The Strategic Fit of Supply Chain Integration in the TFT-LCD Industry

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Abstract

Purpose – The purpose of this paper is to identify what kind of supply chain integration strategies can support TFT-LCD manufacturers seeking to break through the cost constraints and complex co-operation relationships between manufacturers, suppliers and set plants/distributors, and further satisfy the market requirements in terms of cost, quality, delivery, and flexibility.

Design/methodology/approach – This paper encompasses in-depth interviews with 20 TFT-LCD industry executives in three of the largest Taiwan TFT-LCD manufacturing firms.

Finding – Several different supply chain integration strategies have been identified for operational-level improvement of TFT-LCD manufacturer, including direct or indirect investment in suppliers; "made in-house" and "made by resident suppliers" arrangements, "quasi-cluster" formation, and new module assembly line set-up at set plant.

Research limitations/implications – This study involves only three multi-national corporation of Taiwanese origin..

Practical implications – Based on the analysis of the TFT-LCD supply chain structure, the strategic fit of supply chain integration leads to the improvement of TFT-LCD manufacturers' capability to satisfy customer requirements and then attain competitive advantage. Their experience provides guidance for other hi-tech industries..

Originality/value – This paper provides insights into the strategic formulation of supply chain integration in the real world of the TFT-LCD industry and identifies

directions for further empirical research.

Keywords Supply chain, Coordination, Integration strategies, TFT-LCD

Article Type Insight from Industry

1. Introduction

The advent of TFT-LCD (thin film transistor-liquid crystal display) has opened up great opportunities for innovative electronic technologies and prosperous business perspectives. The omnipresence of TFT-LCD related products is so obvious because LCD manifests itself in the form of flat panel display televisions, panel monitors for personal computers, notebook computer screens, mobile phone displays, automotive vehicle instrument clusters, and many other applications (Huang and Liao, 2002; Chang, 2005; Liu and Lee, 1997).

Thus, the diffusion of TFT-LCD applications progresses rapidly in the market whist consumer demand and customer requirements are pushing the industry very hard in the areas of product quality , price and delivery lead times, with customers expecting manufacturers to provide the production flexibility to respond to fluctuations in demand. However, under the constraint of cost and complex co-operation relationship between manufacturers, suppliers, and set plants/distributors, TFT-LCD manufacturers struggle to control price, quality, delivery time, and production flexibility. This paper, reports the results from a series of executive interviews regarding how Taiwan TFT-LCD manufacturers have managed to break through the constraints of cost and complex cooperation relationship between partners, through strategic co-ordination and integration.

2. Supply chain and cost structure of TFT-LCD industry

According to Venables (2000), Jeong (2001) and Kuo and Yang (2006), the industry

structure of TFT-LCD manufacturing supply chain features component suppliers as the upstream, manufacturers as the midstream, and set plants/distributors as the downstream. The suppliers provide the manufacturer at each manufacturing stage with components, including bare glass, color filter, polarizer, flexible printed circuit (FPC), IC driver, back light unit, and upper cover.

The TFT-LCD manufacturing process comprises three levels: Array, Cell and Module. The array level includes starting from eight masking processes on the bare glass to the process of covering the glass with a color filter. The Cell level's processes are to compress the panel and infuse the liquid crystal into it, cover it with a polarizer after the test and then test again. The module level adds the FPC panel, the IC drivers, and back light (BL) unit to the partially-finished product and puts the upper cover on the BL unit to complete the semi-finished TFT-LCD panel. The throughput of the module assembly line influences the shipment and delivery speed to the set plant. As a result,, the module shop plays the role of the shipment buffer to respond to the purchase order from downstream firms. After the module level process, the product is delivered to the set plant which is responsible for carrying out the remaining tasks, including installation of loudspeakers and all built-in functions to the half-finished panels, completing the finished products, and sending them to distribution channels for sale.

The overall structure of the TFT-LCD supply chain is shown in Figure 1, from which it s evident that the integration of the TFT-LCD supply chain influences manufacturers' capability to satisfy market requirements. The integration relationship involves suppliers, manufacturer, and firms downstream. In the co-ordination between manufacturer and suppliers, the manufacturer sets up production planning by demand forecasting or firm order from certain customers, and then places orders to all

component suppliers. Tthe ability of the suppliers, who are independent firms, to provide the components just-in-time determines the throughput of production and further affects the lead time and production flexibility. Thus, the extent to which manufacturer and supplier processes are intergrated has a major impact on the manufacturer's ability to respond to customer orders.

