APPLICATION OF INCENTIVE COMMITMENT TO CONTROL CHANGES IN CUSTOMER ORDERS

By
NITHIKARN YONGYUTH

A Final Report of the Six-Credit Course
SCM 2202 Graduate Project

Submitted in Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN SUPPLY CHAIN MANAGEMENT

Martin de Tours School of Management
Assumption University
Bangkok, Thailand

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Approved for Graduation on: November 13, 2010

Martin de Tours School of Management
Assumption University
Bangkok, Thailand

November, 2010

Assumption University

Martin de Tours School of Management

Master of Science in Supply Chain Management

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Application of Incentive Commitment to Control Changes in Customer Orders

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and hereby certify that the verbiage, spelling and format is commensurate with the quality of internationally acceptable writing standards for a master degree in supply chain management.

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Master of Science in Supply Chain Management

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I, Nithikarn Yongyuth declare that this thesis/project and the work presented in it are my own and has been generated by me as the result of my own original research.

Application of Incentive Commitment to control changes in Customer orders

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ABSTRACT

This research project sprang from the realization by a company of a mismatch between its forecast of customer orders, high level of excess inventory, high capital investment of inventory cost, and low customer service level. The aim of this research study is to propose a new planning mechanism under the concept of 'incentive commitment'.

Incentive commitment refers to the process of sharing costs, risks, and benefits among the participating members (Simatupang and Sridharan, 2002). This scheme motivates the partners to realize the benefits of strong relationships toward achieving common goals and mutual objectives, in which desired behavior between collaborative partners can be motivated by bonuses in terms of discounts, and penalties, by levying fee charges and excess inventory charges.

The purpose of this research study is to provide the company with an effective decision making tool for planning and forecasting customer orders, enabling the company to provide strong commitment and achieve whatever is promised, gain the benefits of credibility and good performance ratings in terms of improving the customer service level, and lastly, benefits in terms of inventory level and cost reduction.

The research findings show positive improvements in what the study is expected to achieve. The variance between forecast and customer orders has tremendously decreased to 5.34%. The opportunity profit shows an increase of $28,622.1 from the planned forecast, and the excess inventory level/cost shows only 16 units or $ 3,387.2. Finally, the company can achieve a 100% customer service level.

ACKNOWLEDGEMENTS

I would like to convey my special thank to my project advisor, Dr. Peeratarat Ittarattanachoke for excellent support, innovative ideas, and recommendations. Without his dedicated contribution, I might not have been able to complete my graduate project.

My thanks also to my supervisor and my colleagues who always cheered me up and gave me a thousand kind words when I was discouraged and exhausted. Moreover, thank you for providing me with this opportunity to improve myself and make me realize the importance of self-development.

Lastly, thank you to my family and friends, who are always by my side, encouraging me to pursue my best efforts to finally complete my graduate project and receive the Master's Degree.

Ms. Nithikarn Yongyuth
Assumption University
November, 2010

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CHAPTER I

GENERALITIES OF THE STUDY

1.1 Background of the Study

As everyone knows, demand is the greatest source of uncertainty that a company faces, as most companies find themselves in trouble with numerous errors in their forecasts. They realize that the forecast is inexact and does not match with the customer orders, but unfortunately they do not know how to fix it. Inaccurate forecasts cause many companies to accumulate a huge amount of holding inventory and its associated costs.

Company A is one of the companies which has encountered this problem of a mismatch between forecast and customer orders. Inventory holding is another business practice that a company uses in to answering the requirement for on time delivery and to increase its position in the market. However, a trade off needs to be considered in terms of the associated cost and a tendency towards obsolescence.

Lack of collaboration among supply chain partners is often a root cause of the problem. This research study introduces the concept of incentive commitment by using bonus and penalty to control the changes in customer orders by a certain percentage per period of time. The concept will enhance the quality of decision-making, reduce demand uncertainty and forecast error, and ultimately improve supply chain performance.

Company Background

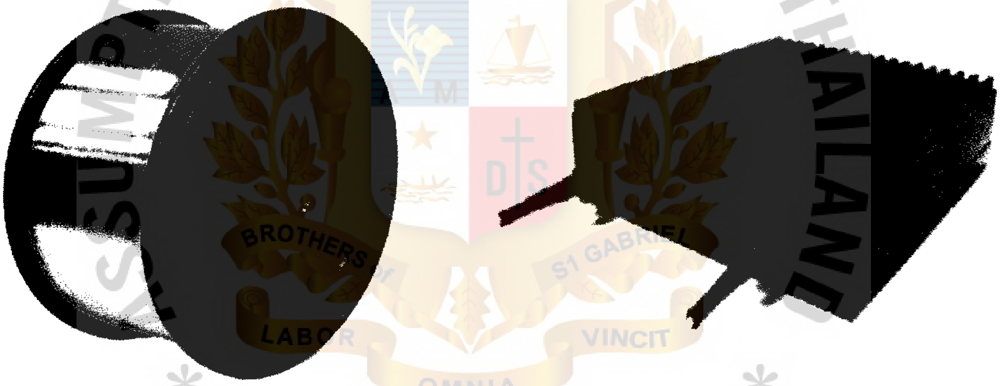
Company A is an electronics manufacturing service to provide fiber optics electronic components and communication equipment to its leading customers in Asia-Pacific, China, India, Europe and the United States.

Company product

Intelligent Photonic Solutions™ from Company A encompass discrete active or passive stand-alone components, integrated optical modules and optical subsystems. One company product introduced in this research study is Dispersion Compensation Module (DCM). The DCM product can be expressed as a unique expertise product of the company, and there are less than five companies in the world who develop, design and supply this product to the market. Moreover, Company A is the only supplier in Thailand.

- **Dispersion Compensation Modules (DCM)**

Figure1.1: Company product: Dispersion Compensation Modules (DCM)



Source: Company A

1.2 Statement of Problem

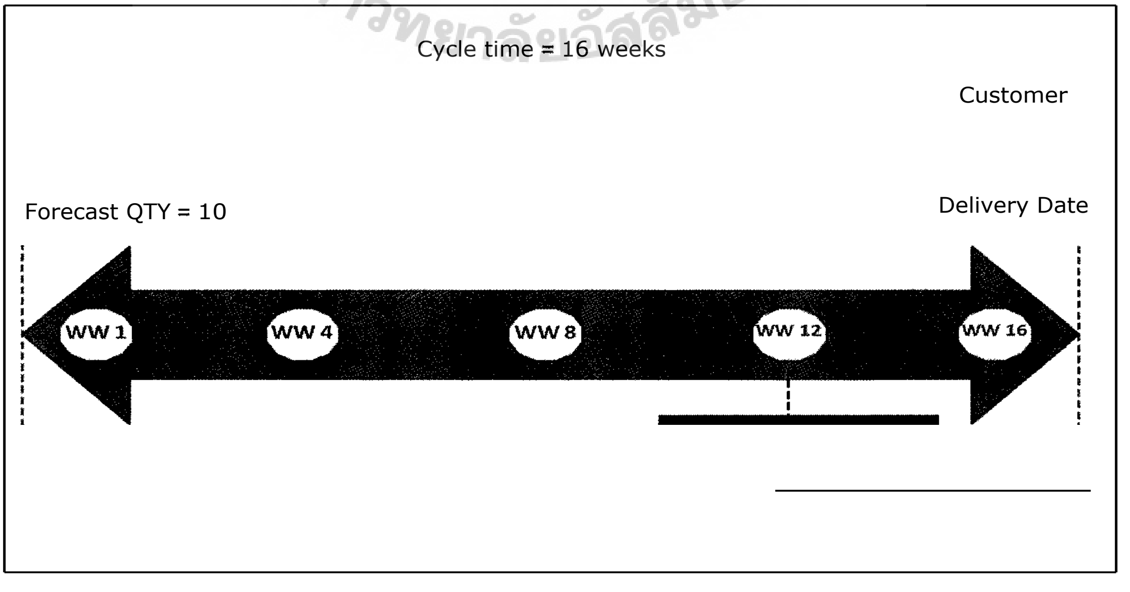
The Product Line Manager and Sales person develop and design yearly forecasts based on volume of orders provided by customers. This forecast data will be classified into four quarters in a year, then the information will be reviewed and the correctness adjusted for appropriateness before being sent to the planning team at the Bangkok, Thailand office. The planning team verifies the forecast and communicates it to a contract manufacturer (CM) in order to prepare the production process, which includes requiring raw materials or parts from suppliers, and production capacity (machine and labor), for each period of the required order.

The problem occurs when a customer order provided by a customer does not match with the planned forecast from the Product line Manager and sales. Possible causes for forecast and customer order mismatch can be that the customers change their orders abruptly or because of strong market trends. The result from these possible two reasons is that there is more pressure exerted on the company to produce more products in response to the shifting new demand within a tight cycle time schedule. However, sometimes the planned forecast demand is lower than an actual customer order. This may be caused by a design change, or customers reduce their demand of the product due to a drop in market demand or low profitability. In this case, the company does not need to be in a rush to pressurize the production process to catch up with new changing demands. However, the drawback comes in the form of excess capacity and inventory. This unused inventory is kept in the warehouse, with the risk of obsolescence.

There are two simulated examples from the company's forecast and customer order mismatch problem.

Example 1: Forecast =10, customer order = 30, cycle time = 4 months (16 weeks)

Figure 1.2: Example of forecast and customer order mismatch in the condition when forecast is less than customer demand



The example in Figure 1.2 illustrate that the planned forecast for Product A is 10 units under its cycle time of 16 weeks or 4 months. The forecast has been placed until reaching work week 12. Unexpectedly, the customer order has been changed by increasing it from 10 to 30 units. Unfortunately, there are only 4 weeks left to expedite an extra 20 units in order to catch up and be able to ensure shipment on the customer's requested date.

This situation makes it difficult for the company to apply more pressure in expediting the contract manufacturer to produce another 20 units within the shorter cycle time of 4 weeks. Finally, if the company is able to deliver 30 units of the product on the customer's requested date, the company can achieve its target service level, but there are many hidden costs in this, such as expediting cost, labor hours and wage, and other administrative costs. In another case, if the company fails to deliver the required number of a customer's order for 30 units, it results in a low customer service level, low supplier's credibility, low profit, and opportunity lost, or even worse if the customer switches to a competitor.

Example 2: Forecast = 100, customer order = 70, cycle time = 4 months (16 weeks)

Figure 1.3: Example of forecast and customer order mismatch in the condition when a forecast is more than customer demand

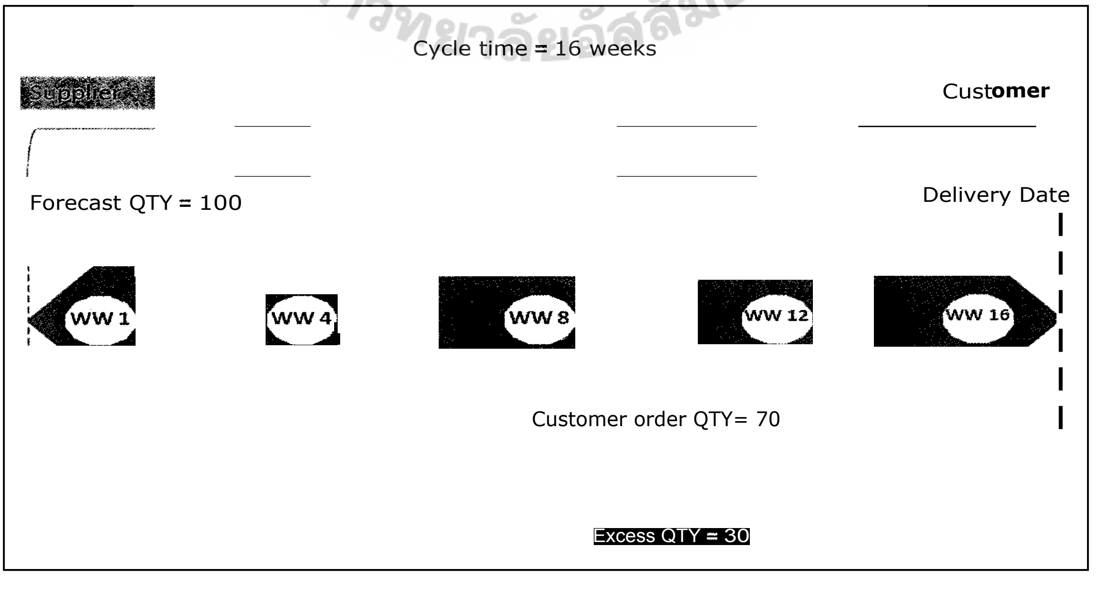


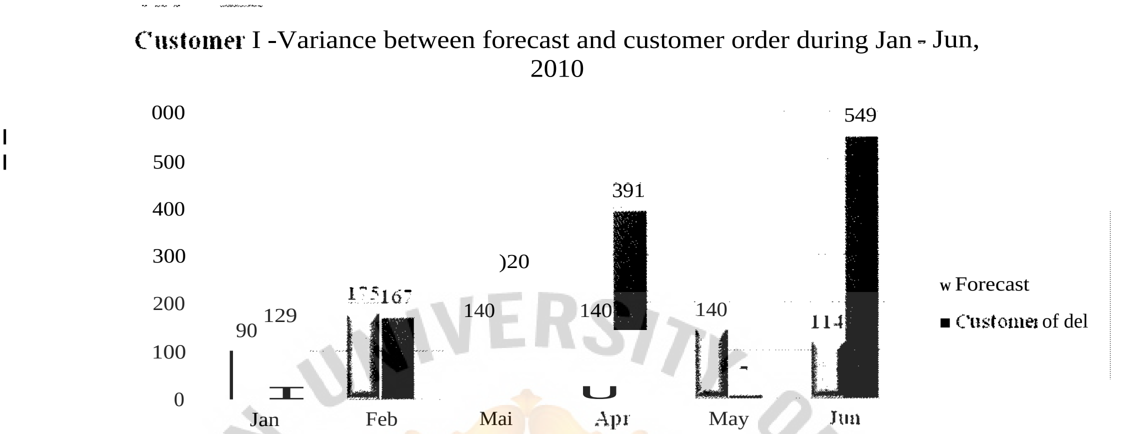
Figure1.3 provides another example of the situation when forecast and customer demand do not match. The forecast for Product B is 100 units, however at work week 10, the customer order is reduced to 70. This situation reflects the opposite of the first example. In this case the forecast order is more than (>) the customer's order. Obviously, the company accomplishes delivery of the required number of the product (70 units) to the customer on their requested date. Customer demand has been satisfied, and the company got sales revenue from on-time delivery. At the same time, there is an excess inventory of Product B of 30 units. This causes the company to accrue a high level of inventory which requires warehouse management cost and also the company's capital investment on inventory holding. The company is also at risk from the tendency to product obsolescence.

