TIM 125 Final Project Report

RecTech Virtual Reality

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Executive Summary

Who Are We?

- Our company is RecTech is a medium sized company based off of Microsoft

Strategy and Business Goals:

- Our competitive strategy is to focus on a differentiated strategy in which we will be developing a new product that is in between the borders of a wide/narrow market segment since we will be developing this for the gaming/entertainment industry as a whole but focusing on the virtual reality aspect of it.

What We Offer and Problem our Business Solves:

- Our company develops licenses and supports a range of software products, services and devices
- The company's segments include Productivity and Business Processes and More Personal Computing
- RecTech products include:
    - operating systems
    - cross-device productivity applications
    - server applications
    - business solution applications
    - desktop and server management tools
    - software development tools
    - video games
    - training and certification of computer system integrators and developers

Our Target Market:

- Our target market is the Virtual Reality industry since we are developing RecTech's very own Virtual Reality headset

Business Plan/Purpose:

- Company Vision:
    - To help an individual live in their wildest dreams.
- Company Mission Statement:
    - Create the opportunity for every organization, company, and individual to achieve their maximum potential with technology.
- Company Business Goals:
    - Redefine what it means to be productive and the business process within which technology companies operate.

- Create more affordable, accessible, and personal virtual reality systems.
  Annual Sales Revenue: 580(M)
  Growth: 1.37%
  Net Income: 75.57(M)
  Profit Margin: 13%

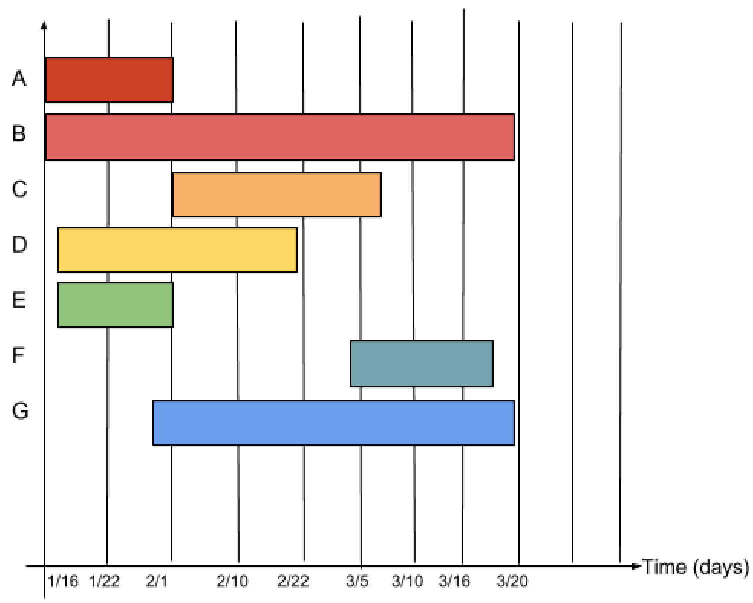
Team Member Contribution

Tasks	Primary Member	Secondary Member
Competitive Strategy	Joshua Victorio	Christian Angel
Supply Chain Network	Joshua Victorio	Robert Fazio, Christian Angel
Supply Chain Strategy	Joshua Victorio	Benjamin Kent, Christian Angel
VR Company Research	Christian Angel	Rebecca Yi
Demand Forecasting	Benjamin Kent	Aaron Cheung
Lead Beer Game	Robert Fazio	Joshua Victorio
Porter Model	Christian Angel	Aaron Cheung
Product Life Cycle	Aaron Cheung	Rebecca Yi
Cash Flow Analysis	Benjamin Kent	Joshua Victorio
Transportation Network	Joshua Victorio, Robert Fazio, Christian Angel	Aaron Cheung
Facilities Network	Joshua Victorio, Robert Fazio, Christian Angel	Benjamin Kent
Cycle and Safety Inventory	Joshua Victorio, Christian Angel	Robert Fazio, Benjamin Kent
High Level Drivers	Christian Angel	Rebecca Yi
VBA	Benjamin Kent	Robert Fazio

Supply Chain Strategy

Strategy:

GANTT and PERT:

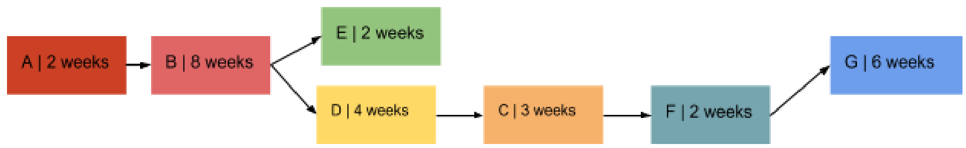


- A “Project Planning” depends on everything and everything depends on the project planning. It is updated as the phase is completed
- B “VBA Project”
- C “Transportation”
- D “Demand Forecasting”
- F “Facilities”
- G “ Backlog”

The GANTT chart shows:

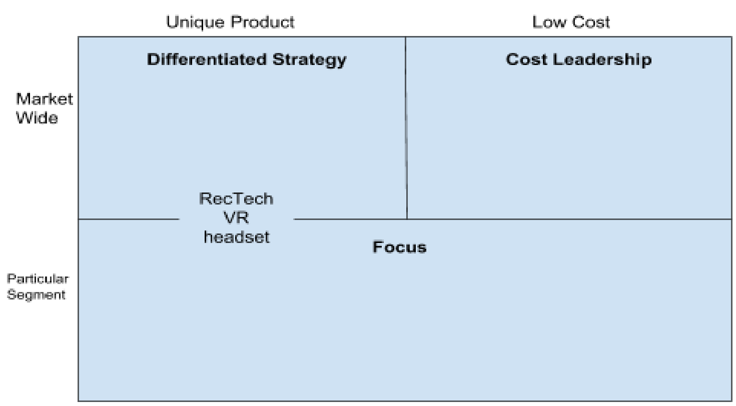
- The start and finish dates of the sub tasks and how they overlap with each of the other task.
- The duration of each individual subclass.
- Progress made on each task at any given point in time.

PERT Chart



The PERT chart shows the evolution of the sub tasks and how they will flow into the next task of the project.

Competitive Strategy:

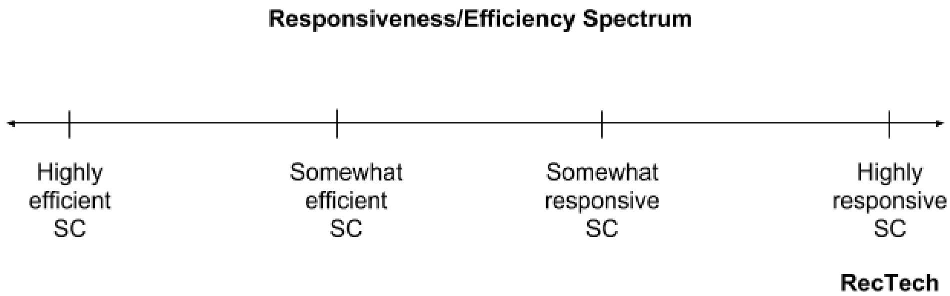


RecTech's competitive strategy for its virtual reality headset is that we will be focusing on having a differentiated strategy in which we will be developing a new product that is in between the borders of a wide/narrow market segment since we will be developing this for the gaming/entertainment industry as a whole but focusing on the virtual reality aspect of it.

Supply Chain Strategy:

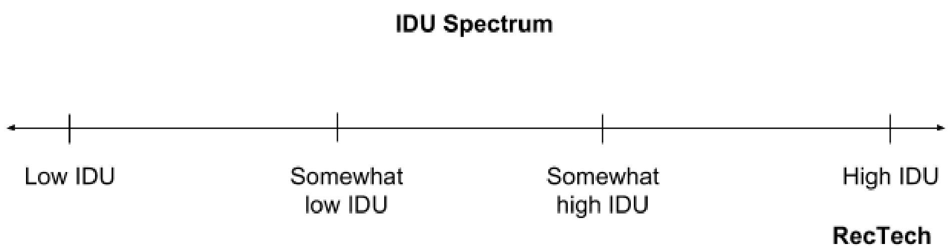
Responsiveness/Efficiency Spectrum

1. Responsiveness/Efficiency Spectrum



- For our company, we will be attempting to implement a highly responsive supply chain since the virtual reality headset that we are developing is going to be somewhat costly and we will want to be able to have our product be readily available to any customers who would want to buy it.
- It would not be logical to try and implement a highly efficient supply chain due to the fact that our product is brand new and it would be difficult to bring down the cost of the product and the whole supply chain itself

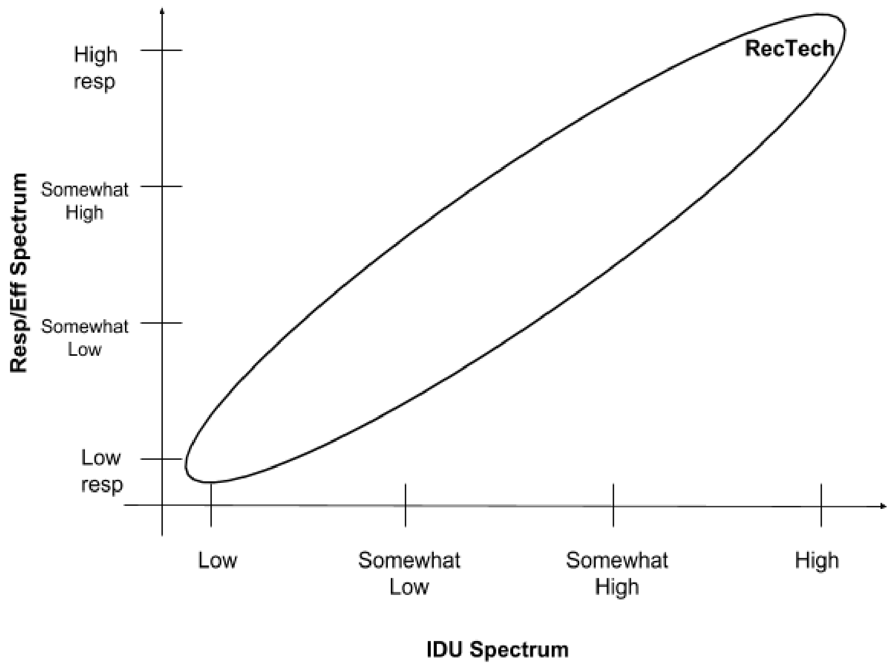
2. Implied Demand Uncertainty Spectrum (IDU)



- Rectech can expect to have high levels of demand uncertainty for our virtual reality headset because our product acts a disruptive technology that is introducing a new concept on how to view and control a virtual space.
- We can expect to see these high levels of IDU in the introduction and decline phase of the product life-cycle because people will want to see how reliable the new technology and later to see how it compares to upgraded versions of the same technology used.

Implied Demand Uncertainty Spectrum:

1. Determine the zone of strategic fit



- From the 2-D space created above, we can see that RecTech's virtual reality headset has a high responsiveness as well as a high implied demand uncertainty which shows that our product will be readily available to consumers **but** the demand for our product is very uncertain and not stable.
- We would essentially like to lower our implied demand uncertainty in order to be aware of how successful our product will be in terms of the amount demanded by consumers and in turn to increase our profits as well

Business Goals:

Total market size for VR Headsets 2017: **$4.9** billion
Growth: **56.1%** compound annual growth rate

Commercial	• Sales Revenue(~) • Growth (~)	• Sales Revenue(~) • Growth (~)
Consumer	• Sales Revenue(~) • Growth (~)	• Sales Revenue(~) • Growth (~)
Enterprises	• Sales Revenue (~) • Growth (~)	• Sales Revenue(~) • Growth (~)
	Virtual Reality Hardware	Virtual Reality Headset

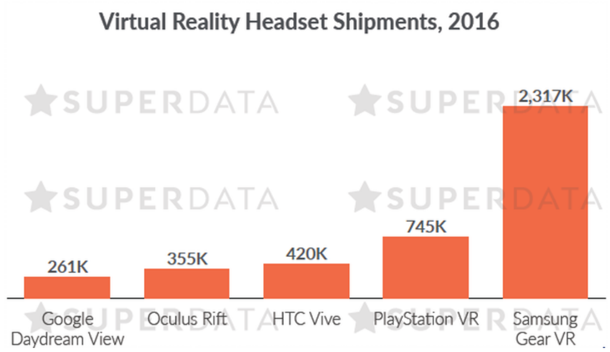
Product Dimension

- As of right now, the market size for VR headsets is growing at an exponential rate and the predicted market for it is set to be around $28.3 billion by the year 2020
- The total revenue for Virtual Reality hardware as of 2017 is estimated to be around $2.6 billion and consumer software/services to be around $1.0 billion
    - Virtual reality hardware saw an 80% growth rate from 2016 to 2017
    - Virtual reality consumer software/services grew about 233% from 2016 to 2017

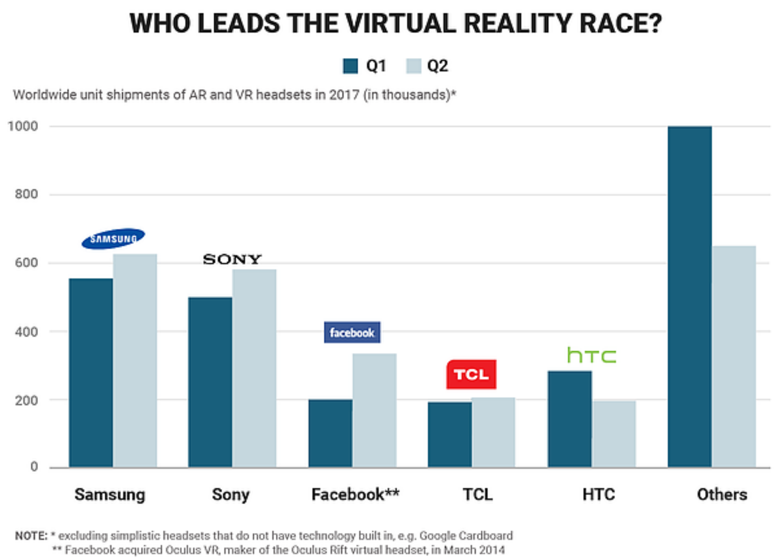
  Source: https://www.superdataresearch.com/market-data/virtual-reality-industry-report/

Sample Demand Model:

Obtain and/or estimate demand data for your product
As a group we researched the different companies that are currently producing VR headsets. Of the companies that we found we believed that Google Daydream View, Oculus Rift, HTC Vive, Playstation VR, and Samsung Gear VR were the better companies that fit our business and market strategies. The team broke up into different groups to find how many headsets each company sells within in a given year. This information was then used to determine how many headsets our company would sell assuming that the product was successful.



