ModiFi
MOT II
Winter 2019

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Introduction

The laptop is one of the most essential electronic devices in our daily life. With the development of information technology, more and more PCs are being manufactured, and people may find out their own preference when they are choosing laptops. However, with laptops always updating, it is difficult for people to have the latest model and best performance on their computer, which has become the reason people replace their computer over and over. The primary purpose of ModiFi is not only making a DIY and modular laptop but also keeping up-to-date with technological advancement. When our customer wants to update their computer, they can just buy some components and rebuild it, like a LEGO. This will allow customers to save more money and maintain their laptop performance in the long run.

We came up with this idea by doing brainstorming as a group. As a team in TIM 105 and TIM 125, Management of Technology I and II, we want to build something useful and interesting. After coming up with 10-20 ideas, we chose the modular laptop for our final topic. For most of us in our group, the laptop is a familiar topic, so we have more knowledge regarding the laptop, which allowed us to finish the project easier. The brand name "ModiFi" came from the word "Modify": we want to make a "modular laptop" with high performance, a low price, and environmentally friendly construction.

Executive Summary

The **Modular Laptop** is an original concept developed by ModiFi. What differentiates the modular laptop from normal laptops is its **capability of "upgrading" each individual component** to allow end-users to customize their laptop for their particular interests. This enables ModiFi to target different markets from casual users to high-end gamers, video editors, and enterprises; from basic software to demanding, cutting-edge programs.

Our product also hopes to tackle major issues in the technological world, including the **rising e-waste problem and the planned obsolescence of hardware**. Both of these problems stem from the poor longevity of technology: laptops, like cell phones, are designed to be bought, used, and discarded over the course of only a few years. With the ModiFi Modular Laptop, users can upgrade and replace any number of parts within the laptop instead of discarding the entire laptop to buy a newer model. In the long run, this will both save our users money and reduce the amount of e-waste generated from the overall laptop market.

Starting from our project we had created in the previous quarter, TIM 105, we began by **revising our conceptual design** to be more synchronized and accurate to the product. Our team then developed the business models and strategies required to produce the modular laptop utilizing modular hardware parts. We also refined the business plan for our mid-sized company. This quarter, we shifted our focus to developing the supply chain, both in terms of supply chain strategy and the specific calculations and optimization for each supply chain driver.

With optimization in mind for our supply chain, we prioritized a few areas: demand forecasting (using various forecasting models), inventory, warehouses and facilities, and transportation costs. By directly referencing the notes taken in lectures, we applied those tools to implement our own demand forecasting methods into the project. Inventory, facilities, and transportation calculations followed a similar track, though with different calculations and data inputs. Throughout the project, the resulting calculation from each section feeds into the calculations for the next section. As such, the project flows in a linear fashion, with **each previous component or result integrated into the next section.**

Next, the data we collected and calculated were moved to Excel and Visual Basic for further optimization. We created a **Visual Basic software platform** that aggregates and automates the calculations performed in Excel, giving us a tool that can be used to greatly speed up any future calculations that must be performed.

Overall, we discovered that creating the product, developing the supply chain, and optimizing the supply chain's development process are all crucial to the success and efficiency of our company. This quarter taught us the importance of not only creating the idea of a product, but the value of production, transportation, and inventory costs, all of which affect the way we must operate in our company. We are hoping to expand our customer reach to not only third party consumers but to businesses worldwide as well. With these goals in mind, we hope to create a product that is successful in the wider laptop market.

Project Proposal

Our Proposal:

What are we proposing?

- Our product is a **modular laptop** that is able to be taken apart and rebuilt with different parts (like a LEGO).
- This would **save the customer money** in the long run, as well as function as a **more environmentally friendly** alternative to current laptop solutions.

Our Plan:

- Reference the project plan from below.

Project Plan

TASK	Due Date
Form project teams and choose technology domain	Jan 8, 2019
Project Proposal	Jan 10, 2019
Phase 1 (Technology/Product Strategy and SC Strategy/Design)	Jan 22, 2019
Phase 2 (Supply Chain modeling and planning; demand forecasting)	Feb 5, 2019
Phase 3 (Supply Chain Operations: inventory, transportation, and	Feb 19, 2019

facilities)	
Phase 4 (The software information systems for the SC; simulation)	Mar 5, 2019
Phase 5 (Closure and Final Report)	Mar 14, 2019

"Time-Phased" Project Plan

WEEK 1

- Form project teams and build the project proposal (1/10/19) **DUE**

WEEK 2

- **Meeting**:
  - Group Meeting: Wednesday (1/16/19) 4:30PM-6:30PM, Mchenry Library
  - With Subhas: Tuesday (1/1) 5/19) 5:15PM-5:30PM, E2 Room 561
- Project Proposal; (1/15/19) **DUE**

WEEK 3

- **Meeting**:
  - Group Meeting: Wednesday (1/23/19) 4:30PM-6:30PM, Mchenry Library
  - With TA/Subhas:
- Project Phase 1 (Technology/Product Strategy and SC Strategy/Design); (1/22/19) **DUE**
- Begin to brainstorm and plan Phase 2

WEEK 4

- **Meeting**:
  - Group Meeting: Wednesday (1/30/19) 4:30PM-6:30PM, Mchenry Library
  - With TA/Subhas: Tuesday (1/29) 6:00PM-6:30PM, E2 Room 561
- Work on Phase 2

WEEK 5

- **Meeting**:
  - Group Meeting: Tuesday (2/5/18) 1:30 PM-4:30 PM, Science and Engineering Library
  - With TA/Subhas: Wednesday (2/6/18) 5:15-5:30PM, E2 Room 561
- Project Phase 2 (Supply Chain modeling and planning; demand forecasting); (2/5/19) **DUE**
- Begin to brainstorm and plan Phase 4

WEEK 6

- **Meeting**: Wednesday (2/13/19) 4:30 PM-6:30 PM, Mchenry Library
- Work on Phase 3

WEEK 7

- **Meeting**:
  - Group Meeting: Wednesday (2/20/18) 4:30 PM-6:30 PM, Mchenry Library
  - With Subhas/ TA:

- Project Phase 3 (Supply Chain Operations: inventory, transportation, and facilities); (2/19/19) **DUE**
- Brainstorm and Plan Phase 4

WEEK 8

- **Meeting**:
  - Group Meeting: Wednesday (2/27/19) 4:30 PM-6:30 PM, Mchenry Library
- Work on Phase 4

WEEK 9

- **Meet**:
  - Group Meeting: Wednesday (3/6/19) 4:30 PM-6:30 PM, Mchenry Library
  - With TA/Subhas:
- Phase 4 (The software information systems for the SC; simulation) (3/5/19) **DUE**

WEEK 10

- **Meet**:
  - Group Meeting: Wednesday (3/13/19) 4:30 PM-6:30 PM, Mchenry Library
  - With TA/Subhas:
- Phase 5 (Closure and Final Report) (3/14/19) **DUE**

Organizational Structure: Responsibilities, GANNT, PERT, etc.

Roles and Responsibilities:

- Will be subject to change as we continue on with the project and lecture course.

Name	Roles/Responsibilities
Qizhang Chen	Meeting Coordinator (Professor, TA, Group)
Wan Fong	Project reviewer (Flow)
Eric Hong	Research
Caleb Jones	Data Analysis, Project Lead
Antoine Rocha	Project reviewer (Graph, analysis)
Yu Chen Shih	Data Analysis
Monique Van	Data collection and project planning

Tasks and Responsibilities:

Week 1	**Activities**	**Due Date:**	**Members**:

Proposal (1)Review project from last quarter (2)Build Project	A	1/10/19	All
Proposal Development (1)Develop the Proposal	B	1/10/19	All
Week 2			
Meet Professor Subhas	C	1/15/19	Everyone but Richard - Roof leaking from rain
Fix-ups (1)Conceptual Design - Specify requirements (2)Financial Model	D	1/17/19	All
Phase 1 Development (1)Proposal (2)Develop Relevant Supply Chain	E	1/17/19	All
Week 3			
Meet Professor Subhas	F	1/22/19	All
Phase I Fix-ups (1) Supply Chain Network - Infrastructure	G	1/24/19	All
Phase II Development (1) GANT and PERT (PHASE 2) (2) Demand forecasting (3) Cash flow analysis	H	1/24/19	All
Week 4			
Meet TA	I	1/30/19	All
Phase I Fix-ups (1) Sub-systems of FAST diagram (2) Supply Chain network matchup with subsystems	J	1/31/19	All
Phase II Development (1) Business Models (2) SC Strategy (3) 4 Key Structures (4) Time Phased Plan for Software Development	K	1/31/19	All

(5) Implement Credible Demand Data			
Week 5			
Phase II Development (1)Cycle Inventory (2)Safety Framework	L	2/05/19	All
Week 6			
Phase III Development (1)Preliminary Simulation (2)Benchmarking	M	2/12/19	All
Week 7			
Phase III Fix-ups (1)Meet with Professor Subhas (2)Updates and fixes to previous work (3)Change of demand data and explanation	N	2/19/19	All
Week 8			
Phase IV (1)Integration of system (2)Implementation of cycle, safety, transportation networks and facilities of SC network	O	2/26/19	All
Week 9			
Meet Professor Subhas	P	3/5/19	Everyone but William - had class at that time
Phase IV (1)Benchmarking of ModiFi	Q	3/5/19	All
Week 10			
Phase IV Fix-ups (1)Explain the implementation of cycle, safety, and transportation networks and facilities of SC network (2) Include a user manual that guides users through the integration of our system with screenshots.	R	3/12/19	All

Week 11			
Project Review and Fix-ups (1) Meet-up with everyone after finals and work together (2) Read through the whole project and find what needs to be fixed (3) Edit the parts that are inconsistent (4) Add explaination to parts that lacks information	S	3/19/19	All

Activity Matrix:

Week	Activities		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Proposal Development: (1)(2)	**A**	**A**	●																	
	Project Proposal (3)	**B**	●	**B**																	
2	Meet Professor	**C**			**C**	●	●														
	Fix-ups: (1)(2)	**D**			●	**D**	●														
	Phase 1 Development: (1)(2)	**E**			●	●	**E**														
3	Meet TA	**F**						**F**	●	●											
	Phase I Fix-ups: (1)	**G**						●	**G**	●											
	Phase II Development: (1)(2)(3)	**H**						●	●	**H**											
4	Meet TA	**I**									**I**	●	●								
	Phase I Fix-ups: (1)(2)	**J**									●	**J**	●								
	Phase II Development: (1)(2)(3)(4)(5)	**K**									●	●	**K**								

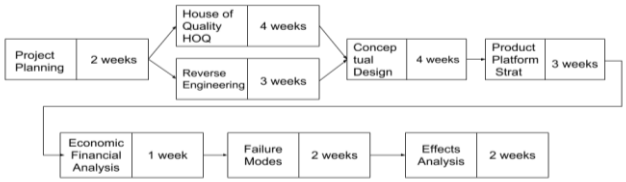
5	Phase II Development: (1)(2)	**L**												**L**						
6	Phase III Development: (1)(2)	**M**													**M**					
7	Phase III Fix-ups: (1)(2)	**N**														**N**				
8	Phase IV Development: (1)(2)	**O**															**O**			
9	Meet Professor Subhas	**P**																**P**	●	
	Phase IV Development: (1)	**Q**																●	**Q**	
10	Phase IV Fix-ups: (1)(2)	**R**																		**R**	●
11	Project Review and Fix-ups (1)(2)(3)(4)	**S**																		●	**S**

GANTT Chart:

Week	**Activities**		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**
1	Proposal Development: (1)(2)	**A**																			
	Project Proposal (3)	**B**																			
2	Meet Professor	**C**																			
	Fix-ups: (1)(2)	**D**																			
	Phase 1 Development: (1)(2)	**E**																			
3	Meet TA	**F**																			

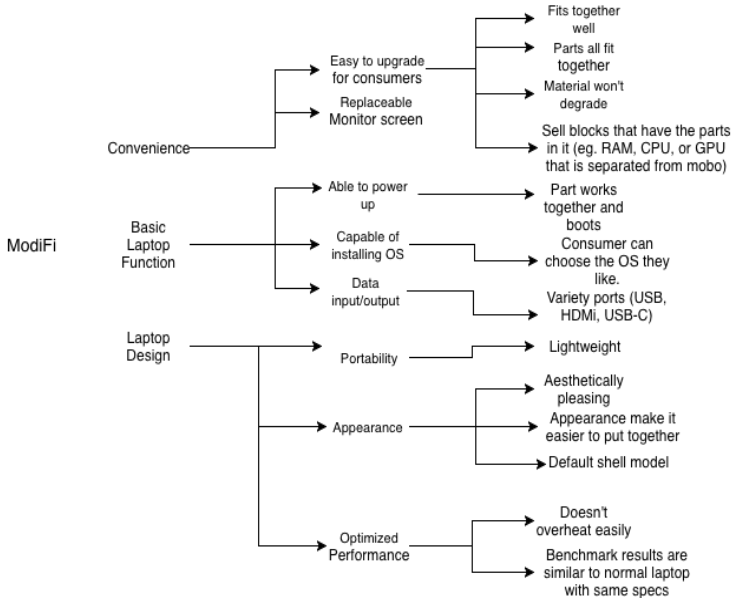
	Phase I Fix-ups: (1)	**G**																			
	Phase II Development: (1)(2)(3)	**H**																			
4	Meet TA	**I**																			
	Phase I Fix-ups: (1)(2)	**J**																			
	Phase II Development: (1)(2)(3)(4)(5)	**K**																			
5	Phase II Development: (1)(2)	**L**																			
6	Phase III Development: (1)(2)	**M**																			
7	Phase III Fix-ups: (1)(2)	**N**																			
8	Phase IV Development: (1)(2)	**O**																			
9	Meet Professor Subhas	**P**																			
	Phase IV Development: (1)	**Q**																			
10	Phase IV Fix-ups: (1)(2)	**R**																			
11	Project Review and Fix-ups (1)(2)(3)(4)	**S**																			

PERT Chart:



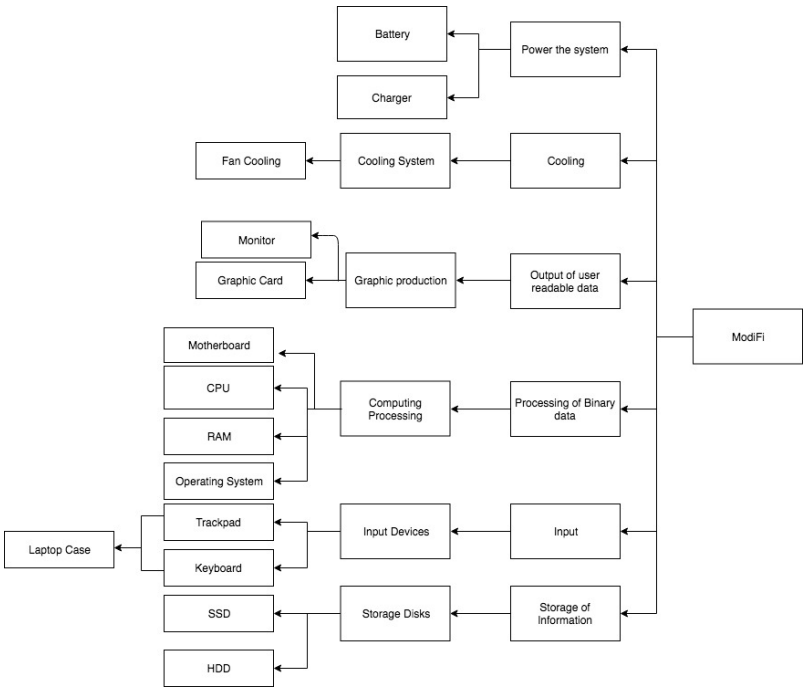
- When doing the PERT chart and observing which path to take, we've come to a conclusion that the best critical path matrix that we should follow is 1 > 3 > 4 > 5 > 6 > 7 > 8. This is because this path takes the least amount of time to complete. Subtask 3 can be completed one week faster than Subtask 4 (3 weeks vs. 4 weeks).

Product Needs



FAST Diagram

The FAST diagram below is a break down for our product and its many subsystems. This is needed in order to develop out supply chain because we need to know what all of our components are so that we can accurately design and find out suppliers.

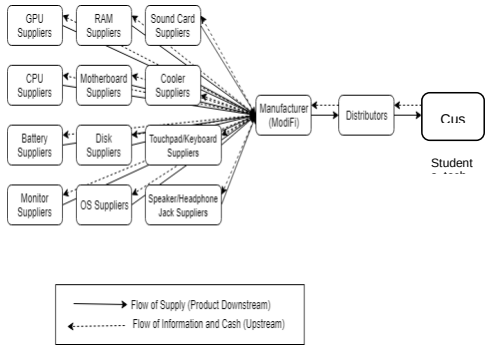


Subsystems:

Charger	This subsystem provides an electrical current to run through every computer part in the overall design. The current runs into the system through a charger and could either be stored in a battery or directly into the system which allows them to power it on through an on/off switch.
Fan Cooling	This subsystem is a breakdown between liquid cooling as the microprocessor requires a cooling system to prevent it from overheating which will be done by either intaking air or using water in a reservoir to cool the microprocessor.
Battery	This subsystem is the laptop's battery, which is charged via. wall adapter to provide power to the overall system.
Monitor	This subsystem works in conjunction with the graphics card to produce an image for the user. The microprocessor would send binary data to the graphics card which the graphics card would process into an image capable of being read by the user on the monitor.
Laptop Case	This subsystem consists of the modular case itself, which has various different PCIe connection points that enable each

	modular piece to connect and communicate to the overall system.
CPU (Microprocessor)	This subsystem is the most important piece of the entire system. It involves the overall processing of binary data which is then sent to every other system to be processed into user identifiable forms. (i.e. images, sound, etc)
RAM	This subsystem is a short term memory storage for the overall system. It helps the microprocessor store information; it may need in the short term to be processed which is why it is still in the computing factor.
Operating System	This subsystem works in conjunction with the microprocessor as it allows the user to effectively use the system and it powers each individual part to produce effective information. It also allows the user to troubleshoot each individual part in situations should that part fail.
Graphics Card	This subsystem powers the graphical interfaces of the laptop. This is a critical subsystem for higher-performance gaming or video editing, as the Graphics Card controls most image processing.
Motherboard	This subsystem is the core of the laptop, and the central hub that connects to most of the other subsystems with physical wiring.
Disk (HDD)	This subsystem allows the user to store information in the system. The Solid State Drive (SSD) is a faster drive for the system to store the operating system which allows for faster boot up but the Hard Disk Drive (HDD) allows for larger storage of user data.
Disk (SSD)	

Preliminary Supply Chain:



This is the initial prototype of ModiFi's supply chain. It will be expanded and elaborated on later in this project. This supply chain is based on the FAST diagram and each of our subsystems have different suppliers. Our company will contact our suppliers for the necessary components and

from there, we will manufacture the product, send it to our distributor who will deliver them to our customers (students, tech influencers, working individuals, etc)

Business Model

---

a. Define

- **i.** Develop a business model for the Supply Chain that ModiFi will be implementing which will include:
    1. What should ModiFi's competitive strategy be?
    2. What should ModiFi's supply chain strategy be to align with its competitive strategy?

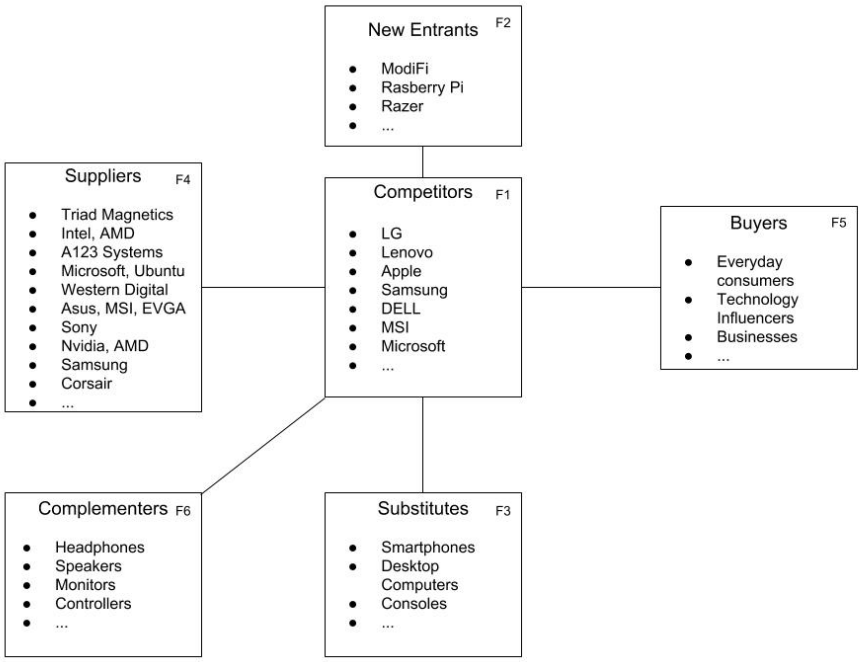
b. Plan

- **i.** What should ModiFi's competitive strategy be?
    1. Do a competitive analysis of the business landscape for ModiFi using Porter's five (six) forces framework
    2. Then, characterize the competitive strategy of SPC using the 2x2 grid of "strategic target" and "source of competitive advantage".
- **ii.** What should ModiFi's supply chain strategy be to align with its competitive strategy?
    1. Explain what supply chain strategy ModiFi should use that will align with their supply chain strategy.

c. Execute

- **i.** What should ModiFi's competitive strategy be?
    1. Do a competitive analysis of the business landscape for ModiFi using Porter's five (six) forces framework

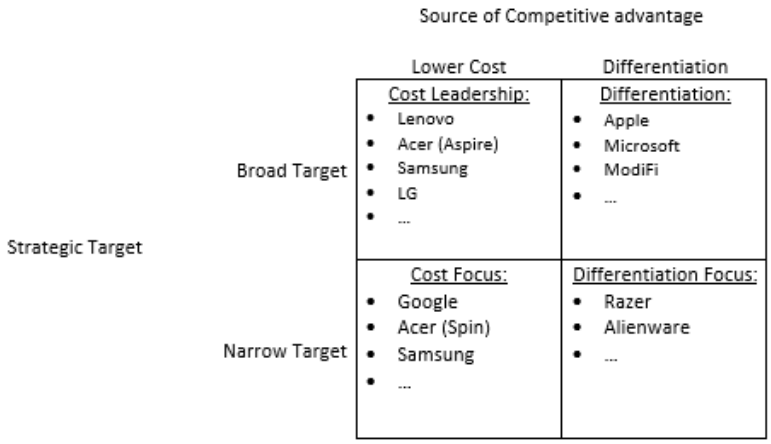
Porter five(six) forces model



Force	Strength/Analysis
Threat of New Entrants	***High;*** The threat of new entrants in the PC industry is high. This is because there are major barriers to entry in this business. Apart from tremendous capital investment, the need for technological infrastructure and skilled employees strongly discourage any new entrants.
Threat of Buyers	***High;*** The buyers' power is low to moderate due to the already established brand image. The consumers are either individuals or large enterprises. Customer loyalty is high as customers buy from name brands which they are accustomed to..
Threat of Suppliers	***Low;*** Supplier power is low. This is because the industry is populated with suppliers where the

	number of established PC brands they already sell is small. Thus, companies that have established brands have leverage on suppliers making supplier power low.
Threat of Substitutes	***Moderate;*** The PC industry has been on the decline as people are moving away from PC to chromebooks and smartphones. Till some years ago laptops were tools of professionals. Now there are better options that provide similar features like tablets and smartphones, so the threat of substitutes are moderate.
Threat of Complementors	***Low;*** Several organizations produce either complementary products which can boost the efficiency of laptops but are just compliments to the laptop and do not cause individuals to buy a laptop because of it.
Threat of Rivalries	***High;*** Rivalry in the PC industry is high. Companies such as Acer, Asus, HP, and Lenovo are notable rivals. HP and Lenovo are at the top with the highest market share followed by Apple. Due to the decline in the computer industry the focus has shifted to price and innovation.

