seasonality, we calculate the level, trend, and seasonality for the remainder of the forecast. This is shown in Excel:

	A	B	C	D	E
1	Period	Demand	Level	Trend	Seasonal Factor
2	0		80504	1018	
3	1	111,000	82,741	1,091	1.09
4	2	120,700	89,944	1,458	0.65
5	3	17,000	86,908	1,188	1.03
6	4	113,000	87,870	1,175	1.34
7	5	100,000	89,131	1,180	1.11
8	6	18,000	85,870	913	0.69
9	7	120,000	88,923	1,042	0.98
10	8	125,000	90,178	1,055	1.34
11	9	89,000	90,586	1,016	1.11
12	10	55,000	91,086	985	0.66
13	11	123,000	93,911	1,095	1.00
14	12	124,000	94,859	1,086	1.34
15	13	79,000	94,503	1,000	1.10
16	14	30,000	92,504	820	0.66
17	15	117,000	94,603	897	1.02
18	16	124,000	95,331	887	1.34

Step 3: We can now calculate the forecast for the remainder of the periods. For any time t, Ft+1 = (Lt+Tt)*St+1. The complete forecast is shown in Excel.

	A	B	C	D	E	F
1	Period	Demand	Level	Trend	Seasonal Factor	Forecast
2	0		80504	1018		
3	1	111,000	82,741	1,091	1.09	88,859
4	2	120,700	89,944	1,458	0.65	54,491
5	3	17,000	86,908	1,188	1.03	94,143
6	4	113,000	87,870	1,175	1.34	118,048
7	5	100,000	89,131	1,180	1.11	98,402
8	6	18,000	85,870	913	0.69	62,452
9	7	120,000	88,923	1,042	0.98	85,042
10	8	125,000	90,178	1,055	1.34	120,262
11	9	89,000	90,586	1,016	1.11	100,912
12	10	55,000	91,086	985	0.66	60,696
13	11	123,000	93,911	1,095	1.00	92,265
14	12	124,000	94,859	1,086	1.34	127,282
15	13	79,000	94,503	1,000	1.10	105,414
16	14	30,000	92,504	820	0.66	62,944
17	15	117,000	94,603	897	1.02	95,243
18	16	124,000	95,331	887	1.34	127,757

Step 4: Finally, we perform an error analysis calculating the error, absolute error, Mean Squared Error, Mean Absolute Deviation, Percent Error, Mean Absolute Percentage Error, and Tracking Signal. This is shown in Excel:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Period	Demand	Level	Trend	Seasonal Factor	Forecast	Error	Absolute Error	MSE	MAD	% Error	MAPE	TS
2	0		80504	1018									
3	1	111,000	82,741	1,091	1.09	88,859	-22,141	22,141	490,224,767	22,141	20	20	-1.00
4	2	120,700	89,944	1,458	0.65	54,491	-66,209	66,209	2,436,945,853	44,175	55	37	-2.00
5	3	17,000	86,908	1,188	1.03	94,143	77,143	77,143	3,608,331,278	55,165	454	176	-0.20
6	4	113,000	87,870	1,175	1.34	118,048	5,048	5,048	2,712,619,815	42,635	4	133	-0.14
7	5	100,000	89,131	1,180	1.11	98,402	-1,598	1,598	2,170,606,430	34,428	2	107	-0.23
8	6	18,000	85,870	913	0.69	62,452	44,452	44,452	2,138,162,256	36,099	247	130	1.02
9	7	120,000	88,923	1,042	0.98	85,042	-34,958	34,958	2,007,293,082	35,936	29	116	0.05
10	8	125,000	90,178	1,055	1.34	120,262	-4,738	4,738	1,759,187,782	32,036	4	102	-0.09
11	9	89,000	90,586	1,016	1.11	100,912	11,912	11,912	1,579,489,803	29,800	13	92	0.30
12	10	55,000	91,086	985	0.66	60,696	5,696	5,696	1,424,784,997	27,390	10	84	0.53
13	11	123,000	93,911	1,095	1.00	92,265	-30,735	30,735	1,381,134,365	27,694	25	78	-0.58
14	12	124,000	94,859	1,086	1.34	127,282	3,282	3,282	1,266,937,658	25,659	3	72	-0.50
15	13	79,000	94,503	1,000	1.10	105,414	26,414	26,414	1,223,151,948	25,718	33	69	0.53
16	14	30,000	92,504	820	0.66	62,944	32,944	32,944	1,213,305,660	26,234	110	72	1.77
17	15	117,000	94,603	897	1.02	95,243	-21,757	21,757	1,163,974,999	25,935	19	69	0.95
18	16	124,000	95,331	887	1.34	127,757	3,757	3,757	1,092,108,722	24,549	3	64	1.16
19													

Results: The MAPE and TS are important components of securing accuracy. The TS ranges from -2.00 to 1.77 with an average of 0.098, meaning it does not under-forecast while being less than 6. Thus, the forecast is acceptable.

Section 11: Inventory

Section 11.1: Cycle Inventory

Definition: *Cycle inventory* is the average inventory in a supply chain due to either production or purchase in the lot sizes that are larger in demand.

Step 1: Identify the components in the product.

We need to b the cycle inventory for each component in the Snoozie, so we must first identify the components in the product.