The Company solved the uncertainty and mismatch problem between forecast and customer order by a short term solution of increasing the level of inventory to satisfy the immediate requirement. However, by building up inventory, the company has caused a widespread negative impact on the other supply chain partners. Each member acts responsively in the same way by adding inventory in their warehouse. The situation is called the Bullwhip effect and has unavoidably happened.

Next, is a summary of forecast and customer order mismatch that actually happened between the company and three first tier customers.

The variance between forecast and customer order from January to June, 2010 for **Customer I** has been shown in Figures 1.4 and 1.5. I January, the customer order was higher than forecast by approximately 34 %. In February, the figure is slightly different; there was an excess inventory of only 8 units. In March, there was a significant increase of the customer orders by about 64 %, but in April, there was a critical discrepancy of customer orders which were about 179 % higher than the planned forecast. Then in May, customer orders were only 7 out of the 140 forecast quantity. The variance was the highest in June in which customer orders were 382 % higher than forecast.

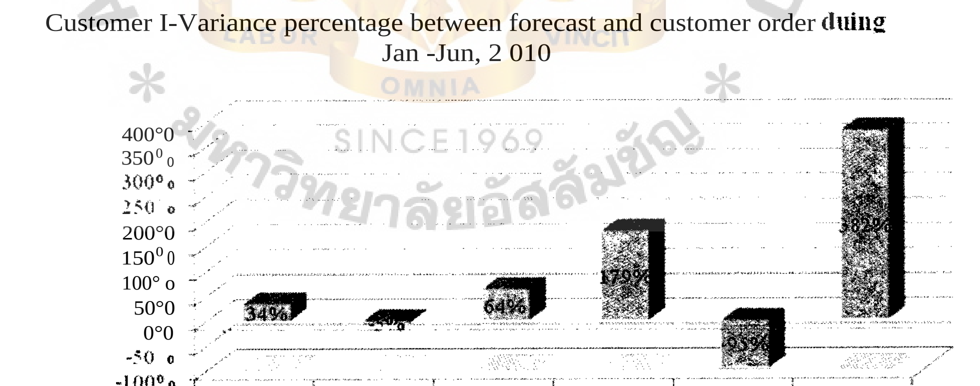
Figure 1.4: Summary of variance between forecast and customer order of Customer I during January – June, 2010



	Jan	Feb	Mar	Apr	May	Jun
Forecast	90	175	140	140	140	114
Customer order	129	167	229	391		549

Source: Company A

Figure 1.5: Summary of variance percentage between forecast and customer order of Customer I during January – June, 2010



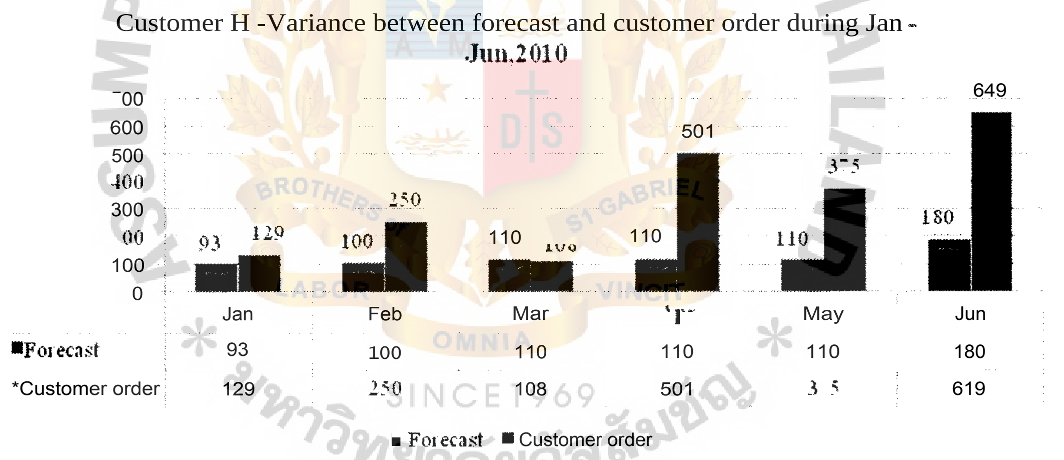
	Jan	Feb	Mar	Apr	May	Jun
Variance percentage	34%	-5%	64%	179%	-95%	382%

Variance percentage

Source: Company A

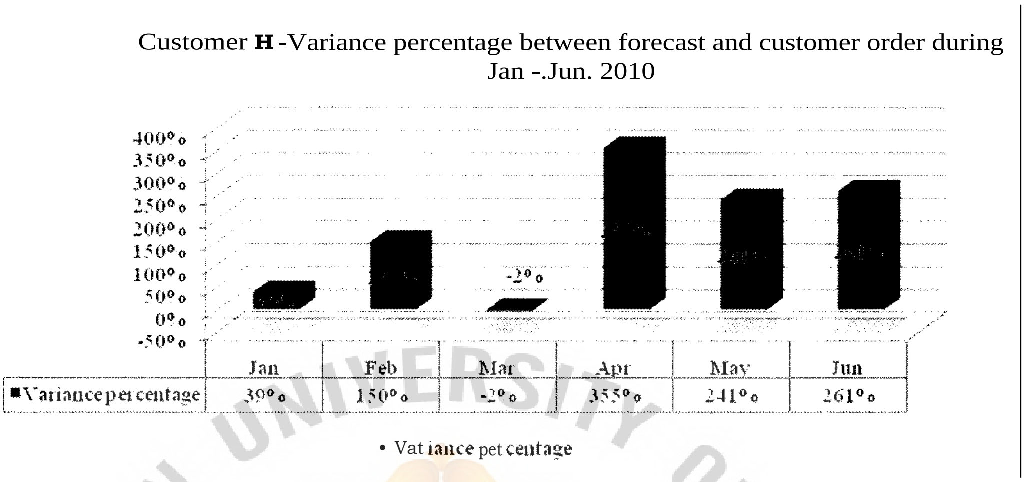
The variance between forecast and customer order from January to June, 2010 for **Customer H** has been shown in Figures 1.6 and 1.7. In January and February, customer orders' variance was high, approximately 39% and 150 % respectively. The number was similar in March when forecast was a bit higher than customer order by only 2 units or 2 %. However, the company encountered the problem of seriously expediting an order to catch up with nearly five customer demand changes in April in which the variance percentage was 355 %. In May and June, customer order also maintained a high level, the customer orders being more than 200 % from the planned forecast.

Figure 1.6: Summary of variance between forecast and customer order of Customer H during January – June, 2010



Source: Company A

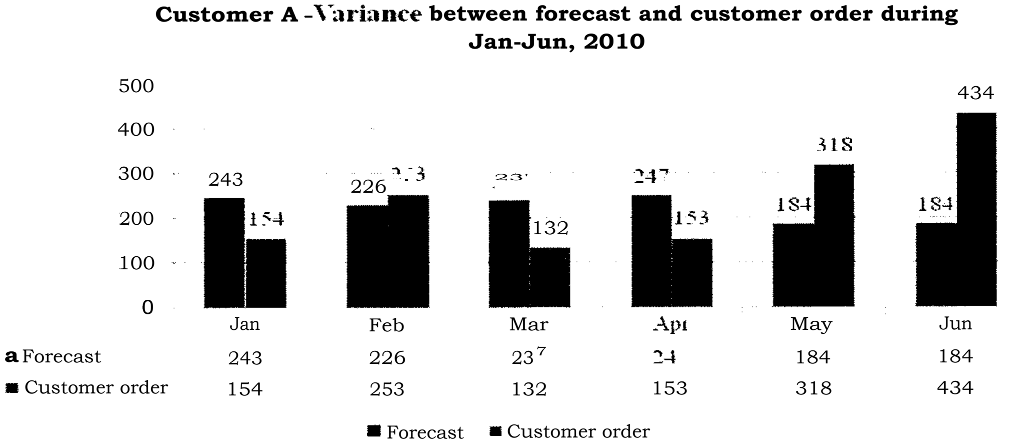
Figure 1.7: Summary of variance percentage between forecast and customer order of Customer H during January – June, 2010



Source: Company A

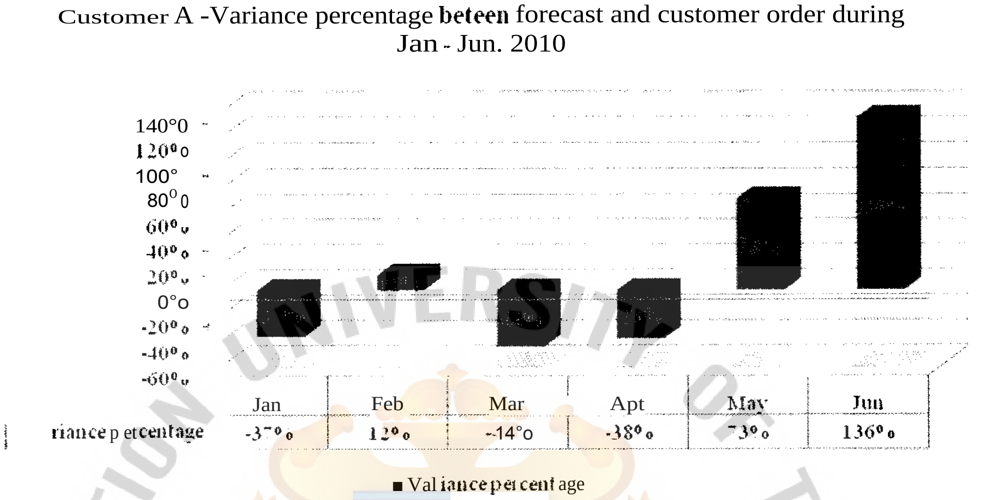
The variance between forecast and customer order from January to June, 2010 for **Customer A** has been shown in the figure 1.8 and 1.9. In January, forecast was higher than customer order by about 37 %. While in February, customer order significantly increased by 253 or 12 %. In March and April, demand dropped to 132 and 153 and it led to 44% and 38 % for excess inventory. Obviously, in May and June, demand was doubled and tripled by up to 73% and 136 % higher than forecast.

Figure 1.8: Summary of variance between forecast and customer order of Customer A during January – June, 2010



Source: Company A

Figure 1.9: Summary of variance percentage between forecast and customer order of Customer A during January – June, 2010



Source: Company A

Consequently, the company's problem due to forecast and customer order mismatch can be summarized as the following:

1). The Company failed to deliver customer order on the requested date due to the customer order changing, upwards, compared to planned forecast (customer order > forecast), resulting in a low percentage of shipment on the customers' requested date (STR percentage).

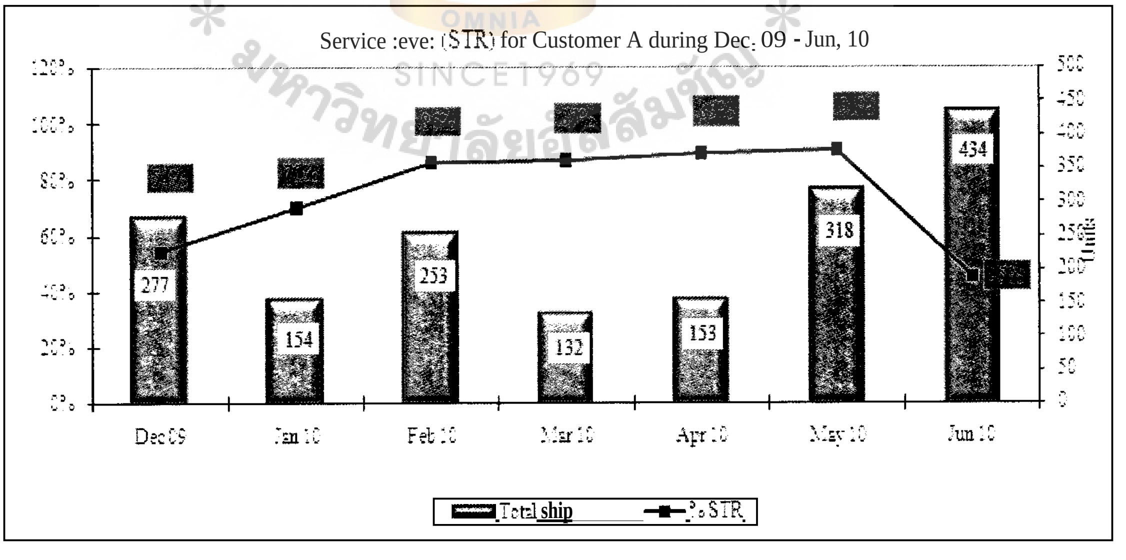
Below are Tables which summarize support information to show the percentage trend of shipment on customers' requested date, for three company customers from December, 2009 to June, 2010.