2. Then, characterize the competitive strategy of SPC using the 2x2 grid of "strategic target" and "source of competitive advantage".



ii. What should ModiFi's supply chain strategy be to align with its competitive strategy?

1. Explain what supply chain strategy ModiFi should use that will align with their supply chain strategy.

- ModiFi's competitive strategy is centered around **<u>differentiation</u>** where a broad target of consumers will be satisfied by modular laptops which allows them to start of from a base model laptop that can have their parts changed out to meet the demands of the consumers. This differs from other laptop producers as it enables consumers to strive for high ranges of customizability and prevents consumers from having to change their laptops so often, bringing a new type of innovation into the industry through a blue-ocean strategy. To accomplish this strategy ModiFi needs to:
    1. Identify and simplify their product and services
    2. Attain a larger market share with loyal consumers
    3. Lead the industry in end-user computing solutions
    4. Scale alternative computing solutions
    5. Offer high quality customer service as the innovation is relatively new

- ModiFi's supply chain strategy will involve a pull-model supply chain as ModiFi implements a build-to-order method. This will involved building the laptop once there is a consumer that demands it. The process will begin when a consumer orders their laptop with their desired specifications which will be processed and transferred to our assembly plant that will assemble the final product which will be directly sent to our consumers from the assembly plant.

d. Check

i. The business model is based on the business analysis from TIM 105, and it is consistent with the class notes. Several members from the group re-checked it to ensure it aligns with the process of the supply chain.

e. Learn and Generalize

i. We analyze the six forces of competitors, new entrants, buyers, suppliers, substitutes and complementors, especially for the horizontal view, which is the supply chain dimension. Then, we identified the company's position in the laptop market, which is a differentiated product to our customer and other laptop manufacturers. This process was efficient in specifically identifying what our supply chain strategy should be to align with our competitive strategy.

Supply Chain Strategy

---

a. Define

i. Develop our company's supply chain strategy by examining:

ii. Where does ModiFi's lie in the zone of strategic fit between IDU and responsiveness?

b. Plan

i. Where does ModiFi's lie in the zone of strategic fit between IDU and responsiveness?

Understand customer needs
Determine where the product lies in its market life cycle, which determine its IDU
Place the product's IDU on the IDU spectrum
For the given product establish the corresponding competitive strategy
Determine the trade-off between responsiveness & efficiency for the product based on the competitive strategy
Map the resp/eff tradeoff onto the resp/eff spectrum
Create a 2-D space
Define a zone of strategic fit in this 2-D space
Position the SC strategy for the product at the appropriate location in the zone of strategic fit

c. Execute

i. Where does ModiFi's lie in the zone of strategic fit between IDU and responsiveness?

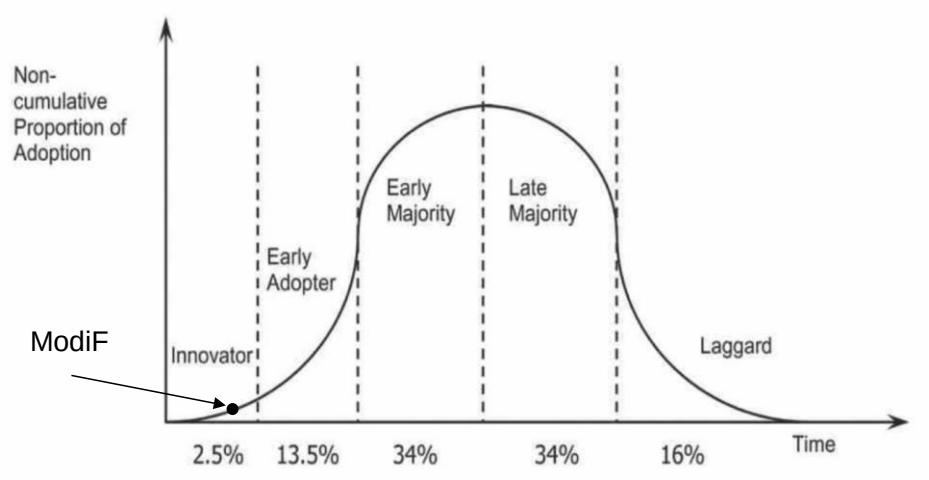
1. Understand customer needs

Customer Needs	**Importance Scale (1-10)**

Portability	7/10
Appearance	6/10
Convenience	10/10
Data Input and Output	8/10
Price	5/10
Screen Quality	7/10

Note: Customer needs is from TIM 105 group project (ModiFi) but updated needs and values.

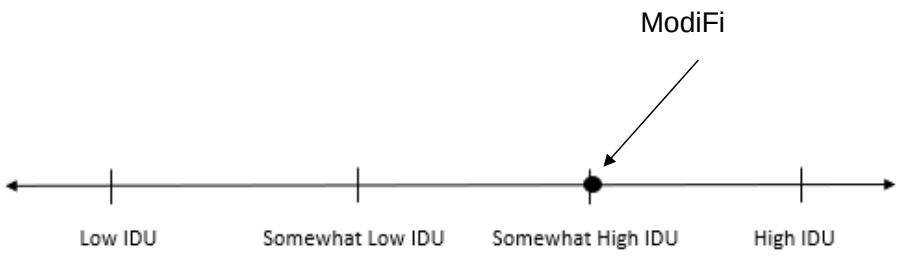
. Determine where the product lies in its market life cycle, which determine its IDU



- ModiFi would lie near the beginning of the product life cycle because it is a relatively new innovation from a start-up company. This means that our market share would be lower in comparison to other organizations. Furthermore, the IDU of a product in the innovator phase would be low. However, the product is not a functional product but instead an entirely new product that is a disruptive technology which pushes its IDU much higher.

3. Place the product's IDU on the IDU spectrum

IDU spectrum



Since ModiFi is in the innovators phase of the product life cycle this would mean that it has a low IDU. However, the product is not a functional product but instead an entirely new product that is a disruptive technology which pushes its IDU much higher.

For the given product establish the corresponding competitive strategy

As explained above in the business model the competitive strategy is differentiation while targeting a broad number of consumers because of ModiFi's product that allows customization of laptops for consumers while being a new concept in the industry.

4. Determine the trade-off between responsiveness & efficiency for the product based on the competitive strategy

When considering that ModiFi is implementing a pull model supply chain while being build-to-order will require it to have a **more responsive than efficient supply chain** because:

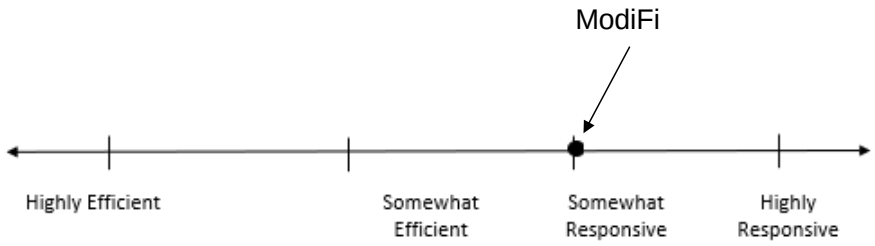
1. **Order-fill accuracy** - Since ModiFi is build to order we must ensure that our product that will be delivered to the consumer meets their desired specification without error hence responsive to the need of the customers.
2. **Scalable fulfillment** - Laptop purchasing will experience different ups and downs depending on the suppliers as they will release new computer parts which can disrupt our own product even though their force is low in the porter five model. ModiFi will still

consider this because we do not want to change our suppliers often as we plan to develop long lasting partnerships with them in our supply chain.

3. **Communication** - One of the goals of our competitive strategy is to provide consumers with high quality customer service because it is a relatively new innovation and such will require a more responsive supply chain in situations where consumers have questions about the product, problems with assembling the product, or concerns with the laptop. Communication is not limited to our consumers but our suppliers too. Our supply chain network will implement an information system that notifies suppliers to ship supplies for production when our safety inventory level is met.
4. **Customer satisfaction** - ModiFi plans to attract loyal customers who believe in our vision of producing a laptop that is customizable and does not require customers to change laptops so often, instead changing parts to further its lifespan. Hence, this will require us to provide high levels of customer satisfaction for customers to return which is a more responsive supply chain.

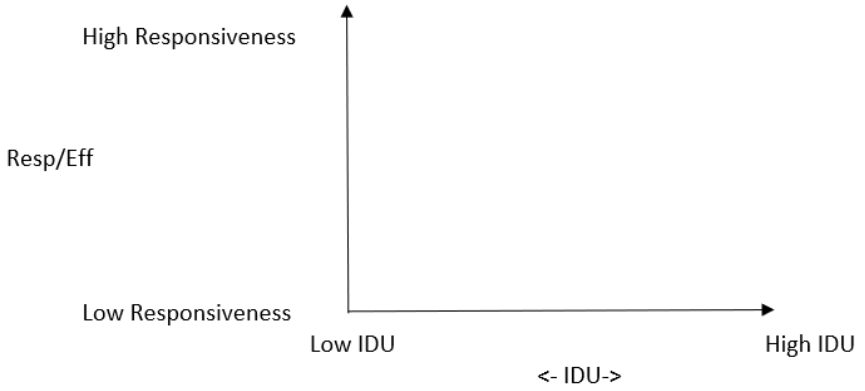
Map the resp/eff trade-off onto the resp/eff spectrum

Responsiveness/Efficiency Spectrum

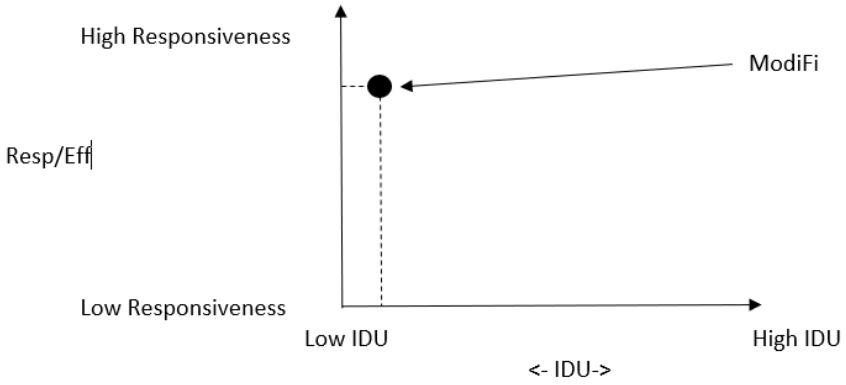


Create a 2-D space

Define a zone of strategic fit in this 2-D space



Position the SC strategy for the product at the appropriate location in the zone of strategic fit



- Our company is between somewhat responsive and highly responsive. We are in between those areas on the spectrum because we felt that our company is more responsive since it is interactive with customers (we are build-to-order). We are also a new and disruptive technology. There is not a lot of companies in the market that are developing modular technology like we are.

d. Check

i. Looking back at the work done and reviewing our lecture notes, it is consistent with lecture notes and research found online. We have coordinated as a group to make the final decisions where several group members looked through the document and agreed that the IDU should be low while responsiveness should be somewhat higher.

e. Learn and Generalize

i. Most startups will jump into the market with limited preparation to weather market demands, but we have determined where our company stands in the market, IDU, and responsiveness spectrum and are better prepared to strategically maneuver our fit into the scope.

High-level Structure for the 4 key Drivers of the Supply Chain

a. Define

i. Illustrate where would ModiFi's supply chain strategy be for each of the supply chain drivers.

b. Plan

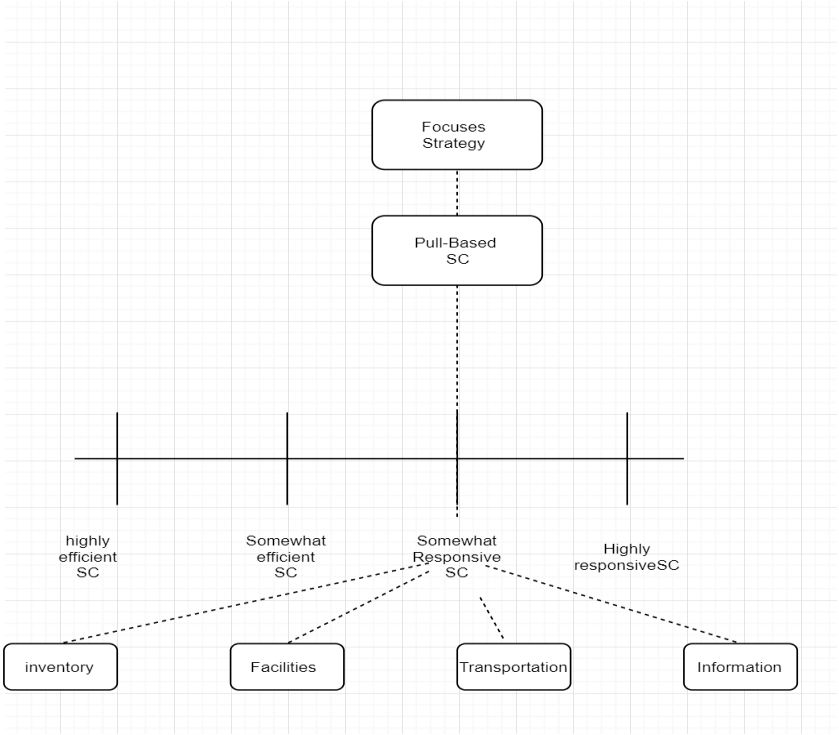
i. Illustrate where would ModiFi's supply chain strategy be for each of the supply chain drivers.

1. Position ModiFi's supply chain drivers on the Responsiveness/Efficiency Spectrum
2. Develop a high level SC strategy for Facilities
3. Develop a high level SC strategy for Transportation
4. Develop a high level SC strategy for Inventory
5. Develop a high level SC strategy Information
6. Design the SC configuration (a.k.a. Structure, a.k.a. network) to meet desired performance objectives (responsiveness, efficiency, levels)

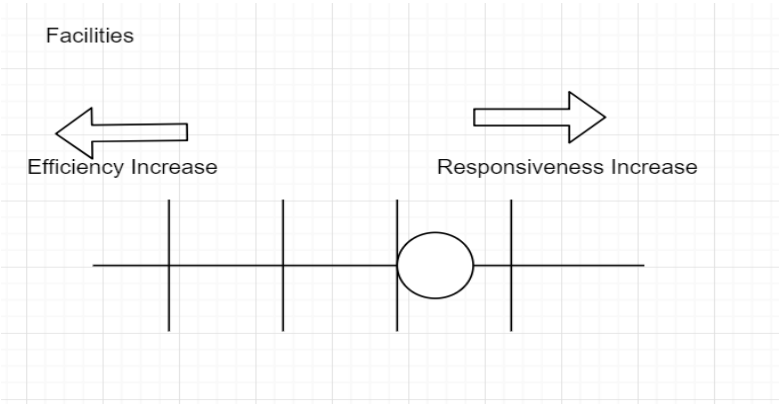
c. Execute

i. Illustrate where would ModiFi's supply chain strategy be for each of the supply chain drivers.

1. Position ModiFi's supply chain drivers on the Responsiveness/Efficiency Spectrum



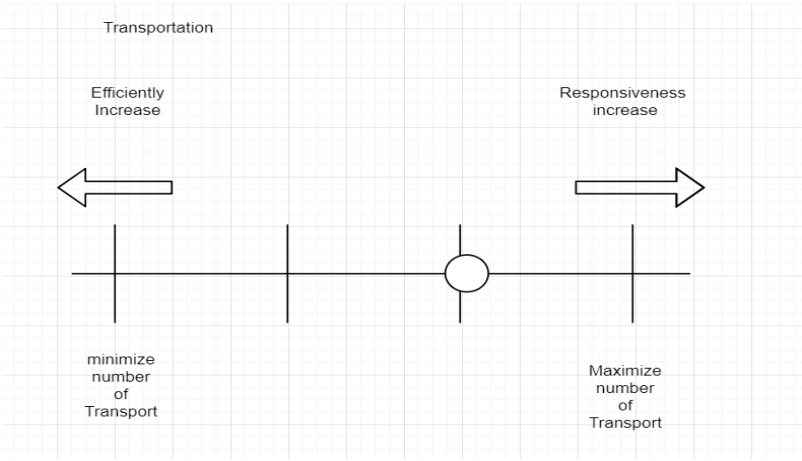
2. Develop a high level SC strategy for Facilities



- There should be fewer facilities to centralized work and maximize efficiency. Five facilities should be enough. Multiple manufacturing plants for the modular laptop shell and assembly. The other will be assembly plants that will be

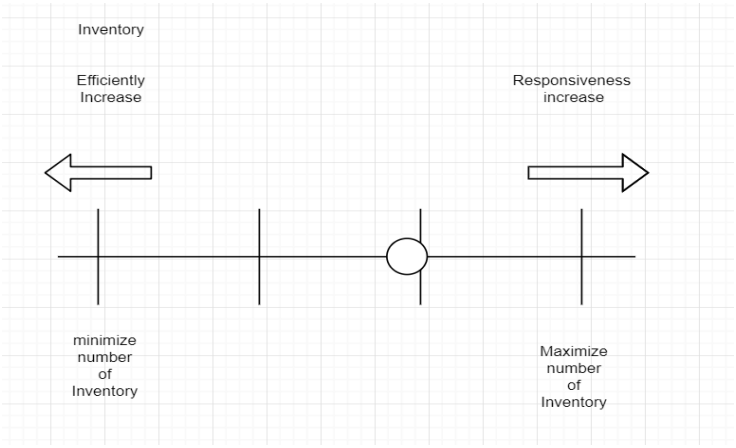
outsourced from other companies. Location decision will be important and will be located in Asia. As Asia is a world wide trade hub.

3. Develop a high level SC strategy for Transportation



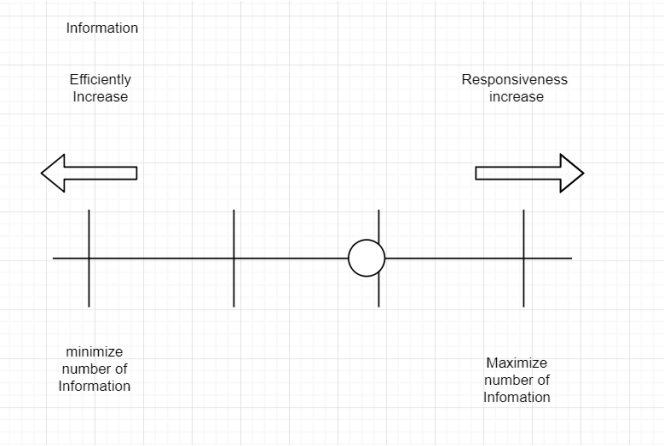
- Transport will be done by land. Because facilities are based in California, ModiFi is aiming to distribute in this area and no other form of transportation will be needed. We will aim for some heat more responsive modes of transportation to cut and reduce cost.

Develop a high level SC strategy for Inventory



- Our inventory driver will be on the responsive side which can be had by having higher levels of inventory. This is due to the possibility of losing customers where demand cannot be satisfied,but Efficiency in inventory management will reduce inventory levels of all items and items that do not sell as frequently.

Develop a high level SC strategy Information



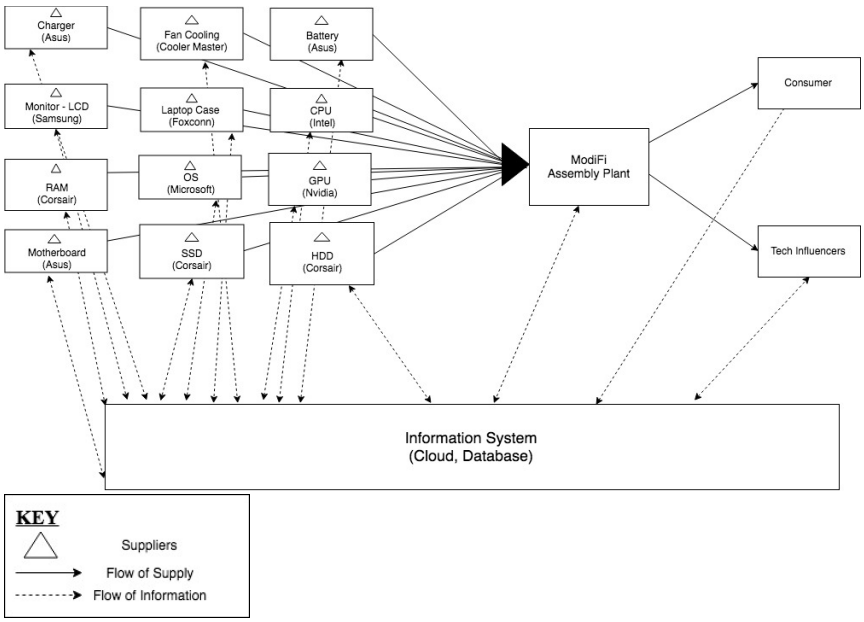
- ModiFi information driver will be more on the somewhat responsive side. The information will help improve the utilization of the chain it will improve our product availability while decreasing inventories. We can achieve this by collecting and sharing accurate timely data with other drivers. This will also meet customer needs at a lower cost, due to enabling ModiFi responding quickly to new demands in high Technology world of electronic devices.

