Value Chain Analysis

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INTRODUCTION TO VALUE CHAIN ANALYSIS

The notion that key processes across the supply chain form a value chain and the method of analyzing the value chain for competitive advantage was introduced by Michael Porter of Harvard Business School (Porter 1985). Subsequently, value chain analysis (VCA) was developed in the management accounting literature (Coopers and Lybrand 1996; Shank 1989; Shank and Govindarajan 1993) and more recently in the operations management literature (Rainbird 2004; Zokaei and Simons 2006), following on from previous claims that supply chain management should go beyond a narrow focus on efficiency management to deliver superior value to the end consumer (Christopher 2005). Value chain analysis refers to a structured method of analyzing the effects of all core activities on cost and/or differentiation of the value chain. According to Dekker (2003, 5), VCA analyzes where in the supply chain the "costs can be reduced or differentiation can be enhanced."

Therefore, in an operational sense VCA is a subset of value chain management (VCM), which itself is an augmentation of conventional supply chain management (SCM). It must be noted that this chapter looks at VCA from an operational angle rather than management accounting. Moreover, financial VCA has been subject to criticism, especially in relation to its practical relevance. Lord (1996, 364) argues that the lack of empirical evidence on the application of VCA in the management accounting stream implies that it may just be "a figment of academic imagination." When performing accounting VCA, a company's first concern is about its future bargaining position and leakages of sensitive financial information to its competitors (Dekker 2003). Despite emphasizing the impracticalities of value chain analysis in its management accounting sense, Lord (1996) and Hergert and Morris (1989) acknowledge that the process itself provides valuable insights by screening various chain activities against value to the end user.

The essence of the value chain analysis methodology developed by the author and colleagues at Cardiff Business School is producing a systemic map of the value chain and a systematic method of analyzing each strategic activity in relation to the consumer value. In this sense, the proposed VCA method draws extensively upon the lean paradigm (Womack and Jones 1996), value stream mapping (Hines and Rich 1997; Rother and Shook 1998; Jones and Womack 2000), and Porter's value chain analysis. A key attribute of the proposed method is that analyses and metrics are based on determinant attributes such as quality and time, not on output financial attributes (Fitzgerald et al. 1991). The advantages proposed for deployment of determinant or operational measures are that they are the leading indicators of financial attributes, and that from a change management perspective operational measures are more easily shared across company boundaries than is sensitive financial data.

The proposed VCA method, so far, has been developed and adapted in several primary agri-food sectors in the United Kingdom (red meat, dairy, cereals, horticultures, and organic produce) and has steadily evolved from a value chain mapping tool to a strategic management priority. The application of the VCA is explained in more detail in a later section, "Practical Methods for Value Chain Analysis." But first the following section discusses the evolution of the *chain management* body of knowledge, showing the differences between conventional SCM and VCM.

FROM SUPPLY CHAIN TO VALUE CHAIN

Value chain analysis is an approach to understanding and improving supply chains and is a subset of value chain management (VCM). The VCA approach is particularly different from the conventional supply chain improvement approaches in emphasizing the concept of consumer orientation and consumer value. Whereas conventional supply chain improvement initiatives predominantly focus on waste elimination and cost reduction (i.e., supply chain efficiency), value chain management is concerned with differentiation and value enhancement in the supply chain (i.e., effectiveness of supply chains) as well as efficiency management.

The term *supply chain management* is typically deployed in the literature to refer to the management of the entire flow of goods (and services) and therefore carries a profound notion of systems thinking. In the following discussion, the author first explains how SCM has evolved over the past two decades to become VCM. Supply chain management itself is a fairly new concept which only started to make a significant appearance in the management literature in the 1980s (Houlihan 1985; Oliver and Webber 1982; Stevens 1989) and which has since been

popularized by several authors as an independent field of study (Cooper and Ellram 1993; Christopher 2005; Cousins, Lawson, and Squire 2006; Davenport 1993; Gibson, Mentzer, and Cook 2005; Mentzer et al. 2001). Nonetheless, much of the underlying thinking dates back several decades. In fact, the roots of SCM can be traced to systems dynamics and analysis (Forrester 1958), integrated logistics management (Bowersox et al. 1959), and the idea of forming cooperative relationships with suppliers (Farmer and Macmillan 1976). Although it is not clear whether SCM is sufficiently developed to be regarded as an independent discipline, the general consensus among academics is that SCM is a general problem domain represented by a significant yet diverse body of knowledge in the literature (Burgess, Singh, and Koroglu 2006; Croom, Romano, and Giannakis 2000).

The following subsection provides a rounded understanding of the evolution of SCM concepts from logistics to supply chain to demand chain to value chain. Table 1.1 reviews some key definitions of chain management presented in a chronological order. In the light of this trend analysis, it is explained that chain management has evolved from a narrow focus on physical aspects to a broad, multifaceted theory.

Evolution of Chain Management Concepts

Along with the growing attention to VCM in the management literature, over the past two decades there has been an increasing divergence in the way the terms *value chain* and *chain management* are understood and defined by management theorists. Table 1.1 provides an overview of some of the most frequently cited perspectives, illustrating how the concept has evolved over time. The review concludes by highlighting that although there is little consensus on the scope or meaning of the value chain or value chain management, an evolutionary trend is evident. The later value chain contributions are much more strategic and broader in scope in conceptualizing chain management.

This literature review confirms the hypothesis that there is little consensus on the scope or meaning of SCM or VCM. One reason for this is that the value chain has been viewed and studied from different theoretical perspectives (Giannakis and Croom 2004). Cousins, Lawson, and Squire (2006) argue that chain management can be viewed as an overarching field of study covering differing theories used to study a variety of phenomena and situations. The aim of this chapter is neither to ascertain the appropriateness of the aforementioned delineations of chain management nor to discuss whether VCM is a discipline in its own right. In fact, these contributions are all apt in the capacity of the industry or the historical background from which they have emerged. This section looks at the evolution of SCM/VCM in the literature and discusses what VCM entails both in practice and as an academic domain.

