A New Way to Manage a Fashion Industry Supply Chain

Chia-Ling Huang

Abstract The pressure for fashion companies to compete not only on price and new product ranges, but also their ability to deliver newness and "refresh" product. This provides a challenge to supply chain management. Instead trying to improve the forecasting with a forecast-driven mode of SCM, there are alternative ways have been suggested by many researchers, however, there are prerequisites but not sufficient. So the keys the proposed scheme in this paper describes a new way to manage a fashion industry supply chain are: cut the batch size for the blind zone of every season, quick response time improvement, stop pushing inventory to the point of maximum errors – the retail point and detect and correct stockout and surplus just in time. The Chinese implementation case shows that the propose scheme is capable to realize in order to reduce surplus and shortage, increase gross profit, net profit, and cash flow.

Keywords Fashion industry • Pull system • Supply chain management

1 Introduction

According to (Christopher et al. 2004; Sen 2008), fashion industry has the following characteristics; short products life cycles, tremendous product variety, high volatility and low predictability demand, high impulse purchasing (many buying decisions are made at the point purchase) and a complex supply chain. To maintain competitive advantage, most retailers focused on price, by sourcing increasingly from low cost countries in the Far East (Jackson and Shaw 2001; Bruce et al. 2004), and adopt a strategy of constantly renewing product ranges with fashion-led styles that attract

C.-L. Huang (✉)
Department of Logistics and Shipping Management, Kainan University, Taoyuan, Taiwan
e-mail: clhuang@mail.knu.edu.tw

E. Qi et al. (eds.), *Proceedings of 20th International Conference on Industrial Engineering and Engineering Management*, DOI 10.1007/978-3-642-40063-6_113,

media attention and entice their (mostly) young female or male customers into the stores frequently. However, the pressure for fashion companies to compete not only on price and new product ranges, but also their ability to deliver newness and "refresh" product (Christopher et al. 2004). This provides a challenge to supply chain management (SCM). Efficient SCM practices can spell the difference between success and failure. Many companies involved in manufacturing and retailing in fashion industry have seen the profitability severely affected by their in ability to match supply with demand. Traditional ways of responding to customer demand in fashion industry have been forecast-driven mode of operation, with the resultant risk of over-stocked for the slow movers at the end of season and under-stocked for the high runners during the season.

In fact, experience seems to suggest that the way to cope with non match supply with demand is to improve the quality of the forecast (Au et al. 2008). However, according to (Mohanty 2012), one of the latest branches of science called the Chaos Theory states that it is almost impossible to predict (with any reasonable accuracy) an output of a complex system because of non-linear feedback loops in reality. The relationship of variables in this system is not predetermined and a small change can have a disproportionate impact and vice-versa (remember the bullwhip effect (Lee and Whang 1997)). Unfortunately, the demand of fashion related SKUs at selling points has the characteristics of a complex system and hence any mathematical model, which uses predefined linear or even non-linear relationships between variables, cannot have any reasonable accuracy. Even if we put 20 variables in our model, the error can throw us off gear.

It is a waste of time to even try and model a non-linear reality of the market. Neither can it be easily modeled nor it is required to be done. So, instead of trying to improve the forecasting with a forecast-driven mode of SCM, there are alternative ways have been suggested by many researchers, however, there are prerequisites but not sufficient:

1. To nullify the effect of local variation, many people advocate an "aggregate forecast" or the top down forecast. Top down forecasting (which tries to take advantage of aggregation) or bottoms up forecasting (which takes advantage of knowledge of many local variables) or even a combination of the two does not yield better results when one has to forecast for large number of SKUs for a long horizon. Even if the aggregate forecast looks better, the advantages are lost when the inventory is eventually pushed to the point of maximum errors – the retail point.
2. To improve supply chain reaction time. Programs to improve reaction time have been suggested by many researchers such as: lead time reduction management (Christopher and Peck 1997), quick response program implementation (Birtwistle et al. 2003), IT to improve quick response (Lo et al. 2008), agile or lean supply chain development (Masson et al. 2007; Bruce et al. 2004; Christopher et al. 2004; Fernie and Azuma 2004), vertical integration (members of a supply chain owned by a single authority) or virtual organization (Wang and Chan 2010). However, we know that the actual production lead time of a