Design the SC configuration (a.k.a. Structure, a.k.a. network) to meet desired performance objectives (responsiveness, efficiency, levels)

Supply	**Company**
Charger	Asus - We decided to use Asus charger because the battery will be provided by them.
Fan Cooling	CoolerMaster - Known for having cooler fans that provides steady performance and airflow through the microprocessors.
Battery	Asus - We decided to use Asus battery because the charger will be provided by them

Monitor	Samsung - Known for the quality LCD monitors they produce.
Laptop Case	Foxconn - Known for its capability of filling larger orders and manufacturing quality products such as the iPhone.
CPU (Microprocessor)	Intel - Well established company that is well known for their processor
RAM	Corsair - The RAM they produce are very durable and they have a steady track record.
Operating System	Microsoft - Universal operating system that is widely used by varying consumers.
Graphics Card	Nvidia - Nvidia provides reliable graphics card that aren't susceptible to overheating compared to other graphics cards.
Motherboard	Asus - Asus is a company that offers motherboard with stable performances.
SSD	Corsair - Corsair is known to have reliable SSD and we have established deals with them on other supplies so we would like to maintain partnership with them.
HDD	Corsair - Corsair is known to have reliable HDD and we have established deals with them on other supplies so we would like to maintain partnership with them.

We have the same suppliers for several components because of economies of scale: ordering more from one manufacturer will reduce the total order cost.



Since ModiFi is utilizing a build to order business model, we decided to receive supplies from multiple different companies and have our assembly plant manufacture the laptops. Deals are made with these companies on what specific parts or models we want. Our manufacturing plant will coat some of these supplies with our special casing that makes these parts modular. We wish to establish a long term relationship with the following suppliers in this Supply Chain Network because having a good relationship will reduce the chances of us having to establish deals with other firms for specific parts. Our information system will be responsible for exchanging information with the companies, collect feedback from consumers and technology influencers, and keep technology influencer updated on our product. Our information system will contact the companies automatically and we will respond to the demand with our safety inventory when our product hits the safety inventory level (threshold). Furthermore, the information it collects from consumers and technology influencers will be analyzed and have important details saved in a backlog. Last but not least, it will update the technology influencers with updates of our newest products. If they approve of our product, they may share the information with others and bring publicity to our product.

We are currently using the same supply parts for our base model for the time being so that we can provide a stable financial model along with a forecast. After a year, we will branch out into using other parts and this will give the users the option of purchasing other parts for our computer.

d. Check

i. After looking back and referring to the notes, the answers to the questions seems correct. This section has been edited several times as each time we meet Subhas the alignment seems off but now we are sure that the network is correct.

e. Learn and Generalize

i. From conducting this problem, each team member gained a better understanding of integrating high-level strategies with the detailed implementation of each driver. The team has solidified which direction we are going with each supplier and the responsiveness of each driver.

Time Phased Plan

a. Define

i. Based on industry standards, develop a plan (time-phased) for the development of the software required for modular laptops.

b. Plan

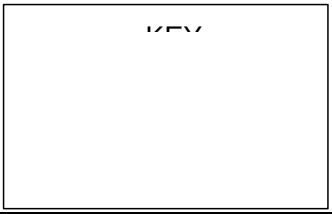
i. Research industry standards for development cycles.
ii. Include hardware driver software, compatibility software, and part interfacing software.
iii. Create high-level time-phased plan for overall software development.

c. Execute

i. Industry research (time frame for an average SDLC project)
   1. Planning and Requirements - two to four weeks
   2. Design and Architecture - two weeks
   3. Development and Coding - three to eight months
   4. Implementation - two to four weeks
   5. Testing and Maintenance - three to six weeks
   6. Production - three weeks or more
   7. **Overall:** Approximately **1-2 years**, depending on scope.

ii. Adjusting above estimate for hardware projects (drivers, compatibility, hardware interfacing, etc.)
   1. **Overall:** Approximately **2 years** (higher-end estimate for an SDLC software project).

iii. High-level time-phased software development plan:



	Y1Q1	*Y1Q2*	*Y1Q3*	*Y1Q4*	*Y2Q1*	*Y2Q2*	*Y2Q3*	*Y2Q4*
Driver Software	P	P D	D	D C	C	C I	T	T
Compatibility Software	--	P	P D	D	D C I	I T	T	T

Hardware Interface Software	--	--	P	P	P D	D C I	T	T
Third-party Software Integration	--	P	P	P D	D C	C	C I	T

d. Check

i. We went back on this problem and fixed any minor typos we might have had, reformatted the high level table to fit, and to understand what each letter meant on they chart, we added a key defining every one.

e. Learn and Generalize

i. Software development projects in the SDLC framework take a significant amount of time to complete. This time requirement is increased substantially if the project is of a large scale and/or requires research, development, and extensive testing, as a new technology often does.

Demand Data

---

a. Define

i. Create and implement a process to obtain credible demand data for your product

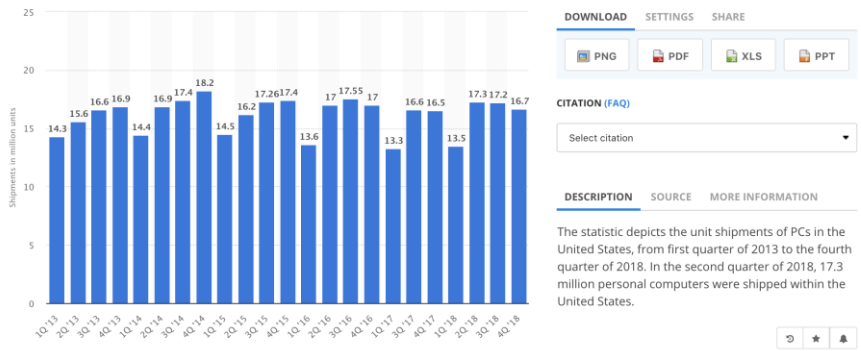
b. Plan

i. Research current market statistics for laptop demand data
ii. Create a process to integrate the data for ModiFi to use
iii. Execute the process
iv. Present the data for ModiFi to use it with demand forecasting

c. Execute

i. Research current market statistics for laptop demand data

Quarterly unit shipments of personal computers (PCs) in the United States from 2013 to 2018 (in million units)*



Source: https://www.statista.com/statistics/576151/unit-shipments-pcs-united-states/

This data comes from statista.com which includes the the total shipments of personal computers in the United States from 2013 to 2018. This is highly credible and useful as we plan to start in the United States before expanding to other regions. This data also considers every personal computer which is the ideal market we will be competing in. The data from this research we will be using will be:

Year	Quarter	Sales in Millions
2013	1	14.3
2013	2	15.6
2013	3	16.6
2013	4	16.9
2014	1	14.4
2014	2	16.9
2014	3	17.4
2014	4	18.2
2015	1	14.5
2015	2	16.2
2015	3	17.26

2015	4	17.4
2016	1	13.6
2016	2	17
2016	3	17.55
2016	4	17
2017	1	13.3
2017	2	16.6
2017	3	16.5
2017	4	13.5

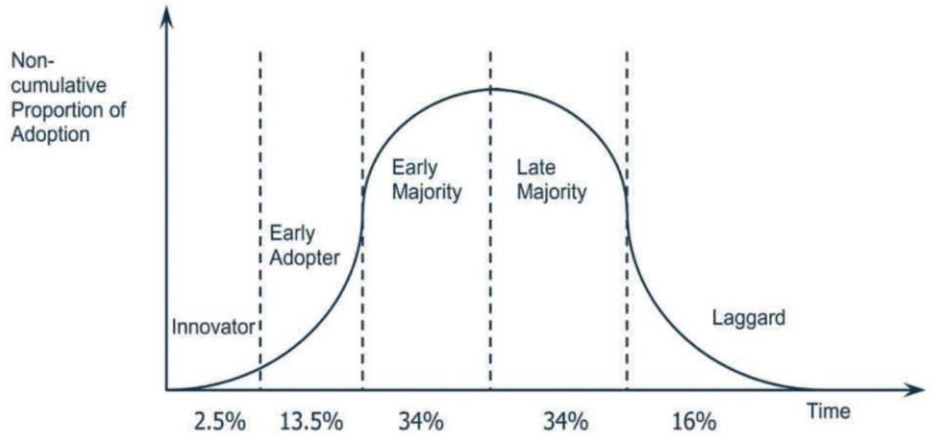
ii. Create a process to integrate the data for ModiFi to use

Now that we know of the entire shipment of laptops in the United States for each quarter, we can begin by integrating ModiFi's market share by multiplying the sale value with our market share. Ideally, as we are a start-up will relatively low market share in comparison to our competitors the multiplied value should be a market share of 1%

Sales in Millions * Market Share = ModiFi's Market Share of laptops

- Ex.: 14.3 * 0.01 = 0.143 ← ***(ModiFi's sales in the millions for 2014 in Q1)***

Now that we have the ModiFi's sales in the Millions we have to incorporate the product life cycle



To incorporate the product life cycle, we multiplied each year with the corresponding phase such as Year 1 = 2.5% (innovators), Year 2 = 13.5% (Early Adopters), Year 3 = 34% (Early Majority), Year 4 = 34% (Late Majority), Year 5 = 16% (Laggard).

ModiFi's sales in the Millions * Phase of product life cycle = Demand data
Ex.
0.143 * 0.025 = 0.003575 (ModiFi's demand data for Year 2014 in Q1 in the millions)

When converting the value from millions to thousands it will provide us with a demand data.
Ex.
0.003575 * 1,000,000 = 3575 sales

This is the process that we have used for calculating the demand graph and it is credible as we have considered our market share and the product life cycle from the overall sales.

iii. Execute the process

Year	Quarter	Sales in Millions	Demand Data
2013	1	14.3	3,575
2013	2	15.6	3,900
2013	3	16.6	4,150
2013	4	16.9	4,225
2014	1	14.4	19,440

2014	2	16.9	22,815
2014	3	17.4	23,490
2014	4	18.2	24,570
2015	1	14.5	49,300
2015	2	16.2	55,080
2015	3	17.26	58,684
2015	4	17.4	59,160
2016	1	13.6	46,240
2016	2	17	57,800
2016	3	17.55	59,500
2016	4	17	57,800
2017	1	13.3	21,280
2017	2	16.6	26,560
2017	3	16.5	26,400
2017	4	13.5	21,600

iv. Present the data for ModiFi to use it with demand forecasting

Year 1	Year 2	Year 3	Year 4	Year 5
3,575	19,440	49,300	46,240	21,280
3,900	22,815	55,080	57,800	26,560
4,150	23,490	58,684	59,500	26,400
4,225	24,570	59,160	57,800	21,600

d. Check

i. We went back to this problem to check to see if we conducted the problem correctly. After checking, we changed a few typos, restructured the execution phase and replaced some of our data retrieved from statista.com with more accurate numbers and data.

e. Learn and Generalize

i. Demand is one of the most important factors to consider when discussing a retail product. By taking existing data and conforming it to a new product, a relatively accurate demand estimate can be approximated.

Financial Modeling Refinements (Last Quarter)

a. Define

i. Refine the financial data from last quarter's project.

b. Plan

i. Review the data from final report TIM 105
ii. Check the work and see if there is any mistake
iii. Revise the data from last quarter.
iv. Create a more credible financial model.

c. Execute

i. The Financial modeling from last quarter:

Scenario Input Paramenters	
Sales & production	80,000
Development cost	30,000,000
Unit Price	1500
Unit Production Cost	600
Ramp-up Cost	2,000,000
Marketing & Support Cost	3,000,000
Annual Discount Factor	10
Base-Case NPV	117250.52

For our product, the price and cost can be high or low depending on the customers' expectations to their laptop's performance. For example, if a customer wants higher computing performance and a better video card on the laptop in order to run games, the price of its components will be high, so the price of the whole computer will be higher. For us, the cost of this computer is higher as well, because we will purchase better video card and CPU for the customer. As in the Financial Modeling, we say the price of a computer is $1,500, and the cost of this computer is $600. As in this case, the profit of each laptop is about the same, at $900.

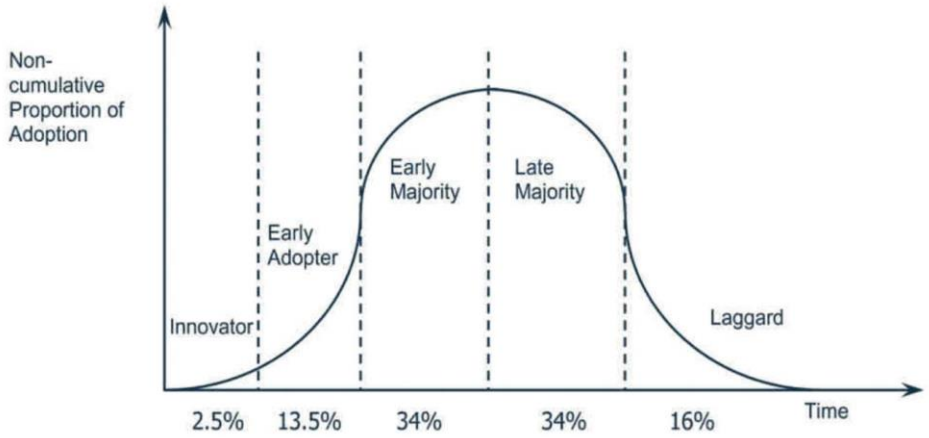
However, the data from last quarter has some mistakes. For example, the predicted unit sold is too high. After the group meeting, we came up a new sales volume for our first year which is 50,000 units, and the new NPV is $59,069k which is more applicable for a medium size company.

Revised Financial Modeling:

Scenario Input Paramenters	
Sales & production	50,000
Deveolpment cost	30,000,000
unit price	1,500
unit production cost	600
ramp up cost	2,000,000
marketing & support co	3,000,000
annual discount factor	10
Base-Case NPV	-71,464

Base Case																	
	year 1				year 2				year 3				year 4				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
($ values in thousands)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q23	Q4	Q1	Q2	Q3	Q4	
Development cost	-7500	-7500	-7500	-7500													
Ramp up cost				-1000	-1000												
Marketing & support cost					-750	-750	-750	-750	-750	-750	-750	-750	-750	-750	-750	-750	
production cost						-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	
Production volume						12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	
unit prodcution volume						-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	
sales revenue						468.75	468.75	2531.25	2531.25	6375	6375	6375	6375	3000	3000	3000	
sales volume						312.5	312.5	1687.5	1687.5	4250	4250	4250	4250	2000	2000	2000	
unit price						1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	
period cash flow	-7500	-7500	-7500	-8500	-1750	-7781	-7781	-5719	-5719	-1875	-1875	-1875	-1875	-5250	-5250	-5250	
PV year 1, r=10%	-7500	-7317	-7139	-7893	-1585	-6877	-6710	-4811	-4694	-1501	-1465	-1429	-1394	-3808	-3716	-3625	
Project NPV, $	-71,464																

To consider the product life cycle, starting from Year 2 quarter 2 the sales volume and revenue has been multiplied by the percentages shown in the product life cycle below.



Year 2 Quarter 2 & 3 are the innovators for the product life cycle, so we multiply by 25% (taken from the graph above). Following the graph above, we multiply the next year by 13.5% and so on. Calculations are shown below. The highlighted sections are the percentages we multiplied to incorporate the product life cycle.

Quarter 2, Year 2 - Innovator

- Sales volume =(ScenarioParameters!$B$2/4)*0.025
- Sales Revenue
  =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.025)*(1/1000)

Quarter 3, Year 2 - Innovator

- Sales volume =(ScenarioParameters!$B$2/4)*0.025
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.025)*(1/1000)

Quarter 4, Year 2 - Early Adopter

- Sales volume =(ScenarioParameters!$B$2/4)*0.135
- Sales Revenue
  =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.135)*(1/1000)

Quarter 1, Year 3 - Early Adopter

- Sales volume =(ScenarioParameters!$B$2/4)*0.135
- Sales Revenue
  =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.135)*(1/1000)

Quarter 2, Year 3 - Early Majority

- Sales volume =(ScenarioParameters!$B$2/4)*0.34
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.34)*(1/1000)

Quarter 3, Year 3 - Early Majority

- Sales volume =(ScenarioParameters!$B$2/4)*0.34
- Sales Revenue
  =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.34)*(1/1000)

Quarter 4, Year 3 - Late Majority

- Sales volume =(ScenarioParameters!$B$2/4)*0.34
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.34)*(1/1000)

Quarter 1, Year 4 - Late Majority

- Sales volume =(ScenarioParameters!$B$2/4)*0.34
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.34)*(1/1000)

Quarter 2, Year 4 - Laggard

- Sales volume =(ScenarioParameters!$B$2/4)*0.16
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.16)*(1/1000)

Quarter 3, Year 4 - Laggard

- Sales volume =(ScenarioParameters!$B$2/4)*0.16
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.16)*(1/1000)

Quarter 4, Year 4 - Laggard

- Sales volume =(ScenarioParameters!$B$2/4)*0.16
- Sales Revenue =(ScenarioParameters!$B$4*(ScenarioParameters!$B$2/4)*0.16)*(1/1000)

d. Check

i. The revised financial modeling is based on group meeting of Group 22 and previous financial modeling. The work is correct and sensible.

e. Learn and Generalize:

i. In this task, we made more credible data about financial modeling by group meetings and meet with Professor Subhas. The revised data is more convincing and more along the lines of a medium size company.

Demand Data for our Product Using the 5 Methods

---

a. Define

i. Forecast Demand for our product using the following:
   1. Product life cycle
   2. Market analysis
   3. Cash-flow analysis

b. Plan

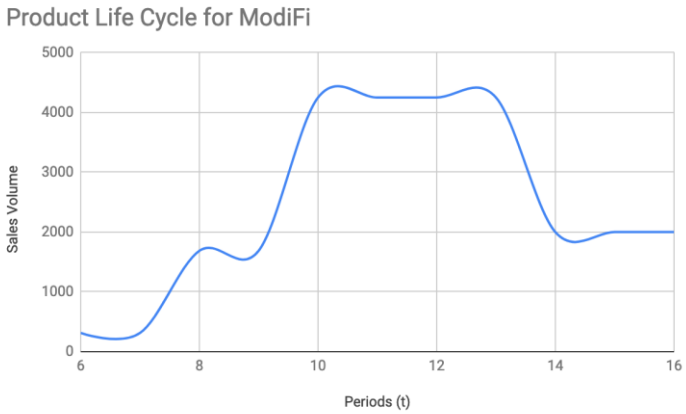
i. Create the product life cycle
ii. Market analysis
iii. Cash-flow analysis
iv. Forecast demand using the following methods:

1. Static forecasting
2. Moving average
3. Simple Average Smoothing
4. Holt's Method
5. Winter's Method

v. See which forecasting method is most reliable

c. Execute

i. Life cycle of ModiFi modular laptop



ModiFi's laptop lifecycle will follow a similar cycle seen in many technology products. A slow start (low adoption due to the newness of the technology) will start the lifecycle. Then, as marketing and adoption take place, the sales volume will increase considerably. Afterwards, sales will plateau before dropping as the life cycle is complete.

ii. Create a market analysis for our product:

Shown in the competitive strategy above, the competition is high with many companies such as Apple and Microsoft. In order to compete with them, we need brand and product recognition with capital as we are currently in the introduction phase of the cycle. Along with many competitors such as tablets and other computers this market is heavily saturated. Therefore our competitive strategy is a focused competitive strategy. By targeting a specific market, we can leverage our advantage of modularity. Also, by making our product customizable and unique, we can gain brand recognition while achieving our competitive strategy of being leaders in innovation of laptops.

iii. Cash Flow Analysis

Commented [1]: Show a process when deriving these numbers. Subhas doesnt like being explained.

