

Show HP the money!

Golden Solutions solving HPs problems



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Preface

This is the document to round off the module Professional Skills. During this module a team of students took on the role of consultants – working as consultants for the fictional consultancy firm Golden Solutions. In this role we had to work on a case that takes place at HP.

This document has been written by a team of six students. All students of this team are fourth year students of the study Logistics and Economics at the Rotterdam University of Applied Sciences. This report has been written primarily for our tutors Ms Van Hove and Mr Pikaar, but also for our classmates who will act as our clients – working at HP – during the final meeting.

We would like to use this opportunity to thank our tutors. Ms Van Hove and Mr Pikaar gave us good tips during our first trainings sessions, which were very useful in the further process of writing this document. Finally, we hope you will find this document interesting, informative and maybe even somewhat entertaining.

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Management summary

Hewlett-Packard (HP) introduced the DeskJet printer in 1988, which became a great success for the company. During the 1990s over 600 thousand were sold per year.

There are two tasks for the consultancy team of Golden Solutions. The first issue is about inventory, with the project team needing to develop an inventory model. The second issue is whether printers should be assembled at distribution centres – the so-called 'postponement'.

In the current situation all DeskJet printers are produced in Vancouver, Canada. The production in Canada also includes the so-called 'localization', which is the process of making printers specific for certain countries by adding manuals in correct languages etc.

HP has a lot of problems containing stock, which leads to annual costs (for inventory and ordering costs) of \$ 8,679,900.

The first method Golden Solutions has calculated gave annual costs of \$ 7,547,600. In these calculations the consultancy company used a number of logistical formulas, such 'reorderpoint', 'economic order quantity' and the 'average inventory level' which have led to significant savings of 13 percent for HP.

The second method Golden Solutions looked at is postponement. A postponement strategy aims at delaying some supply chain activities until customer demand is revealed in order to maintain both low system wide costs and fast response. This kind of strategy has a lot of consequences for an organization, e.g. in process flexibility, improving competitiveness, reducing stock levels and money spent on assembly postponement.

The postponement method gives annual costs of \$ 4,789,850, but these costs are increased by investment costs which were calculated to be \$ 560,000 during the first year. Even including these investment costs HP could save \$ 3,330,050 (or 38 percent) during the first year on inventory and ordering costs in comparison to the current situation.

Golden Solutions believes HP has three possible options regarding their problems. These options being:

1. Keep working as in the current situation
2. Start working with the developed inventory model
3. Implementing postponement

The consultants of Golden Solutions believe that implementing postponement will be the best choice. This option brings the largest amount of savings to HP, as mentioned before.

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Introduction

Hewlett-Packard benefited from the successful introduction of the DeskJet printer in 1988. The top of the success story came in the 1990s when Hewlett-Packard sold around 600 thousand units a year of this printer. But in the highly competitive printer market Hewlett-Packard still want to improve their performances while saving money. For this case Hewlett-Packard asked the consultants from Golden Solutions to give advice about the following subjects:

- Inventory levels and forecasting for the DeskJet printer;
- Integration of the printer assembly in the distribution process.

First the consultants will describe the issues for Hewlett-Packard. Followed by a sketch of the current situation of the processes, the inventory levels and forecasting for the DeskJet printer. This part is followed by a calculation of the total cost in the current situation. After that an advice is given about ordering, lowering inventory costs and total savings.

The second part of this report is about the integration of the assembly process in the distribution centres. After that an explanation is given about the application of postponement, together with the advantages of this strategy. This part is followed by a calculation of the actual costs of this method.

At the end of this document the consultants will give recommendations to Hewlett-Packard about managing the inventory levels and forecasting and the possible application of postponement. This is supplemented by an overview of the possible savings for Hewlett-Packard.