Table 1.1: Summary of percentage of shipments on requested date for Customer A during December, 2009 – June, 2010

Customer A	Dec, 09	Jan, 10	Feb, 10	Mar, 10	Apr, 10	May, 10	Jun, 10	Total
Total ship (lines)	48	47	51	30	28	53	33	290
Miss STR (lines)	22	14	7	4	3	5	18	73
% STR by line	**54%**	**70%**	**86%**	**87%**	**89%**	**91%**	**45%**	**75%**
Total ship (Unit)	277	154	253	132	153	318	434	1,721
Total miss STR (Unit)	127	46	35	17	17	29	239	510

Source: Company A

Figure1.10: Summary of percentage of shipments on requested date for Customer A during December, 2009 – June, 2010



Source: Company A

Table 1.1 and Figure 1.10 show that the total requested shipments for Customer A from December, 2009 to June, 2010 are 290 lines. In December, 2009 the percentage of shipments on the customer requested date was 54%, and in May the percentage increased to 70%. In February, March and April, the percentage showed significant growth from 86%, to 87% to 89% respectively. **In** May the best percentage of shipments to customer on requested date was 91%, in which only 29 out of 318 units has missed the shipment. Unfortunately, in June, the percentage dropped to 45%.

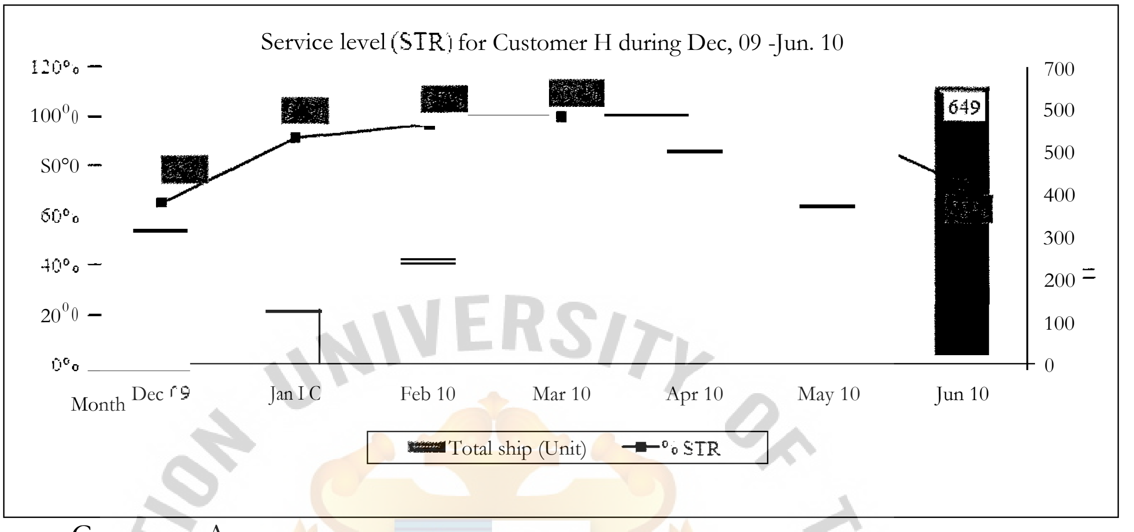
The average percentage of STR reached was 75%, which is quite low when compared to the customer target service level (95%). After consideration, it was found that nearly one third of total units missed the shipment (510/1721). This unpleasant situation occurred as a result of customer orders having been changed within a tight cycle time schedule, so the company was unable to deliver the required order on the committed delivery date.

Table 1.2: Summary of percentage of shipments on requested date for Customer H during December, 2009 – June, 2010

Customer H	**Dec, 09**	**Jan, 10**	**Feb, 10**	**Mar, 10**	**Apr, 10**	**May, 10**	**Jun, 10**	**Total**
Total ship (lines)	60	23	30	35	59	79	66	[illegible]
Miss STR (lines)	21	2	1	0	1	2	18	[illegible]
% STR by line	**65%**	**91%**	**97%**	**100%**	**98%**	**97%**	**73%**	
Total ship (Unit)	332	129	250	108	501	375	649	
Total miss STR (Unit)	262	26	1	0	1	3	293	

Source: Company A

Figure 1.11: Summary of the percentage of shipments on requested date for Customer H during December, 2009 – June, 2010



Source: Company A

Table 1.2 and Figure 1.11 show the average percentage of total requested shipments of Customer H from December, 2009 to June, 2010 as 87%, which was quite satisfactory when compared to the percentage of STR for Customer A (74%). In January, February, April and May, company provided nearly perfect delivery on customer requested dates, which result in only a few units missing shipment. Moreover, in March, all ordered units were delivered to customers on the committed date. December 2009 showed the lowest percentage of STR (65%), and in June the STR dropped to 73%.

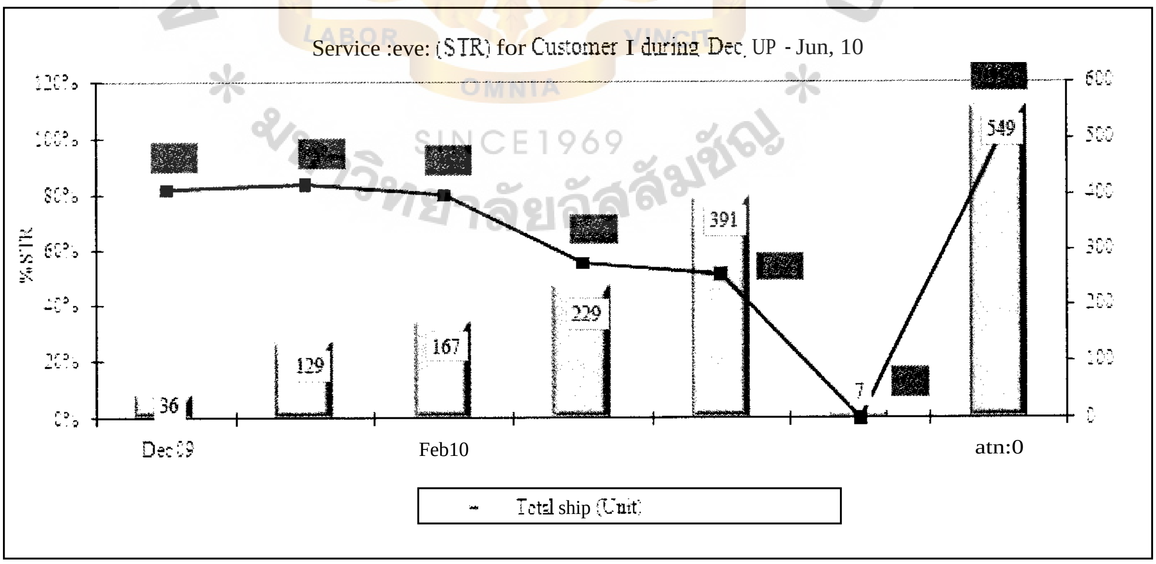
When we compare he percentage of STR reached (87%) and percentage of target service level (95%), the company performance was not so far off its target, considering that 1,756 out of 2,343 units had been shipped to the customer. The variance of 586 units that failed to be delivered to the customer caused the company lost profit of approximately $300,000. Besides profits which the company lost from inability to deliver products on the required date, the company is also recognized as a bad supplier among the customers.

Table 1.3: Summary of the percentage of shipments on requested date for Customer I during December, 2009 – June, 2010

Total ship (lines)	**11**	**25**	**20**	**29**	**45**	**1**	22	
Miss STR (lines)	**2**	**4**	**4**	**13**	**22**	**1**	**0**	
% STR by line	**82%**	**84%**	**80%**	**55%**	**51%**	**0%**	**100%**	**0%**
Total ship (Unit)	**36**	**129**	**167**	**229**	**391**	**7**	**549**	**50S**
Total miss STR (Unit)	**5**	**30**	**22**	**105**	**123**	**7**	**0**	

Source: Company A

Figure 1.12: Summary the percentage of shipment on requested date for Customer I during December, 2009 – June, 2010



Source: Company A

Table 1.3 and Figure 1.12 show the fluctuating percentage from the beginning, middle and end periods. December, 2009, January and February, 2010 showed good percentages of STR which were 82%, 84% and 80%. However, at the middle of the period, the percentages dropped down to 55% and 51%. Unfortunately, in May, the company was unable to deliver any shipments to this customer, even though the ordered units were only 7. This resulted in the percentage of STR sharply dropping to zero. From this loss, the company improved its production and could deliver 100% in June. The company showed progressive performance from zero delivery in May to 100% in June, but in terms of supply chain excellence, the company is required to better maintain and sustain its service level in order to synchronize supply chain operations.

Surprisingly, when we look at the variance percentage between forecast and customer order each month, its number seems to be huge when compared to the achieved percentage of shipments on the customer requested date (STR). For example, the variance percentage from forecast and customer order changes for Customer I in April is 179% (forecast = 140, order = 391), but the STR percentage that the company could achieve was 84%. To achieve that level of STR, the company could deliver to the customer 268 units (forecast unit (140) + Expedite unit (128)). Another example is that Customer H changed the order from 180 to 649 unit, an increase of 261%. The percentage of STR was 73% in which the company delivered 356 units (forecast unit (180) + Expedite unit (176).

From the above, if the company's top management looks at the company's business only as a complete picture, they can realize how well they performance. Even in terms of customer, they will react repeatedly to changes in customer orders since they would find that finally the company can perform their best to do whatever the customer wants, to maintain their service level and company profitability.

The dedicated contribution behind the success is that the company's planning team plays tough and pushes so hard against the contract manufacturer and its supplier in an attempt to fulfill customer requirements. This backstage contribution creates many drawbacks in the company profits in which there are many hidden costs to achieve change in a customer's order. There are *expedite fee charges* which includes labor wage and hours from manufacturer, and cost of pulling parts or materials, and logistics cost from suppliers.

The contribution effort of the company together with assistance from contract manufacturer can help the company to meet committed customer orders from time to time without any compensation from customer. Up to now, no solution for the root cause has yet been considered or solved properly. The Company and contract manufacturer spend their time by solving daily changes in customer orders. The Process of Expediting has still continued in the manufacturing, while the planning process and agreement have not been raised in discussions.

2). In the case when at changed customer order is less than the planned forecast (customer order < forecast), this results in inventory for some parts numbers showing excess quantity, and its cost are high and there are risks of product obsolescence.

Information supports the problem in the case of customer orders being less than forecast, that it results in a high amount of on hand inventory and its associated cost, as below. In June, 2010 Customer A has on hand inventory of 754 units which can be calculated as $ 325,244.21, Customer H has on hand inventory of 1,015 units which can be calculated as $490,103.68, and Customer I has on hand inventory of 233 units which can be calculated as $152,238.07. Therefore, it can be concluded that the company spends capital investment on holding inventory for these three customers at a cost of $967,585.96!

Inventory of the company are kept in the warehouse for many reasons. The Company keeps inventory as safety stock in order to maintain responsiveness to demand uncertainty. Another reason comes from an excess inventory left from the variance between forecast and where a customer order changed demand to less than forecast.

The Company can provide a summary of excess inventory quantity and its cost in June, 2010 for each customer. Customer A has excess inventory of 653 units which costs $305,670.17, Customer H has excess inventory of 606 units which costs $338,964.60, and Customer I has excess inventory of 192 units which costs $91,909.41. It can be said that the company built excess orders for these three customers with a cost of invested capital aty $736,544.18 during the first half year!

However, this research study realizes the severe impact of these problems and proposes the planning mechanism of incentive commitment by using bonus and penalty as tool to control the customer changing orders. This designed concept should be able to respond to the following questions.

Research Questions

1. What is the implementation strategy to provide the solution for the forecasting demand and customer order mismatch situation?
2. Is the strategy able to improve customer satisfaction in terms of higher levels of shipments on customer requested dates (STR)?
3. Will the strategy provide opportunity profit to the company in conditions where forecasts are less than the customer order (forecast < customer order)?
4. Is the strategy able to reduce excess inventory and its cost in conditions where forecast is more than the customer order (forecast > customer order)?

1.3 Research Objectives

Currently, the company has problem of forecast and customer order mismatch due to sometimes customers increase their orders unexpectedly,. and sometimes the market demand trend is in decline, or a tendency for innovative parts or designs is imminent, resulting in lower demand from the placed orders.

Whether customers shift their demand upward or downward, both directions still have an impact not only between the two parties which are company and customer, but also on supply chain partners as a whole. This research aims to study how to minimize forecast and customer order mismatch by proposing the planning mechanism of incentive commitment which uses bonus and penalty as tools to control the customer changing orders. The overall objective of the research study is to be able to provide a positive answer to the research questions which are the ability to provide an effective solution to solve the problem of forecast and customer order mismatch, so as to improve the customer service level in term of STR, to provide opportunity profit and to reduce excess inventory level and its costs.

1.4 Scope of the Research

- Scope of data

The study will be concentrated on the data of Dispersion Compensation Module (DCM).products. A DCM product is known as a fiber optics cable lines used in communication networks. This product can be said to be a unique expertise of the company..The Company is successful in researching, designing and developing the product until it is highly acceptable to many customers or even competitors. The proportion of DCM product's profit margin when compared to other product lines of the company is approximately 43%.

Even though DCM product sales price is considered to be significantly cheaper than other products, it is worth when considering its huge volume from customers and its low production cost. Moreover, the further consumption trend for DCM products is still bright and attractive in the market.

There are many customers who place orders for the DCM product. Basically, the company classifies customer into tiers, in which the first tier will be highly considered as the most important, the first priority customer. This research study will pick parts numbers that are high volume purchases and provide high profit returns to the company. These parts will be chosen from three first tier customers: Customer A, Customer H, and Customer I.

