TIM 125 Team 4
SCM Integration and Final Report

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EXECUTIVE SUMMARY

This detailed final report goes through the supply chain management system that HydroFittings has developed for its new product, the SmartFaucet, over the past ten weeks. The report details all aspects of the supply chain and the processes the team used to design it, from high-level strategy to the in-house software solution we developed to calculate the various metrics involved throughout the entire supply chain.

With the current water crisis in California at the significant level that it is today, HydroFittings plans to target the majority of the California residential and enterprise water fixtures market with a shower and faucet product which is highly water efficient and user friendly. Being a California company, we have designed our supply chain to be operated within the state. We begin this process by designing our facilities network and show how we distribute our facilities throughout the state in a way which minimizes total costs. From here we detail the design of our transportation network, detailing all optimization calculations and costs, and determine that a network based on trucks is the best cost-efficient solution to distributing our new product throughout the state to our customers.

Throughout the course of our project, the team has collectively developed an automated SCM software solution which allows the company to run demand forecasting, determine inventory costs, and optimize our facilities and transportation networks. This report examines the details of this system—both how it operates and how it was used—and is a sufficient example of how this technology can be used in the future to continually help the company maximize the profitability of its supply chain.

The final details of the supply chain we have designed which is detailed in this report is supply chain drivers and guidelines—which are a structured summary of how the supply chain is to operate as a whole—as well as an extensive list of all the necessary inventories needed to create our product. These inventory reports discuss both the different types and quantities of components needed to produce our product as well as the suppliers we plan to purchase each component from.

Within the entire context of this report the team has designed a supply chain which is both efficient for distributing our new product and responsive to customer demand. Through the understanding of the supply chain's high-level design and the use of our software system, the company can continue to operate the supply chain efficiently in the future, throughout the life cycle of our SmartFaucet.

INTRODUCTION

Throughout the last six months, HydroFittings has worked endlessly on developing a revolutionary product, as well as implementing a flawless supply chain system. This detailed final report will define how our supply chain will be properly managed. The report will include various topics from the four project phases, including our supply chain strategy, demand forecasts, and sophisticated software used to simulate and manage our entire supply chain.

The first phase of our project will simply define our goals and objectives of our supply chain. In this phase our team worked together to develop the overall strategy for our supply chain by clearly stating the logic we used to determine our strategy. In addition, we also designed our high-level structure of supply chain drivers, which include inventories, facilities, transportation, and information.

In the second phase we continued on developing our supply chain strategy, but primarily focused on analyzing our product by creating various demand forecasts. We used five different forecasting methods in order to determine the most suitable method for our product.

By the third phase, our software engineers had almost completed the software module for our company. By using VBA, our company is able to simulate different scenarios taking into account various elements, including safety inventory, cycle inventory, transportation, and facilities.

The fourth phase of our project includes our completed Virtual Basic software and supply chain guidelines. As noted before, the sophisticated software that our engineers have developed will be able to help us prepare for future scenarios or uncertainties in the future. The supply chain guidelines will specifically outline how our supply chain will be managed. This will include what forecasting method to use, the type of inventories required for operation, and how our company will align itself with the four supply chain drivers. In addition to all this, the software manual will provide users on how to operate our Virtual Basic software.

FINAL PHASE

<u>Project Planning</u>

Step 1: Define the Problem

Prepare a project phase 4 for a clear statement from previous project phases and additional information of the cycle and safety inventory, implementing software, supply chain scenarios, high-level strategies for each driver, and develop the proper SC management guideline for project review with the instructor on Tuesday, 3/10/2015.

Step 2: Plan

- In addition to cycle and safety inventory, two important new elements of your project will be designing/implementing the Transportation Network and the Facilities. Be sure to pro-actively plan for these elements.
- Work on implementing the software (Information) framework for your project using Excel and Visual Basic. For example, develop the demand forecasting module and the product safety inventory module.
- Simulate your product's supply chain and examine various scenarios using your integrated software.
- Align and integrate your high-level strategies with the detailed implementations of each driver.
- Develop the proper SC management guidelines for your firm's products, as well as a user's manual for your software module.
- Create an outline of the final report, and then compile the final report. The final report should include a table of contents, a 1-2 page meaningful executive summary up-front, an introduction, and a conclusion/lessons learned section at the end.
- Each team member must create a very specific 1-2 page "write-up" for the final report clearly explaining her/his "aggregated" contribution to the project over the course of the quarter, in particular, but not limited to, the following issues: high-level objectives of your particular work on the project, your work-plan/work-process; implementation details; results; conclusions; connection to other parts of the project. This explanation will be an important part of the individual's project grade.

Step 3: Execute

Project Plan:

Task	Sub-tasks	Member responsibilities	Due Date
Form project team		All members	(in class) 1/6/2015
Formulate Project Proposal			1/8/2015
	Compile proposal and create project plan	Sean	
	Product dissection	Jon, Jason	
	Develop supply chain	David, Asha, Jon, Jason	
	Assess team's work from last quarter	All members	
Phase 1 (Technology/Product Strategy and Supply Chain Strategy/Design)			1/20/2015
	Firm up the Project Proposal	David, Amy	
	Develop the overall supply chain strategy, and clearly state the logic used to determine this strategy	Asha, Amy	
	Design the high-level structure (drivers) for your supply chain	Jon, Jason	
	Develop a high-level plan for the software development part of your project	Asha	
	Obtain and/or estimate demand data for your product	Sean	
Phase 2 (Supply Chain modeling and planning; demand forecasting)			2/3/2015
	Design and Create MIT Beer Game Board	Asha David	
	Play MIT Beer Game	All members	
	Define SC Strategy and Role in SC	Sean	

	Building the software platform or “architecture” (in Excel) to manage the supply chain. Financial Analysis/ Demand Forecasting (Static, Moving Average, Simple Exponential Smoothing)	Asha Jon David Jason	
	Compilation and Editing	Amy	
Phase 3 (Supply Chain operations: inventory, transportation, and facilities)			2/24/2015
	Cycle and Safety Inventory	David	
	Designing and Implementing Transportation Network and the Facilities	Amy	
	Work on implementing the software (Information) framework for your project using Excel and Visual Basic for the demand forecasting module.	Sean Asha Jon	
	Work on implementing the software (Information) framework for your project using Excel and Visual Basic for the product safety inventory module	Asha David	
	Simulate your product’s supply chain and examine various scenarios using your integrated software	Jon Amy	
	Align and integrate your high-level strategies with the detailed implementations of each driver	Jason	
	Develop the proper SC management guidelines for your firm’s products, as well as a user’s manual for your software module	Sean	
	Compilation and Editing	Amy	
Phase 4 (The software information system for the Supply Chain;			3/10/2015
	In addition to cycle and safety inventory, two important new elements (SCM “drivers”) of your	Sean Asha David	

simulation) and Final Report	project are designing/implementing Facilities and Transportation Network.	Jason	
	Work on implementing the software (Information) framework for your project using Excel and Visual Basic. For example, create and link demand forecasting, product safety inventory module, and transportation module and facilities modules.	Sean David Asha	
	Simulate your product's supply chain and examine various scenarios using your integrated software.	All Members	
	Align and integrate your high-level strategies with the detailed implementations of each driver.	Jon Amy	
	Develop the proper SC management guidelines for your firm's products, as well as a user's manual for your software module.	Jon Amy Sean	
	Each team member is expected to spend a few minutes clearly explaining her/his "aggregated" contribution to the project over the course of the quarter. This explanation will be an important part of your project grade.	All Members	
	Compilation and Editing	Amy	
	Summary, Introduction, Table of Contents, and Final Conclusion	All Members	3/17/2015

4. Check your Work

The plan was on roles and responsibilities carried out as planned. All the following work has been checked and looked over for honesty and accuracy.