HTC Vive:
https://www.fastcompany.com/4040163/data-shows-that-less-than-1-of-htc-vive-owners-are-using-vr-at-any-time
https://www.viarbox.com/single-post/2017/09/19/Virtual-Reality-HMD-Sales-Numbers-in-Q1-and-Q2-2017
http://www.playstationlifestyle.net/2017/06/02/psvr-sales-top-400k-in-first-quarter-of-2017/
https://www.idc.com/getdoc.jsp?containerId=prUS43021317
https://jasoren.com/third-quarter-of-2017-ends-with-over-1-million-of-sold-vr-headsets/
https://techcrunch.com/2017/11/28/virtual-reality-headset-unit-sales-are-slowly-improving/



- HTC has sold about half a million if its high-end Vive virtual reality systems in 2017
- HTC managed to sell 190,900 units in the Q1 of 2017. This is about 8.4% of the market share
- They shipped out 94.5 thousand shipments during Q2 which gave them 4.4% of the market share
- For Q3 they shipped out 160,000 units and contributed to 14% of the market share

Oculus:

- 355k in 2016 (superdata)
- Q1 sold slightly less than 100k units
- Q2 (september 2017) Oculus shipped 246.9 thousand units and had 11.7% of the market share
- Q3 sold 210 thousand units and had 21% of market share

Samsung:

- Q1 sold 489.5 thousand units, taking top spot.
- Q2 sold 568 thousand units and had 26.7% of the market share, the most of all VR headsets

Sony's Playstation VR:

- Sony sold about 429,000 units in its first quarter of 2017
- Sony managed to ship out 519.4 shipments in Q2 that accounted to 24.4% of the market share
- They shipped out 490,000 units in Q3

Cash Flow Analysis:

Senario Input Parmeters	
Sales & Production Volume(units/year)	200000
Development Cost (total$)	2000000
unite Price ($/unit)	500
Unite production cost ($/unit)	160
ramp-up cost (total $)	100000
Marketing & support cost ($/year)	500000
annual discount facotr(%)	15
Base-Case NPV	127239

Base Case																
	Year 1				Year 2				Year 3				Year 4			
Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
($ Value in thousands)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Development Cost	-500	-500	-500	-500												
Ramp-up cost				-50	-50											
Marketing & Support					-125	-125	-125	-125	-125	-125	-125	-125	-125	-125	-125	-125
Production Cost						-8,000	-8,000	-8,000	-8,000	-8,000	-8,000	-8,000	-8,000	-8,000	-8,000	-8,000
Production volume						18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750
Unit production cost						-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43
Sales Reveue						30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Sales Volume						59,201	71,698	93,241	121,499	60,204	76,201	98,203	147,597	63,204	83,203	101,478
Unit Price						0.51	0.42	0.32	0.25	0.50	0.39	0.31	0.20	0.47	0.36	0.30
Period Cash Flow	-500	-500	-500	-550	-175	21875	21875	21875	21875	21875	21875	21875	21875	21875	21875	21875
PV year 1, r=2%	-500	-482	-465	-492	-151	18197	17540	16906	16295	15706	15138	14591	14063	13555	13065	12593
projected NPV,$	165558															

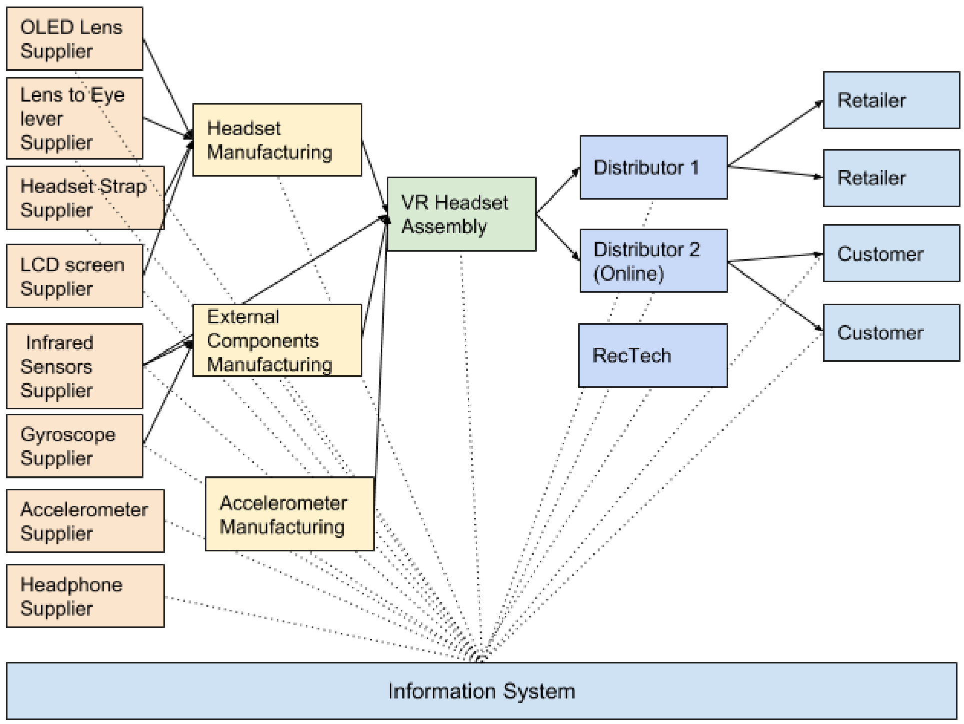
Above is the cash flow analysis of the first four years of the product. The final output for the NPV analysis with an 8% discount factor is 12.72 million dollars.

Over the four years we expect a steady growth in our sales volume.. At this point in time all we can predict is that our product sales will a few thousand every quarter allowing the company to make a profit. This data can be used to determine if the project is worth preforming or if the sales volume is sufficient to support the project.

Drivers:

Drivers Information:

a. Design the high-level structure (drivers) for your supply chain
   i. Inventory (triangle):
      1. Sensors
      2. Lenses
      3. Headset frame
      4. Strap
      5. LCD screen
   ii. Facilities (squares)
      1. Inventory Warehouses
      2. Component Manufacturers
      3. Final Assembly Plant
   iii. Transportation
      1. Trucks
      2. Trains
      3. Boats
      4. Planes
   iv. Information
      1. Online Buyer Information
         a. Delivery
         b. Payment
      2. Inventory Information
         a. Raw Materials
         b. Number of final product



Sample Suppliers:

Company	Part
Purdy Electronic Company	OLED Lenses
VR Lens Lab	Lens to Eye lever
Acatel	Headset Strap
Shenzhen Xinyi Technology Co., Ltd.:	LCD Lenses
Omega Engineering:	Infrared Sensors
Dongguan Shinecon Industrial Co., Ltd.:	Gyroscope
Rec. Tech.	Accelerometer

Align and integrate your high level strategies with detailed implementations of each driver

i.) Inventory

- Our company will manufacture the gyroscope in house.
- Our inventory includes sensors, lenses, headset frame, strap, and LCD screen.
- We would start off by having less inventory to save costs on storage before we are able to gauge demand. Once we are able to gauge demand, the inventory stock can change accordingly so that responsiveness is efficient.
- With a larger amount of inventory the responsiveness is increased to the customer.

ii.) Facilities

- We have three different facilities, inventory warehouses, component manufacturers, and the final assembly plant.
- The final assembly plant, distribution center, and some inventory warehouses will be located in Springfield, Oregon.
- Our facilities will strive for to be highly responsive so we will have a lot of warehouses located near customers to increase the arrival time of the product. This however decreases efficiency.

iii.) Transportation

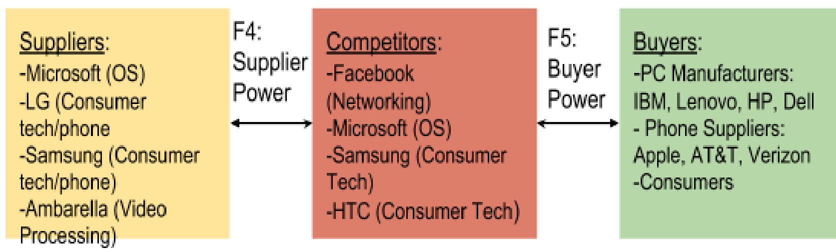
- RecTech will use faster modes of transportation using existing shipping companies like FedEx, United States Postal Service, and UPS to transport our product between the different stages in a supply chain
- The fast transportation these companies provide will allow our company’s supply chain to maintain its high levels of responsiveness that we established we would aim towards to meet our customer demand.
- There will be a reduction in efficiency of our supply chain because of the high levels of responsiveness because it will cost us more to transport the different parts to build our final product.
- Our VR headset and all its components are fairly small with our final product weighing about 1 pound. For this reason we will use air transportation to receive to transport our components to our manufacturing facilities. After our product is assembled we will use truck transportation to ship them to our distribution center and finally to the stores that will sell our product.

iv.) Information

- Our information system is important to our supply chain because it will contain the data that is imputed from our suppliers, transportation service, our manufacturing facilities, and our distribution center.
- With a detailed information system our company will raise its responsiveness and efficiency levels.

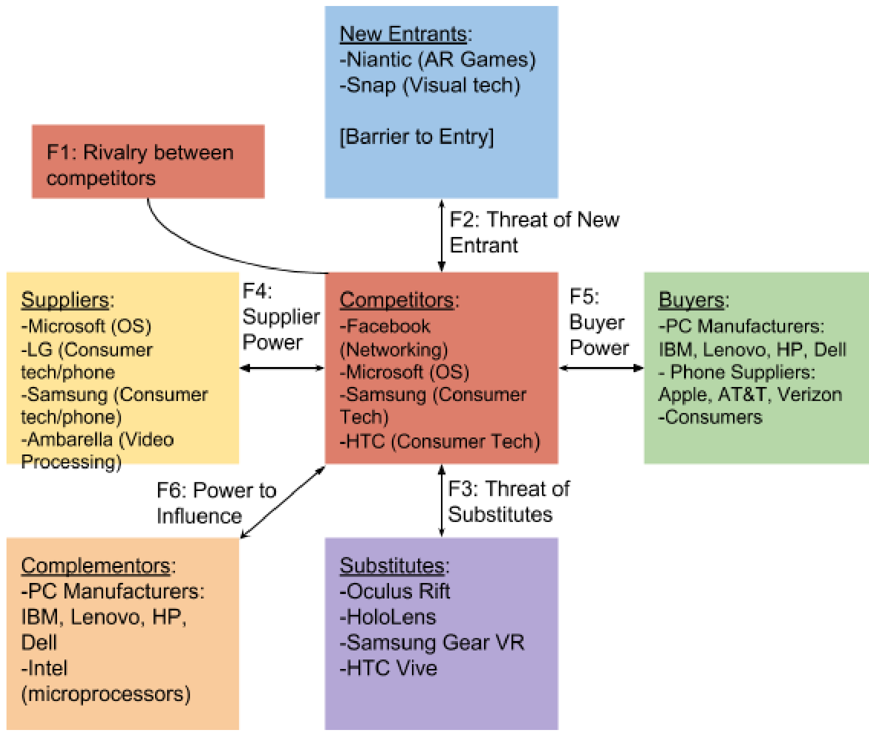
- We will have a scheduling system to organize the our orders that we place to revive the necessary components to assemble our VR headset.
- Our warehouse management system will help us visualize our warehouse inventory that can allow us to stock more inventory to meet our demand while also helping us make decisions that will keep our costs low.
- Our product will not offer premium options for customization since our headset is designed to deliver a different experience for each individual but the responsiveness will be there through the demand information for different regions.
- Our information system will use the push methods that will use customer demand that will be transmitted through the supply chain to influence the production and distribution of the headset.

Porter Model:



Horizontal dimension of Porter's Model is the Supply Chain Dimension

Porter Model Market Analysis



The effects of Porter's six forces on the demand for VR headsets

1. Competitors: Competition is probably the main driving force that affects the demand for all products and is especially true for the VR headset industry. This is because VR technology is fairly new and expensive meaning that the established companies offer customers more advanced and reliable products. For this reason RecTech's demand would be fairly small in the initial phases of our product cycle. Demand will increase once our technology proves to be at par or more advanced than other headsets and when our supply chain tailors to our customers needs.
2. New entrants: Since there are large barriers of entry in the VR headset industry the demand for our companies headset should not be greatly affected. The goal for existing VR companies is to try to own the largest market share they can with their products with some like Sony owning up 24% of the market.
3. Substitutes: There are various types of VR systems available in the market like systems that use phones as their main components and other that use computer as as their drivers. Depending on what system the customer prefers the demand for our headset can both increase and decrease every quarter.

4. Suppliers: When we as a company decided to outsource some of our hardware we had work together with our suppliers to determine what our replenishment cycles would be like. Our orders would depend on customer trends that would comply to their demand of our VR headset.
5. Buyers: Our buyers are what drive the demand for our product and depending on their needs they can make demand rise and fall at different points of our products life cycles. Our priority is to have our product available for the buyer whenever they see fit to purchase it.
6. Complementors: Complementors like intel's processors should increase the demand of our product because they work together with our headset to enhance the VR experience that we strive to create.

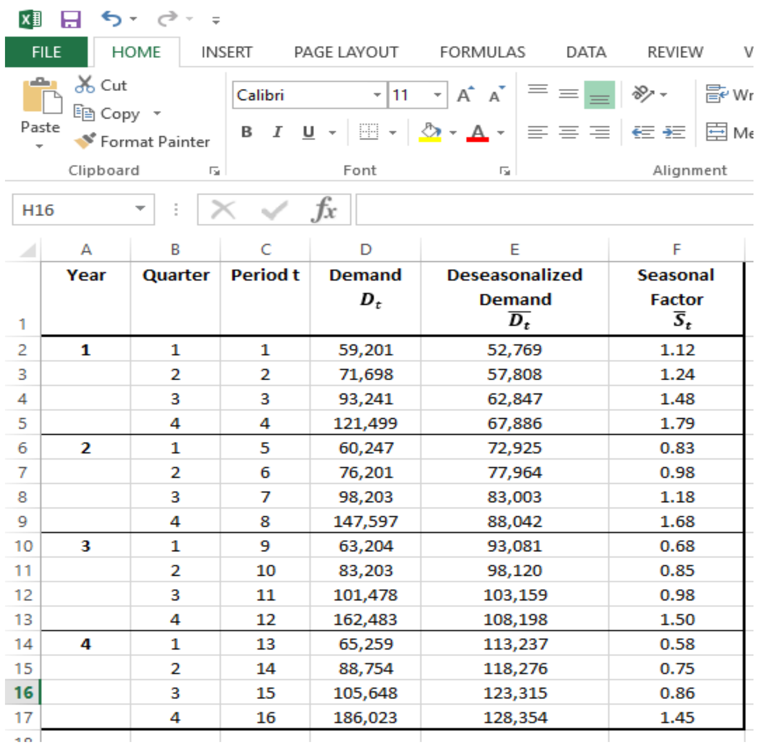
Conclusion:

The information above defines the strategy that the company should follow. Given this information a company can use the information to determine what type of market the company it getting involved in. This helps to determine if the company should follow an efficient or responsive supply chain. The difference between the two is key in that, efficient strategy will focus on creating product for cheap while maintaining a low IDU or creating a responsive product to market demands with a high IDU. This also allows a company to determine if the project is executable and profitable. They would be allowed to see the demand form the competitors and determine if the NPV generate is worth the effort to enter the market with an idea as to how they would supply their customers.

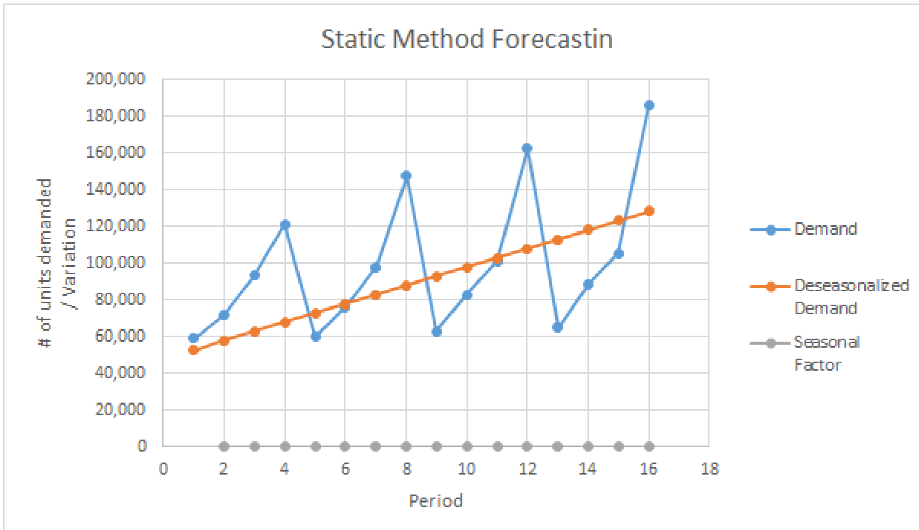
Demand Forecasting:

Demand Forecasting:

Static Method:



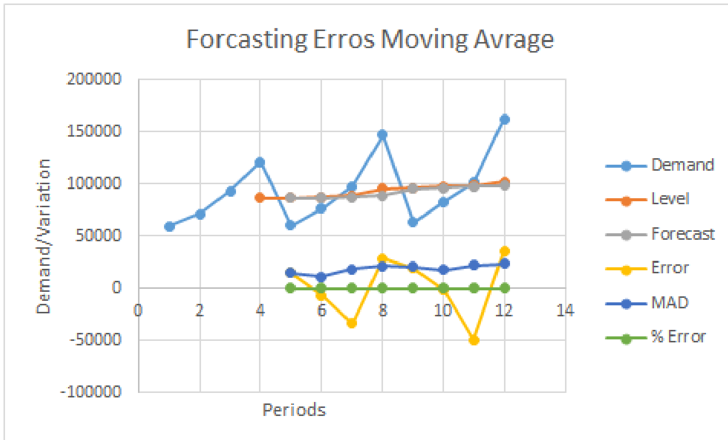
Year	Quarter	Period t	Demand D_t	Deseasonalized Demand $\overline{D_t}$	Seasonal Factor $\overline{S_t}$
1	1	1	59,201	52,769	1.12
	2	2	71,698	57,808	1.24
	3	3	93,241	62,847	1.48
	4	4	121,499	67,886	1.79
2	1	5	60,247	72,925	0.83
	2	6	76,201	77,964	0.98
	3	7	98,203	83,003	1.18
	4	8	147,597	88,042	1.68
3	1	9	63,204	93,081	0.68
	2	10	83,203	98,120	0.85
	3	11	101,478	103,159	0.98
	4	12	162,483	108,198	1.50
4	1	13	65,259	113,237	0.58
	2	14	88,754	118,276	0.75
	3	15	105,648	123,315	0.86
	4	16	186,023	128,354	1.45



From the static model above we can see the deseasonalized demand along with the seasonal factor which we can see is very close to 1 so we know that the ratio of deseasonalized demand to demand is fairly consistent.