Part numbers can be summarized into 43 out of 600 part numbers, classified by each customers as:

1. Customer A => 19 part numbers as the following

Table 1.4: Sampling part numbers of Customer A

CUSTOME	e .umber	escriptio
Customer A	A-001	A-001-987654321-DCBA
Customer A	A-002	A-002-987654321-DCBA
Customer A	A-003	A-003-987654321-DCBA
Customer A	A-004	A-004-987654321-DCBA
Customer A	A-005	A-005-987654321-DCBA
Customer A	A-006	A-006-987654321-DCBA
Customer A	A-007	A-007-987654321-DCBA
Customer A	A-008	A-008-987654321-DCBA
Customer A	A-009	A-009-987654321-DCBA
Customer A	A-010	A-010-987654321-DCBA
Customer A	A-011	A-011-987654321-DCBA
Customer A	A-012	A-012-987654321-DCBA
Customer A	A-013	A-013-987654321-DCBA
Customer A	A-014	A-014-987654321-DCBA
Customer A	A-015	A-015-987654321-DCBA
Customer A	A-016	A-016-987654321-DCBA
Customer A	A-017	A-017-987654321-DCBA
Customer A	A-018	A-018-987654321-DCBA
Customer A	A-019	A-019-987654321-DCBA

Source: Company A

2. Customer H => 13 part numbers as the following

Table 1.5: Sampling part numbers of Customer H

[redacted]	[redacted]	
Customer H	H-001	H-001-1234567 -ABCD
Customer H	H-002	H-002-1234567 -ABCD
Customer H	H-003	H-003-1234567S9-ABCD
Customer H	H-004	H-004-1234567S9-ABCD
Customer H	H-005	H-005-1234567S9-ABCD
Customer H	H-006	H-006-1234567S9-ABCD
Customer H	H-007	H-007-1234567S9-ABCD
Customer H	H-00S	H-00S-1234567S9-ABCD
Customer H	H-009	H-009-1234567S9-ABCD
Customer H	H-010	H-010-1234567S9-ABCD
Customer H	H-011	H-011-1234567S9-ABCD
Customer H	H-012	H-012-1234567S9-ABCD
Customer H	H-013	H-013-1234567S -ABCD

Source: Company A

3. Customer I => **11** part numbers

Table 1.6: Sampling part numbers of Customer I

	[redacted]	[redacted]
Customer I	I-001	I-001-IKJGFOIFJHIK-554326756
Customer I	1-002	I-002-IKJGFOIFJHIK-554326757
Customer I	1-003	I-003-IKJGFOIFJHIK-55432675S
Customer I	1-004	I-004-IKJGFOIFJHIK-554326759
Customer I	1-005	I-005-IKJGFOIFJHIK-554326760
Customer I	1-006	I-006-IKJGFOIFJHIK-554326761
Customer I	1-007	I-007-IKJGFOIFJHIK-554326762
Customer I	I-00S	I-00S-IKJGFOIFJHIK-554326763
Customer I	1-009	I-009-IKJGFOIFJHIK-554326764
Customer I	1-010	I-010-IKJGFOIFJHIK-554326765
Customer I	I-011	I-011-IKJGFOIFJHIK-554326766

Source: Company A

This research study will focus only on implementation for Customer A. The scope is to find details of the problem from historical data, then design the planning mechanism of incentive commitment which uses bonus and penalty as tools to control the customer changing orders, with the purpose of improving customer satisfaction, company profit, and reduced inventory level and its costs.

- Scope of time

Historical data includes forecast, customer order, and percentage of shipment on customer requested date. This is information which has been recorded and studied from January to June, 2010. On-hand and excess inventory level and their costs have been recorded up to June, 2010.

1.5 Limitations of the Research

- Data for DCM product of three first tier customers (Customer A, Customer H and Customer **I)** has been gathered, collected and analyzed consecutively for 6 months from January to June, 2010, which may not cover all the problems situations.
- Marginal proportions of incentive commitment for bonus (discount) and penalty (charge) have been raised in this research study as an arbitrary model in which an actual one is subject to product characteristics, profit and loss and management negotiation.
- The finding of this research can be used primarily in the Electronics industry. However it can be generalized by means of marginal percentage modification to other business industries.

1.6 Significance of the Study

This study is useful to design a planning mechanism for use in Company A with the purpose of achieving the following:

- Stronger commitment plan

By utilizing the planning mechanism of incentive commitment by using bonus and penalty, the tendency for forecast and customer order mismatch will be reduced. The Company is able to fully control business performance concerning to customer orders with a high response to whatever company commits, without any expediting cost.

- Decision making tool to synchronizing forecast and customer orders

The Company uses bonus and penalty schemes as communication signal to make an agreement with customer. This concept will make customers increase their awareness in changing their demands and consideration of the consequences. In term of the supply chain concept, company and customers try to make the supply chain balance, and avoid demand variability which causes the Bullwhip effect.

- To achieve expected benefits; credibility, supplier performance and opportunity profits

As an outcome from a stronger commitment plan and development of decision making tool, undoubtedly the company can earn more profit, reduce opportunity loss, and receive high credibility.

- To be able to improve customer satisfaction in terms of improving shipment on Customer Requested Date (STR)

If forecast and customer orders are matched, customers always receive what they ordered, within the committed date. The Company's service level can be precisely foreseen and improved.

- To be able to reduce inventory level and it costs

If forecast and customer order are matched, there is less tendency for excess capacity, inventory, and also their associated costs.

1.7 Definition of Terms

Bullwhip Effect is a situation which occurs when the demand order variability in the supply chain is amplified as it moves up the supply chain (Lee et al., 1997).

Cycle times are an indicator of responsiveness and are measured in terms of elapsed time from order receipt to order delivery.

Incentive alignment refers to the process of sharing costs, risks, and benefits among the participating members (Simatupang and Sridharan, 2002).

This scheme motivates the members to act in a manner consistent with their mutual strategic objectives, including making decisions that are optimal for the overall supply chain and revealing truthful private information. It covers calculating costs, risks, and benefits as well as formulating incentive schemes such as pay-for-performance and pay-for-effort.

Shipment on customer requested date (STR) is the company's term to assess the customer service level. STR is a performance target for service related measures (i.e. delivery performance, lead time, etc.) compared to the established service requirement (Supply Chain Council, 2006).

CHAPTER II

REVIEW OF RELATED LITERATURE AND RESEARCH FRAMEWORKS

In order to clarify the concepts and theoretical perspective related to the study, the literature review includes six main parts.

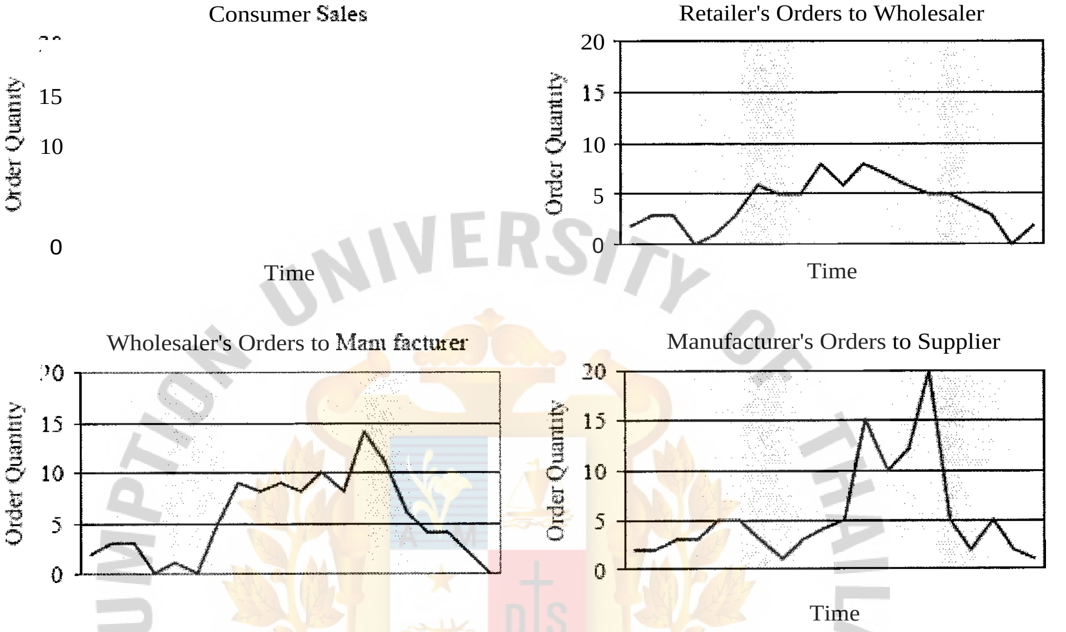
If we look beyond the link between company and its customer, this problem spreads its effect throughout the supply chain All supply partners along the chain are impacted by the variability of customer orders. Its boundary has extended from downstream of the customer's customer to upstream of the supplier's supplier. In the next part, the research will introduce the concept of the Bullwhip effect.

2.1 Bullwhip Effect

The increased variability of orders along the stages in the supply chain is called *the Bullwhip effect.* The Bullwhip effect causes excessive swings in different demands or inventory levels throughout the supply chain. Most companies react to this uncertainty by increasing the level of holding inventory in order to maintain the targeted customer service level (Paik & Bagchi, 2007). As a result, this uncertainty will propagate throughout the supply chain in the form of amplification of ordering variability, which leads to excess safety stock, increased logistics cost, and inefficient use of resources (Yu, Yan, & Cheng, 2001).

Lee, Padmanabhan, and Whang (1997) explained the Bullwhip effect as small order variability at the customer level amplifies the orders for upstream players, such as wholesaler and manufacturer, when the order moves up the supply chain. As shown in Figure 2.1, the first picture; customer demand tends to be relatively constant. Secondly, an order placed by a retailer to wholesaler is likely to fluctuate more from the actual demand perceived by the retailer. The third picture shows that an order that the wholesaler placed to the manufacturer is even higher, and lastly, an order from a manufacturer to a suppler unreasonably reaches the peak.

Figure 2.1: The Bullwhip Effect



Source: Lee et al. (1997)

Ravichandran (2008) explained that Bullwhip effect is a consequence of rational behavior of the supply chain partners. It usually reflects when the partners operate in isolation and optimize their individual objective functions. Consequently, there is no coordination among the supply chain partners, or if it exists, it is weak.

Since Bullwhip effect has tremendous negative consequences in the supply chain as a whole, there are many researchers who turn their attention to find many possible causes and alternative solution for this phenomenon.

Forrester (1958, 1961) conducted a had study by using computer simulation models. His research found that the increase of order variability caused by irrational and over-reactive behavior of each supply chain partner built up the demand amplification.

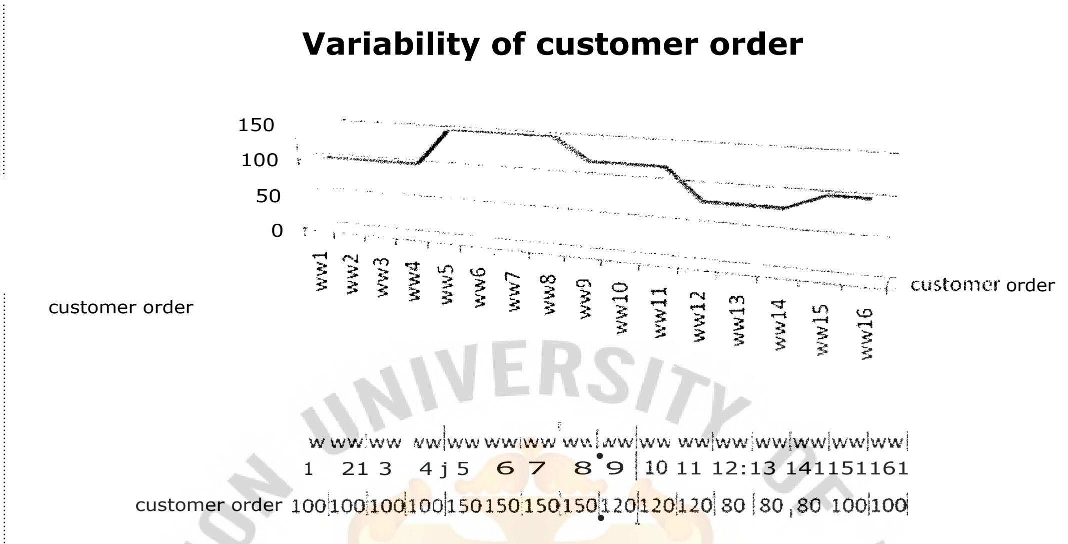
Bullwhip effect can be reduced by lead time reduction, revision of reordering procedures, control and limit of process fluctuation, and promotion and the integration of planning and performance measurement (Lee & Billington, 1992).

Baljko (1999) suggested that the way to eliminate bullwhip effect is to share knowledge between suppliers and customers so as to better gauge demand. There should be, cooperation between supply chain partner to analyze the cause of overreaction and use technology to speed communication and improve response time.

Lee et al. (1997) discussed four possible causes of the bullwhip effect: demand forecast updating, order batching, price fluctuation and rationing and shortage gaming. However, he had developed a solution to control the bullwhip effect. It needs coordination mechanism in term of information sharing, channel alignment and operation efficiency.

The above theoretical concept of Bullwhip effect can be applied well to the research problem of forecast and customer order mismatch. To begin with, a customer placed an order of 100 but later changed it to 150. This message signaled to retailer and manufacturer as a tendency of increased customer orders. The Company (as a retailer) pushed the manufacturer to produce 80 more units (50 plus 30 in case of an upward demand trend). The Manufacturer expedited action in pulling parts or materials from the supplier of about 100 units (80 plus 20 in order to be ready for the assembling process). The supplier interpreted the message by stocking 200 more parts. Unexpectedly, the customer changed the order from 150 to 120 and then 80. Within a product cycle time of 16 weeks, the customer kept changing the order repeatedly, and finally reverted back to the original 100.

Figure 2.2: The Bullwhip Effect from variability of company's customer order



Source: Company A

From the customer's aspect, they consider that an order that they placed in the beginning and at the end was the same (100). However, in terms of the supply chain, it is a mess. Demand variability has been amplified, which results in accumulation of inventory quantity along the supply chain pipeline. Even though inventory holding devalues the company's profit, most of them still insist on maintaining it at a certain level.

2.2 Inventory

Inventory is one of the most expensive and important assets in many companies, representing as much as 50% of total capital investment. A firm can try to reduce cost by reducing the on-hand inventory level. On the other hand, customers become dissatisfied when frequent inventory outages (called stock-outs) occur. Therefore, companies must maintain an optimal balance for inventory while trying hard to maintain or improve the customer service level.

