Service Chain Management – Optimizing Service Delivery

Supply Chain Management is a holistic approach to delivering manufactured products to the end customer. Using advanced information technology and optimization software, the elements of the supply chain are coordinated to achieve efficient distribution unavailable in traditional logistics systems. Service Chain Management is an analogous systems approach designed for manufacturing and delivering a service; it addresses the challenges and opportunities for organizations facing the prospect of establishing a service chain or improving an existing chain.

Introduction

Over the past decade, the topic of Supply Chain Management has received much attention. The supply chain paradigm, enabled by information technology, has eliminated non-value-adding activities and established interdependent relationships among trading partners. In this article, we propose the study of supply chains for services and call it Service Chain Management; service chains can benefit from many of the same principles developed for goods supply chains with at least similar, if not greater, gains in productivity.

Service sector growth and supply-side competition underscore the importance of Service Chain Management. For example, the home health care industry faces unprecedented growth in demand over the next 10 years: suppliers of home health care services must do more with less. Under deregulation, market competition is forcing many utilities to streamline operations; globalization confronts, these organizations with potential markets orders of magnitude larger than their existing customer base. Companies unwilling to compete on cost alone must redesign their existing supply chains to deliver the service portion of their product offerings in a cost-effective manner.

Some of the challenges facing Service Chain Management organizations include the opportunity for bi-direction optimization, the role of conversion and distribution, effective use of productive capacity, the perishable nature of the service product, the level of customization, the sequence of transactions implied by the service offering, and the level of uncertainty; the degree to which they impact Service Chain Management is often extreme: for many services, production and consumption must be simultaneous.

We illustrate many of the concepts here using one of the most important segments of the service sector: services delivered through a mobile workforce. This service segment of the economy is comprised of 15 million workers who produce a trillion dollars of the United States GDP (15% of the GDP). Figure 1.0 provides a comparison of a goods supply chain with a service supply chain for a mobile workforce that captures many of the issues that we will discuss in this paper.

Defining the Service Chain

In defining the service chain, we take the view of the external customer. The processes involved in delivering a service to a customer define the service chain. Customers generally consider the request and
Examples of Service Chain Management in Home Healthcare

Home healthcare visits by 2001 will exceed 600 million visits provided by over 300,000 health workers.¹ This large mobile workforce is comprised of workers with a variety of skill sets and knowledge: registered nurses, licensed vocational nurses, nursing aids, physical and occupational therapists, respiratory therapists, etc.

Patients receiving home healthcare are even more varied, with different needs and preferences. A bedridden patient may prefer a same-gender nurse for bathing procedures and other very personal care matters. Some patients do not speak fluent English and require language-appropriate providers. Because of the personal nature of healthcare, most patients prefer to receive their care from a limited number of familiar providers.

Given the nature of the business of home healthcare, the solution to the “traveling salesman problem” for this market is exceedingly complex; traditional approaches of organizing and providing home healthcare are significantly sub-optimized.

With this background, tools and tactics that can automate and optimize cost-drivers are becoming an essential part of the survival strategy of home healthcare enterprises.

The mission-critical functions of home healthcare agencies are generally organized by a series of paper-based systems. New patients are received via telephone referrals. Nurses go to the patient’s home and perform assessments that address the complete medical and social environment of the patient. This drives the creation of a care plan which defines the “visit plan,” a calendar-driven work plan which maps out when the patient is seen, what happens during each visit, what skill set is associated with each visit and when the patient’s status requires re-assessment.

On a weekly basis, supervisory nurses at the home healthcare agency office take these care plans and write down all the “jobs” for each patient by day, for the current week, to create a master schedule.

Fulfillment portions of a service as a single system. See Figure 1.0.)

Many companies and systems can create a “virtual” service system. Most service companies separate service-request processes from service-production processes, with inherent inefficiencies.⁶ One strategy of Service Chain Management is to integrate these two separate systems into one.

In healthcare, there is a virtual system that connects the various service providers (doctors, hospitals, pharmacies, etc.) in responding to patient needs; it may be a multi-step process involving an HMO, a primary care physician, a specialist, a hospital-based-out-patient radiology department and a national laboratory. Treatment is similar; it may include independent pharmacies, medical equipment suppliers, home healthcare providers and return visits to the physician’s office to measure responses to treatment. Even in “integrated delivery networks” there are often surprisingly separate units that rarely function efficiently from the patient’s view.

Bi-Directional Optimization

Bi-directional optimization implies doing what is best from both the customer and the service enterprise perspective. In service production, customers often “co-produce” the service. Direct customer involvement facilitates bi-directional optimization, a simultaneous optimization of both supply and demand for the service; this provides individualized service for the customer and cost-effective service for the service enterprise.