Moving Average Method:

Period	Demand	Level	Forecast	Error	Absolute I	Squard Err	MAD	% Error	MAPE	TS
1	59769									
2	71698									
3	93241									
4	121499	86551.75								
5	60247	86671.25	86551.75	14853.75	14853.75	2.21E+08	14853.75	20.71711	20.71711	1
6	76201	87797	86671.25	-6569.75	6569.75	1.32E+08	10711.75	7.045988	13.88155	0.773356
7	98203	89037.5	87797	-33702	33702	4.67E+08	18375.17	27.7385	18.50053	-1.38328
8	147597	95562	89037.5	28790.5	28790.5	5.57E+08	20979	47.78744	25.82226	0.160756
9	63204	96301.25	95562	19361	19361	5.21E+08	20655.4	25.4078	25.73937	1.100608
10	83203	98051.75	96301.25	-1901.75	1901.75	4.34E+08	17529.79	1.93655	21.77223	1.188363
11	101478	98870.5	98051.75	-49545.3	49545.25	7.23E+08	22103.43	33.56792	23.45733	-1.29905
12	162483	102592	98870.5	35666.5	35666.5	7.92E+08	23798.81	56.43076	27.57901	0.292157
13	65259	103105.8	102592	19389	19389	7.46E+08	23308.83	23.30325	27.10392	1.130129
14	88754	104493.5	103105.8	1627.75	1627.75	6.71E+08	21140.73	1.604042	24.55394	1.323027
15	105648	105536	104493.5	-57989.5	57989.5	9.16E+08	24490.61	35.68958	25.56627	-1.22577
16	186023	111421	105536	40277	40277	9.75E+08	25806.15	61.71869	28.57897	0.397473

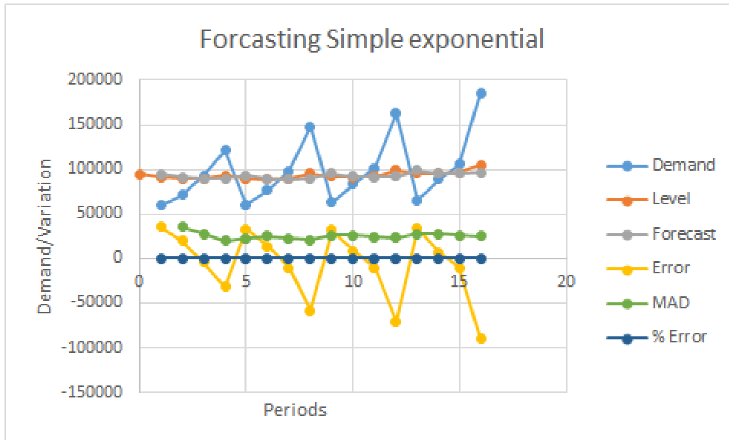


Since the TS is within +/- 1% the moving average is a very good predictor for the demand forecast. However the MAPE is at 20% which is relatively high meaning that the moving average may not be the best for of demand casting for the VR headset data. This means that best case the data should be fine if the case is made that demand forecast is required.

Simple Exponential Method:

Alpha = .1

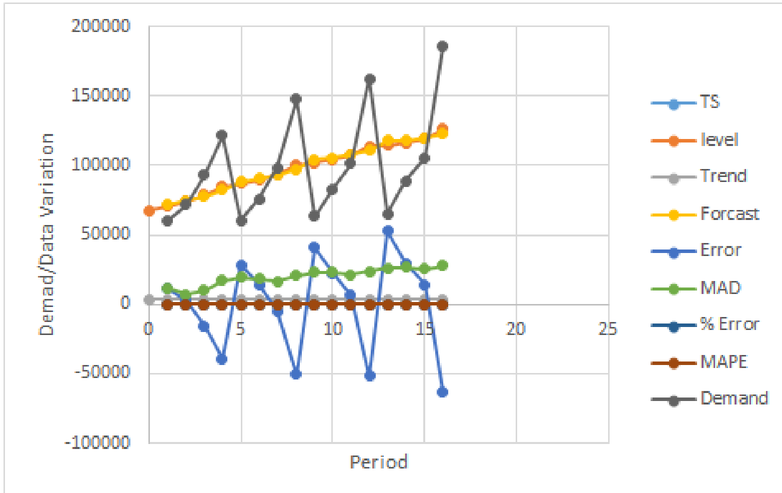
Period	Demand	Level	Forecast	Error	ABS Error	MSE	MAD	% Error	MAPE	TS
0		94901.92								
1	59769	91388.63	94901.92	35132.92	35132.92	1.23E+09	35132.92	58.78117	58.78117	1
2	71698	89419.56	91388.63	19690.63	19690.63	8.11E+08	27411.77	27.46328	43.12223	2
3	93241	89801.71	89419.56	-3821.44	3821.438	5.46E+08	19548.33	4.098452	30.1143	2.609027
4	121499	92971.44	89801.71	-31697.3	31697.29	6.6E+08	22585.57	26.08852	29.10786	0.854741
5	60247	89698.99	92971.44	32724.44	32724.44	7.42E+08	24613.34	54.31712	34.14971	2.113864
6	76201	88349.19	89698.99	13497.99	13497.99	6.49E+08	22760.78	17.71367	31.41037	2.878954
7	98203	89334.57	88349.19	-9853.81	9853.807	5.7E+08	20916.93	10.03412	28.35662	2.661645
8	147597	95160.82	89334.57	-58262.4	58262.43	9.23E+08	25585.12	39.47399	29.74629	-0.10119
9	63204	91965.13	95160.82	31956.82	31956.82	9.34E+08	26293.08	50.56138	32.05908	1.116941
10	83203	91088.92	91965.13	8762.135	8762.135	8.48E+08	24539.99	10.53103	29.90627	1.553789
11	101478	92127.83	91088.92	-10389.1	10389.08	7.81E+08	23253.54	10.23776	28.11823	1.192974
12	162483	99163.35	92127.83	-70355.2	70355.17	1.13E+09	27178.68	43.30002	29.38338	-1.56793
13	65259	95772.91	99163.35	33904.35	33904.35	1.13E+09	27696.04	51.95352	31.11954	-0.31448
14	88754	95071.02	95772.91	7018.912	7018.912	1.05E+09	26219.1	7.908276	29.46159	-0.0645
15	105648	96128.72	95071.02	-10577	10576.98	9.9E+08	25176.29	10.01153	28.16492	-0.48728
16	186023	105118.1	96128.72	-89894.3	89894.28	1.43E+09	29221.17	48.32428	29.42488	-3.49617



In the case of simple exponential we have a TS Range of -3.5 to 2.8, which is a relatively good predictor for the demand forecast although it isn't as good as moving average TS. The MAPE goes from 29-59% which is a rather fluctuate. Therefore we can say that simple exponential is not a good way to forecast for demand.

Holt's Method:

Year	Quarter	Period	Demand	level	Trend	Forcast	Error	Absolute Error	Squard Error	MAD	% Error	MAPE	TS
		0		67878	3665								
1	2	1	59769	70836.56	3622.614	71543	11774	11774	138627076	11774	19.69918	19.69918	1
1	3	2	71698	74293.5	3612.673	74459.17	2761.174	2761.1736	73125577.82	7267.587	3.851117	11.77515	2
1	4	3	93241	78826.27	3667.879	77906.18	-15334.8	15334.82344	127135988.5	9956.666	16.44644	13.33224	-0.08031
2	1	4	121499	84834.44	3808.296	82494.14	-39004.9	39004.8553	475696675.6	17218.71	32.10303	18.02494	-2.3117
2	2	5	60247	86938.99	3706.072	88642.73	28395.73	28395.73224	541820862.3	19454.12	47.13219	23.84639	-0.58645
2	3	6	76201	89778.42	3654.073	90645.06	14444.06	14444.05989	486289196.3	18619.11	18.95521	23.03119	0.16302
2	4	7	98203	93718.72	3671.247	93432.49	-4770.51	4770.510737	420070421.5	16640.74	4.857806	20.43499	-0.10428
3	1	8	147597	100402.4	3851.992	97389.97	-50207	50207.03329	682654892.8	20836.52	34.0163	22.13266	-2.49285
3	2	9	63204	101791.4	3704.211	104254.4	41050.38	41050.38083	794041434.3	23082.51	64.94902	26.89003	-0.47187
3	3	10	83203	104158	3623.958	105495.6	22292.57	22292.56874	764333153	23003.51	26.79299	26.88033	0.495607
3	4	11	101478	107403.7	3601.263	107782	6303.972	6303.972122	698461054	21485.37	6.212156	25.0014	0.824033
4	1	12	162483	114093.7	3786.584	111005	-51478	51478.003	861088032.2	23984.76	31.68209	25.55813	-1.40812
		13	65259	114723	3597.147	117880.3	52621.26	52621.2612	1007850271	26187.57	80.63449	29.79477	0.719728
		14	88754	116546.2	3490.709	118320.1	29566.13	29566.13301	998300695.6	26428.89	33.31245	30.04603	1.831861
		15	105648	119173.5	3438.909	120036.9	14388.87	14388.87442	945549963	25626.23	13.61964	28.95094	2.450729
		16	186023	126417.1	3667.187	122612.5	-63410.5	63410.54859	1137759195	27987.75	34.08748	29.27197	-0.02171

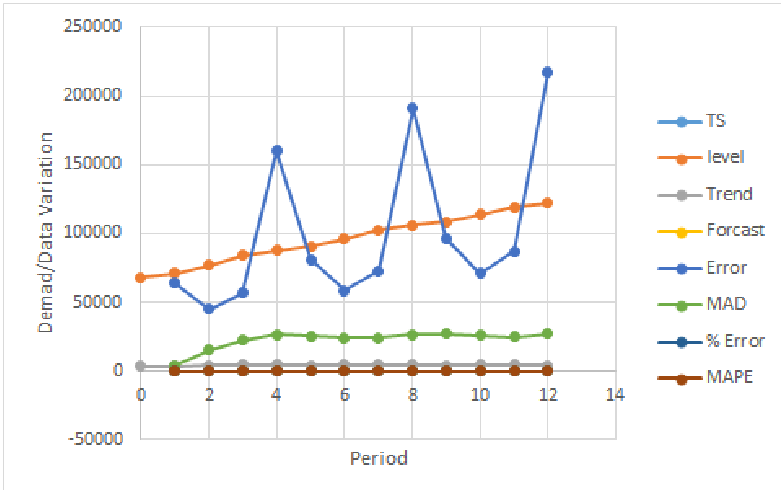


The Tracking Signal for Holt's method is -2.5 to 2.5 which is also a good predictor for demand forecast. The MAPE goes from about 11-20%. Holt's method seems to be the best method to forecast.

Winter's Method:

5. Winter's Method

Year	Quarter	Period	Demand	level	Trend	Seasonal I	Forcast	Error	Absolute Error	Squard Er	MAD	% Error	MAPE	TS
		0		67878.1	3665.13									
1	2	1	59769	71323.9	3621.26	0.89	63673.5	3904.47292	3904.47292	1.5E+07	3904.47	6.53261	6.53261	1
1	3	2	71698	77172.7	4066.77	0.6	44967.1	-26730.92014	26730.92014	3.6E+08	15317.7	37.2827	21.9076	-1.4902
1	4	3	93241	83837.6	4586.39	0.7	56867.6	-36373.36215	36373.36215	6.8E+08	22336.3	39.0101	27.6084	-2.65039
2	1	4	121499	87359.1	4373.42	1.81	160047	38548.38977	38548.38977	8.8E+08	26389.3	31.7273	28.6382	-0.78257
2	2	5	60247	90542.5	4135.41	0.88688	81355.7	21108.70355	21108.70355	8E+08	25333.2	35.0369	29.9179	0.01805
2	3	6	76201	96091.8	4418.19	0.61974	58676	-17525.00192	17525.00192	7.2E+08	24031.8	22.9984	28.7647	-0.71021
2	4	7	98203	102260	4768.11	0.72473	72842.5	-25360.45263	25360.45263	7E+08	24221.6	25.8245	28.3446	-1.75167
3	1	8	147597	105811	4524.78	1.78485	191028	43431.19191	43431.19191	8.5E+08	26622.8	29.4255	28.4798	0.03768
3	2	9	63204	108437	4144.92	0.87359	96388.4	33184.37685	33184.37685	8.8E+08	27351.9	52.5036	31.1491	1.24991
3	3	10	83203	113554	4339.5	0.63014	70942	-12261.0354	12261.0354	8.1E+08	25842.8	14.7363	29.5078	0.84845
3	4	11	101478	118866	4533.99	0.73887	87107.7	-14370.28978	14370.28978	7.5E+08	24799.8	14.161	28.1126	0.30468
4	1	12	162483	121842	4222.42	1.76145	217364	54880.61478	54880.61478	9.4E+08	27306.6	33.7762	28.5846	2.28651
		13	65259	123573	3724.02	0.85615	107930	42671.11137	42671.11137	1E+09	28488.5	65.3873	31.4156	3.68949
		14	88754	127906	3845.91	0.63629	80998.2	-7755.829694	7755.829694	9.4E+08	27007.6	8.73857	29.7958	3.60462
		15	105648	132248	3945.04	0.74576	98255.1	-7392.905744	7392.905744	8.8E+08	25699.9	6.99768	28.2759	3.50036
		16	186023	134742	3654.81	1.73578	236401	50377.59656	50377.59656	9.9E+08	27242.3	27.0814	28.2013	5.15143
		17		131477	2270.84	0.83646	115764	115763.8316	115763.8316	1.7E+09	32449.4			7.8923
		18		127060	933.367	0.63975	85565	85565.00203	85565.00203	2E+09	35400.3			9.65149
		19		121594	-346.569	0.74894	95859.9	95859.90373	95859.90373	2.4E+09	38582.4			11.34
		20		115185	-1559.04	1.71447	207874	207874.4384	207874.4384	4.4E+09	47047			13.7182



The TS for Winter's method is from 13.7 to -2.6 which is not a very good predictor for a firm's forecast. The MAPE goes from about 6.5% to 31.4% which is a big gap.

Conclusion:

Method	Mape	% Error	MAD	Error
Moving Average	23.6	28.5	20312	854
Simple Exponential	33.687	29.4	24985	-3551
Holt's	24.3	29.2	19972	-37
Winter's	27.2	28.2	26768	32270

Comparing all of the different methods together it is clear that Holt's method is the best method to us for demand forecasting. That means that our company Rec. Tech. should use Holt's method of demand forecasting to predict the demand for the VR headset. This will help in determining the rate at which shipments need to be made so that they retailers never fall into their safety stock or miss the ROP.

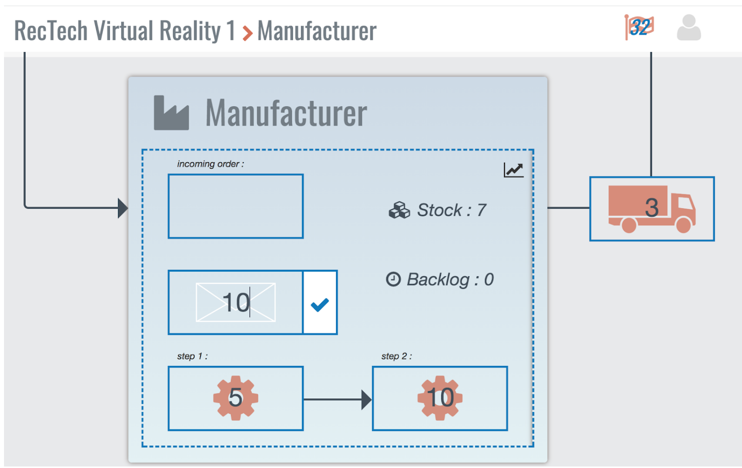
Inventory

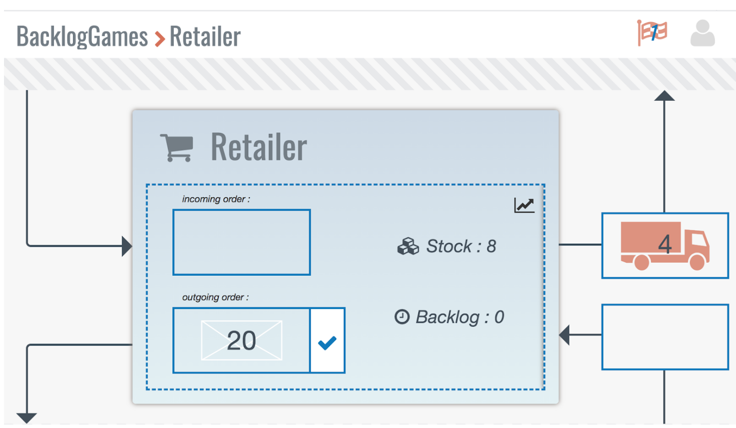
Inventory Analysis:

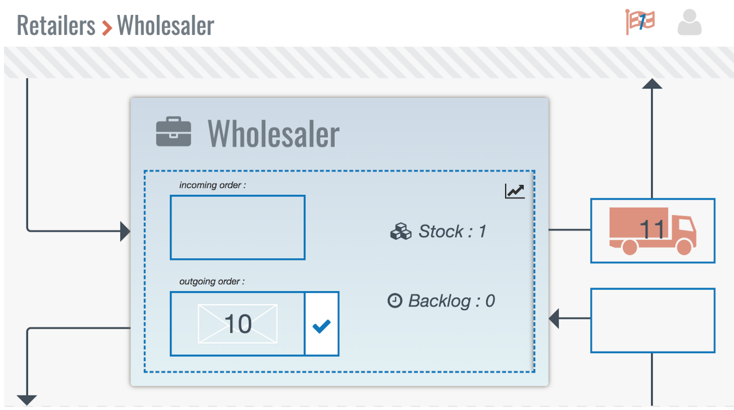
Lead Beer Game:

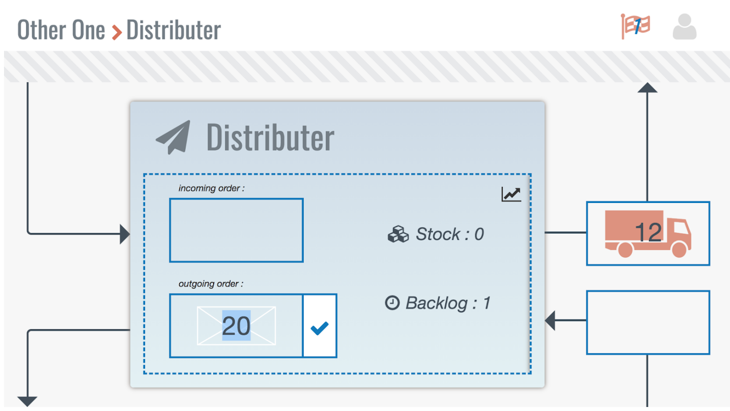
Goal: The goal of the beer game is to closely predict the incoming order from one of the other stages, so that your stage minimizes cost of supply or stock.