The role of inventories

Waters (2002) explained that due to increasing globalization which leads to longer supply lead times, this undoubtedly results in higher level of inventory in order to maintain the same service level. With longer supply lines, there is higher potential of increasing variation in supply lead time which further result in increased amounts of safety stock.

In a lean supply chain, Womack and Jones (1996) said that inventory is one of seven wastes which need to be reduced as much as possible. Christopher and Towill (2001) also agreed that inventory should be held at a minimum level so that the company is able to respond to and exploit change in market demand.

Etienne (2005) stated that inventory provides security against variation in customer demand while creating another risk of high inventory level. It can be concluded that inventory is a net destroyer of supply chain responsiveness in terms of speed to market for new products, responsiveness to new technology (leading to potential obsolescence of existing inventory), and responsiveness to market niches.

The potential disadvantages of holding inventory are widely recognized, and many strategic improvement have been hailed, such as a reduction in production lead time (Harrison & van Hoek, 2005), the use of production postponement, (van Hoek, 1998), the visibility of end customer demand to all supply chain participants in an attempt at inventory reduction (Christopher, 2005) and total cycle time compression for both information and material flow lead times (Mason-Jones & Towill, 1999).

Reason for holding inventory

Inventory has a value, so that holding inventory means a monetary cost. However, there are many valid reasons why a company needs to keep inventory at a certain level and even more than its requirement for the next immediate period.

Stock and Lambert (2002) stated the reasons for holding inventory, as described below:

1. Variation in customer demand. Customer's demand changes from time to time, and it is not easy to define exactly what they really need. Inventory always needs to be kept in order to be able to supply at a time of demand fluctuation or extra need, that is, to satisfy and maintain customer service level. Moreover, it is more economical to hold inventory rather than place an expedited order for a customer's changed order.

2. Available product at a time of sale. A product has to be shown or delivered at a time when the customer needs it. Failure to show or deliver means a lost sale which results in lower business benefit.

3. Price discount. If products are purchased in bulk, the benefit of a discount can be derived.

4. Anticipated price increase. A product may be held in anticipation of a price increase such as tax increase or inflation rate.

5. Protect demand uncertainty. This is a means of improving customer service level by reducing a tendency of stock-outs

Inventory decision and its cost

Render, Stair, and Hanna (2006) suggested that there are two fundamentals decisions to make when controlling inventory:

1. How much to order
2. When to order

Inventory fulfills many important functions within the company. As inventory level goes up, the cost of holding inventory also increases. It is important to have a good balance in establishing inventory levels. A major objective to control inventory is to minimize total inventory cost. Some of the most significant inventory costs include the cost of an item (purchase cost or material cost), cost of ordering, cost of holding inventory, and cost of stock-outs.

2.3 Excess Inventory

Theoretically, companies realize that inventory is a kind of waste. They make an effort to eradicate it, but in a practical way most companies cannot maintain inventory levels at zero level. That is because a company needs to stock inventory at a level that allows the company to be flexible and responsive enough to face any uncertainty. As mentioned in the research study, inventory is also held to serve as safety stock to provide flexibility when there is variance between forecast and customer order.

Accordingly, the problem of overstock or excess inventory can unavoidably happen. Supply chain practitioners have to realize the benefits and drawbacks of inventory while formulating a best practice to optimize stock inventory while maintaining the customer service level.

Rahman, Shams-UR (1998) has studied the theories of a constraint thinking process approach to developing strategies in the supply chain, by constructing a current reality tree (CRT) as a tool to identify the cause and effect relationships in the system. The study found that too much make-to-stock inventory is one important constraint in supply chain success.

2.4 Incentive alignment

Incentive alignment refers to the process of sharing costs, risks, and benefits among the participating members (Simatupang & Sridharan, 2002). This scheme motivates the members to act in a manner consistent with their mutual strategic objectives, including making decisions that are optimal for the overall supply chain and revealing truthful private information. It covers calculating costs, risks, and benefits as well as formulating incentive schemes such as pay-for-performance and pay-for-effort. The contribution of incentive alignment can be justified based on compensation fairness and self-enforcement. Compensation fairness ensures that aligned incentives motivate the chain members to share equitably the loads, and benefit from the results of collaborative efforts.

Lee (2000) and Simatupang and Sridharan (2002) proposed a reciprocal approach since he believed that this concept is the most appropriate way to interact between partners in the supply chain by mean of matching and complementing each other.

Simatupang and Sridharan (2005) developed the Collaborative Supply Chain Framework (CSCF) which consists of five important components: Collaborative Performance System (CPS), information sharing, decision synchronization, incentive alignment and integrated supply chain processes. The result of the study found that this reciprocal approach is a powerful tool to allow deeper understanding and enhance relationship between supply chain members.

Puplani and Fu (2005) studied a coordination framework for supply chain alignment. They stated that it is normal that each of parties will perform their business in their own most profitable way. Since different parties have different incentives for doing business, they will not cooperate with their supply chain partners unless they have an incentive for doing so. They cited that incentive misalignment refers to a lack of shared visions between supply chain partners such as supplier, manufacturer and retailer, which leads to each party often optimizing their inventory level according to their own forecast of future demand. The result is high inventory cost, high response time and poor service level.

Puplani and Fu (2005) developed a coordination framework called alignment of supply chain executions and decisions (ASCEND) to align supply chain inventory decisions under the guideline principle of establishing a proper incentive mechanism based on cost sharing and service level contracts. The result of the study shows a reduction of about 10.4 percent in supply chain inventory holding cost and more efficiency in the coordination process.

Other successful examples of incentive alignment can be seen from Dell, Chemical and also Computer Hardware Company. Dell encouraged its suppliers to deliver in small batches to increase inventory speed in compensating for higher order commitment and cash receivables (Magretta, 1998). Quantum Chemical Company uses gain-sharing contracts by offering incentive scheme to its third party logistics provider in return for order accuracy, on-time deliver, inventory accuracy, elimination of customer complaints, and reporting timeliness (Lambert, Stock, & Ellram, 1998). Suppliers of computer hardware offer a subsidy on price protection, mid-life returns, and end-of-life returns to motivate their resellers to maintain a high level of product availability (Campbell & Pereira, 1998).

2.5 Customer service level

Most objectives from the company's contribution are concerned with achieving customer satisfaction. In business, success has to be measured by the level of customer service. For Company A, the percentage of shipments on the requested date is a key performance index that evaluates how well the company can perform in the electronics business.

The Supply Chain Council (2006) defined customer service level as a performance measurement index of company service provision, such as on-time delivery and in perfect condition compared to the targeted service level.

Fawcett, Ellram, and Ogden (2007) said that customer service level consists of making the right product available at a time and place of usage, in which key measurements are fill rate, complete orders, shipment delivery, stock-outs and back orders.

A business's time management is concerned with on time delivery and cycle time. On time delivery is the company's ability to deliver product at a time for which the company has made a commitment with the customer. Cycle time is a response measurement that company can provide to a customer from the time of receiving an order to the time of shipment delivery. A long cycle time affects the company's business process to handle less flexibility in production planning and manage order variability.

Leenders (2002) defined the method of calculation of service level as:

$$\text{Service level} = \frac{\textbf{Number of times an item is provided on demand}}{\textbf{Number of times an item is demanded}}$$

2.6 Conclusions

Inventory is still a red flag issue for the company to consider. Apart from bullwhip effect that creates inventory due to demand amplification throughout the supply chain the company still faced the situation of how to decide and how much inventory level should be carried. A trade-off between holding too much inventory (excess inventory) and holding too little inventory (stock-outs) should be evaluated. Currently, the company found itself with no direction or mechanism to find an optimal quantity of its inventory holding.

From the previously mentioned theoretical literature, and analysis of recent studies, this research study selects the concept of incentive alignment to develop and apply to the case, under the name of 'Application of incentive commitment to control the changes of customer orders'.

The Company's decision making tool on how much inventory should be carried is still a question. Whether it should be hold too much or too little, no one knows. Currently, the company has no mechanism to manage and optimize its level properly. Accuracy and precision of forecast compared to an actual customer order is a vital factor for company performance measurement. If the amount of a customer order exceeds the planned forecast, production planning deteriorates and leads to high expedition cost and a lower customer service level. At the same time, if the customer order is less than the planned forecast, there is excess capacity and inventory left. The Company misses its committed target for opportunity profit on sales. Outcomes show as negative result in whatever condition. The discussion in this chapter aims to design a competitive strategy to solve previous and continuing problems.

Mutual benefits that the company and customers will gain through a win-win collaborative relationship are tremendous and significant:

- Stronger commitment plan
- Decision making tool to synchronize between forecast and customer order
- To achieve expected benefits; gain credibility, supplier performance and opportunity profits
- To be able to improve customer satisfaction in term of improving shipment on Customer Requested Date (STR)
- To be able to reduce inventory level and its cost.

CHAPTER III

RESEARCH METHODOLOGY

This chapter will guide the reader through the research methodology. The sections will include the methods of research used, collection of data, a review of the company's current process, the design planning mechanism as a method to solve the research problem, and will conclude with a summary.

3.1 Methods of Research Used

This research study uses both Historical research and Case study approaches. There is a summary and conclusion of the company's historical data, which are transforms into visual Tables, Figures and analytical information, in order to understand the company's current situation. Background information leads to an attempt to design suitable mechanism to develop systematic planning of incentive commitment with a customer. The main purpose of the study is the outcome which enables the company to apply a technique to its real and similar situation.

3.2 Collection of data

The research study concentrates on the data of Dispersion Compensation Modules (DCM) one of many company products. The Reasons behind the selection is that DCM product is a unique specialized product of the company in which its profit margin is shown as a significant portion of the whole, which captures attention to develop an improvement mechanism. Besides, its future trend is still expanding.

There are more than 600 part numbers, divided into parts, components, and finished products. In the research, a sample of 43 part numbers has been extracted from the total base on the criteria of customer priority ranking. Part numbers which achieve high profits and high volume order from first tier customers (Customer A, Customer H and Customer I) are observed in the analysis process.

Required data used in the research study include the following list:

(1) Forecast data

(2) Historical customer orders

(3) Percentage of shipments to customer on requested date

(4) On-hand, excess inventory and its cost

The Company's historical data has been collected for six months continuously from January – June, 2010. Information is used in an as-is comparable model to the outcome of the new design concept.

3.3 Review Current process and impact of company's forecast and customer order

A forecast plan has been developed and designed by the Product Line Manager and Sales team. Numbers will be divided into quarters according to an agreement with customers. After the forecast is complete, it is sent to the planning team in the Thailand office, and then forecast data is sent as a trigger to prepare production capacity and resources requirements to the contract manufacturer. The process has been done normally, until customers expressed their new demand. Changed customer orders are received by a Customer Service Representative. After realizing the changes, even big or small amounts, the CSR team organizes a meeting with the planning team to figure out any possible ways to meet customer demand. The planning team then has an urgent meeting with the Program Coordinator from the contract manufacturer to explore the possibility of expediting more production and confirm commitment. The Company always allows customers to change their orders without setting any rule or compensation fee. Understandingly, as the nature of business is to get a high volume of customer orders, this means being able to sell more products and achieve higher profit. To do that, the company has to play a role in pushing for expediting until the last minute, to get what the customer wants. Definitely, there are dedication and also expediting costs behind this success.

Almost every day, company acknowledges changes in customer orders, both up and down. The variance percentage of forecast and customer order mismatch for three customers is shown in Figures 1.4 - 1.9, giving evidently proof of the failure of the company's effective management.

The Company performance will be scored by the percentage of shipments on the customer requested date (STR) which is the company's term of rating achieved customer service level. Most customers set their target service level at a reasonably high level of 95 percent, which makes the company encountering the mentioned problems difficult to meet this level. The shown numbers of STR percentages in Tables 1.1 - 1.3 significantly contrast with the huge gap between forecast and customer orders. This means the company team plays an important role in increasing the capability to produce more products in an attempt to increase their STR percentage. A trade-off between an achieve high STR against an expedite fee should be investigated and balanced.

Historical information of on-hand inventory for June, 2010 shows that the company invested capital in holding inventory for Customer A, Customer H and Customer I, costs $325, 244.41, $490,103.68 and $152,238.07 respectively. It seems that inventory cost of only three customers for DCM product has an estimated value of $967,585.96. This is because the company implemented the concept of safety stock and also results from excess inventory, which makes the company lose its opportunity profit to achieve targeted revenue.

Finally, uncertainty in customer orders does not impact only to the company but also to the other company supply chain members, such as contract manufacturer, suppliers, distributor, and third party logistics as a whole. The bullwhip effect has occurred as each member makes rational adjustments in its own way. This adjustment brings an amplification of demand along the pipeline (see Figure 2.2).

The research study reviews the problem background and applies the simple but practical concept of a planning mechanism of incentive commitment with customers by using bonus and penalty to control the changes of customer orders.

3.4 Design planning mechanism of incentive commitment with customer by using bonus and penalty to control the changes of customer orders

The research study has developed a planning mechanism of incentive commitment as a decision making tool which enables the company to have control over customers changing their orders. The Company uses a quantity flexibility contract that allows customers to change their orders by increasing or decreasing the aggregate order quantity of products, by not being in excess of, or lower than, a given specified percentage in each period of cycle time.

The Company divides cycle time into four periods. The first period is counted from 1-4 work weeks; the second period is from 5-8 work weeks; the third period is from 9-12 work weeks; and the last period is from 13-16 work weeks.