small batch is very short (a few days) relative to the supply lead time. So it is not surprise that these researches can demonstrate that the production lead-time can be cut to very short (for example 1 week). However, in reality, there is a limitation that makes it difficult. Raw material, for example dying the fabric, from suppliers is a batch process (meaning long supply lead time). You need much more than willingness to pay slightly higher prices to convince a supplier to cut all the batches to be in line with 1 week consumption (cutting the batches to be less than one tenth of what they are now). Such a change will necessitate a super culture revolution. Moreover the supplier is not willing to guarantee the same material in subsequent batches. So even production lead time can be reduced, if long material lead time is existed, still makes quick response difficult.

3. To improve buyer/supplier relationship so that the information on consumer demands can be shared as close to real time as possible (Christopher and Peck 1997; Yu et al. 2001; Kurata and Yue 2008; Bertolini et al. 2004). This enables all parties in the chain to benefit through reduced inventories, better use of capacity, fewer stock-outs and less obsolesces. The shared information is important; however, much more important is how to use the information and how to operate the supply chain – push or pull.

How can we provide the sufficiency? This requires us to understand the operation mode of current fashion supply chain.

2 Current Operational Mode of Fashion Supply Chain

Fashion industry's business normally is based on two seasons (or more seasons) a year, therefore, every 6 months (or 3 months) they launch a new collection. They order, produce and buy in batches of 6 months (or 3 months) – for the whole season. If they can reduced the supply lead time through the programs mentioned in the previous section, they can order, produce and buy in batches of half season (or less) and reacts 2–3 times during the season to changes in market demand. Unfortunately, even with share information improvement, when start buying for the season (no matter how many months) at start of the season, it still forces the fashion company to rely on forecast for first 2–3 months (or more) of the season – so every season starts with "blind" zone. More seasons means more blind zones. Each period of blind zone exposes the fashion company to the mess of forecasting errors – high inventory for the slow movers end of season. Table 1 is a case result of an apparel company in China. So how can we reduce the overstocked for the slow mover end of the season?

Once they get the goods they immediately push about 60–80 % into the retail to fill up the pipelines in equal quantities with different sales velocities. Those with faster sales velocities will potentially have shortages while those with slow sales will end up with surpluses and, frequently, because too much inventory was pushed, the central warehouse might not have enough to supply those shops that sold out. So we can have shortages and surpluses at the same time on a specific title.

Table 1 A case result of an apparel company in China

Items	2011 winter	2012 spring	2012 summer
A: Planning volumes	162,176	76,293	152,606
B: Retailers' order	214,022	158,050	
C: Production quantity of first order	169,037	145,932	173,960
D: Replenish order	45,010	6,380	24,759
E: Actual sales	145,889	73,451	138,743
F: End of season inventory(C + D − E)	68,158	78,861	59,976
F/(C + D)	32 %	52 %	30 %

Compounding the impact of shortages of articles that are fast-movers and/or have a short shelf-life (i.e. a small window of opportunity to capitalize on their full sales potential) is the fact that a long delay in detecting or correcting shortages could turn a potential best seller into a disappointment. Surpluses result not only from too high initial sales forecasts, but also because of the long "time to detect" (stock review or order lead time) and the long "time to correct" (return lead time) a surplus. The longer the time to detect and to correct the higher the level of surpluses, wasted shelf space and lost sales on items that could have been stocked and sold.

3 A New Way to Manage a Fashion Industry Supply Chain

So the keys, therefore, to solving the problem of shortages and surpluses for fashion industries are: cut the batch size for the blind zone of every season, quick response time improvement (the replenishment lead time becomes much shorter than the current practice), stop pushing inventory to the point of maximum errors – the retail point and detect and correct stockout and surplus just in time.

Concerning the response time improvement, there is a limitation that makes it difficult. Dying the fabric is a batch process. You need much more than willingness to pay slightly higher prices to convince a supplier to cut all the batches to be in line with 1 week consumption (cutting the batches to be less than one tenth of what they are now). Such a change will necessitate a super culture.