The information in Table 1.1 is indicative of the evolution of SCM theory. The early conceptions of SCM (Houlihan 1985; Stevens 1989) emphasize the importance of holism as opposed to single firm optimization. In fact, chain management theory begins with showing the potentials which lie beyond the boundaries of a single firm. The original supply chain contributions focus largely on the physical aspects in the supply chain—for example, the dynamics of information and material flows (Forrester 1958) and inventory management and transportation (Jones and Riley 1985). The narrow focus of the early SCM literature has inspired several authors to compare and contrast SCM with integrated materials and logistics management (Christopher 1992; Cooper, Lambert, and Pagh 1997; Hewitt 1994; Houlihan 1985). These authors have generally come to the same conclusion that SCM is a much broader concept encompassing issues beyond the boundaries of the logistics subsystem.

The later accounts of chain management in Table 1.1, however, transcend this narrow focus by taking account of broader issues such as long-term performance of the whole chain (Council of Logistics Management 1998), supply chain competitiveness (Christopher 2005), consumer enrichment (Ross 1998), and new product development (Womack and Jones 1996). Therefore, it is concluded that over the past two decades SCM has evolved from a one-dimensional subject with a rather narrow focus on logistics and physical aspects of material flow into a multifaceted theory encompassing a broad range of subjects. For example, Hewitt (1994, 7) contends that modern chain management simultaneously addresses "all aspects of the operation of the supply chain, including work practices, information flows and authority/decision making structures." Modern SCM can be more appropriately described as value chain management since it encompasses value enhancement and strategic differentiation as well as cost reduction and operational efficiency improvements. Internationalization of trade, sophistication of technology and markets, increased global competition, and the rise and dominance of the Japanese production philosophies (Womack and Jones 1996; Hines 1994; Lamming 1993) have immensely contributed to the evolution of SCM and its core concepts.

Value chain management is best described in Ross (1998) as the synchronization of competencies along the whole chain to create unique, innovative, and individualized sources of consumer value. Another notable conjecture by Womack and Jones (1996) describes "value stream management" as the integration of the problem-solving and new product development task, management of the information task, and the physical transformation and transportation task. Christopher (2005) is more direct in describing SCM as "demand chain management" to reflect the market orientation required in today's businesses.

This literature review clearly shows that strategic connotations of SCM only make an appearance in the literature in the recent years (Christopher 2005; Hewitt 1994; Mentzer et al. 2001). Maybe due to its origin in logistics and operations management, chain management is a domain where efficiency improvements are the prime objective—for example, time-based competition (Christopher 2005; La Londe and Masters 1994; Stalk and Hout 1990; Womack and Jones 1996), cash-to-cash time (Bowersox and Closs 1996), quality-based competition (Womack, Jones, and Roos 1990) and cost-based competition (Shank and Govindarajan 1993; Cavinato 1991). Few recent publications, however, emphasize the importance of enhanced consumer satisfaction in the context of chain management (Zokaei and Hines 2007;

Table 1.1: Overview of Some Key Contributions Concerning Value Chain and Value Chain Management

Contributor	Proposed Delineation for Value Chain, VCM, or Related Constructs	Key Features of the Definition
Forrester (1958)	Forrester fostered the dynamic study of whole systems as opposed to the study of separate functions or companies. "Company [and value chain] will come to be recognized not as a collection of separate functions but as a system in which the flows of information, materials, manpower, capital equipment, and money set up forces that determine the basic tendencies towards growth, fluctuation, and decline. I want to emphasise the idea of movement here because it is not just the simple three-dimensional relationships of functions that counts, but the constant ebb and flow of change in these functions—their relationships as dynamic activities."	Forrester aims to show the importance of the interrelationships between company functions and between the company and its network of suppliers and customers. Forrester emphasizes that the dynamics of relationships between the flows of information, materials, human power, finances, and capital equipment should be studied and standard management methods should be extracted from such studies.
Houlihan (1985)	The whole supply chain is a single business process. SCM can be defined as having the following key characteristics: "The supply chain is viewed [and managed] as a single process. . . . "SCM calls for and in the end depends on strategic decision making. Supply is a shared objective of every function in the chain. . . . "SCM calls for a different perspective on inventories which are used as a balancing mechanism of last, not first, resort. "A new approach to systems is required—integration rather than interfacing" (p. 26).	Houlihan characterizes the differences between SCM and the traditional materials and manufacturing control science. Houlihan argues that, on account of the new economy, the traditional logistics and materials management approaches, which sought trade-offs among various conflicting key functional objectives of purchasing, production, distribution, and sales, do not work very well any longer. It is necessary to adopt a new approach: supply chain management.
Porter (1985)	Michael Porter proposed the concept of value chain and the value chain model as means of analyzing intrafirm competitiveness. In addition he introduced the value system model, which effectively is an extension of the value chain model to the whole supply chain, for analysis of interfirm competitiveness. The value chain and value system models are activity-based views of the firm and the chain. According to Porter, every firm/chain is a collection of value activities performed to make a product valuable to buyers.	The value system model is probably, today, recognized as the *value stream map*. The value system model disaggregates the supply chain into strategically relevant activities (processes) in order to understand the sources of competitive advantage. More importantly, the value system and value chain models emphasize the importance of the linkages between the activities along the chain. The process reengineering approach to SCM is the extension of his work (Davenport 1993).
Stevens (1989)	Stevens defines the supply chain and SCM as follows: "The supply chain is the connected series of activities which is concerned with planning, coordinating and controlling material, parts and finished goods from suppliers to the customer. It is concerned with two distinct flows through the organisation: material and information" (p. 3). "The objective of managing the supply chain is to synchronise the requirements of the customer with the flow of materials from suppliers in order to effect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit costs" (p. 3).	Stevens provides one of the earliest clear-cut definitions of supply chain and supply chain management. He puts customer service at the heart of SCM and defines it as a bundle of delivery service, pre- and post-sales service, technical support, and financial packages. Stevens proposes a structured framework for developing an integrated supply chain strategy which is even applicable to today's supply chains. This framework has three stages: 1. Identifying the customer needs. 2. Diagnosing supply chain opportunities. 3. Developing an action plan for implementation.