Component	*Purpose*
Motor	To vibrate pillow.
Bluetooth Electronics	Connect to temperature monitor, heart rate monitor, and application in order to set up alarm.
Heart Rate Monitoring Electronics	Monitors user's heart rate to help compute optimal sleep schedule and wake times.
Diffuser Pad	Prevent user from feeling Bluetooth Device and Vibrating Attachment unless it is vibrating.
Temperature Monitor	Keeps track of user temperature to regulate temperature based on user settings.

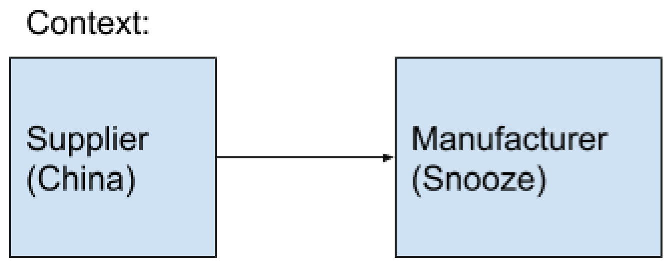
Each Snoozie has one unit of each component and each component has the same supplier lead time, so we can assume that the demand for the Snoozie is the same as the demand for each component. The cycle inventory will also be the same for each component. We will calculate the cycle inventory for motors step by step, and use that calculation for the remainder of the components.

We will be using the forecast done using Winter's Method as it resulted in the smallest average percent error. We will be using a continuous review policy because we are a new company and have high levels of demand uncertainty.

Total demand throughout the forecast is 1,465,700 units and the forecast is spread over 208 weeks, so the average demand per week is 7,046.63 units. The daily demand will be 1006.66 units.

Step 2: Determine the lot size.

We first determine the lot size in order to establish the number of units of supply in each order.



With a lead time of 2 weeks, our shipment will need to frequent our shipping docks biweekly. Given that weekly demand is 7,046.63 units, our lot size will need to be 14,093.26 ~ 14,094.

Step 3: Determine Optimal Lot Size.

The Optimal Lot Size will minimize the total cost of each component of Snoozie.

Variable	**Unit**	**Value**
h	Holding Cost	20%
C	Material / Unit Cost	$16
Dd	Daily Demand	1006.66
D	Annual Demand	366,425
S	Shipment order / cost	$500
Ql	Lot Size	14,094
Ql*	Optimal Lot Size	21,336

Comment: Demand data was forecasted using, Winter's method since it had the lowest MAD and MAPE of all the methods used.

Optimal Lot Size = Ql* = √(2DS/hC)
Ql* = √(2*1,465,700*500/0.2*16) = **21,336**

Step 4: Determine Average Inventory.

We need to determine the average inventory in order to compare current inventory levels with future inventory levels.

Cycle inventory = lot size/2 = Ql*/2
Cycle inventory = 21,336/2 = 10,668

Comment: We are using the value of Ql* in order to minimize total cost.

Step 5: Determine Flow Time.

We need to determine flow time in order to determine the amount of time one unit of supply is in inventory.

Formula:

Flow Time = $(1/Q_L)\int_0^{QL} t dQ = (1/Q)[(½)Q_L T] = T/2$

Flow Time = 2/2 = 1 Week

This concludes that on average, 1 Snooze unit will stay in inventory for 1 week.

Step 6: Determine Shipment Frequency.

We need to determine shipment frequency in order to calculate the number of shipments per year.

Formula:

Shipments per year = $n = D/Q^*_L$

n = 366,425/21,336 = 17.17

This concludes that Snooze will have about 17.17 shipments from the supplier per year.

Step 7: Determine cycle inventory holding cost.

We need to determine cycle inventory holding cost in order to minimize the cycle inventory holding cost for Snoozie.

Formula:

Minimum Cycle Inventory Holding Cost = $C^*_I = (Q^*_L/n)hC$

C^*_I= (21,336/17.17)(0.20*16) = 3976.42

This concludes that the minimum cost of holding our annual inventory is $3976.42.

Section 11.2: Safety Inventory

Definition: *Safety Inventory* is excess inventory kept so a company can still satisfy their customers needs in case actual demand exceeds forecasted demand.

We will be using the forecast done using Winter's Method as it resulted in the smallest average percent error. We will be using a continuous review policy because we are a new company and have high levels of demand uncertainty. Using a continuous review policy will allow us to adjust to changes in demand in real time. Given that we will develop an information system to track the flow of products in and out of our facilities, it will be fairly easy to implement this continuous review policy.

Step 1: Identify the components in the product.

We need to calculate the safety inventory for each component in the Snoozie, so we must first identify the components in the product.

Component	*Purpose*
Motor	To vibrate pillow.
Bluetooth Electronics	Connect to temperature monitor, heart rate monitor, and application in order to set up alarm.
Heart Rate Monitoring Electronics	Monitors user's heart rate to help compute optimal sleep schedule and wake times.
Diffuser Pad	Prevent user from feeling Bluetooth Device and Vibrating Attachment unless it is vibrating.
Temperature Monitor	Keeps track of user temperature to regulate temperature based on user settings.

Each Snoozie has one unit of each component and each component has the same supplier lead time, so we can assume that the demand for the Snoozie is the same as the demand for each component. The safety inventory will also be the same for each component. We will calculate the safety inventory for motors step by step, and use that calculation for the remainder of the components.

Step 2: Calculate the weekly demand statistics for motors.