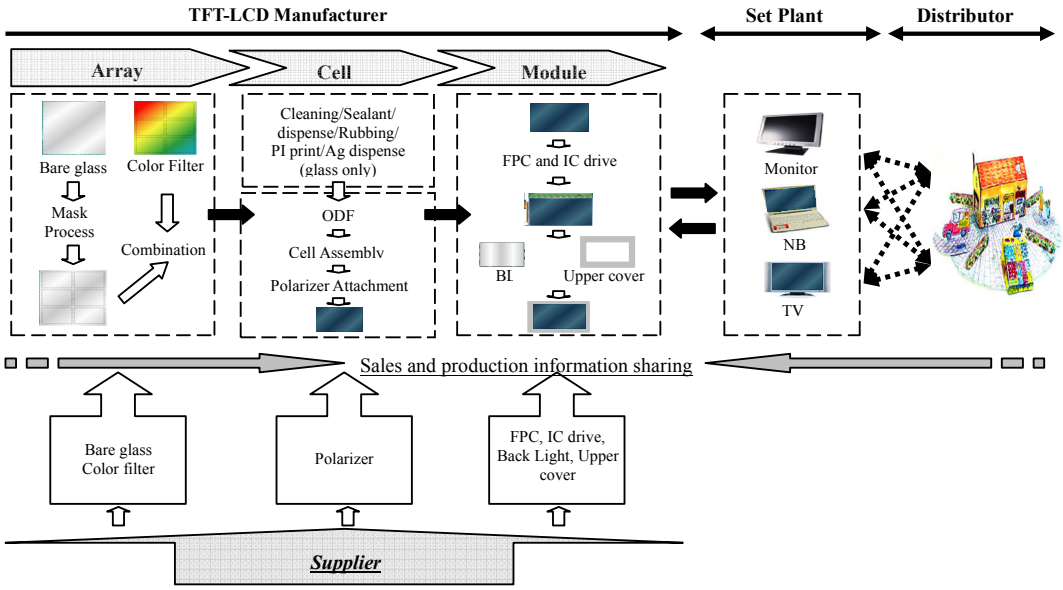

Figure 1: Supply Chain for TFT-LCD manufacturing

The efficiency of the TFT-LCD manufacturing process also depends on components delivered by suppliers, as the manufacturer himself is unable to take direct control of component quality. Under these circumstance, the manufacturer needs to communicate and co-ordinate all the necessary actions with suppliers through the establishment of integrated relationships.

In addition to delivery, flexibility, and quality, cost is also a crucial factor. Component costs represent a significant share (circa 79%) of the total costs associated with TFT-LCD production. The cost structure is shown in Figure 2. However, through

process integration and co-operation with suppliers, the purchasing costs of components can be reduced.

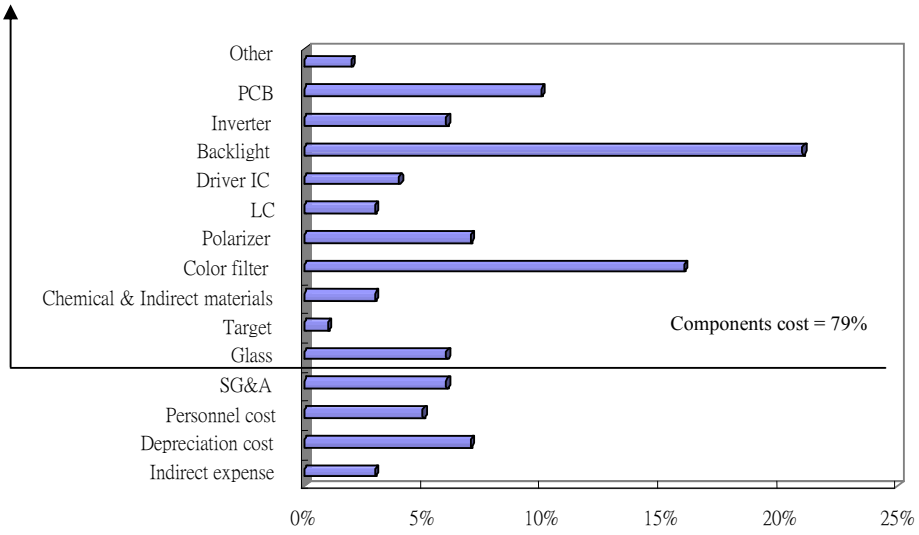

Figure 2: Cost structure for TFT-LCD

Downstream firms (distributors and set plants) are also responsible for providing market demand information to the manufacturer, in addition to placing orders to the manufacturer and expediting end product delivery (Lin et al., 2006). However, in absence of process integration and co-operative relationships between manufacturers and downstream firms, manufacturers have difficulty in obtaining accurate market information, which undermines their ability to become more flexible and responsive to customer demand. Therefore, in order to closely monitor market volatility and develop the capability to respond to demand fluctuations, manufacturers need to adopt a strategy of integration with set plants and distributors.