Knowledge management is a strategy to organize and use available information, experience and expertise to create a competitive advantage for a business. Technology innovations now enable a near instantaneous inclusion of customer requirements and preferences into the knowledge management strategy of service companies.

Every customer has unique expectations, wants, needs, preferences and desires. These factors are the basis for buy decisions, the perception of quality, the chance for repeat business and the value of branding.
The dynamic availability of individual customer requirements and preferences adds a new dimension to the knowledge management possibilities of service companies. This capability is transforming how a mobile workforce provides highly personalized services at significantly lower cost than before.

For mobile service, a “time-window” is reserved for each customer to be available for a service worker to perform the requested service. Customers see generous time-windows as a major inconvenience equivalent to wasting their time for the benefit of an inefficient service provider. Currently, mobile workforce service providers ask customers to be available for extended time windows because routes, customer sequencing, and interval service provider job status updates are not built into the information system. Service Chain Management uses forecasting data to construct an initial daily plan for each worker. It offers several service appointment choices to customers based on a pre-optimized calculation of an optimized solution for the whole group of service workers in a city or any defined geographic area. This optimization process can reduce customer time windows from 5 hours to 1 hour, improve responsiveness to individual customer preferences, eliminate paper-based documentation and billing forms, and decrease operational costs from 5% to 15%.

The Role of Conversion and Distribution
Conversion is the process of creating value for the customer. For goods, conversion is principally located in the factory; for services, including mobile services, it is typically located at a customer site. In manufacturing, production rarely involves the customer actively; in services, the customer often is a co-producer. In the typical manufacturing supply chain, conversion occurs early in the process, in the service chain it occurs late in the process. A typical factory will focus on a limited number of standard products, a mobile service worker generally has considerable discretion and will be expected to customize the service to the customer’s needs. These conversion process differences distinguish between the production of goods and services and have implications for the strategies used for operational optimization.

Distribution of most manufacturing value is associated with strategies to have products available on the retail store shelf when a customer reaches makes a purchase. Distribution logistics and delivery of goods are a relatively low-cost component of most manufactured items. Sales channels that are long-term, relatively static partnerships create additional opportunities to decrease the relative cost of a distribution network.

In mobile service production, the nature and character of the service is

 providers generally continue working with patients they have already seen. This master schedule is then reformed into a daily task list for each provider. There is often a frenzy of activity just prior to schedule release associated with “holes” in the schedule and supervisors “fishing” for a willing provider to take just one more patient.

Once the weekly schedules are finalized and printed, providers pick up their schedules and the week begins. Home healthcare providers work autonomously. The time of home visits is generally not considered when producing the schedules. Providers are left to make arrangements with patients based on mutual agreement and providers often intermingle personal tasks with patient visits. This schedule freedom, while attractive, builds invisible inefficiency into the system.

Once home care visits are completed, visit documentation is returned to the agency office where the billing process can be initiated.

Service Chain Management of this system consists of automation and optimization of the important cost drivers associated with the mission critical function of home healthcare. It begins with the automation of the care planning process using a PC-based visit tool that is used as the patient intake tool (this is the same as a graphical user interface for a call center). Individual patient address, clinical requirements and personal preferences are entered and can now be actively and consistently incorporated into the enterprise knowledge management system.

On the same PC is the database that organizes provider information by skills, preferences, licensing, current training and certification, salary or contract payment data, provider home address, as well as fax, pager and mobile phone numbers. Also on the same PC is an advanced software module that can process the information for enterprise operational optimization. In a matter of minutes it explores the requirements, preferences, and location of every patient and the skills, training, licensure,
preferences and location of every provider. It can run millions of scenarios that match patients and providers in different combinations and sequences. The complex mathematical modeling, advanced artificial intelligence algorithms and extensive solution-space exploration are invisible to the user.

Cost and quality drivers are an essential component of the software; the system has “dials” which can be adjusted for each. For example, continuity of care is an important factor in patient satisfaction. Having the same provider for a given patient 95% of the time versus 80% of the time may have a very significant impact on the cost of providing services for the entire enterprise. Similarly, each preference of the patient and provider can be given a relative weight and the effect of these decisions on different solutions can be compared. This system-wide understanding of the impact of certain policy decisions on the actual cost of providing services is a new possibility for the home healthcare enterprises.

It is our view that Web-based connectivity will shortly replace or significantly change the myriad of care documentation and disparate billing systems which are the focus of most of the information technology investment in the home healthcare industry.

Service Chain Management for a home health agency can anticipate service demand using a database that contains patient age, diagnosis, co-diagnosis, care requirements, individual preferences and patient location. This accessible data can drive a whole range of productive capacity issues for the agency; a predominance of diabetes among Spanish-speaking patients in a metropolitan area may drive hiring and training of local providers with a certain skill-set, leading to shorter travel-times, better provider continuity, improved responsiveness and lower overall enterprise costs. Forecasting demand with greater detail in the data can significantly impact the way an enterprise builds and maintains it workforce to meet the individual needs and preferences of the patient population usually determined relatively close to the time of delivery. Every moment spent in distribution equals a lost moment of productive capacity. This relationship reversal gives a significantly enhanced importance and value to the role of distribution in the mobile service sector. Traditional inventory stocking and demand anticipation strategies of most of the manufacturing sector are impossible for the mobile service sector. The productive capacity of a mobile service worker cannot be placed into inventory for distribution at a later time.

Managing Productive Capacity

For mobile workers, a primary consideration of productive capacity is the amount of time spent between jobs. Because value is created predominantly through time at the customer site, time spent traveling is lost productive capacity. Service Chain Management can decrease the travel time for the enterprise significantly, which greatly increases workforce productivity through providing more time for workers to be with customers. Strategies to improve productive capacity of the service worker also include transfer, replacement and embellishment.

- Transfer makes knowledge available to customers so that value can be transferred with very low cost. One example is a Web-based FAQ database. This information-transfer tool can replace more expensive nursing resources and is always available. Patients can access disease-specific areas of a Web site and obtain information about side effects of medicines, explanations of symptoms, or procedures to follow.

- Replacement substitutes expensive resources with cheaper ones. For patients needing blood pressure measurements three times daily, an automated measurement system might be substituted for a nurse visit

- Embellishment of customer skills to enable self-service is a third strategy to enhance the productive capacity of the home healthcare system. Teaching a patient or family member to change a surgical dressing is appropriate in certain circumstances. This embellishment of customer skills requires an incremental amount of additional nursing time initially, but significantly decreases the use of nursing resources if the wound is chronic and requires daily changes for an extended period of time. In a typical scenario, a nurse might check the healing wound...
every three days instead of daily, resulting in a 66% decrease in the amount of nursing time required to care for the patient.

These three approaches to improving the productive capacity of a service system maximize the efficiency of systems such as “capitated” healthcare services. Until recently, reimbursement in home healthcare was based on the number of visits provided. The financial incentive in the marketplace was not to enhance productive capacity, but to maximize the number of patient visits. The result is that home healthcare has been, generally, as expensive as the system would allow, short of fraudulent, unnecessary visits. The Medicare payment system is currently transitioning the home healthcare payment system to a “prospective payment system.” Under this new payment system, the patient’s diagnosis drives a single, “flat fee” payment for the entire disease process episode. Extending the productive capacity of nurses has now become an important strategy of the business of home healthcare.7

Management of Perishability

Unlike the manufacturing sector, it is impossible to capture service worker time to store for future service demands. The productive capacity of a service worker is limited to the time he or she is at the customer site, with the right tools and skills, with knowledge of the customer’s requirements and preferences. Management of perishability is the approach used in Service Chain Management to minimize the negative impact of idle time on the productive capacity of the distributed service workforce.

For the mobile workforce, managing perishability has two foci. The first is a time allocation system that offers time windows to customers based on “best use” of workers. In Service Chain Management systems that use dynamic schedule optimization software, schedules are constructed and revised up until the very last possible moment. Service systems with no communication infrastructure allowing “real-time” dispatch produce daily schedules at the beginning of the workday. Service systems with mobile data communications coupled with advanced optimization algorithms may produce “real-time” schedules so that a worker only learns of the next job at the completion of the current job. The dynamic allocation of jobs among workers assures that idle (perishable) time is minimized.

Managing perishability also involves the process of training, refining and extending the skills and capabilities of workers. Potential idle time of workers can, it serves. Forecasting is a knowledge management tool which is used to convert historical care experience, geographical patient and provider data, and cumulated preference and requirement data to systematically build a workforce that is the most appropriate and cost-effective for the patient population served by a home healthcare enterprise.

Similarly, service chain bi-directional optimization of the patient-agency requirements, capabilities, and preferences is a system that incorporates new levels of responsiveness into the provider system. This is based on the process of automation and optimization of the closely coupled conversion and distribution aspects of the service process, a distinctly different coupling than is existent in the supply chain for manufactured goods.

Service Chain Management is critical in the home healthcare industry; transferring, replacing and embellishing productive capacity is an important response to the new capitated payment system. Provider training, skill set enhancement, and cross-functionality should be part of the service process. Given that much of this is modular, self-paced, “distance learning” activity, incorporating these activities into the enterprise plan and cost model is an opportunity to create an “inventory hedging” model for home healthcare.

