Using Service Inventory to Push Performance

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A basic tenet of service management claims that services cannot be held in inventory the way physical products can. This assertion, however, rests on a limited definition of inventory as finished product waiting for customers. Inventory also serves as a way to store work, and because that work is stored, a customer does not have to wait for it to be performed on demand. Further, less capacity is required after the customer arrives if some work has been stored. We believe that failing to recognize this important role of inventory has led to many missed opportunities in the service industry. By storing work – performing work in anticipation of a customer's arrival – companies can both speed the delivery of service and support a greater variety of offerings often at lower cost.

We define this stored work as *service inventory.* Service inventory includes all process steps that are completed prior to the customer's arrival. Much like inventories of physical products, service inventories affect how quickly – and at what cost – a firm can fill demand. By leveraging service inventories, companies have the potential to offer greater quality, speed, and variety to its customers at reasonable prices. Deciding the correct form and amount of service inventory a firm will hold is consequently one of the most important decisions a company can make in designing a service process.

Service inventory can take many different forms. A rheumatologist, for example, must produce letters for insurers on a patient's status. A system that automatically generates letters as the physician fills in patient details represents service inventory. eBay has built service inventory in the form of tools that allow users to set up and run auctions. Credit rating agencies have built an entire industry around service inventory. Their databases of customer histories and credit scores form service inventory that they sell to a variety of financial institutions. And financial institutions have their own service inventory in the form of predetermined rules on what terms to offer a customer with a given profile and credit score. Fidelity Investments has built service inventory in the form of databases and queries that provide current stock prices or the status of trades and tools that allow a customer to analyze her portfolio. In each of these

examples, some of the work that is part of a service request is performed in advance – before the customer request arrives. Thus, this stored work represents service inventory.

In a supply chain, the *push-pull boundary* represents the point at which a supply chain switches from building to forecast (i.e., a push phase where work is stored) to reacting to demand (i.e., a pull phase that builds to order). Service inventory is work done in the push phase in anticipation of a customer request. Service inventory allows a service provider to move the push-pull boundary closer to the customer. The rheumatologist's boilerplate letter, eBay's tools for auctions, the credit agency's scoring formula, the lender's decision rules, and Fidelity's tools are all built in anticipation of customer requests during the push phase. By doing this work in advance, the service provider in each case reduces the work to be done in the pull phase once the service request arrives.

Traditionally, most products have been made to stock while most services have been made to order. Product supply chains have traditionally carried finished goods inventory while service processes have operated with little or no service inventory. The past decade has seen a concerted effort to move the push-pull boundary in product supply chains away from end customers in order to have more of the supply chain acting on a pull basis. Firms in the manufacturing sector have focused on holding product inventory in unfinished component form and creating the final product in response to a customer order. Our thesis is that service firms generally stand to gain from moving in the opposite direction. Moving the push-pull boundary closer to the customer – doing more work in an anticipatory fashion – can both speed the delivery of service and support a greater variety of offerings often at lower cost. Below, we examine the role of "pushing work" in services and discuss how service inventory can be a strategic lever in designing and managing services.

Services as attributes and processes

We view service firms as offering customers a value proposition that is delivered through processes. Therefore, service firms are fundamentally no different from goods-producing firms. Whether a company produces a good or service, customers choose to patronize a firm only if the attributes of a particular company's offerings are more attractive than the available alternatives. Thus, every service can be considered as a bundle of attributes produced through a set of

processes. Just which attributes matter, of course, depends on the setting, but we emphasize four:

Quality Higher quality adds to customer perception of a service's value. Quality in services has implications for both the nature of the service experience and the nature of the service outcome.

Speed Many service customers must wait for a service to begin or for a service to be completed, and hence the responsiveness of a service provider matters.

Customization Many services inherently involve working on or with the customer, and customers consequently value experiences and outcomes closely tailored to their needs.

Price Price is the most obvious service attribute. Customers want more for less, and ultimately the question they ask themselves is whether the other attributes of a firm's offering are of sufficient value to justify the price being charged.

Consumers would generally prefer to receive higher quality with greater customization, and they want to receive it faster and at a lower price. Providing increased levels of all four of these attributes, however, can be exceedingly difficult. For example, speed and customization are attributes often emphasized in service settings. The goals of providing customization and serving customers quickly are inherently at odds. Customization introduces variability, and variability introduces delay. Cars can roll off an assembly line once every sixty seconds because there is minimal variation from one vehicle to the next. Services rarely enjoy the blessed sameness of an auto plant. An emergency room may see an essentially unlimited number of patients in one day, and each may have a unique malady.

Service Processes

How well a service firm can deliver its bundle of attributes depends on the processes in place. We view a process as a collection of resources executing activities in order to transform inputs into outputs. If there are any laws governing processes, they begin with the acknowledgement that one size does not fit all. Processes must be tailored to the attributes they are to deliver. Thus, process design is one of the most fundamental managerial choices. We emphasize three drivers of process performance (see Figure 1):

Service inventory Service inventory represents work done in anticipation of customer arrivals.

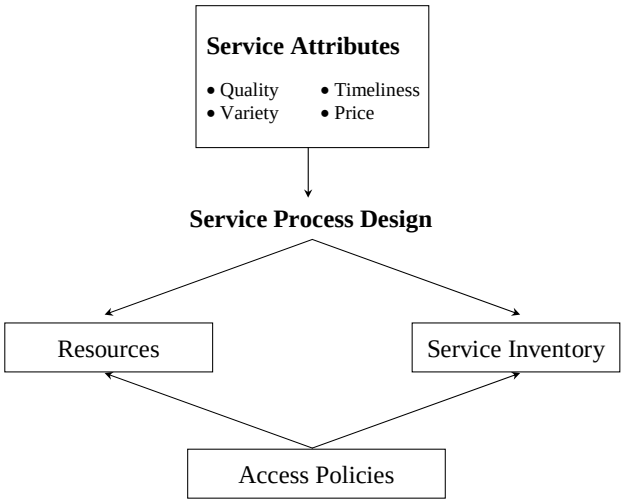

Figure 1: A Framework for Service Process Design

Resources The actual work to deliver a service is performed by resources including people and equipment. In a hospital resources include operating rooms and nurses; in a bank they include tellers and support staff.

Access policies Access policies govern how customers may use service inventory and resources. An example of access policies includes the differential pricing structures airlines employ for customers buying online versus buying through a customer sales agent over the phone.

Most experts who study the service industry have ignored service inventory and instead focused on resources as the key lever when designing service processes. We assert, however, that the choices of service inventory, resources, and access policies are interrelated. Failing to explicitly evaluate the role of service inventory neglects a valuable and effective means to better meet customer needs at lower cost.

Pushing services: The role of service inventory

To see the power of service inventories, it is useful to consider the role of physical inventories in product-based supply chains. Product inventories serve two purposes. They allow the exploitation of economies of scale while also acting as buffers. Consider an electronics

retailer carrying an inventory of printers. This inventory of finished goods lets the supply chain meet customer demand quickly while allowing for bulk shipping to the retailer (exploiting economies of scale) and level production rates at the manufacturer (buffering production from daily variations in demand). Level production allows manufacturers to reduce the overall capacity required. The downside of this approach is that printers must be produced ahead of demand, and the supply chain may be saddled with unsold goods if demand does not materialize.

To reduce this risk, many product supply chains have attempted to move the push-pull boundary away from the customer. Less work is stored in anticipation of demand and more is done in reaction to demand. Dell Computer is the proverbial poster child for this movement. Rather than hold finished computers, Dell holds component inventories that are assembled to order, effectively moving the push-pull boundary away from the customer to final assembly. The company has lowered its inventory levels by holding more resources to assemble PCs, which inherently imposes a delay on customers. Dell is not alone. Many industries have seen an increasing demand for product variety combined with increasing cost to holding inventory, making it beneficial to forgo holding inventories by building up capacity and introducing delay.

Most service firms, however, have been at the opposite extreme of holding finished goods inventory. Because they assume that services cannot be inventoried, many service providers have initiated all service steps after the customer request arrives, i.e., the push-pull boundary in service settings often occurs at the beginning of the process. This results in high levels of process capacity and long customer waits for service.

Service inventories offer an alternative way of thinking about process design. By building appropriate service inventories, service providers can cut the cost of capacity while improving response times for customers (see Figure 2). Holding service inventory moves the push-pull boundary closer to the market and reduces the amount of work that must be done once customers arrive.

Good examples of service inventory and the movement of the push-pull boundary are found in mortgage lending. Today, a lender does not start from scratch when a would-be customer inquires about a loan. Rather, the lender has access to credit reports that provide pre-existing information on millions of potential borrowers. These credit reports exist as service inventory that was produced in anticipation of a customer request. The lender then has internal rules that specify the amount that can be lent to a customer of a particular profile. The lender