5. Learn and Generalize

Overall from this project we learned how to delegate tasks and work efficiently as a team. Over the two quarter we have greatly improved in communication and work quality. The following work was done with the utmost care and accuracy as can be attained while simulating a real company.

Facilities Networks

1. Define the Problem
    a. In addition to cycle and safety inventory, two important new elements (SCM drivers) of your project are designing/implementing a Facilities Network.
        i. Implement process and design for calculations regarding Facilities.
2. Plan the Problem
    a. In addition to cycle and safety inventory, two important new elements (SCM drivers) of your project are designing/implementing Facilities and Transportation Network.
        i. Implement process and design for calculations regarding Facilities.

Process for designing the Facilities Driver

STEP 1 – Determine the strategy for the Facilities driver to be aligned with the SC strategy and the competitive strategy of the firm.

STEP 2 – Determine the role, location, and capacity of the facilities

Role – What is the purpose of the facility? Manufacturing, assembly, warehouse, retail…

Location – Where is the facility located?

Capacity – How big (# of items) should the facility be?

Pose an optimization problem called the "Capacitated Plant Location Model" to help determine location, capacity, and other SC variable to minimize total cost à maximize efficiency.

Use the following Notation:

i – denotes plants or facilities (I = 1, 2, … n)

n – total # of plants

j – denotes the regions of demand, j = 1, 2, … m (a.k.a. markets)

m – total # of demand regions

for each plant i, (i = 1, 2, … n)

f_i = fixed annual cost of operating the plant

y_i = decision variable

(If y_i = 1, have a plant at location i. If y_i = 0, do not have a plant at location i)

k_i = capacity of plant i (# of units or items) [given]

for each demand region j, (j = 1, 2, … m)

D_j = annual demand for region j

Between a plant i, (i = 1, 2, … n) and a demand region j, (j = 1, 2, … m) we have

X_{ij} = quantity of items shipped form plant i to demand region j.

c_{ij} = total cost (material + manufacturing + holding + transp. …) per item

Total Annual Cost, C =

Fixed Cost of operating the plants + Var. cost for flows b/t plants and demand regions

$$C = \sum_{i=1}^{n} f_i Y_i + \sum_{j=1}^{m}\sum_{i=1}^{n} X_{ij} c_{ij} \rightarrow Equation\ 1$$

Constraints -
Demand side constraint [For any demand region j, (j = 1, 2, … m)]:

$$X_{1j} + X_{2j} + \cdots X_{nj} \geq D_j$$

$$\sum_{i=1}^{n} X_{ij} \geq D_j; (j = 1, 2, \ldots m) \rightarrow Equation\ 2$$

Supply-side constraint:

$$Y_i K_i \geq X_{1j} + X_{2j} + \cdots X_{nj}$$

$$Y_i K_i - \sum_{j=1}^{m} X_{ij} \geq 0 \quad (i = 1, 2, \ldots n) \rightarrow Equation\ 3$$

OBJECTIVE – Minimize the total annual cost C given by equation 1 subject to the constraints given by equations 2, 3, and 4.
APPROACH –
1. Set – up the Objective functions (equations) in EXCEL
2. Use Solver to determine
    a. The decision variables Y_i
    b. The flows X_{ij}, (i = 1, 2, … n), (j = 1, 2, … m)

STEP 3 – Determine the actual (physical location of each facility using a "Gravity Location" model (refer to textbook for details)
STEP 4 – Optimize the entire (total) Supply Chain Network

3. Execute the Plan
Calculating transportations costs for Facilities:
The national average rate for a truck per mile is $1.96.
Here are distances from each supply city to each demand city (miles)

City	SF	San Jose	LA	Fresno	Sac	San Diego
San Gabriel	395	348	11	227	393	121
Santa Clara	45	5	345	157	119	465
Oakland	11	41	370	177	81	490
San Bernardino	435	392	60	272	437	107

Long Beach	405	363	24	242	408	106

Transportation costs = $1.96 * miles

City	SF	San Jose	LA	Fresno	Sac.	San Diego
San Gabriel	774	682	22	445	770	237
Santa Clara	88	10	676	308	233	911
Oakland	22	80	725	347	159	960
San Bernardino	852	768	117	553	857	209
Long Beach	794	711	47	474	800	208

Forecasted Demand in each Region for next four periods using Holt’s

Total	SF	Fresno	Sac.	San Diego	LA	San Jose
55759	5788	3520	26709	9405	26831	6901
61144	6347	2860	29288	10213	29523	7568
66529	6906	4200	31867	11222	32014	8235
71914	7465	4540	34447	12130	34606	8901

Inputs - Costs, Capacities, Demands								
	Demand City							
	Production and Transportation Cost per 1,000 Units						Fixed	
Supply City	San Francisco	Fresno	Sacramento	San Diego	San Jose	Los Angeles	Cost ($)	Capacity
Long Beach	774	682	22	445	770	237	2200	4
Santa Clara	88	10	676	308	233	911	3100	6
Riverside	22	80	725	347	159	960	3700	7
Oakland	852	768	117	553	857	209	4300	5
San Gabriel Valley	794	711	47	474	800	208	2500	2
Demand	2.16	1.31	1.24	3.51	10.01	2.57		
Decision Variables								
	Demand City - Production Allocation (1000 Units)						Plants	
Supply City	San Francisco	Fresno	Sacramento	San Diego	San Jose	Los Angeles	(1=open)	
Long Beach	0	0	0.34126299	3.358737	0	0	1	
Santa Clara	2.159421255	1.3132	0.05	0.05	2.42738	0	1	
Riverside	0	0	0.05	0.05	6.9	0	1	
Oakland	0	0	0.79453483	0.05	0.68284	2.57479379	1	
San Gabriel Valley	0	0	0	0	0	0	0	

Constraints						
Supply City	Excess Capacity					
Long Beach	0.29999998					
Santa Clara	0					
Riverside	0					
Oakland	0.897833333					
San Gabriel Valley	0					
	San Francisco	Fresno	Sacramento	San Diego	San Jose	Los Angeles
Unmet Demand	0.00	0.00	0.00	0.00	0.00	0.00
Objective Function						
Cost=	18014.72156					

Solver

4. Check your Work
For this problem we used data from the book to double-check our work and ensure that we had a working system before we put in data from our actual project. Although we ran into some trouble embedding solver into the program as well as getting the solver to function appropriately, in the end were able to solve all our issues and create a work facilities system.

5. Learn and Generalize
Overall, for this problem we learned a lot more about visual basic and how it works to ease excel processes. Although the tool was new, we were able to pick it up fast and create a working system. We also got to work with solver and learn how this tool can greatly help and speed up processes. Lastly, by using the system we made, we were able to identify the best facilities set-up that would be beneficial and cost efficient for our company.

<u>Transportation Networks</u>

1. Define the Problem
    a. In addition to cycle and safety inventory, two important new elements (SCM drivers) of your project are designing/implementing Transportation Network.
        i. Implement process and design for calculations regarding Transportation.
2. Plan the Problem
    a. In addition to cycle and safety inventory, two important new elements (SCM drivers) of your project are designing/implementing Transportation Network.
        i. Implement process and design for calculations regarding Transportation.

Process for Transportation Network Design

PROBLEM – Design the transportation network connecting suppliers to end-customers with the objective of minimizing total cost.

PROCESS –

STEP 1 – Q: Which mode of transportation should be used?

A: Choose the mode (air, water …) that minimizes total cost.

Total Cost = Transportation Cost + Inventory Holding Cost

(Inventory = Cycle + Safety + In-Transit)

Create a table of options with mode, lot size, transportation cost, cycle inventory cost, safety inventory cost, In-transit inventory cost, total inventory cost, total cost.

Read the "Eastern Electric/ Golden" example in "Transportation" chapter of textbook.

STEP 2 – Q: Should inventory be aggregated spatially?

A: Yes, explore options for spatial aggregation of inbound transportation.