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Table 1.1: (*continued*)

Hewitt (1994)	Hewitt defines the supply chain as a single business process which should be managed as a whole. Hewitt contends that this approach is sharply distinct from the conventional logistics management since it simultaneously addresses all aspects of the operation in the whole chain. Hewitt regards this level of logistical evolution as "integrated intra-company and inter-company supply chain management" (p. 4).	Hewitt defines SCM as the final stage in the evolution of logistics management. Successful SCM depends on the recognition and management of three critical dimensions in the chain: 1. Physical flow (work activity). 2. Information flow. 3. Decision/authority flow.
Womack and Jones (1996)	"The Value Stream is the set of all the specific actions required to bring a specific product (whether a good or service or increasingly a combination of the two) through the three critical management tasks of any business: the problem-solving task running from concept through detailed design and engineering to production launch, the information management task running from order-taking through detailed scheduling to delivery, and the physical transformation task proceeding from raw materials to a finished product in the hands of the customer" (p. 19).	The first principle of lean thinking (Womack and Jones 1996) is consumer value. Womack and Jones bring consumer satisfaction, and subsequently the new product development process, to the heart of the SCM argument. Womack and Jones introduce the notion of *value stream*, which is essentially a *value system* looked at from a single product point of view (Porter 1985). Whereas Porter contends that "the relevant level for constructing a value chain [and value system model] is a firm's activities in a particular industry (the business unit)" (Porter 1985, 36), lean thinkers (Womack and Jones 1996; Hines et al. 1997) propose that the appropriate level of analysis is disintegration of the chain into processes/activities at product level.
Council of Logistics Management (CLM) (1998)	"Supply Chain Management is the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole."	In 1998 CLM distinguished SCM from logistics management and acknowledged that logistics is one of the aspects of SCM. This distinction led to CLM changing its name to the Council of Supply Chain Management Professionals (CSCMP) in 2004. According to CSCMP, SCM extends the research on logistics to take into account issues of governance, multifirm relationships, and innovation in the chain to create consumer value. Thus, SCM is a philosophy for synchronization of all activities/capabilities (not just logistics) to create consumer value.
Croom et al. (2000)	". . . the supply chain should be seen as the central unit of competitive analysis. . . . In short, the contention that it is supply chains, and not single firms, that compete is a central tenet in the field of supply chain management" (p. 68). "Supply chain management and other similar terms such as network sourcing, supply pipeline management, value chain management, and value stream management have become subjects of increasing attention in recent year" (p. 67).	The paper sets out to "establish the general problem domain of supply chain management" (p. 67). It maps and evaluates SCM research and provides a topology of the domain which confirms a profound lack of theoretical research—in other words, SCM is not theoretically and conceptually well-researched. The paper points out the central role of the supply chain for competitiveness and argues that VCM and SCM are the same. The authors contend that "whilst supply chain management as a concept is a recent development, much of the literature is predicated on the adoption and extension of older, established theoretical concepts" (p. 68) such as transaction cost economics and competitive strategy.

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Mentzer et al. (2001)	"A supply chain is defined as a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer" (p. 4). "SCM is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole" (p. 18). "SCM is concerned with improving both efficiency (i.e., cost reduction) and effectiveness in a strategic context (i.e., creating customer value and satisfaction through integrated SCM) to obtain competitive advantage that ultimately brings profitability" (p. 15).	Implicit in this definition of supply chain is that supply chains—as business phenomena—exist whether they are managed or not. Thus, the authors draw a definitive distinction between the *supply chain* as a given phenomenon and *supply chain management* as the science and art of managing supply chains. Mentzer et al. distinguish between SCM philosophy and implementation. The philosophical view that companies across the supply chain constitute a potentially coordinated entity is regarded as a management philosophy and branded as *supply chain orientation*. Subsequently, SCM is defined as the implementation of a supply chain orientation vision and an upshot of supply chain orientation. This contribution addresses the importance of both chain efficiency and effectiveness.
Gibson, Mentzer, and Cook (2005)	"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence Supply Chain Management integrates supply and demand management within and across companies" (p. 22).	This contribution reports on the results of a Council of Supply Chain Management Professionals (CSCMP, formerly Council of Logistics Management) survey of its members' views of SCM. The survey proposed two potential definitions for SCM. Based on the results of this study, the authors conclude that the verified definition (in the left box) is not definitive and that further refinement and evolution of the definition are both possible and desired.

Zokaei and Simons 2006; Hines, Rich, and Hittmeyer 1998). In this context, understanding consumers' attributes and jointly striving on augmentation of consumer satisfaction are imperative to successful VCM. Value chain analysis (VCA) is a methodological approach for identifying best solutions both to add superior value to the end customer and to eliminate operational waste. The following section provides a step-by-step practical guide to VCA.

PRACTICAL METHODS FOR VALUE CHAIN ANALYSIS

The 10 Days Method

As mentioned earlier, the following VCA method has been developed during the VCA program which looked at four key sectors within the UK agri-business industry: dairy, cereals, red meat, and fresh produce. This major piece of

research consisted of in-depth analysis of 33 value chains from primary production to the point of consumption, covering different routes to market and different raw materials (e.g., pork, beef, and lamb in the case of the red meat industry). Each of the chains was studied independently as a separate project facilitated by a lead researcher and on average took three to five months to complete.

A standard data collection protocol was developed during the VCA program, referred to as the 10 days VCA method (Francis 2004; Zokaei and Simons 2006). The 10 days VCA protocol is rooted in lean thinking (Womack and Jones 1996) and, similar to lean value stream mapping techniques, it begins with the selection of a single product family for analysis. A *product family* is defined as products or stock-keeping units (SKU) that flow through similar processes in their value chains. The method requires establishment of a value chain team to follow the flows of the selected product across firms and functions.

Generally speaking, a cross-company team of various stakeholders (e.g., primary producer, processors, retailer, food service, etc.) was pulled together in each project, and on average 8 to 12 contact days were spent with the team members in the field. All data was treated as confidential unless cleared by companies, and a confidential report was published per project containing a detailed analysis for the selected product. Various case studies and sector-specific final reports were also published as and when required by sponsors. Broadly speaking, the data collection protocol consisted of four stages:

1. *Team building and introduction.* At this stage, the team was familiarized with the mapping and analysis techniques deployed during the project and also the basic principles of SCM. At least one representative from each participating firm committed to walk the whole value chain from farm to the end point of sales or point of consumption, depending on the project. A benefit-share agreement was put in place to ensure that the potential gains were fairly shared. Early team-building activities had a great impact on the overall success of the projects and were recognized as significant events later on during the project.
2. *Interfirm and intrafirm data collection.* During this stage a current state map of the physical and information flows along the whole supply chain was constructed with a specific focus on the time data (Rother and Shook 1998). Rother and Shook were first to document the lean mapping technique for a single firm, which was later extended to the whole supply chain by Jones and Womack (2000), both heavily borrowing from Toyota's approach to value chain analysis. The team walked the whole value chain and collected the necessary information over a period of, on average, three to four months. Some common units of analysis during the mapping stage are time, delivery, and quality, recorded for each echelon along the chain. Also, the team looked at operations and logistics efficiency measures such as demand amplification, on-time/in-full delivery performance, lead times, and defective parts. Financial data were not investigated to ensure maximum buy-in from all participant companies. Mapping of the end-to-end supply chain and collection of the current state data often required four to five days in the field depending on the size and complexity of the chain.
3. *Evaluation of the current state and suggestions for the future state of the supply chain.* Having gained a clear understanding of the current state, the team studied the data to identify potential improvement opportunities both at the whole chain and individual firm levels. Also, there was an opportunity to compare and contrast the current state against the team's understanding of the consumer value. The VCA was an opportunity for the team members to connect their role in the chain with the ultimate satisfaction of consumers. Clearly, consumer satisfaction can come either at a basic level where known requirements are met or at a much more advanced level where consumer expectations are exceeded. Normally, various improvement opportunities were identified ranging from low-hanging fruits to very difficult.
4. *Action planning.* In the final stage of the project an action plan was developed to take the supply chain from the current state to the future state based on the immediacy of the actions, the size of the prize, availability of change resources, and the relevance of the identified improvement opportunities to the consumer needs. The VCA project did not go further into a detailed implementation phase.

The data collection protocol (i.e., the 10 days activity plan) is described in Table 1.2.

Value Chain Analysis Case Study

The fieldwork for this case study was conducted as part of the VCA program in the UK. This project looked at the entire supply chain from a medium-size pig farm through a consolidated abattoir and processing plant to a public sector canteen. The companies involved were a farm, a meatpacker, a food service company, and the catering department of a public sector company. A team of senior company representatives and two academic facilitators followed pork legs and loins from farm to canteen. The public sector organization had a central contract with the food service company to provide their entire catering requirement to various locations throughout the UK and overseas. Therefore, there was demand both from within the UK and from overseas. Table 1.3 lists the companies involved and representatives from each company.

The mapping exercise showed that the UK canteens have a relatively steady demand due to almost a fixed number of people being catered for daily, with occasional significant changes in demand related to additional numbers being brought in. The value chain members decided to participate in the project to ensure that the highest levels of logistical efficiency are achieved and that the chain tightly adheres to the target budget. So, at the outset, the VCA participants primarily aimed at improving the whole chain efficiencies. The food service company is one of the UK's leading food service organizations with a turnover of over £1 billion a year. It supplies a food range of around 1,600 products across three temperature bands—ambient, frozen, and chilled—delivered to around 1,000 delivery points, making 150,000 deliveries

Table 1.2: Value Chain Analysis: The 10 Days Activity Plan

Session	Event	Activities
1	Initial team-building workshop	Explanation of key chain management concepts such as flow, pull, agility, demand amplification, and so on. Explaining value stream mapping techniques and tools deployed during VCA, such as process activity mapping, product variety funnel, and so on. Explaining principles of collaboration along the chain. Discussing a benefit sharing agreement. Identifying the core team members and establishing a value chain continuous improvement office.
2	Workshop: Current state	Selecting a suitable product group for mapping. For example, choosing the largest mutual flow or a product with biggest potential for improvement. Creating a generic big-picture (current state) map of the value chain.
3,4,5,6	On-site mapping	Creating detailed current state maps for individual firms along the chain, such as farm, food processor, distribution centers, and retail store. The current state maps cover both the physical and information flows. Also, the current state maps bear all the relevant operational (determinant) performance indicators. Identifying internal operational improvement opportunities at each facility.
7	Workshop: Whole chain ideal state map	Discussing and creating an ideal state map so that the whole team can aspire towards a single shared vision—in other words, an ideal lean value chain. Identifying, discussing. and categorizing consumer value. Identifying key performance indicators (KPIs) for the whole chain.
8, 9	Workshop: Future state map	Discussing and creating a future state for the whole chain. The ideal state is a vision whereas the future state is an achievable target. At this workshop the ideal state map is rationalized to the future state map. Identifying key projects towards the future state. Linking key projects (opportunities for improvement) with the measures of consumer value to identify the vital few projects for improvement. Creating a clear action plan where all key stakeholders and people responsible for implementation are identified.
10	Presentation of final results	Team presentation of recommendation for improvement and findings to top tier management of all companies involved. Confirm proposal with all stakeholders and various project owners. Discussions around benefit allocations and milestones. Final decisions taken as to which improvement projects to pursue.

Table 1.3: Supply Chain Improvement Core Team Members

No.	Company	Representative
1	Farmer	No representation in the core team
2	Abattoir and meatpacker	General sales manager
3	Food service company	Director of public catering supply
		Senior buyer—fresh foods
4	Public organizations catering department	Operations manager
5	Cardiff University	Academic facilitators

and assembling 21 million food items per year. The total value of this catering contract in 2005 was just less than £100 million per annum where approximately £15 million was spent on red meat procurement only (including pork). The contract required delivery to flexible locations and formats.

The case study looks at the supply of frozen pork loins and legs from a meatpacking plant in East Anglia. The farm was an integrated system of cereals, potatoes, and pigs, located in Lincolnshire, with a long-term relationship with the meatpacker. The following shows *how* the supply chain team was able to identify the disconnectedness of consumer value both with the product attributes and the supply chain activities. Also, there are discussions around *how* processes along the supply chain were potentially realigned with the consumer requirements and *why* supply chain effectiveness was partially improved. This is followed by a description of the subsequent efficiency gains.

No	Activity step	Duration (Seconds)	Distance (Meters)	Touches	Operation	Legal	Transport	Inspection	Storage	Delay
1	Pig removal from chiller to the cutting line	30	15	1			■			
2	Queue of carcasses to the processing room	60	10	1			■			
3	Head removal	15	1	1	■					
4	Pigs from hook to conveyor	30	15	0			■			
5	Separation into subprimal	12	15	4	■					
6	Removal of rind	2	3	1	■					
7	Movement to the end of line	2	10	0	■					
8	Check and trim	2	1	1				■		
9	Check weight (make sure it meets specs)	3	1	1				■		
10	Product placed on racks	2	1	1			■			
11	Filling rack to capacity (100 each rack)	360	0	0						■
12	Rack weighed on scale	60	3	1				■		
13	Rack moved to chiller	30	22	1			■			
14	Holding in chiller	14400	0	0						■
15	Chiller to packing line	150	60	1			■			
16	Bag loins (on rack)	20	0	1	■					
17	Metal detection	5	0	1		■				

Figure 1.1: Sample Process Activity Map—Abattoir

Case-study Findings and Analysis

The Current State Map As previously explained, a variety of mapping tools and techniques were deployed during the project, such as quality filter map, delivery adherence map, demand amplification, and so on (Hines and Rich 1997). The relevant tools were introduced to the team members at the outset of the project. The most basic tool deployed was process activity mapping (PAM), which is a means of recording every step along the chain and provides a platform for creating current state maps. It captures the details of all the tasks required for completion of each process, including time taken to complete each task, distances moved, and the number of times operators touch the product during each task. A separate PAM sheet was created for the farm, the abattoir, the processing plants, the distribution center, and the canteen. Activities were then categorized as value-adding (VA) and non-value-adding (NVA) along the whole chain.

Figure 1.1 shows a sample PAM sheet related to the cutting process at the abattoir for pork loin. As illustrated, PAM records all activities in a flow chart and classifies them into five distinct categories: operations, delay, inventory, inspection, and transportation.

Only a fraction of the operational category in the PAM sheet is considered to be value-adding. The aim is to increase value-adding operational time where possible. In the lean approach the ultimate arbiter of value is the end consumer, and the yardstick for determining VA and NVA activities is the consumers' willingness to pay for the service. It must be noted that some NVA activities are necessary given the technical and practical constraints. For example, if a product is waiting in stock, it is recorded as NVA in the lean approach; nonetheless, a certain amount of inventory is inevitable in any supply chain. In the example in Figure 1.1, only 5 out of the 17 steps are operational steps, while only 4 are considered to be value-adding operations; step 7, which is picking the subprimal and moving it to the end of line, is not considered a value-adding operation despite the fact that it is necessary in the existing layout. The total time is 15,178 seconds (or approximately 253 minutes), out of which only 49 seconds are value-adding; in other words, 0.3 percent is VA time.

Subsequently, all PAM data were pulled together to create a current state map of the physical flows for the whole chain and then the information flows were added to generate the current state map, as illustrated in Figure 1.2. The current state map shows the physical flows, the information flows, total lead time, value-adding time, and so on. It shows that the total lead time for loin is 276 days and 11 hours, out of which 233 days are spent at farm (animal breeding and rearing). So lead time excluding the time at farm is 43 days and 11 hours, and according to PAM sheets the value-adding time was just less than 25 hours (i.e., 24 hours cooling at the meat packer, 15 minutes value-adding operation in slaughter and cutting, 15 minutes value-adding operation in the distribution center, and 20 minutes value-adding time during cooking in the canteen's kitchen). That is 2.4 percent of the total lead time excluding time spent at the farm.

In the diagram, the physical flows are shown in black and information flows are illustrated in red across the top of the map. The dotted red lines represent rework or information processing that should be avoided in the first place—for example, at the food service depot the exceptions and the order substitutions are keyed in separately; this is caused by unavailability and is considered to be rework or failure demand. The triangles stand for inventory in the map. Finally, the timeline is given at the bottom of the diagram. On the timeline, figures in parentheses represent the value-adding time at each stage.

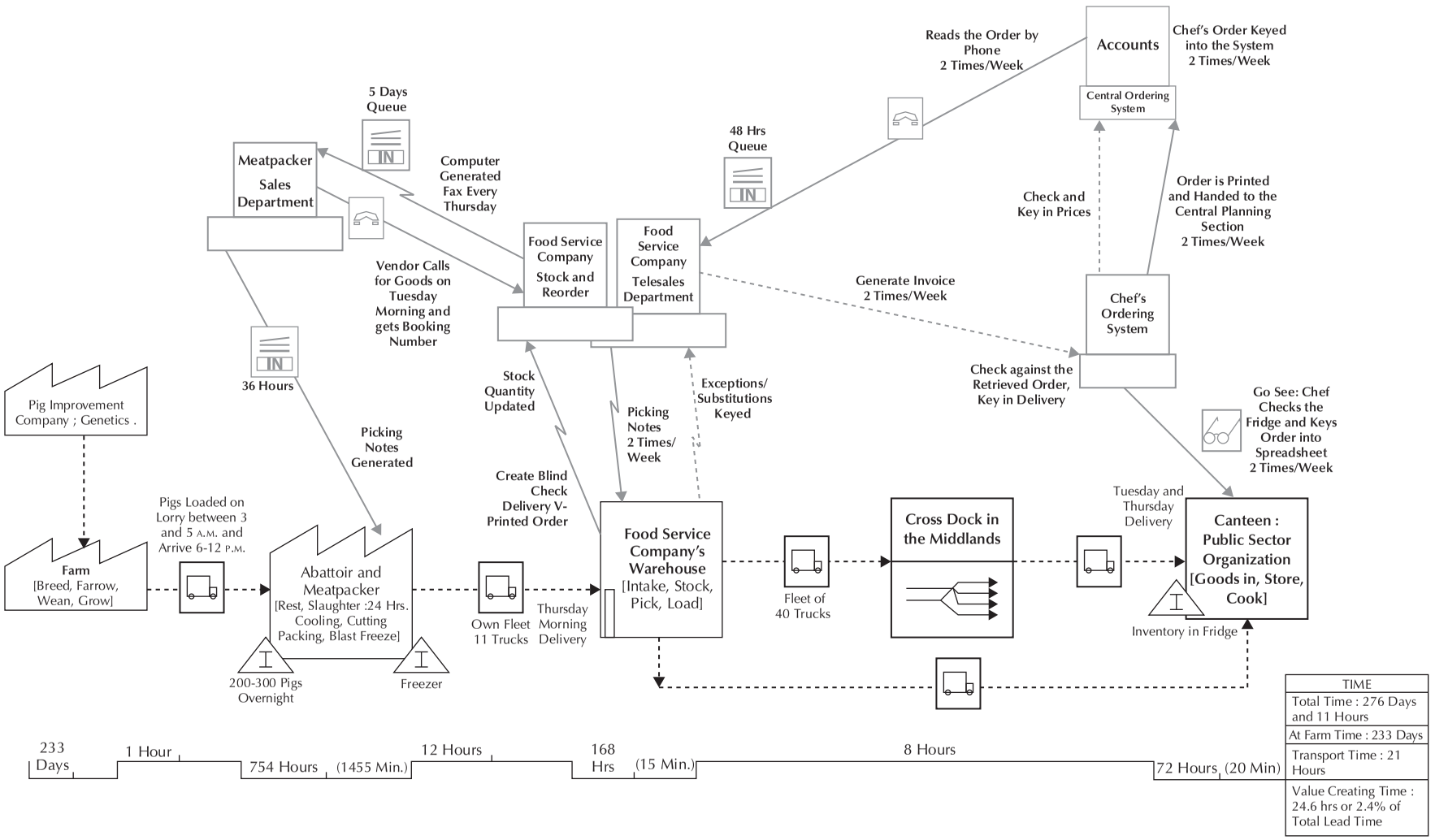

Figure 1.2: Current State Map for Pork Loins from Farm to Canteen

Identifying the Key Opportunities for Improvement and Generating a Future State Map The analysis of the chain threw up many opportunities for improvement ranging from quick fixes to long-term changes. Value stream mapping often leads to the exposure of several quick fixes which are in most cases related to the supplier's unfamiliarity with the actual needs of the customer.

During the future state mapping sessions a full list of all opportunities was generated and they were ranked through discussion and consensus. Discussions circled around the perceived cost/benefit ratio of implementing each improvement opportunity. After much qualitative discussion, the team identified the following five key opportunities to be taken forward:

1. Review of the product specifications. The product specifications had not been not revised since they were established in 1963, and they were by and large outdated.
2. Setting up electronic data interchange (EDI) between the food service company and the public sector organization. A telesales system was in operation with 20 staff dedicated to the telesales department at the food service company.
3. Backhaul opportunities between the supplier and the distribution company. Both the processor and the food service company operated their own fleet. The team established that, in addition to this value stream, plenty more opportunities existed for backhaul to and from the central warehouse through better planning with various suppliers.
4. In-house improvement opportunities at the processing plant (such as an improved layout, work balance, and packing equipment performance).
5. Work standardization at the farm—for example, reducing the variance in the performance of stockmen. Historic records showed that the skilled stockmen achieved a piglet mortality rate four times lower than the poor stockmen. The attempt was made to standardize the skilled stockmen's operations for training of the new staff.

Having mapped and analyzed the current state, the team worked toward generating a collective vision of a supply chain that operates as an integrated entity, focusing on the enhancement of the supply chain value proposition and elimination of all non-value-adding activities. The shared point among all team members was the satisfaction of the end consumer. Also, as already mentioned, consumer value is the first principle of lean thinking. The team members brainstormed various attributes of the consumer value, categorized them, and related them to a set of supply chain key performance indicators (KPIs), as illustrated in Table 1.4. Through consensus, five factors were identified as the key constituents of value, reflecting the requirements set by the public sector organization, the chefs, and the actual consumers. The voice of customer (VoC) can be seen as a bundle of various explicit or implicit value attributes (Khalifa 2004). The brainstorm session was a rudimentary way of capturing and discussing VoC. The outcome of the discussion session was largely influenced by and depended on the public organization sharing their knowledge of the consumer needs acquired through focus groups and direct contact with chefs.

At this stage it was obvious that, even though the food service company and the public sector organization were separately measuring and analyzing consumer satisfaction, they had never coherently linked together the requirements of the consumers, the product features, and the supply chain activities. The future state workshop provided the opportunity to link the three together for the first time. Altogether, a lack of consistent understanding about the consumer requirements was observed, which suggests that, from a supply chain effectiveness perspective, the chain was in a state of unconscious incompetence. In contrast, the efficiency levels along the supply chain were good. For example the distribution service achieved 99.7 percent lines delivered in full against lines ordered (substitutions permitted). In the abattoir a state-of-the-art slaughter line was observed, which had excellent ergonomics, leading to better consistency in quality, and the first Autofom application in the UK that ultrasonically scanned each carcass immediately after slaughter. A three-dimensional picture was built up of the muscle and fat present, which allowed accurate payment to the producer for the actual meat delivered, when fully implemented.

Table 1.4 shows different aspects of value in the ranking of importance as agreed upon by the team members. The team's perception was that the most important feature of value was cost-efficient distribution. This was linked into an overall measure for the total cost of delivering the pork product. There was a cost-plus contract in operation between the food service company and the public sector organization. Accordingly, in order to encourage ongoing collaboration, any saving in the cost of distribution was to be shared equally between the two parties. The team's perception was that the aim of the VCA project is to deliver cost savings, and an obvious area for cost saving—which could be equitably shared—was the distribution cost.

The second most important facet of value was the quality and consistency of the product, which was already being measured through rigorous methods such as customer direct feedback to the suppliers and random quality checks. The evidence acquired from the end customer suggested that the supply chain consistently met the specifications and the quality criteria. However, this was later proved to be wrong due to the lack of understanding of consumer needs.

The third attribute of the consumer value was the cost-efficient purchase of the raw material. This was also being measured through independent third-party monitoring of the procurement of the top 40 products (which included the pork lines). The fourth aspect of the consumer value was on-time/in-full (OTIF) delivery into the canteen. The food service company achieved 97 percent OTIF (calculated by checking the credit notes against the invoices). The measure was closer to 99.7 percent when substitutions were taken into account (the contract allowed for substitutions within reason).

Last but not least, the end customer required a strategic reserve of at least 21 days of stock to be kept in the distribution pipeline at anytime (i.e., inventory anywhere

Table 1.4: Translating Consumer Value into Supply Chain KPIs

Consumer Value	Supply Chain KPIs
Cost-efficient distribution	Total cost to serve for the whole job
Quality and consistency	Produced to exact product specifications as required by the final customer
Value for money	Top 40 products' buying effectiveness (examined by independent third-party company)
Delivery on time/in full	99.7% right quantity delivered (substitution allowed) 97% perfect order (measured by comparing credit notes with invoices—no substitutions)
Strategic reserve	21 days to feed

between the distribution company's warehouse and the canteen). It was not clear whether this was actually needed or just a legacy of past systems. However, keeping a strategic reserve was not a big issue since the products were delivered via a frozen chain. Then again, a chilled chain would have meant supply of cheaper, tastier, and fresher produce.

The key improvement opportunities and the issues related to consumer value have so far been discussed in this case study. Moreover, value attributes were related to a set of supply chain KPIs. In order to understand the extent to which the key projects deliver against the supply chain objectives, a sanity check against the supply chain KPIs was carried out during the future state workshop.

In Figure 1.3, each box is scored on a scale of zero to three, where zero denotes no impact on the relevant KPI and three shows very high impact. As illustrated, implementation of the EDI link and product specification review equally had the highest impacts against the supply chain KPIs. The implementation of EDI could result in significant efficiency gains estimated at around £400,000 per year. Nevertheless, it required relatively large capital investment and hence the need for a long-lasting cost/benefit sharing agreement between the food service and the public sector organization. The two companies could not reach an agreement mainly because the remaining length of the contract did not cover the payback period for the required investment. By contrast, the review of product specifications required zero investment while potentially improving both effectiveness and efficiency of the chain. The rest of this section explains how chain effectiveness was improved and what efficiency gains were obtained as a result.

The future state discussions revealed that the food service company and the public sector procurement organization were both active in understanding the consumer needs through focus groups. Moreover, the processor and its suppliers took great care to produce to the correct specifications. Even though the product was reasonably priced, had good quality, and was delivered 99.7 percent in right quantity (allowing for substitutions), it did not match the customer's desired attributes. The supply chain analysis connected all aspects of the supply chain together and revealed that the product specifications were outdated and did not reflect the true consumer needs. The team identified opportunities for changing the boneless loin product attributes and supply chain activities as follows.

Boneless Loin—Opportunities for Improvement The current state map showed that the loin was being supplied with bone. In the kitchen, the product needed to be deboned, and the disposal of the bone incurred additional cost. The impacts of aligning the chain to the consumer value in this case were twofold:

1. *Effectiveness gains*. A questionnaire was sent out by the public sector organization, following the team's suggestion, to see whether delivering boneless loin is aligned to the customers' preference. One limitation of the study was in consulting the chefs rather than the actual end consumers about their preferences. Moreover, the telephone interview did not ask exactly why chefs liked or disliked the boneless product; nor did it follow up when the answer was not specified. This issue increases the possibility of type II error in analyzing the results of the questionnaire. Twenty-three answers were received from chefs responsible for fairly similar size canteens supplied from the same source and through similar channels. In all cases the public sector organization had followed up by telephone, and in a few cases had even obtained the results through telephone interviews. The results of the questionnaire are illustrated in Figure 1.4.

   The results showed that the final customer preferred the boneless product since there was no need for boning in the kitchen. Out of the 23 respondents 14 preferred boneless loin, 3 were indifferent, and 6 said no. That is 61 percent in favor, 14 percent indifferent, and 25 percent against boneless loin. The statistical question is whether the proportion of yes answers is significantly higher than would be expected by chance. To find an answer to this question, the researcher used the binomial distribution to identify the probability of finding 6 or fewer negative answers in a sample of 20 when the random probability of a no in each trial is 50 percent. The probability of 6 or fewer respondents disliking the boneless product out of 20 respondents is 0.057—that is, $B(20, 6, 0.5) = 0.057$. It must be noted that three respondents did not specify their preference and therefore were regarded as meaningless data. Assuming an alpha level of 0.05, it can be (marginally) concluded that the customers preferred boneless loin.
2. *Efficiency gains*. Realignment of the supply chain with the consumer value (i.e., boning at the cut-and-pack stage and delivering boneless loin) leads to a number of efficiency improvements. First, the boning operation was more time consuming and labor intensive

Supply Chain Improvements Opportunities

Consumer Value Attributes	Supply Chain KPI	Review of Product Specification	Electronic Data Interchange	Backhaul between Abattoir and Food service	Farm Work Standards	Meatpacker In-house Efficiency Gains	
Cost-effective distribution	Total cost to serve for job	2	3	2	0	0	**7**
Quality and consistency	Product specification	3	1	0	0	0	**4**
Value for money	Check top 40 products' price	3	3	1	3	3	**13**
Deliver on-time in-full	97% perfect order	0	1	0	0	0	**1**
Strategic reserve	21 days to feed	0	0	0	0	0	**0**
		8	**8**	**3**	**3**	**3**	

Figure 1.3: Key Improvement Projects' Impact against Supply Chain Key Performance Indicators (Scale: 0 to 3)

when carried out at the canteen as opposed to being done at the processor on an industrial scale. The processor produced boneless loin for other customers and could batch products together. Second, there was a small residual value to the bone at the processor. Third, there were logistical savings to be made along the chain. Four bone-in loins could be fitted in a box, compared with six boneless products after the modification. Therefore 33 percent fewer boxes and delivery pallets were needed, which amounted to 96 full pallet deliveries saved in a single year. Total potential savings were around 1.75 percent on the final price delivered to the canteen.