We first calculate the mean demand per week for motors so that we can understand what demand we will face during the lead time for the product. Total demand throughout the forecast is 1,465,700 units and the forecast is spread over 208 weeks, so the average demand per week is 7,046.63 units.

Step 3: Calculate the weekly standard deviation for motors.

We next calculate the weekly standard deviation in demand for motors to understand what standard deviation of demand we will face during the supplier lead time. Standard deviation per week is the standard deviation of the forecast error for all the periods divided by the number of weeks per period. Each period is comprised of 13 weeks and the standard deviation per period is 34,081 units, so the standard deviation for motors per week is 2,621.62 units.

Step 4: Determine the lead time for deliveries of motors.

Our manufacturers take two weeks to satisfy orders, so our lead time is 2 weeks. Our Cycle Service Level, CSL, is 95% or 0.95.

Step 5: Calculate the demand statistics for the supplier lead time.

We now calculate both the mean demand and standard deviation during the lead time. The mean demand during the lead time is the mean demand per week multiplied by the lead time, and the standard deviation during the lead time is the square root of the lead time multiplied by the standard deviation per week.

Demand during the lead time, DL = 7,046.63 * 2 = 14,093.26 units.

Standard deviation during the lead time, SL = sqrt(2) * 2,621.62 = 3,707.53 units.

Step 6: Calculate the amount of motors we will carry as safety inventory.

Safety inventory, ss = NORMSINV(0.95) * SL = **6,098.34 units.**

Step 7: Calculate the reorder point, ROP, for motors.

ROP = DL + ss = 14,093.26 + 6,098.34 = 20,191.6 or 20,192 units.

Variable	**Unit**	**Value**
DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units
L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95
SS	Safety Inventory	6,098.34 units
ROP	Reorder Point	20,192 units

Step 8: Safety Inventory for Bluetooth Electronics component.

Variable	**Unit**	**Value**

DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units
L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95
SS	Safety Inventory	6,098.34 units
ROP	Reorder Point	20,192 units

Step 9: Safety Inventory for Heart Rate Monitoring Electronics component.

Variable	**Unit**	**Value**
DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units
L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95
SS	Safety Inventory	6,098.34 units
ROP	Reorder Point	20,192 units

Step 10: Safety Inventory for Diffuser Pads component.

Variable	**Unit**	**Value**
DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units

L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95
SS	Safety Inventory	6,098.34 units
ROP	Reorder Point	20,192 units

Step 11: Safety Inventory for Temperature Monitors.

Variable	**Unit**	**Value**
DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units
L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95
SS	Safety Inventory	6,098.34 units
ROP	Reorder Point	20,192 units

Step 12: Calculate the safety inventory for the Snoozie.

The safety inventory for the Snoozie is the same as every for every other component, except we don't have a reorder point for the Snoozie, just the components.

Variable	**Unit**	**Value**
DL	Demand during lead time	14,093.26 units
SL	Standard Deviation during lead time	3,707.53 units
L	Lead time	2 weeks
CSL	Cycle Service Level	95% or 0.95

SS	Safety Inventory	6,098.34 units

Step 13: Calculate the Fill Rate for the Snoozie.

We need to understand the Fill Rate that will be achieved given this safety inventory policy to determine if it is satisfactory. To calculate the fill rate we first calculate the expected shortage per replenishment cycle, ESC.

ESC = -ss[1-NORMDIST(ss/SL,0,1,1)] + SL*NORMDIST(ss/SL,0,1,0)

= 6098.34 * (1-NORMDIST(6098.34/3707.53,0,1,1)) + 3707.53 * NORMDIST(6098.34/3707.53,0,1,0) = 77.46

We can now calculate the fill rate that will be achieved with our safety inventory policy.

Fill Rate, fr = (Lot Size - ESC)/Lot Size = (21,336 - 77.46)/21,336 = 0.9964 = 99.64% which is acceptable.

Expected Shortage per Replenishment Cycle	78 units
Fill Rate	99.64%

Section 12: Our Six Drivers

- **Facilities:** Our manufacturing facility will be located in ShenZhen, China, for most cost-efficient facilities, equipment and labor. Our facility will further be located near most of our suppliers. This will provide us with a more cost-efficient strategy, as land, labor and material costs have proven to be cheaper in China.
- **Inventory:** We will hold a safety inventory of 12,099 units and when our inventory drops below 35,000 units on hand, we will re-order inventory to meet customer demand.
- **Transportation:** Transportation for our materials and finished products will be sourced domestically and internationally. The materials will be purchased from the companies listed under “Sourcing”, and will be transported domestically by cargo trucks into our manufacturing facilities in China by Shenzhen Uni-Home International Logistics Co., Ltd. At the end of our manufacturing process, we will continue to partner with Shenzhen Uni-Home International Logistics Co., Ltd. to ship our finished products to our warehouse in the US, which will later be distributed to our stores.
- **Information:** Since we are using a continuous review policy for our safety inventory we will need an Information System developed well enough to give us real time data from each part of the supply chain. We will also use the

Information System to track and optimize the movement of materials, information, and finances throughout the SC.

Our Supply Chain consists of the suppliers we purchase parts from, the facilities where we assemble the products, the distribution centers where we send products to retailers, and the customers who will purchase the products. I will describe how our SCM software can be used at each phase of the Supply Chain.