Utilized a MIT Beer Game simulator to play through. Below we see us playing as a

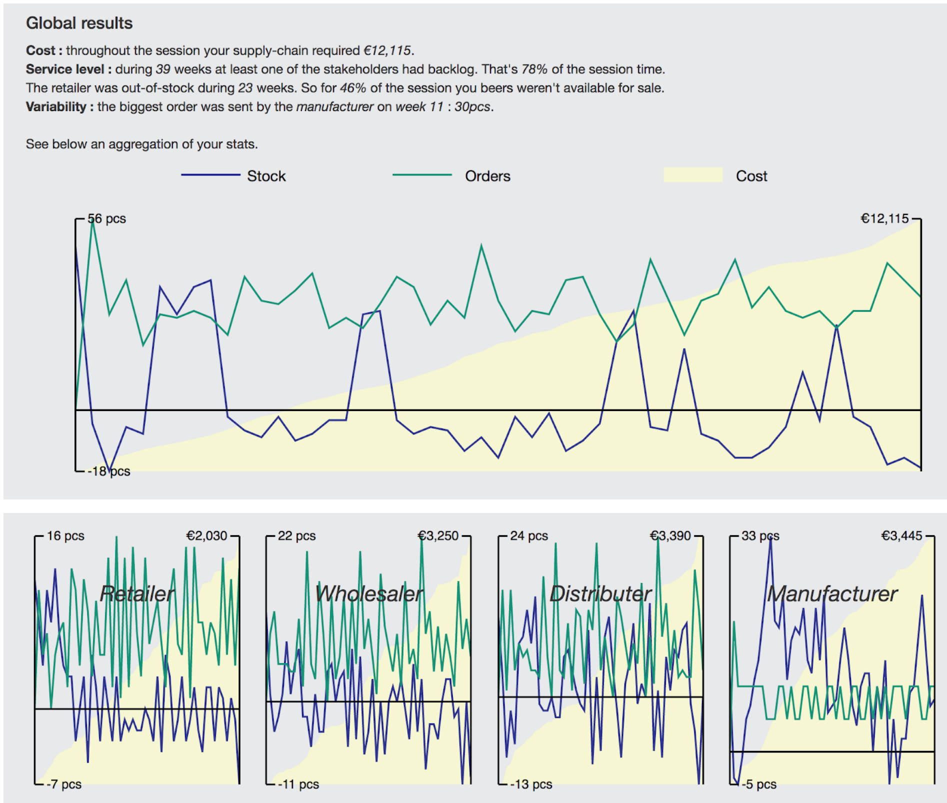








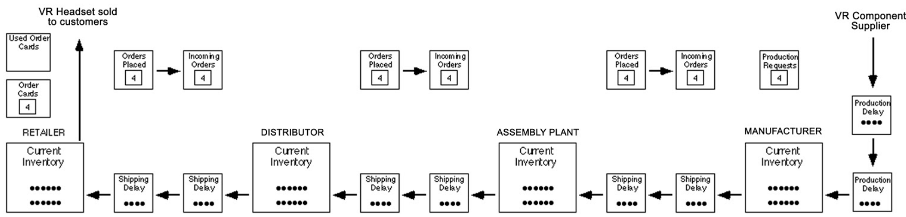
Above are screenshots from each of our screens. One of us playing manufacturer, distributor, Wholesaler, and Retailer.



Above are the results of the MIT beer game while playing the manufacturer.

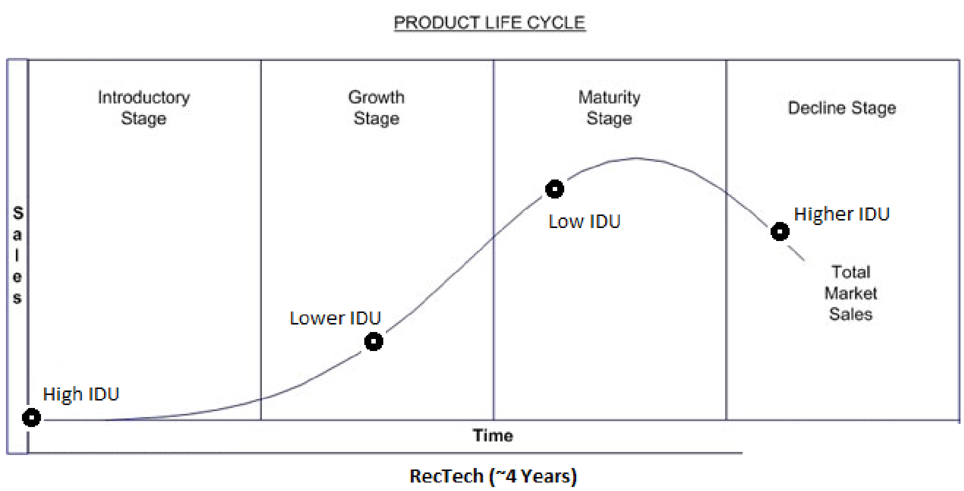
- Maintaining a strategy of manufacturing between 10 and 5 Beers depending on the current stock and the stock in manufacturing served well to keep the stock above the orders
- We came out on top with the highest profit margins of $3,445

ii) Customize for our own product



Above we see the supply chain cycle adapted from the MIT Beer Game. We start from the Headset component suppliers through each stage (Manufacturer, Assembly, Distributor, Retailer) then sold out to the customers.

Product Life Cycle:



This diagram shows the Implied Demand Uncertainty (IDU) of RecTech's product life cycle. IDU refers to the uncertainty in demand for the product implied by the customer need for the product during the product life cycle. For our company, we are currently in the growth stage.

Cycle Inventory:

RechTech has its VR headset distribution center/assembly plant in Springfield, Oregon and all of our outsourced hardware and software components are shipped to this location to be assembled and distributed to their pertaining vendors. The following numbers show the demand and costs our company faces in conducting our inventory cycle.

- Transportation cost: S = $32,829
- Annual demand using Holt's method: $\frac{346207+382248+410366+445684}{4}$ = 396,126.25 VR headsets
- Cost for 1 unit: C = $160
- Holding cost = 10% or 0.10

1. Annual material cost
   C_M = DC = 396126.25 * ($160)
   C_M = 63,380,200
   Over the course of a year our company will spend $63,380,200 on material cost for developing the headset.

2. Our company will solve for the optimal lot size $Q_L{}^*$ of headsets we will produce over a period of time
   Optimal lot size: $Q_L{}^* = \sqrt{\frac{2DS}{hC}}$
   $= \sqrt{\frac{2(396126.25)(\$32829)}{(10\%)(\$160)}} = 40,318.15\ units$
   To minimize the total cost at RechTech, we will have to have order a lot size of 40,318.15 headsets for each replenishment order.

3. Number of shipments per year: n = $\frac{D}{Q_L} = \frac{396126.25}{40318.15}$ = 9.8250
   Using our annual demand of 396126.25 headsets and our optimal lot size of 40,318.15 to minimize our total cost our company expects to have about 10 shipments per year.

4. Annual shipment costs: C_S = nS = $\frac{D}{Q_L}$ S
   = 9.8250 * ($32829) = 322,544.925
   Given that we will incur a shipment cost of $32,829 if our company plans to order 9.8250 shipments over the course of the

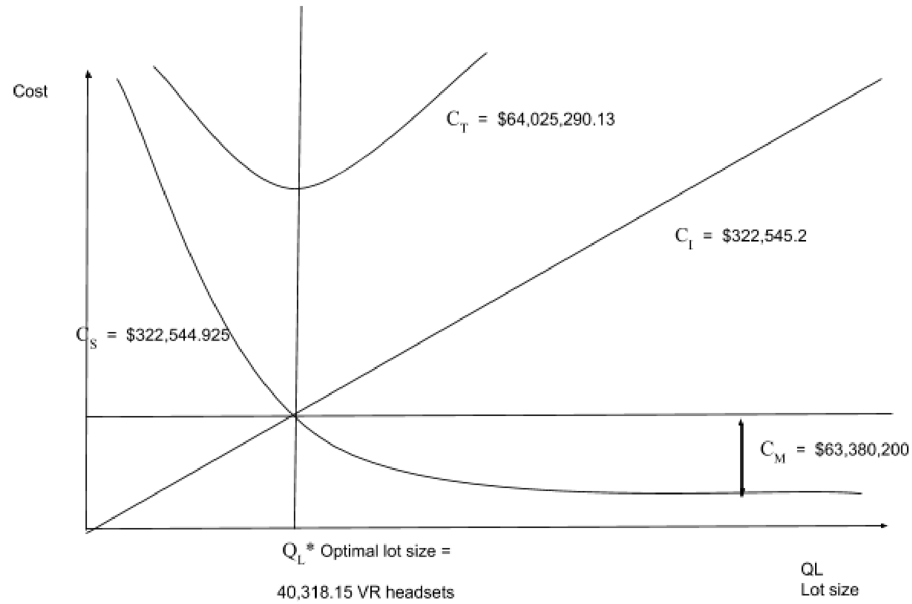
year then we can expect to have an annual shipment cost of about 322,544.925.

5. Holding cost per unit = hC
   = 0.10 * ($160) = $16to
   With a holding cost of 10% it cost about $16 hold one VR headset in inventory

6. Average inventory held in the year or Cycle Inventory $= \frac{Q_I^*}{2}$
   $= \frac{40318.15}{2} = 20{,}159.075$
   On average our facilities will hold about 20,159.075 headsets during the year with an optimal lot size of 40,318.15 headsets.

7. Cycle Inventory holding cost $C_I^* = \frac{Q_I^*}{2} * \text{ hC}$
   = 20159.075 * 16 = 322,545.2
   Our company can expect to incur a cost of about $322,545.2 to hold an average of 20159.075 headsets given that our holding cost per unit is 10%.

8. Now that we have calculated all the individual cost that our company will face to develop and stock our VR headset we must determine what are total cost is:
   Total cost $C_T = C_M + C_S + C_I$
   = 63,380,200 + 322,544.925 +322,545.2
   = 64,025,290.13
   After adding up our material, shipping, and inventory holding costs we will experience a total cost of about $64,025,290.13 to operate our inventory cycle.



The chart above shows the trend that our costs follow the more we raise our lot size the larger our costs become. Our economic order quantity of 40,318.15 headset is what our company has determined that is needed to minimize our overall cost that include material, shipping, and inventory costs.

9. Replenishment cycle time T = $\frac{365}{n}$

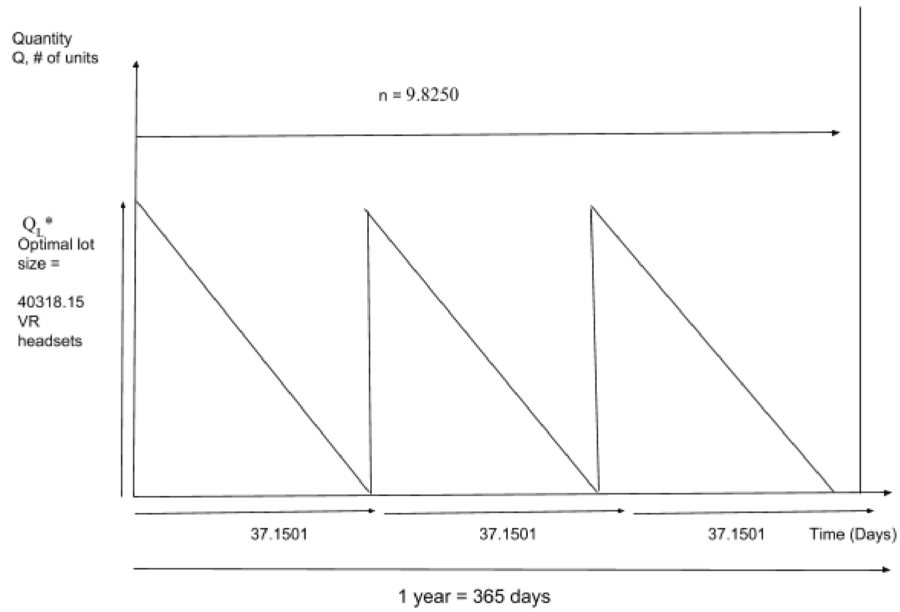
$= \frac{365}{9.8250} = 37.1501$

To keep up the inventory at our facilities our company will have about 37 replenishment cycles over the course of the year.

10. Flow time = $\frac{T}{2}$

$= \frac{37.1501}{2} = 18.5750$

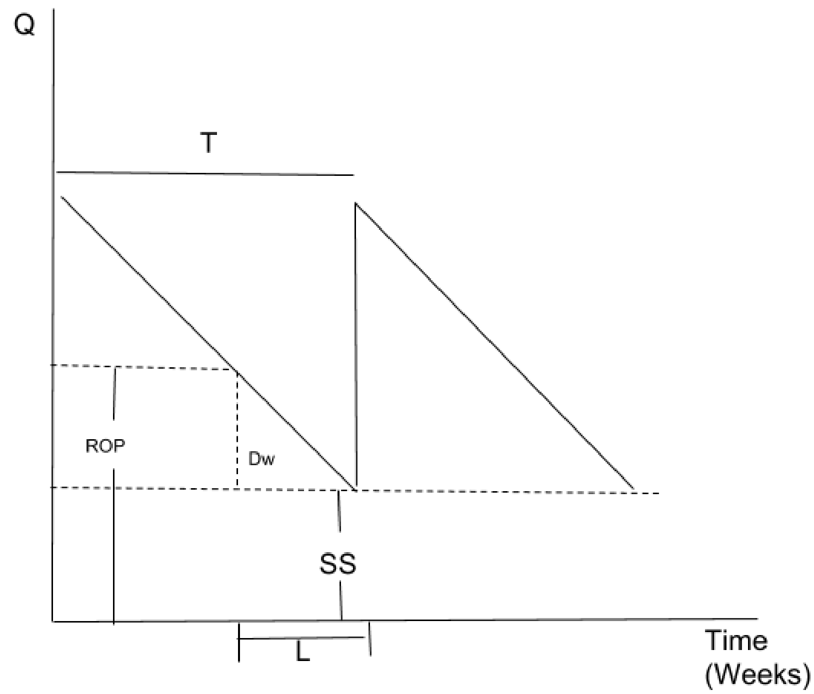
The average amount of time that 1 unit of our VR headset is held in inventory is about 19 days at each facility that receives about 38 replenishment cycles in a year.



The chart above shows how our inventory cycle will function over the course of a year given a replenishment cycle of about 38 days in 9.8250 shipments to meet our optimal lot size of 40318.15 VR headsets that will minimize our costs and help us meet our demand.

Safety Inventory:

We will be using a continuous review inventory management policy so that our company can monitor the inventory level using our information system and when the inventory level reaches a ROP we place an order with our suppliers.



The chart above shows the general relationship that time in weeks and quantity have on our reorder point and our safety stock based on the lead time it takes our suppliers to ship the necessary components to build our product.

1. First we will solve for our Weekly Demand Statistics
   Mean value of weekly demand
   $D_W = \frac{D}{52} = \frac{396{,}126.25}{52} = 7617.81$
   Standard deviation of weekly demand
   $\sigma_{Dw} = 677.98$
   Supplier lead time
   L = 1 week
   Desired Cycle Service Level

CSL = 95%

2. Our next step is to calculate the demand statistics for the supplier lead time
   Mean of demand during lead time
   $(D_L)_m = LD_W$
   = 1 * 7617.81 = 7617.81
   From this calculation our company can expect our average mean demand to 7,617.81 during a lead time of 1 week it takes us to get all our components.

   Standard deviation of demand during lead time
   $\sigma_{Dw} = \sqrt{L} * \sigma_{Dw}$
   $= \sqrt{1} * 677.98 = 677.98$
   The spread of our demand during the lead time of 1 week will be 677.98.