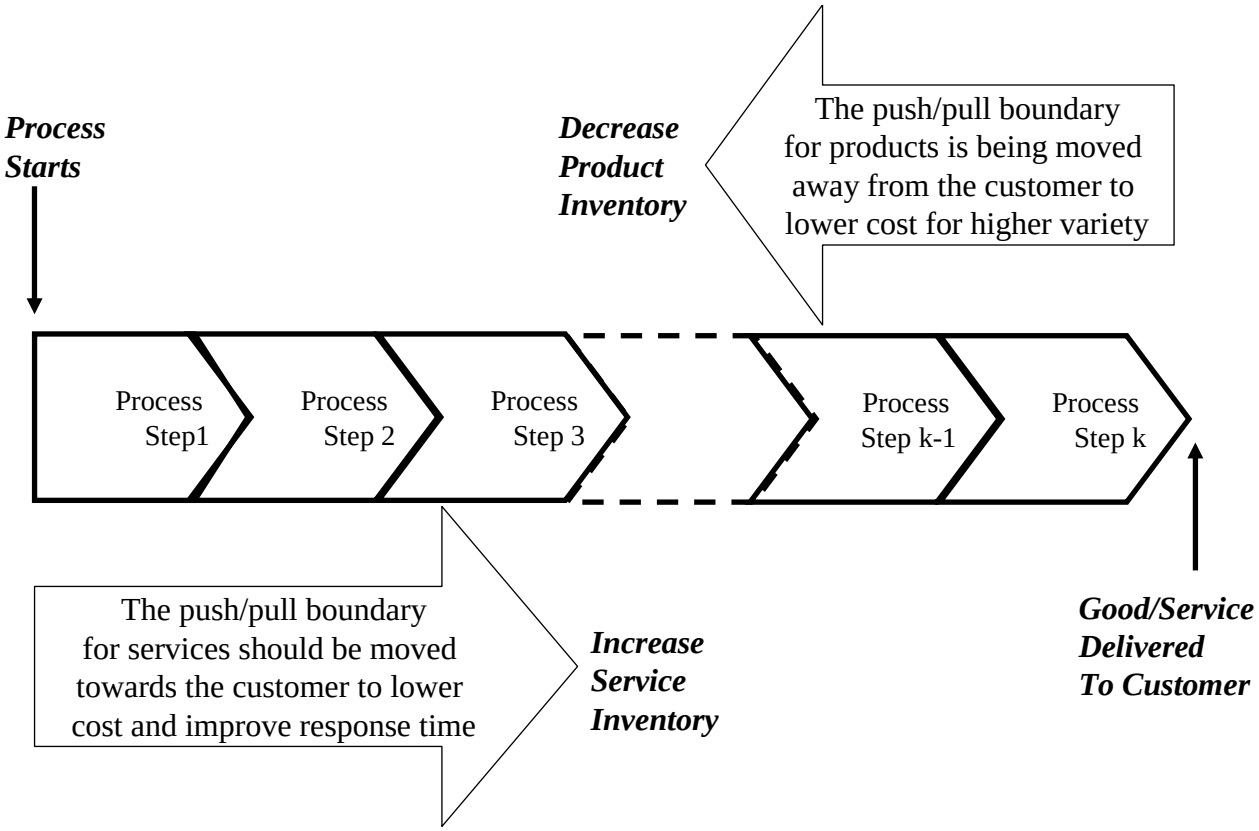

Figure 2: Moving the Push/Pull Boundary to Improve Service Performance

may even have automated appraisals available to determine the value of a real estate asset from its address and basic features. The lending rules and methodologies for automated appraisals also represent service inventory built before the arrival of a customer. In each case, the buildup of service inventory by the lender stores work and decreases the work to be done after the customer request arrives.

The nature of service inventory

As the mortgage example illustrates, service inventory is often (but not always) held in the form of information. Stored work typically takes the form of databases or a decision-support mechanism, whether through rules of operation or through formal computer algorithms. The mortgage lender makes use of service inventory in the form of a database and a decision support mechanism: Purchased credit reports are inputs into a decision-support logic, which renders an approval or denial. Databases maintained by financial service firms allow customers to track the

value of their assets and the status of various transactions. Similarly, real estate firms allow customers to quickly locate properties in their databases that fit a customer's search criteria. All these instances are examples of the various forms of service inventory, because they pre-process tasks and store work, reducing the amount of work needed when a service request arrives.

Service inventory is often information, but not all information is service inventory. Information is service inventory *only* if it represents pre-performed steps in the delivery process, i.e., only if a service provider can save work from being done later. Thus, a database holding the credit scores of potential customers is service inventory for a mortgage lender because the evaluation of credit history is part of the process of making a decision on a loan application. By contrast, a database simply listing everyone who has applied for a mortgage in the past year is not service inventory. It is an asset that may have some value, but standing alone, it does nothing to reduce the work needed to reply to a service request. Similarly, generic software such as a word processing program is not service inventory while code that allows house-hunters to search real estate listings is service inventory. The latter includes logic to narrow search choices and display results prioritized by the client's criteria. This is stored work and thus is service inventory – the search tool replaces a real estate agent's time and effort. A word processing package simply replaces a typewriter; the user must still compose the letter.

Service inventory versus product inventory

The basic tradeoffs that govern the buildup of service inventory have many similarities to those governing product inventory. Like product inventory, service inventory can be expensive to generate. Computer routines that allow novice real estate customers to search through listings take time and effort to develop. Likewise, creating a credit database is costly. Additionally, service inventory could also be wasted. The real estate listing service may include search options that are hardly ever used, and a credit agency may collect data on people who go years without demanding new credit cards or loans. Thus, similar to product inventory, there is a cost if service inventory is never used. Finally, like product inventory, relying on service inventory limits the variety and customization that can be provided. A car dealer's inventory dictates what a buyer can drive home today. A mortgage lender using a credit score database along with pre-programmed rules cannot easily account for extenuating circumstances in a customer's credit history. By contrast, a lender starting from scratch can account for many factors when underwriting a loan for a customer. Whereas a financial advisor can perform a variety of

analyses for a customer, Fidelity's pre-programmed tools limit the type of analysis that a customer can perform. Similarly, eBay's tools limit the type of auction that can be run, while an auction house can change the bidding rules for each product. The key point here is that the presence of service inventory in each case decreases the variety of customers that can be served. Service inventory, however, speeds up the response time and decreases the capacity required after the service request.

Service inventory also differs from product inventory in important ways because there are typically extreme economies of scale in its creation and usage. Creating service inventory in the form of a structured database is expensive and time consuming. Adding records once the database is established, however, costs a pittance in comparison. In other words, the cost of creating a database with a million records is not significantly higher than the cost of a database with two million records. By contrast, the cost of producing two thousand cars is much larger than the cost of producing a thousand cars. Usage also differs between service inventory and product inventory since service inventory does not need to be replenished in the same manner as product inventory. The same service inventory can be used to serve essentially an unlimited number of customers. Dell requires two hard drives to serve two customers, but a real estate firm can allow two (or even two hundred!) customers to search its listing at the same time.

The economics of service inventory are consequently markedly different from the economics of product inventory. Economies of scale in creation imply that the cost of holding service inventory is much lower than physical goods. Because so much service inventory is held in the form of information, a company simply needs adequate – generally inexpensive – storage. Holding two cars in inventory costs about twice as much as holding one car, but storing one more record in an existing database is essentially free. Thus, once a credit agency has created a system to collect and analyze credit records, it should create and maintain entries for as many people as possible. By contrast, a car dealer should not hold cars with infrequently requested options in inventory. Both mortgage lenders and car buyers value variety and customization, but only the former can be served cheaply out of inventory.

In contrast to products, economies of scale in usage imply that deciding the number of units to hold in service inventory is trivial. Whereas a car dealer must decide on the number of cars to hold in inventory, eBay can facilitate a large number of simultaneous auctions with the same set of tools. When building service inventory, the primary decisions are what variety to

offer and at what stage of completion. In other words, a company must decide what process steps should be pre-performed and stored in service inventory and for what range of service requests.

The strategic impact of service inventory

To see the benefits that follow from using service inventory, let's return to our list of strategic attributes that differentiate service offerings: quality, speed, customization and price.

Quality

Consider a retail banking customer with a question on her bank's policies or offerings. Two decades ago, she likely could only find an answer by calling or visiting her local bank branch. Today, her phone call is almost certainly routed to the bank's call center or she is directed to the bank's Web site. Call centers and Web sites are troves of service inventory. An agent at the call center will work through a script to answer the customer's question, or a Web-based "Frequently Asked Questions" (FAQ) page may have the answer in writing. Appropriate service inventory improves both the quality of the outcome and the experience. The outcome is now consistent, ensuring that the answer a customer gets does not depend on who answers the question. The experience is smoother and more professional. The customer sees a clean, efficient process, not a teller hunting around for the appropriate information.

Service inventory can also improve another important aspect of service quality – service recovery. Firms must be prepared for occasions when things go wrong during service delivery. A company's ability to do this, of course, depends on how easy it is to anticipate the nature of the service failure. Airlines, for example, know that at some point flights will be late and connections will be missed. To make matters worse, many delays are driven by factors such as weather that are beyond an airline's control. How an airline responds to these problems, however, is very much within its control. One possibility is to attempt to re-book stranded customers once they speak up. Alternatively, the airline can begin the re-booking process before the delayed flight touches the ground. This latter approach requires building service inventory and may result in some wasted effort if a customer objects to a proposed rerouting. If the rerouting is well done, however, the majority of passengers will have received superior service because of the buildup of service inventory.

Speed

Inventory can be used to increase the speed of a service. A fast-food restaurant serves a hamburger more quickly than a sit-down establishment because it holds an inventory of assembled sandwiches. By contrast, the sit-down restaurant must still cook the meat. The presence of inventory – whether in the form of burgers under heat lamps or a database of client records – reduces the amount of work that must be done from the point at which the customer enters. Less work results in less time to serve the customer. Borrowers benefit from credit reports because they reduce the amount of time that a lender needs to verify their credit worthiness. Investors can save time by using the tools on the Fidelity Web site to analyze their portfolios without having to wait for an appointment with a professional.

Beyond reducing the amount of work that must be performed, service inventory can decrease the time to deliver a service by altering a firm's resource decisions. The responsiveness of a process depends on both the number of tasks that must be executed and the capacity available to carry out these tasks. The more complex and involved the work, the more expensive the required resources. By allowing the more difficult work to be done ahead of the customer's arrival, service inventory reduces the skill level required of front-line workers. To the extent that less sophisticated capacity is less costly, firms can afford to deploy more capacity.

A clear example of this is the airline check-in process. Airlines have developed significant service inventory to simplify the process of checking in. Indeed, they have reached the point where customers can check themselves in by pulling up their reservations, declaring how many bags they need to check, and selecting their seats. As a consequence, the majority of domestic passengers can be processed by electronic kiosks that are much cheaper to produce and maintain than the cost of employing a human counter agent. Airlines can therefore justify providing far more "check-in" capacity than ever before. This reduces the time customers have to wait before checking in.

The situation is similar for banks with ATM machines, grocery stores with self-check-out lanes, and catalog merchants with order-taking Web sites. All are examples of using service inventory to facilitate faster service delivery with ample, cheap capacity. A more extreme example is a movie theater that allows patrons to print out tickets at home. In this case, service inventory has allowed the theater to substitute customers' time and resources for their own.

Customers benefit from quicker response because there are no capacity constraints but their own, while the cinema enjoy lower costs.

This is not to suggest that the sole role of service inventory is to "dumb down" a service to the point that it may carried out by the minimally qualified. Instead, companies should think of service inventory as providing structure and support to the service encounter. Service inventory, for example, can also reduce time by making front-line workers more flexible and capable of handling a wider range of tasks. Consider a financial services call center. Properly supported by service inventory, one agent can sell a variety of sophisticated products and handle a range of transactions. Without service inventory, training workers in such a wide scope of work might be impractical. The firm would face the choice of not offering some services or forcing customers to suffer through multiple hand-offs that increase delays. With service inventory, customers receive a full range of services through a single point of contact and do not have to wait between hand-offs.

In evaluating how to use service inventory, the relevant question is what the customer values: Does she want a simple process that she can execute herself or does she want a single point of contact that can deliver a basket of services? The appropriate form and amount of service inventory can be used to decrease response time in either case.

Customization

Whereas inventory in general constrains choice, suitable service inventory can be used to offer greater variety and customization quickly and at relatively low cost. Marriott Hotels, for example, has introduced a program called "At Your Service," which tracks guests' preferences and complaints. If a guest prefers feather to foam pillows, this preference is entered in a database, and on her next visit to a Marriott hotel (not just the one at which she asked for the feather pillow), she will find a feather pillow on the bed.[1] Through "At Your Service," Marriott is building up its service inventory and is effectively using that inventory to customize its offerings. What would otherwise be a generic hotel room can be tailored to the traveler's individual tastes.

This approach is applicable in other settings as well. Financial service Web sites offer individualized information based on what they know about customers. This may be as simple as

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[1] Curt Harler, "CRM at Your Service," **Hospitality Technology**, June 2002.

tracking the customer's portfolio or it may be more detailed, for example, pitching college savings plans based on the age of the customer's children. A Web portal is, perhaps, the most extreme example of using service inventory to provide customization. By allowing registered visitors to specify a range of topics from hobbies and favorite celebrities to hometown sport teams and political interests, they let the customer design the Web site they encounter. Any given article is generic in the sense that all Red Sox fans see the same box score but the combination of sports scores, local weather, and stock quotes is unique to each customer.

Marriott is collecting information and taking action before customer arrival, and Web portals are organizing their information in databases that facilitate customized Web sites. In each case, the service provider has created a personalized service by increasing service inventory and moving the push-pull boundary closer to the customer. This is in contrast to manufacturers who have reacted to demands for increased variety by moving the push-pull boundary away from end customers in order to decrease inventory. There are three key reasons for this difference in the way the service industry provides variety versus the way manufacturers do.

First, as discussed above, service inventory is cheap to hold and maintain. Marriott can afford to keep records on its guests' idiosyncrasies because the cost of storing a database record is trivial, as is the marginal cost of accessing and using that information. This is in contrast to manufactured products such as personal computers, where it would be cost-prohibitive for a retailer to hold all possible configurations in inventory.

Second, the uniqueness of services often comes from the unique inputs from individuals, not the processing of the inputs themselves. The processing steps can thus be built as service inventory. For example, whereas each person's portfolio is unique, the analysis required is often the same across a wide variety of portfolios. Well-built analytical tools allow each customer to perform an analysis that is tailored to his or her situation. eBay works in much the same way. Every auction is unique in terms of the property and parties involved, but all auctions can be set up and run using the same set of generic tools.

Third, service inventory in the form of information is inherently modular and allows a service provider to combine a limited number of parts into a mind-boggling number of options. Modularity lies at the heart of mass customization and, fundamentally, amounts to using generic capacity to deliver customized goods. This is what services such as Web portals do so well. Whether they develop their own content or simply rely on wire service reports, they can take a

finite number of stories and present highly personalized bundles of articles to users. Service inventory is built in the form of databases that hold the articles and the queries used to create customers' Web pages. The result is that generic server capacity can produce an incredible variety of customized Web pages for clients.

Price

As discussed earlier, service inventory lowers cost by allowing companies to use less expensive resources, and possibly even move their customers toward self service. Service inventory also lowers cost by making resources more flexible.

We want to emphasize, however, that employing service inventory differs from Theodore Levitt's vision of industrialized service to reduce costs.[2] Industrialized service argues for reducing cost by standardizing service operations as much as possible. The logic of Levitt has given us Jiffy Lube, a cheap and convenient place to get an oil change but also a car-service facility incapable of performing a brake job. Process design involves trade offs, and industrialized service sacrifices flexibility and variety in order to wring as much cost out of the system as possible. By contrast, building service inventory is a way to offer consistency, speed, and customization with reasonable costs. This is not to say that Jiffy Lube has made a poor choice in its process design. Processes must be tailored to a strategic end, and Jiffy Lube has certainly done so. However, few services are as standard as an oil change. Most demand some measure of customization, and the judicious use of service inventory is a way of meeting this need.

Bringing it all together

The role of service inventory in improving performance along the four service attributes is summarized in Figure 3. To see how service inventory can allow a firm to offer high-quality, customized service at a reasonable price, consider Carmichael Training Systems (CTS) of Colorado Springs, CO, which bills itself as "the leader in endurance coaching, training, and aerobic development." Nearly every health club offers personal trainers to guide clients in getting in shape and developing a weight-training program. CTS concentrates on a different market. It focuses on people participating in cycling, multi-sport events, running, ultra-

[2] Theodore Levitt, "The Industrialization of Service," Harvard Business Review, Sep-Oct, 1976.

Service Attribute	Service Inventory helps Improve Performance by …
Quality	• Providing consistency of service • Facilitating service recovery
Speed	• Decreasing work to be done after customer arrival • Making capacity cheaper by allowing provider to invest in more of it
Customization	• Using standardized service inventory applied to individual inputs • Using modularity of service inventory
Price	• Facilitating self service by customer • Decreasing capacity required in response to customer request • Reducing skill required to perform service • Allowing a resource to provide multiple services

Figure 3: How Service Inventory Improves Performance Along Service Attributes

endurance events, and rowing. These clients range from casual runners training for their first 10K to seasoned athletes competing at a national level. CTS offers personalized service at an affordable price that might not otherwise be available in a customer's area. CTS pairs its clients with experienced coaches specialized to their sport and develops custom workout programs for them. Further, all customers have access to a proprietary CTS field test to determine fitness levels and physiology; online forums focused on sports psychology, nutrition, physiology, training and injury prevention; and a library of sport-specific training and nutritional articles. The cost of the service runs from $29 per month for the most basic program to $499 per month for the Pro Deluxe package. CTS serves 3,000 clients.

How does CTS support a large client base at reasonable prices? It begins by running with a relatively lean workforce. It has roughly 70 coaches, but many of the coaches are independent contractors, not full-time CTS employees.[3] CTS leverages this staff through service inventory. All of its training packages are derived from a suite of over 5,000 training programs written by company founder Chris Carmichael and CTS Premier Coaches. A client's assigned coach selects the appropriate program, making adjustments to match the client's physiology. The customer

[3] Chris Walsh, "Colorado Springs, Colo., Training Firms Helps Athletes Fulfill Their Potential," Knight Ridder Tribune Business News, December 31, 2002.

receives a customized regimen, but the effort required to produce it is minimal since CTS has done so much work in advance of demand.

Another business based on service inventory is Flaherty & O'Hara, a Pittsburgh-based law firm specializing in alcohol and hospitality law. Alcoholic beverages have a tortuous regulatory history in America. The layers of control run from the federal and state level down to counties and towns. That suggests that law practices focusing on liquor regulation should be primarily regional, specializing in the quirks of one state's or locale's liquor laws. Flaherty & O'Hara has broken out of this mode and created a national practice. Demand for a firm with national reach has arisen with the growth of restaurant and hotel chains that hold liquor licenses in multiple states. Flaherty & O'Hara describes itself as "as a 'one contact' liquor law resource for licensed establishments nationwide by tracking license renewals, coordinating license acquisitions and transfers, reviewing marketing activities for compliance, and troubleshooting." The firm aims to partner with a client's staff to maintain a centralized database in order to assure compliance with reporting requirements and filing deadlines. It counts among its clients the national chains Applebee's, Hooters, Starwood Hotels, and Wyndham Hotels.

How has Flaherty & O'Hara managed to nationalize a formerly regional service? One possibility would be to hire a huge staff, but the firm has just five lawyers (including the two named partners) and nine legal assistants. This small staff is supported by service inventory. The firm has created a computerized database covering liquor laws for every state.[4] While no client may ever ask about the rules governing happy hours in Montana, Flaherty & O'Hara is prepared to answer the question. This service inventory allows the firm to offer its customers convenience and lower costs by having one firm manage all of the customer's license and compliance issues. Flaherty & O'Hara clients never need to identify and contract with an attorney in every market in which they operate – it's all handled by one firm.

Implementing a service inventory strategy

Unlike CTS and Flaherty & O'Hara, many service firms carry too little service inventory. Trapped in a mindset that services must be produced to demand, providers have set the push-pull boundary far from the market, which results in long waits and high costs on customers.

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[4] Paulette Thomas, "Case Study: Cracks in Big Business Provide Niche for Firm," **Wall St. Journal**, January 6, 2004.

Consequently, there are real opportunities to move the push-pull boundary toward customers and exploit the power of service inventory to improve quality, speed, and customization while lowering cost. This is not to say that all service inventory is good and worth building. Total system performance depends not just on service inventory. The complementary drivers of resources and access (see Figure 1) must also be considered. Thus, before committing to designing a service offering around service inventory, a company must examine what factors favor building service inventory and how the presence of service inventory affects choices of resource capacity, and access policies.

When does a high level of service inventory make sense?

Whether a company should aggressively pursue building service inventory depends on both market characteristics and the cost of service inventory. Market characteristics determine the probability that service inventory will be used. The inherent risk in both product and service inventory is that it might be bought and paid for but go unused. This is the danger that has led product firms such as Dell to move the push-pull boundary away from the customer in order to reduce their inventory and their risk. The same issue is relevant for service inventory: Building service inventory is more attractive when there is greater certainty that it will actually be used.

The question then becomes, when is service inventory most likely to be used? We point to two factors. The first is when the service requires the application of a common process to individual inputs. Building high service inventory then allows a firm to reduce cost and response time. ATMs at banks and check-in kiosks at airports are obvious examples. The process for both services is standardized, although the details of each transaction differ. Here, service inventory exists to cut the cost of a standard transaction. eBay has followed a related path by standardizing what had been totally idiosyncratic transactions. They have developed tools that allow anyone to set up an online auction for nearly any offering. For all of these examples, concentrating on what is common across service requests has allowed firms to build service inventories with the knowledge that they will in fact be used.

The second factor affecting probability of use shifts the focus from lowering costs to increasing customization. Service inventory is valuable when the provider can learn about specific customers over time and tailor its offering accordingly. Marriott maintains significant service inventory on repeat customers and uses its knowledge to adapt from one guest to the

next. Because this service inventory revolves around frequent customers, it is all but certain to be used over and over.

In addition to market considerations, costs also play a role in determining whether service inventories make sense. As we have seen, the economics of service inventory can differ dramatically from those of traditional product inventory. Once a company has developed a service inventory infrastructure, it is generally cheap to maintain, store and augment that inventory. Hence, for firms such as a Web portal, it is appropriate to build extremely high levels of service inventory since the marginal cost of adding and storing records is small. Further, a greater breadth of coverage increases the value of the service to customers.

Whether inventory is modular also impacts the cost of service inventory. Modularity supports wide product variety and allows a cheap generic process to deliver customized results. Carmichael Training Systems and Web portals use this form of service inventory to create tailored experiences for each customer. Each additional item has an exponential effect on possible final offerings. Greater modularity then leads to higher levels of service inventory when the service provider aims to offer high customization at a reasonable cost.

The impact on capacity and access

Service inventory sets the parameters of the process, determining what work must be done when a service request arises. The presence of service inventory thus fundamentally alters a firm's capacity decisions. This may result from allowing customers to execute transactions themselves, or from having less skilled resources handle a broader range of tasks. When designing a service process, a key tradeoff is found between investing in service inventory and building more expensive capacity. Given that initially developing service inventory is generally expensive (although it is cheap to maintain) and that maintaining a skilled workforce is expensive, a service provider faces a clear choice: It can invest up front to enjoy lower continuing costs, or it can lower startup costs at the price of higher continuing costs. This tradeoff generally favors building high levels of service inventory when the probability of use is high.

Once a firm has created service inventory, it benefits by encouraging as many customers as possible to use the service inventory. There is little value for an airline to create a check-in kiosk if all customers continue to check in using a customer service representative. A firm must recognize that its access policies influence – if not directly control – whether customers use

service inventory. Some service providers have tackled this problem by forcing all customers to first access service inventory through cheap capacity (such as routing all incoming phone calls through an automated menu) before allowing them to move on to more expensive service capacity (such as human service agents).

For example, American Airlines has steadily tried to move customers to automated self-check-in kiosks, even though these kiosks cannot process all customers (e.g., customer's whose tickets have been re-booked). To enforce this shift, the airline instructed its counter personnel not to wait on coach customers directly unless they have a receipt from one of the self-check-in terminals indicating that the customer had attempted to check in but was unable to do so. In other instances, firms have rules in service inventory that are used to identify exceptions, which are then handled using more expensive capacity. For example, a lender might use automated rules to create three groups of loan requests – accept, reject, and further processing. All requests that require further processing are then handled by more expensive capacity in the form of a person.

Another method for controlling access to service inventory is to impose a differential cost on customers based on whether they use service inventory or not. This cost difference may come in the form of different waiting times or in the form of different pricing. Most airlines provide enough capacity that there is rarely a wait to check in at a kiosk, whereas there is almost always a line to check in with an agent. Airlines have also imposed differential pricing, charging a service fee for tickets purchased through a representative instead of online.

When the goal of service inventory is to increase customization or offer additional services (as opposed to merely reducing costs), access policies are crucial for targeting who receives enhanced service. Marriott's "At Your Service" program is only available to frequent guests. Fidelity provides its portfolio analysis tools free to customers having significant account balances; all other must pay for the use of these tools even though they are essentially costless to provide once they have been developed. Service inventory in these examples primarily serves to increase the customer's perceived value of the service. Access policies assure that only those valuable customers will capture these benefits.

Summary: Service Inventory as a framework for process design

Taken together, these observations provide guidance for designing a service process. A company must first determine what the market values: Do customers want quick, cheap service, or do they place greater value on variety and enhanced customization? In the former case, a company must consider how service inventory can turn diverse transactions into a standardized flow of work. In the latter, a company must consider whether it can develop modular inventory that can be quickly customized to the user's needs. Note that these market demands may not be mutually exclusive: Some customers may be looking for cheap self-service while others demand greater touch and customization. A firm may choose to build processes to serve both.

A company's service inventory strategy then feeds forward to capacity decisions. Standardized flows suggest cheaper, less flexible capacity that perhaps even requires the customer to provide a significant share of the resources. Customization demands flexible resources with greater skills. In this case, service inventory allows talented workers to take on a greater scope of work or to become fully productive more quickly.

Access policies then determine the daily use of resources and inventory. These policies are particularly important when a firm seeks to serve customers with diverse needs. Cost-conscious customers, for example, must be directed away from highly customized processes – these customers receive perks they do not value while simultaneously interfering with the firm's ability to quickly serve those demanding customization. In such a setting, poor management of access can destroy the value created by carefully planned service inventory and capacity decisions.

This focus on service inventory provides a distinct and novel way to think about service management. The traditional view that services cannot be inventoried has limited how managers think of service process design. Obviously, whole services cannot be stored, but we maintain that significant amounts of work can. Identifying which process steps can be done in advance of demand so that the push-pull boundary can be moved closer to the market requires creativity and skill, but it offers the possibility of large a payoff. Failing to recognize the role of service inventory explicitly is to ignore an important driver of service performance. Appropriately applying service inventory offers a way to push performance to higher levels.