Suppliers: We will not be sourcing any materials or inputs ourselves so the SCM software will not be used in this phase of the Supply Chain.

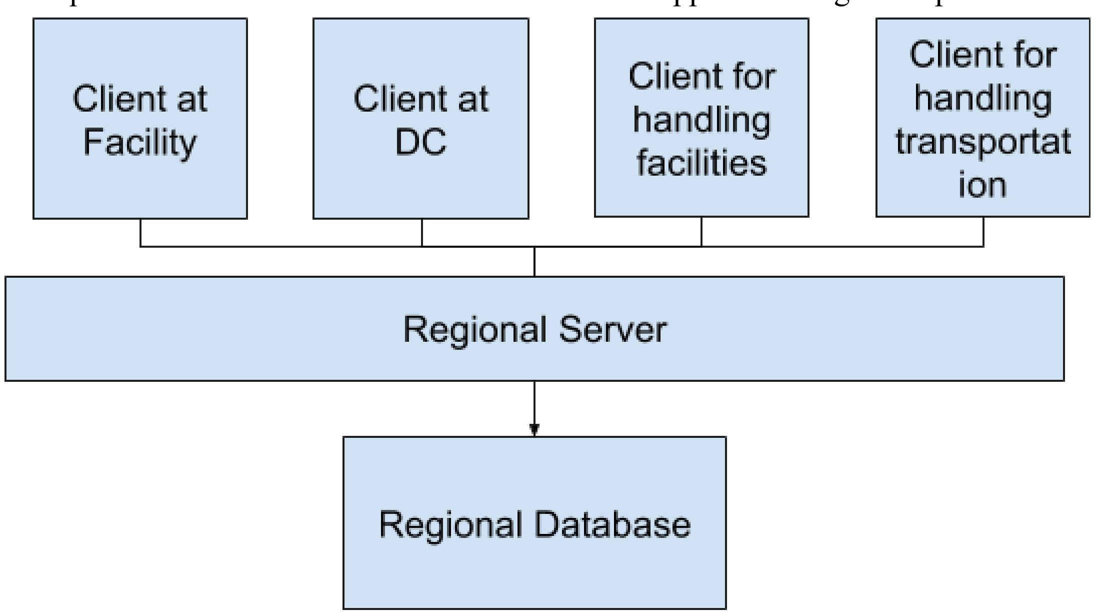
Facilities: We will use the software to perform demand forecasting to understand what our expected demand is for the next year. We will use the software to calculate our cycle and safety inventory, including the reorder point when the software will automatically order a new lots worth of inventory. We will also use the SCM software to determine where to place these facilities and what their capacity will be.

Distribution Centers: We will use the software to determine where to place these facilities and what mode of transportation to use for them.

Retailers: We will use the software to track what areas are seeing increases in demand so we can ship more products to retailers in those areas.

Customers: We can use the software to target advertisements at customers who are more likely to purchase our product.

We will use a client-server architecture with clients located at each facility and distribution center we operate and these clients will connect to the servers at that regional headquarter. We will also have clients at each of our regional headquarters tracking where demand is increasing and searching for potential new customers. We will maintain servers at each of our regional headquarters and we will have databases located near each regional headquarter. The clients will be thick since handle application logic and presentation logic.



- **Sourcing:** We will be sourcing our materials from suppliers in China based on the different materials needed. Despite having a shipping cost, the material cost itself is extremely low, and would prove to be more cost-efficient with greater amounts of orders.
  We will be sourcing from:
  - Shanghai F8 electronic
  - Shenzhen Yongjiani Electronics Co.
  - Shenzhen Xiongfa Weiye Electronics Co., Ltd.
  - Shanghai Yuexia Industrial Co., Ltd.
  - Guangzhou Great Power Energy & Technology Co.

  for the main components of our products.

- **Pricing**: We priced our products based on the two product lines that we have, high-end and low-end. First we looked at the total cost in order to make a single pillow:
  - Price of technology purchases alone: $27.86 per pillow
  - Total Pricing of pillow including polyester and cooling gel: $34.87 per pillow
  - Assembly Cost: $5

  To make the product affordable, we compared prices between existing products. The Zeeq pillow has a retail price of $299. Since the Zeeq is a high end product, we will set our high end price to about $180. Our lower end product will be at a price of $70.

Section 13: Transportation Network

Section 13.1: Network Strategies

Designing Transportation Network

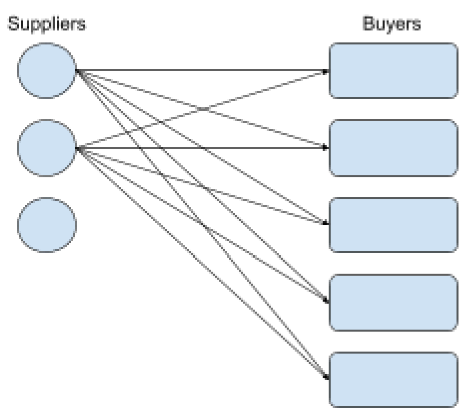
- The design of a transportation network, like the facilities, affects the performance of a supply chain by establishing the infrastructure within which operational transportation decisions regarding scheduling and routing are made. A well-designed transportation network allows a supply chain to achieve the desired degree of responsiveness at a low cost.