Commented [2]: FLAT

- *Taken from cash-flow analysis created in TIM 105 but now including the product life cycle*

Base Case																
	year 1				year 2				year 3				year 4			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
($ values in thousands)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q23	Q4	Q1	Q2	Q3	Q4
Development cost	-7500	-7500	-7500	-7500												
Ramp up cost				-1000	-1000											
Marketing & support cost					-750	-750	-750	-750	-750	-750	-750	-750	-750	-750	-750	-750
production cost						-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500	-7500
Production volume						12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500
unit prodcution volume						-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
sales revenue						468.75	468.75	2531.25	2531.25	6375	6375	6375	6375	3000	3000	3000
sales volume						312.5	312.5	1687.5	1687.5	4250	4250	4250	4250	2000	2000	2000
unit price						1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
period cash flow	-7500	-7500	-7500	-8500	-1750	-7781	-7781	-5719	-5719	-1875	-1875	-1875	-1875	-5250	-5250	-5250
PV year 1, r=10%	-7500	-7317	-7139	-7893	-1585	-6877	-6710	-4811	-4694	-1501	-1465	-1429	-1394	-3808	-3716	-3625
Project NPV, $	-71,464															

iv. Forecasting Demand Static Forecasting

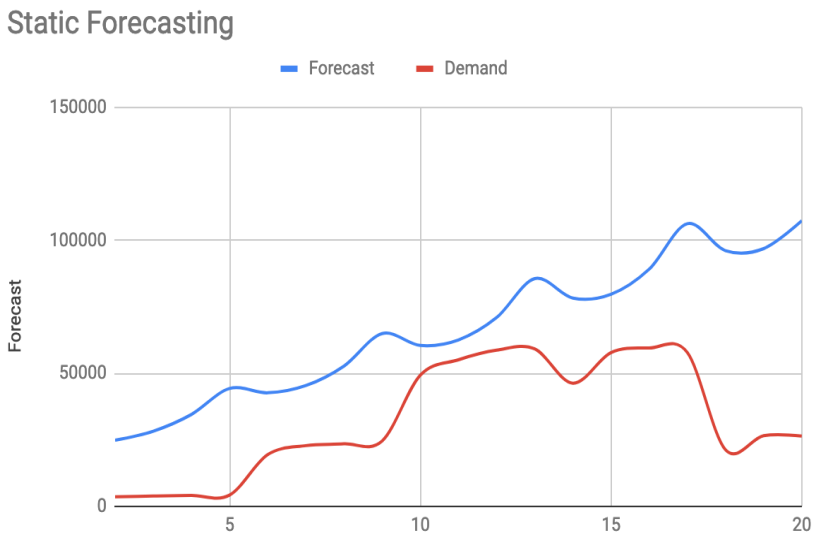
- *Quarterly demand Given*

Year	Quarter	Period t	Demand Dt
1	1	1	3575.0
	2	2	3900.0
	3	3	4150.0
	4	4	4225.0
2	1	5	19440.0
	2	6	22815.0
	3	7	23490.0
	4	8	24570.0
3	1	9	49300.0
	2	10	55080.0
	3	11	58684.0
	4	12	59160.0
4	1	13	46240.0
	2	14	57800.0
	3	15	59500.0
	4	16	57800.0
5	1	17	21280.0
	2	18	26560.0
	3	19	26400.0
	4	20	21600.0

Adjusted sales volume for out forecast, plotted the data and created a trendline and Level

- *Deseasonalized Demand and linear regression*

Year	Quarter	Period t	Demand Dt	De-seasonalized Demand
1	1	1	3575.0	13653.5
	2	2	3900.0	16097.2
	3	3	4150.0	18540.9
	4	4	4225.0	20984.6
2	1	5	19440.0	23428.3
	2	6	22815.0	25872.0
	3	7	23490.0	28315.7
	4	8	24570.0	30759.4
3	1	9	49300.0	33203.1
	2	10	55080.0	35646.8
	3	11	58684.0	38090.5
	4	12	59160.0	40534.2
4	1	13	46240.0	42978.0
	2	14	57800.0	45421.7
	3	15	59500.0	47865.4
	4	16	57800.0	50309.1
5	1	17	21280.0	52752.8
	2	18	26560.0	55196.5
	3	19	26400.0	57640.2
	4	20	21600.0	60083.9



- ***Estimate seasonal Factors***

Year	Quarter	Period t	Demand Dt	De-seasonalized Demand	Regressed Demand Dt	Seasonal Factor
1	1	1	3575.0	13653.5	13653.5	3.82
	2	2	3900.0	16097.2	16097.2	4.13
	3	3	4150.0	18540.9	18540.9	4.47
	4	4	4225.0	20984.6	20984.6	4.97
2	1	5	19440.0	23428.3	23428.3	1.21
	2	6	22815.0	25872.0	25872.0	1.13
	3	7	23490.0	28315.7	28315.7	1.21
	4	8	24570.0	30759.4	30759.4	1.25
3	1	9	49300.0	33203.1	33203.1	0.67
	2	10	55080.0	35646.8	35646.8	0.65
	3	11	58684.0	38090.5	38090.5	0.65
	4	12	59160.0	40534.2	40534.2	0.69
4	1	13	46240.0	42978.0	42978.0	0.93
	2	14	57800.0	45421.7	45421.7	0.79
	3	15	59500.0	47865.4	47865.4	0.80
	4	16	57800.0	50309.1	50309.1	0.87
5	1	17	21280.0	52752.8	52752.8	2.48
	2	18	26560.0	55196.5	55196.5	2.08
	3	19	26400.0	57640.2	57640.2	2.18
	4	20	21600.0	60083.9	60083.9	2.78

- ***Average seasonal Factor:***

Year	Quarter	Period t	Demand Dt	De-seasonalized Demand	Regressed Demand Dt	Seasonal Factor	AVG Seasonal Factor
1	1	1	3575.0	13653.5	13653.5	3.82	1.821
	2	2	3900.0	16097.2	16097.2	4.13	1.755
	3	3	4150.0	18540.9	18540.9	4.47	1.862
	4	4	4225.0	20984.6	20984.6	4.97	2.111
2	1	5	19440.0	23428.3	23428.3	1.21	
	2	6	22815.0	25872.0	25872.0	1.13	
	3	7	23490.0	28315.7	28315.7	1.21	
	4	8	24570.0	30759.4	30759.4	1.25	
3	1	9	49300.0	33203.1	33203.1	0.67	
	2	10	55080.0	35646.8	35646.8	0.65	
	3	11	58684.0	38090.5	38090.5	0.65	
	4	12	59160.0	40534.2	40534.2	0.69	
4	1	13	46240.0	42978.0	42978.0	0.93	
	2	14	57800.0	45421.7	45421.7	0.79	
	3	15	59500.0	47865.4	47865.4	0.80	
	4	16	57800.0	50309.1	50309.1	0.87	
5	1	17	21280.0	52752.8	52752.8	2.48	
	2	18	26560.0	55196.5	55196.5	2.08	
	3	19	26400.0	57640.2	57640.2	2.18	
	4	20	21600.0	60083.9	60083.9	2.78	

- ***Error Analysis:***

Forecast Ft	Error Et	Absolute Error At	Squared Error MSEt	MADt	% Error	MAPEt	TSt
24866.38	21291.38	21291.38	453322859	21291	595.6	595.6	1.0
28243.09	24343.09	24343.09	522954435	22817	624.2	609.9	2.0
34523.14	30373.14	30373.14	656145528	25336	731.9	650.5	3.0
44302.27	40077.27	40077.27	893656060	29021	948.6	725.1	4.0
42668.77	23228.77	23228.77	822839977	27863	119.5	603.9	5.0
45393.37	22578.37	22578.37	770663795	26982	99.0	519.8	6.0
52723.87	29233.87	29233.87	782657393	27304	124.5	463.3	7.0
64938.69	40368.69	40368.69	888529117	28937	164.3	425.9	8.0
60471.16	11171.16	11171.16	803669739	26963	22.7	381.1	9.0
62543.65	7463.65	7463.65	728873379	25013	13.6	344.4	10.0
70924.59	12240.59	12240.59	676233264	23852	20.9	315.0	11.0
85575.11	26415.11	26415.11	678026996	24065	44.7	292.4	12.0
78273.54	32033.54	32033.54	704805526	24678	69.3	275.3	13.0
79693.94	21893.94	21893.94	688701165	24479	37.9	258.3	14.0
89125.32	29625.32	29625.32	701298387	24823	49.8	244.4	15.0
106211.53	48411.53	48411.53	803947002	26297	83.8	234.4	16.0
96075.93	74795.93	74795.93	1085740196	29150	351.5	241.3	17.0
96844.22	70284.22	70284.22	1299858600	31435	264.6	242.6	18.0
107326.04	80926.04	80926.04	1576130496	34040	306.5	245.9	19.0
126847.95	105247.95	105247.95	2051180515	37600	487.3	258.0	20.0

Evaluate MAD

- The mean absolute deviation while using static's forecasting showed that there are large fluctuations of data from the mean in the second year. This is due to the changes in demand data from fluctuations of the product life cycle being implemented which suggests that the data is spread out and that the mean of this data is less relevant.

Evaluate MAPE

- The MAPE is fairly high around the 200% which suggest a lot of errors in the forecasting method.

Evaluate MSE

- The mean square error is similar to mad due to its changing demand data causing it to fluctuate greatly.

Evaluate bias

- The bias can be determined by the tracking signal and the tracking signal suggests that there is significant bias as it increases with the period.

Evaluate TS

- As explained with the bias there is possible bias as the tracking signal keeps increasing.

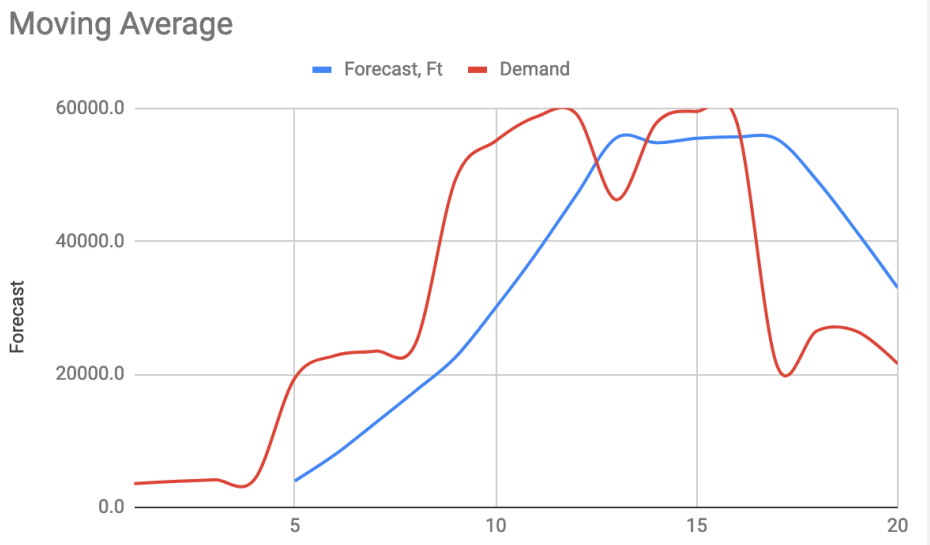
Forecasting Demand Moving Average Forecasting

Forecasting Demand using Level

Year	Quarter	Period t	Demand Dt	Level, Lt	Forecast, Ft
1	1	1	3575.0		
	2	2	3900.0		
	3	3	4150.0		
	4	4	4225.0	3962.5	
2	1	5	19440.0	7928.8	3962.5
	2	6	22815.0	12657.5	7928.8
	3	7	23490.0	17492.5	12657.5
	4	8	24570.0	22578.8	17492.5
3	1	9	49300.0	30043.8	22578.8
	2	10	55080.0	38110.0	30043.8
	3	11	58684.0	46908.5	38110.0
	4	12	59160.0	55556.0	46908.5
4	1	13	46240.0	54791.0	55556.0
	2	14	57800.0	55471.0	54791.0
	3	15	59500.0	55675.0	55471.0
	4	16	57800.0	55335.0	55675.0
5	1	17	21280.0	49095.0	55335.0
	2	18	26560.0	41285.0	49095.0
	3	19	26400.0	33010.0	41285.0
	4	20	21600.0	23960.0	33010.0

Error Analysis

Error, Et	Absolute Error	Squared Error, MS	MADt	% Error	MAPEt	TSt
-15477.5	15477.5	239553006.3	15477.5	79.6	79.6	-1.0
-14886.3	14886.3	230576722.7	15181.9	65.2	72.4	-2.0
-10832.5	10832.5	192832167.2	13732.1	46.1	63.7	-3.0
-7077.5	7077.5	157146877.0	12068.4	28.8	54.9	-4.0
-26721.3	26721.3	268522541.9	14999.0	54.2	54.8	-5.0
-25036.3	25036.3	328237753.9	16671.9	45.5	53.2	-6.0
-20574.0	20574.0	341816571.3	17229.3	35.1	50.6	-7.0
-12251.5	12251.5	317851906.5	16607.1	20.7	46.9	-8.0
9316.0	9316.0	292178123.1	15797.0	20.1	43.9	-7.8
-3009.0	3009.0	263865718.9	14518.2	5.2	40.1	-8.7
-4029.0	4029.0	241353639.1	13564.6	6.8	37.0	-9.6
-2125.0	2125.0	221617137.9	12611.3	3.7	34.3	-10.5
34055.0	34055.0	293780667.7	14260.8	160.0	43.9	-6.9
22535.0	22535.0	309069636.0	14851.8	84.8	46.8	-5.1
14885.0	14885.0	303235875.3	14854.1	56.4	47.5	-4.1
11410.0	11410.0	292420389.4	14638.8	52.8	47.8	-3.4



Evaluate MAD

- The mean absolute deviation while using moving forecasting showed that there are minimal fluctuations in data. This suggests that the moving average method accounts for the fluctuations in data.

Evaluate MAPE

- The MAPE is fairly low in comparison with the other methods. The errors stay within the 100 which means more accurate forecasting compared to other methods.

Evaluate MSE

- The mean square error is similar to mad with constant numbers throughout.

Evaluate bias

- The bias can be determined by the tracking signal and the tracking signal suggests that there is significant bias as it increases in certain periods.

Evaluate TS

- As explained with the bias there is possible bias as the tracking signal keeps increasing.

Forecasting Demand Simple Smoothing Forecasting

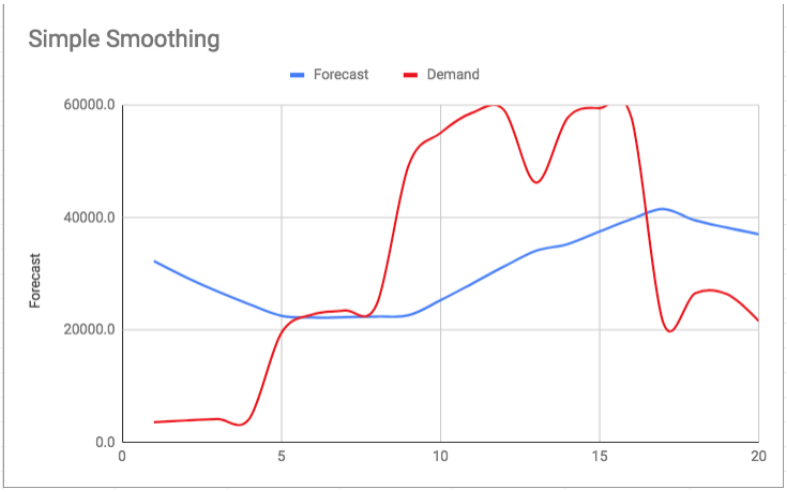
Forecasting Demand

Year	Quarter	Period t	Demand Dt	Level Lt	Forecast Ft
		0		32278.5	
Year 1	1	1	3575.0	29408.1	32278.5
	2	2	3900.0	26857.3	29408.1
	3	3	4150.0	24586.6	26857.3
	4	4	4225.0	22550.4	24586.6
Year 2	1	5	19440.0	22239.4	22550.4
	2	6	22815.0	22296.9	22239.4
	3	7	23490.0	22416.2	22296.9
	4	8	24570.0	22631.6	22416.2
Year 3	1	9	49300.0	25298.5	22631.6
	2	10	55080.0	28276.6	25298.5
	3	11	58684.0	31317.3	28276.6
	4	12	59160.0	34101.6	31317.3
Year 4	1	13	46240.0	35315.5	34101.6
	2	14	57800.0	37563.9	35315.5
	3	15	59500.0	39757.5	37563.9
	4	16	57800.0	41561.8	39757.5
Year 5	1	17	21280.0	39533.6	41561.8
	2	18	26560.0	38236.2	39533.6
	3	19	26400.0	37052.6	38236.2
	4	20	21600.0	35507.3	37052.6

Error Analysis

Error Et	Absolute Error At	Squared Error MSEt	MADt	% Error	MAPEt	TSt
28703.5	28703.5	823888041.9	28703.5	802.9	802.9	1.0
25508.1	25508.1	737275731.3	27105.8	654.1	728.5	2.0
22707.3	22707.3	663390895.4	25639.6	547.2	668.0	3.0
20361.6	20361.6	601191504.3	24320.1	481.9	621.5	4.0
3110.4	3110.4	482888131.7	20078.2	16.0	500.4	5.0
-575.6	575.6	402462001.9	16827.7	2.5	417.4	5.9
-1193.1	1193.1	345170775.0	14594.2	5.1	358.5	6.8
-2153.8	2153.8	302604264.6	13039.2	8.8	314.8	7.4
-26668.4	26668.4	348004102.9	14553.5	54.1	285.8	4.8
-29781.5	29781.5	401897748.9	16076.3	54.1	262.7	2.5
-30407.4	30407.4	449417001.4	17379.1	51.8	243.5	0.6
-27842.7	27842.7	476566696.8	18251.1	47.1	227.1	-1.0
-12138.4	12138.4	451241601.9	17780.9	26.3	211.7	-1.7
-22484.5	22484.5	455121127.1	18116.9	38.9	199.3	-2.9
-21936.1	21936.1	456859200.8	18371.5	36.9	188.5	-4.1
-18042.5	18042.5	448651204.5	18350.9	31.2	178.7	-5.1
20281.8	20281.8	446457012.2	18464.5	95.3	173.8	-3.9
12973.6	12973.6	431004620.8	18159.5	48.8	166.8	-3.3
11836.2	11836.2	415693656.8	17826.7	44.8	160.4	-2.7
15452.6	15452.6	406848125.1	17707.9	71.5	156.0	-1.8

Diagram for Simple Smoothing Forecasting



Evaluate MAD

- The mean absolute deviation while using simple exponential smoothing shows that the values are slowly decreasing.

Evaluate MAPE

- The MAPE is very high and slowly decreases over time which suggest high margins of error.

Evaluate MSE

- The mean square error is similar to mad due to its changing demand data causing it to fluctuate greatly.

Evaluate Bias

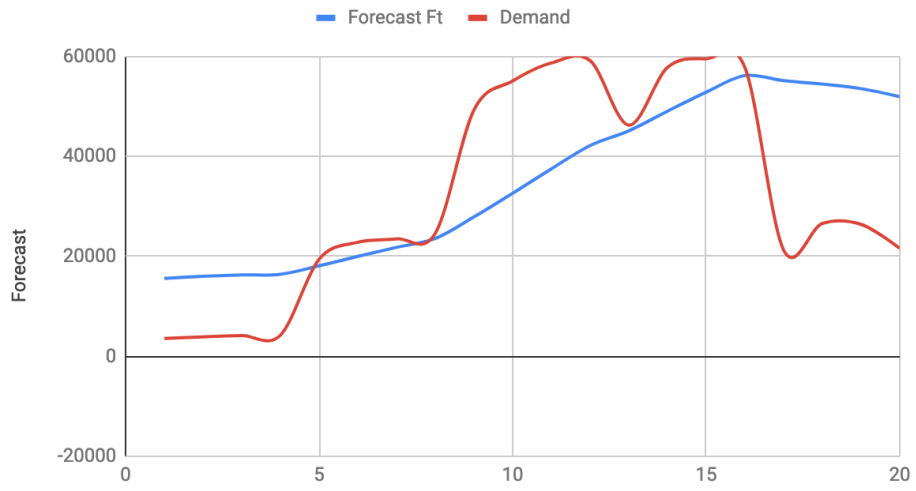
- The bias can be determined by the tracking signal and the tracking signal suggests that there is no significant bias as it maintains within the [6, -6] intervals which is a good rule of thumb for determining bias. However, it does deviate in some situations which mean some values could be incorrect.

Evaluate TS

- As explained with the bias there does not seem to be significant bias based of the tracking signal which stays within the intervals.

Holt's Method

Year	Quarter	Period t	Demand Dt	Level Lt	Trend Tt	Forecast Ft	Error Et	Absolute Error	Mean Square E	MADt	% Error	MAPEt	TSt
		0		13199.48421	1817.044361								
1	1	1	3575.0	13872.37571	1702.629075	15575.00479	12000.0	12000.00479	144000114.9	12000.00479	335.6644696	335.6644696	1
	2	2	3900.0	14407.50431	1585.879027	15993.38334	12093.4	12093.38334	145125017.8	12046.69406	310.0867523	322.8756109	2
	3	3	4150.0	14809.045	1467.445194	16276.4902	12126.5	12126.4902	145767266.7	12073.29278	292.2045831	312.651935	3
	4	4	4225.0	15071.34118	1346.930292	16418.27147	12193.3	12193.27147	146494417.3	12103.28745	288.5981413	306.6384866	4
2	1	5	19440.0	16720.44432	1377.147577	18097.5919	-1342.4	1342.4081	117555945.7	9951.111579	6.905391459	246.6918675	4.730199367
	2	6	22815.0	18569.33271	1424.321658	19993.65437	-2821.3	2821.345631	99289953.31	8762.817254	12.3661873	207.6375875	5.049676922
	3	7	23490.0	20343.28893	1459.285115	21802.57405	-1687.4	1687.425954	85512446.6	7752.047069	7.183592822	179.0013026	5.490416884
	4	8	24570.0	22079.31664	1486.959374	23566.27602	-1003.7	1003.723984	74949323.5	6908.506683	4.085160701	157.1367848	6.015517974
3	1	9	49300.0	26139.64841	1744.296614	27883.94503	-21416.1	21416.05497	117582444.3	8520.456493	43.44027378	144.5038391	2.363980283
	2	10	55080.0	30603.55053	2016.257164	32619.80769	-22460.2	22460.19231	156270223.7	9914.430075	40.77740071	134.1311953	-0.2338007469
	3	11	58684.0	35226.22692	2276.899087	37503.12601	-21180.9	21180.87399	182848332.8	10938.65225	36.09309862	125.2186411	-2.148242271
	4	12	59160.0	39668.81341	2493.467827	42162.28123	-16997.7	16997.71877	191687842	11443.57446	28.73177614	117.178069	-3.538806346
4	1	13	46240.0	42570.05311	2534.245014	45104.29812	-1135.7	1135.701876	177041840.2	10650.66118	2.456102673	108.3533023	-3.90889308
	2	14	57800.0	46373.86831	2661.202033	49035.07034	-8764.9	8764.929655	169883422.4	10515.96607	15.16423816	101.6969406	-4.792448463
	3	15	59500.0	50081.56331	2765.85133	52847.41464	-6652.6	6652.58536	161508320.4	10258.40736	11.18081573	95.66253229	-5.561273676
	4	16	57800.0	53342.67318	2815.377183	56158.05036	-1641.9	1641.949641	151582550.3	9719.878753	2.840743323	89.86117048	-6.038322282
5	1	17	21280.0	52670.24532	2466.59668	55136.842	33856.8	33856.842	210094503.3	11139.70012	159.1017011	93.93414287	-2.229406374
	2	18	26560.0	52279.1578	2180.82826	54459.98606	27900.0	27899.98606	241667543.2	12070.82712	105.0451282	94.55141984	0.2539235783
	3	19	26400.0	51653.98746	1900.228399	53554.21586	27154.2	27154.21586	267756169.3	12864.68968	102.8568782	94.98854923	2.349009904
	4	20	21600.0	50358.79427	1580.68624	51939.48051	30339.5	30339.48051	300392564.7	13738.42922	140.4605579	97.26214966	4.40798311



Evaluate MAD

- The mean absolute deviation while using Holt's forecasting showed that there are large fluctuations of data from the mean in the second year. This is due to the changes in demand data from fluctuations of the product life cycle being implemented which suggests that the data is spread out and that the mean of this data is less relevant.