Select the scenario that minimizes the total cost, or provides the best balance between efficiency and responsiveness.

STEP 3 – Q: Should orders be aggregated in time (temporal)

A: Explore options for temporal aggregation.

Aggregation of orders in time will reduce transportation of order in time will reduce transportation cost (i.e. increase efficiency) but will reduce responsiveness (because of delay in shipping items to the customers). Create a table of options.

3. Execute the Plan

STEP 1 – Q: Which mode of transportation should be used?

A: Choose the mode (air, water …) that minimizes total cost.

Total Cost = Transportation Cost + Inventory Holding Cost

(Inventory = Cycle + Safety + In-Transit)

Create a table of options with mode, lot size, transportation cost, cycle inventory cost,

Mode	Lot Size	Transportation Cost	Cycle Inventory Cost	Safety Inventory Cost	In-transit Inv. Cost	Total Inv. Cost	Total Cost
Mode 1 - Rail	3914.176542	39141.76542	195708.8271	76753.44227	1049.368356	273511.6377	312653.4031
Mode 2 - Air	4793.867645	58712.64813	239693.3823	44313.62056	349.7894521	284356.7923	343069.4404
Mode 3 - Truck	3195.911763	26094.51028	159795.5882	88627.24111	1399.157808	249821.9871	275916.4974

safety inventory cost, In-transit inventory cost, total inventory cost, total cost.

The method of transportation that minimizes cost is to use trucks and go by land.

STEP 2 – Q: Should inventory be aggregated spatially?

A: Yes, explore options for spatial aggregation of inbound transportation.

Select the scenario that minimizes the total cost, or provides the best balance between efficiency and responsiveness.

	Current Scenario	Option A	Option B
# of stocking locations	5	5	1
Re-order interval (weeks)	2.5	1	1
Cycle Inventory	1227.626442	491.0505769	491.0505769
Safety Inventory	376.0135391	307.0137691	122.8055076
Total Inventory	1603.639981	798.064346	613.8560846
Annual Inv. Holding Cost	32072.79963	15961.28692	12277.12169
Shipment Type	Replenishment	Replenishment	Customer Order
Shipment Size	2455.252885	982.1011538	2
Shipment Weight	6138.132212	2455.252885	5
Annual Transport Cost	6138.132212	2455.252885	9821.011538
Total Annual Cost	38210.93184	18416.5398	22098.13323

Based on these three scenarios, it would be best to re-stock more frequently to lower inventory holding costs substantially, but going all the way to a customer order system would increase transportation costs too much and decrease efficiency. The difference in efficiency is low enough that it may still be worth it to have the option for customers to order the product directly while also having the product in retail locations.

STEP 3 – Q: Should orders be aggregated in time (temporal)

A: Explore options for temporal aggregation.

Aggregation of orders in time will reduce transportation of order in time will reduce transportation cost (i.e. increase efficiency) but will reduce responsiveness (because of delay in shipping items to the customers). Create a table of options.

		Two-Day Response		Three-Day Response		Four-Day Response	
Day	Demand	Quantity Shipped	Cost ($)	Quantity Shipped	Cost ($)	Quantity Shipped	Cost ($)
1	699.5789041	699.5789041	134.9789452				
2	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904		
3	699.5789041	699.5789041	134.9789452			2098.736712	204.9368356
4	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904		
5	699.5789041	699.5789041	134.9789452				
6	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904	2098.736712	204.9368356
7	699.5789041	699.5789041	134.9789452				
8	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904		
9	699.5789041	699.5789041	134.9789452			2098.736712	204.9368356
10	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904		
11	699.5789041	699.5789041	134.9789452				
12	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904	2098.736712	204.9368356
13	699.5789041	699.5789041	134.9789452				
14	699.5789041	699.5789041	134.9789452	1399.157808	169.9578904	1399.157808	169.9578904
			1889.705233		1189.705233		989.7052329

After exploring temporal aggregation, it is clear that aggregating orders over time reduces the cost by quite a lot. From this table looking at two-day, three-day, and four-day response, it seems that the best option to create a balance of efficiency and responsiveness would be to have a three-day response. It lowers costs substantially and adds only 1 day to the response time.

Overall, we would suggest a transportation network using trucks to carry our product as well as our supplies to each location. Additionally, having a system of distribution warehouses would be good to reduce transportation costs while having an additional customer order system would increase responsiveness for the system as a whole. Finally, we would suggest a slight aggregation over time, increasing the response time to three days rather than two to reduce costs while maintaining a good amount of responsiveness.

4. Check your Work

For this problem we used both the lecture notes and the textbook to guide us in understanding how a company determines their transportation system. After much research, trial and error, we were able to create the above system. While coding on Visual Basic, we faced a lot of problems and had look over the code many times to find the issue. In the end, with the help of the example in the textbook, we were able to create an efficient, accurate transportation system to determine the transportation we would need for HydroFittings.

5. Learn and Generalize

From this portion of the project, we learned more about how a company determines which form of transportation to use to move products and supplies. As can be seen above, trucks proved to be the most cost efficient form of transportation for HydroFittings. Outside of this, we had to determined the annual cost as well as cost in-relation to response timings. With our system we learned that 4-days was the cheapest option, but it lacked responsiveness in relation to the customer order. In order to get the a cost-efficient yet responsive system, a 3-day response would be the best option for our medium-sized company.

User Manual for Software Module

1. Define the Problem
   a. Develop a user's manual for your software module.
2. Plan the Problem
   a. Develop a user's manual for your software module.
      i. Review all work done on Software Module and explain how a new user would use the software to their advantage.
3. Execute the Plan
   a. Develop a user's manual for your software module.

Sheet1:

"Choose Module Button": Displays the "Choose a Module" window

Choose a Module Window:

- Demand Forecasting Button: Click to select Forecasting method to perform
- Inventory Button: Click to perform Inventory management computations
- Transportation Button: Click to perform Transportation management
- Facilities Button: Click to perform Facility management
- Finish Button: Click to finish (hide all windows)

Demand Forecasting Module

- Static Forecasting Button: Click to perform Static Forecasting
- Moving Average Button: Click to perform Moving Average Forecasting method
- Simple Exponential Smoothing Button: Click to perform Simple Exponential Smoothing forecasting method
- Holt's Method Button: Click to perform Holt's method of forecasting
- Winter's Method Button: Click to perform Winter's method of forecasting
- Forecast All Button: Click to perform all forecasting methods with default input parameters. Creates a summary worksheet.

Static, Moving Average, Simple Exponential Smoothing, Holt's, an d Winter's Forecasting Modules:

- In each window, enter the values applicable to that forecasting method.
- Enter a range of demand data from Sheet1. (Ex: Sheet1!$A$2:$A$20)
- Back Button: click to go back to the previous window
- Forecast Button: click to run the forecast
- Done Button: Click to finish

Inventory Module:

- Enter values required and Click the "Compute Inventory" Button to calculate metrics.
- Back Button: Click to go back to "Choose a Module" window
- Finish Button: Click to finish

Facilities Module:

- Enter range of demand data. Demand cities make up the columns and supply cities the rows. Each entry is the transportation cost between each pair of supply and demand cities.