1. Case description

In 1988 Hewlett-Packard (HP) introduced the DeskJet printer and in a few years the printer became one of the most successful products HP ever produced. Customers from all over the world bought the printers and at the top in the 1990s the printer sold over 600 thousand pieces a year. Because of the big success HP had to fill up their distribution centres to the maximum inventory level, especially in Europe. But the European departments were still claiming to raise the inventory levels for the printer. Beside the inventory levels, HP also had another problem in Europe. Because of a difference in language and in power supply requirements, HP has to customize the printer for the local countries. This process, localization called, involves assembling of the power supply module and packaging the manual written in appropriate language. As a result of the localization there are six different models produced for the European market. Every model has the same factory throughput; this will take about one week. Transportation time from Vancouver to the European Distribution Centre is about five weeks. And every week one shipment is made for Europe.

The printer industry can be described as highly competitive and resellers would like to have as little inventory as possible. As a result of that, HP has to keep high inventory levels in the European distribution centre. In the past HP already managed to provide a high service level to their customers because of forecasting the demand. However the forecasting was a result of some judgmental rule of thumb. Nowadays this type of forecasting isn't working anymore and to make more accurate forecasts it's important to reconsider the safety stock rules.

For this research the management team decided that the consultants should use the following assumptions:

- Because of various inventory carrying costs, the management decided to use 25 percent;
- The approximate cost price for the printer is \$ 250, including transport to Europe;
- The probability should be at least 98 percent.

The distribution process in the distributions centres can be described as a simple straight-line, standardized process. In total there are four processes in the distribution centre:

- Receiving and stocking products
- Picking products
- Shrink-wrap the order
- Ship the order

The DeskJet printer fits well in this simple straight-line, standardized process. And because of that the management of the distribution centres and the top management are arguing about integration of the printer assembly in the process. The management of the distribution centres believes that the distribution should focus on the distribution process. The top managers of HP however are interested in the possibility to assemble printers in the process.

In this case there are two problems which have to be solved. Firstly, the consultants have to find a solution for the inventory issues and develop an inventory model. Then the consultants have to compare the results to the current situation.

The second issue is about the discussion of the integration of the printer assembly in the distribution centres. For this issue the consultants should give advice about inventory investments impact for the distribution centres.

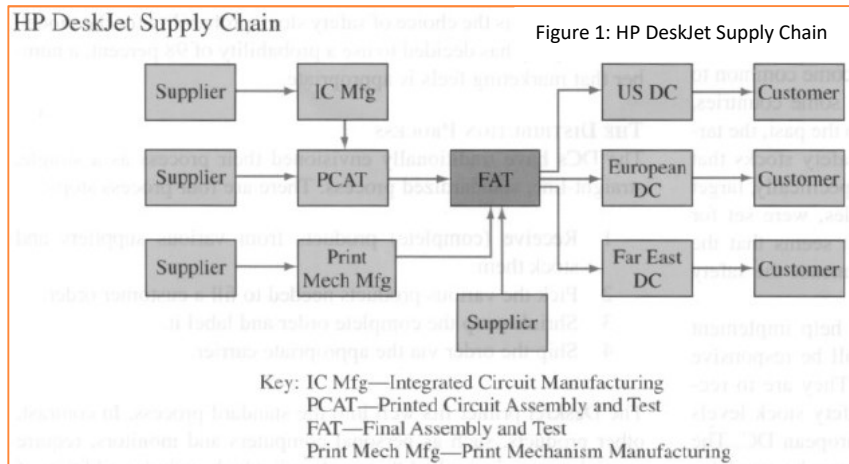
2. Current situation

In this chapter the current situation at HP will be described by the consultancy team. Firstly, the processes will be described followed by the stock and the costs of the current situation.

2.1 Processes

In the current situation, certain processes can be distinguished in the factory and in the entire supply chain. First off, the consultants will describe the situation in the supply chain and have a closer look at the process situations in the factory.

Figure 1: HP DeskJet Supply Chain shows the supply chain of the printers of HP. In the current situation, the manufacturing plant in Vancouver receives goods from the supplier. The DeskJet printers get made in this factory. The process of 'localization', where products are specified for different countries and regions, takes place in Vancouver as well. For the



European market, currently six different types are being produced. When this process is finished, the goods get shipped to the different distribution centres, in particular the European distribution centre. The transit time from the factory in Vancouver to the European distribution centre is five weeks, and shipments are weekly. At this rate, the stock is kept high to provide satisfactory product availability. Once in Europe, the products get shipped further on to the customers.