Figure 3.1: Concept of incentive commitment to control customer orders at each period of cycle time

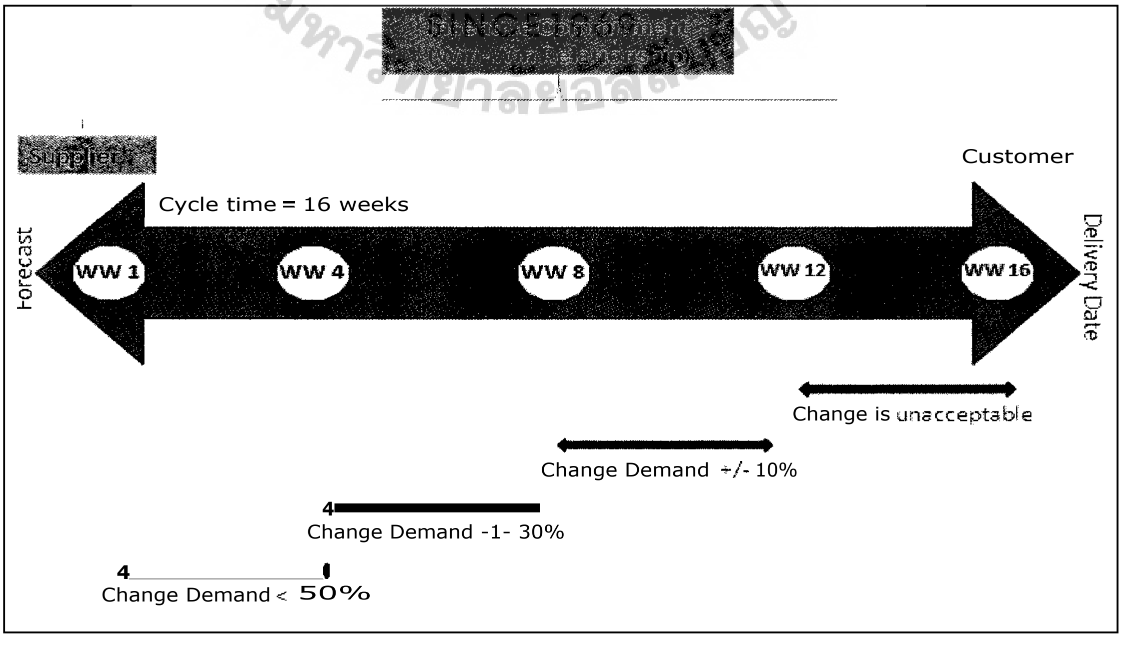


Figure 3.1 shows the concept of incentive commitment by using bonus and penalty to control customer orders at each period of cycle time. The first period (1-4 weeks) is compared to one fourth of the whole cycle time from forecast to delivery date: the customer is about to increase or reduce the aggregate order quantity by not more or less than 50 % from the previous planned forecast. In the second period (5-8 weeks), the customer is allowed to change the order by plus or minus 30 % of its planned forecast. In the third period (9-12 weeks), the cycle time has a tight schedule to absorb any change, and the customer is able to adjust by only plus or minus 10 %. The last period (13-16 weeks), called the 'frozen period', makes it unacceptable for a customer to change its order.

As each of the supply chain partners have different costs and revenue structures, so they have different individual gains in capturing the benefits. To address this problem, it becomes an emerging incentive concept, building motivation in a customer by providing for compensation in terms of bonus (discount) and punishment in terms of penalty (additional charges such as expedite fee charge and inventory charge). The Company believes that fair compensation can motivate customers towards desired behaviors and also form mutual rapport between the company and its customers.

For customers who are able to comply with the rules, the company compares the total of forecasts each quarter against monthly customer orders. If the number does not exceed or is less than the specified order percentage, the customer will get a bonus by means of a 20 % discount of its total payment. On the other hand, if a customer order change exceeds the maximum order percentage, the company still processes the order production but with the condition of a penalty payment. The customer needs to pay an expedite fee charge of 10% (5% to company and another 5% to the manufacturer) for any order quantity which exceeds the agreed percentage. However, if customer changes its orders less than the minimum percentage provided for each period of cycle time, the customer needs to accept and pay for the minimum order quantity.

Most rules have exceptions, especially in business. Exceptions need to be identified and discussed by optimal consensus agreement upon action. The Company

Most rules have exceptions, especially in business. Exceptions need to be identified and discussed by optimal consensus agreement upon action. The Company occasionally agrees to allow customers to change order by a percentage beyond or below the previous specified number. In the Electronics industry, most companies have set their target revenue per quarter. Revenue achievement has a significant impact on the company as well as employee performance measurement. Both customer and company need to gain profit as much as they can, close to its target. In practice, the company allows customer to change their aggregate order percentage in March, June, September and December, or at each quarter end period, by increasing orders by not more than plus or minus 15 % from the previous given percentage. This means that for 1-4 weeks, changed demand must not exceed plus or minus 65 %. For 5-8 weeks it is plus or minus 45 %. For 9-12 weeks it is plus or minus 25 %. For the frozen period it is not more than 15 %.

As a result of the agreement on exceptions, the company still needs to hold some amount of inventory as safety stock for supplying customers during the frozen period in case a contract manufacturer might not be able to produce more customer orders under the very tight cycle time of 4 weeks.

Finally, this concept implementation leads to the tendency of reduce the Bullwhip effect in the company supply chain, since demand from customers has been clearly stated, monitored and controlled under an incentive mechanism.

3.5 How incentive commitment by using bonus and penalty to control the changes of customer orders can answer the research questions and achieve the objectives

The methodology of incentive commitment obviously helps the company by removing conflict of interest between the company and its customers and aligns partners' operations by sharing costs, risks, and benefits together. The mutuality of coordination can be defined and increased as individuals shift their performance measurement from internal to a co-performance system at inter-company level.

Part 3.4 explained the concept and implementation details in applying a planning mechanism and how it can solve or relieve high variance percentages between forecast and customer orders. This scheme motivates customers to act in a manner that is consistent with the mutual strategic objectives, including making decisions that are optimal for the company and the overall supply chain and revealing truthful private information.

Incentive commitment is a key feature to motivate collaboration and underlying values of responsibility among partners, with a strong emphasis on sustaining relationships to build effective goal attainment. The clearer the linkage between performance and incentives, the more effectively the company can motivate customers towards desired behavior.

3.6 Expected results

It can be said that the company is successful in developing incentive commitment as a decision making tool to control forecast and customer orders in each period of time. This tool can facilitate the company to be able to provide a stronger promise for its ability to deliver products on a customer's required date. The Company will gain opportunity profit from a specified certain percentage of order increment while able to eliminate or reduce inventory levels from excess demand against forecast. If so, the company can finally achieve positive consequences by reaching a high STR percentage, gain opportunity profit, achieve good supplier performance rating and a good reputation among competitive supply chain partners.

CHAPTER IV

PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

This chapter will discuss the results after implementation of the concept of incentive commitment using bonus and penalty with customers. The aim of designing a new model is to control customer orders deviation from the planned forecast by a certain percentage under a specified period of time. This is achieved by using an incentive scheme of bonus and penalty in order to align partners to act in a manner consistent with mutual strategic objectives to provide a solution of the forecast and customer order mismatch problem, improve the customer service level (shipment on customer requested date), provide opportunity profit, and also reduce excess inventory and its cost.

The aim of this chapter is to present a critical discussion on the result of the new planning mechanism, using sensitivity analysis. Each case scenario concerning planned forecast, customer order, variability at each period of cycle time, and applied incentive commitment concept, has been developed and analyzed.

4.1 Sensitivity Analysis of Cases

Sensitivity Analysis is the study of how the variation (uncertainty) in the output of a mathematical model can be apportioned, qualitatively or quantitatively, to different sources of variation in the input of a model.

From the research study, cases can be summarized by six cases which can be separated into 3 actual cases and 3 proposed cases. An actual case is a case that actually happened in the current business situation without a planning mechanism to control input and output. A proposed case represents a case that has adopted a new planning mechanism as a tool to control variability of input towards an optimal output. The findings of these two different cases will be shown as comparative

Table 4.1: Sensitivity Analysis of Actual Cases 1-3

							Relationship	
Cases	Forecast QTY	Customer Order Q	Delivered QTY	Expedite Fee	Profit per unit	Profit exclude expedite cost	Company	Customer
Actual Case 1	100	120	120	[redacted]	$ 10	$ 1,200	Lose	Win
Actual Case 2	100	120	100	No	$ 10	$ 1,000	Lose	Lose
Actual Case 3	100	80	80	No	$ 10	$ 800	Lose	Win

__Actual Case 1:__ If forecast = 100 units, customer order = 120 units, product price = \$20 and product cost = \$10 (profit per unit =\$10)

<u>Remark:</u> there is no incentive commitment of bonus and penalty

In this case, the research study shows the current situation which the company has encountered from an increased customer order, from 100 to 120 units. Company A is able to expedite and deliver all the required customer order of 120 units, and the company can achieve the customer service level in terms of shipment on customer requested date (STR) and does not lose opportunity profit, but instead the company has to pay the expedite fee for 20 more to the manufacturer. The profit that the company gets from sales will be as the following:

Total Profit = Delivered quantity * Profit per unit

Total Profit = 120*\$10 = \$1,200

<u>Remark:</u> Amount of total profit is prior to deducting the expedite fee from the manufacturer.

This case can represent a relationship type between company and customer, known as *Lose-Win relationship* in which every company will achieve its targeted service level in terms of product delivery. Contrarily, the company has hidden costs of an expedite fee (labor wage and labor hour) for pushing the manufacturer to produce 20 more units without prior notification. On the other hand, the customer is satisfied since all the required products (120 units) are delivered on the committed date.

Actual Case 2: If forecast = 100 units, customer order = 120 units, product price = $20 and product cost = $10 (profit per unit =$10)

Remark: there is no incentive commitment of bonus and penalty

In this case, the research study shows the current situation which company has encountered from an increased customer order, from 100 to 120 units. If the company is able to deliver only the forecast quantity of 100 on its committed date, the company cannot achieve its target service level or ship to the customer on the requested date (STR), and will have a bad reputation, but the company has no need to pay an extra charge for expediting production of the extra unit by the manufacturer. However the company loses opportunity profit to sell 20 more units from the increased customer order. The profit that company gets from sales will be as the following:

Total Profit = Delivered quantity * Profit per unit

Total Profit = 100*$10 = $1,000

Remark: No extra charge for expediting production by the manufacturer

This case can represent a relationship type between the company and a customer, known as *Lose-Lose relationship.* The Company fails to satisfy a customer's new demand change which results in a company low service level and also loses revenue. The customer becomes unpleasant since the customer also fails to meet its end customer's demand, and loses opportunity profit from selling product to the customer's customer. This case shows that both company and customer are in the same situation of negative impact of being unable to be responsive to its own customer's demand, and loses opportunity profit from selling product to the customer's customer. This case shows that both company and customer are in the same situation of negative impact of being unable to be responsive to its own customer demand change, and there is no mechanism to manage and control the mismatch between forecast and customer order.

Actual Case 3: If forecast = 100 units, customer order = 80 units, product price = $20 and product cost = $10 (profit per unit =$10)

Remark: there is no incentive commitment of bonus and penalty

In this case, the research study shows a current situation which company has encountered from a decrease in a customer order from, 100 to 80 units. As a result, the company has excess inventory of 20 units that are left from production capacity. This excess inventory ties up the company's invested capital for inventory cost and warehouse management cost. The profit that the company gets from sales will be as the following:

Total Profit = Delivered quantity * Profit per unit

Total profit is 80*10 = $800

Remark: Profit has been reduced from $1,000 to $800

This type of case can represent a relationship type between a company and customer, known as *Lose-Win relationship* in which the company has a negative impact from a customer order reduction since all the production have been processed according to the forecast quantity, but the required units have then been reduced, resulting in excess capacity and inventory level. Chapter 1 has shown that there is high excess inventory level left for each customer, in which its inventory cost is $736,544.18 on

June, 2010. In terms of customers, they are free to reduce their order demand without prior notice which may be caused by a potential design change, a customer's customer reduced order demand due to market demand drop or low profitability. Since there is no mechanism to control order variability, finally the company ends up with high a level of inventory and its associated costs.

From these actual cases, it is clearly found that mutual benefits cannot be achieved. Both company and customer finally failed. Hence, a planning mechanism of incentive commitment by using bonus and penalty with customer has been adopted and implemented in the proposed cases below:

Proposed Case 1: If forecast = 100 units, customer order = 100 units, product price = \$20 and product cost = \$10 (profit per unit =\$10)

Forecast QTY	**100**
Customer Order QTY	100
Price per unit	20
Cost per unit	**10**
Profit	**10**

Remark: There is no change between forecast and customer order

Table 4.2: Sensitivity Analysis of Proposed Case 1

Period	Change Allowable Percentage	Maximum Delivered QTY	Minimum Delivered QTY	Delivered QTY	Additional Delivered QTY	Revenue (Pre)	Cost (Pre)	Total Revenue (Post)	Total Profit (Post)
WW 1-4	50%	150	50	100	0	\$ 2,000	\$ 1.000	\$ 1,600	\$ 600
WW 5-8	30%	130	70	100	0	\$ 2,000	\$ 1,000	\$ 1,600	\$ 600
WW 9-12	10%	110	90	100	0	\$ 2,000	\$ 1,000	\$ 1,600	\$ 600
WW 13-16	0%	100	100	100	0	\$ 2,000	\$ 1.000	\$ 1.600	\$ 600

If the customer order remains 100 units, as in the planned forecast, the customer will get a bonus from company in terms of a 20 percents discount from the total payment. The profit that the company gets from sales will be as the following:

Total Profit = (100*$20)*80% - (100*$10)

Total Profit = $600

This case can represent a relationship type between company and customer known as *Win-Win relationship* in which the company can achieve its targeted customer service level as well as having no need to expedite more production units from the manufacturer. In terms of the customer, it can get a discount of 20 percent off its total payment. This significant amount of discount leads to higher profit to the customer from selling the product to its end customer.