When potential savings are repeated over time and in a range of products, at some point there may be the potential to redeploy resources to other activities. This is the *continuous improvement* principle of lean thinking (Womack and Jones 1996). Total immediate savings were at least 0.51 percent, equal to about 1 percent profitability on sales against a backdrop of only 3 to 5 percent average chain profitability across the whole red meat sector. The savings related to labor in the canteen were partly offset by the extra labor required at the processing end to debone loins; however, this factor is not included in these calculations due to a lack of data.

Discussions, Conclusions, and Recommendations

There is a tendency for supply chain improvement efforts to solely focus on the efficiency factors. This case study sheds light on the great need to address consumer value in the context of supply chain management by explaining *how* and *why* the supply chain in question was disconnected from the consumer needs despite being reasonably efficient. For example, pork products were being delivered 99.7 percent right; yet a huge amount of waste existed since the product specifications had essentially not been revisited since they were established in 1963. That is, the supply chain was delivering the wrong product (bone-in loins) 99.7 percent on time/in full.

The case study shows that efficiency measurement and improvements per se fall short of meeting the consumer requirements. The value chain improvement exercise threw up many improvement opportunities; the team opted for the review of product specification, which delivered both supply chain effectiveness and efficiency improvements while requiring almost nil investment. By contrast, opting for efficiency improvements such as the implementation of EDI would have required hefty capital investment up front while not necessarily securing consumer satisfaction since the same out-of-spec product would have been delivered.

One limitation of the study is that the real requirements of consumers were not captured. That is, only a post-event questionnaire was sent to chefs and the actual consumers were not surveyed. As explained earlier, it is imperative for the industry to reconnect with the consumer value, to duly realign processes to deliver the basic requirements, and to find ways even to enhance consumer value beyond the basic needs at different stages along the value chain.

CONCLUSION

This chapter provided a practical, step-by-step guide for implementing a successful value chain analysis project. It explained that (consumer) value and system effectiveness should be the starting premise of value chain improvement endeavors. The case study provided insight into the practicalities of the proposed method and the challenges ahead.

In this case study, the different parts of the chain had differing opinions of what was meant by value; this led to conflicting behavior and poor overall delivery of value to the end consumers. In addition, the role of SCM was perceived as limited to delivering operational/logistical

Type of Product Listed on Menu from Loin		Roast	Chops	Roast	Steak	Stir Fry	Escalope	Medallion	Dice	General Preference
Canteen	(Bone in or out)	In	In	Out	Out	Out	Out	Out	Out	Boneless (YES/No)
1			Menu	Menu	Menu	Menu	Menu	Menu	Menu	NO
2				Menu	Menu	Menu	Menu	Menu	Menu	NO
3				Menu		Menu	Menu	Menu	Menu	YES
4				Menu	Menu	Menu				YES
5				Menu						NO
6		Menu	Menu	Menu					Menu	NO
7					Menu	Menu	Menu	Menu	Menu	YES
8			Menu	Menu					Menu	Not specified
9		Menu		Menu	Menu	Menu	Menu		Menu	Not specified
10		Menu		Menu	Menu	Menu	Menu		Menu	Not specified
11				Menu		Menu	Menu			YES
12					Menu	Menu	Menu	Menu	Menu	YES
13		Menu		Menu	Menu	Menu	Menu	Menu	Menu	NO
14				Menu						YES
15		Menu	Menu			Menu			Menu	YES
16			Menu		Menu		Menu	Menu		YES
17					Menu	Menu	Menu		Menu	YES
18					Menu	Menu	Menu		Menu	YES
19			Menu	Menu		Menu	Menu			YES
20			Menu	Menu	Menu	Menu	Menu			YES
21		Menu								NO
22										YES
23				Menu	Menu					YES
	Total Yes	6	7	15	13	15	14	7	13	14
	% Yes	26%	30%	65%	57%	65%	61%	30%	57%	61%
	% In-different									13%

Figure 1.4: Customer Preference for Boneless Loin: Results of the Questionnaire
Source: Anonymous Public Sector Organization

services only (i.e., quality, cost, and delivery). This perception was countered by obtaining consumer information (capturing VoC) and by steering the supply chain improvement initiative towards greater supply chain effectiveness. Moreover, the case study showed how interorganizational potentials can be leveraged to improve the overall supply chain consumer satisfaction.

GLOSSARY

Council of Logistics Management (CLM): An association of logistics executives and experts in the United States which, in 2004, changed its name to the Council of Supply Chain Management Professionals.

Current State Map: The first stage in the value stream mapping change process. The current state map shows the physical and information flows for a product, capturing the key operational measures and tracking the processes through which it travels.

Key Performance Indicators (KPIs): A few business measures selected to manage and improve value stream processes.

Lean: The term *lean* was first coined by John Krafcik at the Massachusetts Institute of Technology and was later popularized by Womack, Jones, and Roos (1990). The origins of the concept are strongly associated with the Toyota production system and Taichi Ohno, who is widely acknowledged as the architect of lean production.

On Time, In Full (OTIF): A measure of a perfect delivery.

Process Activity Mapping (PAM): An industrial engineering technique applied to value streams for measuring time and to understand the value-adding steps within the process.

Supply Chain Management (SCM): The strategic and tactical management of the product and information flows across different organizations.

Stock-Keeping Unit (SKU): A term for describing each distinct product that is ordered from a supplier.

Value Chain Analysis (VCA): A general term for various methods deployed for improving supply chains. Most VCA approaches involve creating end-to-end process maps of the supply chain.

Voice of Customer (VoC): By definition, *consumer value* should be defined by the consumers. Capturing the voice of the customer and analyzing it are the first steps in understanding consumer value.

CROSS REFERENCES

Customer Service in Supply Chain Management; Managing the Flow of Information and Materials across the Supply Chain; Supply Chain Management; Supply Chain Strategies.

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