A study on information sharing mechanism for an opto-electronic company

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Abstract. Information sharing is a precondition for improving supply chain performance such as forecast accuracy, supplier inventory management VMI, supplier innovation, and the flexibility. Information sharing in the supply chain will improve the accuracy of production planning, reduce inventory, reduce the production of sluggish inventory, increase the rate of perfect order, and shorten the lead time. In this paper, the supply chain management for an opto-electronic ACO is studied. The information sharing mechanism is established and proven to mitigate the problems such as high-level-inventory, overstock and forecast inaccuracy.

1. Introduction

Whether supply chain operation is smooth or not will directly affect supply chain performance. By improving information flow management, we can improve supply chain performance such as, order fulfillment rate, order fulfillment cycle, supply chain flexibility and supply inventory turnover days. The information flows with the flow of product in a series of activities of purchasing, producing, delivering and returning, and also integrated with a network power structure. The failure of information sharing will result in the difficulty of the production capacity planning, inefficient inventory management and the waste of resources.

The factors that affect the sharing of information include sharing system, shared content, shared object, the degree of trust among shared entities, the consistency of shared entities, information security, etc. To achieve sharing, shared entities, content and frequency will be the key points. ACO is a backlight Cover manufacturer whose production mode is making to order. The lack of shared information and inaccurate forecast has contributed to high-level-stock, low turnover of inventory, unreasonable capacity planning of production. This situation seriously affects the performance of the company. In order to improve performance and increase the competitiveness of ACO, a mechanism of information sharing should be proposed.

The contribution is supposed to be twofold. Firstly, although much studies have devoted to relations between information sharing and supply chain performance, there is less research focused on the sharing contents and detailed procedure. Secondly, for the companies like ACO, there are not only many second tier customers, but also many second tier supplies, the sharing mechanism can be for reference by many enterprises in practice.
2. literature review

Much of supply chain research has shown how the sharing of order-related information reduces the upstream amplification of errors in forecasting demand signals and reduces the bullwhip effect [1]. Since long replenishment lead-time contributes to the bullwhip effect, shortening the lead-time is a direct and effective counter-measure [2]. Company may share information on its inventory positions with its supplier to inform their production schedule and to facilitate vendor-managed inventory. Company sharing its demand information will enable the vendor to plan capacity better [3]. The information sharing among supply chain partners is based on strict confidentiality agreements. Otherwise it may reduce willingness to share due to the risk of information leakage to competitors. Confidential information also relates to fear of losing control of sensitive data which could reduce competitiveness in the marketplace [4], [5]. There are proponents of information sharing along the supply chain that highlight potential benefits such as, improved production planning, lower inventory costs, increased customer service, and reduced lead times through the supply chain [6]. In literature, a general assumption of information sharing is that all the partners in the supply chain would have access in real time to same information [7], [8] Kim indicates that supplier innovativeness positively affects information sharing and supply chain agility. The factors of information sharing across multiple supply chain tiers include some factors [9]: forecasting ability, planning competence, information quality, trust, confidential information, common goal, and common performance measures. [10] Zhou and Benton findings show that both effective information sharing is critical in achieving good supply chain performance. The longer the retailer’s lead time the higher the retailer’s inventory and backlog cost [11]. Information sharing may bring advantages to manufacturing such as inventory reduction, increased productivity, organizational efficiency, improved services, early problem detection, and quick response, reduced cycle time from order to delivery and better tracing and tracking [12].

3. The management status of ACO

Products of ACO mainly include Electronic Backlight Cover. Its production life cycle is short but fast update. We need to constantly innovate and launch new products to fulfill customer needs and occupy the market. It is suitable for reactive supply chain, fast response to customer demand, flexibility in production capacity, to fulfill customers’ adjustment, and to continuously improve the supply cycle, with high marginal revenue. The product technology is produced through the designed specifications after customer certification, and followed by purchasing, production and delivery according to customer needs. The flow of logistics and information is illustrated as follows figure 1.

Information transmission is only carried out step by step between cooperative customers and suppliers, including information content, order information, and delivery information. ACO internally purchases raw materials according to customer orders, and arranges production and delivery. When demand changes, slow adjustment, low response and agility, cannot quickly respond to market and customer needs. When the demand is raised, the company's schedule is unable to reach the customer's
schedule, resulting in low customer satisfaction and loss of orders; The reduction of demand causes overstock, even sluggish inventory, the high turnover days, the low order fulfill rate and the overcapacity planning or the shortage of capacity. Employees are busy with remedying and solving the problems that have happened. Each enterprise on supply chain is isolated, and the performance of supply chain is low. Compared with the best practice in industry, ACO has faced with high inventory turnover days, low order fulfillment rates, long order fulfillment periods, low flexibility, and huge pressure on sluggish inventory. ACO's top managers invited relevant partners in the supply chain to discuss and eventually reach consensus on information sharing. Over the years, information sharing has been proven by many researchers to be effective in enhancing corporate performance. ACO is determined to eliminate all difficulties and establish information sharing mechanisms to enhance the company's effectiveness.