<u>Proposed Case 2:</u> If forecast = 100 units, customer order = 120 units, product price = $20 and product cost = $10 (profit per unit =$10)

Forecast QTY	100
Customer Order QTY	120
Price per unit	20
Cost per unit	10
Profit	**10**

<u>Remark:</u> There is a 20 percent increase in the customer order from the planned forecast

Table 4.3: Sensitivity Analysis of Proposed Case 2

Period	Change Allowable Percentage	Maximum Delivered QTY	Minimum Delivered QTY	Delivered QTY	Additional Delivered QTY	Revenue (Pre)	Cost (Pre)	Total Revenue (Post)	Total Profit (Post)
WW 1-4	50%	150	50	120	0	$ 2,400	$ 1.200	$ 2,320	$ 1,120
WW 5-8	30°	130		120	0	$ 2,400	$ 1,200	$ 2320	$ 1.120
WW 9-12	10%	110	90	110	10	$ 2.200	$ 1 200	$ 2,420	$ 1,220
WW 13-16	0°0	100	100	100	20	$ 2.000	$ 1,200	$ 2,440	$ 1,240

In Table 4.3, the company's total profit will be varied, based on each specified period of time. At work weeks 1-4 and 5-8, when a customer order is allowed to adjust by 50 and 30 percent respectively, the customer order has been increased by 20 percent which is considered to be acceptable within the period (ww1-8). It means an order of 120 units is in the range between maximum quantity (150 units) and minimum quantity (50 units). Therefore, the customer achieves the benefit of getting a bonus of 20 percent discount from its increased order (20 units). The profit that the company gets from sales will be as the following:

Total Profit = (100*$20) + (20*$20*80%) – (120*$10)

Total Profit = $1,120

At work week 9-12 when a customer order is allowed to adjust by 10 from the planned forecast, the order has been increased by exceeding the allowed percentage. Consequently, there is a penalty of 10 percent for the expedite fee (5 percent to the company and another 5 percent to the manufacturer) from the increased order (10 units) that the customer needs to pay to the company. The profit that the company gets from sales will be as the following:

Total Profit = (110*$20) + (10*$20*110%) – (120*$10)

Total Profit = 1,220

At work week 13-16, the 'frozen period', in which change is unacceptable from the planned forecast, the customer order has been increased by 20 percent but the change allowable is zero. Therefore, the customer needs to pay 10 percent of the expedite fee from the increased order (20 units). The profit that the company gets from sales will be as the following:

Total Profit = (100*$20) + (20*$20*110%) – (120*$10)

Total Profit = 1,240

This case represents a relationship type between company and customer known as a ***Win-Win relationship.*** In term of the company, more revenue and profit have been received from an increased order, with a good customer service level and also a good reputation and credibility among customers and competitors. Besides, the company can allocate a penalty charge that gets from the customer to pay the manufacturer for expediting units of production. The manufacturer itself sees the opportunity to increase sales volume by producing more units under the agreed compensation from the company. The customer is allowed to increase its order by an allowed percentage from the planned forecast without any charge under the company's commitment for product delivery in full quantity on the committed date, of the desired product deliverable to its end customers, and also increases revenue from selling more products.

Even if a customer needs to increase its order beyond the specified percentage, it is allowed to do so but needs to pay the expedite fee for the additional required units. This case provides positive reinforcement to motivate all parties to practice mutual cooperation and share benefits.

<u>Proposed Case 3:</u> If forecast = 100 units, customer order = 80 units, product price = $20 and product cost = $10 (profit per unit =$10)

Forecast QTY	100
Customer Order QTY	80
Price per unit	20
Cost per unit	**10**
Profit	10

<u>Remark:</u> There is a 20 percent decrease in customer order from planned forecast

Table 4.4: Sensitivity Analysis of Proposed Case 3

Period	Change Allowable Percentage	Maximum Delivered QTY	Minimum Delivered QTY	Delivered QTY	Additional Delivered QTY	Revenue (Pre)	Cost (Pre)	Total Revenue (Post)	Total Profit (Post)
WW 1-4	50%	150	50	80	0	$ 1,600	$ 500	$ 1520	$ 720
WW 5-8	30%	130	70	80	0	$ 1,600	$ 500	$ 1,520	$ 720
WW 9-12	10%	110	90	90	-10	$ 1,800	$ 900	$ 1,800	$ 900
WW 13-16	0%	100	100	108	-20	$ 2,000	$ 1,000	$ 2,000	$ 1,000

In Table 4.4, the company's total profit will be varied, based on each specified period of cycle time. At work week 1-4 and 5-8 when a customer order is allowed to be adjusted by 50 and 30 percent respectively, the customer order has been reduced by 20 percent which is considered to be acceptable within the mentioned period (ww1-8). It means that an order of 80 units is in the range between maximum quantity (150 units) and minimum quantity (50 units). Therefore, the customer achieves the benefit by getting a bonus of 20 percent discount off the decreased order (20 units). The profit that the company gets from sales will be as the following:

Total Profit = (80*$20) – (20*$20*20%) – (80*10)

Total Profit = $720

At work week 9-12, when a customer order is allowed to adjust by 10 from the planned forecast, the order has decreased by below the allowed percentage.

Consequently, the customer needs to accept and pay for the minimum order quantity which is 90 units. The profit that the company gets from sales will be:

Total Profit = (80*$20) + (10*$20) – (90*10)

Total Profit = 900

<u>Remark:</u> The amount that is below the allowable percentage (10 units) will be charged by price ($20) because in this case the decreased units have been completely processed as finish products. However, in case the 10 units is still work in process in which production can be halted, management negotiation will begin to find the optimal solution for mutual benefit. A solution may include a company charge to the customer in material price for the decreased units, or the company keeps the raw materials to produce another design model or part number.

At work week 13-16, the 'frozen period' in which change is unacceptable from the planned forecast, the customer order has decreased by 20 percent, but the change allowable is zero. Therefore, the customer needs to accept and pay for the minimum order quantity of 100 units. The profit that the company gets from sales will be:

Total Profit = (100*$20) – (100*$10)

Total Profit = $1,000

This case can represent a relationship type between company and customer known as a ***Win-Win relationship*** in which the company itself can manage the customer order and control inventory level more efficiently and effectively. The Company can reduce capital investment in holding high excess inventory and its associated costs. Besides, the company can reduce the risk of product obsolescence and increase flexibility for new product design change or development. The customer is allowed to change its order by a specified percentage under each period of cycle time. If the customer changes its order by following the mechanism, the customer finally achieves the discount benefit provided by the company. The manufacturer also plays safe from the customer's order reduction due to the final customer needing to accept the production units at the minimum order quantity according to each period of cycle time.

These proposed cases show that the result of implementing the concept of incentive commitment with customers by using bonus and penalty provides positive outcomes (win-win relationship) in terms of enhanced relationships between trading partners, improvement in the company's targeted service level, achieved opportunity for profit, and also increase in the company's total revenue.

4.2 Trial Period of Implementation the new planning mechanism

4.2.1 Sampling of Customer

Since this concept is something very new to the company's customers, an initiative strategy needs tight cooperation and strong relationship between the company and customers. Customer H, who has been the company's loyal customer for many years, has realized the competitive advantage that the company will get from implementing the new planning mechanism in collaborative forecasting. Customer H is willing to shake hand, discuss the new concept, analyze the benefits and drawbacks and begin a trial project with the company for three months from July – September, 2010.

4.2.2 Sampling of Part numbers

The sample of part numbers from Customer H has been chosen to implement the trial period under the concept of incentive commitment using bonus and penalty to control the changes in customer orders. The top five part numbers have been selected by

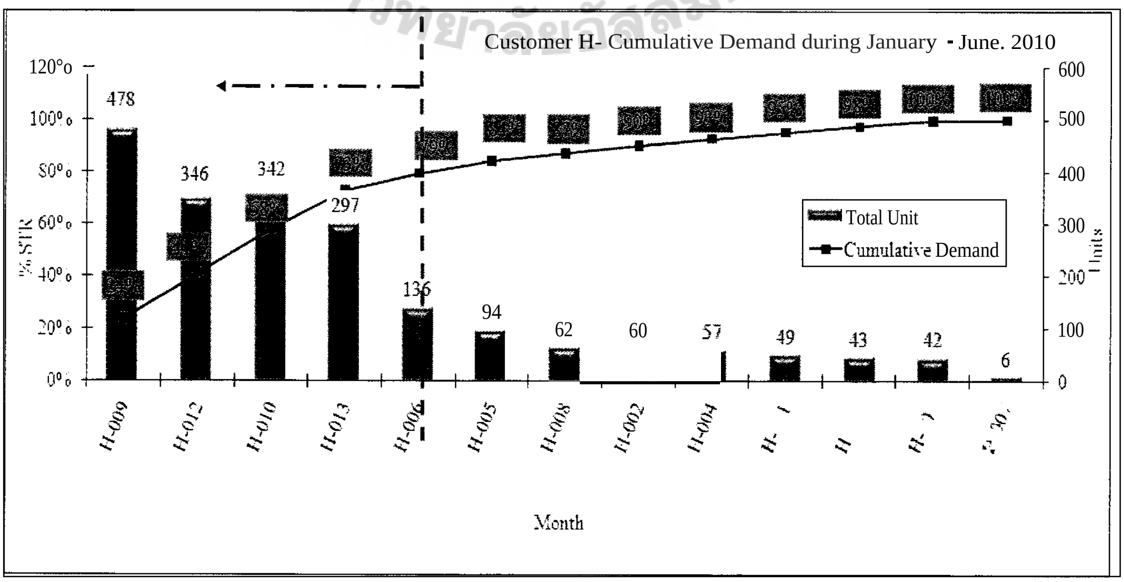
Pareto Analysis according to the highest percentage of total customer orders from January – June, 2010.

Table 4.5: Top five part numbers of Customer H

CUSTOM ER	Part Number	Total Customer Order	Percentage of Customer Order	Ranking Order
Customer H	H-009	478	23.76%	
Customer H	H-012	346	17.20%	2
Customer H	H-010	342	17.00%	
Customer H	H-013	297	1436%	4
Customer H	H-006	136	6.76%	
Customer H	H-005	94	4.67°o	6
Customer H	H-00S	62	3.0S°o	-
Customer H	H-002	60	2.9S°o	S
Customer H	H-004	57	2.S3°o	9
Customer H	H-011	49	2.44°o	10
Customer H	H-003	43	2.14°o	11
Customer H	H-001	42	2.09°6	12
Customer H	H-007	6	0.30°o	13

Above Table shows that the 5 part numbers which are H-009, H-012, H-010, H-013 and H-006 have been selected according to their highest percentage of customer orders, of 23.76%, 17.20%, 17.00%, 14.76% and 6.76% respectively. According to Pareto Analysis, the total customer orders of these 5 part numbers represent nearly 80 percent of the total order of Customer **H** from January to June, 2010 (see Figure 4.1).

Figure 4.1: Pareto Analysis for top five part numbers of Customer H



4.3 Result Discussion

The research study will next discuss the result of implementation in terms of variance between forecast and customer order, on-hand, excess inventory level and its costs, company's opportunity profit, and lastly, customer's service level in terms of shipment on the customer requested date (STR).

4.3.1 Variance between Forecast and Customer Order

The research study has collected and reviewed customer order details on a monthly basis by comparing them to total quarterly forecast during the period of implementing the new planning mechanism from July to September, 2010.

Table 4.6 shows that total forecast from July to September is 1,610 units and customer orders of each month are 597, 570 and 529 units, respectively. The result shows that the total variance between forecast and customer order is 86 units, which can be calculated to be the variance percentage of 5.34% in which customer orders are more than the planed forecast.

Table 4.6: Variance between total forecast and monthly customer orders of Customer H during July – September, 2010

	Jul - Sep	**Jul**	**Aug**	**Sep**
Part number	**Forecast**	**Customer order**	**Customer order**	**Customer order**
H-009	600	219	204	**184**
H-010	300	126	114	112
H-012	300	112	106	102
H-013	300	11	120	109
H-006	110	23	26	[illegible]
Total	**1610**	**597**	**570**	**529**
Total variance	**-86**			

The monthly result can be explained in detail as in the following:

In July, the variance percentage between forecast and customer order is reduced to 9 percent, in which there are about 47 units of customer order increases from the planned forecast. In August, the percentage continues to improve to 8 percent, which customer order is 570 units and forecast is 530 units. Finally, in September, the percentage shows as nearly zero, in which only one unit has been left as excess inventory from the planned forecast of 530 units (see Figures 4.2 and 4.3).

Figure 4.2: Variance between forecast and customer order of Customer H during January – September, 2010

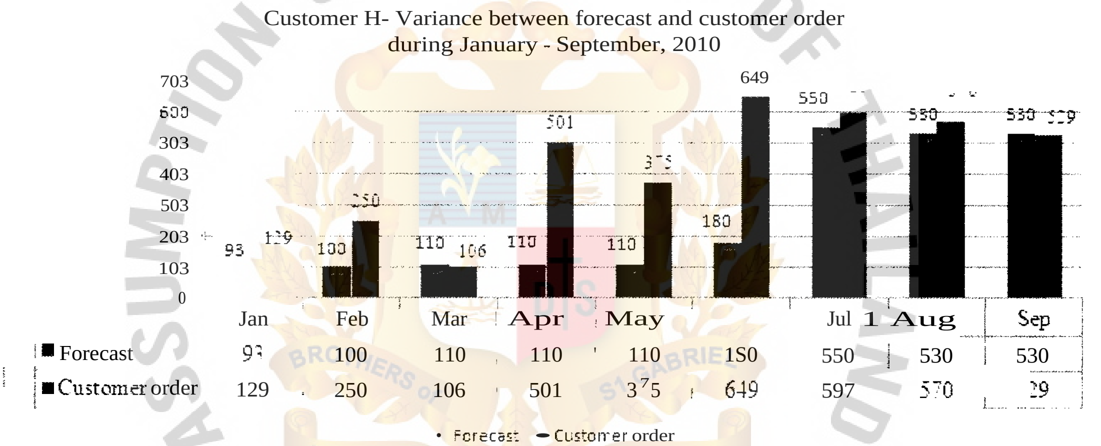
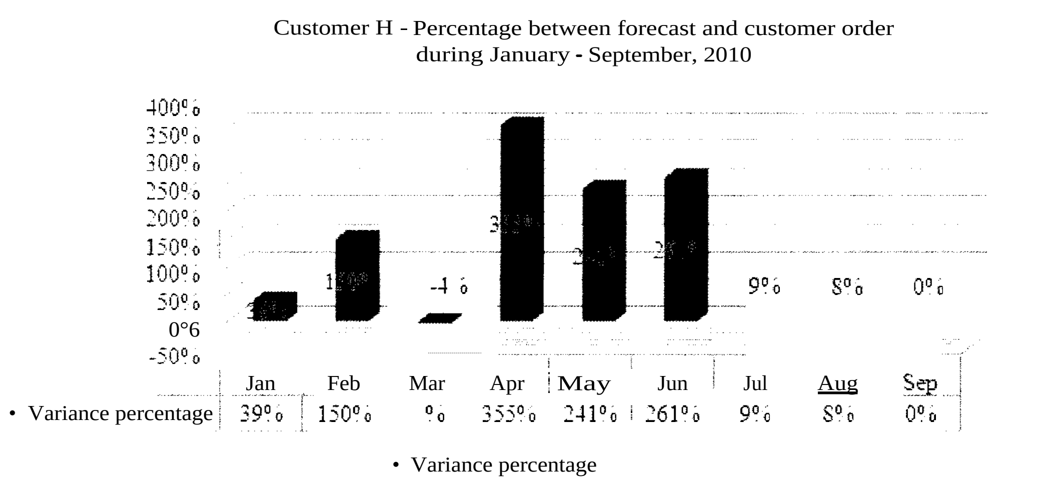


Figure 4.3: Variance percentage between forecast and customer order of Customer H during January – September, 2010



4.3.2 On-hand, Excess inventory level and its costs

Besides an improvement in the variance between forecast and customer order, the record of inventory level also shows that the on hand and excess inventory in September has been significantly reduced. The result is obviously shown by comparing below two tables, of data collected from January to June, 2010 against data collected from July to September, 2010, by considering on hand, excess inventory quantity and also their costs.

