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Research Report: MISI-2014-6
Locating the Decoupling Point in Component-Board System Supply Chain
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Locating the Decoupling Point in Component-Board System Supply Chain

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Summary: The consumer electronics (CE) industry is currently among the most dynamic and high demand uncertainty; products that did not exist until a decade ago have undergone rapid change, spawning an endless chain of innovations and new products. Today's consumer electronics devices are witnessing growing demand because they are changing the way people interact, consume entertainment, manage their finances and organize their lives. With costs and lead-time considered in out supply chain, it would be practical to apply robust optimization techniques in the model.
Since there are practices, which are not consistent in their impact towards internal supply chain, for instance customer relation, there is a need to test this practice for any indirect impact on the location of the decoupling points. Future research should endeavor to collect data from multiple members across the supply chain and also consideration the more detail BOM structure.

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KEY INSIGHTS

1. The high demand uncertainty leads to high changing frequency, resulting in the high supply chain costs.

2. Based on Bill of Material (BOM), the decoupling points of current supply chain are determined based on the sensitivity of those components.

3. Consider all the parameters related to the supply chain costs such as holding costs, setup costs, and asset specificity costs, and build up a mathematical model.

4. Optimize the mathematical model with those practical data to minimize the overall supply chain costs.

Overview of Intel Corporation

Intel Corporation is a large semiconductor manufacturing in the world. Its business units are mainly related to the core processor unit (CPU). Intel uses external foundries to manufacture wafers for certain components such as networking devices and communications products. Also, Intel uses sub-contractors for manufacturing board-level products and systems. Besides, Intel purchases certain communications networking products and mobile phone components from external vendors, primarily in the Asia-Pacific region. Meanwhile, for Intel's 2012 revenue, Hewlett-Packard (HP) Company accounted for 18% of net revenue, compared to 19% in 2011, Dell Inc. accounted for 14% of net revenue, compared to 15% in 2011, and Lenovo Group Limited accounted for 11% of net revenue, compared to 9% in 2011. No other customer accounted for more than 10% of Intel's net revenue during these periods. In 2012, 84% of Intel's revenue from unaffiliated customers came from outside the U.S. Intel Corporation also owns its factory while applying some contract manufacture for the new products. Meanwhile, there are some consignments and some turnkey solutions for the new product.

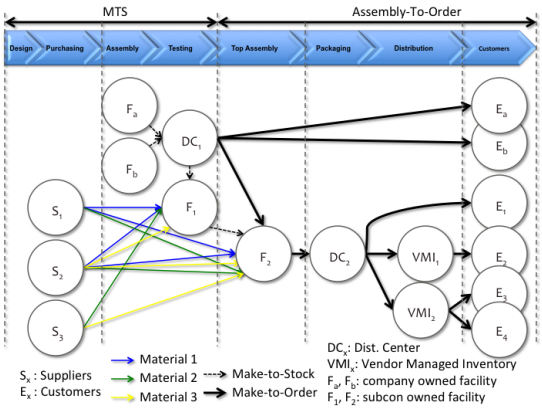

Figure 1: The Supply Chain of Intel Corporation
Source: Author

With this supply chain network when facing the high demand uncertainty, Intel suffers from the high buyback and obsolete costs, thus resulting in high supply chain costs. In order to optimize its own supply chain network, the Design For Supply Chain (DFSC) is considered and aligned with its product characteristics. As you can see from Figure 2, the changes in every month ranges from two hundred in January to more than eight hundred in August. With such a high changing frequency for the components, it is very critical to analyze the Bill Of Material (BOM) and design for supply chain (DFSC) as well as determine the manufacturing process for decoupling points.

In light of Intel Corporation's new products' supply chain; it is necessary for Intel Corporation to exert tighter control on the total costs at each processing steps and also those contract manufacturers. Based on the supply chain structure (Figure 1), those data related to the costs and the production time is taken into account. Due to the short product life cycle, the production time is very critical to meet customer's delivery time, thus becoming constraints for the mathematical model. The costs are important for optimization.

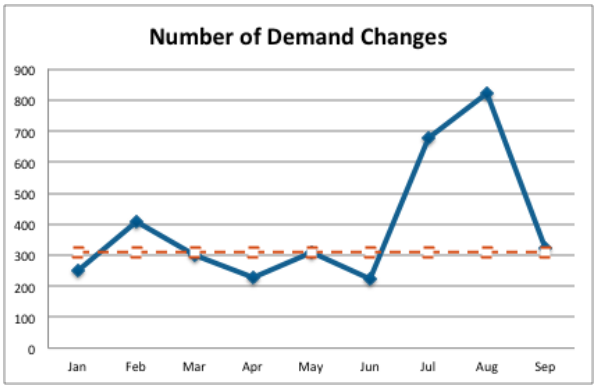

Figure 2: Changes per Month
Source: Author

Simulation Model

The simulation was built using a math model with the consideration of production lead-time and supply chain costs. With mapping of the BOM (Figure 3) according to the manufacturing process, the mathematical model is built by considering the holding costs, setup costs, and buyback costs as well as asset specificity costs. With the code sequence representing the decoupling points, the supply chain structure is determined and the total supply chain costs can be optimized (Table 1). With different configurations of the locations of decoupling points, the optimized results is derived and the overall supply chain costs are minimized (Table 2).