Evaluate MAPE

- The MAPE is fairly high around the 100% but as more data is fed into the algorithm the MAPE decreases which means it is slowly getting more accurate.

Evaluate MSE

- The mean square error is similar to mad due to its changing demand data causing it to fluctuate greatly. The MSE using the Holt's method reveals large numbers

which suggest large forecasting error but in comparison to the other methods the MSE in static forecasting shows that it is quite accurate.

Evaluate Bias

- The bias can be determined by the tracking signal and the tracking signal suggests that there is no significant bias as it maintains within the [6, -6] intervals which is a good rule of thumb for determining bias. However, it does deviate in some situations which mean some values could be incorrect. Overall, it is far more accurate than the other methods.

Evaluate TS

- As explained with the bias there does not seem to be significant bias based of the tracking signal which stays within the intervals and is fairly constant around the 0.

Winter's Method

Year	Quarter	Period t	Demand Dt	Level	Trend	Seasonal Factor	Forecast	Error	ABS Error	MSE	MAD	% Error	MAPE	TS
		0		11209.78	2443.7									
1	1	1	3575.0	12484.4527	2326.79727	1.821	24863.0	21288.0	21288.0	453178393.9	21288.0	595.5	595.5	1.0
	2	2	3900.0	13552.3472	2200.906993	1.755	25993.7	22093.7	22093.7	470655952.4	21690.9	566.5	581.0	2.0
	3	3	4150.0	14400.8074	2065.662313	1.862	29332.6	25182.6	25182.6	525157732.6	22854.8	606.8	589.6	3.0
	4	4	4225.0	15019.96485	1921.011828	2.111	34760.7	30535.7	30535.7	626975811.2	24775.0	722.7	622.9	4.0
2	1	5	19440.0	16412.6712	1868.18128	1.668	28249.7	8809.7	8809.7	517102748.3	21581.9	45.3	507.4	5.0
	2	6	22815.0	17871.36588	1827.232619	1.608	29400.7	6585.7	6585.7	438147487.4	19082.6	28.9	427.6	6.0
	3	7	23490.0	19106.76014	1768.048783	1.705	33578.6	10088.6	10088.6	390094916.4	17797.7	42.9	372.7	7.0
	4	8	24570.0	20061.6863	1686.736522	1.928	40247.2	15677.2	15677.2	372055040.3	17532.6	63.8	334.1	8.0
3	1	9	49300.0	22618.24298	1773.718537	1.619	35215.6	-14084.4	14084.4	352756625.2	17149.5	28.6	300.1	7.4
	2	10	55080.0	25449.65979	1879.488365	1.575	38420.1	-16659.9	16659.9	345236294	17100.5	30.2	273.1	6.4
	3	11	58684.0	28137.60757	1960.334306	1.657	45287.0	-13397.0	13397.0	330167395.7	16763.9	22.8	250.4	5.7
	4	12	59160.0	30272.73325	1977.813443	1.858	55912.9	-3247.1	3247.1	303532082.4	15637.5	5.5	230.0	5.9
4	1	13	46240.0	31785.64401	1931.323175	1.675	54028.4	7788.4	7788.4	284849521.5	15033.7	16.8	213.6	6.7
	2	14	57800.0	33882.54165	1947.880622	1.634	55094.5	-2705.5	2705.5	265025977.7	14153.1	4.7	198.7	6.9
	3	15	59500.0	35747.48737	1939.587131	1.700	60909.9	1409.9	1409.9	247490091.1	13303.6	2.4	185.6	7.5
	4	16	57800.0	37013.65906	1872.245587	1.867	70375.0	12575.0	12575.0	241905183.1	13258.0	21.8	175.3	8.4
5	1	17	21280.0	36284.50111	1612.105233	1.653	64286.9	43006.9	43006.9	336474875.5	15008.0	202.1	176.9	10.3
	2	18	26560.0	35725.25947	1394.970546	1.641	62196.5	35636.5	35636.5	388335006.8	16154.0	134.2	174.5	11.8
	3	19	26400.0	34964.44527	1179.392071	1.696	62970.7	36570.7	36570.7	438286631.7	17228.5	138.5	172.6	13.2
	4	20	21600.0	33705.42751	935.5510884	1.837	66388.1	44788.1	44788.1	516671053.7	18606.5	207.4	174.4	14.6

Evaluate MAD

- The mean absolute deviation while using Winters's forecasting showed that there are large fluctuations of data from the mean in the first year. This is probably from the initial level and trend numbers.

Evaluate MAPE

- The MAPE is fairly high around the 500 which suggest highly incorrect forecasting. It does decrease over time but it is still higher than the other forecasting methods.

Evaluate MSE

- The mean square error is similar to mad which shows values that are very large and does not seem to be following the correct trends of mean.

Evaluate bias

- The bias can be determined by the tracking signal and the tracking signal suggests that there is bias as it breaks of from [6, -6] in the tracking signal.

Evaluate TS

- As explained with the bias there does seem to be significant bias in the tracking signal as the number deviates from [6, -6].

d. Check

i. Work of each forecasting method was reviewed over by each team member from Group 22 and were double checked. All work and data displayed above is done correctly.

e. Learn and Generalize

i. When considering all the error analysis the Holt's method proved to be most accurate method for forecasting. This means that we used the Holt's method to forecast our future year.

MIT Beer Game

a. Define

i. Play the "M.I.T beer game and create a similar game for your own product

b. Plan

What information is available to solve this problem?

The information that is available to solve this problem is the handout that was uploaded to the courses website. We will need to play the game as a group in order to start creating a similar game for our product. We also have the internet as an additional resource and our project report to use as a reference.

- Read Handout
- Play the MIT beer game
- Use Internet for additional research
- Create a similar game

c. Execute

Playing the Game

The game is played in simulations of weeks played by rounds.

Every player has to carry out the following steps in the following round:

1. Receiving incoming tablet orders
2. Receiving incoming tablet deliveries
3. Updating the playsheet for the game
4. Send out the delivered tablet orders
5. Decide on the amount of tablets to be ordered

Essential Rules

- Every order has to be fulfilled in every round. Players should try to fulfill each game play by spending the least amount of money
- Inventory and backlog cost are incurred by each item in stock.
- Each tablet costs $100 per week, while the backlog cost of each
- tablet is $150.

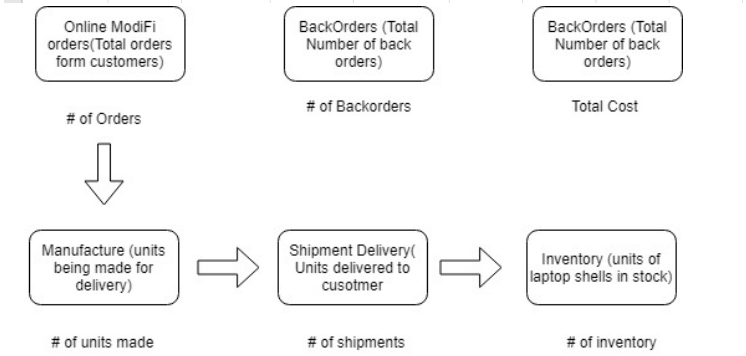
- **Players are not allowed to talk to one another. They are only able to share information regarding their order amount.**

- ***Customer Demand.***
  - The external demand is predetermined in the beginning. The game is pre-initialized with inventory levels, orders and tablet units in the shipping delay field. These numbers are generated by the customers.

i. *Beer Game Excel Sheet*

	Participant	Week	Incoming Delivery	Incoming Order	Outgoing Delivery	Backorder	Inventory	Cost	Order
2	***Antoine***	1	100	100	100	0	400	200	300
3		2	100	400	400	0	400	200	300
4		3	300	400	400	0	100	200	500
5		4	300	400	300	0	0	200	500
6		5	350	400	350	100	0	300	100
7		6	250	400	250	150	0	350	500
8		7	412	400	412	300	0	500	700
9		8	188	400	188	288	0	488	700
10		9	490	400	490	500	0	700	500
11		10	460	400	460	410	0	610	1000
12		11	554	400	544	350	0	550	100
13		12	634	400	596	196	0	396	1000
14		13	257	400	295	0	0	200	200
15		14	731	400	505	105	0	305	100
16		15	1007	400	400	0	0	200	0
17		16	810	400	400	0	38	416.5	0
18		17	331	400	400	0	0	621.5	0
19		18	326	400	400	0	226	587	0
20		19	331	400	400	0	833	550	0
21		20	0	400	400	0	0	360	0
22	***Eric***	1	100	100	100	0	400	200	100
23		2	100	400	400	0	400	200	100
24		3	100	400	200	0	100	200	100
25		4	100	400	100	200	0	400	100
26		5	100	400	100	500	0	700	0
27		6	100	400	100	800	0	1000	400
28		7	0	400	0	1100	0	1300	400
29		8	400	400	400	1500	0	1700	400
30		9	200	400	200	1500	0	1700	400
31		10	475	400	475	1700	0	1900	400
32		11	125	400	125	1625	0	1825	400
33		12	568	400	568	1900	0	2100	400
34		13	32	400	32	1732	0	1932	400
35		14	685	400	685	2100	0	2300	400
36		15	640	400	640	1815	0	2015	400
37		16	448	400	448	1575	0	1775	400
38		17	427	400	427	1527	0	1727	400
39		18	400	400	400	1500	0	1700	400
40		19	400	400	400	1500	0	1700	400
41		20	400	400	400	1500	0	1700	400
42	***Caleb***	1	100	100	100	0	400	200	100
43		2	100	400	400	0	400	200	150
44		3	100	400	200	0	110	200	200
45		4	150	400	150	200	0	400	250
46		5	200	400	200	450	0	650	250
47		6	250	400	250	650	0	850	500
48		7	250	400	250	800	0	1000	500
49		8	418	400	418	950	0	1500	1200
50		9	279	400	279	932	0	1132	200
51		10	404	400	404	1053	0	1253	300
52		11	313	400	313	1049	0	1249	300
53		12	390	400	390	1136	0	1336	400
54		13	353	400	353	1146	0	1346	1500
55		14	824	400	824	1193	0	1393	1500
56		15	691	400	691	769	0	969	1500
57		16	378	400	378	478	0	678	1500
58		17	739	400	483	500	0	700	1500
59		18	780	400	389	417	0	617	2000
60		19	800	400	739	428	0	628	1500
61		20	600	400	200	400	0	600	1500
62	***Qizhang***	1	100	100	100	0	400	200	300
63		2	100	400	400	0	400	200	300
64		3	300	400	400	0	100	200	500
65		4	300	400	300	0	0	200	500
66		5	350	400	350	100	0	300	100
67		6	250	400	250	150	0	350	500
68		7	412	400	412	300	0	500	700
69		8	188	400	188	288	0	488	700
70		9	490	400	490	500	0	700	500
71		10	460	400	460	410	0	610	1000
72		11	554	400	544	350	0	550	100
73		12	634	400	596	196	0	396	1000
74		13	257	400	295	0	0	200	200
75		14	731	400	505	105	0	305	100
76		15	1007	400	400	0	0	200	0
77		16	810	400	400	0	38	416.5	0
78		17	331	400	400	0	0	621.5	0
79		18	326	400	400	0	226	587	0
80		19	331	400	400	0	833	550	0
81		20	0	400	400	0	0	360	0

82	*yu chen*	1	100	100	100	0	400	200	100
83		2	100	400	400	0	400	200	150
84		3	100	400	200	0	110	200	200
85		4	150	400	150	200	0	400	250
86		5	200	400	200	450	0	650	250
87		6	250	400	250	650	0	850	500
88		7	250	400	250	800	0	1000	500
89		8	418	400	418	950	0	1500	1200
90		9	279	400	279	932	0	1132	200
91		10	404	400	404	1053	0	1253	300
92		11	313	400	313	1049	0	1249	300
93		12	390	400	390	1136	0	1336	400
94		13	353	400	353	1146	0	1346	1500
95		14	824	400	824	1193	0	1393	1500
96		15	691	400	691	769	0	969	1500
97		16	378	400	378	478	0	678	1500
98		17	739	400	483	500	0	700	1500
99		18	780	400	389	417	0	617	2000
100		19	800	400	739	428	0	628	1500
101		20	600	400	200	400	0	600	1500
102	*Monique*	1	100	100	100	0	400	200	100
103		2	100	400	400	0	400	200	100
104		3	100	400	200	0	100	200	100
105		4	100	400	100	200	0	400	100
106		5	100	400	100	500	0	700	0
107		6	100	400	100	800	0	1000	400
108		7	0	400	0	1100	0	1300	400
109		8	400	400	400	1500	0	1700	400
110		9	200	400	200	1500	0	1700	400
111		10	475	400	475	1700	0	1900	400
112		11	125	400	125	1625	0	1825	400
113		12	568	400	568	1900	0	2100	400
114		13	32	400	32	1732	0	1932	400
115		14	685	400	685	2100	0	2300	400
116		15	640	400	640	1815	0	2015	400
117		16	448	400	448	1575	0	1775	400
118		17	427	400	427	1527	0	1727	400
119		18	400	400	400	1500	0	1700	400
120		19	400	400	400	1500	0	1700	400
121		20	400	400	400	1500	0	1700	400
122	*Wan*	1	100	100	100	0	400	200	100
123		2	100	400	400	0	400	200	150
124		3	100	400	200	0	110	200	200
125		4	150	400	150	200	0	400	250
126		5	200	400	200	450	0	650	250
127		6	250	400	250	650	0	850	500
128		7	250	400	250	800	0	1000	500
129		8	418	400	418	950	0	1500	1200
130		9	279	400	279	932	0	1132	200
131		10	404	400	404	1053	0	1253	300
132		11	313	400	313	1049	0	1249	300
133		12	390	400	390	1136	0	1336	400
134		13	353	400	353	1146	0	1346	1500
135		14	824	400	824	1193	0	1393	1500
136		15	691	400	691	769	0	969	1500
137		16	378	400	378	478	0	678	1500
138		17	739	400	483	500	0	700	1500
139		18	780	400	389	417	0	617	2000
140		19	800	400	739	428	0	628	1500
141		20	600	400	200	400	0	600	1500



d. Check

i. Each member double checked the formulas and numbers when doing the Beer Game, and after doing so, we fixed certain numbers that were off and after that, all of our work was correctly done.

e. Learn and Generalize

Takeaways After playing the Beer Game:

i. Low inventory is advantageous, if you have too high of an inventory that will increase the total cost by a significant amount.

ii. Back orders build quickly, thus forecasting as accurately as possible will aid in lowering inventory levels and thus total cost.

iii. The amount you ship is limited so ordering the amount forecasted is not a a good idea

iv. Demand varies weekly, forecasting consistently is needed to minimize cost.

Product Platform for ModiFi

Commented [3]: Before: Fixed Subsystems - was originally bullet pointed but now was changed. 12 subsystems are counted by Subhas. What do you mean by electricity. <- Cannot build a sub system - electricity ; provide power is the sub section : need to find something that gives us power (ex: charger) Combine power supply w electiricity. Clean up and try making a sketch

a. Define:

i. Build a product platform to simulate and manage your supply chain (use expertise from other courses in programing and product design)

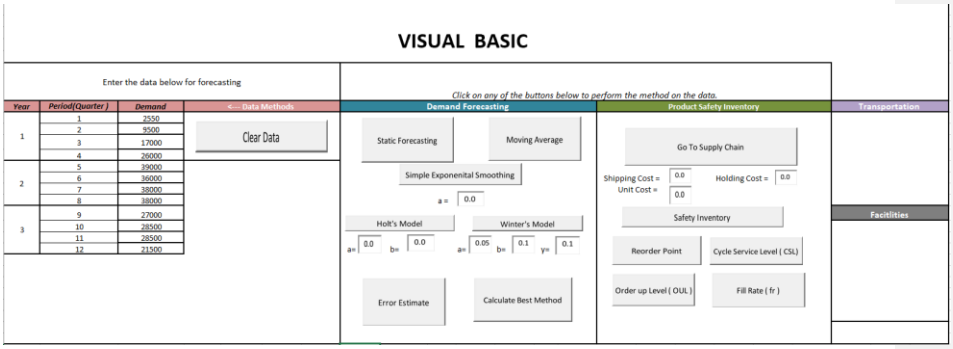
ii. Attempt a preliminary simulation of your product's supply chain by integrating the demand forecasting and cycle inventory software modules.

b. Plan

i. Build user interface based on plan

ii. Make a GUI for our modular product

c. Execute



d. Check:

i. Looking back on our work done, we double checked our calculations/work and changed whatever what was necessary. After doing so, we can say that our work is all done correctly

e. Learn and Generalize

i. In order for customers to buy our modular products, they will need to know what they need and having this system constantly update and tell users what needs to be upgraded will allow them to be informed.

Cycle and Safety Inventory

a. Define

i. Develop and implement the necessary processes (qualitative and quantitative) for cycle inventory management for your product**.**

ii. In addition to cycle and safety inventory, two important elements of our projects will be designing/implementation the transportation network and facilities. Be sure to proactively plan for these elements.

b. Plan

Calculate the cycle inventory for our product

- Equations necessary for answering the following questions
- Calculate the cycle inventory

Calculate the safety inventory for our product

- Equations necessary for answering the questions
- Calculate the safety inventory

Design and implement the Transportation Network

- What is the function of a network
- What mode of transportation

Design Transportation Network Options

- Which transportation mode should be used
- Should orders be aggregated spatially

c. Execute

Calculate the Cycle inventory of our product

1. **Given:** Data is taken from Demand chart (found on page
   - **a.** Annual Demand (D) = 50,000
   - **b.** Average Unit Price for the 1st year (C) = 1,500
   - **c.** Holding Cost (hC) = 10% = 150
   - **d.** Cost per Order (S) = 500
2. *Equations necessary for answering the questions*
   - **a.** Annual Ordering Cost = $(\frac{D}{Q}) * S$
   - **b.** Annual Holding Cost = $(\frac{Q}{2}) * hC$
   - **c.** Optimized lot size = Q* = $\sqrt{\frac{2DS}{hC}}$
   - **d.** Number of annual orders = $\frac{D}{Q}$
   - **e.** Total annual Cost = $Order\ Cost + Holding\ Cost$
3. Calculate the cycle inventory
   - **a.** Find Economic Order Quantity(optimal lot size) Q_L*: $\sqrt{\frac{2DS}{hC}} = \sqrt{\frac{2*50000*500}{0.1*1500}} = \mathbf{578}$

Commented [4]: What are we applying these numbers to? (reference Harley Davidson Problem in notes and homework)

Commented [5]: Net work needs to be fixed

- From these calculations, we can assume that our optimal lot size (the number of items we can carry) is **578 units.**

b. Find number of shipments/year: $\frac{Shipments}{Year\ (n)} = \frac{Annual\ Demand}{Units\ per\ Shipment} = \frac{D}{Q_{L^*}} = \frac{50000}{578} = 86.5 \approx$ **87 shipments/per year**

- We can assume that on average, ModiFi will request that there will be around shipments of their products per year.

c. Cycle Inventory: $(\frac{Q^*}{2})$ (578/2) = **289 units**

- ModiFi should have a cycle inventory of

d. Cycle Inventory Holding Cost: $(Cycle\ Inventory) * hC$ = 289 *150 = $**43,350**

- The cost of holding our cycle inventory is **$43,450.**

e. Find replenishment cycle time: $T = \frac{365}{n}$ = 1.26 days ≈ **1 day**

- For every day, there is a replenishment cycle time of **1 day**

f. Average flow time: $F = (\frac{Q^*}{2D}) = (\frac{578}{2*50000}) = 0.0057 year = 0.07$ month ≈ **1 month**

- Average flow time for our products is roughly around one month.

d. Check

i. We followed the questions from lecture and notes, and used past homework as reference. After double checking everything by calculating by hand, we can say that our work shown is done correctly.

e. Learn and Generalize

i. When conducting the cycle and safety inventory we learn that our company must have 87 shipments annually and has a cycle inventory of 289 units. Our replenishment cycle time is 1 day and an average flow time of 1 month.