In the factory, different processes take place to finish the products. As said before, in the current situation products get 'localized'. All the process steps in the Bill of Materials get finished in Vancouver at the moment. The four steps given in the supply chain figure to create the printers are:

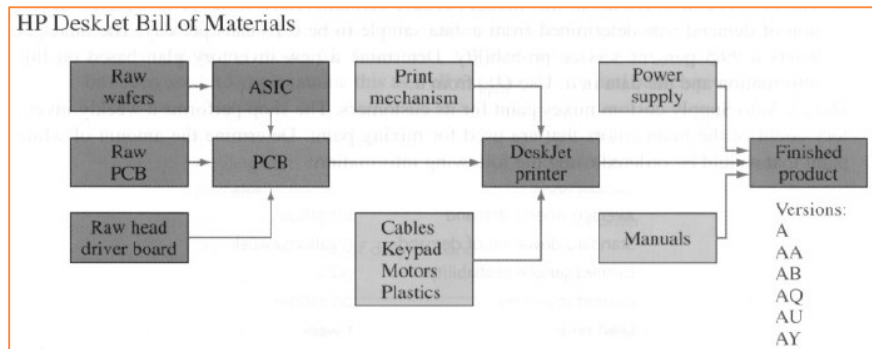


Figure 2: HP DeskJet Bill of Materials

- Integrated circuit manufacturing;
- Print mechanism manufacturing;
- Printed circuit assembly and test (PCAT);
- Final Assembly and Test (FAT).

PCAT and FAT are the two key processes. PCAT involves the assembly and testing of electronic components to make logic boards used in the printer. FAT involves the assembly of other subassemblies to produce a working printer, as well as the final testing of the printer. The components needed for these steps are sourced from other HP divisions and other external suppliers.

The distribution centres have traditionally envisioned their process as a simple, straight-line, standardized process. There are four process stops taking place. First of all, a distribution centre receives (finished) products from various suppliers and stocks them. Then, the various products needed to fill a customer

order get picked. After that, the entire order gets shrink-wrapped and labelled. And finally, the order gets shipped via the appropriate carrier.

2.2 Stock

It is difficult for the management to keep the stock at a good level. The company wants to limit its inventory throughput and at the same time provide a high service level. To keep the service level high, a high level of stock should be kept. The stock levels are determined by the forecasts. In the past, stock levels were based on safety stocks that were a result of some judgmental rule of thumb. In the current situation, inventory levels are based on one-month average sales. The increasing difficulty of getting accurate forecasts, could lead to revisiting the safety stock rules.

The choice of inventory carrying cost used in safety stock analysis remains an issue within the company. Estimates within the company range from 12 percent for HP's cost of debt plus some warehousing expenses, to 60 percent, which is based on the ROI expected of new product development projects. The management has decided to use 25 percent in this case. The company has decided to use a probability of 98 percent for the safety stock probability, because marketing feels that is appropriate.

2.3 Current costs

In the current situation, the inventory level for every product stays the same during the entire year. This causes the inventory costs to be the same every month. Every month, there are six moments the company orders, so the ordering costs stay the same every month as well. The inventory costs are almost \$ 8.7 million on a yearly basis. These costs are calculated by multiplying the yearly inventory with the production and shipping costs and a percentage of the inventory carrying costs. The ordering costs are \$ 14,400 on a yearly basis. Products get ordered six times a month, and 72 times a year. With ordering costs of \$ 200, ordering costs per year are \$ 14,400. Together with the inventory costs, this gives total costs of \$ 8,679,900 per year in the current situation.

Total yearly inventory	138648
Inventory Carrying Costs	25%
Production and Shipping	\$250.00
Inventory Costs	\$8,665,500
Ordering Costs	\$ 14,400
Total Costs	\$8,679,900

Figure 3: Total costs current situation

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3. New situation – Inventory costs reduction

For the new situation the consultants made various calculations in order to reduce the inventory costs. In this chapter the calculation of the highest reduction is presented, these results are shown in *Figure 4: Total costs improved situation without postponement*. The results of the calculations will help HP to become more efficient and save money on the inventory costs. Less space is used, because the stocks will be lower for most products.