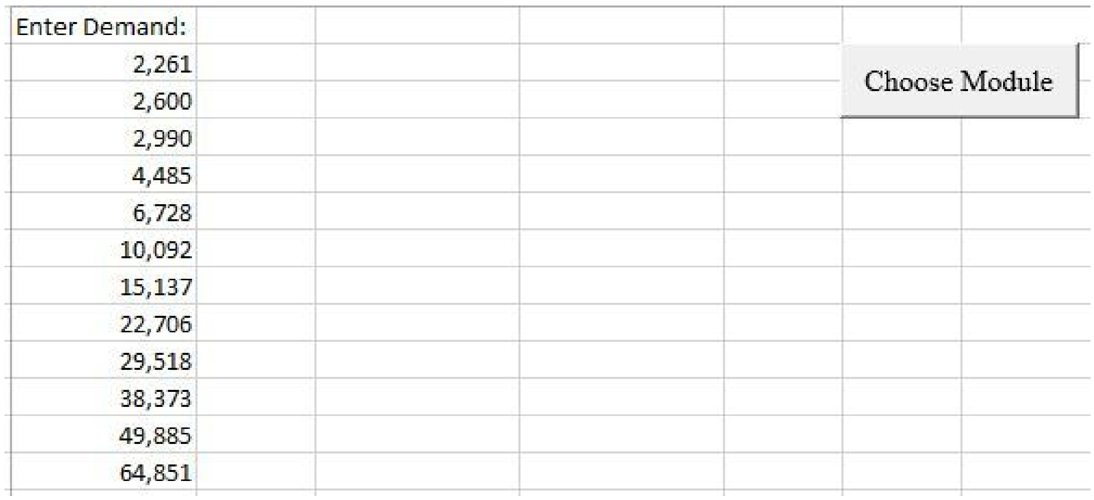
The final row is the total demand from each demand city. The last two columns are fixed cost and capacity, respectively.

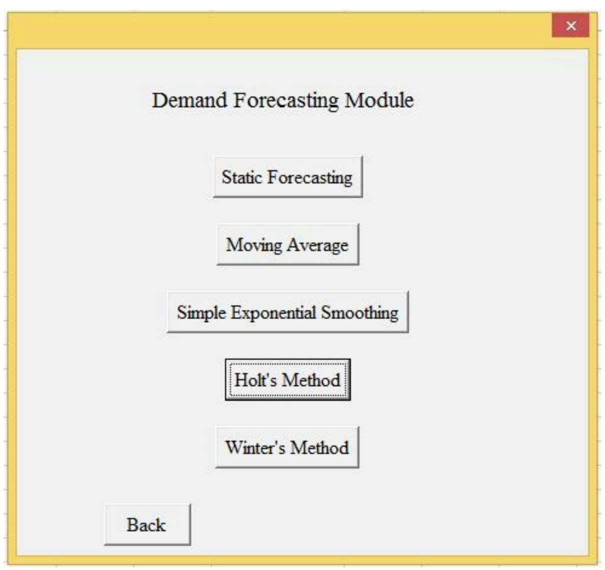
- Compute Facilities Button: Click to create new facilities worksheet
- Back Button: Click to go back to previous module
- Finish: Click to finish

Facilities Worksheet:

- Solver Button: Click to calculate optimization of facilities

Software Modules:





Static

Period	Demand	De-seasonalized Demand	Regressed De-seasonalized Demand	Seasonal Factor	Average Seasonal Factor	Re-seasonalized Demand	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
1	2,261		-11285.94048	-0.20034	0.296552	-3346.87284	-5,608	5607.873	-5,608	31448238	5607.873	248.0262	248.0262	-1
2	2,600		-6089.897321	-0.42694	0.26829	-1633.855744	-4,234	4233.856	-9,842	24686886	4920.864	162.8406	205.4334	-2
3	2,990	3642.375	-893.8541667	-3.34506	-0.27152	242.6987131	-2,747	2747.301	-12,589	18973812	4196.343	91.88299	167.5833	-3
4	4,485	5137.25	4302.188988	1.042493	0.672278	2892.266388	-1,593	1592.734	-14,182	14864559	3545.441	35.51246	134.5656	-4
5	6,728	7592.125	9498.232143	0.708342		2816.723626	-3,911	3911.276	-18,093	14951264	3618.608	58.13431	119.2793	-5
6	10,092	11388.125	14694.2753	0.686798		3942.320344	-6,150	6149.68	-24,243	18762480	4040.453	60.93618	109.5555	-6
7	15,137	16514.5	19890.31845	0.761024		-5400.606577	-20,538	20537.61	-44,780	76338309	6397.189	135.6782	113.2873	-7
8	22,706	22898.375	25086.36161	0.905113		16865.00539	-5,841	5840.995	-50,621	71060673	6327.665	25.72445	102.3419	-8
9	29,518	30777	30282.40476	0.974757		8980.320093	-20,538	20537.68	-71,159	1.1E+08	7906.556	69.5768	98.70136	-9
10	38,373	40388.625	35478.44792	1.081586		9518.496433	-28,855	28854.5	-100,014	1.82E+08	10001.35	75.19481	96.3507	-10
11	49,885		40674.49107	1.226444		-11043.91187	-60,929	60928.91	-160,942	5.03E+08	14631.13	122.1387	98.69507	-11
12	64,851		45870.53423	1.413783		30837.7444	-34,013	34013.26	-194,956	5.58E+08	16246.31	52.44831	94.84117	-12
13			51066.57738			15143.91656								
14			56262.62054			15094.67252								
15			61458.66369			-16687.21716								
16			66654.70685			44810.4834								

Simple Exponential Smoothing

Period	Demand	Level	Forecast	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
0		20802.17									
1	2,261	19875.11	20802.17	18,541	18541.17	18,541	3.44E+08	18541.17	820.0428	820.0428	1
2	2,600	19011.35	19875.11	17,275	17275.11	35,816	3.21E+08	17908.14	664.4272	742.235	2
3	2,990	18210.29	19011.35	16,021	16021.35	51,838	3E+08	17279.21	535.8312	673.4337	3
4	4,485	17524.02	18210.29	13,725	13725.29	65,563	2.72E+08	16390.73	306.0264	581.5819	4
5	6,728	16984.22	17524.02	10,796	10796.02	76,359	2.41E+08	15271.79	160.464	497.3583	5
6	10,092	16639.61	16984.22	6,892	6892.22	83,251	2.09E+08	13875.19	68.2939	425.8476	6
7	15,137	16564.48	16639.61	1,503	1502.609	84,754	1.79E+08	12107.68	9.926729	366.4303	7
8	22,706	16871.55	16564.48	-6,142	6141.521	78,612	1.61E+08	11361.91	27.04801	324.0075	6.918928
9	29,518	17503.88	16871.55	-12,646	12646.45	65,966	1.61E+08	11504.64	42.84316	292.7671	5.733844
10	38,373	18547.33	17503.88	-20,869	20869.12	45,097	1.89E+08	12441.09	54.38491	268.9288	3.624818
11	49,885	20114.22	18547.33	-31,338	31337.67	13,759	2.61E+08	14158.96	62.81982	250.1917	0.971753
12	64,851	22351.06	20114.22	-44,737	44736.78	-30,978	4.06E+08	16707.11	68.98395	235.091	-1.85417
13			20114.22								
14			20114.22								
15			20114.22								

Moving Average

Period	Demand	Level	Forecast	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
1	2,261										
2	2,600										
3	2,990										
4	4,485	3,084									
5	6,728	4,201	3,084	-3,644	3644	-3,644	2655747	3644	54.16171	54.16171	-1
6	10,092	6,074	4,201	-5,891	5891.25	-9,535	7997594	4767.625	58.37545	56.26858	-2
7	15,137	9,111	6,074	-9,063	9063.25	-18,599	18589723	6199.5	59.87481	57.47066	-3
8	22,706	13,666	9,111	-13,596	13595.5	-32,194	39370710	8048.5	59.87624	58.07205	-4
9	29,518	19,363	13,666	-15,852	15852.25	-48,046	62917724	9609.25	53.70367	57.19838	-5
10	38,373	26,434	19,363	-19,010	19009.75	-67,056	92763011	11176	49.53939	55.92188	-6
11	49,885	35,121	26,434	-23,452	23451.5	-90,508	1.34E+08	12929.64	47.01113	54.64891	-7
12	64,851	45,657	35,121	-29,731	29730.5	-120,238	1.97E+08	15029.75	45.84432	53.54834	-8
13			45,657								
14			45,657								
15			45,657								
16			45,657								

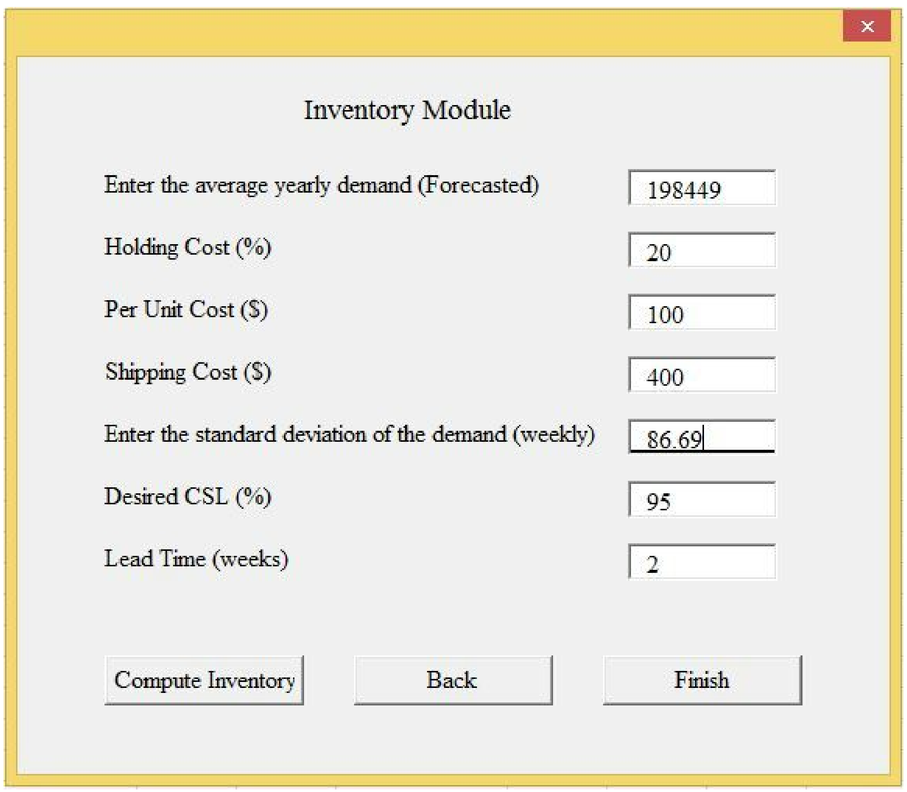
Holt's

Period	Demand	Level	Trend	Forecast	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
0		-14195.1	5384.196									
1	2,261	-8257.31	5411.876	-8810.91	-11,072	11071.91	-11,072	1.23E+08	11071.91	489.6909	489.6909	-1
2	2,600	-2573.17	5425.489	-2845.44	-5,445	5445.439	-16,517	76120002	8258.675	209.44	349.5654	-2
3	2,990	2859.206	5425.833	2852.322	-138	137.678	-16,655	50752987	5551.676	4.604616	234.5785	-3
4	4,485	8095.037	5416.333	8285.039	3,800	3800.039	-12,855	41674814	5113.767	84.72774	197.1158	-2.5138
5	6,728	13172.2	5399.375	13511.37	6,783	6783.371	-6,072	42542675	5447.687	100.823	177.8572	-1.11453
6	10,092	18147.6	5378.176	18571.58	8,480	8479.577	2,408	47436100	5953.002	84.02276	162.2182	0.404495
7	15,137	23106.34	5357.204	23525.77	8,389	8388.774	10,797	50712589	6300.97	55.419	146.9611	1.713503
8	22,706	28175.66	5342.81	28463.54	5,758	5757.539	16,554	48517173	6233.041	25.35691	131.7606	2.65589
9	29,518	33318.45	5332.809	33518.47	4,000	4000.472	20,555	44904574	5984.978	13.55265	118.6264	3.43439
10	38,373	38637.34	5332.113	38651.26	278	278.2577	20,833	40421859	5414.306	0.725139	106.8363	3.84777
11	49,885	44265.24	5346.902	43969.46	-5,916	5915.542	14,917	39928384	5459.873	11.85836	98.20191	2.732199
12	64,851	50374.08	5384.999	49612.14	-15,239	15238.86	-321	55952930	6274.788	23.49827	91.9766	-0.05122
13				49612.14								
14				49612.14								
15				49612.14								

Winter's

Period	Demand	Level	Trend	Seasonal Factor	Forecast	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
0		-16482	5196.043										
1	2,261	-1830.83	9923.599	0.296552	-3346.87	-5,608	5607.873	-5,608	31448238	5607.873	248.0262	248.0262	-1
2	2,600	8891.897	10323.16	0.26829	2171.206	-429	428.794	-6,037	15816051	3018.333	16.49208	132.2591	-2
3	2,990	4101.477	2766.371	-0.27152	-5217.26	-8,207	8207.261	-14,244	32997077	4747.976	274.4903	179.6695	-3
4	4,485	6769.598	2717.246	0.672278	4617.102	132	132.1018	-14,112	24752170	3594.007	2.945414	135.4885	-3.92649
5	6,728	-2426.17	-3239.26	-0.4692	-4451.27	-11,179	11179.27	-25,291	44796931	5111.059	166.1603	141.6229	-4.94831
6	10,092	15166.52	7176.713	0.280345	-1588.28	-11,680	11680.28	-36,971	60068916	6205.928	115.738	137.3087	-5.95743
7	15,137	44258.94	18134.57	0.228743	5110.862	-10,026	10026.14	-46,998	65848134	6751.673	66.23596	127.1555	-6.96087
8	22,706	48207.56	11041.59	0.667399	41641.39	18,935	18935.39	-28,062	1.02E+08	8274.637	83.39376	121.6853	-3.39134
9	29,518	20520.55	-8322.71	-1.62115	-96051.8	-125,570	125569.8	-153,632	1.84E+09	21307.44	425.4009	155.4314	-7.21025
10	38,373	46672.71	8914.726	0.472879	5768.107	-32,605	32604.89	-186,237	1.77E+09	22437.18	84.96832	148.3851	-8.30037
11	49,885	115195.8	38718.89	0.285377	15863.35	-34,022	34021.65	-220,258	1.71E+09	23490.32	68.20015	141.0956	-9.37657
12	64,851	133923.9	28723.52	0.569202	87608.56	22,758	22757.56	-197,501	1.61E+09	23429.25	35.09207	132.262	-8.42967
13				-0.09135	-14857.1								
14				0.647526	105318.4								
15				0.359211	58424.74								
16				0.52672	85669.64								

Inventory Calculation



Final Inventory Comparison

Cycle Inventory	
Inputs	
Yearly Demand =	198449
Holding Cost (%) =	0.2
Per Unit Cost ($) =	100
Common Order Cost ($) =	400
Outputs	
Optimal Order Quantity (units) =	2817.439
Number of shipments (per year) =	70.43596
Cycle Inventory (units) =	1408.719
Order Frequency (days) =	5.182012

Safety Inventory	
Inputs	
Average Weekly Demand =	3816.327
Lead Time	2
Standard Deviation of weekly demand =	86.69
Target cycle service level (CSL) =	0.95
Distribution during lead time	
Mean Demand during lead time =	7632.654
Standard Deviation during lead time =	122.5982
Output	
Safety Inventory (ss) =	201.6561
Re-order Point (ROP) =	7834.31

4. Check your Work

The user manual created above is entirely based on lecture notes, the textbook processes, and most importantly, our system. As you can see above, all work done is based on our final system that has been tested and checked for accuracy. The above manual simply guides a new user through the processes of a fairly simple to use system.