Safety (Information) Framework

a. Define

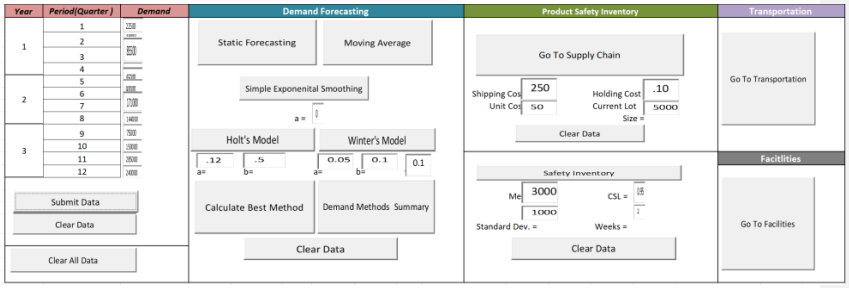
i. Work on implementing the software (information) framework for your project using Excel and Visual Basic.
   1. *For example, develop the demand forecasting module, and the product cycle inventory module.*

b. Plan

i. Google how visual basics is conducted on Excel
ii. Develop the demand forecasting module, and the product cycle inventory module.
iii. Implement software (information) framework for our project

c. Execute

i. Here is our Visual Basic using Excel



When testing out this visual basic, we can see that it is accurate and we shall be using this in future problems of our project.

d. Check

i. Looking back at our work, we can surmise that our work is done correctly. We have double checked our work with our references.

e. Learn and Generalize

i. Setting up visual basics takes a while especially when conducting it on Mac, but even though it takes a while, in the long run, it is quite helpful and gives us accurate information without needing to do multiple calculations

Preliminary Simulation of Product's Supply Chain

a. Define

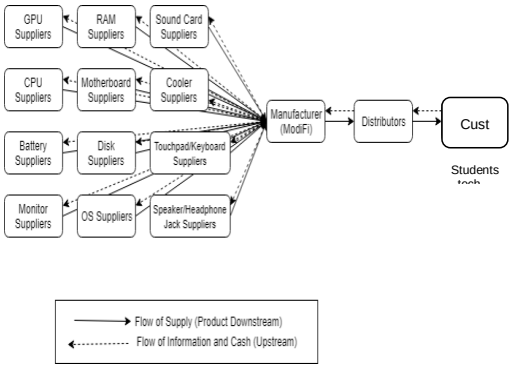
i. Attempt a preliminary simulation of your product's supply chain by integrating the demand forecasting and cycle inventory software modules.

b. Plan

i. Information of the supply chain is provided through the existing graph in the previous section (*page 1 section 1,2*). Additional information will be further explained below and can be referenced to previous online references.

c. Execute

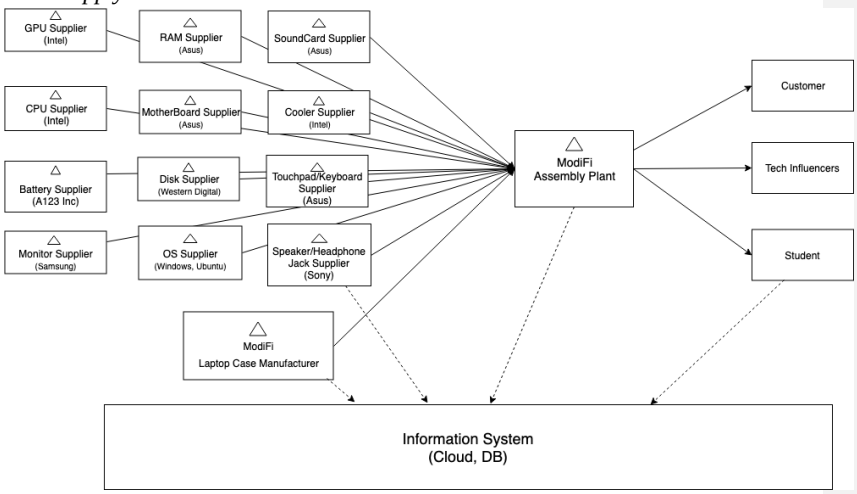
i. *Preliminary Supply Chain*



Preliminary Model:

- This preliminary supply chain model ***includes distributors,*** which are ***not included in the revised high-end supply chain below***. This is because the team later determined that a ***direct-to-consumer model*** (similar to DELL's supply chain model) would be most efficient and allow us to cut out some transportation and holding costs.
- In the diagram, the 12 sub-systems (computer components) involved in the laptop manufacturing process are each represented by a supplier. Supply (product) flows downstream, from the suppliers -> manufacturer (ModiFi) -> distributors -> customer. As this is a ***preliminary model***, the details of each step are not included.

ii. High-End Supply Chain



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Our Simulation:

- Our target consumers begin with the ***students in the education sector*** and will eventually expand towards other consumers in other sectors (businesses,

employees, etc). The preliminary simulation will be determined by the following two graphs and will display the specifics of the ModiFi supply chain product.

- We are going to have suppliers give us the necessary components to building our laptop and producing the replacement parts that are needed when upgrading our laptops. Looking at our supply chain network above, our software units (microprocessors, CPU, GPU, etc.) will be supplied by Intel. Our hardware units (keyboard, monitor, sound system, etc.) will be supplied by companies such as Sony, Asus, and Samsung. Once all products shipped into our warehouse, our assembly plant will manufacture the laptop and distribute directly to our customers (students, tech influencers, etc.)

d. Check

i. Looking back on our work done above, we can say that all of our work is done correctly.

e. Learn and Generalize

i. We have generalized the preliminary simulation of the product's supply chain in order to narrow down the specifics of the supply chain. As shown in the graphs, the first graph displays an abstract diagram of the supply chain, while the other represents a more detailed explanation of our high end supply chain.

Benchmarking: ModiFi vs. Plantronics

a. Define

i. Benchmark your SCM approach and implementation against Plantronics.

b. Plan

i. Information on plantronics supply chain management is accessible through the presentation posted on the class website. Further information on benchmarking and Plantronics can be found online.

1. Identify key factors on Plantronics Supply chain
2. Identify important key factors in ModiFi supply chain management
3. Compare and Contrast both
4. Evaluate how to improve ModiFi supply chair

c. Execute

Plantronics supply chain management approach is at a global scale and at a larger volume. Plantronics inventory is managed from different facilities around the world. They also depend on their IT department. We will use the fundamental approaches Plantronics used to improve ModiFi's supply chain management.

By comparing certain segments in the supply chain management of Plantronics and ModiFi, we are able to evaluate what to prioritize and what to focus on implementing into our company.

Plantronics **ModiFi**

- 6 Distribution warehouses - Low accuracy forecasting - Responsible for ¾ th's of their manufacturing. - Responsiveness/Efficiency is highly responsive	- 4 facilities within Americas - Forecast demand has a low percentage of error. - Demand uncertainty is high - Responsiveness/Efficiency is somewhat and highly responsive

We are designing our supply chain management to be allocated through three warehouse within North America. Our facilities will be kept low in order to budget the company's money better and be kept smooth production flow of tables. Our forecast demand has been strategized based off multiple analysis, and we believe we need to improve on the reliability of our demand forecast.

Furthermore, Plantronics focuses on certain issues that will improve their supply chain flow, but also set up expectations on what they should hold up a bit of expectations. Plantronics highlights the effective optimization, working with clost involvement with suppliers and customers, and effective implementation of Information Technology. We will use these tactics in order to improve our supply chain management of ModiFi and focus on wasting the least amount of inventory.

d. Check

i. We were able to evaluate work by looking back through plantronics slideshow and through our supply chain report.

e. Learn and Generalize

i. We have learned that even though Plantronics is a top company, they still do not have a perfect supply chain management. However, they have been in the market long enough to know how to prioritize resources. That is why it is important for our company to benchmark Plantronics strategies in order to avoid making mistakes and producing an efficient supply chain. By benchmarking our company's supply chain management approach and implementations against plantronics we can reevaluate our strategy and enhance our approach. Since Plantronics has a good supply chain management we can compare certain aspects of their supply chain tactics and integrate improvements towards our strategies.

Cycle, Safety Inventory, transportation network, and facilities of SC Network

- **Context:** *ModiFi is expected to have an annual demand of 217,242 and a weekly demand of* 4,163 units with a standard deviation of 200 units. ModiFi *will also price its product 1,500 dollars per unit for its first year and an expected holding cost form its warehouses of 10%. The Cost per order form its suppliers is $500 per order. ModiFi supplier lead*

time is projected for 2 weeks with a goal of ascertaining a Customer Service level of 90%.

a. Execute

i. Develop and implement the necessary processes (qualitative and quantitative) for cycle inventory management for your product**.**

ii. In addition to cycle and safety inventory, two important elements of our projects will be designing/implementation the transportation network and Facilities. Be sure to proactively plan for these elements.

b. Plan

Calculate the cycle inventory for our product

- Equations necessary for answering the following questions
- Calculate the cycle inventory

Calculate the safety inventory for our product

- Equations necessary for answering the questions
- Calculate the safety inventory

Design and implement the Transportation Network

- What is the function of a network
- What mode of transportation

Design Transportation Network Options

- Which transportation mode should be used
- Should orders be aggregated spatially

c. Execute

Calculate the Cycle inventory of our product

1. *<u>Given:</u> Data is taken from Demand chart (found on page*

a. Annual Demand (D) = 217242

After conducting the error analysis on our forecasting methods, we have found that The Holt's method is the most accurate forecasting model to our demand data. We used this method to forecast this following year and summed the numbers per quarter to form our annual demand.

b. Average Unit Price for the 1st year (C) = $1,500

C stands for the unit price we sold to customers. Since the price of our product is quite flexible, so we will use $1500 as the number for C

c. Holding Cost (hC) = 10% = $150

Holding cost stands for the cycle inventory holding cost coefficient, we use 0.1 as our holding cost variable. The holding cost will not be very high for ModiFi because we do not need very rigor inventory.

d. Cost per Order (S) = $500

S stands for cost incurred per order. Since our product is new product that introduces disruptive technology, we decided that we would spend more money

on advertising to inform people of what our product is and what makes us stand out from other laptop companies.

2. *Equations necessary for answering the questions*
   - **a.** Annual Ordering Cost = $(\frac{D}{Q}) * S$
   - **b.** Annual Holding Cost = $(\frac{Q}{2}) * hC$
   - **c.** Optimized lot size = Q* = $\sqrt{\frac{2DS}{hC}}$
   - **d.** Number of annual orders = $\frac{D}{Q}$
   - **e.** Total annual Cost = $Order\ Cost + Holding\ Cost$
3. Calculate the cycle inventory
   - **a.** Find Economic Order Quantity(optimal lot size) Q_L*: $\sqrt{\frac{2DS}{hC}} = \sqrt{\frac{2*217242*500}{0.1*1500}}$= **1203.45 ≈1203**
     - ModiFi has calculated ***1203 units*** should be their optimal lot size which is the ideal quantity we should purchase for our inventory.
   - **b.** Find number of shipments/year: $\frac{Shipments}{Year\ (n)} = \frac{Annual\ Demand}{Units\ per\ Shipment} = \frac{D}{Q_L*} = \frac{217242}{1203} = 180.58$ ≈**181 shipments/per year**
     - ModiFi has calculated ***181 shipments*** from their suppliers each year. This value could change as we are a responsive supply chain and may need more shipments or less depending on the demand.
   - **c.** Cycle Inventory: $(\frac{Q^*}{2})$ (1203/2) = **602 units**
     - ModiFi calculated a cycle inventory of ***602 units*** which is the portion of inventory that the we will cycle through before replenishing our inventory. As explained before our information system will implement a feature that notifies our suppliers if our inventory reaches the safety inventory level they will immediately ship supplies.
   - **d.** Cycle Inventory Holding Cost: $(Cycle\ Inventory) * hC$ = 602 *150 = **$90,030**
     - The cycle inventory cost has been calculated as ***$90,030*** which is fairly high and may need adjustments as we are currently not making a large profit as a start-up.
   - **e.** Find replenishment cycle time: $T = \frac{365}{181}$ = 2.0165 days ≈ **2 days**
     - The replenishment cycle is every ***2 days*** as we have a very responsive supply chain which means tight connection with our suppliers. This method is efficient as we are build to order and have to be scalable depending on the demand.
   - **f.** Average flow time: $F = (\frac{Q^*}{2D}) = (\frac{1203}{2*217242}) = 0.00276880161year =$ *0.0332256193* month ≈ **1 day**

- The average flow time calculated is ***1 day*** which is very low and meets our responsiveness as a supply chain. This means that the business process from beginning to end should only be a day.

Conclusion:

- From the calculations above, we will order a **lot size of 1203** units and order **181 shipments per year.** The cycle inventory will be **602 units**, with a total **cycle inventory holding cost of $90,030.**

4. Calculate the safety inventory of our product

Given: Data is taken from Demand chart (found on page

a. *Expected Weekly Demand (D_w)* = Annual Demand / (# of weeks in a year)
   - **≈ 4163 units**

b. *Standard Deviation of Weekly Demand (σ_D)* = **200**
   - Our Standard Deviation of weekly demand is lower because we are following a method of build to order, we have a better grasp of the demand data in comparison to retailers having demand data.

c. *Supplier Lead Time (L)* = **2 weeks**
   - ***Source:*** Lead time is the gap between the time an order is placed and when it is received. Since we are getting supplies from multiple different suppliers from different companies, we decided that 2 weeks is a sufficient time for us to receive all the needed supplies.

d. *Cycle Service Level (CSL)* = 90% = **0.90**
   - ***Source:*** CSL is the expected chances of not hitting a stock-out before next replenishment cycle. Since we have a smaller SD of weekly demand and we have our own demand data, there is less uncertainty in the demand data. This is able to get us a higher CSL.

Equations necessary for answering the questions

- *Expected demand during lead time:* $D_L = L * D$
- *Standard deviation of demand during lead time:* $\sigma_L = \sqrt{L} * \sigma_D$
- *Safety inventory:* $ss = F^{-1}(CSL) * \sigma_L$
- *Reorder Point:* $ROP = ss + D_L$

e. *Expected Shortage per replenishment cycle:* $ESC = -ss[1 - F_s(\frac{ss}{\sigma_L})] + \sigma_L fs(\frac{ss}{\sigma_L})$

f. *Fill Rate* = $\frac{Q_L - ESC}{Q_L} = 1 - \frac{ESC}{Q_L}$

5. *Calculate the Safety Inventory*

g. Find the Expected demand during lead time: $D_L = L * D$ =2*4178 = **8326 units**
   - The expected demand during lead time which is the demand when the customer places the order to the moment it is out for delivery.

h. Find the Standard deviation of demand during lead time: $\sigma_L = \sqrt{L} * \sigma_D = \sqrt{2} * 200$ = **283 (282.84) units**

- The standard deviation of demand during lead time is ***283*** which is large demand fluctuation but is understandable because of our large fluctuations in forecasting. The supply chain model we plan to implement though will be scalable to demand which will negate this.

i. Find the Safety inventory(Safety Stock): $ss = F^{-1}(CSL) * \sigma_L = \boldsymbol{1.28 * 283} = \boldsymbol{724.1} \approx$**<u>362 units</u>**

- Our safety inventory is ***362 units*** which is greater than the standard deviation of demand during lead time which is good so that we can accommodate the fluctuations in demand.

j. Find the Reorder Point: $ROP = ss + D_L = \boldsymbol{362 + 8326}$ =**<u>8688 units</u>**

- The ROP is relatively high which means there is an error somewhere which is most likely from the fluctuating forecast.

k. Find the Expected Shortage per replenishment cycle: $ESC = -ss[1 - F_s(\frac{ss}{\sigma_L})] + \sigma_L fs(\frac{ss}{\sigma_L})$ =-72.5+99 = 26.5 = **27**

- The expected shortage per replenishment cycle is ***27***

l. Find the Fill Rate = $\frac{Q_L - ESC}{Q_L} = 1 - \frac{ESC}{Q_L} = 1 - \frac{27}{578} = 0.988$= **98.8%**

- Our fill rate is 0.988 which means that ***98.8%*** ModiFi's customers can purchase our product.

Conclusion:

The final safety inventory (safety stock) for our product will be **362 units**, with a reorder point (ROP) of **8718 units**.

d. Check

i. Looking at all of our calculations, we can say that all of the work is done correctly

e. Learn and Generalize

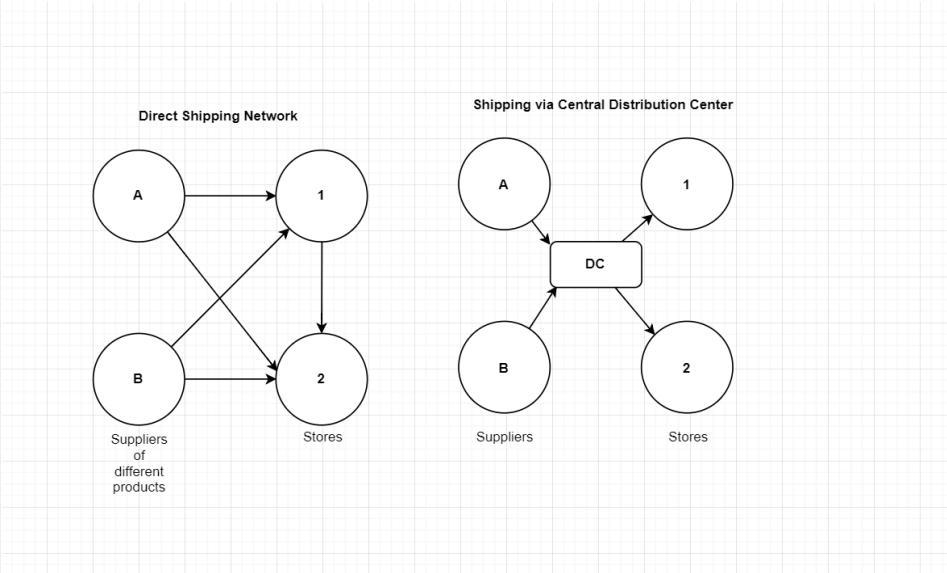
i. From doing this problem we learned how much cycle inventory and safety inventory our company has for our product.

3. Design/ Implement the Transportation network

1) General Considerations in Transportation network design
   a. Function of transportation Network
      - ModiFi needs to create a responsive transportation system that will aid in store replenishment so that the products available match existing customer needs.
   b. Decision making
      - The carrier(UPS,USPS) is the party that designs the transportation network an is the party that requires movement of the product.
   c. Modes of Transportation

- Trucks will be used as the mode of Transportation

2) Transportation network options



3) Process for Transportation Network Design

- Which mode of transportation should be used?

Table of Transport Mode Options:

Mode	Lot size	Transport Cost	Cycle Inv	Safety Inv	In-Transit Inv	Inventory cost	Total cost
TL	7000	$1,750,000	3,250	11,986	17,979	996,473	$31,644,190
LTL	15,000	$1,421,875	7,500	17,979	29,966	$1,663,356	$51,322,555

To find the inventory cost and cycle inventory, safety inv and in transit inventory are added and multiplied by the holding cost.

The LTL mode of transport has the lowest total cost out of all of the other options, so we will pick that option.

Options	Scenario 1 TL	Senario 2 LTL
# of stocking locations	2	2
Replenishment interval	4 weeks	2 weeks
Cycle inv cost Safety inv cost	Cycle inv cost = 3,200 Inv cost= 11,986	Cycle inv cost =7,500 Inv cost = 17,979
Annual inv holding cost	$29,894,190	$49,900,680
Shipment weight	Replenishment 23,660lbs	Replenishment 23,669lb
Annual trans cost	$1,421,875	$1,7,50,000
Annual total cost	$31,322,55	$51,322,555

Direct mode of transportation has the lowest total cost out of all the other options, so we will pick the Direct mode of transportation.

4) **Design/Implement the facilities**

a) Plot cost and demand data

Inputs- Cost, Capacities, Demands									
	Demand Region Production and Transportation Cost 1M units								
Supply Region	Norcal	Socal	Cental us	South us	Northeast Us	**Fixed Cost**	**Low Capacity**	**Fixed Cost**	**High Capacity**
norCal	80	100	80	120	110	6500	15	9000	20
Socal	117	77	108	98	100	4500	10	6750	20
Central us	102	105	95	119	111	6500	10	9750	20
south us	115	125	90	59	74	4100	10	6150	20
north us	142	100	103	105	71	4000	10	6000	20
Demand	12	8	14	16	7				

This is the initial data. The costs are in 1 million per unit The low capacity plant will be represented with y and the high capacity with z.

b) Input decision variables

Supply Regio	Norcal	Socal	Cental us	South us	Northeast Us	Plants (1= open)	Plants (1= open)
norCal	0	0	0	0	0	0	0
Socal	0	0	0	0	0	0	0
Central us	0	0	0	0	0	0	0
south us	0	0	0	0	0	0	0
north us	0	0	0	0	0	0	0

Here is where we set the decision variables. The data will be empty until we solve and optimize the best plant configuration. If either the low capacity or high capacity equals one, a plant will be built. It is important to note that both y and z cannot = 1. Either one

of none of them must equal 0. This would convey that both plants should be built in one location which is wrong in the equation form (Y,Z)=/=(1,1)

c) Insert Constraint and objective function

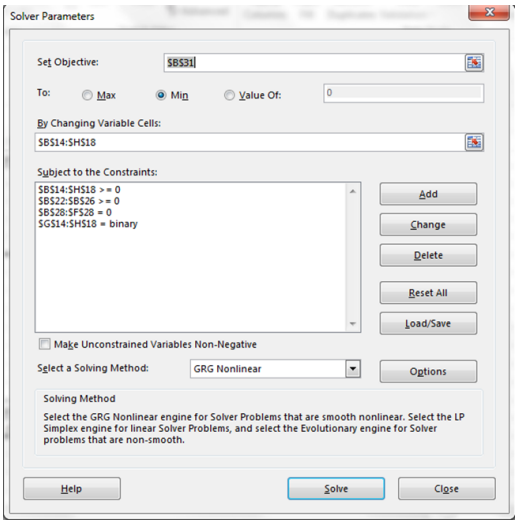
Function to minimize cost becomes:
$C=\Sigma ni=1(fi)Lyi+\Sigma ni=1(fi)Hzi+\Sigma ni=1\Sigma m_j=1X_{ij}C_{ij}$
Fi is the fixed annual cost of the operating plant
With an L sub denoting low capacity and H sub denoting a high capacity plant

If a plant is "On(Y_i or Z_i=1)" the cost will be added to the function, if it is off, it will zero out.

X_{ij} is the amount of items shipped from supply region i to demand region j

C_{ij} is the total cost of items being shipped from supply region i to demand region j

Use solver to get regional configuration



Above are the parameters inputted into solver to solve for regional configuration.
B14:H18>0 ensures all decision variables are non negative

T B22:B26 >0, or $K_iy_i-\Sigma^m_{j=1}x_{ij}\geq 0$

B28:F28=0, or $D_j-\Sigma^n_{i=1}x_{ij}=0$

G14:H18 is so that the location variables y_i can only equal a one or zero

d) Get optimal regional network configuration

Descion var							
Supply Region	Norcal	Socal	Cental us	South us	Northeast Us	Plants (1= open)	Plants (1= open)
norCal	0	0	0	0	0	0	0
Socal	2	8	0	0	0	1	0
Central us	0	0	0	0	0	1	0
south us	0	0	4	16	0	0	0
northeast us	0	0	10	3	7	1	0
Constraints	Excess Capacity						
Supply Region	0						
norCal	5						
Socal	0						
Central us	0						
south us	0						
northeast us	5						
	Norcal	Socal	Cental us	South us	Northeast Us		
Unmet Demand	4.00E-07	3.00E-14	0.00E+00	-4.00E-08	-7.00E-08		
Objective Function							
Cost (M)=	$20,192						

Check

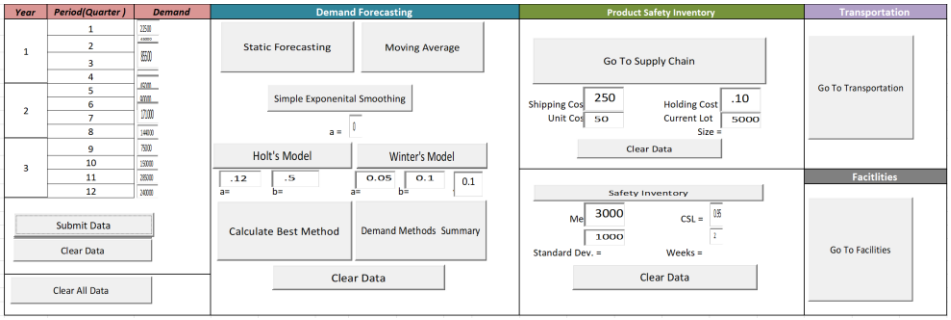
We Followed the equations from lecture and notes, and used past homework as reference, we Believe that our work in correct.

