

# Managing Supply Chain at High Technology Companies<sup>1</sup>

Latif Al-Hakim  
School of Management and Marketing  
Faculty of Business  
University of Southern Queensland  
Queensland, 4350, Australia  
[hakim@usq.edu.au](mailto:hakim@usq.edu.au)

Soin Singh  
Venture Corporation,  
Newark, California, USA.  
[Soin09@yahoo.com](mailto:Soin09@yahoo.com)

**Abstract:** *There is an expectation that high technology companies use unique and leading edge technology to gain competitive advantage by investing heavily in supply chain management. This research uses multiple case study methodology to determine factors affecting the supply chain management at high technology companies. The research compares the supply chain performance of these high technology companies against the supply chain of benchmark (or commodity-type) companies at both strategic at tactical levels. In addition, the research also looks at supply chain practices within the high technology companies.*

*The results indicate that at the strategic level the high technology companies and benchmark companies have a similar approach to supply chain management. However at the tactical, or critical, supply chain factor level, the analysis suggests that the high technology companies do have a different approach to supply chain management. The analysis also found differences in supply chain practices within the high technology companies; in this case the analysis shows that high technology companies with more advanced supply chain practices are more successful.*

**Keywords:** *Critical success factors, high technology, supply chain management.*

## 1. INTRODUCTION

One of the earliest approaches to competitive advantage is the microeconomic approach, or the idea of perfect competition [1]. In perfect competition products are homogenous, consumers and producers have perfect information, prices will reach equilibrium, and as a result profits are negligible or low in the long run. However, such a perfect economy is an abstraction, because there are monopolies, oligopolies, and perfect competition [2]. Nevertheless, perfect competition provides a benchmark against which the behaviour of other markets is judged [3].

Porter [4] argues that competitive advantage comes from the many discrete activities a firm performs in designing, producing, marketing, delivering, and supporting its product. Porter proposes a framework for analyzing industries and competitors and describes three generic strategies – cost leadership, differentiation, and focus. He postulates that if a firm is able to do well in any of these strategies, it will gain competitive advantage. Based on Porter's arguments, firms were constrained by their customers' or suppliers' lack of collaboration and unresponsiveness. These attributes prevented firms from responding quickly to changes in the market or to customers' requirements [5].

Lambert & Copper [6] point out that one of the most significant paradigm shifts of modern business management has been that individual businesses no longer compete as autonomous entities, but rather as supply chains. As a result, the supply chain approach to gaining competitive advantage has moved into the mainstream of business strategies.

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Managing the supply chain has become a means of improving competitiveness [7]. Proactive supply chain managers begin to view the supply chain as a whole, and promote customer-focus, supplier partnership, co-operation and information sharing [8].

Three major developments in global markets and technologies have brought the emerging supply chain management (SCM) to the forefront of management's attention [9]:

1. The information revolution,
2. Customer demands in areas of product and service cost, quality, delivery, technology, and cycle time brought about by increased global competition; and
3. The emergence of new forms of inter-organisational relationships.

Although it is clear that the supply chain must be integrated from supplier (or upstream activities), to internal processes, to downstream activities, and to customers, there seem to be few examples of truly integrated supply chains [10]. Hence, the synchronized supply chain seems to be more aspiration than reality. Furthermore, according to Siekman [11] quoting Sandor Boyson, co-director of Supply Chain Management Center at the University of Maryland, only a fourth of 117 companies in an e-commerce association claim to have extended trading via e-commerce. Evidently, as companies work towards better coordination and integration of the various supply chain activities into SCM systems, they are faced with many barriers, such as lack of internal support, short-term performance focus, misaligned measures and rewards, poor use of technology, and lack of trust [12].

This research concentrates on studying the supply chain management in high technology industries. These are companies that produce and deliver computer and electronic products, such as computers, computer systems and networks, electronic measurement systems, and other electronic products. There is an expectation that these high technology companies will use unique and leading edge technology, and invest heavily in supply chain management. Hence, it will be beneficial to understand how such companies manage their supply chain in comparison with other supply chains at both strategic and tactical levels. The research employs a multiple case study research methodology. Five high technology companies (with World-wide operations) based in California, USA, have been selected. To benchmark the supply chain performance of these high technology companies with supply chain of other supply chains, four benchmark manufacturing companies were selected from the membership roster of the Council of Logistics Management, USA.

## 2. RESEARCH METHODOLOGY

This research adopts multiple case study approach for the following reasons:

- The focus of this research is on high technology companies operating in California, USA. Hence, there is a concern that there will be a small number of companies willing to participate in a large (sample size) quantitative survey.
- Supply chain management is a vast collection of techniques. Hence, selection of supply chain factors and strategies can be a complex process. In such a dynamic setting it is best to use case studies to understand the situation.
- Face-to-face meetings with respondents can help provide understanding and information on several qualitative areas, such as: reasons for implementing specific supply chain factors (or strategies), customer needs data, and discussions and feedback on the questionnaire.
- Since all the selected companies are high technology companies, they are expected to be facing similar business and external issues. Therefore a smaller number of cases can be deemed sufficient and appropriate to compare and contrast findings and establish replication [13]. Further, case study approach can provide a robust insight and thus achieve a higher level of external validity and reliability.

This research considers five high technology companies. Products of two of these companies have short product life cycles of one to two years. The others are companies that produce products with longer life cycles of 2 to 5 years. Table 1 illustrates the type of companies and number of interviewed respondents at each company.

**Table 1** Case selection and interview matrix

	Companies with short product life cycles of about 1-2 years.		Companies with longer product life cycles of 2 to 5 years.		
	A	B	C	D	E
Line of Business	Electronic Documentation equipment	Global Provider of Printers and Computers	Analytical and measurement instruments	Radio frequency and power amplifiers	Network equipment
Number of employees	67,000	140,000	32,000	1,000	36,000
Annual Revenue US \$	\$15B	\$70B	\$6B	\$330M	\$19B
Respondent Profile					
General. Sales, or operations Manager	1 (A1)	1 (B4)	1 (C4)	1 (D3)	1 (E2)
Supply Chain or Material Manager	2 (A2, A3)	3 (B1, B2, B3)	3 (C1,C2,C3)	2 (D1, D2)	2 (E1,E3)
Number of respondents	3	4	4	3	3

To benchmark the supply chain performance of the high technology companies with supply chain of other companies, four benchmark manufacturing companies were selected from the membership roster of the Council of Logistics Management, USA, and were approached to participate in the case study. These four companies, with a total of four respondents are commodity-type companies. The profiles of the selected companies are shown in Table 2. The benchmark companies are either the market leader or among the market leaders in their product categories. Four respondents were interviewed: two respondents were business managers and the others are supply chain or material managers.

**Table 2** Profile of benchmark companies

Company	Lines of Business	Revenue, latest quarter
Company J	A company dealing in up-market mineral water and other beverages – a market leader	US\$ 2.8B
Company K	A company dealing in sugar manufacturing and distribution – among the market leaders	No comparable data available
Company L	A company dealing in tools & appliances – among the market leaders	US\$ 1.2B
Company M	A company dealing windows, window frames, & other home items – among the market leaders	No comparable data Available

### 3. THE QUESTIONNAIRE

The questionnaire comprises 52 questions which pertain to supply chain factors that will have specific influence on supply chain management (refer to Appendix A). These 52 questions are classified into 10 supply chain categories as shown in Table 3. Of the 10 categories, 9 are strategic supply chain management categories, while the 10<sup>th</sup> category covers employee performance. Interested researchers can obtain directly from the authors the list of the supply chain management factors or a copy of the questionnaire.

**Table 3** Categories of the questions

Supply chain category	Supply chain factors (denoted by question numbers) in each category
Logistics	1 to 4
Procurement	5-8
Inventory Management	9-14
Manufacturing	15-24
Partnership & Collaboration	25-27
Customer Relationship Management	28-32
Information Systems & Technology	33-39
Supply Chain Agility	40-42
Decision Making & Organization Factors	43-47
Employee Performance	48-52

In addition to the questions on supply chain management factors, there is a question that requires the respondents are asked to choose the top six supply chain categories mentioned in Table 3 and rank them from 1 to 6. Any category that receives one vote or less in each company is discarded. The purpose of this forced ranking exercise is to understand overall priorities and important areas in supply chain management at the case study companies.

### 4. CASE STUDY RESULTS

#### 4.1 High technology companies Vs benchmark (commodity-type) companies

Looking at Table 4, it can be observed that five of the top six categories (out of 10) are the same for benchmark and high technology companies. These categories are manufacturing, decision-making & organisation, partnership & collaboration, customer relationship, and inventory management. *Hence it can be concluded that the focus of supply chain management at the high level is similar at both the benchmark and high technology companies.* However, the high technology companies put the highest priorities to partnership & collaboration and customer relationship categories while the benchmark companies emphasise manufacturing and decision-making & organisation. All companies have similar ranking for inventory management category.

**Table 4** Important supply chain categories at benchmark and high technology companies

<b>Supply Chain <u>Categories</u> prioritized by Rank</b>			
<b>BENCHMARK COMPANIES</b>		<b>HIGH TECHNOLOGY COMPANIES</b>	
<b>Supply Chain Category</b>	<b>Rank</b>	<b>Supply Chain Category</b>	<b>Rank</b>
Manufacturing	1	Partnership & Collaboration	1
Decision Making & Organization Factors	2	Customer Relationship	2
Partnership & Collaboration	3	Decision Making & Organization Factors	3
Customer Relationship	4	Procurement	4
Logistics	5	Manufacturing	5
Inventory Management	6	Inventory Management	6

At a tactical or actual area of supply chain factor implementation, there are some similarities but major differences (refer to Table 5). ‘On-time delivery’ factor is very important at all companies reviewed in this study. ‘Superior product quality’ is another factor emphasised by companies but beyond that there are differences. *The benchmark companies put a great emphasis on supply chain factors that improve or manage customer services, product quality, and costs.* The benchmark companies deal in commodity-type products and hence they have to focus on differentiating themselves through implementing supply chain factors that provide strong customer services and affordable products. *The high technology companies put more emphasis to responsiveness to market fluctuations, information systems, and outsourcing.*

This different approach is, possibly, due to the fact that the short life cycle of the high technology company’s products enforces these companies on issues that enhance the quick response to the market demands, while the benchmark companies deal in commodity-type business (with longer product cycles) and focus more effort on customer services at affordable costs.

**Table 5** Summary of critical supply chain factors at benchmark companies & high technology companies

<b>Supply Chain <u>Factors</u> prioritized by Importance</b>			
<b>BENCHMARK COMPANIES</b>		<b>HIGH TECHNOLOGY COMPANIES</b>	
<b>Supply Chain Factor</b>	<b>Average</b>	<b>Supply Chain Factor</b>	<b>Average</b>
2. Provide on-time delivery to customers	4.75	2. Provide on-time delivery to customers	4.71
24. Superior product quality compared to competitors	4.50	5. Partnership with suppliers	4.65
28. Monitoring and measuring customer service level	4.50	16. Effective use of ERP & MRP systems	4.65
43. Top management commitment	4.50	20. Outsourcing of non-core manufacturing activities	4.65
29. Effective management of customer complaints	4.25	47. Teamwork and inter-organizational coordination	4.56
30. A process to manage customer dissatisfaction returns	4.25	24. Superior product quality compared to competitors	4.53

49. There is high employee productivity	4.25	43. Top management commitment	4.50
51. High utilization of employee's skills and abilities	4.25	42. Responding to high market fluctuations	4.47
5. Partnership with suppliers	4.00	17. Responsiveness to meet engineering changes	4.44
8. Company-wide purchasing contracts for best pricing	4.00	41. Responding to unexpected demand from customers	4.41

#### 4.2 Similarities and differences in supply chain practices within high technology companies

Next, we analysed the similarities and differences in supply chain practices within the high technology companies in our study. We observed that the companies fell into two distinctive clusters.

Looking at Table 6, we can see the top supply chain categories of each high technology company. We can observe that Companies B and E are very distinct and both emphasize customer relationships, decision making and organizational factors, and information systems (top 3 categories in both companies).

On the other hand, Companies A, C, and D are very much focused on supply chain categories that improve their manufacturing capabilities or are less advanced (or more traditional) - they favour such factors as logistics, procurement, and partnership.

**Table 6** Ranking of supply chain categories at the high technology companies

Supply Chain <u>Categories</u> prioritized by Rank at High Technology Companies				
COMPANY				
A	B	C	D	E
Partnership and Collaboration	Customer Relationship	Manufacturing	Partnership and Collaboration	Customer Relationship
Supply Chain Agility	Decision Making and Organization Factors (tie with first place)	Inventory Management	Procurement	Decision Making and Organization Factors
Procurement	Information Systems	Partnership and Collaboration	Logistics	Information Systems
Logistics	Inventory Management	Customer Relationship	Manufacturing	Manufacturing
Decision Making and Organization Factors	Partnership and Collaboration	Decision Making and Organization Factors	Inventory Management	Inventory Management

Table 7 shows the top 5, or critical, supply chain factors at each of the high technology companies. The factor 'On-time delivery to customers' is important at all case study companies. This is reasonable, since every company that cares for its customers should consider this of paramount importance. This fact validates the accuracy of the data collected – the respondents are putting some thought into answering the questionnaire accurately.

Beyond this commonality, the high technology companies behave differently, and can again be segmented into 2 distinct clusters. Companies B and E again take an approach of emphasizing customers, customer information systems, and outsourcing of manufacturing activities. The information system factors include 2 important customer engagement factors: sell-through information (point of sales data) from distributors/partners and effective use of the Internet for

business-to-business commerce. At the same time, Companies A, C, D have ranked and emphasized more traditional practices such as manufacturing information systems (ERP/MRP and CAD/CAM systems), engineering responsiveness, and just-in-time manufacturing.

**Table 7** Summary of critical supply chain factors at high technology companies

<b>Supply Chain <u>Factors</u> prioritized by Importance at the High Technology Companies</b>				
<b>Company A</b>	<b>Company B</b>	<b>Company C</b>	<b>Company D</b>	<b>Company E</b>
43. Top management commitment	2. Provide on-time delivery to customers	5. Partnership with suppliers	18. Just-In-Time manufacturing	2. Provide on-time delivery to customers
47. Teamwork and inter-organizational coordination	20. Outsourcing of non-core manufacturing activities	16. Effective use of ERP and MRP systems	24. Superior product quality compared to competitors	20. Outsourcing of non-core manufacturing activities
2. Provide on-time delivery to customers	25. Sell-through information (point of sales data) from distributors/partners	42. Responding to high market fluctuations	2. Provide on-time delivery to customers	33. Effective use of Internet to manage Business-to-B commerce
16. Effective use of ERP and MRP systems	45. Employees are empowered to make decisions and changes	2. Provide on-time delivery to customers	5. Partnership with suppliers	36. Inter-organizational information coordination and sharing
17. Responsiveness to meet engineering changes	28. Monitoring and measuring customer service level	15. Effective use of CAD, CAE, and CAM Systems	6. Focus on reducing the number of suppliers	37. Intra-organization information systems to coordinate and integrate the entire Supply Chain

**Segmentation of the high technology companies into distinct clusters:**

From the analysis, the case study companies can be segmented into 2 distinctive clusters: Traditional, ‘old style’, manufacturing companies and more progressive manufacturing companies.

**Traditional ‘old style’ manufacturing companies that are internally focused:** These companies’ supply chain management is focused on manufacturing-type activity including internal information systems. This internal or manufacturing focus is given priority by the company over supply chain efforts that look forward and allow closer connection with customers. Companies A, C, D are in this cluster.

**Progressive manufacturing companies that are externally focused:** These companies’ supply chain management is focused on customer relationships type activity and information systems that connect with the customers. Furthermore, a strong emphasis is also placed on outsourcing. This external, or customer focus, is given priority by the company; companies B and E are in this cluster. We can say that these companies are using the more advanced supply chain practices.

Hence in summary, there are differences between critical supply chain management factors at various high technology companies. The selection of the critical supply chain factors depends on whether a company is a traditional ‘old style’ manufacturing company or a progressive manufacturing company that uses the more advanced supply chain practices.

**4.3 Competitive advantage versus supply chain practices**

To understand if any company has competitive advantage and profitability, we looked at the financial performance of the high technology companies over a 6 year period, specifically 2002 – 2008.

Companies B and E have been very profitable during the entire period. These companies are externally focused on customer satisfaction, customer oriented information systems, and heavy outsourcing.

Companies A and D have been doing poorly financially during this entire period and are currently near to zero profit.

Company C was unprofitable for many years; it has downsized considerably over the last few years, shed several businesses, returning to its core competencies, and is finally profitable. We have noticed that it now does much more outsourcing between 2002 and 2008 but still has weak information systems to manage customers and its supply chain and inventory.

Overall the approach of all these 3 companies has been either differentiation and/or focus by:

- Having customer oriented information systems and hence externally focused on customer satisfaction
- Ensuring heavy outsourcing in order to achieve cost leadership.

## 5. CONCLUSION

In this analysis we looked at supply chain practices between high technology companies and benchmark (commodity-type) companies; we also looked at similarities and differences in supply chain practices within high technology companies. . The analysis of high technology companies and benchmark companies suggest that at the high level, or supply chain category, management of all companies have a similar approach to supply chain management. However at the tactical, or critical, supply chain factor level, the analysis suggests that the benchmark companies (which happen to be companies dealing in commodity-type products) have a different approach to supply chain management. *The benchmark companies deal in commodity-type products and hence they have to focus on differentiating themselves through implementing supply chain factors that provide strong customer services and affordable products. The high technology companies put more emphasis to responding to market fluctuations, information systems, and outsourcing.*

The case study companies can be segmented into 2 distinctive clusters: Traditional, 'old style', manufacturing companies and more progressive manufacturing companies.

**Traditional 'old style' manufacturing companies that are internally focused:** These companies supply chain management is focused on manufacturing-type activity and internal information systems.

**Progressive manufacturing companies that are externally focused:** These companies supply chain management is focused on customer relationships type activity and information systems that connect with the customers. A strong emphasis is also placed on outsourcing. We can say that these companies are using the more advanced supply chain practices.

**Competitive advantage Vs advanced supply chain practices:** Our analysis shows that high technology companies with advanced supply chain practices (externally focused with customer oriented information systems in order to achieve customer satisfaction, and heavy outsourcing) are financially more successful than other companies.

## 6. DIRECTIONS FOR FUTURE RESEARCH

This research employs the case study methodology that relies primarily on an inductive approach to obtain data for analytical generalization rather than statistical generalization. It is recommended that further research should test this theory using a larger sample and use a more quantitative research method for the purpose of statistical generalization. Future research can also try to understand if there are different behaviour and characteristics of companies, such as traditional and progressive manufacturing companies. If the difference can be confirmed, it can lead to recommended strategies on how companies can improve performance. Most importantly, future research can try to understand which specific critical supply chain factors can contribute to competitive advantage and business success.

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## APPENDIX A

### List of 52 supply chain management factors in questionnaire

Question
1. A centrally coordinated logistics function
2. Provide on-time delivery to customers
3. Provide logistics at lowest cost
4. Company-wide logistics (outsourcing) contracts
5. Partnership with suppliers
6. Focus on reducing the number of suppliers
7. Just-in-time (JIT) delivery
8. Company-wide purchasing contracts for best pricing
9. Company-wide coordination and management of inventory

## Question

10. Just-in-time (JIT) delivery
11. Vendor managed inventory (VMI) at production sites
12. Lowest inventory driven costs
13. Regional distribution centers for product distribution
14. Automated warehouse management systems
15. Effective use of CAD, CAE, & CAM Systems
16. Effective use of ERP & MRP systems
17. Responsiveness to meet engineering changes
18. JIT (Just In Time) manufacturing
19. Product customization or postponement to meet customer needs
20. Outsourcing of non-core manufacturing activities
21. Product design for environmental & recycling needs
22. Zero-defect manufacturing or use of 6-Sigma concepts
23. Company-wide quality program
24. Superior product quality compared to competitors
25. Sell-through information (point of sales data) from distributors/partners
26. Planning and involving customers in demand management
27. Information sharing with supply-chain partners
28. Monitoring and measuring customer service level
29. Effective management of customer complaints
30. A process to manage customer dissatisfaction returns
31. A 360-degree view of customer needs & preferences
32. Effective use of multiple-media to manage customer relationships
33. Effective use of Internet to manage Business-to-B commerce
34. Effective use of Internet to manage Business-to-Consumer commerce
35. Collaboration and bidding for parts & commodities via the Internet
36. Inter-organizational information coordination & sharing
37. Intra-organization information systems to coordinate/integrate the entire S Chain
38. Optimizing the supply chain via Efficient Consumer Response (ECR)
39. Eliminating non-value layers (such as wholesalers) in supply chain
40. Radical and successful business process reengineering
41. Responding to unexpected demand from customers
42. Responding to high market fluctuations
43. Top management commitment
44. Employees are trained in supply chain concepts & management
45. Employees are empowered to make decisions and changes
46. Employees are involved in supply chain management
47. Teamwork and inter-organizational coordination
48. There is high employee morale
49. There is high employee productivity
50. Quick resolution of industrial disputes
51. High utilization of employee's skills and abilities
52. The concept of internal customers is widely understood

## APPENDIX B

**Table X High Technology Company Performance**

Business Performance, during latest quarter in year 2003 & Year 2009  
(Source: MSN Financial Web-Site and Company Web-Site)

	Company A		Company B		Company C		Company D		Company E	
Item\Year	2003	2009	2003	2009	2003	2009	2003	2009	2003	2009
Profit Margin	(minus) -1.99%	0.66%	6.4%	7.04%	- (minus) -10%	7%	(minus) -20%	-VE	20%	20%