5. Learn and Generalize

From this portion of the project we learned how to shape our system for new users. By testing the software on other team members we were able to identify what areas the user manual would need more explanation and which areas were already very clear and easy to understand. We hope all users will able to follow the above manual and be able guide themselves through the system with ease.

Supply Chain Drivers and Guidelines

1. Define the Problem
    a. Align and integrate your high-level strategies with the detailed implementations of each driver.
    b. Develop the proper SC management guidelines for your firm's products.
2. Plan the Problem
    a. Align and integrate your high-level strategies with the detailed implementations of each driver.
        i. Identify the high-level strategies involved with each driver.
    b. Develop the proper SC management guidelines for your firm's products.
        i. Research components of the product and identify what it takes to organize the project and the make the product a reality. Create guidelines for the firm to follow.
3. Execute the Plan
    a. Align and integrate your high-level strategies with the detailed implementations of each driver.

Inventories: Our inventories that make up our product include batteries, infrared sensors, hoses, etc. In the next few pages, we have listed the required materials, which will include various information relating to safety and cycle inventory. We will store our inventories at convenient locations in order to minimize transportation costs. We will also continue to analyze our demands for our product so that we do not have any surplus or shortage of supplies.

Facilities: Currently, all our facilities are located in California. We have manufacturing plants located in Long Beach and Santa Clara, assembly plant in San Gabriel Valley, and distribution centers at Riverside and Oakland. The locations of our facilities are distributed through North, Central, and South California; in which, our company can stay close to the production of our product.

Transportation: Since all our facilities are located throughout California, we ill be using group transportation to deliver our product to retailers and distributors. With our assembly plant, located in San Gabriel Valley, which is in Central California, we can easily get to our manufacturing, and distribution centers in North and South California.

Information: To analyze all our data that is collected throughout our operations we will implement Oracle's SCM software. This will allow us to install a system that can adjust to our system conveniently, while providing us with reliability and excellence. In addition to Oracle's SCM software, our software engineers have developed a Virtual Basic module that we can use to simulate different scenarios that may arise in the future.

b. Develop the proper SC management guidelines for your firm's products.

Suggested Forecasting Method:

After running through various demand forecasts for HydroFittings, we have determined that the Holt's method will provide us with the most accurate forecast. We can conclude that there is a significant positive effect to our forecast by incorporating level and trend into it. The tracking signals for this demand forecast are much lower than other methods we have forecasted (-2.53 < ts < 3.85). Our average yearly demand is forecasted to be 255,346 units.

Period	Demand	Level	Trend	Forecast	Error	Absolute Error	Bias	MSE	MAD	% Error	MAPE	TS
0		-14195.1	5384.196									
1	2,261	-8257.31	5411.876	-8810.91	-11,072	11071.91	-11,072	1.23E+08	11071.91	489.6909	489.6909	-1
2	2,600	-2573.17	5425.489	-2845.44	-5,445	5445.439	-16,517	76120002	8258.675	209.44	349.5654	-2
3	2,990	2859.206	5425.833	2852.322	-138	137.678	-16,655	50752987	5551.676	4.604616	234.5785	-3
4	4,485	8095.037	5416.333	8285.039	3,800	3800.039	-12,855	41674814	5113.767	84.72774	197.1158	-2.5138
5	6,728	13172.2	5399.375	13511.37	6,783	6783.371	-6,072	42542675	5447.687	100.823	177.8572	-1.11453
6	10,092	18147.6	5378.176	18571.58	8,480	8479.577	2,408	47436100	5953.002	84.02276	162.2182	0.404495
7	15,137	23106.34	5357.204	23525.77	8,389	8388.774	10,797	50712589	6300.97	55.419	146.9611	1.713503
8	22,706	28175.66	5342.81	28463.54	5,758	5757.539	16,554	48517173	6233.041	25.35691	131.7606	2.65589
9	29,518	33318.45	5332.809	33518.47	4,000	4000.472	20,555	44904574	5984.978	13.55265	118.6264	3.43439
10	38,373	38637.34	5332.113	38651.26	278	278.2577	20,833	40421859	5414.306	0.725139	106.8363	3.84777
11	49,885	44265.24	5346.902	43969.46	-5,916	5915.542	14,917	39928384	5459.873	11.85836	98.20191	2.732199
12	64,851	50374.08	5384.999	49612.14	-15,239	15238.86	-321	55952930	6274.788	23.49827	91.9766	-0.05122
13				55759.08								
14				61144.08								
15				66529.08								
16				71914.08								

Inventory

Batteries

Cycle Inventory

Inputs	
Yearly Demand =	14186
Holding Cost (%) =	0.2
Per Unit Cost ($) =	67.92
Common Order Cost ($) =	15
Outputs	
Optimal Order Quantity (units) =	177.001427
Number of shipments (per year) =	80.1462463
Cycle Inventory (units) =	88.5007137
Order Frequency (days) =	4.55417461

Safety Inventory

Inputs	
Average Weekly Demand =	272.807692
Lead Time	3
Standard Deviation of weekly demand =	86.69
Target cycle service level (CSL) =	0.95
Distribution during lead time	
Mean Demand during lead time =	818.423077
Standard Deviation during lead time =	150.151485
Output	
Safety Inventory (ss) =	246.977214
Re-order Point (ROP) =	1065.40029

HydroFittings sensor faucet will require 4 Alkaline- C Size batteries to power the system for a minimum of two-years. We have decided to purchase our supply of batteries from McMaster-Carr in packs of 72 batteries. Average annual demand for batteries is going to be 14,186 packs in order to meet our forecasted demand of 255,346 faucets. We have determined that our optimal order quantity is going to be 177 packs of Alkaline- C Size batteries every 4 to 5 days. In addition, we will store a safety inventory of 247 packs incase of any demand uncertainties that may occur. Approximate total cost for batteries is going to be $663,899.60 yearly.

Infrared Sensor

Cycle Inventory		Safety Inventory	
Inputs		**Inputs**	
Yearly Demand =	255346	Average Weekly Demand =	4910.5
Holding Cost (%) =	0.2	Lead Time	4
Per Unit Cost ($) =	3.52	Standard Deviation of weekly demand =	86.69
Common Order Cost ($) =	7	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	2253.42038	Mean Demand during lead time =	19642
Number of shipments (per year) =	113.314853	Standard Deviation during lead time =	173.38
Cycle Inventory (units) =	1126.71019		
Order Frequency (days) =	3.22111346	**Output**	
		Safety Inventory (ss) =	285.184722
		Re-order Point (ROP) =	19927.1847

Our company has decided to purchase our sensor technology from Texas Instruments, located in Santa Clara, which will be right by one of our manufacturing plant. Each one of our sensor faucets will require one Infrared Thermopile Sensor to detect hand motion. In order to optimize our ordering process, we will order 2,253 units every 3 to 4 days, which comes out to approximately 113 shipments a year. Taking into account our lead-time of 4 weeks and required safety stock of 285 units to meet demand increases, our re-order point is currently at 19,927 units. Approximate total cost for infrared sensors will be $898,817.92 yearly.

Flow Monitor

Cycle Inventory		Safety Inventory	
Inputs		**Inputs**	
Yearly Demand =	255346	Average Weekly Demand =	4910.5
Holding Cost (%) =	0.2	Lead Time	4
Per Unit Cost ($) =	6.90	Standard Deviation of weekly demand =	86.69
Common Order Cost ($) =	7	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	1609.49267	Mean Demand during lead time =	19642
Number of shipments (per year) =	158.649992	Standard Deviation during lead time =	173.38
Cycle Inventory (units) =	804.746337		
Order Frequency (days) =	2.30066195	**Output**	
		Safety Inventory (ss) =	285.184722
		Re-order Point (ROP) =	19927.1847

Initially, we were going to install a plastic turbine into our system to monitor water usage. However, after further research we have decided that a Digital Flow Sensor from Futurelec will be much more cost effective and durable than a custom turbine. It will also provide us with a much more convenient installation process. Each of our sensor faucets will require one Digital Flow Sensor at a cost of $6.90 per unit. In order to optimize our yearly demand of 255,346 units, we will order 1,610 flow sensors every 2 to 3 days. With a lead-time of 4 weeks and a desired safety inventory of 285 units, our re-order point currently is going to be at 19,927 units. Approximate total cost for our flow sensors will be $1,761,887.40 yearly.

Spray Hose

Cycle Inventory		Safety Inventory	
Inputs		**Inputs**	
Yearly Demand =	255346	Average Weekly Demand =	4910.5
Holding Cost (%) =	0.2	Lead Time	4
Per Unit Cost ($) =	10.78	Standard Deviation of weekly demand =	86.69
Common Order Cost ($) =	15	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	1884.9541	Mean Demand during lead time =	19642
Number of shipments (per year) =	135.465368	Standard Deviation during lead time =	173.38
Cycle Inventory (units) =	942.477049		
Order Frequency (days) =	2.6944156	**Output**	
		Safety Inventory (ss) =	285.184722
		Re-order Point (ROP) =	19927.1847

Our sensor faucets are going to require one DANCO Spray Hose, which we will be purchasing through Home Depot. Each spray hose unit will include the necessary adapters for proper linkage. In order to meet our yearly demand of 255,346 units, we will be making approximately 136 orders with Home Depot. Each shipment will include 1,885 units of spray hoses. To prepare for any demand uncertainties that may occur, we will have a desired safety inventory of 285 DANCO Spray Hoses. In addition to our safety inventory, the lead-time of 4 weeks means we will have a re-order point of 19,927 units. Approximate total cost for spray hoses will be $2,752,629.88 yearly.

Gaskets

Cycle Inventory		Safety Inventory	
Inputs		**Inputs**	
Yearly Demand =	51069	Average Weekly Demand =	982.096154
Holding Cost (%) =	0.2	Lead Time	2
Per Unit Cost ($) =	4.76	Standard Deviation of weekly demand =	86.69
Common Order Cost ($) =	7	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	866.611046	Mean Demand during lead time =	1964.19231
Number of shipments (per year) =	58.9295512	Standard Deviation during lead time =	122.598174
Cycle Inventory (units) =	433.305523		
Order Frequency (days) =	6.19383642	**Output**	
		Safety Inventory (ss) =	201.656051
		Re-order Point (ROP) =	2165.84836

All DANCO Spray Hose are going to require two gaskets to properly seal any possible leakages. We have decided to get our supply of Viton Fluoroelastomer gaskets from McMaster-Carr who supplies them in packs of 10 gaskets. To meet our yearly demand of 255,346 sensor faucets, we will need to purchase 51,069 packs of gaskets from McMaster-Carr. To optimize our yearly shipping process, we will order 867 packs of gaskets every 6 to 7 days. This means that we will receive about 59 shipments from McMaster-Carr. Taking into account the lead-time of 2 weeks and desired safety inventory or 202 packs, the re-order point for gaskets will be at 2,166 packs.

Stainless Steel

Cycle Inventory		Safety Inventory	
Inputs		**Inputs**	
Yearly Demand =	510692	Average Weekly Demand =	9821
Holding Cost (%) =	0.2	Lead Time	4
Per Unit Cost ($) =	1.3	Standard Deviation of weekly demand =	86.69
Common Order Cost ($) =	15	Target cycle service level (CSL) =	0.95
Outputs		**Distribution during lead time**	
Optimal Order Quantity (units) =	7676.32725	Mean Demand during lead time =	39284
Number of shipments (per year) =	66.5281695	Standard Deviation during lead time =	173.38
Cycle Inventory (units) =	3838.16362		
Order Frequency (days) =	5.48639776	**Output**	
		Safety Inventory (ss) =	285.184722
		Re-order Point (ROP) =	39569.1847

As a manufacturer for our own faucets, we decided to purchase our stainless steel from Phillips Steel Company located in Long Beach, CA. Shipping costs for steel will not be expensive because our second manufacturing plant will be located in Long Beach as well. To supply our yearly demand of 255,346 faucets, we will need 510,692 pounds of stainless steel. Currently cost of steel is at $1.30 per pound, however, prices tend to vary depending on demand. To optimize our ordering process, we will order 7,676 pounds of stainless steel every 5 to 6 days. With a lead-time of 4 weeks and a desired safety inventory of 285 pounds of stainless steal, our re-order point is at 39,569 pounds.

Step 4: Check work
All work has been done correctly and we have followed format that was given to us by the instructor. In order to really understand each component and part of our product we put in a lot of research and found numbers of value to us. After researching we applied our new found knowledge to the product and double checked all our work.

Step 5: Learn and Generalize
After previous meeting with the instructor about our project phase 1, 2 and 3, we compared and contrast the needs and improvements that we needed to make. So for project phase 4, we have updated the previous information that we had from project phase 1, 2 and 3 and improved it. In this project phase we added more information on how we approach our development of our supply chain by developing the supply chain guideline. While creating the guideline we were able to really understand our product and what it will take to make this product a reality.

EXECUTIVE CONCLUSION

Throughout the last six months, HydroFittings has worked ceaselessly on developing a revolutionary product, as well as implementing a flawless supply chain system. This final report defines how our supply chain can be properly managed. The report includes various topics from the four project phases, including our supply chain strategy, demand forecasts, and sophisticated software used to simulate and manage our entire supply chain.

The first phase of our project defined the goals and objectives that our team needed to complete in regards to the supply chain of our premier product, the Smart Showerhead. In this first phase, our team worked together and developed the overall supply chain strategy using the processes taught throughout the course. We also designed the high-level structure of the supply chain drivers: inventories, facilities, transportation, and information.

The second phase included a continuation on the development of our supply chain strategy while focusing on an analysis of our product via demand forecasting. The demand forecasting methods we performed included static forecasting, moving average, simple exponential smoothing, Holt's, and Winter's methods. After using each method we were able to determine the best method for forecasting the demand of our product: Holt's method.

At the third phase, the software engineers within our team had completed the demand forecasting and inventory modules of the software for our company's supply chain management. This was done through use of VBA, Visual Basic, to simulate different possible scenarios un order to find the best configuration of safety inventory, cycle inventory, transportation, and facilities possible for our company.

The fourth phase of our project includes our complete supply chain management software, made with Visual Basic and Excel. The software that our engineers have developed will help us prepare for future scenarios and uncertainties. The supply chain guidelines presented outline how our supply chain will be managed using our software and scenarios designed by our team. This includes which forecasting method is best for our product - Holt's method, the type of inventories our operation requires, and how our company aligns itself with the four main drivers of the supply chain. Additionally, this report provides a manual to provide users the information and methods on how to operate the Visual Basic software we have created.

With a good scope of the industry and our system ready to go, HydroFittings is ready to enter the shower product market and introduce to the world to the Smart Showerhead.

Roles and Responsibilities - DAVID ANTISDEL

Project Proposal:
For our project proposal, I worked with several of my group members to develop the supply chain network, including integration with competitive strategy, supply chain strategy, and creating a high-level model of our company's supply chain network. We also worked together in analyzing the team's work from the previous quarter.

Phase I:
In Phase I, I was responsible for going back and firming up the project proposal as well as helping to design the high-level structure for the supply chain (including beginning to think about the drivers). I also helped to begin planning for the software development part of the project.

Phase II:
In phase II, I worked with Asha to design and create, as well as facilitate the MIT beer game and began development of the demand forecasting module of the software with Sean. At this point we were mostly just completing tutorials for visual basic to acquaint ourselves with the software before we began the software for the project in earnest.

Phase III:
In Phase III I worked with Sean on implementing Static Forecasting in the demand forecasting module of the software to gain an understanding of using Visual Basic with Excel and then developed the Cycle and Safety inventory modules for our project. The inventory modules needed a bit of work after this phase that I learned of during the review meeting, and that was completed between Phase III and Phase IV.