Learn and Generalize:

From the data listed above it is best to build a low capacity facility in Socal, Central Us, or south US. Overall fixed costs outside california are lower.

Software Platform Development (Visual Basic):

a. **Define:**
   i. Finalize the software framework and simulate the supply chain in various scenarios using the software
b. **Plan:**
   i. Finalize the GUI and software
   ii. Scenario 1:1.25 times the demand than expected, regards to inventory, and transportation
      - For inventory
      - For transportation
c. **Execute:**
   i. ***GUI of Visual Basic Platform:***



- When data is filled out for the three years provided in quarters and then inputting the necessary parameters the values given will calculate the product inventory as soon below.

Product Safety Inventory

Year 4	
Quarter 1	151651
Quarter 2	231855
Quarter 3	381334
Quarter 4	291855

Variables	
Annual Demand (D)	1056695
Shipping Cost Per Lot (S)	500
Unit Cost©	20
Holding Cost Per Year (h)	30
Current Lot Size (Q)	1000

INDEPENDENT ORDERING

LOT SIZING		OPTIMAL LOT SIZING (EOQ)	
Annual Holding Cost	300,000.00	Optimal Lot Size (Q*)	1,327.09
Annual Material Cost	21,133,893.46	Optimal Ordering Frequency	796.25
Annual Order Cost	528,347.34	Cycle Inventory	663.54
Number of orders per year	1,056.69	Number of orders per year	1,056.69
Total Annual Cost	21,962,240.79	Annual Ordering and Holding Cost	796252
		Average Flow Time	0.00063

- In addition to the product safety inventory The SS, OUL, and ESC will be calculated.

General

Variables	
R(L)	6000
o(L)	1414.2136
CSL	0.95
Weeks	2
Mean	3000
Standard Dev.	1000
Solution	
Reorder Point (ROP)	8326
Safety Inventory (ss)	2326

Order Up Level (OUL)

Variables	
R(L)	30000
o(L)	3162.27766
CSL	0.95
Weeks	8
Mean	3000
Standard Dev.	1000
Solution	
Order Up Lvl (OUL)	35201
Safety Inventory (ss)	5201

Cycle Service and Fill Rate

Variables	
R(L)	6000
o(L)	1414.213562
CSL	6.71664E-05
Lotsize of Supplier	1000
fill rate	-4.400022264
Solution	
Safety Inventory (ss)	-5400
Reorder Point (ROP)	600
Expected Shortage	5400

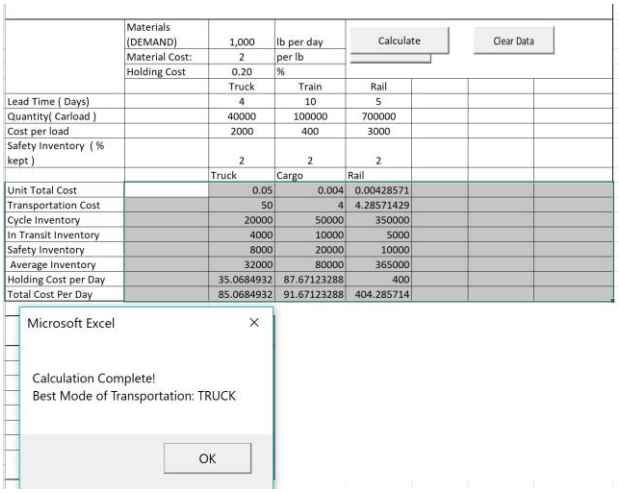
Expected Shortage Cost (ESC)

Variables	
R(L)	6000
o(L)	1414.213562
CSL	0.95
Standard Dev.	1000
Lotsize of Supplier	500
fill rate	0.99
Solution	
Safety Inventory (ss)	2326
Reorder Point (ROP)	8326
Expected Shortage	30

Aggregation

Variables	
R(L)	0
o(L)	1414.213562
CSL	0.95
Lotsize of Supplier	1000
fill rate	0.970452894
Solution	
Safety Inventory (ss)	2326
Reorder Point (ROP)	600
Expected Shortage	30

- In regards to transportation button that was shown in the GUI interface. Once clicked it will take you to the transportation Gui shown below. Once given input is provided and calculated putton is shown



	Materials (DEMAND)	1,000	lb per day	Calculate	Clear Data
	Material Cost:	2	per lb		
	Holding Cost	0.20	%		
		Truck	Train	Rail	
Lead Time (Days)		4	10	5	
Quantity(Carload)		40000	100000	700000	
Cost per load		2000	400	3000	
Safety Inventory (% kept)		2	2	2	
		Truck	Cargo	Rail	
Unit Total Cost		0.05	0.004	0.00428571	
Transportation Cost		50	4	4.28571429	
Cycle Inventory		20000	50000	350000	
In Transit Inventory		4000	10000	5000	
Safety Inventory		8000	20000	10000	
Average Inventory		32000	80000	365000	
Holding Cost per Day		35.0684932	87.67123288	400	
Total Cost Per Day		85.0684932	91.67123288	404.285714	

d. Check your work:

i. The work is shown above. We believe it is accurate and I only changed parameters in the automation.

e. Learn and Generalize:

i. Over the course of multiple weeks we learned how to adapt to hypothetical situations in the supply chain. All of these situations are possible so it is good to see what could change with unforeseen changes and how to adapt to maximize profit

Explanation:

- This is the ***GUI (Graphic User Interface)*** for our Visual Basic implementation of the software platform for our supply chain. The spreadsheet will take in demand data and ***calculate demand forecasts*** for the subsequent years (this is accomplished by inputting that data into spreadsheets containing the forecasting methods). The ***cycle inventory*** is calculated in a similar way, as all of the spreadsheets are connected.

Detailed Implementations of Each Driver

a. Define:

i. Using the detailed strategies of each chain driver, align and integrate your high-level strategies with implementations for each driver.

b. Plan:

i. Align and integrate high level SC strategy for Facilities

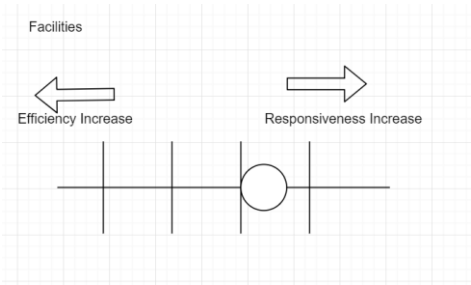
ii. Align and integrate high level SC strategy for Transportation

iii. Align and integrate high level SC strategy for Inventory

iv. Align and integrate high level SC strategy for Information

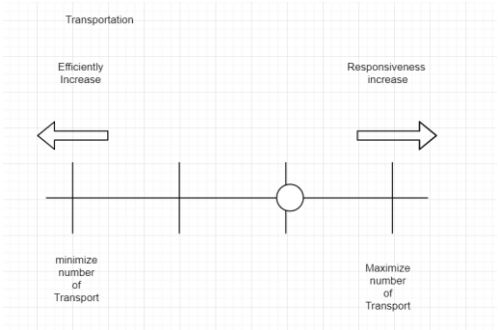
c. Execute:

i. **Facilities**



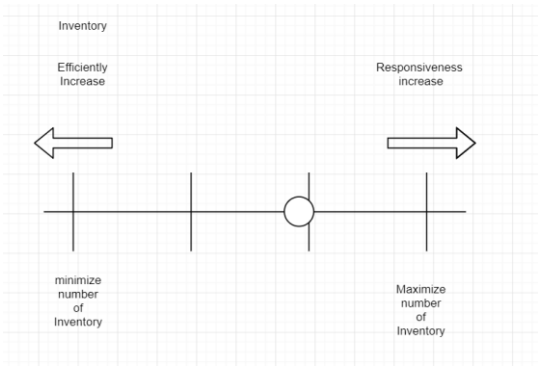
- There should be **more facilities to maximize responsiveness**. Five facilities will be sufficient. There manufacturing plants for the laptop shell & hardware/software. For our facilities, we know that we want to be more responsive, so we expand the number of facilities.
- Currently, we are **focusing our product in California**, so we decided to ensure that our facilities are closely located to California to ensure shipping and transportation costs will be low. We will place two facilities in California. The first facility will be located outside of **Redding, CA** to be able to capture northern California market. The second facility will located near **Bakersfield, CA** to capture southern California market. We believe that these two facilities will be a good amount to have in order to keep costs low and be Responsive as possible.

i. **Transportation**



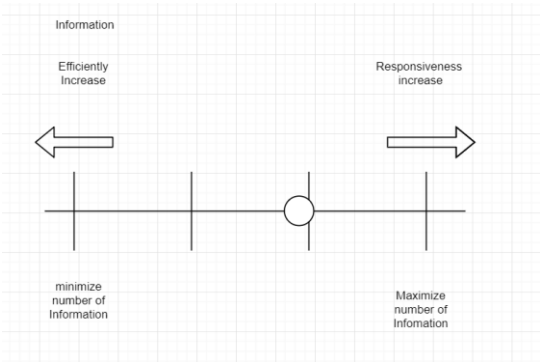
- **Transportation will be done by land.** Because all facilities are based in California and Nevada we are aiming to distribute in this area, no other form of transportation will be needed.
- We are aiming for **somewhat more responsive modes of transports** - they will take a shorter route, not necessarily the most cost-effective one. Transportation will be done **solely on truck**. It can be done Via UPS. or USPS or FedEx. We will be working with these companies to deliver our products for us. We will have a driver deliver our product directly to the customer.

i. **Information**



- Our **inventory driver will be more on the responsive side**. This is due to the possibility of losing customers when demand cannot be satisfied We must be able to meet customer inventory demand.
- We want to be more on the responsiveness side so we will have **higher inventory.** As we are trying to hit as many customers as possible in California, we need to make sure we have enough inventory to suffice for the demand that will be coming.

i. **Inventory**



- Our information driver will be more on the **somewhat responsive** side. The good information will help improve the utilization of the chain. It will improve our product availability while decreasing inventories.
- Information is crucial in order to make sure that all aspects of our supply chain are in accordance with one another. The information shared across our supply chain management will be shared via an enterprise resource planning system for ModiFi that will allow us to keep track of flow of inventory within facilities expected shipments to be sent out and received, pricing information and other logistics that will enhance ModiFi's

supply chain. Even though it will be a minor cost, this will help reduce errors that the company would make without a communication system.

d. Check:

i. Looking back at our work, we can say everything is done correctly.

e. Learn and Generalize:

i. From doing this problem, we learned more about our company's SC strategy and what certain parts to focus on in order for our company to perform at its best. +

SC Management Guidelines & User Manual

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a. Define:

i. Develop proper SC management guidelines for firms products

ii. Develop a user's manual for software module

b. Plan:

i. Provide an explanation of our company's inventory management by explaining the following
   - What does ModiFi's supply chain look like?
   - What will be the inventory that we are going to deal with?
   - What stages are these inventories at?
   - Will it involve more stages?

ii. Provide an explanation of ModiFi's transportation management by explaining the following
   - What are we using for our route of transportation?
   - How did we come along to do this transportation?
   - What does our transportation network look like?

iii. Create a software Users Manual

c. Execute:

USER MANUAL FOR SCM SOFTWARE

i. ***What does this software do?***

- This software solution is built in excel and allows one to simulate a supply chain based on the key elements: Visual Basic GUI, Static Forecasting, Demand Regression Static Regression, Static regression, Moving average, simple smoothing, holt's model, Hots Regression, Winters Model, Error Estimate, and product.

ii. ***What do you need?***

- The users are required to run this software on a windows platform computer running the latest version of Microsoft office or excel with the microsoft solver tool enabled.

iii. ***Recommendations***

- Run this software on windows based machine.

iv. ***How to run the Software***

- To run the software, open the workbook file located on the software cd drive.

v. ***How to use the Software Modules***

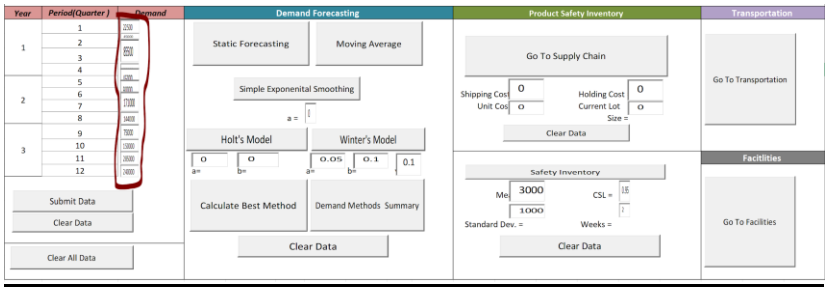
- The software consists of 4 modules. The interactions panel. The first worksheet "Visual Basic GUI" is the most important module as it acts the main interface. You will enter the demand data, then click the forecasting method you want.

Visual Basic GUI

- This module takes user input in the form of demand values imported into excel and allows for forecasting methods to be employed on the data.

  5 Methods:

  - Static
  - Moving average
  - Exponential smoothing
  - Holt's
  - Winters



- When you open the SCM modele, you will view 5 different areas. The first area is for the user to insert the demand throughout the periods. The second area is the Demand Forecasting area, this is where the user can click through the different forecasting methods. The green is product safety inventory that allows the user to go to the supply chain. The last two areas are for transportation and facilities.

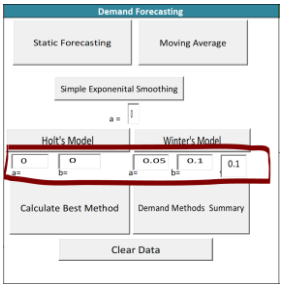
Step 1: Begin the software by submitting data

- In the red boxed area above, insert the demand data
- Select submit data
- The user may also clear data or all data

Demand Forecasting Module

Step 2: Simulate alpha, beta, and theta values

- These inputs can be viewed on the blue forecasting module panel and are used in the forecasting models for variation calculation to better match forecast data with historical data.



- The user can then choose their demand forecasting method:

Static forecasting

This is the spreadsheet that the Visual Basic software links to in order to predict the Static demand forecast:

Static Forecasting

Year	Period	Demand	Deasonalized Demand	Regressed Deseasonlized	Seasonal Factor	Average Seasonal Factor	Deseasonlized Demand Forecasting	Error	Absolute Error	MAD	%Error	TS
1	1	22500		20750	1.08	0.70	14560	-7940	7940.115	7940.115	35	-1
	2	45000		37031	1.22	1.00	36943	-8057	8056.555	7998.335	18	-2
	3	85500	59063	53313	1.60	1.53	81749	-3751	3751.401	6582.69	4	-3
	4	72000	67500	69594	1.03	1.10	76655	4655	4655.368	6100.86	6	-2.473865
2	5	45000	83813	85875	0.52	0.70	60257	15257	15256.87	7932.062	34	0.020697
	6	90000	103500	102156	0.88	1.00	101914	11914	11914.03	8595.723	13	1.40514
	7	171000	116250	118438	1.44	1.53	181610	10610	10610.31	8883.521	6	2.553999
	8	144000	127500	134719	1.07	1.10	148389	4389	4388.546	8321.649	3	3.253808
3	9	75000	149250	151000	0.50	0.70	105954	30954	30953.86	10836.34	41	5.355214
	10	150000	175500	167281	0.90	1.00	166885	16885	16884.61	11441.17	11	6.547892
	11	285000		183563	1.55	1.53	281472	-3528	3527.977	10721.79	1	6.658177
	12	240000		199844	1.20	1.10	220122	-19878	19878.28	11484.83	8	4.484984
4	13			216125		0.70	151651					
	14			232406		1.00	231855					
	15			248688		1.53	381334					
	16			264969		1.10	291855					

Moving Average

This is the spreadsheet the the Visual Basic software links to in order to predict the Moving Average demand forecast:

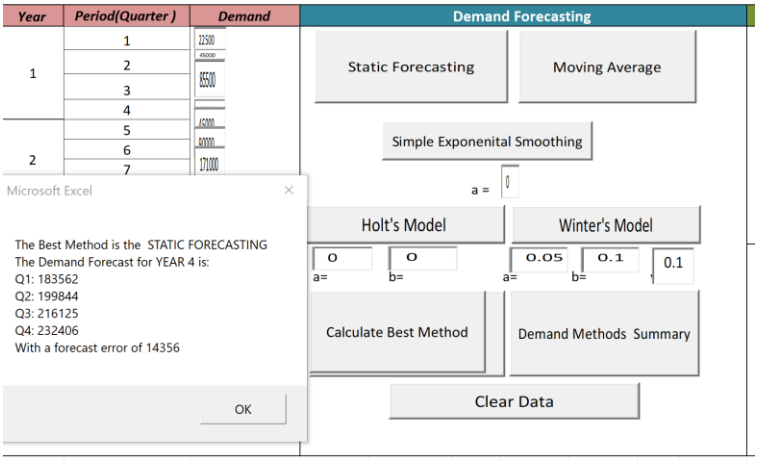
Main Page

Moving Average

Year	Quarter	Period	Demand	Level	Forecast(Ft)	Forecast Error	Absolute Error	MAD	MAPE	MSE	TS	Error %
1	1	1	22500									
	2	2	45000									
	3	3	85500									
	4	4	72000	56250								
2	1	5	45000	61875	56250	11250	11250	11250	25.00	126562500	1	25.0
	2	6	90000	73125	61875	-28125	28125	19687.5	28.13	458789063	-0.86	31.3
	3	7	171000	94500	73125	-97875	97875	45750	37.83	3499031250	-2.51	57.2
	4	8	144000	112500	94500	-49500	49500	46688	36.97	3236835938	-3.52	34.4
3	1	9	75000	120000	112500	37500	37500	44850	39.57	2870718750	-2.83	50.0
	2	10	150000	135000	120000	-30000	30000	42375	36.31	2542265625	-3.70	20.0
	3	11	285000	163500	135000	-150000	150000	57750	38.64	5393370536	-5.31	52.6
	4	12	240000	187500	163500	-76500	76500	60094	37.80	5450730469	-6.38	31.9
4	1	13			187500							
	2	14			187500							
	3	15			187500							
	4	16			187500							

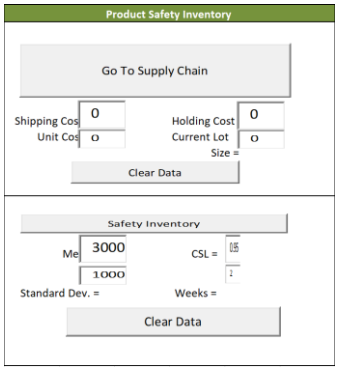
(This process continues for every remaining demand forecasting module.)

- The “Calculate Best Method” button will show the demand summary and tell you the best method out of the 5 possible methods (the method with the lowest errors).

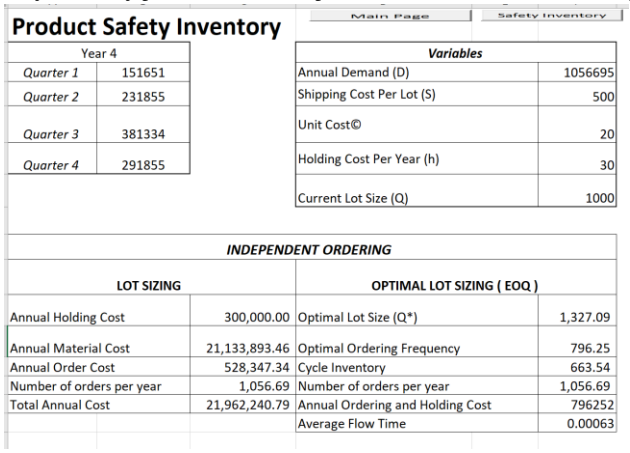


Product safety inventory module

- **Step 4: Select product safety inventory**
  - This module panel can be used for calculating inventory values such as:
    - Shipping cost
    - Unit cost
    - Holding cost
    - Lot size
  - Figure for product safety inventory panel:



- The product safety inventory panel has 4 main input values that must be simulated by the user.