Service Chain Management software includes modules for forecasting demand, automating the patient-intake and care planning processes, and a global optimization module for deploying the provider workforce based on the agency-cost-model, patient requirements, location and preferences, as well as provider skills and location. The automation and optimization tools can produce a 6% reduction in overall operating costs while improving patient satisfaction, worker satisfaction and agency responsiveness to patient preferences.

In one agency, total weekly scheduling time was reduced from 144 hours to 36 hours. Missed visits, (approximately 2.5% historically, usually due to paper-based
transcription errors) were completely eliminated. Non-billable visits (patient not at home) could be greatly reduced due to inclusion of patient-availability parameters within the global optimization database (Figure 3.0).

The total weekly miles driven was reduced by 25% (Figure 4.0). Decreasing travel time for the mobile workforce significantly expands productive capacity of the enterprise; the optimization module of the Service Chain Management software produces this while still meeting all patient and provider requirements. It also includes an agency-managed balance of preferences and cost metrics for the patient and the enterprise. Service Chain Management tools produce bi-directional optimization of the scheduling process, and increase productive capacity by decreasing travel miles (time) and transferring replacement and embellishment of provider skills as a planned approach to the business of home healthcare. Perishability management in the home healthcare sector will become a more important strategy in workforce optimization as the mobile data infrastructure of this industry grows.

by design, be directed to these activities by the process of work schedule optimization in Service Chain Management. When actively incorporated into the business process of the service worker, significant service production capacity time can be “prospectively reclaimed.” This service-inventory-hedging strategy benefits the enterprise by directing these skill-enhancing activities into idle time slots and creates potential availability of the worker during the time when traditional worker training efforts would have consumed productive capacity. The mobile worker with mobile data communication tools can consume training, certification and testing material online, maximizing this hedging strategy.

Perishability can also be managed by adjusting capacity. Capacity adjustments tend to take longer and be more costly than adjusting inventory levels to meet changes in demand. Consequently, in a service chain, adjustment lags resulting from changes in demand tend to be longer. As a result, the potential for the bullwhip effect is greater.

Customization

Like goods, services range from commodities to highly customizable products. However, the extent to which a service is customizable is greater. Figure 2.0 compares the time-from-final-customization to delivery to an end-user of a good and a service. For the traditional make-to-stock supply chain, the opportunity for customization ends anywhere from 30 to 120 days out (i.e., the customer selects from a variety of products built one to three months, ago). The best direct model supply chains offer dramatic improvement by permitting customization to within 72 hours of the moment of consumption. In services, the service chain can be designed to permit some level of customization right up until the moment of consumption. As Fisher poses, customization at this level requires a supply chain that is flexible and responsive to changes in demand.

Flexibility and responsiveness can come from managing capacity, having more highly-skilled, “cross-trained” workers, and/or bi-directional optimization.9

Managing a Sequence of Transactions

While most goods require a single sales transaction, many services require a sequence of transactions over a period of time. Such arrangements are common in home health care and equipment maintenance. This presents many challenges and opportunities. It requires more sophisticated forecasting techniques (e.g., life cycle management strategies) for predicting the timing and the nature of a series of related events, and also requires a database containing the history of each transaction sequence, i.e., a case history. When this type of information is coupled with real time information and bi-directional optimization, a service chain can be flexible and responsive to changing customer needs throughout the sequence of transactions.
In order to mitigate uncertainty for a sequence of service transactions, contracts are often used. However, the terms of these contracts require not only legal expertise but also reliable forecast information on both demand and supply of the service in order to establish pricing arrangements that are profitable for the seller and affordable for the buyer.

Management of Uncertainty
Uncertainty results from having to predict a sequence of service transactions, and from the operating environment; many services are produced in uncontrolled operating environments, and there exists a greater level of uncertainty in service delivery. For example, in the oilfield services industry, mobile workers conduct operations in an outdoor environment around the world, facing uncertainty from weather, terrain, wildlife and property permitting.

Although the level of uncertainty for service delivery may be high, it must be assessed to develop proper hedging strategies against risk. Forecasting and simulation tools can be combined with the best information available on local conditions (e.g., terrain, weather, etc.) to assess risk and then develop strategies to manage it.

Conclusion
Service Chain Management is a set of tools that are used to model, automate and optimize the delivery of services. Although conceptually similar to supply chain management, the “means and measures” of Service Chain Management are different because the nature of service delivery and goods production is fundamentally different. Highlighting these differences are the methods used to facilitate bi-directional optimization, and the management of productive capacity and perishability.

It is probable that these ideas will be important in other service sectors of the economy. Bundling of services with goods and services will increasingly be a differentiation strategy for producers of both goods and services. It is likely that, in the future, more and more of these bundled services will be directed toward the fast-growing aging population. Effectively serving this population will increasingly include services provided by mobile workers.

Footnotes