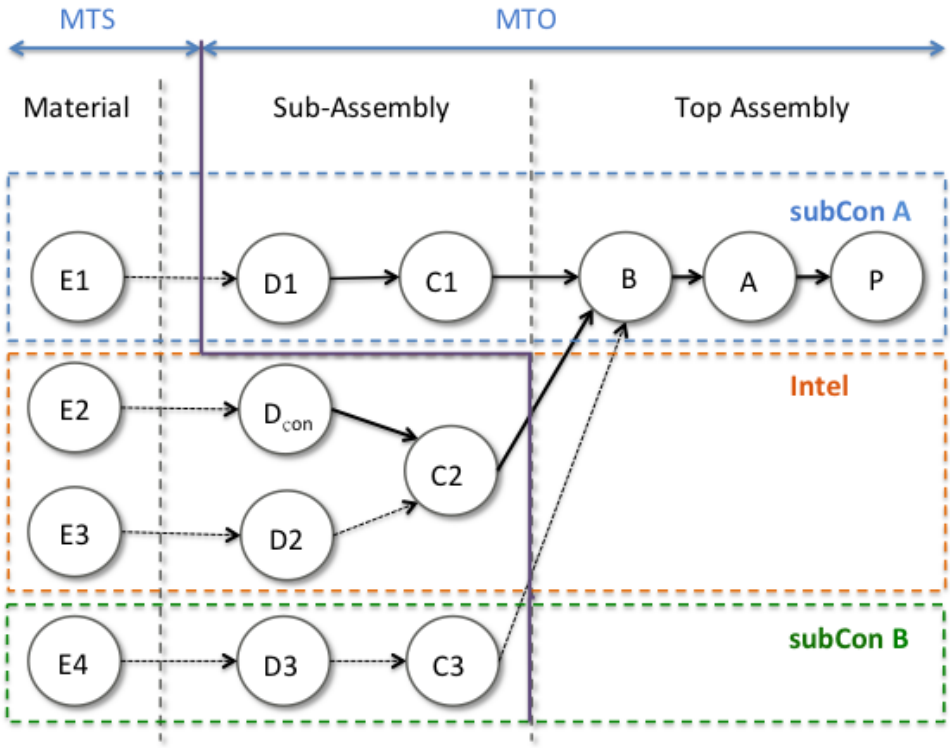

Figure 3: BOM Mapping the manufacturing process
Source: Author

	A	B	C1	C2	C3	D1	Dcon	D2	D3	E1	E2	E3	E4
Code String, X	0	0	0	1	1	0	1	1	1	1	1	1	1
Parent Item	P	A	B	B	B	C1	C2	C2	C3	D1	Dcon	D2	D3
Production Lead time	4	8	8	1	9	7	8	1	5	5	8	9	6

Table 1: Parameters For Each Component
Source: Author

ymbol	Cost	Make-to-order	Make-to-stock
S_i	Setup Cost	K_i	K_i/OI_i
I_i	Inventory holding cost	0	$b_i \int_0^{ED_i} (ED_i - q_i) f(q)\, dq$
B_i	Buy-back cost	0	$\int_{ED_i}^{+\infty} (q_i - ED_i) f(q)\, dq\, (\gamma \times c + (1-\gamma) \times e)$
A_i	Asset specificity cost	0	$o_i(\sigma_i/\mu_i)$
otal cost	The sum of above cost	TC^{MTO}	TC^{MTS}

Table 2: The Costs Of Different Symbols
Source: Author

This mathematical model considers those costs such as the setup costs Si, Inventory holding costs Ii, Buy-back costs Bi, and Asset specificity costs Ai (Table 2). Those costs differ from Make-To-Order (MTO) and Make-To-Stock (MTS).

1. Setup Cost: Si equals to Ki when component i uses MTO because the firm carry on the procurement, production or assembling process when a trigger signal arrives
2. Inventory Holding Cost: It means expected inventory cost of component I and only exists when the item is MTS while it is zero in MTO mode.
3. Buy-back Cost: It means buy-back cost of component I due to the constant order interval and equals to zero in MTO mode.
4. Asset Specificity Cost: It means significant fixed investments that are unique to a special transaction and cannot be redeployed easily for other application.

Analysis Results

Based on the results of the simulation, it appears that three decoupling points should be considered to improve the supply chain network and to minimize the overall supply chain costs (Figure 4).

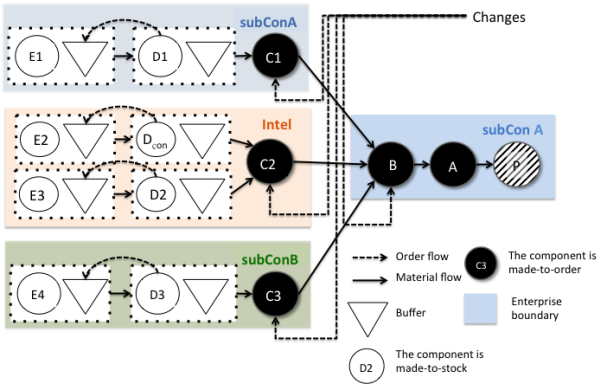

Figure 4: The optimized supply chain structure
Source: Author

Recommendations

In order to increase the flexibility and manage the high uncertainties, the decoupling points play a very critical role in the overall supply chain.

Future Research

This research provides a foundation to perform additional analysis and also more detail BOM information for the supply chain structure into the mathematical model to improve the overall process operations.

Key Takeaways

The decoupling points are very important for Design For Supply Chain (DFSC) to make the supply chain more responsive, thus reducing the supply chain costs.