  <u>Three basic questions need to be considered when designing a transportation network between two stages of a supply chain:</u>

  1. Should transportation be direct or through an intermediate site?
  2. Should the intermediate site stock product or only serve as a cross-docking location?
  3. Should each delivery route supply a single destination or multiple destinations?

Direct Shipment Network to Single Destination

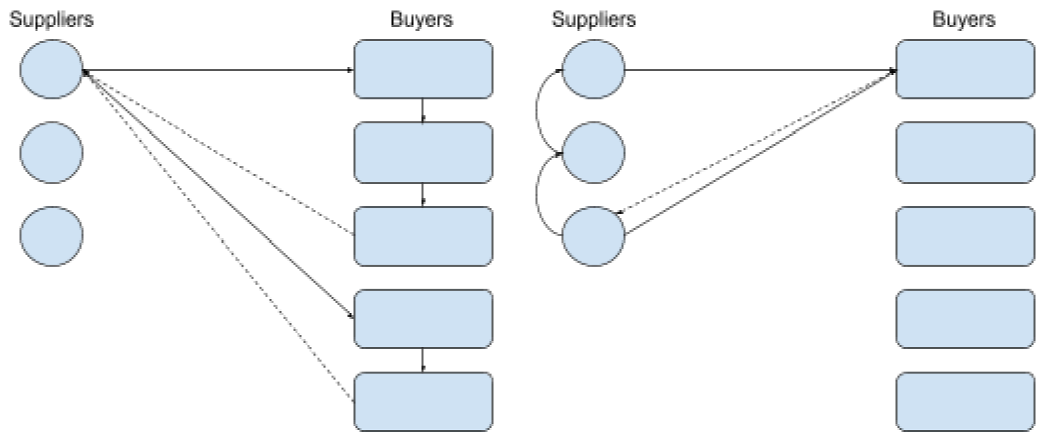
- Buyer structures the transportation network so that all shipments come directly from each supplier to each buyer location.
- Supply chain manager only needs to decide the quantity to ship and mode of transportation.



Direct Shipping with Milk Runs

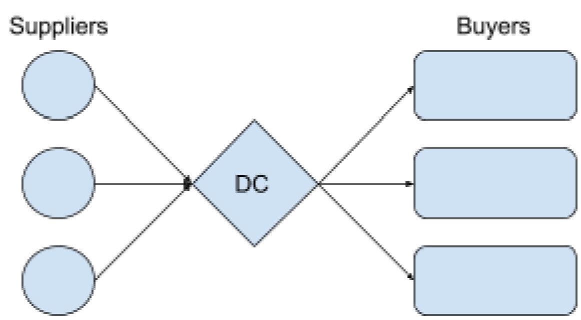
- A milk run is a route on which a truck either delivers product from a single supplier to multiple retailers or goes from multiple suppliers to a single buyer location.

- In direct shipping with milk runs, a supplier delivers directly to multiple buyer locations on a truck or a truck picks up deliveries destined for the same buyer location from many suppliers.
- A supply chain manager has to decide on the routing of each milk run.



All Shipments via DC (Distribution Center)

- Product is shipped from suppliers to a central distribution center then stored until needed by buyers when it is shipped to each buyer location.

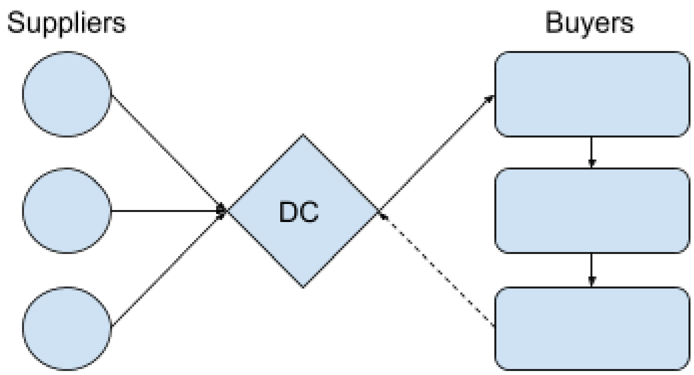


All shipments via central DC with cross-dock

- Suppliers send their shipments to an intermediate transit point (which could be a DC), where they are cross-docked and sent to buyer locations without storing them.

Shipping via DC using milk runs

- Milk runs can be used from a DC if lot sizes to be delivered to each buyer location are small.



Pros and Cons of Different Transportation Networks		
Network Structure	**Pros**	**Cons**
Direct Shipping	No immediate warehouse Simple to coordinate	High inventories
Direct Shipping w/ Milk Runs	Lower transportation costs for small lots Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation costs through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement Lower transportation cost through consolidation	Increased coordination complexity
Shipping via DC using milk runs	Lower outbound transportation cost for small lots	Further increase in coordination complexity
Tailored Network	Transportation choice best matches needs of individual product and store	Highest coordination complexity

Section 13.2: Transportation Network Selection
Selecting a transportation network:

The best transportation network for our our product should be one that is easy to coordinate. Because we are mass producing to sell our products, a high inventory is not a problem. The Direct Shipping transportation method would seem to be the best option. If this network is successful, we can later focus on increasing coordination complexity and do direct shipping with milk runs in order to lower our transportation costs and inventories.