Table 4.7 shows that there is an on hand inventory of 753 units and an excess inventory (amount of on hand inventory deducted from safety stock) of 436 units, which can be calculated to be $229,969.40 of the company's capital investment in excess inventory from January – June, 2010. However, Table 4.8 shows that there is on hand inventory of 322 units (reduced by more than half of previous on hand inventory on June, 2010) and there is excess inventory of only 16 units, which cost $3,387.20! The Company is able to reduce its on hand inventory level for these 5 part numbers by about 96.33 percent as well as reduce the tendency for product obsolescence, while improving financial management in term of excess inventory cost reduction of about 98.53 percent.

Table 4.7: On hand and excess inventory for five part numbers of Customer H during January— June, 2010

Customer	Part u er	Price (S)	Safety stock	On-band QTY	Excess QTY	Cost of Excess QTY (S)
Customer H	H-006	663.1	35	50	15	9,946.50
Customer H	H-009	211.7	12	32	20	4,234.00
Customer H	H-010	324.5	90	224	134	43.453.00
Customer H	H-012	663.1	90	315	225	149,197.50
Customer H	H-013	550.2	90	132	42	23,108.40
Total		S 2,412.60	317	753	436	229,969.40

Table 4.8: On hand and excess inventory for five part numbers of Customer H during July— September, 2010

Customer	Part number	Price (S)	Safety stock	On-band QTY	Excess QTY	Cost of Excess QTY (S)
Customer H	H-006	663.1	35	35	0	0.00
Customer H	H-009	211.7	12	2S	16	3,387.20
Customer H	H-010	324.5	90	90	0	0.00
Customer H	H-012	663.1	90	SS	0	0.00
Customer H	H-013	550.2	90	S1	0	0.00
Total		S 2.412.60	317	322	16	S 3,387.20

4.3.3 Company's Opportunity profit

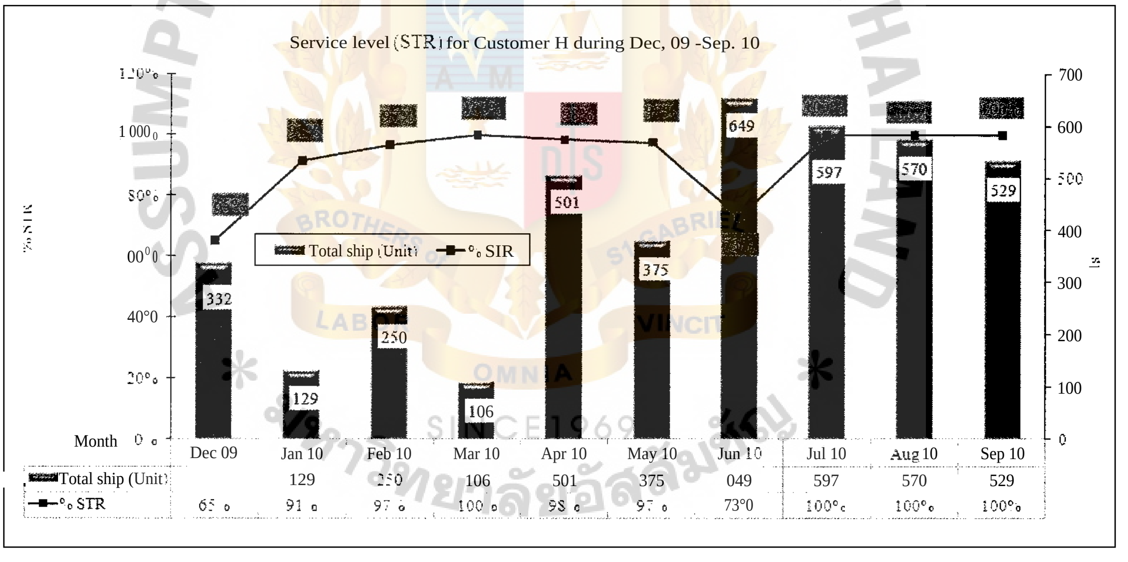
Company opportunity profit can be calculated by means of customer order's quantity that exceeds the planned forecast's quantity. From findings of the implementation from July – September, it can be concluded that the total opportunity profit that the company can get from four part numbers (H-009, H-010, H-012 and H-013) is \$28,622.1 (\$746.9 + \$8,554 + \$6,662 + \$12,659.2). Another part number that shows an opportunity loss is H-006 in which customer order is less than planned forecast by about 39 units, which cost of \$12,990.9. However, company considers this loss only in terms that the customer order is less than forecast, but the company is not affected by excess inventory or product obsolescence since management of both parties negotiated and agreed to derogate to keep materials (39 units) to use for other part numbers.

<u>Remark:</u> Trial implementation will not cover all the exceptions provided in Chapter 3 in which the customer is allowed to adjust its order quantity beyond or below 15% from previous specified percentage at each period of cycle time.

4.3.4 Customer's service level in terms of shipment to customer on requested date (STR)

The research study found that during the period of trial implementation, the company perfectly achieved 100% of shipment to customer on requested date (STR) in which there is no units missed delivery. Therefore, the company finally meets and exceeds its target service level of 95% for Customer H. This achievement, the company can express as a good performance, with high credibility of suppliers in the Electronics Manufacturing Service Company compared to other competitors.

Figure 4.4: Percentage of shipment on requested date for Customer H during December, 2009 – September, 2010



4.4 An overview of result between current and proposed model

Table 4.9: Comparison result between current and proposed model

Current Model*	Proposed Model**
1) Variance between Forecast and Customer order (Jan-Jun, 2010) Total forecast: 703 units Total customer order: 2,012 units Variance **percentage:** 186.20%	**1) Variance between Forecast and Customer order (Jul-Sep, 2010)** Total forecast: 1,610 units Total customer order: 1,696 units Variance percentage: 5.34%
2) Excess Inventory and its Cost Excess inventory quantity: 436 units Excess inventory cost: $229,969.40	**2) Excess Inventory and its Cost** Excess inventory quantity: 16 units Excess inventory cost: $3,387.2
3) Company's Opportunity Loss Missed ship: 586 units	**3) Company's Opportunity Profit** Missed ship: 0 units Opportunity Profit: $28,622.1
4) Customer service level in terms of Shipment to customer on requested date (STR) **(Dec, 2009 – Jun, 2010)** Achieved customer service level: 87% Company's target service level: 95%	**4) Customer service level in terms of Shipment to customer on requested date (STR)** **(Jul-Sep, 2010)** Achieved customer service level: 100% Company's target service level: 95%
5) Collaboration Individual gain and loss, no joint collaborative planning and forecasting, no compensation and profit sharing between trading partners	**5) Collaboration** Present tight cooperation and strong relationship between company and customer toward same common goal of mutual profit optimization and improved business operations

Remark: Result of Current model* has been collected from January – June, 2010
Result of Proposed model** has been collected from July – September, 2010

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

According to the finding explained in Chapter 4, this chapter aims to bring those results into the discussion to answer the research questions. In the first main part is a discussion of the research findings. The second part contains the research conclusion before ending with the last part which contains recommendations for further study.

5.1 Discussion of the Research Findings

This part presents the main findings with reference to the research questions mentioned in Chapter 1 and in previous studies.

1. What is the implementation strategy to provide the solution for the forecasting demand and customer order mismatch situation?

The finding for the first research question can prove that the new planning mechanism by implementing incentive commitment using bonus and penalty, evidently provides a positive solution to improve the variance between planned forecasting demand and customer order.

This research study shows that after implementing the new planning mechanism from July – September, 2010 for 5 part numbers of Customer H, the outcome shows that total variance between forecast and customer order is only 86 units, which can be calculated to be a variance percentage of 5.34% in which the customer order is more than the planned forecast.

2. **Is the strategy able to improve customer satisfaction in terms of a higher level of shipment to customer on the requested date (STR)?**

From July – September, company can perform perfectly to satisfy 100% of customer demand in which no unit missed delivery to the customer on its committed date. It can be concluded that from this implementation, the company not only meets its targeted customer service level of 95% but also performs superbly, above expectation.

3. **Will the strategy provide opportunity profit to the company when forecast is less than customer order (forecast < customer order)?**

It can be concluded that total opportunity profit which the company can get from implementing an incentive commitment by using bonus and penalty during July — September is $28,622.1, in which the company can sell 125 production units more than the planned forecast of 4 part numbers (H-009, H-010, H-012 and H-013).

4. **Is the strategy able to reduce excess and on hand inventory and their cost when forecast is more than customer order (forecast > customer order)?**

From the findings in Chapter 4 it can be summarized that the level of excess inventory has been tremendously reduced from 436 units to only 16 units in September 2010, which can be calculate to be 96.33% of inventory level reduction. Moreover, the research found that the company can reduce its capital investment in excess inventory by about 98.53% which can be calculated to be $ 226,582.20.

The findings of the new planning mechanism implementation are able to provide positive answers to the research questions which are matched with the objectives of the research study. Also, the research findings enable the company to achieve the significance of the study, which consist of the following:

- Stronger commitment plan
- Decision making tool to synchronize between forecast and customer order

- To achieve expected benefits; gain credibility, supplier performance and opportunity profits
- To be able to improve customer satisfaction in term of improving shipment on customer requested date (STR)
- To be able to reduce inventory level and it costs

5.2 Research Conclusions

This research project started from the realization of the company's mismatch between forecast and customer order, high level of excess inventory, high capital investment of inventory cost, and low customer service level. The research study aimed to propose a new planning mechanism under the concept of incentive commitment.

Incentive commitment refers to the process of sharing costs, risks, and benefits among the participating members (Simatupang and Sridharan, 2002). This scheme motivates the partners to realize the benefits of a strong relationship toward common goals and mutual objectives in which desired behavior between collaborative partners can be motivated by a bonus in terms of discount and a penalty in terms of an expedite fee and excess inventory charge.

The purposes of this research study are to provide the company with an effective decision making tool for planning and forecasting customer orders, to enable the company to provide strong commitment and fulfill its promises, gain benefits of credibility, good performance rating in term of improving its customer service level, and lastly, benefits in term of inventory level and cost reduction.

The research findings show positive improvements, and achieved the study's expectations. Variance between forecast and customer order has been tremendously reduced to 5.34%.; the opportunity profit shows as $28,622.1 increasing from the planned forecast, and excess inventory level and its cost show only 16 unit or $ 3,387.2. Finally, the company can achieve 100% of its customer's service level.

5.3 Managerial Implications

From the research study, the results of implementation shows tremendous benefits in various aspects, include strategic management in controlling changing orders, financial benefits of increased revenue from opportunity profit and also reduction of capital investment on inventory. The Company definitely achieves success in adopting the concept of incentive commitment by using bonus and penalty to control the changes of customer orders, even after only a short period of trial implementation. Full benefits can be significantly achieved if the company is interested in further study and development.

5.4 Recommendations for Further Study

From the research findings, there are other further processes to be discussed and developed in order to achieve and maximize the competitive strategy linked to this research problem, as in the following suggestions:

1. Expand the mechanism in controlling customers changing orders, through incentive commitment by using bonus and penalty to another 38 part numbers of DCM products (for Customer **H,** Customer A and Customer I) and also to other company products since each product has differences and uniqueness in characteristics, benefits, market demand and trend. This mechanism will optimize the company's performance in terms of customer service level, and financial benefits in terms of inventory level and its associated cost reduction, and achieve opportunity profit

2. Expand the mechanism to other customers in the first and second tiers and to other supply chain partners such as manufacturer, suppliers or even third party logistics

providers, in order to align all supply chain operations and maximize mutual benefits through this collaboration

3. Develop concept of consignment inventory for customers in cases where forecast is more than the customer order. Excess inventory from order reduction needs to be discussed as to its method of management, whether it will be self-custody by the customer or will be handled by the company at the manufacturer's warehouse.

4. The research study findings can be summarized to prove that the company has better control of customer orders through incentive commitment, which results in higher profit while reducing inventory level. Consequently, if the company can further develop the mechanism to be more precise, responsive and effective, the safety stock level of the company's products can be reduced or eliminated to zero.

5. This research study has proposed an arbitrary model in designing incentive commitment for percentages of bonus and penalty for each product of each customer. An optimal proportion needs to be discussed, verified and adjusted due to different product types, marginal profit, and agreement between collaborative partners.

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