Phase IV/ Final Report:
My role in Phase IV was to assist Jason with the development of the Transportation software module. I also worked with Jon and Jason to develop the transportation network for our company. Together with the rest of the group I also simulated our products data with our software up to this point and continued to integrate the modules together.

Roles and Responsibilities - JONATHAN CHAN

Project Proposal:
For the project proposal, Jason and I were responsible for the product dissection, which was actually completed in TIM 105. However, it was still important for our group to include this just to refresh our memory on the specifications of our product. The next thing I worked on was the development of our supply chain with several other group members. This involved determining who was going to actually play a key role in our supply chain. This required all of us to research different companies that would either supply our product or purchase our product. However, throughout our phases some of these companies will have changed.

Phase I:
For Phase I of our project, Jason and I were responsible for developing the high-level structure for our supply chain. For this section, we aligned our supply chain strategy with our competitive strategy by defining the drivers for our supply chain, which included inventory, facilities, transportation, and information.

Phase II:
For Phase II of our project, we all got together to play the “MIT Beer Game”, which allowed us to understand how supply chains operated much better. For this phase, I was also responsible for developing the “moving average” method of our demand forecasting. This involved using my knowledge from past homework and implementing our data into this demand forecast.

Phase III:
For Phase III of our project, I was responsible for developing our supply chain guidelines, which turned out poorly after meeting with Subhas. Too be honest, I was unclear of what my part entitled, but after meeting with Subhas, we all had a much clearer understanding of what the guidelines consisted of. A mistake I did for this phase, was that I determined the cycle inventory and safety inventory as if we were the actual retailer, which is completely incorrect. Instead, I needed to go back to the beginning of our project and determine what our entire inventory consisted of, and analyze each one of those results.

Phase IV/ Final Report:
For phase IV of our project, I was responsible for creating a correct supply chain guideline for how our supply chain will be managed. I conducted this by doing lots of research on the different types of inventory our product required, and determined the costs, cycle inventory, and safety inventory of each inventory. We all contributed to where the actual locations of where our facilities would be, but Amy was responsible for developing that guidelines for it.

Roles and Responsibilities - SEAN MCGRATH

Project Proposal:
For our project proposal, I created the project plan and was responsible for compiling all of our work into the final proposal. I was also one of the members responsible for designing the supply chain network, including creating the competitive strategy, supply chain strategy, and high-level model of the supply chain network. I also participated in analyzing the team's previous work (this was a group effort).

Phase I:
In Phase I, I was responsible for creating the high-level plan for our software development which included assigning specific roles to each group member. I also compiled all of our work into the final Phase I document.

Phase II:
In phase II, I defined our role as the manufacturer in the supply chain as well as performed financial analysis for our product which included incorporating the product life cycle into the financial analysis from last quarter. Additionally, I participated in playing the MIT beer game with the group and helped us gain a better understanding of the bullwhip effect.

Phase III:
During this phase I began work on developing the software for our SCM system. This included implementing Static Forecasting (which I worked on with David) and then implementing all other forecasting methods including Moving Average, Simple Exponential Smoothing, Holt's Method, and Winter's Method. I also developed Supply Chain Guidelines and created a preliminary user's manual for our software module.

Phase IV/ Final Report:
My Phase IV responsibilities included implementing the Facilities software module with Asha, aiding in the integration of all our software modules, and helping in the design of our facilities which included determining location, calculating regional demand, and calculating shipping costs between facilities and demand regions. I also developed our user's manual for our SCM software system and wrote our Executive Summary

Roles and Responsibilities - ASHWATHI SREEKUMAR

Throughout the project, I worked hard and always contributed to the overall progress of the team project. I always took care of my roles and finished my responsibilities in a time efficient manner.

Project Proposal:
For the proposal I worked on creating the basic supply chain and supply chain network that we would follow for the rest of the quarter. With the help of my teammates, I used lucidcharts.com to build the diagrams.

Phase I:
For this phase, I further worked on the Supply Chain and added more in depth details. For example, after researching with the team, we determined as a group who our suppliers would be as well as who our retailers should be. For this phase I also developed a high level plan of future software development plans.

Phase II:
For phase two, I worked hard to research and create an easy to use board game to play the MIT beer game. This required me to really understand the game and how a supply chain works in order to create the board.

Phase III:
For phase 3, I worked on reading ahead and getting ready for the facilities and transportation implementations for the next phase. After reading and looking at in class notes, I planned out how both sections should be done to the best of knowledge.

Phase IV/ Final Report:
For phase 4 I worked on implementing the Facilities portion of the Visual Basic enabled software. For this job, I researched and learned more about VB as well as how to use macros. Both these processes helped me streamline the process and my understanding of the Visual Basic. Through this phase I also learned more about solver and and how to use constraints when making a calculation. For the actual final report, I made my roles and responsibilities sheet and made the table of contents.

Roles and Responsibilities - AMY ZHEN

Project Proposal:
For the project proposal, I was responsible for doing research for our product and analysis the research to incorporate the research into our final proposal. I was also responsible for the analysing the different products that our company is compared to, and developing new ideas on how our product is better than ones in the market.

Phase I:
For project phase 1, I was working on various parts of the project phase. David and I were responsible for overlooking at the project proposal. I was working with Asha for developing the overall supply chain strategy, and clearly state the logic used to determine this strategy.

Phase II:
In project phase 2, our group started the project phase by playing the MIT beer game, and learned about the different strategies and effects that each part of the supply chain has, such as the bullwhip effect. I was also responsible for compiling and editing our work into the final project phase 2 document.

Phase III:
For project phase 3, I was designing the implementing transportation network and the facilities, which was working on the different parts of the networking strategy for our company. Jon and I were also simulating the product's supply chain and examine various scenarios using the integrated software. We were testing our software for problems that can occur in our system, and how we need these problem to be fixed. I was also responsible for compiling and editing our work for project phase 3.

Phase IV/ Final Report:
In project phase 4, I was working on align and integrate the high-level strategies with the detailed implementations of each driver, which was looking back at the supply chain drivers that we have done before and adding more details to them. I was also working on developing the proper SC management guidelines for the company's product. Our group also overlooked the overall project together and identify questions that we had for our project to improve our strategy. I was also responsible for compiling and editing work for project phase 4.

Roles and Responsibilities - JASON ZHOU

Project Proposal:
For the project proposal, Jonathan and I were responsible for the product dissection. This was more of a recap on what we had completed in TIM 105. It helped our group refresh their memories in the specifications of our product and determine what components to research in developing our own product. Next, as a group we worked on the development of our supply chain. This involved determining the key roles and players in our supply chain. We researched different companies that would supply our product and we determined the region for favorable suppliers.

Phase I:
For Phase I of our project, Jonathan and I developed the high-level structure for our supply chain. We defined the drivers in our supply chain, which included inventory, facilities, transportation, and information.

Phase II:
For Phase 2 of our project, we all got together and played the MIT Beer Game to better understand a supply chain. It gave me a basic idea of forecasting demand in order to have the necessary inventory to meet customer demands. It also helped me understand how I had to factor in replenishment time and safety inventory to meet sudden spikes in customer demand. We also worked together in implementing the different demand forecast methods into the software platform (Excel).

Phase III:
For Phase 3 of our project, I tried my best in integrating our high-level strategies with detailed implementations of each driver.

Phase IV/ Final Report:
For Phase 4 of our project, I worked with David in implementing the Transportation Network portion of visual basic into our software framework. This part was fairly difficult for me, so I had to shadow David and learn how to use visual basic before being able to proceed with using visual basic on my own. We were able to implement formulas in calculating transportation costs as well as the differences in costs for different modes of transportation into visual basic. Together as a group we also worked in completing the remaining portions of this project.