3.1 Basics of the model

Some terms in *Figure 4: Total costs improved situation without postponement* may be not exactly clear. This paragraph will help to explain the used terms and a short motivation why these are calculated. The calculations were based on a 98 percent service level degree.

- ROP stands for 'reorderpoint'. The employees of HP in Europe should order new products at the moment when the stock of a product is lower than this point. If you use these levels to reorder you will not run out of stock in 98 percent of the customer orders. This is because of the safety stock which will save the company when the demand of a customer for a product is higher or the lead time is longer due to longer shipping times for example.
- EOQ means 'economic order quantity' and is the size of the order when the reorderpoint is passed. This is the most cost efficient order quantity. With the EOQ you can calculate how many orders the employees of HP Europe will place during a year.
- AIL 1 is the 'average inventory level'. With these levels the inventory costs are calculated. The AIL is the safety stock plus the EOQ divided by 2. That is because the average inventory is the point between the inventory at the beginning of the month and the inventory at the end of the month.

European options	Total	Average monthly demand	leadtime (in maanden)	ROP	STDEV	Safety Stock	EOQ	AIL1	Orders per year	annual ordering costs	annual inventory costs	Total Costs
A	508	43	1,25	54	32,4	52	57	84	9	\$ 1.800	\$ 63.000	\$ 64.800
AB	189960	15830	1,25	19788	5624,7	9004	1103	5605	172	\$ 34.400	\$ 4.203.750	\$ 4.238.150
AU	50496	4208	1,25	5260	2204,6	3530	568	2334	89	\$ 17.800	\$ 1.750.500	\$ 1.768.300
AA	5042	421	1,25	527	203,9	327	180	344	28	\$ 5.600	\$ 258.000	\$ 263.600
AQ	27614	2302	1,25	2878	1168,5	1871	420	1356	66	\$ 13.200	\$ 1.017.000	\$ 1.030.200
AY	3682	307	1,25	384	103,1	166	154	237	24	\$ 4.800	\$ 177.750	\$ 182.550
Total costs:										\$ 77.600	\$ 7.470.000	\$ 7.547.600

Figure 4: Total costs improved situation without postponement

The used formulas all give logical answers except for the result of the safety stock of product A. The AIL of the DeskJet with European option A is almost the average demand for two months. This is a result of the calculations because the standard deviation was relatively high compared to the average demand per month. The consultant team would like to discuss with the top management of HP what a sufficient safety stock will be.

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3.2 Costs

In the new situation without the postponement method HP will probably save about 10-15 percent of the costs for holding and ordering a year. This is presented in *Figure 5: Costs savings in percentages*. The inventory costs will decrease with high proportions because the inventory levels will be lower. The consequence of the lower inventory levels is that the employees of HP in Europe should place more (smaller) orders a year. The ordering costs will increase, but savings on the inventory costs will cover these extra costs and save after those costs as well.

Inventory and order costs		
	Total costs	Savings
Costs current situation	\$ 8.679.900	
Costs new situation	\$ 7.547.600	13%

Figure 5: Costs savings in percentages

4. Postponement

In this chapter there is some research will be presented of the idea of supplying generic printers to the Europe distribution centre and integrating the product by packaging the power supply and the instruction manual at the distribution centre just prior to delivery to the European resellers.

At this moment each country has specific requirement on power cord, transformer and language manual. The localization is done in the FAT phase of the production at the Vancouver manufacturing plant.

Before giving advice on the possibility to apply postponement, the consultants from Golden Solutions would like to inform the top management of HP about postponement.

In this part, a research is performed of the possibility to expand the activities in the distribution centres and support assembly processes. It is about supplying generic printers to the distribution centres in Europe and integrating the product by packaging the power supply and instruction manual at the distribution centres just prior to shipment to the European resellers. Generic printers could be produced and shipped to Europe instead of the factory making products specific to a country.