Selecting a transportation mode:

Ranking of Transportation Modes in Terms of Supply Chain Performance(1 = Best, 6 = Worst)					
Mode	Cycle Inventory	Safety Inventory	In-Transit Cost	Transportation Cost	Transportation Time
Rail	5	5	5	2	5
TL	4	4	4	3	3
LTL	3	3	3	4	4
Package	1	1	1	6	1
Air	2	2	2	5	2
Water	6	6	6	1	6

The decision regarding carriers with which a company contracts is a planning decision, whereas the choice of transportation mode for a particular shipment is an operational decision. For both decisions, a shipper must balance transportation and inventory costs. The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain. Cheaper modes of transport typically have longer lead times and larger minimum shipment quantities, both of which result in higher levels of inventory in the supply chain. Modes that allow for shipping in small quantities lower inventory levels but tend to be more expensive.

Section 14: Facilities

Section 14.1: Facilities Design

We face demand in North America, South America, Europe, Asia, and Africa. We are considering having facilities in Beijing, Mexico City, Frankfurt, Cairo, and Lima. Our low capacity plants will have a production capacity of 65,000 units and our high capacity plants will have a production capacity of 80,000 units. We will now fill in the initial Excel sheet showing the costs, capacities, and demands we face.

	A	B	C	D	E	F	G	H	I	J
1	**Inputs-Costs, Capacities, Demands**									
2		Demand Region Production and Transportation Cost per 1,000,000 units								
3	Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity
4	N. America	81	92	101	130	105	6,000	65	9,000	80
5	S. America	117	77	108	98	100	4,500	65	6,750	80
6	Europe	102	105	95	119	111	6,500	65	9,750	80
7	Asia	115	125	90	59	74	4,100	65	6,150	80
8	Africa	142	100	113	105	71	4,500	65	6,000	80
9	Demand	510	147	510	220	73				
10										

All values are in thousands. We now add the decision variables to the Excel sheet.

Formula Bar

	A	B	C	D	E	F	G	H	I	J
1	**Inputs-Costs, Capacities, Demands**									
2		Demand Region Production and Transportation Cost per 1,000,000 units								
3	Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity
4	N. America	81	92	101	130	105	6,000	65	9,000	80
5	S. America	117	77	108	98	100	4,500	65	6,750	80
6	Europe	102	105	95	119	111	6,500	65	9,750	80
7	Asia	115	125	90	59	74	4,100	65	6,150	80
8	Africa	142	100	113	105	71	4,500	65	6,000	80
9	Demand	510	147	510	220	73				
10										
11	**Decision Variables**									
12		Demand Region - Production Allocation (1000 units)					Plants	Plants		
13	Supply Region	East	South	Midwest	West		1 = open	1 = open		
14	N. America	0	0	0	0	0	0	0		
15	S. America	0	0	0	0	0	0	0		
16	Europe	0	0	0	0	0	0	0		
17	Asia	0	0	0	0	0	0	0		
18	Africa	0	0	0	0	0	0	0		
19										

We now add the constraints to the Excel sheet.

	A	B	C	D	E	F	G	H	I	J	K
1	**Inputs-Costs, Capacities, Demands**										
2		Demand Region Production and Transportation Cost per 1,000,000 units									
3	Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity	
4	N. America	81	92	101	130	105	6,000	65	9,000	80	
5	S. America	117	77	108	98	100	4,500	65	6,750	80	
6	Europe	102	105	95	119	111	6,500	65	9,750	80	
7	Asia	115	125	90	59	74	4,100	65	6,150	80	
8	Africa	142	100	113	105	71	4,500	65	6,000	80	
9	Demand	510	147	510	220	73					
10											
11	**Decision Variables**										
12		Demand Region - Production Allocation (1000 units)					Plants	Plants			
13	Supply Region	N. America	S. America	Europe	Asia	Africa	1 = open	1 = open			
14	N. America	0	0	0	0	0	0	0			
15	S. America	0	0	0	0	0	0	0			
16	Europe	0	0	0	0	0	0	0			
17	Asia	0	0	0	0	0	0	0			
18	Africa	0	0	0	0	0	0	0			
19											
20	**Constraints**										
21	Supply Region	Excess Capacity									
22	N. America	0									
23	S. America	0									
24	Europe	0									
25	Asia	0									
26	Africa	0									
27											
28		N. America	S. America	Europe	Asia	Africa					
29	Unmet Demand	510	147	510	220	73					
30											
31	**Objective Function**										
32	**Cost =**	**0**									
33											

Using these inputs and constraints we will use Excel to determine where to place our facilities and what capacity they will have to minimize cost. The resulting Excel sheet is:

	A	B	C	D	E	F	G	H	I	J	K
1	**Inputs-Costs, Capacities, Demands**										
2		Demand Region Production and Transportation Cost per 1,000,000 units									
3	Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity	
4	N. America	81	92	101	130	105	6,000	65	9,000	80	
5	S. America	117	77	108	98	100	4,500	65	6,750	80	
6	Europe	102	105	95	119	111	6,500	65	9,750	80	
7	Asia	115	125	90	59	74	4,100	65	6,150	80	
8	Africa	142	100	113	105	71	4,500	65	6,000	80	
9	Demand	510	147	510	220	73					
10											
11	**Decision Variables**										
12		Demand Region - Production Allocation (1000 units)					Plants	Plants			
13	Supply Region	N. America	S. America	Europe	Asia	Africa	1 = open	1 = open			
14	N. America	510	147	0	0	0	1	0			
15	S. America	0	0	0	0	0	0	0			
16	Europe	0	0	0	0	0	0	0			
17	Asia	0	0	510	220	0	1	0			
18	Africa	0	0	0	0	73	0	0			
19											
20	**Constraints**										
21	Supply Region	Excess Capacity									
22	N. America	5343.00004									
23	S. America	0									
24	Europe	0									
25	Asia	3,370									
26	Africa	0									
27											
28		N. America	S. America	Europe	Asia	Africa					
29	Unmet Demand	0	0	0	0	0					
30											
31	**Objective Function**										
32	**Cost =**	**128,997**									
33											