4. Shared entities, contents and frequencies
How to achieve sharing, how to select shared entities and how to select frequency are the key issues of information sharing. Supply chain information sharing is a process of expansion beginning with foremost a trust among partners, followed by a common goal, and finally a win-win situation. In order to overcome the sharing obstacles mentioned in the literature, ACO puts forward the following three points. First, it proposes to select supply chain partners, choose long-term development partners and establish strategic alliances. Secondly, a confidential agreement is signed between strategic partners to ensure the safety of information sharing among enterprises. Finally, the cooperative enterprises assign the person in charge of transferring the shared information and establish the sharing mechanism. Information delivery is using electronic data and vendor platform. At the same time, according to its own characteristics, a series of shared data tables have been worked out. The information shared includes from prediction, production, inventory, EOL, to R & D and so on. In addition, Considering 70% raw material lead time is 7 days, 20% is 15 days, 8% is 30 days and 2% is 45 days, rolling demand preparation, supply chain partners negotiate sharing frequency is set to once a week.

4.1. Forecast information sharing process
The downstream customers predict the demand at least 6 months according to the market demand (consumers), and share the information with partners in the supply chain at the same time. The partners refer to the forecast, plan the future production in parallel, and prepare for the longer raw material rolling demand in the pre purchase period, so that the demand changes flexibly, shorten the production delivery cycle and improve the efficiency. Because the prediction source is direct consumers, so the prediction data is more accurate. In addition, supply chain cooperation enterprises refer to the same forecast, avoiding data bullwhip effect.

(1) Downstream customers share forecasts to customers. The production and material planning are arranged by customers, and then share the needs to ACO.

(2) ACO receives customer demand data and compares downstream customer forecast data. If there is no difference, the main production plan MPS will be arranged, and the material demand plan MRP with the actual demand is display to the supplier.

(3) Suppliers compare the difference between ACO's needs and downstream customer's prediction data, if there is no difference, continue to share with upstream suppliers
Each company will compare the difference between downstream customer prediction and customer needs, and determine the following execution. Under the premise of shared inventory, if the enterprise finds the difference of demand data, it will notify the downstream businesses to communicate again, and then confirm the execution. The prediction sharing schema is like figure 2.
Downstream customers predict 6 months’ demand at least, and electronic data shared to customers, companies, upstream suppliers, and updates a weekly forecast. Electronic data is as in table 1.

![Figure 2. Forecast sharing schema.](image)

**Table 1.** Downstream customers’ forecast sharing form.

| Forecast | Apr’18 | May’18 | Jun’18 | July’18 | Aug’18 | Sept’18 |
|----------|--------|--------|--------|---------|--------|---------|
| commodity A | 100000 | 120000 | 200000 | 220000 | 250000 | 230000 |
| Cum        | 10000  | 220000 | 420000 | 640000 | 890000 | 1120000 |

According to forecast monthly plan and weekly plan, customers can share at least three months’ demand to the ACO after planning the demands; First month will be displayed daily demand. The weekly demand plan begins next month. Electronic data is as in table 2.

**Table 2.** Customers’ forecast sharing form.

| Model | Stock | Apr’18 | May’18 | Jun’18 |
|-------|-------|--------|--------|--------|
| commodity A | 10000 | 90000 | 120000 | 200000 |
| Cum    | 10000 | 100000 | 220000 | 420000 |

**Table 3.** Company's forecast sharing form for daily.

| Model | Stock | Apr’18 | 2018/4/1 | 2018/4/2 | 2018/4/3 | 2018/4/4 | 2018/4/5 | 2018/4/6 | 2018/4/7 |
|-------|-------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| commodity A | 10000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 |
| Cum    | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 40000 | 45000 |

According to customer needs, ACO compares downstream customer’s forecast data during this period. If there is no difference, ACO will input customers required delivery data for three months in SAP system, and arrange master production plan MPS. The system calculates MRP material requirement plan based on company inventory and main production plan, and uploads system supplier platform. This data shows the daily demand plan in the first week, and the second week will be shown the weekly demand plan. Electronic data show in table 3 and table 4.