   Our company's mean and standard deviation values during the lead time are additive meaning that our mean demand of 7617.81 and standard deviation of 677.98 are the result of adding them iteratively by the number of weeks it takes us to gather all the components from our suppliers which in our case is 1 week.

3. Next we will examine our actual demand the actual demand D_L during a 1 week lead time that corresponds to the time it takes our supplier to ship our components to our DC/assembly facility in Springfield, Oregon. This process will ultimately lead us to finding the reorder point we need to determine if our product is available to our customers during the supplier lead time.

   To obtain the reorder point we will utilize the equation $ROP = (D_L)m + ss$ where we need to determine the safety stock for our product but we need to manipulate it to get our safety stock first.
   $ROP = (D_L)m + ss$
   ROP = L D_W + ss
   ss = ROP - L D_W
   Since z = $\frac{D_L - (D_L)m}{\sigma_{DL}}$

And z' = $\frac{ROP - (D_L)m}{\sigma_{DL}}$

z is less than or equal to z' is equal to the defined CSL we have

$ss = [\sqrt{L}\sigma_{Dw}]\ F^{-1}[(CSL)_{desired}]$

4. Safety stock

$ss = [\sqrt{L}\sigma_{Dw}]\ F^{-1}[(CSL)_{desired}]$

$= [\sqrt{1} * 677.98\ ]\ F^{-1}[(0.95)_{desired}]$

= 677.98 * 1.65

= 1118.667 VR headsets

Our company will have a safety inventory of 1118.667 VR headsets than our forecasted demand we obtained using holts model to make sure our product is available to our customers.

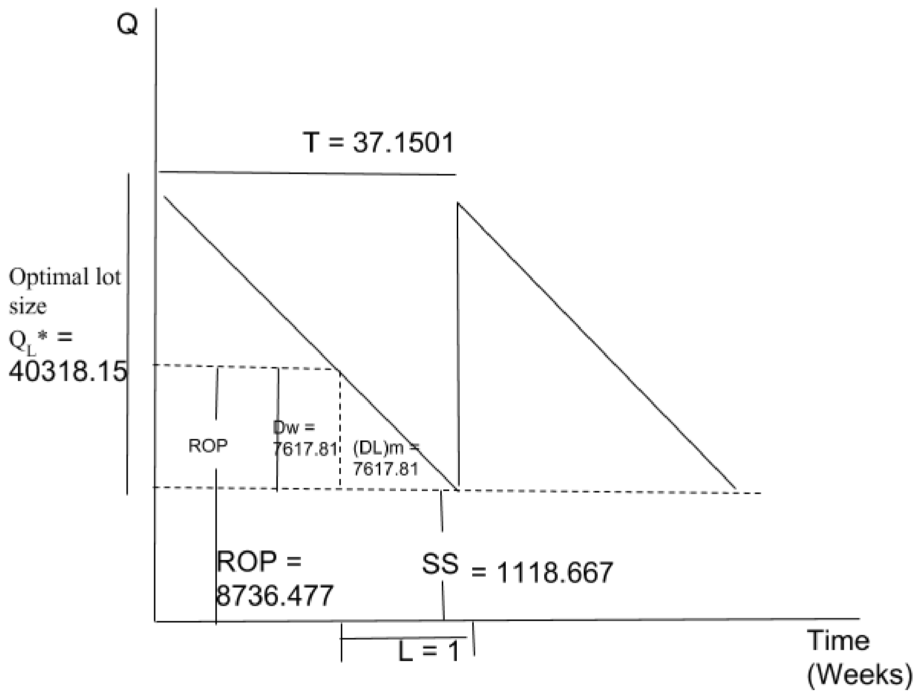
5. Using the safety inventory we obtained we can now solve for our ROP

ROP = L D_W + ss

= (1)(7617.81) + 1118.667

= 8736.477

Our reorder point for when RechTech will place another order of components from our suppliers will be when we hit the threshold of 596,126.25 VR headsets. Since our actual demand of 396,126.25 is larger than our ROP then our we can expect our product will not be available to all customers during the lead time and we would have to make adjustments to make sure we meet all our demand during the lead time.



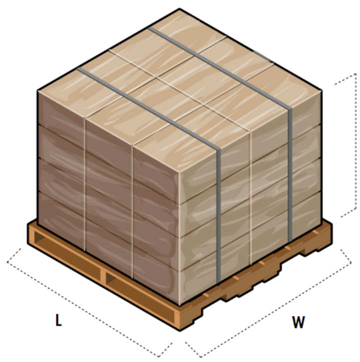
The chart above shows the model that will affect our ROP and SS given the lead time of 1 week it takes for our suppliers to ship the components to our DC/assembly plant. Our company will have a safety stock of 1118.667 headsets more than our forecasted demand meaning that our reorder point will be when we reach the threshold of 8736.477. Overall our ROP is less than our actual demand meaning that our company will not be able to meet the demand during the supplier lead cycle.

Conclusion:

One of the most important and crucial parts of a supply chain is determining and the cycle and safety inventory levels our particular company needs to have in order to have their supply meet the demand for the product, and in case of anomalies, have enough stock in order to keep customers happy. Safety stock will be 1119 headsets rounding up cause we cannot have half a headset which means that the ROP will be 8736. On the other hand,our facilities will hold about 20,159.075 headsets during the year with an optimal lot size of 40,318.15 headsets which is the cycle inventory for our company. ROP is less than demand which means that the company won't meet demand during supplier lead cycle.

Transportation

Example Procedure for calculating Transportation costs (UPS):



U.S. Export and Import

$$\boxed{\text{Dimensional Weight in Pounds}} = \frac{L \times W \times H}{139}$$

L = Length in inches
W = Width in inches
H = Height in inches

Billable Weight Calculation

Customer has a shipment with 3 pallets weighing 600 pounds, 800 pounds and 1,000 pounds. All pallets are the same size with the following dimensions: 48 in. x 40 in. x 60 in.

1. Determine actual weight.
Actual Weight = 600 lbs. + 800 lbs. + 1,000 lbs. = 2,400 lbs.

2. Determine dimensional weight.
Pallet Dimensional Weight = $\frac{\text{48 in. x 40 in. x 60 in.}}{139}$ = 829 lbs.
Shipment Dimensional Weight = 829 lbs. + 829 lbs. + 1,000 lbs. = 2,658 lbs.

3. Determine billable weight.
Shipment Billable Weight = 2,658 lbs.

Using the size and weight of our inventory (Headset parts):

- Dimensions of 1 unit: L=8, W=6, H=6
- Weight of 1 unit: 4lbs
- 1 Pallet: L=48, W=42, H=60
- (48*42*60)/139 = 870lbs
- Units per pallet 6*7*10 = 420 units
  - Actual Weight = 420 units*4lbs = 1,680lbs
  - Billable weight = 1680+870 = **2,5501bs**
- Optimal lot size/pallet size = 6707/420 = **17 pallets per lot**

China, People's Republic of/CN	962	962	462	462	692	662

Import

UPS Worldwide Express Freight®

Guaranteed delivery by end of day from/to more than 60 countries and territories. Delivery is guaranteed on the next business day from Canada and Mexico and one to two business days from Asia, Europe and Latin America. Rates include door-to-door and non door-to-door delivery with routine, in-house, customs clearance by UPS Supply Chain Solutions for palletized shipments of more than 150 pounds.

Zones	456	457	458	459	461	462	463	470	471
151-999 Lbs. (Price per Lb.)	$11.15	$13.86	$20.82	$10.87	$11.55	$12.83	$10.87	$9.62	$11.15
1,000 Lbs. or More (Price per Lb.)	10.87	13.09	19.66	10.49	11.25	12.25	10.48	9.51	10.87
Minimum Rate	1,683.65	2,092.86	3,143.82	1,641.37	1,744.05	1,937.33	1,641.37	1,452.62	1,683.65

- $1937*17 pallets = **$32,929** minimum for lot size
- Optimal lot size: $Q_L{}^* = \sqrt{\frac{2DS}{hC}} = \sqrt{\frac{2(396126)(\$4.89)}{(10\%)(\$1.60)}} = 4,921\ units$
- Average Inventory = Average inventory: $\frac{Q_L}{2} = \frac{4921}{2} = 2,461\ units$
- To find the safety stock we use the equation $ss = [\sqrt{L}\sigma_{Dw}]\ F^{-1}[(CSL)_{desired}]$ and we obtain $ss = [\sqrt{2} \times 429\ units]\ F^{-1}(0.95) \rightarrow [\sqrt{2} \times 2,461]\ (1.65)$ = **5,741 VR headsets**
- Cycle inventory holding cost: $C_I^* = (\frac{Q_L^*}{2})hC \rightarrow (2,461)(.10)(\$160) = \$39,376$
- Note: Used the above procedure for the rest of the Transportation options...

1. Transportation Network Design
   a. Step 1: Select mode of transportation

Transportation Options

Alternative	Lot size	Transportation cost	Cycle inventory	Safety inventory	Inventory cost	Ship time	Total cost
UPS Worldwide Express	4921 units	$32,829	2,460.5 units	5741 units	$39376	<1 week	**$67,858**
Fedex International Economy	4921 units	$42,320	2,865 units	6224 units	$41560	1-2 weeks	**$86,840**
DHL Express World-Wide	4921 units	$25,748	1,980 units	5310 units	$33201	4-8 weeks	**$53,696**

The mode of transportation that we will be using is UPS Worldwide Express due to the fact that our company is striving towards being a hybrid between a responsive and efficient supply chain network.

b. Step 2: Determine if inventory should be aggregated spatially

Options	Scenario 1	Scenario 2	Scenario 3
Number of stocking locations, X	X =50	X=50	X=1(complete aggregation)
Replenishment interval, T	4 weeks	2 weeks	1 week
Cycle inventory	429	214	107
Safety inventory	1001	714	216
Annual inventory cost	$472,512	$236,256	$97,771
Shipment type	Replenishment	Replenishment	Customer order
Shipment size	17 pallets	8 pallets	3 pallets
Shipment weight	1,680 lbs	840 lbs	350 lbs
Annual transportation cost	$1,803,082	$2,640,013.42	$4,113,456.93
Annual total cost	$2,275,594.68	$2,876,269.42	$4,211,227.93

The scenario that minimizes total cost is

c. Step 3: Determine if order should be aggregated in time (temporal)

		2-day response		**3-day response**		**4-day response**	
Day	Demand	Quantity shipped	Cost	Quantity shipped	Cost	Quantity shipped	Cost
1	1,024	1,024	$151.20	0	-	0	-

2	826	826	$141.30	1,850	$178.96	0	-
3	633	633	$131.65	0	-	2,483	$215.72
4	1,298	1,298	$164.90	1,931	$187.24	0	-
5	964	964	$138.60	0	-	0	-
6	893	893	$135.72	1,857	$179.67	3,155	$228.14
Total cost	-	-	$863.37	-	$545.87	-	$443.86

d. Step 4: Explore tailored transportation
   i. By customer density and distance
   ii. By product demand and value

Transportation Options Based on Customer Density and Distance

	Short distance	**Medium distance**	**Long distance**
High density	Private fleet with milk runs	Cross-dock with milk runs	Cross-dock with milk runs
Medium density	Third party milk runs	LTL carrier	LTL or package carrier
Low density	Third party milk runs or LTL carrier	LTL or package carrier	Package carrier

- For short distance/high density, our company will attempt to own a fleet of trucks that are used with milk runs originating at the DC to supply customers, because this scenario makes very good use of the vehicles.
- For high density/long distance, it does not pay to send milk runs from the warehouse because trucks will travel a long distance empty on the return trip.
  - Better to use a public carrier with large trucks to haul the shipments to a cross-dock center close to the customer area, where the shipments are loaded onto smaller trucks that deliver product to customers using milk runs. In this situation, it may not be ideal for a firm to own its own fleet.
- As customer density decreases, use of an LTL carrier or a third party doing milk runs is more economical because the third-party carrier can aggregate shipments across many firms.
  - If our company wants to serve an area with a very low density of customers far from the warehouse, even LTL carriers may not be feasible and the use of package carriers may be the best option.

Aggregation Strategies Based on Value/Demand

Product type	**High value**	**Low value**
High demand	Disaggregate cycle inventory. Aggregate safety inventory. Inexpensive mode of transportation for replenishing cycle inventory and fast mode when using safety inventory.	Disaggregate all inventories and use inexpensive mode of transportation for replenishment
Low demand	Aggregate all inventories. If needed, use fast mode of transportation for filling customer orders.	Aggregate only safety inventory. Use inexpensive mode of transportation for replenishing cycle inventory.

- The cycle inventory for high-value products with high demand is disaggregated to save on transportation costs because this allows replenishment orders to be transported less expensively
- For high-demand products with low value, all inventories should be disaggregated and held close to the customer to reduce transportation costs.
- For low-demand, high-value products, all inventories should be aggregated to save on inventory costs
- For low-demand, low-value products, cycle inventories can be held close to the customer and safety inventories aggregated to reduce transportation costs while taking some advantage of aggregation

Conclusion:

- From our transportation network calculations and models, we have concluded that the most optimal mode of transportation will be UPS Worldwide Express.
    - Due to the fact that our company is striving towards being a hybrid between a responsive and efficient supply chain network we will be choosing UPS because it's in the middle of the pack of most efficient and responsive

- We have also concluded that having a 4-day response time for our transportation is most cost effective and therefore efficient.
- We can use all these calculations to determine our desired cost and transportation methods that will be aligned with our supply chain and competitive strategy which is to be both a responsive and efficient supply chain.

Facilities

Capacitated Plant Location Model:

Inputs - Costs, Capacities, Demands								
	Demand City							
	Production and Transportation Cost per 1,000 Units						Fixed	
Supply City	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angele	Cost ($)	Capacity
Long Beach	774	682	22	445	770	237	2200	4
Santa Clara	88	10	676	308	233	911	3100	6
Riverside	22	80	725	347	159	960	3700	7
Oakland	852	768	117	553	857	209	4300	5
San Gabriel Valley	794	711	47	474	800	208	2500	2
Demand	2.16	1.31	1.24	3.51	10.01	2.57		

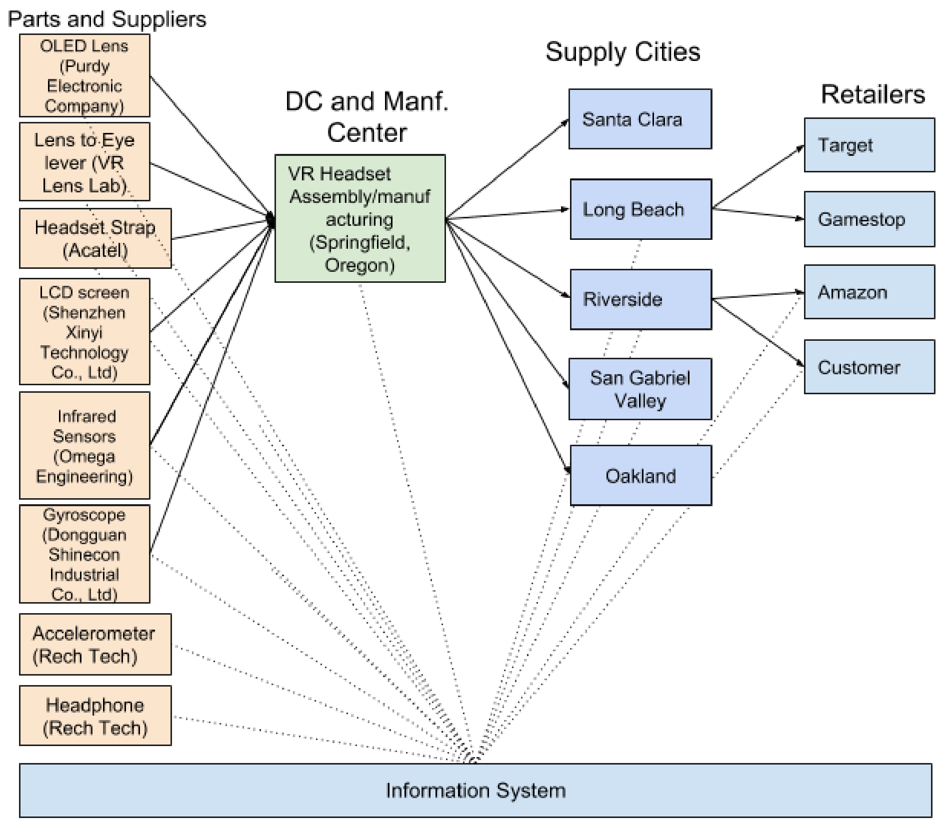
Decision Variables							
	Demand City - Production Allocation (1000 Units)						Plants
Supply City	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angele	(1=open)
Long Beach	0	0	0.49	3.51	0	0	1
Santa Clara	2.16	1.31	2.2E-10	0	2.53	2.2E-10	1
Riverside	0	0	2.2E-10	2.2E-10	7	2.2E-10	1
Oakland	0	0	0.75	0	0.48	2.57	1
San Gabriel Valley	0	0	0	0	0	0	0

Constraints						
Supply City	Excess Capacity					
Long Beach	0					
Santa Clara	0			Solver		
Riverside	1.1E-08					
Oakland	1.2					
San Gabriel Valley	0					
	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angeles
Unmet Demand	1E-08	0	0	0	0	0
Objective Function						
Cost=	17814.6					

For this Capacitated Plant Location Model, we have our cost for setting up all the plants in Long Beach, Santa Clara, Riverside, Oakland, San Gabriel Valley to add up to about $17,814,600 with Riverside being the only supply city with an excess capacity and Springfield being the only plant with an unmet demand. Everything else in the screenshots from our module above is self-explanatory depicting the plant capacity, demand allocation per city, and production and transportation costs for each city. Our company will be headquartered in Springfield, Oregon due to tax reasons, too costly to be headquartered in California.