Section 14.2: Facilities Location

The locations with a value of 1 mean that we should have a plant in those locations. Those with values of 0 mean that we should not. In the Regions with a value of 1, We will have low capacity plants in Beijing and Mexico City. The Beijing plant will serve demand in Europe and Asia, the Mexico City plant will serve demand in North and South America,

Section 15: Software User Guide

<u>Quick Start User Guide:</u>

Step 1: Open the software module

Step 2: Using the GUI, navigate to the function you would like to perform.

Step 3: If you are using the forecast function, please be ready to input demand data.

Step 4: If you wish to plot the forecast against the demand data simply press the "Generate Demand vs Forecast Graph" button

Step 5: If you want to go back to the GUI, simply push the back button until you reach the main menu.

Step 6: When you are done, push the finish button and the software module will exit.

Demand Forecasting Guide:

Step 1: Open the software module.

Step 2: Using the GUI, navigate to the function you would like to perform.

Step 3: Enter all the following data as they apply: *historical demand data, smoothing constant values, number of forecasted periods.*

Step 4: Select Generate.

Step 5: Retrieve computed data for demand forecasting.

Step 6: When you are done, push the finish button and the software module will exit.

Product Safety Inventory Guide:

Step 1: Open the software module.

Step 2: Using the GUI, navigate to the function you would like to perform.

Step 3: Enter all the following data as they apply: *Demand, SD of demand, Supplier Lead Time, Desired Cycle Service Level.*

Step 4: Select Apply.

Step 5: Retrieve computed data for safety inventory.

Step 6: When you are done, push the cancel button and the software module will exit.

Cycle Inventory Guide:

Step 1: Open the software module.

Step 2: Using the GUI, navigate to the function you would like to perform.

Step 3: Enter all the following data as they apply: *Demand for specific year, percent holding cost, product costs, shipping costs.*

Step 4: Select Apply.
Step 5: Retrieve computed data for cycle inventory.
Step 6: When you are done, push the cancel button and the software module will exit.

Facilities Software Guide:

Step 1: Open the software module.
Step 2: Using the GUI enter all relevant data including manufacturing costs, holding costs, and transportation costs.
Step 3: Click apply and fill out next form with all regions of demand and potential manufacturing locations that apply.
Step 4: Select Submit.
Step 5: Retrieve computed data for facility locations.

Section 16: Concluding Remarks

Our project served as a crucial learning experience in regards to overcoming all the complications of what it means to run a business. Thus being the workflow management of manufacturers, suppliers, retailers, all the way to customers. We were able to uncover how certain markets may be impossible to enter because they don't have large enough information systems, but that there is always something unique to offer. We also learned how beneficial it is to observe supply chains and analyze competition for the further growth of our company.

Our group also came to realize the importance of analyzing the costs included in each business process, which depends on the size of the lot. Costs like: holding cost, ordering costs, transportation costs, facility costs, fixed costs, and material costs. For example, fixed costs include the labor required to place the order, handle paperwork, and the cost of transportation to ship the order. The holding cost is how much it costs to hold/store inventory. This cost is considered to be a variable cost which includes the cost of capital and all of the costs associated with physically storing inventory. Costs like facilities, location, transportation and capacity fall into place and need proper cost allocation. When it comes to transportation there are many different modes of travel and each company, depending on their product, needs to make the right decision keeping in mind costs. Overall, there are a lot of costs that make up a delivery of a product to the customer and since there are multiple suppliers, we(and other companies) must be able to make appropriate calculates as to help determine the most cost effective one.

Section 17: Project Contributions

Vinshaan's Contribution

In phase 1, I helped to determine the customer needs for our product and created the product life-cycle in the market diagram where I determined where our product lies in the life cycle. I also determined the IDU for our product and placed it on the IDU spectrum. After meeting with Professor Desa, he asked me to learn visual basic to I could develop software that will speed up our demand forecasting. I believe this was my biggest contribution to the project. I spent many hours researching on how to get started. A few of my group mates like Dan, Austin, and Ethan also helped research Visual Basic because it was not a simple task. With their help, I was able to learn the basics and I created a GUI (Graphical User Interface) which allows the user to navigate through the different methods on forecasting with ease. On the menu, each button will forward the user to the appropriate spreadsheet where they can input data and see the forecast. I also added a button that would automatically plot the period, forecast and demand so we can easily see how demand compares to the forecast. In adding this function, we saved a lot of time from trying to graph it manually. After I got the basics down, I taught the rest of my group on how to do it so they could implement it in their parts such as facilities. Implementing the software really helped us to speed up our processes in phases 3 and 4. On the final report, I helped add in analysis and conclusions where it was applicable.