**Table 4.** Company's forecast sharing form for weekly.

| Model | Apr’18 | May’18 |
|-------|--------|--------|
| commodity A | 4/8-4/14 | 15000 | 4/22-4/28 | 20000 | 5/13-5/19 | 25000 | 5/20-5/26 |
| Cum    | 60000 | 78000 | 98000 | 118000 | 143000 | 168000 | 193000 |

The supplier will reach to the company's supplier platform to download the demand and check the customer's needs. If the difference is more than 10% (General standard is about 3 days of demand.
within 10%），the supplier will contact ACO to confirm the demand plan again. After the confirmation is completed, the requirement plan of ACO will be prepared, and send the demand forecast to the upstream suppliers.

The upstream supplier receives the supplier's needs and compares the downstream customer's needs. If there is any discrepancy, it will be fed back to the supplier to confirm again. Plan, purchase, production and delivery get confirmed according to the needs. Comparison forecast data form is as appendix table A.

4.2. Production information sharing
After confirming demand, ACO will share the input and output data of customers. The content includes customer demand, capacity, output per day, number of sunrise goods and inventory quantity, which validate future delivery plan to fulfill downstream customer demand, covering important supply chain demand plan. In addition, ACO share information such as material planning, material stock and loss rate, that is, Clear to Build (CTB) report. According to the CTB report, if the plan fails to reach customer needs, a coordination meeting will be held to track, and followed by a final result of coordination. The forms are as follows table 5 and table 6.

| Table 5. Clear to Build form. |
|-------------------------------|
| Date | Beginning stock | 2018/4/1 | 2018/4/2 | 2018/4/3 | 2018/4/4 | 2018/4/5 | 2018/4/6 |
| Downstream customer Forecast-A company | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Cum | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 |
| Output Capacity | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Daily idle CAPA | 1,400 | 3,700 | 5,000 | 5,000 | 5,000 | 5,000 |
| Total Output | 3,600 | 1,300 | 0 | 0 | 0 | 0 |
| Daily Output (based on material)-customer A | 1,800 | 650 |
| Daily ETD | 1,800 | 0 | 650 | 0 | 0 | 0 |
| Cum ETD | 1,800 | 1,800 | 2,450 | 2,450 | 2,450 | 2,450 |
| Daily ETA | 1,800 | 0 | 650 | 0 | 0 | 0 |
| Cum ETA | 1,800 | 1,800 | 2,450 | 2,450 | 2,450 | 2,450 |
| Delta to customer Forecast-A company | -3,200 | -8,200 | -12,550 | -17,550 | -22,550 | -27,550 |
| A company Stock-customer A | 0 | 650 | 0 | 0 | 0 | 0 |

| Table 6. Material simulation plan form. |
|------------------------------|
| Material | Loss rate | Date | Beginning stock | 4/1 | 4/2 | 4/3 | 4/4 | 4/5 | 4/6 |
| A | 1% | Daily ETA | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | | Cum ETA | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 |
| | | BOH | 3,812 | 7,526 | 12,526 | 17,526 | 22,526 |
| B | 1% | Daily ETA | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | | Cum ETA | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 |
| | | BOH | 3,812 | 7,526 | 12,526 | 17,526 | 22,526 |
| C | 1% | Daily ETA | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | | Cum ETA | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 |
| | | BOH | 3,812 | 7,526 | 12,526 | 17,526 | 22,526 |
| D | 2% | Daily ETA | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | | Cum ETA | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 |
| | | BOH | 3,812 | 6,364 | 8,890 | 11,415 | 13,941 |

The flow chart of the production information sharing process is as follows figure 3.
4.3. Stock information sharing
The supplier provides inventory, WIP, raw material and PO data tables every week, and then it is compared whether total inventory exceeds ACO's needs. ACO agrees with suppliers to prepare some stock (finished goods). Cause 70% material lead time within 7 days and most suppliers lie in the vicinity of ACO, the safety stock will be prepared 2 days demand. In the other hand, it will reduce risk when the demand reduction. If suppliers meet the requirements of shipment, they can prepare stock for 2 days quantity of delivery, so that they can response quickly to demand adjustment. It will be fulfill the ACO demand advanced or increased. ACO monitors whether the finished product inventory is controlled within 2 days, and whether the total demand is in line with ACO's needs. If there are differences, consensus will be reached through consultation and communication. Electronic data is as follows table 7.