3. Strategic fit through analysis of integration structure

This paper involved in-depth interviews with 20 TFT-LCD industry executives from three successful Taiwan TFT-LCD manufacturing firms with significant global market share (firm A – 22.5%; firm B – 13%; and firm C – 7%).

As a result of the interviews, we have identified a range of integration strategies that should significantly improve the performance of the TFT-LCD industry in Taiwan. These strategies are: direct or indirectl investment in suppliers; "made in-house" and "made by resident suppliers", "quasi-cluster" formation, and new module assembly line set-up at the set plant.

Direct or indirect investment in suppliers

Acquiring components through direct or indirect investment in the supply chain not only enables TFT-LCD manufacturers to monitor component cost structures but also ensures delivery priority for quality components. However, this option provides little flexibility and directs investment away from other areas that may be critical in the longer term, such as R&D and NPD.

"Made in-house" and "made by resident suppliers" arrangement

"Made in-house" and "Made by resident suppliers" arrangements are used to adjust production volumes to cope with demand fluctuation and problems relating to quality, cost and delivery. Both "made in-house" and "made by resident suppliers" arrangements mean that the TFT-LCD manufacturer accommodate several production lines for some components inside the plant. The difference between "made in-house" and "made by resident suppliers" is that the manufacturer has no authority to manage the resident component production line that is owned by a supplier, whereas, the manufacturer with the ownership can manage the "made in-house" component production line.

The component production line is set up inside the plan regardless of whether it is

“made in-house” or “made by resident suppliers”, providing easy access advantage when quality or other production problems occur. For example,, the manufacturer as well as supplier’s resident personnel can respond quickly to any problems, to ensure product quality is maintained. In addition, because the production line is located within the manufacturing plant, just-in-time delivery of components becomes possible. The ‘in-house’ and ‘resident’ production line arrangement also alleviates problems associsated with logistics and reduces transportation costs.

“Quasi-cluster” formation

Manufacturers can meet market requirements for short delivery time, production flexibility, and responsiveness through a “quasi-cluster” approach to supporting the integration between the manufacturer and downstream firms. The“quasi-cluster” approach gathers supply chain partners’ facilities in the vicinity of a manufacturer’s site, but involves only the module plant and the set plant. The module plant becomes the centre of the shipment buffer and the set plant is the last station next to the distributors and the market. This strategy of “quasi-cluster” setting helps the manufacturer to carry out the across-firm collaboration for market responsiveness.

New module assembly line set-up at the set plant

This approach further transplants the module process into the set plant for seamless interaction and responsive collaboration. It is feasible only when the set plant has a share of the equity in a module plant. In the early stages of the TFT-LCD industry, this approach was used to save labour costs and resultedin the development of a closer cooperation model between TFT-LCD manufacturers and downstream set plants. In the initial staged of TFT-LCD production, the arraysand cells are made with sophisticated automated equipment, but only part of the module process is semi-automatic whilst the

final assembly job is done manually. When TFT-LCD panels are delivered to the set plant, the ancilliary hardware and built-in interface assembling are also carried out manually. However, manufacturers discovered that these processes required a substantial amount of manpower and involed a degree of task duplication. In other words, if both the production processes were integrated, labor could be saved.

Applying this approach enables close co-operation between the set plant and the module vendor, which reduces the lead-time and enables a more rapid response in a dynamic market environment, providing a further source of competitive advantage.

4. Conclusion

Market forecasts indicate that there will be a demand boom for TFT-LCD flat panel displays to substitute the conventional Cathode Ray Tube (CRT) display that is approaching the end of the product life cycle. Therefore, it is so imperative for TFT-LCD manufacturers to develop better products to satisfy market requirements in terms of quality, cost, delivery, and services. To do so, TFT-LCD manufacturers must improve the integration of their supply chain. This paper has highlighted the benefits associated with a range of strategies for significantly improving the performance of supply chain integration. Further research is required to explore the transferability of these integration strategies to other hi-tech industries.

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