Supply Chain:

a. Step 3: Optimize the entire (total) Supply Chain Network



- For our optimized supply chain network, we will be obtaining all of our parts for our VR headsets from the suppliers listed above and will be shipped to our distribution and manufacturing facility in Springfield, Oregon (also our headquarters).
- From our distribution center, we will then transport our VR headsets to our supply cities listed above and from there on shipped to our targeted retailers.

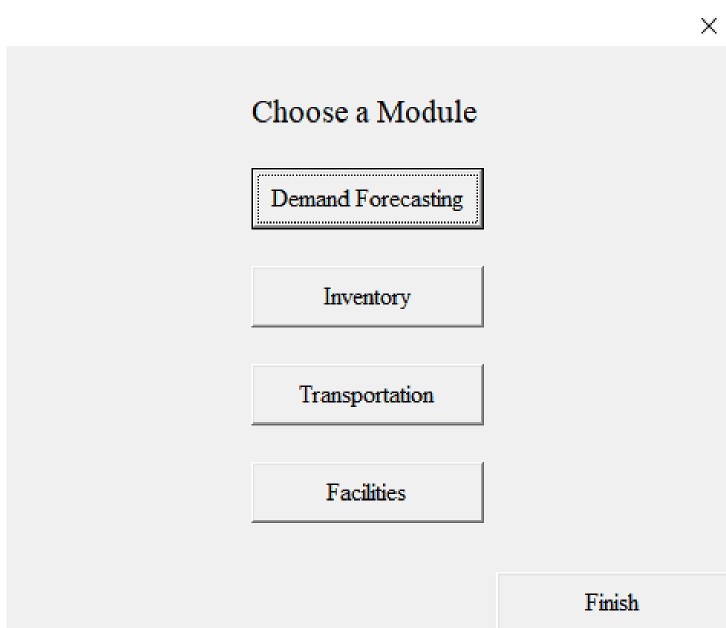
VBA

VBA work:

User Manual:

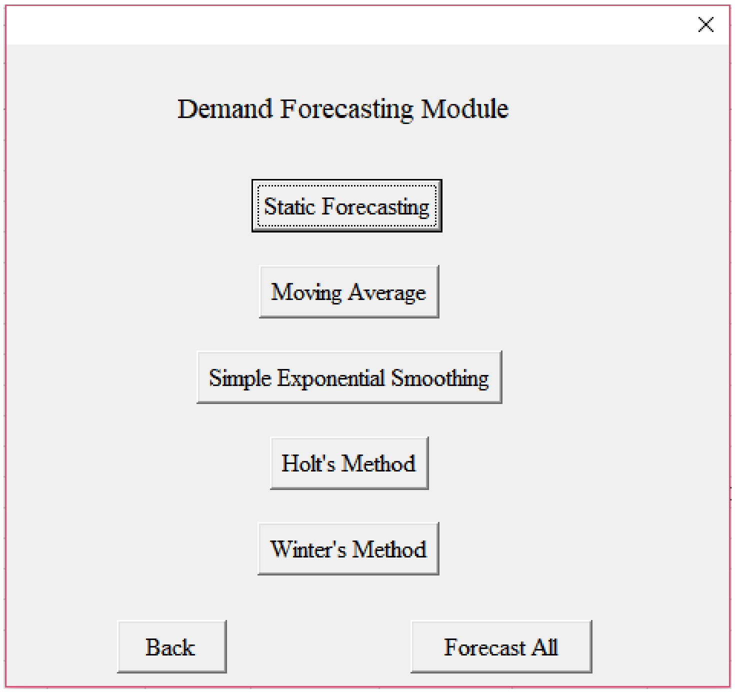
Step1: Choose a Module

Step2: Choose the method of operation

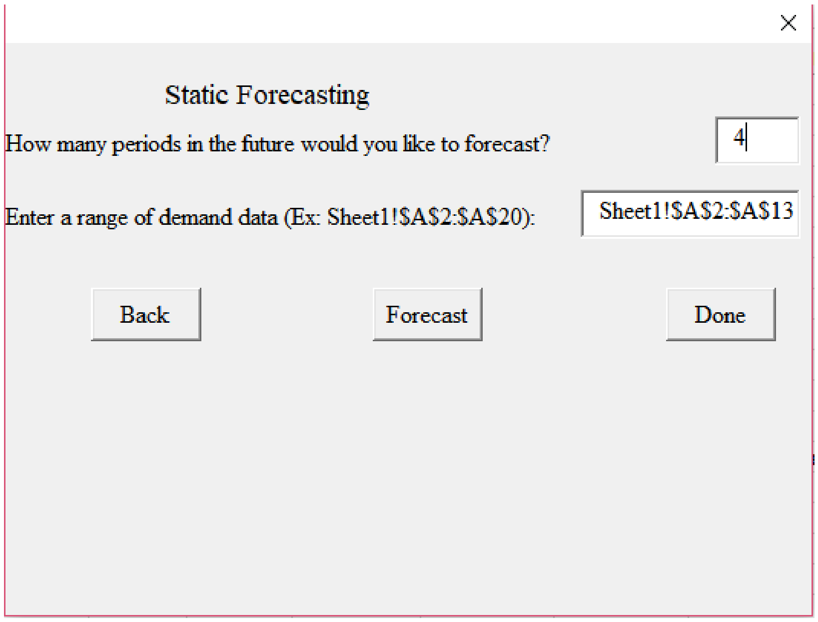


Step 3: Demand forecasting
Choose the Demand Forecasting button

Step 3a: Select the Static method

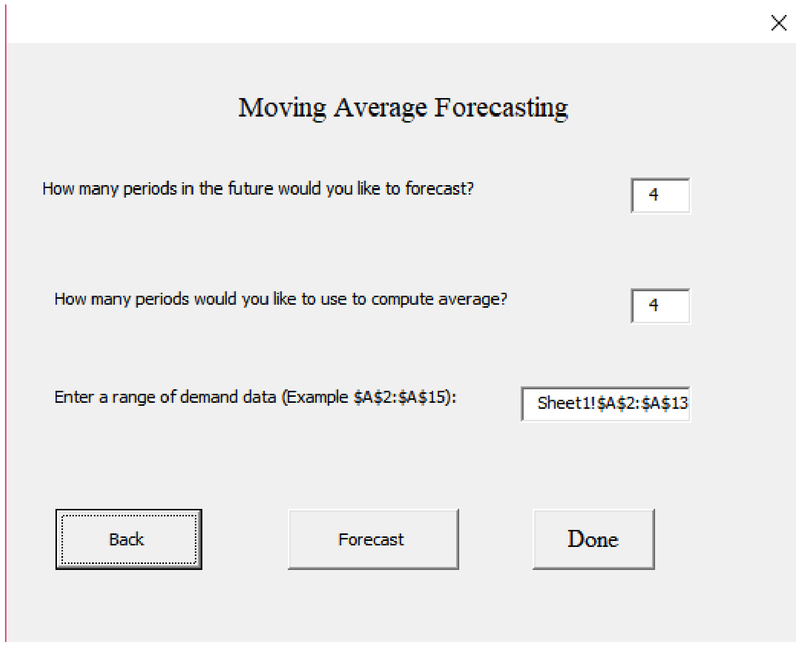


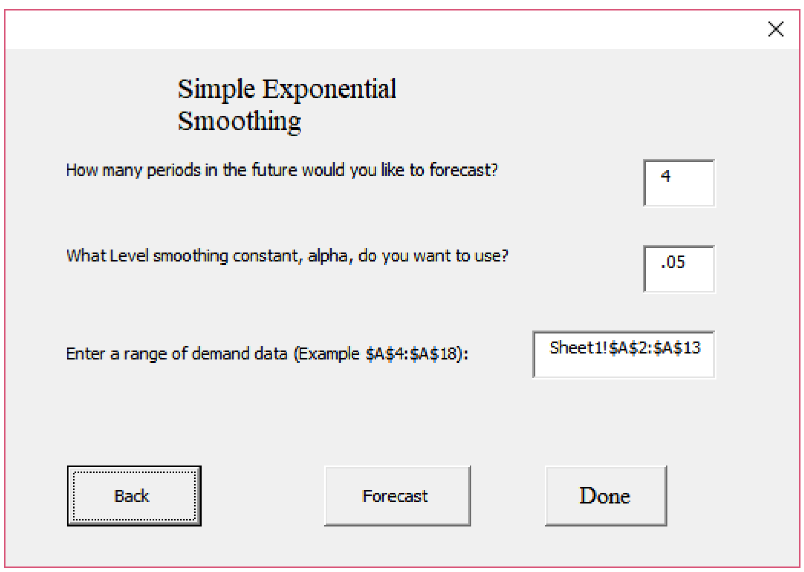
In the static method fill in the missing information needed to calculate



Step 3b: Moving Average
Select Moving Average in the demand forecasting page

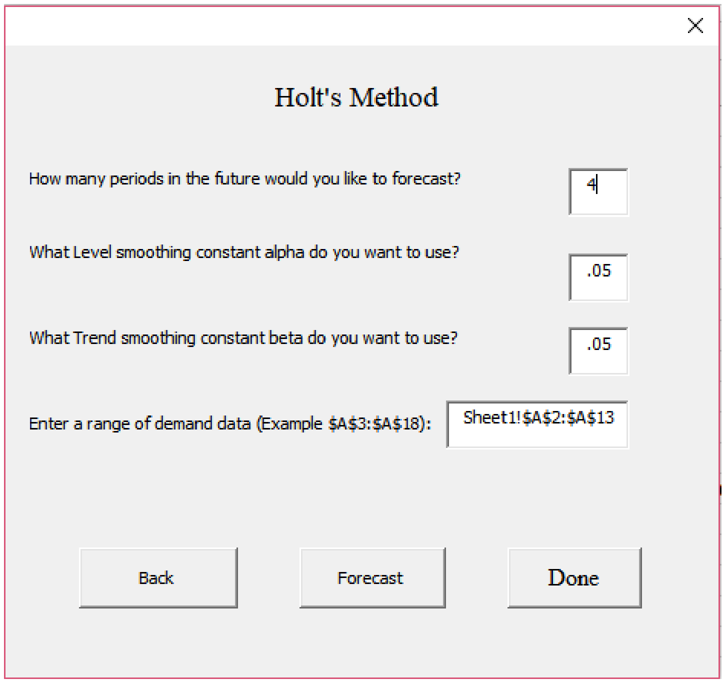
Step 3c: Simple Exponential
Select Simple Exponential and fill in the missing information such as the different smoothing factors





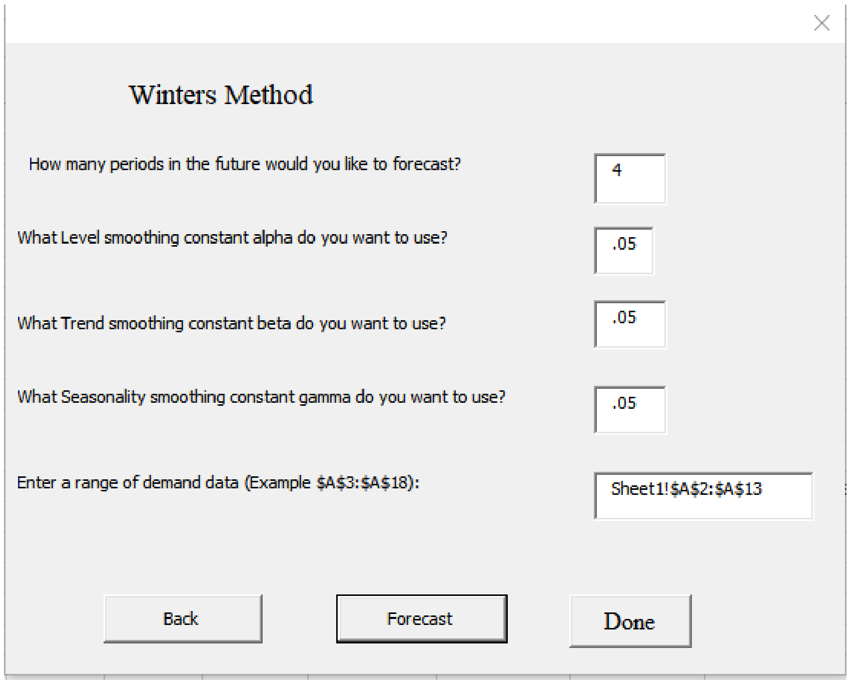
Step 3d: Holt's Method

Select Holt's Method and fill in the missing information such as the different smoothing

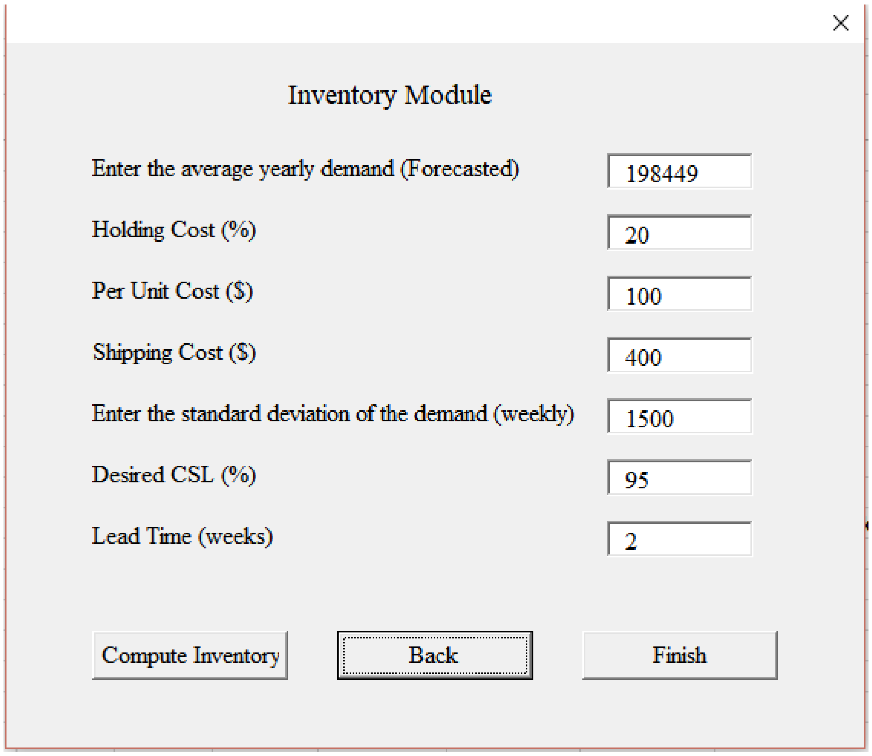


Step 3e: Winter's Method

Select Winter's Method and fill in the missing information such as the different smoothing



Step 4 Inventory:
Select inventory in the directory and then fill out the required information. Once the information is filled out select compute inventory to calculate.



Step 5a Transportation:

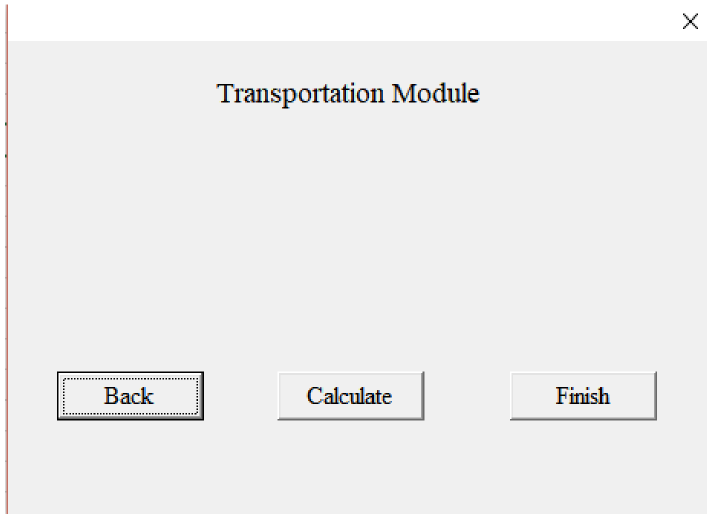
Fill out the information about the different types of transportation on the main page.

	DCity1	DCity2	DCity3	DCity4	DCity5	DCity6	Fixed Cost	Capaci
SCity1	774	682	22	445	770	237	2200	
SCity2	88	10	676	308	233	911	3100	
SCity3	22	80	725	347	159	960	3700	
SCity4	852	768	117	553	857	209	4300	
SCity5	794	711	47	474	800	208	2500	
Demand	2.16	1.31	1.24	3.51	10.01	2.57		

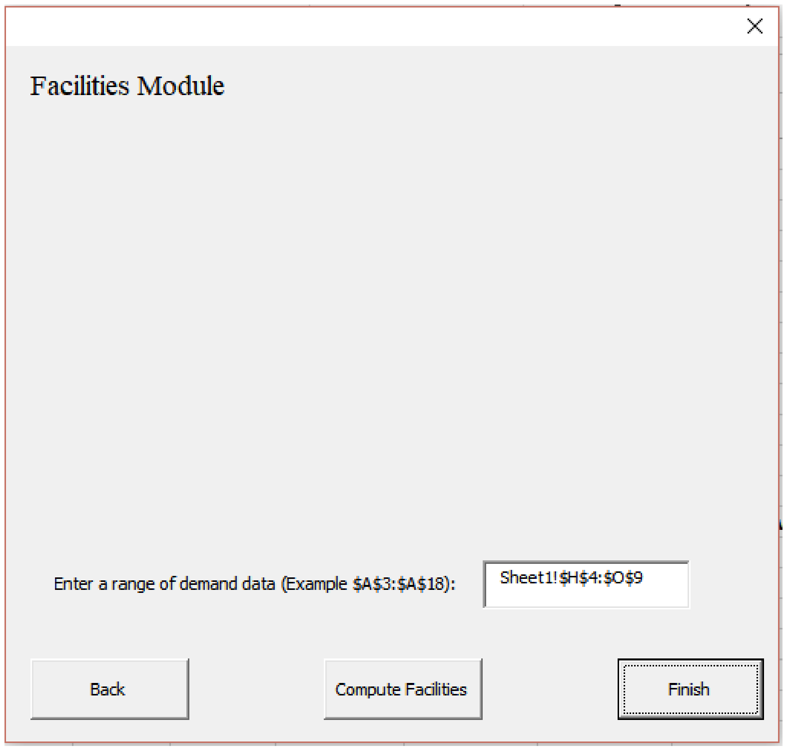
Transportation Input

Modes	**Holding Cost**	**Per Unit Cost**	**Shipping Cost**	**st. dev. Of weekly demand**	**Desired CSL**	**Lead Time (weeks)**		**Unit V**
Rail	0.2	100	600	381	95	1.5		
Air	0.2	100	900	381	95	0.5		
Truck	0.2	100	400	381	95	2		

Step 5b Transportation:
Select the transportation module and then calculate:



Step 6a Facilities:
Select Facilities under the main page. Fill in the required information on the Facility page and then calculate.


Facilities Module
Enter a range of demand data (Example $A$3:$A$18):
Sheet1!$H$4:$O$9
Back
Compute Facilities
Finish

Step 6b Facilities:

On the Facilities page that was generate click solver button to optimize the information

	Demand City - Production Allocation (1000 Units)						Plants
Supply City	San Franci	Fresno	Sacramen	San Diego	San Jose	Los Angel	(1=open)
Long Beach	0	0	0.49	3.51	0	0	1
Santa Clara	2.16	1.31	2.17E-10	0	2.53	2.17E-10	1
Riverside	0	0	2.17E-10	2.17E-10	7	2.17E-10	1
Oakland	0	0	0.75	0	0.48	2.57	1
San Gabriel Valley	0	0	0	0	0	0	0
Constraints							
Supply City	Excess Capacity						
Long Beach	0			Solver			
Santa Clara	0						
Riverside	1.07E-08						
Oakland	1.2						
San Gabriel Valley	0						
	San Franci	Fresno	Sacramen	San Diego	San Jose	Los Angeles	
Unmet Demand	1E-08	0	0	0	0	0	
Objective Function							
Cost=	17814.64						

Simulation:

Demand Data:

Static Method:

Period	Demand	De-seasonalized Demand	Regressed De-seasonalized Demand	Seasonal Factor	Average Seasonal Factor	Re-seasonalized Demand	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
1	59,201		82101.58639	0.72107	0.52923	43450.97855	-15,750	15750	-15,750	2.5E+08	15750	26.6043	26.6043	-1
2	71,698		84120.64015	0.85232	0.66555	55986.29015	-15,712	15711.7	-31,462	2.5E+08	15730.9	21.9137	24.259	-2
3	93,241	86540.5	86139.69391	1.08244	0.81481	70187.14466	-23,054	23053.9	-54,516	3.4E+08	18171.9	24.725	24.4144	-3
4	121,499	87234.125	88158.74767	1.37818	1.22495	107990.4034	-13,509	13508.6	-68,024	3E+08	17006	11.1183	21.0903	-4
5	60,247	88417.25	90177.80143	0.66809		47725.18885	-12,522	12521.8	-80,546	2.7E+08	16109.2	20.7841	21.0291	-5
6	76,201	92299.75	92196.85519	0.8265		61361.39568	-14,840	14839.6	-95,386	2.6E+08	15897.6	19.4743	20.77	-6
7	98,203	95931.625	94215.90895	1.04232		76767.69362	-21,435	21435.3	-116,821	2.9E+08	16688.7	21.8275	20.921	-7
8	147,597	97176.5	96234.9627	1.53371		117883.3947	-29,714	29713.6	-146,535	3.7E+08	18316.8	20.1316	20.8224	-8
9	63,204	98461.125	98254.01646	0.64327		51999.39915	-11,205	11204.6	-157,739	3.4E+08	17526.6	17.7277	20.4785	-9
10	83,203	100731.25	100273.0702	0.82976		66736.50121	-16,466	16466.5	-174,206	3.3E+08	17420.6	19.7908	20.4097	-10
11	101,478	102848.875	102292.124	0.99204		83348.24258	-18,130	18129.8	-192,335	3.3E+08	17485	17.8657	20.1785	-11
12	162,483	103799.625	104311.1777	1.55768		127776.3859	-34,707	34706.6	-227,042	4E+08	18920.2	21.3602	20.2769	-12
13	65,259	105014.75	106330.2315	0.61374		56273.60945	-8,985	8985.39	-236,027	3.8E+08	18156	13.7688	19.7763	-13
14	88,754	108478.5	108349.2853	0.81915		72111.60674	-16,642	16642.4	-252,670	3.7E+08	18047.8	18.7511	19.7031	-14
15	105,648		110368.339	0.95723		89928.79154	-15,719	15719.2	-268,389	3.6E+08	17892.6	14.8789	19.3815	-15
16	186,023		112387.3928	1.65519		137669.3772	-48,354	48353.6	-316,743	4.9E+08	19796.4	25.9934	19.7947	-16
17			114406.4465			60547.81975								
18			116425.5003			77486.71227								
19			118444.5541			96509.34049								
20			120463.6078			147562.3685								

Moving Average Method:

Period	Demand	Level	Forecast	Error	Absolute	Squard Err	MAD	% Error	MAPE	TS
1	59769									
2	71698									
3	93241									
4	121499	86551.75								
5	60247	86671.25	86551.75	14853.75	14853.75	2.21E+08	14853.75	20.71711	20.71711	1
6	76201	87797	86671.25	-6569.75	6569.75	1.32E+08	10711.75	7.045988	13.88155	0.773356
7	98203	89037.5	87797	-33702	33702	4.67E+08	18375.17	27.7385	18.50053	-1.38328
8	147597	95562	89037.5	28790.5	28790.5	5.57E+08	20979	47.78744	25.82226	0.160756
9	63204	96301.25	95562	19361	19361	5.21E+08	20655.4	25.4078	25.73937	1.100608
10	83203	98051.75	96301.25	-1901.75	1901.75	4.34E+08	17529.79	1.93655	21.77223	1.188363
11	101478	98870.5	98051.75	-49545.3	49545.25	7.23E+08	22103.43	33.56792	23.45733	-1.29905
12	162483	102592	98870.5	35666.5	35666.5	7.92E+08	23798.81	56.43076	27.57901	0.292157
13	65259	103105.8	102592	19389	19389	7.46E+08	23308.83	23.30325	27.10392	1.130129
14	88754	104493.5	103105.8	1627.75	1627.75	6.71E+08	21140.73	1.604042	24.55394	1.323027
15	105648	105536	104493.5	-57989.5	57989.5	9.16E+08	24490.61	35.68958	25.56627	-1.22577
16	186023	111421	105536	40277	40277	9.75E+08	25806.15	61.71869	28.57897	0.397473

Simple Exponential Method:

Alpha = .1

Period	Demand	Level	Forecast	Error	ABS Error	MSE	MAD	% Error	MAPE	TS
0		94901.92								
1	59769	91388.63	94901.92	35132.92	35132.92	1.23E+09	35132.92	58.78117	58.78117	1
2	71698	89419.56	91388.63	19690.63	19690.63	8.11E+08	27411.77	27.46328	43.12223	2
3	93241	89801.71	89419.56	-3821.44	3821.438	5.46E+08	19548.33	4.098452	30.1143	2.609027
4	121499	92971.44	89801.71	-31697.3	31697.29	6.6E+08	22585.57	26.08852	29.10786	0.854741
5	60247	89698.99	92971.44	32724.44	32724.44	7.42E+08	24613.34	54.31712	34.14971	2.113864
6	76201	88349.19	89698.99	13497.99	13497.99	6.49E+08	22760.78	17.71367	31.41037	2.878954
7	98203	89334.57	88349.19	-9853.81	9853.807	5.7E+08	20916.93	10.03412	28.35662	2.661645
8	147597	95160.82	89334.57	-58262.4	58262.43	9.23E+08	25585.12	39.47399	29.74629	-0.10119
9	63204	91965.13	95160.82	31956.82	31956.82	9.34E+08	26293.08	50.56138	32.05908	1.116941
10	83203	91088.92	91965.13	8762.135	8762.135	8.48E+08	24539.99	10.53103	29.90627	1.553789
11	101478	92127.83	91088.92	-10389.1	10389.08	7.81E+08	23253.54	10.23776	28.11823	1.192974
12	162483	99163.35	92127.83	-70355.2	70355.17	1.13E+09	27178.68	43.30002	29.38338	-1.56793
13	65259	95772.91	99163.35	33904.35	33904.35	1.13E+09	27696.04	51.95352	31.11954	-0.31448
14	88754	95071.02	95772.91	7018.912	7018.912	1.05E+09	26219.1	7.908276	29.46159	-0.0645
15	105648	96128.72	95071.02	-10577	10576.98	9.9E+08	25176.29	10.01153	28.16492	-0.48728
16	186023	105118.1	96128.72	-89894.3	89894.28	1.43E+09	29221.17	48.32428	29.42488	-3.49617

Holt's Method:

Year	Quarter	Period	Demand	level	Trend	Forcast	Error	Absolute Error	Squard Error	MAD	% Error	MAPE	TS
		0		67878	3665								
1	2	1	59769	70836.56	3622.614	71543	11774	11774	138627076	11774	19.69918	19.69918	1
1	3	2	71698	74293.5	3612.673	74459.17	2761.174	2761.1736	73125577.82	7267.587	3.851117	11.77515	2
1	4	3	93241	78826.27	3667.879	77906.18	-15334.8	15334.82344	127135988.5	9956.666	16.44644	13.33224	-0.08031
2	1	4	121499	84834.44	3808.296	82494.14	-39004.9	39004.8553	475696675.6	17218.71	32.10303	18.02494	-2.3117
2	2	5	60247	86938.99	3706.072	88642.73	28395.73	28395.73224	541820862.3	19454.12	47.13219	23.84639	-0.58645
2	3	6	76201	89778.42	3654.073	90645.06	14444.06	14444.05989	486289196.3	18619.11	18.95521	23.03119	0.16302
2	4	7	98203	93718.72	3671.247	93432.49	-4770.51	4770.510737	420070421.5	16640.74	4.857806	20.43499	-0.10428
3	1	8	147597	100402.4	3851.992	97389.97	-50207	50207.03329	682654892.8	20836.52	34.0163	22.13266	-2.49285
3	2	9	63204	101791.4	3704.211	104254.4	41050.38	41050.38083	794041434.3	23082.51	64.94902	26.89003	-0.47187
3	3	10	83203	104158	3623.958	105495.6	22292.57	22292.56874	764333153	23003.51	26.79299	26.88033	0.495607
3	4	11	101478	107403.7	3601.263	107782	6303.972	6303.972122	698461054	21485.37	6.212156	25.0014	0.824033
4	1	12	162483	114093.7	3786.584	111005	-51478	51478.003	861088032.2	23984.76	31.68209	25.55813	-1.40812
		13	65259	114723	3597.147	117880.3	52621.26	52621.2612	1007850271	26187.57	80.63449	29.79477	0.719728
		14	88754	116546.2	3490.709	118320.1	29566.13	29566.13301	998300695.6	26428.89	33.31245	30.04603	1.831861
		15	105648	119173.5	3438.909	120036.9	14388.87	14388.87442	945549963	25626.23	13.61964	28.95094	2.450729
		16	186023	126417.1	3667.187	122612.5	-63410.5	63410.54859	1137759195	27987.75	34.08748	29.27197	-0.02171

Winter's Method:

Year	Quarter	Period	Demand	level	Trend	Seasonal I	Forcast	Error	Absolute Error	Squard Er	MAD	% Error	MAPE	TS
		0		67878.1	3665.13									
1	2	1	59769	71323.9	3621.26	0.89	63673.5	3904.47292	3904.47292	1.5E+07	3904.47	6.53261	6.53261	1
1	3	2	71698	77172.7	4066.77	0.6	44967.1	-26730.92014	26730.92014	3.6E+08	15317.7	37.2827	21.9076	-1.4902
1	4	3	93241	83837.6	4586.39	0.7	56867.6	-36373.36215	36373.36215	6.8E+08	22336.3	39.0101	27.6084	-2.65039
2	1	4	121499	87359.1	4373.42	1.81	160047	38548.38977	38548.38977	8.8E+08	26389.3	31.7273	28.6382	-0.78257
2	2	5	60247	90542.5	4135.41	0.88688	81355.7	21108.70355	21108.70355	8E+08	25333.2	35.0369	29.9179	0.01805
2	3	6	76201	96091.8	4418.19	0.61974	58676	-17525.00192	17525.00192	7.2E+08	24031.8	22.9984	28.7647	-0.71021
2	4	7	98203	102260	4768.11	0.72473	72842.5	-25360.45263	25360.45263	7E+08	24221.6	25.8245	28.3446	-1.75167
3	1	8	147597	105811	4524.78	1.78485	191028	43431.19191	43431.19191	8.5E+08	26622.8	29.4255	28.4798	0.03768
3	2	9	63204	108437	4144.92	0.87359	96388.4	33184.37685	33184.37685	8.8E+08	27351.9	52.5036	31.1491	1.24991
3	3	10	83203	113554	4339.5	0.63014	70942	-12261.0354	12261.0354	8.1E+08	25842.8	14.7363	29.5078	0.84845
3	4	11	101478	118866	4533.99	0.73887	87107.7	-14370.28978	14370.28978	7.5E+08	24799.8	14.161	28.1126	0.30468
4	1	12	162483	121842	4222.42	1.76145	217364	54880.61478	54880.61478	9.4E+08	27306.6	33.7762	28.5846	2.28651
		13	65259	123573	3724.02	0.85615	107930	42671.11137	42671.11137	1E+09	28488.5	65.3873	31.4156	3.68949
		14	88754	127906	3845.91	0.63629	80998.2	-7755.829694	7755.829694	9.4E+08	27007.6	8.73857	29.7958	3.60462
		15	105648	132248	3945.04	0.74576	98255.1	-7392.905744	7392.905744	8.8E+08	25699.9	6.99768	28.2759	3.50036
		16	186023	134742	3654.81	1.73578	236401	50377.59656	50377.59656	9.9E+08	27242.3	27.0814	28.2013	5.15143
		17		131477	2270.84	0.83646	115764	115763.8316	115763.8316	1.7E+09	32449.4			7.8923
		18		127060	933.367	0.63975	85565	85565.00203	85565.00203	2E+09	35400.3			9.65149
		19		121594	-346.569	0.74894	95859.9	95859.90373	95859.90373	2.4E+09	38582.4			11.34
		20		115185	-1559.04	1.71447	207874	207874.4384	207874.4384	4.4E+09	47047			13.7182

Inventory:

Cycle Inventory		**Safety Inventory**	
Inputs		**Inputs**	
Yearly Demand =	198449	Average Weekly Demand =	3816.327
Holding Cost (%) =	0.2	Lead Time	2
Per Unit Cost ($) =	100	Standard Deviation of weekly demand =	1500
Common Order Cost ($) =	400	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	2817.439	Mean Demand during lead time =	7632.654
Number of shipments (per year) =	70.43596	Standard Deviation during lead time =	2121.32
Cycle Inventory (units) =	1408.719		
Order Frequency (days) =	5.182012	**Output**	
		Safety Inventory (ss) =	3489.261
		Re-order Point (ROP) =	11121.92

Facilities:

Inputs - Costs, Capacities, Demands

	Demand City							
	Production and Transportation Cost per 1,000 Units						Fixed	
Supply City	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angele	Cost ($)	Capacity
Long Beach	774	682	22	445	770	237	2200	4
Santa Clara	88	10	676	308	233	911	3100	6
Riverside	22	80	725	347	159	960	3700	7
Oakland	852	768	117	553	857	209	4300	5
San Gabriel Valley	794	711	47	474	800	208	2500	2
Demand	2.16	1.31	1.24	3.51	10.01	2.57		

Decision Variables

	Demand City - Production Allocation (1000 Units)						Plants
Supply City	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angele	(1=open)
Long Beach	0	0	0.49	3.51	0	0	1
Santa Clara	2.16	1.31	2.2E-10	0	2.53	2.2E-10	1
Riverside	0	0	2.2E-10	2.2E-10	7	2.2E-10	1
Oakland	0	0	0.75	0	0.48	2.57	1
San Gabriel Valley	0	0	0	0	0	0	0

Constraints

Supply City	Excess Capacity
Long Beach	0
Santa Clara	0
Riverside	1.1E-08
Oakland	1.2
San Gabriel Valley	0

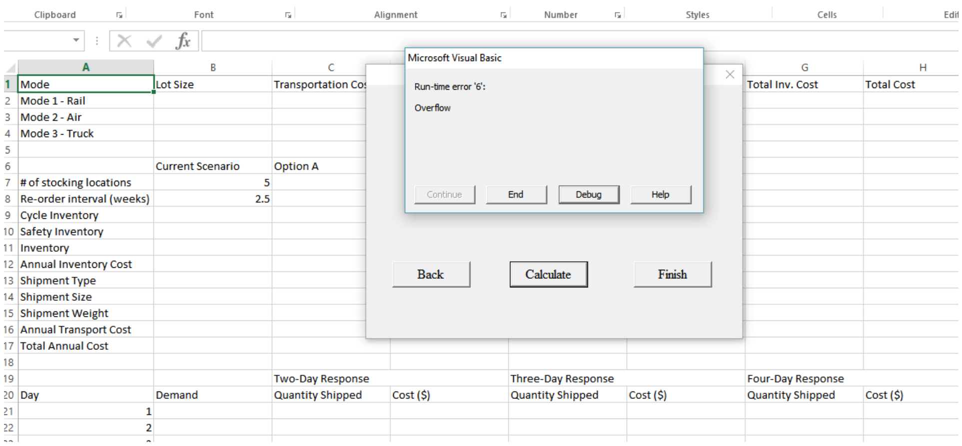
Solver

	Springfeil	New York	Atlanta	Chicago	Tampa	Los Angeles
Unmet Demand	1E-08	0	0	0	0	0

Objective Function

Cost=	17814.6

Transportation:



* the initial equation that was shown during the project meetings was incorrect. The correct equation was applied however now the system has a runtime error which we do not know how to fix.

Conclusion:

The software built from the group project show demand forecasting, inventory management, transportation, and facilities.

Demand Forecast: the company would use demand for the previous years. Input in the section and then it will company the 6 different methods of demand forecasting. This formation provided could them be used to help determine which type of demand forecasting the company should use in the future and help them determine the key points of the inventory.

Inventory Management: once the information from the demand forecasting is taken the company could then use the inventory section to determine key point such as the ROP, Fill Rate, and EOQ. This will help save the company time and money due to the fact that it is faster than a human calculating it by hand is going to be able to update with the different shifts.

Transportation: the company can use the software to determine the cheapest form of transportation so that they can save money with the company. They can then use it to determine which type of shipping method they would prefer. This helps with the company's decision to be efficient or responsive to the customer demands with in the product.

Facilities: This software can decided which are location are better to build different facilities saving the company time and money which the cost of the warehouses and the cost of transportation.

Project Conclusion

We started off from last quarter by choosing differentiated strategy for our company. We started by analyzing the market and creating a strategy. We made a responsiveness/efficiency spectrum for our product. After we established a strategy we created realistic goals and set out with the planning and development of our product. We compared customer needs with technical metrics to find the relative importance each subfunction had in VR products. We decided a combination of inhouse software with outsourcing hardware was the route for manufacturing. Then we developed a few conceptual designs based on the most important sub functions and selected the most valuable concept to develop as our product. After we developed a few different products based on our concept and made a strategy for planning, developing, and releasing those products.We performed the several different methods of demand forecasting which includes winter's method, holt's method, static, and moving average method. From these Holt's was the best predictor of our company's demand forecasting. As our teamwork improved throughout the process of developing this product resulted in a more scrutinized, yet successful product. The organized process we executed over the last few months has proven to be priceless; using it in the projects in the future will help improve the quality of our work. Thanks to the TIM 125 TA's and especially Professor Subhas Desa for the support and guidance throughout the project.

Individual Reports

Joshua Victorio

In the beginning of our project, my main high-level objective was to help in developing the overall Supply Chain with Christian by first creating the company's Competitive Strategy in which we focused on having a differentiated strategy where RecTech will be developing our VR headset in between the borders of a wide/narrow market segment since we will be developing this for the gaming/entertainment industry as a whole, but focusing on the virtual reality aspect of it as well. Both of us also worked on the Supply Chain Strategy in which we have determined from our responsiveness/ efficiency and IDU spectrums that RecTech will be operating under a responsive strategy. In order to truly determine the most plausible Supply Chain Strategy for our company, our process was that we went along with Professor Subhas' advice during class on trying to aim towards a more highly responsive strategy in order for our product to be readily available to any consumers and due to the fact that our product is brand new and costly so the Implied Demand Uncertainty will be fairly high. From this, we were able to use the information to transition into the Transportation Network and Facilities phase of our project in which we calculated and ran the most optimal modes and scenarios for our Transportation mode and Facility Location model. I worked with Robert and Christian for these parts where Robert did a great job in researching the prices for our different shipping modes, such as UPS, while Christian worked on calculating the cycle inventory. From here, I helped determine important endogenous variables in our Transportation Network such as: optimal lot size, average inventory, safety stock, and holding costs. Next, I proceeded by looking through the notes on the class website in order to complete the Transportation Network and went along and created all the tables as well as calculating all the values which I used our textbook as a supplement in order to help me complete the Transportation Network. After finalizing all of our costs and values, we as a group have decided to use UPS Worldwide Express even though it is not the cheapest option because we wanted our transportation system to be as responsive and efficient as possible with our transportation options. Then, we went onto Facilities in which, I worked on the Capacitated Plant Location model in our GUI with Ben in order to determine the specifics of our supplying facilities. We decided that having our Distribution Center/ Assembly plant as well as our headquarters in Springfield was a good choice due to the high costs of setting up our main facility in California. Once that was complete, I optimized our total supply chain network in order to make it more coherent and flow much more logically. It was nice to see how much every single part of the project connected and flowed with one another where we determined the cycle inventory values from using our data from our forecasted demand and from there on utilized that data to determine our most optimal and desired mode of transportation based off of our company's supply strategy, and finally locating our facilities by using all the data that we have obtained over the past quarter to optimize our strategy and execute our company's supply chain. It was great seeing our group become more dynamic through the quarter and work more closely together as a supply chain team.

Aaron Cheung

In TIM 105 and 125 there has been a whole variety of things that I was able to take from both of the courses. Although it may not have been apparent from the beginning of the current course of supply chain management, I slowly learned the importance of inventory, costs efficiencies, locations, and transportation more clearly. My contribution to the project was more of the interpreting of data from all around. While my group mates were working on the networks, strategies, and other kinds of research, I was studying what each number meant and what it was important/needed for our company to thrive. Supply chain is all about the horizontal dimension of Porter's model, so we took our porter model from the previous quarter of the management of technology and built the supply chain according to our research then. By further explaining the placement of the companies on our model, Christian and I began thinking of the explanation of each of the companies in terms of how it affects RecTech's supply chain. The information defines the strategy that RecTech should follow which also tells the company where they should involve the RechTech and their products. There are two different things we must consider: to follow an efficient or responsive supply chain. After finishing that section, Rebecca and I created the Product Life Cycle chart which depicts the IDU (Implied Demand Uncertainty). By referring to the uncertainty in demand for the product, we are able to predict the growth of our virtual reality headset. The transportation section of our project was calculated based off of transportation costs we found online from UPS. We calculated the dimensions of several different VR headsets in order to find out the weight and such which ultimately led us to our conclusion that that UPS is in fact the mode of transportation we would be using. There were multiple areas of calculation we had to consider so even one misstep with numbers could be catastrophic. This is why there were so many people working on finding the right data and calculating with precision with the equations for inventory to transportation costs to consider.

Robert Fazio

Looking back on the last two quarters in TIM 105 and 125, I took on a breadth of valuable knowledge. From product design/development to Supply Chain I have the skills to now create a product and share that product with the world cost efficiently with success. I summarized the value I received from 105, product design last class; so I will continue my conclusion with the this integrated supply chain knowledge. Starting with the basics I learned how to create a supply chain strategy based off market analysis and similar supply chains. For my team I created our goal company's goal supply chain network and helped outline the drivers the were components of this network. Then we moved through demand forecasting, one of my favourite portions of the course to predict the actual demand for the following quarters. This valuable tool was the keystone to our project; I took part in the excel forecasting. We used this predicted demand to develop an idea of the inventory management numerical values we would be working on. We found the optimal lot size, ROP, cycle inventory, safety inventory, etc. While out team worked through this me and Ben got into the automation. This took longer than any part of the project, learning visual basic was a struggle, but I now see the potential it has within Excel. We created a nice excel GUI and automated each component of the inventory management models. Our Automated Inventory Program allows an upper management of our company to easily run scenarios with different numbers; so they could see how a small change would affect all drivers of the supply chain. Moving on from the inventory management model we made a detailed specification of our drivers I worked on the transportation section analysing actual shipping companies and the options they provide to medium to large companies. I went into extreme detail to specify how the individual packages (VR headset boxes) would be packed into a pallet then sent via a ship to truck to our assembly plant. I am proud to say my numbers were very accurate based on our optimal lot size, our forecasted demand, and the UPS shipment manual. After working with this team for the last two quarters and growing to learn so many new skills to apply to real world problems; I have grown as a problem solver, and my eye for the details has sharpened. I am excited to see where by breadth of knowledge takes me after college because I am sure I could improve a medium sized companies supply chain if I got my hands on their year of sales and orders. Thank you to the RechTech team for the enthusiasm and hard work through the past two quarters, I am sure you will all go on to do great things. Thank you Subhas for all the direction and knowledge you have provided through the last three quarters (158, 105, 125) and see you in TIM 101 next quarter!

Christian Angel

Phase I: In phase 1 my high level objective was to develop the overall supply chain strategy for our company that would determine the level of efficiency/responsiveness our company's supply chain would operate under which would also have a tradeoff with implied demand uncertainty. I worked with Joshua on this part which we began by establishing our supply chain strategy to be product differentiation. With this strategy our company would focus on developing a new product that offers different features than what our competitors offer with our defining technology being our OLED display. I focus on determining the Implied demand uncertainty we would face given that RecTech would operate with a high response rate. Using the book and the lecture notes I determined that our company would experience high levels of demand uncertainty for our product during the introduction and decline phase of the product life cycle because our product acts as a disruptive technology that is introducing a fairly new feature. Knowing the demand uncertainty that our company would face would allow us to adjust our numbers for our demand data in phase 2 to be lower in the initial years of our products introduction. In addition to this task I gathered quarterly demand data reference from HTC and SONY so that we could build the realistic demand data for our company.

Phase II : In phase 2, the high level objective that I focused on was the market analysis so that we understood how each force affects our demand estimation for our product.I started the process by describing how each force affects our demand data with the competitors reducing our demand since they would offer the customers a reliable product that is built off older models rather than introducing new technology like our company. Since there are large barriers of entry in the VR industry we can expect this force to have little to no effect on our demand data. In addition, VR headset substitutes vary in features so our demand could both increase and decrease through our products life cycle because it depends on what our users need. Furthermore, suppliers determine what our replenishment cycles would be since our orders would depend on customer trends that might occur with the demand being high in different parts of the year. Buyers might be the biggest driving force that affect our demand directly since they can make demand rise and fall based on their need for our product. Complementors like a processor to make our device faster could increase our demand because it would comply with our supply chain strategy of product differentiation that adds a feature so more customers demand it.

Phase III: My goal in this phase was to conduct the benchmark with our company's supply chain with that of Plantronics. After gathering information from the case study I started my benchmark by comparing what was similar between the companies like how we both use the differentiated strategy to separate our products from our competitors based on features like the size, display or bluetooth compatibility. The next thing I observed were the differences between both companies with the Plantronics using a push model that focuses on the supply of their product so it is available to the customer while Rechtech's supply chain is focused on customer demand so we base our efficiency and responsiveness on those trends to make sure our product is available. Finally, I tried to align our supply chain to Plantronics by using their future plan as a means of inspiration to maintain our company on a customer demand based supply chain that determines how much inventory we will have to achieve our proposed high level of responsiveness.

Phase IV: In this phase the project team aimed to complete our supply chain for our company by simulating our data and establishing where our facilities would be located and what forms of transportation we would use while taking into account our inventory of our product. My task was to derived the cycle and safety inventory our company needs to meet our demand. I did this by taking the values we got from our best forecasting method, Holt's method, to find the annual demand that would give us the optimal lot size to determine the different costs our company would experience. After all the calculations I determined that our company would incur a total annual cost of about $64,025,290.13 with an economic order quantity of 40,318 headsets. For the safety inventory I determined our weekly demand statistics so that I could figure out what safety stock would be during the supplier lead time of 1 week given a CSL of 95%. I discovered that our company would need a safety inventory of about 1118 headsets more to meet all of our demand during the lead time. I then used this value to solve for our reorder point so that our company was aware of the threshold that would let us know when to place another order for our outsourced components needed to assemble our product. Our reorder point would be when we reach 8736 headsets and since our actual demand is larger than this value our company should expect our product to not be available to all customers during the lead time. This section relates to the demand data in the supply chain that has to be adjusted so that we are able to meet all our customer demand.

Ben Kent:

At the start of the project my main job was to try and get the team to get together and work as a team for at least once a week for a few hours. This was due to our lack luster effort on the phase one project review and being appointed project lead. Once the project phase one was complete along with the review the group has a vague understanding as to what the work load for this project was going to be. That was when as a group we decided to meet up one a week on Mondays for 2 to 3 hours. Moving onto phase two, my main contribution was the demand forecasting. Using the examples from in class and the homework's we generated the five different types of demand forecasting. The demand data was take from the work in phase one where the group had to research different companies and find their demand. This information was then used to determine which type of demand forecasting would be the best used for the company and generated our predicted demand for the following years. That predicted demand would then be used latter on in the project during the inventory phase to find our annual inventory so that we could calculate the different costs. The demand data was also used to find the NPV for the project using a cash flow analysis chart from last quarter in TIM 105. The next major contribution I made to the project was the VBA GUI. This required me to research how to code in VBA which was not that difficult. The first phase of the VBA was to create the demand forecasting modules. This was done with a comparison to the models generated originally. The next phase of the VBA was to create the Inventory analysis section. This section was relatively simple to make due to the fact that we just need to plug in the equation. The next phase was the transportation phase. Initially this was working properly. However, when we compared the answers to those that we generated by hand they were different. After debugging the code we realized that the formula was wrong, which lead to the run time error what we currently have. I was unable to figure out where the error was in our code so that the transportation section could be done. The next phase was facilities. This section was simple was well since I simply copied the book when I came to generating the format and equations. Over the VBA was used to check our work and determine if our answers matched our answers and it was used to help determine our facilities. Since our facilities part was not done on time by hand we used VBA to determine our information for the facilities location. Then we generated the new and final supply chain network using the information from the facilities location diagram. My final major contribution to the project was doing major backlog after each meeting to try and make sure that all of the part were up to expectation.

Rebecca Yi

I've learned a lot this from this course series of how to work in a high functioning team and how to produce results. It was my goal to have open communication within the group, to attend the weekly meetings, and to help where I can. In project phase one I did research on other companies to find a demand data reference to build a realistic demand data for our company. I researched Oculus and Samsung for their quarterly demand data. It was interesting to compare the headsets each company sold because the results were quite different. With this data we were able to gauge about how many headsets our company would sell assuming the product be successful. In project phase two I helped to create the Implied Demand Uncertainty of RecTech's product life cycle. In the cycle our company was currently in the growth stage with a lower IDU. With this we were able to predict the future stages of our product in the given time frame. I also helped to analyze the findings of demand forecasting and choose the best choice for our company. We chose Holt's method for the best method to generate predicted demand for the future years. In project phase three I helped to align and integrate the high level strategies with detailed implementations of each driver. It helped to get a clear direction for each driver and how our company is implementing each one. The detailing of each driver helps to guide the company in the direction we want it to go. Overall I helped my group with what I can and tried to be available to help. There were a lot of things I had to learn by rereading the book and going over the lecture notes in order to complete some tasks. I feel that overall I have gotten a lot better at teamwork and hope to build upon this foundation in the future. I was not only able to see myself grow but the whole team was able to collaborate to work as a high functioning group. With the 20 weeks we spent together it was a great learning experience.