However, we know that the actual production lead time of a small batch is very short (a few days) provided the raw materials are available. We further know that raw material cost relative to selling price of fashion goods is quite low. So we first suggest that instead of buying raw material in small quantities, maybe the same large quantities still can be bought and, relying on the fact that the same material is used for more than one SKU, the material can be used according to actual demand. The extent to which this can be done depends on the magnitude of the aggregation that exists at the material level.

We know that there is aggregation since all sizes of the same model use exactly the same material. Moreover, there is a high chance that if one size is a high-runner, the other sizes are not slow movers; there is a correlation between the demand

Table 2 Potential savings of cutting production quantity of first order

Items	2011 winter	2012 spring	2012 summer
A: Planning volumes	162,176	76,293	152,606
B: Retailers' order	214,022	158,050	247,450
C: Production Qty of first order (Half of the B)	169,037 (107,011)	145,932 (79,025)	173,960 (123,725)
D: Replenish order	45,010	6,380	24,759
E: Actual sales	145,889	73,451	138,743
F: End of season inventory(C + D − E)	68,158 (6,132)	78,861 (6,544)	59,976 (9,741)
F/(C + D)	32 % (4 %)	52 % (8 %)	30 % (7 %)

for one size and the demand for another size of the same model. Therefore, the aggregation that we get through different sizes will not help us much – there is no point to divert material to one size just to find, a month later, that we cannot provide another needed size.

So, it all depends on the commonality of the material (magnitude of aggregation) between different models where there is almost no correlation between the demand for one model and the demand for another. In general, about 30 % of the SKUs are depleted before the massive end-of-the-season clearance sale starts – the high runners. Another 30 % are not sold out end-of-the-season (overstock) – the slow movers. That means that in a group of several models there is a high chance that at least one model will be a high runner while at least another model will be a slow mover. So even though we start with a given (forecasted) amount of material, still, in most cases, the magnitude of diversion that we can do (from the actual slow movers to the actual high runners) will help. This proposed way can reduce the material lead time for replenish high runner during the season to zero, only production lead time left (from 9 weeks to 2–4 weeks).

Concerning the cutting the batch size, as it is currently done we'll get the orders per SKU (based on forecast) enough time before the season. Based on the orders we'll buy the entire quantity of materials, as we currently do. But, we will cut, sew and ship only half the quantity of each SKU. Based on the consumption of SKUs in the first few weeks into the season we extrapolate the needed inventory target to accommodate consumption within the replenishment time. For SKUs with inventories below the target we issue a replenishment order equal to the gap. For SKUs with inventories above the target the company does not replenish till inventory goes below the target. The first orders for replenishment are apparently orders for high runners, and, as long as we still have that colored fabric, we will replenish within a time period which is very small relative to the period of the season (2 weeks should be enough for a system that is used to minimum 2 months). Several weeks before the end of the season, we should do with the residual fabric. We can turn it into goods or we can hold it for the next year. Table 2 illustrates the potential saving for the case of Table 1 if the batch size for the blind zone is cut to half (production volumes equal to half of the retailers' order).

Concerning push the inventory to the point of maximum errors – the retail point. Most of the sales managers know the problems of push based supply chain. They also intuitively understand that if they stop the push strategy and supply only as per pure consumption (or only immediate requirement) they will have a much consistent sales pattern across time periods. Most of them know the advantages of smoothening the sales on receivables and capacity planning.

The know-how of how to implement pull is readily available and is also advocated by many consultants. However most players in fashion industries are still operating on the "push mode". One of prime reasons why most companies do not switch to some form of pull distribution is the fear of sale loss. If they implement a pull system and supply what is immediately required, the fear is that the released working capital will be used by the distributor/retailer to buy more of competition products and hence the sales of company implementing the pull system will be jeopardized. This fear of losing immediate sales is holding back organizations to switch from "push" to "pull" mode of sales.

A win-win partnership can make the implementation of pull systems risk free in the transition phase. If on one hand the supplier is helping distributors with frequent replenishments only as per consumption (pure pull), the distributor uses the released capital to stock more variety. In many environments the distributors only deal with small sub-set of SKUs (out of the total company portfolio). They restrict the range to reduce risks to capital stuck in non-moving SKUs. When the supplier company supplies small quantities of new range while releasing capital from the excessively stocked items, a win-win partnership is created and pull system becomes a reality. This has to be coupled with two other enabling supply chain paradigms:

1. The central warehouse should move away from being a flow-through warehouse (or a trans-shipment point) to being an aggregator of inventory. This implies that the inventory at central warehouse is higher than that with the distributors. Having a central warehouse is a critical as it allows for higher availability for any fluctuating demand from its clients (may be regional warehouse or distributors or shops). This is possible as not all distributor sales will peak at the same time. Especially for fashion industries, holding back inventory is very critical as sales are very unpredictable. With the current way of working, fashion industries usually have early stockouts in some areas while huge surpluses in another.
2. A production system has to move away from producing large batches as per monthly forecast to production based on consumption from central warehouse. The production system has to produce to ensure availability in the central/plant warehouses (and not to ensure utilization of machines/resources). With this the warehouse will have 100 % availability the most critical element for high availability further down the chain.

If it is possible to respond in an instant to demand, there is no need to rely on forecast at all! To start replenishing to what is sold, the inventory levels for the SKUs of the saleable range have to be decided. If a mechanism is available to change these levels dynamically purely based on the early warning of stockout or surplus, then an elaborate exercise to determine the starting levels is not required. Fair approximated

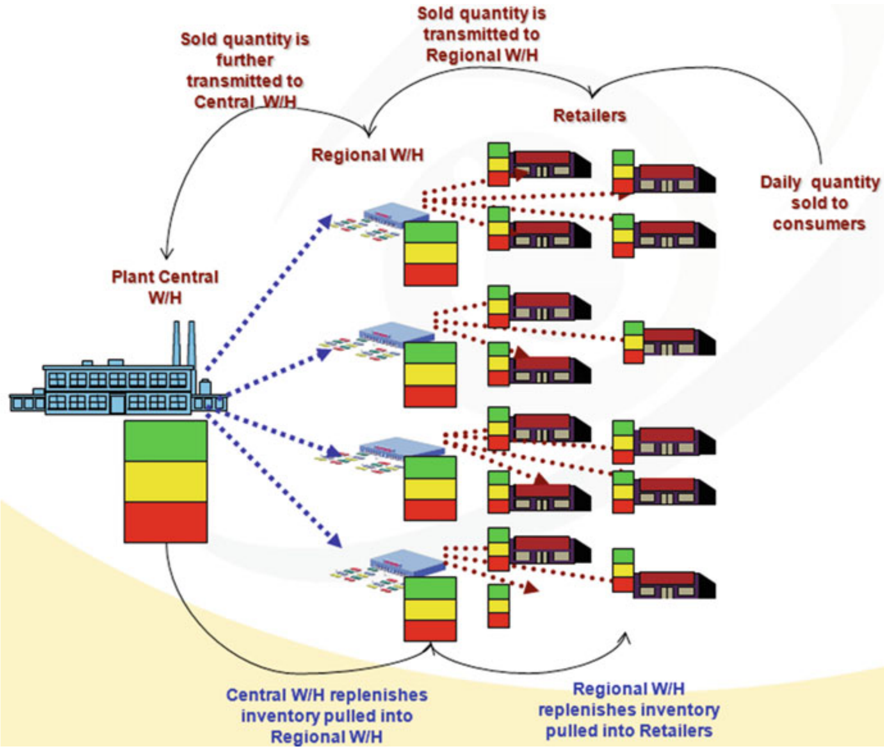

Fig. 1 A pull system for fashion industries

are good enough to start with as these will get corrected soon. Further if the selling points provide daily sales to the previous point, then the total replenishment times are reduced to just transport time. Figure 1 illustrates a pull system for fashion industries.

Concerning the detection and correction of stockout and surplus just in time, we need a method to manage exceptions during execution. Buffer Management developed by (Goldratt 2006) is an execution control method that provides priorities based on the actual consumption of the buffers. The target level of every SKU, at any location, is a buffer. Buffer status measures how much of stock as compared to the target level does not reside at the location. It is defined as the percentage of (target level – on hand) to the target level. What is missing from the on hand stock should be somewhere in the pipeline from the supply site. When the stock at the target is more than 2/3 of the target-level, the buffer is considered to be green (Fig. 2a). This means having too much stock. When the stock at the target is between 1/3 and 2/3 of the target level, the buffer is considered to be yellow which means that the stock level is OK. When the stock at the target is less than 1/3 of the target-level, the buffer is considered to be red which means things are not ok. There is a real risk of running out of stock. There is a need to bring in

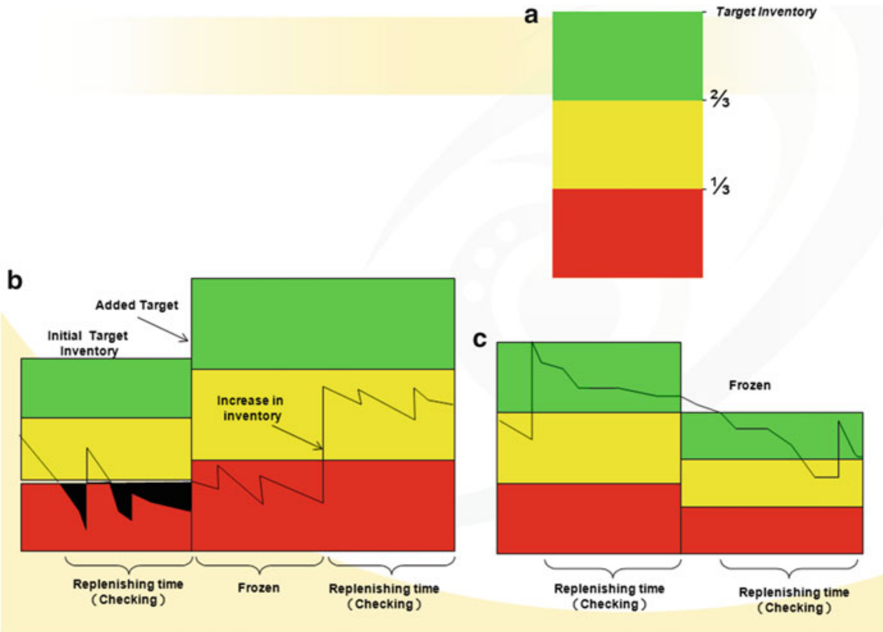

Fig. 2 (**a**) Buffer management system, (**b**) Buffer increase, (**c**) Buffer decrease

quickly some of the replenishment that should be already on the way. If the stock stays continuously in red throughout the replenishment period, there is a need to look at changing the target levels (Fig. 2b). Similarly when the stock stays in green for multiple replenishment periods, there is a time to look at reducing the norms (Fig. 2c). This way of dynamic buffer management helps in aligning stocks based on demand situation per SKU per location. The decision is much better than current practice of just arbitrarily cutting stock norms. When one cuts arbitrarily the stock norms, people usually reduce the fast runners and leading to more stock –outs. Dynamic buffer management prevents such adhoc decisions.

The above proposed idea to solve the problems of shortage and surplus can then be summarized as follows:

1. Determining the initial inventory: Getting the full forecast per SKU for the entire season. Based on the forecast buying the entire (or majority) quantity of raw materials that have considerable long lead times for the entire season. Cutting and producing and shipping only half of the seasonal forecast for each SKU – the initial target inventory level.
2. Aligning the initial inventory to the target inventory: Based on the consumption of SKUs in the first few weeks into the season, extrapolating the needed inventory target to accommodate consumption within the replenishment time. For SKUs at the retailers sites with inventories below the target, issuing a replenishment order equal to the gap. For SKUs at the retailers sites with inventories above the target does not replenish till inventory goes below the target.