This business strategy mentioned above is called 'postponement'. A postponement strategy aims at delaying some supply chain activities until customer demand is revealed in order to maintain both low system wide costs and fast response. It minimizes risk by delaying investment into a product until the last possible moment. In other words: delaying product differentiation to the local markets. In case of HP, it is about assembly postponement: additional assembly may be performed at the distribution centre before shipping the product to the customer after demand is realized. This means that the printers of HP arrived in semi-finished form into the distribution centres in Europe and can be customized quickly.

4.1 Advantages and disadvantages

Implementing postponement has a number of advantages and disadvantages for HP. The advantages and disadvantages are mentioned in the subjects below:

- **Process flexibility:**

A significant and current problem for HP is the inaccurate forecasting of demand in Europe. Momentarily it occurs that some European countries have too little products, while other countries have inventory piling up. If imbalances between supply and demand occur, then it is possible to ship from one to another distribution center but this is not an ideal situation. It is necessary for companies to act quickly and actively on changing markets. Short lead times and responding quickly to customer demands are also necessities. To respond to the continuously changing demand it is a great advantage to implement the postponement strategy. Products can be modified easily in this strategy, causing great chances for HP to respond on demand fluctuations and as a consequence increase service levels.

- **Improving competitiveness:**

The printer industry is highly competitive. Resellers want to carry as little inventory as possible. HP has to provide high levels of availability at the distribution centers, because the lead times have to be short to the markets. The postponement strategy will improve competitiveness by offering customized products quickly, which will prove to be an advantage for HP.

- **Reduction of inventory level:**

The current problem for HP is that the company provides high levels of product availability at the distribution centers. The strategy of HP is to limit its inventory throughput and at the same time provide a high service level. To keep the service level high, a high level of stock should be kept. An advantage of the postponement strategy is a reduction of the inventory level. HP will produce generic printers and transport these to Europe, where the printers can be made specific to a certain demand of a country. The stock will consist of semi-finished products that will be assembled when the wishes of a customer are known. The risk of obsolescence of products will also decrease.

- **Costs of assembly postponement:**

Due to the assembly postponement, the manufacturing costs of the printers will increase. The assembly activities cannot be done in one big batch, so the assembly costs will increase by losing economies of scale. The component costs may increase, because the purchasing of materials that differentiates the printers will be done separately by all the distribution centers. Naturally there also

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some benefits, such as lower inventory costs due to stocking standard printers and lower transportation costs, because it is easier and cheaper to ship generic products than finished products due to the packaging. After manufacturing the printers go straight ahead into their final packaging. Because the final packaging is often oversized there are large amounts of wasted space and bulky padding. However the final packaging is often oversized, has a large amount of wasted space and includes bulky padding. The final packaging of the printers can be postponed until the product is ready to send to the customer. HP can also realize savings in unnecessary inventory costs, because the risk of obsolete products will decrease.

5. New situation – Postponement

For the new situation it is important to investigate the possibility of shipping unlocalized printers to the European distribution centre and localize them after observing local demand. This means that the localization is done just before delivery to the resellers in Europe.

In *Figure 6: Postponement costs* the costs are shown of each process.

Orders per year	Annual ordering costs	Annual inventory costs	Total Costs
9	\$ 1.800	\$ 63.000	\$ 64.800
172	\$ 34.400	\$ 4.203.750	\$ 4.238.150
89	\$ 17.800	\$ 1.750.500	\$ 1.768.300
28	\$ 5.600	\$ 258.000	\$ 263.600
66	\$ 13.200	\$ 1.017.000	\$ 1.030.200
24	\$ 4.800	\$ 177.750	\$ 182.550
	\$ 77.600	\$ 7.470.000	\$ 7.547.600
208	\$ 41.600	\$ 4.748.250	\$ 4.789.850

Figure 6: Postponement costs

The costs after the postponement strategy is reduced 45 percent compared with the current situation, but it must be kept in mind that investment costs are not taken into account in this percentage. The data is illustrated in the *Figure 7: Inventory and order costs* below.

Inventory and order costs		
	Total costs	Savings
Costs current situation	\$ 8.679.900	
Costs after postponement	\$ 4.789.850	45%

Figure 7: Inventory and order costs

The reasons of the lower total costs compared with the current situation and the new inventory model are:

- Safety stock is lower;
- The inventory costs per item will be lower;
- Ordering costs are lower, because of the generic printer is only to order;
- Ordering can be done less frequent and with a higher EOQ.

To apply the postponement strategy it is important to make some important considerations. The most important considerations are:

- Difficult to quantify benefits, like flexibility and better customer service, in cost-benefit analysis of design for logistics initiatives;
- Completing the manufacturing process in the distribution centre reduce tariffs & duties.

5.1 Investment costs

When the management of HP evaluates the idea of supplying generic printers to the Europe distribution centre and integrating the postponement strategy, there must be some investments in different parts of the production. A number of these investments are summed up below:

- More employees are needed in the Europe distribution centre for the local demand;
- The power cord, transformer and language manual are delivered by a local supplier;
- More capacity;

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- Assembly machine is needed.

The costs of implementing the postponement strategy can be seen in the figure below.

Investments				
	#	Costs	Total	Total (dollars)
Hiring new personnel	7 FTE	€ 25 per hour	€ 350.000	
Assembly machine	1	€ 15000 per machine	€ 15.000	
Warehouse capacity	300 m2	€ 180 rent per m2/per year	€ 54.000	
Maintenance		€ 1500 per year	€ 1.500	
Total costs			€ 420.500	\$ 560.000

Figure 8: Investments

As can be seen investment costs for the first year will be \$ 560,000. This amount is based on assumptions made by Golden Solutions.

6. Conclusions and recommendations

In this chapter the consultants of Golden Solutions will present the final conclusions and recommendations of this document.

6.1 Conclusions

Golden Solutions has made extensive calculations for HP. All these calculations result in *Figure 9: Annual costs per situation*.

Situation	Annual costs			Total	Annual savings	Percentage
	Ordering	Inventory	Investments			
Current situation	\$ 14.400	\$ 8.665.500	-	\$ 8.679.900	-	
New situation - Inventory model	\$ 77.600	\$ 7.470.000	-	\$ 7.547.600	\$ 1.132.300	13%
New situation - Postponement	\$ 41.600	\$ 4.748.250	\$ 560.000	\$ 5.349.850	\$ 3.330.050	38%

Figure 9: Annual costs per situation

Figure 9: Annual costs per situation shows that the savings in the postponement method are the biggest. HP can save 38 percent of costs in comparison to the costs in the current situation in the first year alone. Also the developed inventory model achieves substantial savings for HP. The percentage of these savings is 13 percent.

6.2 Recommendations

The consultancy team has performed a large amount of work that can lead to one of three decisions, which eventually have to be made by HP. The possible decisions are:

1. HP continues working how the company is doing momentarily (see *Figure 9: Annual costs per situation I* for an overview of these costs)
2. HP decides to work with the developed method, which is using the model without postponement (see *Figure9: Annual costs per situation I* for an overview of these costs)
3. HP decides to work with the researched postponement method (see *Figure 9: Annual costs per situation I* for an overview of these costs)

Golden Solutions, being a consultancy company, realizes it does not have a real say in what option HP will eventually decide to use. However, Golden Solutions does strongly recommend HP to look very seriously at the postponement method the consultancy team has worked out.

The postponement method will save HP \$ 3,330,050 (or 38 percent) in costs spent on inventory and ordering in comparison to the current method used. The amount named is the savings for the first year, which means that following years the savings can even be more due to fewer investments needing to be made.

The consultancy firm also believes that these kinds of savings are crucial for companies working in the world of selling printers. Because, as mentioned before in this document, the printer selling market is a highly competitive market in which price can be very important.

The postponement method is a very far-reaching method, which will have consequences for many processes, employees, suppliers and customers of HP. And because of all these parties involved there might be some reluctance of implementing this method – Golden Solutions acknowledges this. Nevertheless, the consultancy team believes this will be the best solution for HP and is gladly willing to help by any further decisions or steps that are to be made by HP in the future.

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