Product Safety Inventory

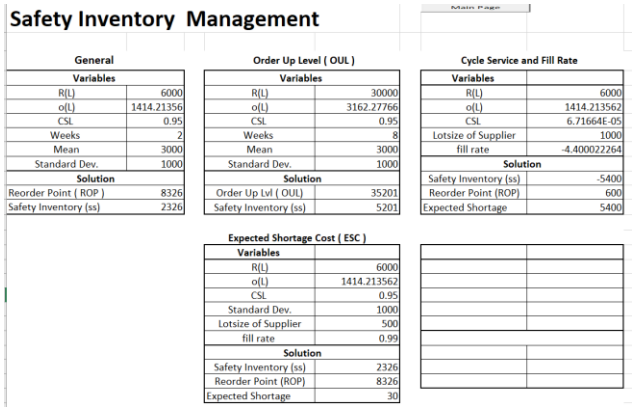
Year 4	
Quarter 1	151651
Quarter 2	231855
Quarter 3	381334
Quarter 4	291855

Variables	
Annual Demand (D)	1056695
Shipping Cost Per Lot (S)	500
Unit Cost©	20
Holding Cost Per Year (h)	30
Current Lot Size (Q)	1000

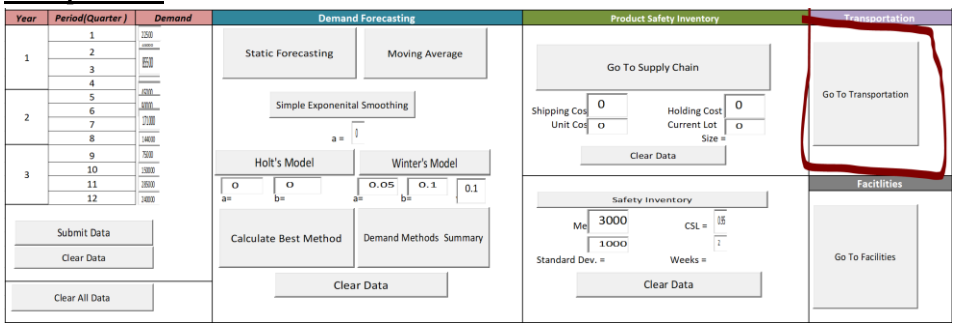
INDEPENDENT ORDERING

LOT SIZING		**OPTIMAL LOT SIZING (EOQ)**	
Annual Holding Cost	300,000.00	Optimal Lot Size (Q*)	1,327.09
Annual Material Cost	21,133,893.46	Optimal Ordering Frequency	796.25
Annual Order Cost	528,347.34	Cycle Inventory	663.54
Number of orders per year	1,056.69	Number of orders per year	1,056.69
Total Annual Cost	21,962,240.79	Annual Ordering and Holding Cost	796252
		Average Flow Time	0.00063

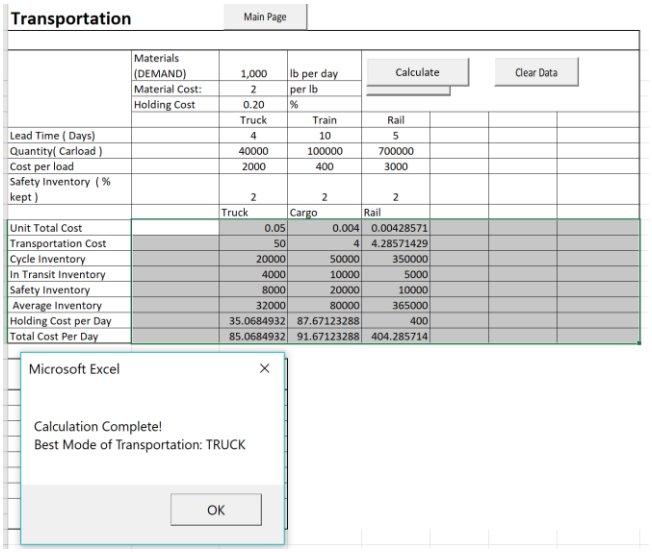
- The safety inventory panel has ***4 inputs***
    1. General
    2. Order level
    3. Expected shortage cost
    4. Cycle and fill rate



Transportation



- This allows user to go to the transportation module:
- Once the input data of material cost, holding cost lead time quantity cost per load and safety inventory, and Demand itself is imputed and method of shipment is put. The calculate button spits out the grayed area and the popup dialog box tells you which method of transportation is best looking at total cost.



d. Check:

i. Fixed minor typos and formatting issues.

e. Conclude:

i. From the following chart done above, we can see that the best mode of transportation for our company is by **truck**, as it is the lowest-cost and therefore most efficient method**.**

Conclusions: Lessons Learned

Results/Conclusions:

Throughout this course, we developed and implemented the supply chain for our company's product, the Modular Laptop. From high-level concerns like supply chain strategy to more detailed calculations like cycle inventory and transportation costs, we built a working simulation of our supply chain.

In general, our supply chain **focuses heavily on responsiveness** over efficiency. As a new technology, our Modular Laptop's demand is uncertain. Our company's supply chain, therefore, must be able to adapt to many changes in demand throughout the product's life cycle. For this reason, the supply chain is more responsive than efficient.

Our company also chose a **direct-to-consumer model** for the Modular Laptop's supply chain, cutting out distributors in favor of a direct line to the customer. This choice was made after researching the success of similar computer hardware manufacturers using this method, and deciding that we could apply it to our own product.

After determining our overall strategy, as well as aligning it to fit our competitive strategy developed last quarter, we began to calculate the specific values and metrics in our supply chain. We forecasted demand with the five major methods, used that forecast to determine our cycle inventory, and finally calculated transportation costs and methods. We then integrated all of these values and automated them with a Visual Basic software implementation.

Lessons Learned:

As the course progressed, it became clear that a major issue in our group was **communication and workflow**. We were frequently not on the same page, working separately on the various sections that were assigned. This caused our results to be scattered and non-cohesive.

In order to fix this, at the professor's suggestion, we came together and communicated about the work being done, revising our group working schedule and methods. We began **meeting more than once per week,** and that allowed us to gain a clearer understanding of the work that we were doing as a group. We also started **working on the project more as a team** than individually, which allowed us to be on the same page in terms of the project's progress. Finally, we **met much more regularly with the professor** for project reviews, which allowed us to have more feedback to improve the project.

Overall, our team put in the hours required to change our communication and working habits, which helped us significantly in the long-run. We learned that **effective communication and planning** are the foundations of a successful project. Without these traits, our project would have been much less focused, with each phase essentially developed in a vacuum, not connected to other parts of the project. TIM 125 (M.O.T II) has not only taught our team the foundations of supply chain management, strategizing, and implementation, but it has also **renewed our focus and drive for developing better projects in the future.**

Individual Contributions

Team Member: Qizhang Chen

High-level objectives:

For the final project this quarter in TIM 125, we continue working on the modify laptop, ModiFi. During this quarter, we meet with the instructor more often and work as a group more. We tried to make the final project of TIM 125 have more connection with the project we did from last quarter. Before we start doing this project, we revised the solution principles from conceptual design and the utility functions when we are choosing the solution principles. After talking with Subhas, we revised Financial Modeling part and make the data more convincible. For the work in this final project, most of the project we worked as a team, I mainly focus on the

conceptual design from last quarter, FAST diagram, supply chain network and demand forecasting.

Work plan/work process:

We work as a group once to twice a week, basically after classes. Before the meeting each week, we will make a to-do list of stuff we need to do, if someone cannot attend the meeting, we will finish our own work online. If some of us have any problem with any work, we will ask the one who is responsible for that part. For most parts of the project, we worked as a team, and we finish the phases on time. Different than last quarter, this quarter we met with Subhas every other week, we will ask about Subhas's advice about our project and revise it based on Subhas's instruction.

Implementation Detail:

For the project we did this quarter, I am mainly responsible for the conceptual design, which is the FAST diagram and Supply Chain Network part. Subhas showed us why we should revise the conceptual design from last quarter properly and the connection between two projects. The conceptual design and solution principles from last quarter will determine the suppliers in the SC network. In ModiFi, there are numbers of components in the laptop, so there will be lots of suppliers in ModiFi's supply chain network. We have to determine each supplier for the SC of ModiFi.

After the SC network, we made the demand forecasting using our financial modeling did in last quarter. We revised the financial modeling to a more convincible data, and calculate our annual demand using 5 methods Subhas told us in class.

Conclusion

Overall, I think our group did a good job this quarter, and we finished a well-structured final project for ModiFi. Everyone in our group deserves a good grade on this course.

Team Member: Wan Fong

High-level objectives:

After our TIM 105 course, our team had headed into 125 with the objective to clear all inconsistencies that existed in our project in which we had devoted our previous quarter into. There were many complications within our data as a result of differing perspectives, and our group reached a consensus where we must backtrack and fix all components that were not consistent with our data. One of the causes of the lack of consistency was that we were unable to meet as a group as often last quarter, but that issue did not exist this quarter. Meeting constantly this quarter has allowed us to adjust our project as needed, and meeting with the TAs as well as Professor Subhas aided us in identifying all inconsistencies in our project.

Plan/Work Process:

The plan and work process began with regularly scheduled meetings every once to twice a week. Throughout the meetings, we discuss as a group what needed to be done in the backlog from the previous week and what to prepare for our next phase as we prep to meet with the TA and the Subhas. In cases when some of us couldn't make the TA/professor meetings, we would

update them on the next team meeting or on slack, our group chat. The same applies to team meetings. In some cases, we would create a list of tasks and assign ourselves to complete them. As a fellow team member, my tasks were completed when we were together, but I struggled to complete tasks when working remotely. This quarter, I placed more emphasis on other classes and caused some inconsistencies in the project that I had to backtrack and adjust.

Implementation Details:

This quarter, I was in charge along with Monique in verifying and editing the flow of the project and worked with Monique on creating team meeting spreadsheet trackers. I worked in the background making edits to various sections of the project to maintain data and information consistencies. I also took note of changes and fixes that must be done in meetings with Subhas, and communicated with the team with what must be changed. In terms of the project itself, I implemented the Company Position in the Laptop Industries section, the Preliminary Responsive/Efficiency Spectrum with Monique, the executive summary, and the preliminary foundation software platform using visual basic that automated calculations performed in excel. We later created a more visually appealing and fully functional software platform in place of it.

Results:

The project has improved significantly since last quarter. We have made the appropriate adjustments in order to make our data more significant, but we had gone over many hurdles and tasks in the backlog in order to get there. It was definitely a struggle, but I believe our project had improved significantly from it.

Conclusions:

I felt that this class definitely had more content to cover compared to last quarter, and I had struggled to keep up with the work that was required. But having supporting teammates and TAs have aided me in staying afloat in this class. I learned a lot from working with my teammates, and even though I definitely had my share of inconsistencies in the project, I have learned to recognize them and resolve it.

Connection to parts of the project:

I collaborated with my teammates for the majority of the project in order to facilitate more communication within the group that was lacking in the previous quarter. I focused in editing and maintaining a consistent style and flow in the project.

Team Member: Eric Hong

High-level Objectives: High Level Objective:

From our TIM 105 project, we have struggled to keep our company's content consistent during that quarter. Because of that, it has affected the first few sections of this group project. From week 1 to 7 Caleb decided to take leadership for our group. However, after a few of the meeting with Professor Subhas, I have noticed that the work that we produce is still inconsistent

because some of the earlier contents were not fixed. After our meeting with Professor Subhas in week 7, I have decided to become the group leader and do overall reviews of work and previous phases. My main goal here is to be a leader, and identify inconsistencies within this project and communicate that with the other members.

Plan/Work Process:

The work process is that I attend classes regularly to get the notes required to produce quality work on this group assignment. After that, our group is scheduled to meet at least once a week and schedule at least one meeting with Professor Subhas or the TA's for each phase. We started scheduling for more of Professor Subhas' office hours because we were able to learn more about the mistakes and loopholes in our assignment from his reviews. We would usually meet as a group on a Tuesday, and sometimes on Thursday after class to work on the phases we were assigned. For me, I was able to meet for most of these meetings and sections with Professor Subhas and the TA's. I missed one of the group meetings because I had a fever one day. However, I made up for that week by working on the document on the weekends.

Implementation Details:

Initially, I was responsible for GANTT chart and the activity matrix. I attended classes, meetings, and reviews with the professor or TA regularly to take notes on the mistakes we have to fix as a group. After that, I would compile the notes into a list and share them with my groupmates. After we met with Professor Subhas the first time on week 2, I started taking on the filler position in the group. During our meeting times, I would work on the harder parts that require more time and effort with a partner to lessen up the work they would do. After our 3rd meeting with Professor Subhas on week 7, I have noticed that the mistakes in our group remained the same. We were having inconsistency issues that mess up the flow of the rest of our project. I decided to step up to be the leader of the group after that week and conduct an overall review of the project on the weekends. I would list down the inconsistencies in our work and what needs to be fixed and explanations that need to be added. Then I would share these details during group meetings and split the work evenly with my groupmates.

Specific contributions of mine included:

Conduct research on the technical aspects of the assignment

- Identifying which companies we should get our supplies from to manufacture our products after we fixed up the FAST diagram.

Conducted the Porter 5 analysis

Activity Matrix

GANTT chart

Fixed up the FAST diagram again along with the Supply Chain Network model

Added explanation to how our supply chain works along with the information flow

Explained how we implemented the product life cycle into into financial modeling

Help made the graphs for the forecasting

I've also identified the sources of the numbers for our cycle inventory

Results:

Initially, we were having consistency issues in the first few weeks. Even though we were getting work done, Professor Subhas still noticed that there were consistency issues. I agree with him as I look back into the project and noticed that the flow of it is inconsistent. After taking the leadership role, I have identified the inconsistencies and communicated with my group members about it. We were able to fix up the mistakes and make it flow better, however, Professor Subhas mentioned that some of our work is still lacking some explanation. After that meeting, I did

review and listed out the things we need to fix. We implemented the explanations into our results and our project looked better overall. The group project started off shaky because of our past mistakes and our working methods. However, this has changed after I took the leadership role. I noticed that our group mates are communicating more after I list the mistakes and our work overall is becoming more consistent.

Conclusions:

From this experience, I've realized how much the leadership position can impact in a group. Similarly, in my TIM 58 class, I had another group project where we struggled because of the lack of leadership. However, I decided to take initiative and conduct project reviews to list out things we need to work on as a team. By doing that in the TIM 125 and 58 class, I have noticed an improvement in the quality of the project results we are producing. Last but not least, communication is important and it is crucial for you to let others speak out their opinions on certain topics. It also important for me to speak up when I have opinions on certains topics too. Because of this, we were able to work more cohesively as a team and produce better results.

Team Member: Caleb Jones

High-level Objectives:

Our high-level objectives during TIM 125 (M.O.T. II) were to accurately analyze, strategize, and implement a supply chain for our company's product, the Modular Laptop. To do so, we had to calculate each piece of the various components that make up the supply chain, including demand forecasting, cycle inventory, and transportation costs.

As a group, high-level objectives included working more collaboratively as a team, discussing conclusions with each other, and forming a more cohesive vision of our product as a team.

Plan/Work Process:

Our group meetings were scheduled once or twice per week, generally in the afternoon after our TIM 125 lecture. When needed, we scheduled additional meeting times to work on important priorities or make critical edits that were suggested by the professor. We then worked remotely for the rest of the week, messaging over Slack to collaborate frequently and get the necessary work done.

Implementation Details:

Throughout the quarter, I served as the group's **project leader**, coordinating and guiding our workflow to prioritize the correct items and make sure the right work was being completed. This involved a significant amount of meeting planning, group discussions, and re-evaluation of our group work. I also reviewed, edited, and corrected a large amount of our overall work throughout the course.

Specific contributions of mine included:

- **Editing last quarter's conceptual design** to be more synchronized (matching subsystems, etc.) *(with group)*
- Helping design this quarter's **high-level supply chain model** *(with group)*
- **Developing the plan for the software and drivers** for our company's modular laptop
- Establishing a **process for getting accurate demand data**
- Writing our **Executive Summary** *(with Wan)*
- Writing our final report's **conclusion**
- Completing a large amount of final edits for the final report, including:
    - Proofreading (fixing typos, etc.) for every section

- Integration of the overall SC *(with group)*
- General formatting and restructuring (redoing diagrams, re-aligning text, etc.)

Results:

The project came together quite well despite having significant edits/backlog to complete from last quarter's work. After the group began working more collaboratively, we were able to get much more done and be on the same page about our results and conclusions.

Conclusions:

With help and advice from the professor, our group came together this quarter and developed a much more cohesive project than last quarter. After fixing our conceptual design (as per the professor's instruction), we all had a much better idea of the work that was being done, and we were no longer crunching numbers for the sake of filling up pages.

Connections to Other Parts of the Project:

The majority of the **rest of the project was completed collaboratively**, with the 7 of us working as a group (mostly in-person, though remote work was also done). This included much of the financial modeling, cycle inventory, and transportation modules.

Team Member: Antoine Rocha

As an individual

Over the course of M.O.T II (T.I.M 125) I along with 7 other team members have contributed to an over 50-page project which focuses on analysis, design and optimization of the supply chain network of our company ModiFi and product a modular laptop. I conducted a Porter's Five forces analysis for the modular laptop industry to gauge the competitive intensity and attractiveness of the industry in terms of profitability. After gauging the overall attractiveness of the laptop industry, I determined ModiFi's competitive position, and strategy in the laptop industry. Upon analysis I determined ModiFi's competitive strategy would center on product differentiation. I came to this conclusion since ModiFi is delivering a modular laptop. Modular customizable laptops have not been offered to the public at large.

The elements of ModiFi's competitive strategy will be to simplify the product, gain customers, scale alternative solutions, and offer quality customer service. This serves as our company's business model which will affect our supply chain strategy for our product and ultimately the financial modeling. Since we are entering an emerging market of modular laptops. In addition to working on the business model, I designed the high-level structure for the 4 key drivers of the supply chain. Since our strategy was a focused strategy our supply chain will be a pull-based SC and given the position of as mid-size company we will have a somewhat responsive supply chain for all 4 key drivers. Those drivers being Facilities, Information, Inventory, and Transportation. This high-level structure will feed into the design/Implementation of the transportation network and integration of the high-level Supply chain strategy for all 4 key drivers. In conclusion my aggregated contribution to the project was on the business model and the integration of the high-level supply chain strategy for the 4 key drivers.

As a Group Member

By working on ModiFi's business strategy and overall business model as well as the high- level structure for the 4 key drivers of the supply chain, I worked with all group members

to make sure that the functions of the supply chain they were working on were correct by checking through our business model By having a good understanding of this material provided to us in this course, I was able to help support my group members understand certain material about supply chain management, as well my my group members help me understand material about other material within the course.

Member: Yu Chen Shih (Richard)

High-level objectives:

The goal of the project was to implement as supply chain that for our intended company ModiFi. A big issue that our group had from last quarter was that our project was not aligned with each section well. This resulted in our group focusing heavily on the alignment this quarter with this project which I do believe is better but still could be improved. Getting the entire group to align work was the greatest challenge as some of the work may have been fixed but would then be changed over and over again. However, the group functioned well when working together which is a big improvement compared to last quarter.

Work plan/work process:

Our group met once a week or sometimes more depending whether we were behind or required to do backlog issues. Sometimes some members could not make it because of conflicts with other classes but they would make up for it by completing work on their own time. There were times when the members could not not meet for the meetings with Subhas or the TA but were filled in of what happened in our slack group.The biggest issue would be alignment as a group with 7 people in a group made it much more difficult to get everyone on the same page.

Implementation Detail:

In this group, I was the person who came up with the idea of how to get credible demand data hence my role as a data analysis by researching the data from statista, multiplying the data with our suggested market share, multiplying the product life cycle, and then using the data to create the forecasts. After getting the data I collaborated with the group and agreed that this would be the data moving forward. I would later then implement the demand data by forecasting it and writing up evaluations for each error checking method. Furthermore, I implemented the product life cycle into our financial modeling so that it is not flat anymore. I would also function as a project reviewer to ensure that our project meets the specifications and is aligned. My work for reviewing can be seen in the business model, supply chain, credible demand data, and forecasting as it is different to the drafts produced. However, I did not change much instead I would build upon others work as we had agreed on it as a group but would build upon it with more explanations and developed process.

Conclusion:

I do believe working on the project has improved as there is more contribution from everyone. This is likely due to familiarity from our group as people are now getting accustomed with each other and have developed more trust. However, reading through the work I think that quality of work has dropped which caused me to redo much of the work and was obviously

criticized when brought to Subhas. This is no ones fault but us as a group because the culture has developed without me saying anything. I wanted to carry my own weight in the group which is why I wanted to review the work to ensure that it is correct but I now understand that when working in a group the groups culture and work ethic has to be set and solidified for good work to be produced

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Team Member: Monique Van

High-level Objectives:

For our group, our overall objective was to make sure that our supply chain for our company ModiFi was understandable and best suited for us. We also wanted to make sure that our overall project had everything that was asked for and had no inconsistencies. We did not repeat the same mistake we did from last quarter's project. In this group, I was mainly in charge of the flow of the project, calculating the cycle and safety inventory for our company, tracking our group meetings, and taking notes during our meetings with Subhas and our TAs to assist us with any backlog for our project. I made sure that all of our work done and had a uniform font and format, was organized, and made sense. If there were instances where there were any inconsistencies or typos in our project, I made sure to edit the mistake and let my group members know what was fixed. Calculating Cycle and Safety Inventory was a bit tricky because there were times where we did not have a solid demand value, but after much trial and error, we were able to determine how much our demand was and calculations were simple. During our group meetings, I also made sure to track the progress of our project, take attendance and notes for our project tracking sheets.

Work-plan/Work-Process:

Our team scheduled to meet once a week or twice a week, depending on how much work was needed to be finished for that week. However, if there were times where only a few members could meet or we were all to busy, we assigned roles for each project phase and worked remotely. At times, I would prioritize other work before doing my role, which caused a lot of problems in the future. I could have done a lot better on time management and making sure my work was accurate and done on time.

Implementation Details:

There were at times where we were unsure on what to do to fix our backlog or how to do certain parts for our phases and because of this, we always ran into problems and during our meetings with the professor and TAs, there were always a lot of problems that were brought up about our project. This added way more backlog for us to do later on during our other project phase. Later on in project phase 4, we managed to complete our backlog and get back on track.

Results:

From doing this project, I found was that back logging was extremely stressful and correct implementation of the phases really took a toll on our ability to perform. There was a lot on concepts that were given to us and it was a bit difficult for me to remember them all at once while trying to relearn what was needed for previous phases. However, when taking the final, it helped me review certain topics and having a large group made it easier to split up tasks that each group member was an expert on.

Conclusions:

Overall, I believe that at the beginning of the project, I did not fully understand most of the concepts in class and because of this, it caused me to underperform on my roles. However, after asking for help, working together with my groupmates, and a lot of reviewing of my notes, I was able to perform my roles to the best of my ability. I made a lot of errors but in the end, learned and improved from it. I believe that all of my team members deserve a good grade on this project because we managed to change what was wrong about our project from the past quarter and we all understand the concepts and what needed to be implemented for each project phase.

Connection to Parts of the Project:

Since our project had many parts, I collaborated with my team members to make sure that our overall project strategy aligned with everything needed for our project. I worked on revising and improving the project to reflect the phases and their requirements. I also made sure that the project was organized and flowed together.