3. Replenishing on actual consumption daily: Shipments or production orders are triggered only to replenish a consumption from a downstream point, (modified according to minimal production batch sizes/full container considerations).
4. Aligning priority: A mechanism is set to ensure that an internal production (or replenishing) order's priority color constantly follows the color of the corresponding inventory (taking into account other already released orders for the same SKU). Purchasing follows up on orders given to suppliers according to the color priority system (focusing mechanism). Remarkable suppliers are continuously made aware of the color status of the orders given to them.
5. Keeping correct inventory level: Buffer Management in distribution is the system used to monitor and modify the target levels of inventory in the various locations (and for expediting decisions). An increase in target inventory triggers the same chain of actions as consumption.
6. Dealing with "end of season: Stop production 1.5 replenishment time prior to the end of the season. Before the "end of production", then determining what to do with the residual materials. Should it turned into goods or should hold it for the next year.

4 Implementation Case

The Chinese case company founded on 1996, products focus on 25–35 years old middle income level female. The revenue of year 2012 is about 1.5 billion RMB. Current inventory is about 50 days; daily inventory is about 0.5 million pieces, most of the inventory are caused by wrong forecast. The company realize in order to reduce surplus and shortage, the only ways are cutting the size of first order, improve replenishment time and replenishment according to daily consumption of retailing shops.

The company started the pilot run form their Beijing district. After a year of pilot run, average 50 % shop inventory reduction, sales increase 45 %, end of season inventory almost reduce to zero and net profit increase 200 %. For the distributors, their average inventory reduce 60 %, 60 %, end of season inventory reduction, gross profit increase 210 %, net profit increase 110 % and cash flow increase 100 %.

5 Conclusion

This work presented a new way to solve the problem of shortages and surpluses for fashion industries, which are: cut the batch size for the blind zone of every season, quick response time improvement, stop pushing inventory to the point of maximum errors – the retail point and detect and correct stockout and surplus just in time with buffer management system. A Chinese implementation case company demonstrated the feasibility and effectiveness of the propose scheme.

References

Au KF, Choi TM, Yu Y (2008) Fashion retail forecasting by evolutionary neural networks. Int J Prod Econ 114:615–630

Bertolini M, Bevilacqua M, Bottani E, Rizzi A (2004) Requirements of an ERP enterprise modeller for optimally managing the fashion industry supply chain. J Enterp Inf Manag 17(3):180–190

Birtwistle G, Siddiqui N, Fiorito SS (2003) Quick response: perceptions of UK fashion retailers. Int J Retail Distrib Manag 31(2):118–128

Bruce M, Daly L, Towers N (2004) Lean or agile: a solution for supply chain management in the textiles and clothing industry? Int J Oper Prod Manag 24(2):151–170

Christopher M, Peck H (1997) Managing logistics in fashion markets. Int J Log Manag 8(2):63–74

Christopher M, Lowson R, Peck H (2004) Creating agile supply chains in the fashion industry. Int J Retail Distrib Manag 32(8):367–376

Fernie J, Azuma N (2004) The changing nature of Japanese fashion: can quick response improve supply chain efficiency? Eur J Mark 38(7):790–808

Goldratt AY (2006) TOC insight into distribution and supply chain. Goldratt Marketing Group, Iowa, USA

Jackson T, Shaw D (2001) Mastering fashion buying and merchandising management. Palgrave, Basingstoke

Kurata H, Yue X (2008) Trade promotion mode choice and information sharing in fashion retail supply chains. Int J Prod Econ 114:507–519

Lee P, Whang S (1997) The Bullwhip effect in supply chains. Sloan Manage Rev 38(3):93–102

Lo WS, Hong TP, Jeng R (2008) A framework of E-SCM multi-agent systems in the fashion industry. Int J Prod Econ 114:594–614

Masson R, Iosif L, MacKerron G, Fernie J (2007) Managing complexity in agile global fashion industry supply chains. Int J Log Manag 18(2):238–254

Mohanty S (2012) Managing a fashion supply chain: an alternative to the crystal ball. http://www.vectorconsulting.in/insights/consumer-goods/managing_fashion_supply_chain.html

Sen A (2008) The US fashion industry: a supply chain review. Int J Prod Econ 114:571–593

Wang WYC, Chan HK (2010) Virtual organization for supply chain integration: two cases in the textile and fashion retailing industry. Int J Prod Econ 127:333–342

Yu Z, Yan H, Cheng TCE (2001) Benefits of information sharing with supply chain partnerships. Ind Manag Data Syst 101(3):114–121