Ethan's Contributions

In Phase 1 I created the high level overview of the companies SCM software, including the functions that would be performed by the software, the components that would be used, and the layout of the software. During phase 2 I performed the demand forecasting using Winter's and Holt's methods. The forecasts were performed in Excel. I worked with the team to determine which method gave us the best forecast, the one we used for other parts of the project. In phase 3 of the project I calculated the safety inventory for each component in the Snoozie and the Snoozie itself. This included determining the fill rate and other metrics so we could decide if our sourcing method were acceptable given the suppliers lead times and other variables. In phase 4 I performed the calculations for determining where to place our facilities and what capacity each facility would have to minimize our total cost. Throughout the project I helped work on the software, creating the modules that calculate the various inventories for the product.

Manzanita Griffin:

For the preliminary report, I described our product and organized the report. I created the FAST diagram and the diagram of the stage view of supply chain; describing which companies are our suppliers and distributors. In phase 1, I went through and finalized the work of others. By phase 2, I decided to organized and distributed project jobs by creating groups of two and I facilitated the work that we had to do. For phase 2, I manually calculated the demand forecasting for static, moving average, and simple exponential smoothing using our financial model. I corrected our financial report from TIM 105 and used the new numbers as a way to calculate our demand data. I also recreated our cash flow for our project. In phase 3, I contributed to the expansion of the six drivers and the supply chain management guidelines. For our final report I brought all the work together and created the executive summary, the block diagram, the FAST diagram, the stage diagram, the financial model, the static, moving average, and simple exponential demand forecasting, and the concluding remarks. I attended all of the meetings and help to facilitate the group work. I also worked to organize each phase using SPSP and spent time fixing the errors that were brought to our attention after each meeting.

Dan Vo:

For phase 1, I analyzed our product and its market to determine where our company is on the Responsiveness/Efficiency Spectrum. The team and I worked on building our supply chain strategy together. After a meeting with Professor Desa, he assigned each team member to work in pairs on certain tasks. I helped out with fixing the demand forecasts on Phase 2 and onwards. On Phase 3 and 4, I needed to understand the difference in the Transportation networks, therefore I analyzed the types of Transportation networks in order to start designing ours. I also worked on aligning the six key drivers to our supply chain in order to further design it. Designing the visual basic software was a very tedious task therefore I helped out with the design and implementing the software. The main function of the visual basic software is to automate the calculations, eliminating the need for manual calculations. The visual basic software allows us to forecast demand, analyze costs of transportation and facilities, and manage our inventory. After all the phases were complete, I added in explanations to diagrams and results where necessary. I also worked with Manzanita as a facilitator to send reminders to the group to start their assigned parts.

Austin Wisherop's Contribution:

My contribution consisted of the following work for each phase.

Phase 1: For Phase 1, I was in charge of obtaining the demand data. In order to do so, I had to conduct research on a similar product to ours to obtain what their initial product sales were. From there I graphed the data to better visualize the meaning and how we can apply it to our product.

Phase 2: For Phase 2, I produced the initial data for the Beer Game that was turned in for phase 2 (which later was adjusted to a more readable general idea of how the simulation went). Additionally I helped create the initial market need analysis which led to the cash flow data analysis.

Phase 3: For Phase 3, I worked with Vinshaan to create the Visual Basic software for both the demand forecasting and inventory management. This process consisted of learning exactly how to code the back-end processing in visual basic and design the front-end for the GUI. Additionally it was at this point that I reviewed all previous phases and made minor adjustments and corrections to each part to progress the development of the project.

Phase 4: For Phase 4, I continued to make adjustments to the visual basic software that Vinshaan and I developed as well as wrote the user guide with Vinshaan for the software.

Final Report: For the final report, I along with another group member made the initial formatting of the report. From there, I was involved with furthering the development of the pieces I worked on, as well as making corrections to any and every part of the report where needed.

Kaitlyn Martinez's Contributions

In Phase 1, I contributed to the supply chain strategy by completing the IDU Spectrum and Zone of Strategic Fit. I did some research on other alarm clock pillow companies, and took into account that our company is a new company in order to complete these items.

In Phase 2, I used a similar method in order to determine market needs and our target market.

In Phase 3, I used the forecasting data, completed by Manzanita, to complete the cycle inventory.

In Phase 4, I helped to restructure and format the transportation network to ensure that it was in line with our supply chain strategy. In the final stage, I updated the cycle inventory in order to track each component that makes up our product, within the supply chain.

Kevin's Contributions

In Phase I, I was in charge of the analysis for the SC strategy, and assisted in obtaining the demand data through research of products manufactured by our competitors. In Phase II, I was in charge of compiling all information for the market need/target analysis. For this, I did a more in depth research on the different health benefits and the many markets of customers we were able to touch. Moreover, I did a considerable amount of research on the different technologies we would be employing, and applied the research to the pricing of dissimilar geographical regions. By focusing on a series of technology, health benefits and types of users, we were then able to measure the market for the number of people we could reach. For Phase III, I was in charge of calculating cycle and safety inventory, designing and implementing the transportation network and facilities. In doing so, I calculated the impact of the 6 drivers, and also found chinese manufacturers through Alibaba, in which I was able to establish our sourcing and pricing methods. For Phase IV, I was in charge of the designing of facilities and its locations. For the final report I was in charge of all analyses, particularly for the financial forecasting. Lastly, I was able to assist in the formatting of the entire document, to add any missing parts we needed.

Section 18: Appendix

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