**Table 7. Supplier inventory information sharing form.**

| Commodity Name | FG | WIP | Raw Material (On Hand) | Open PO | Total | Aco-Forecast | Excess |
|----------------|----|-----|------------------------|---------|-------|-------------|-------|
| Commodity A    | 3  | 1   | 5                      | 14      | 23    | 20          | 3     |

**Table 8. Beginning On Hand (BOH) inventory form.**

| Commodity Name | Config | Raw Material (On Hand) | WIP | FG | Actual shipment from 4/1-4/12 | Company A from Downstream customer | Open Forecast | Excess |
|----------------|--------|------------------------|-----|----|------------------------------|----------------------------------|--------------|-------|
| Commodity A    | Customer A to supplier A | 10,000 | 2,000 | 6,000 | 20,000 | 100,000 | 80,000 | (52,000) |
|                | Customer B to supplier B | 20,000 | 3,000 | 9,000 | 30,000 | 200,000 | 170,000 | (128,000) |
|                | Customer C to supplier C | 10,000 | 2,000 | 6,000 | 20,000 | 100,000 | 80,000 | (52,000) |

ACO shared monitors activities such as procurement and delivery through BOH tables to downstream customer. The customer's inventory monitoring and information sharing manager provide data per week. Setting up statistical table contains the raw material, work in product (WIP), finished goods (FG), actual shipment quantity and open-forecast comparing to downstream customer Forecast...
to get excess quantity. It will check whether there is amplification or shortage, and handle the abnormal part in time. Electronic data is as follows table 8.

4.4. EOL information sharing
Downstream customers inform the supply chain related strategic alliance members that the related products will enter the recession, and the future period is expected to be EOL (the next three months or half a year later EOL). The partners are asked to make a report on the stock and arrange the production carefully. ACO should be followed the below Key implementation events during this period: 1. The demand should be locked in the future; 2. No need to be prepared for safety inventory; 3. The Returned Merchandise Authorization (RMA) products should be finished in time; 4. MOQ, MPQ negotiation are minimized; 5. Weekly monitoring of inventory, electronic data to notify downstream customer making inventory balance. Schematic diagram of EOL information sharing process is as figure 4, and the electronic data is as appendix table B.

4.5. New product progress sharing
Downstream customers share the expected production time, future market demand and share the relevant strategic partners. If there are certified materials, the long pre purchase period can be authorized to prepare in advance. The premise of new product sharing is a close confidentiality agreement signed by all strategic partners and related stakeholders.

5. Effects of information sharing
After information been shared, it will increase the transparency of demand among the partners, make certain the customer's demand, and plan the future production reasonably, and reduce the stock to the minimum under the customer's demand. Better plan production capacity, reduce production loss rate. According to the needs of customers, we adjust the future production plan, purchase plan, avoid demand amplification and prevent dull inventory. All aspects of related production are properly arranged, resources are integrated, and inventory turnover is accelerated, so that supply chain enterprises can coordinate more smoothly and adjust more flexibly. ACO's information sharing mechanism has fully enhanced the company's performance, brought benefits to the company and increased the competitiveness of the company. Comparison form is as follows table 9.

| Item                  | NO sharing | Information sharing |
|-----------------------|------------|---------------------|
| Inventory turnover days| 25days     | 15days              |
| Order performance rate | 80%        | 100%                |
| Order performance cycle | 30days   | 20days              |
| Flexibility of supply chain | 5%    | 30%                  |
| Stagnant sum ratio    | 5%         | 0.10%               |

6. Conclusions
A sharing mechanism is designed and established for ACO for industry characteristics. Through information sharing, it improves the efficiency of product research and development, reduces inventory, especially sluggish inventory, accelerates inventory turnover, and also raises the flexibility of supply chain. Supply chain partners also benefit from these aspects, achieving win-win results, greatly improving supply chain performance and maintaining competitive advantage. This way can be used in other industries, especially in the development of information, such as APP, mobile phones, computers and so on. With corporate management and information technology upgrades, there will be new changes and requirements, especially for the coordination mechanism. For different types of supply chain, sharing content and sharing frequency will be different, and worth further research.
Additional important topics include the impact of the frequency of information sharing on supply chain performance.

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Appendix

Table A. Forecast comparison form.

| Commodity | Forecast | Apr’18 | May’18 | Jun’18 | July’18 | Aug’18 | Sept’18 |
|-----------|----------|--------|--------|--------|---------|--------|---------|
| Downstream customer Forecast to A company - customer |
| Customer Forecast to company |
| A Company A Commit |
| Commit vs Downstream customer Forecast |
| Customer Forecast vs Downstream customer Forecast |
| Cum |

Table B. Statistical list of materials for EOL series.

| Predictor set | EOL Material list | Factory inventory | WIP | Transportation inventory | Supplier inventory (finished goods) | Supplier WIP | Supplier raw material | Open PO |
|---------------|------------------|-------------------|-----|--------------------------|-----------------------------|-------------|----------------------|--------|

The notice date: Statistical date: Maximum set: